stiferite®
thermal insulation

Performance & Safety

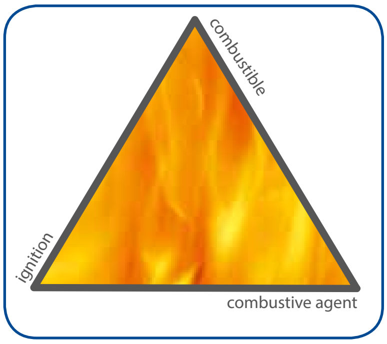
REACTION TO FIRE

Safety and prevention of fires

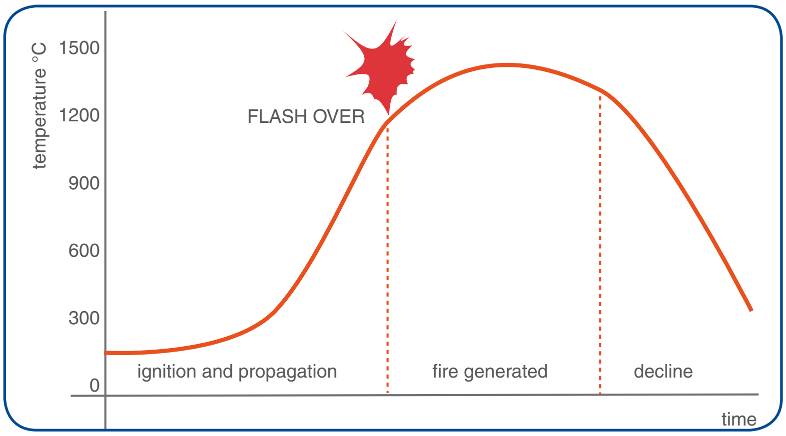
Combustion, fires and phases of development

The issue of safety and risks of fire in buildings, has always been a legislative subject related to the elevated costs encountered by society from damages caused by such events. Economic and social costs arising from: direct damages to people and their personal property, indirect costs for the reconstruction of damaged buildings and loss of jobs.

Having a basic understanding and/or knowledge of the combustion process and what constitutes a fire, is the first step toward identifying how to defend oneself against it and increase the safety of buildings and our activities.



Combustion is a chemical reaction of oxidation, with developments of light and heat that occur from the ignition of a combustible source and oxygen in the air.
A fire is defined as any combustion that is not under control.
It can be described using a triangle where the three sides represent the 3 essential components. In the absence of any of these 3 essential components the reaction cannot occur.



The development of fire can be subdivided in 4 different phases: ignition, propagation, development and decline.
Since during the first two phases the flames are still contained and the ambient temperatures are changing, the risk of damage can be relatively limited. The limit of this risk is tied to the duration of these two phases, which is determined by the geometry and ventilation of the area, and the amount of contact between the combustible source, the oxygen in the air and the ignition.

Up to the point when the flash over is reached, the mix of inflammable gases propagates the flames very quickly. The average temperature rises (over 1200° C) and all combustible material burns and the fire increases.
The decline or extinguishing phase begins after the maximum temperature is reached. The fire is considered extinguished when the ambient temperature drops around 300°C.

stiferite® thermal insulation

The basic criterions of fire prevention

Prevention and protection

Systems of protection have been created for the purpose of preventing fires. These systems are classified as: Active or Passive.
Active systems are associated with containment and/or extinguishment, and require human or automatic activation; these are considered active protection systems, for example: fire extinguishers, smoke detectors, alert system for occupants and/or fire department etc..
Passive protection systems are all building construction and design measures which take in consideration the type of material to choose so as to obstruct and limit the amount of damage of an eventual fire.
Examples of passive protection are:

- Compartments analysis
- Security distances
- Fire-rated walls, doors and smoke barriers
- Safe escape routes
- Structures' resistance to fire
- Reaction to fire of building material.

The subject of fire protection in buildings requirement, is recognized among the 7 essential European regulations for building construction products, and has been greatly regulated by technical norms and state laws established by individual European State Members, to determine the levels of performance and security.
As for the external "wrapping" components of a building, the RESISTANCE TO FIRE of the structure and the individual material's REACTION TO FIRE behaviour is evaluated.

Resistance to fire of the structure and individual compartments

The resistance to fire is the ability of a structure or an individual compartment (external wall, beams, doors and fire barriers etc..) to resist for a determined amount of time to its': stability, integrity and isolation capability. It is expressed in minutes (15, 20, 30, 40, 60, 90, 120, 180, 240 and 360) in reference to the nominal fire curve.
The fire resistance rating of a structure is identified by the REI marking, which is composed by the following elements:

- R = Load bearing: ability of a construction element to preserve its' mechanical characteristic and the relevant load capacity during a normal fire.
- E = Integrity: the structure's ability to NOT allow the passage or production of gas or vapour to the area NOT exposed to the fire.
- I = Thermal Insulation: The ability of a structure to reduce within

stiferite thermal insulation

Fire resistance of the building structure and reaction to fire of material

a temperature limit (normally 140°C) the transfer of heat to the unexposed (cold) side.

Consequently:

- REI (followed by the number n which indicates the classification) = constructive element which must preserve for a determined amount of time n its' mechanical resistance, the integrity of flames and gases, and the thermal insulation.
- RE (followed by the number n which indicates the classification) = constructive element which must preserve for a determined amount of time n its' mechanical resistance, the integrity of flames and gases.
- R (followed by the number n which indicates the classification) = constructive element which must preserve for a determined amount of time n its' mechanical resistance.

For the classification of the elements not meeting the criteria R, it is automatically sufficient as long as E and I are met.

For each element meeting the criteria, tests are made and results are obtained. Classification is then assigned by verifying the time value obtained for mechanical fire resistance with the nominal fire curve reference.

The performance rating of fire resistance can be determined by test results, analytical calculations or at verification tables.

Fire reaction of material

For material considered "structure or compartmentation" like insulation material, the reaction to fire test must show the material's behaviour when exposed to a direct flame of ignition. It is subdivided in reference classes based on the method of test used. Since the level of contribution of a material in a fire is strongly dependent on the type and conditions of the test, it is necessary to distinguish between insulation material with a CE marking in accordance to the European series norms EN13xxx and 14xxx, and those without a CE marking.

For material with a CE marking, the fire reaction rating is defined by the system Euroclass (EN 13501-01), based on the combination of various harmonized tests (EN11925-2 and EN 13823). The system divides insulation products in 7 classes (A1, A2, B-F):

- Class F is assigned to products of which the reaction to fire is not determined. Products having a good reaction to fire rating, paired (jointed), or coated (with a facer) with combustible material, may also belong to this class.
- Classes E-B are assigned to products of organic or inorganic natu-

Reaction to fire: European's system of classification

re with high contents of organic. To obtain a Class E, a small flame test is made while Class D-B are assigned on the bases of the test defined by the harmonized European norm EN 13823 (SBI), a small flame test lasting 30 seconds, is also done.

- Class A (A1-A2) is assigned to products of inorganic nature. In this case the SBI test is combined with the measurement of the power (heat) meter (EN 1716) and the test of incombustibility (EN 1182).

For the Classes A2-D the quantity of smoke produced is evaluated, while for Classes A2-E the droplets (dripping) and burning particles. The harmonized norms of the series EN 13xxx and 14xxx take into consideration the reaction to fire of buildings containing thermal insulation in real life or end use conditions.

In the case of applications where the structure is externally insulated, as in external thermal insulation system is considers, for example, the entire test to one sample wall.

Reaction to fire
Euroclasse and testing methods

	EUROCLASSE	Test method	Alternative test methods or Added classifications
inorganic	A1	EN ISO 1182 EN ISO 1716	
	A2	EN ISO 1182	EN ISO 1716 EN ISO 13823 (SBI)
organic	B	EN ISO 13823 (SBI) EN ISO 11925 (exposure 30")	smoke generation (s) burning droppings/particles (d)
	C	EN ISO 13823 (SBI) EN ISO 11925 (exposure 30")	smoke generation (s) burning droppings/particles (d)
	D	EN ISO 13823 (SBI) EN ISO 11925 (exposure 30")	smoke generation (s) burning droppings/particles (d)
	E	EN ISO 13823 (SBI) EN ISO 11925 (exposure 15")	burning droppings/particles (d)
	F	Reaction not determined	

Fire reaction of STIFERITE's panels

Reaction to fire (EN 11925-2, EN 13823)	
STIFERITE's Panels	EUROCLASSE
RP1 - RP3 - FIRE B	B s1 d0
AI4	D s2 d0
AI6 - AI8 - ALC - ALE - ALL	B s2 d0
GTE - Class S - Class SK - Isoventilato	E
GT - Class B	F
END USE CONDITION	
ETICS System - Class SK panel	B s1 d0
Roof under sheet metal - GTE panel	B s2 d0
Ventilated wall - Class SK plastered	B s2 d0

Thermal insulation and fire load (cfr. PU Europe Fire Handbook)

Material	Density kg/m^3	λ_D W/mK	Thickness mm U = 0,21 W/m^{2}K	Heat Power MJ/kg	Fire load MJ/m^3
PIR/PUR	30	0,023	115	27	93
Rockwoll (Classe A2)	120	0,040	200	3	72
	160	0,037	185	3	89
EPS	20	0,035	175	39,6	139
Wood wool	100	0,04	200	16,2	324

Compared to other thermal insulation panels of the same thickness, STIFERITE'S PIR foam panels have proven to be the most efficient. A complete line of thermal insulation panels are available to satisfy various types of application needs. For over 40 years Stiferite's panels have guaranteed security and energy savings. The use of Stiferite's panels means insulating more with less material. An advantage that translates into more living space, less transportation and installation costs, less building material and therefore less impact on the environment. The efficiency of STIFERITE's insulators is also an advantage in terms of security, due to the drastic reduction of the quantity of material, and the bearing it has on building's fire.

Advantage of carbonization (Charred)

STIFERITE's PIR foam panels are thermo hard and when exposed to an ignition flame, they carbonize (char) and transform into a chemical structure that does not burn. This type of transformation, rarely considered in test reports, is an efficient way to "pacify" the insulation material and effectively, slow down the spread of fire. Since time is a critical variable of a fire, it is of vital importance to limit the amount of material present inside of a building so as not to add to the propagation of a fire, contain the smoke and allow safe escape routes.

In order to increase the level of security in buildings, STIFERITE has been committed in the development of products with excellent fire reaction performance, like the recent STIFERITE's FIRE B panel. It has also been committed in fine tuning and evaluating complete functional, and always more efficient and safer systems.

stiferite® thermal insulation

FIRE B

Euroclass reaction to fire

B s1 d0

Description

STIFERITE'S FIRE B is a PIR foam panel made of Polyiso and Pentane has the blowing agent. It is covered by a mineral fibreglass facer on one side, while the side more exposed to risks of fire, is covered by a special exclusive fibreglass fabric and added mineral fibre, named: FIRE B FACER®.

Main applications

Insulation of ventilated walls
All applications where the highest level of fire resistance is required from organic insulators.

Installation warnings

All panels must be mechanically fixed to the structure using the recommended anchor screws and supported by reinforcement disks. (see side figure).
STIFERITE'S FIRE B panels workable temperature range is from -40 °C to +120 °C.

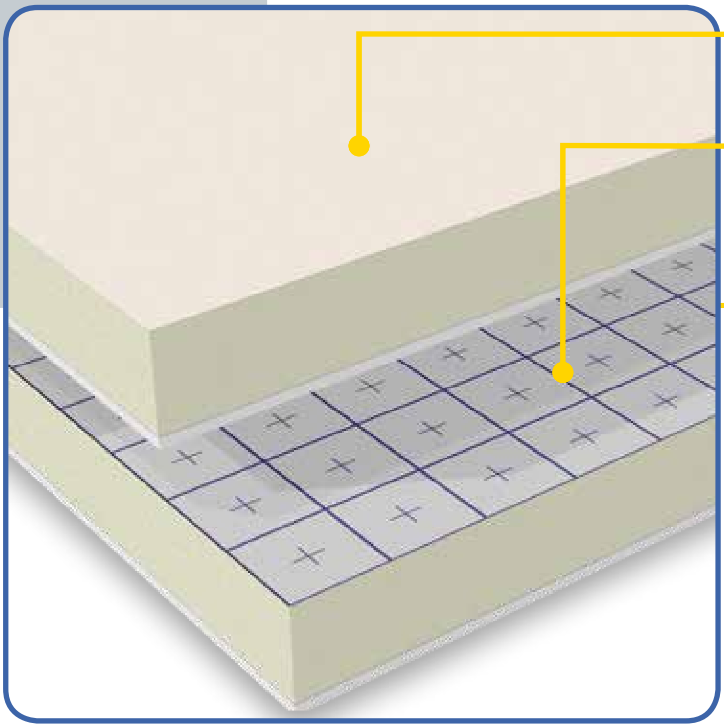
Insulation performance

From 120 to 140 mm thick:
λ_D = 0,025 W/mK

From 80 to 110 mm thick:
λ_D = 0,026 W/mK

From 20 to 70 mm thick:
λ_D = 0,028 W/mK

aluminium reinforcement discs



RP 1
RP 3

Euroclass reaction to fire

B s1 d0

Insulation performance
(reference only to insulation panels)

RP 1
λ_D = 0,023 W/mK

RP 3
λ_D = 0,023 W/mK

Description
RP 1
GT panels of Polyiso (PIR) foam using Pentane has the blowing agent. Covered on both sides by a Duotwin facer and industrially bonded to 9,5mm plasterboard.

RP 3
GTE panels of Polyiso (PIR) foam covered on both sides by a multi-layer aluminium foil facer, and industrially bonded to 9,5mm plaster-board.

Main applications
Internal insulation of perimeter walls.
Internal partition dividers.

Insulation warnings
None.
Same method of installation as in all plasterboard panels.

stiferite thermal insulation

AI4

Euroclass reaction to fire

D s2 d0

STIFERITE AI Description

STIFERITE'S AI4, are made of Polyiso (PIR) foam using Pentane as the blowing agent. They are covered on both sides by an embossed micrometric aluminium facer, of 40µm thick.

Main applications

Insulation of heated floors
Insulation of walls with vapour barrier
Insulation of ventilated walls
Industrial insulation

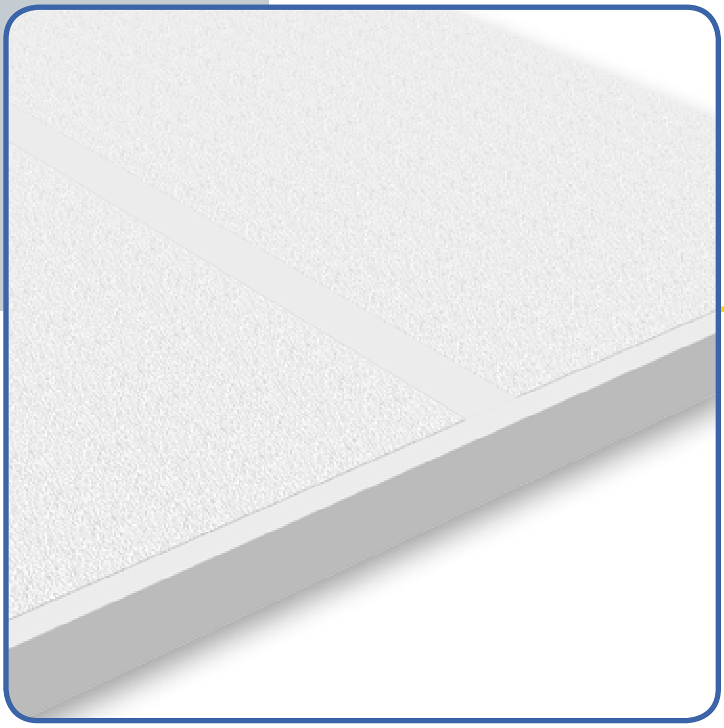
Installation warnings

None.

Insulation performance

λ_D = 0,023 W/mK

stiferite thermal insulation



Test End Use Condition

AI6 - AI8
ALC - ALE - ALL

Euroclass reaction to fire

B s2 d0

Insulation performance

λ_D = 0,023 W/mK

STIFERITE AI6 - AI8

Description

STIFERITE'S AI6 and AI8 are made of Polyiso (PIR) foam using Pentane as the blowing agent. They are covered on both sides by an embossed micrometric aluminium facer, of 60μm (AI6) and 80uμ (AI8) thick.

Main applications

Insulation of heated floors - Insulation of walls with vapour barrier - Insulation of ventilated walls - Industrial insulation

Installation warnings

None.

STIFERITE ALC - ALE - ALL

Description

STIFERITE ISOCANALE'S are height performance insulation boards with a rigid polyisocyanurate polyiso foam core, blowing without CFC or HCFC, coverd:
ALC on both side with 80μm embossed aluminium.
ALE on one side with 80μm embossed aluminium and one side with 200μm embossed aluminium.
ALL on one side with 80μm embossed aluminium and one side with 80μm smooth aluminium thickness.

Main applications

For construction of air distribution ducts

Installation warnings

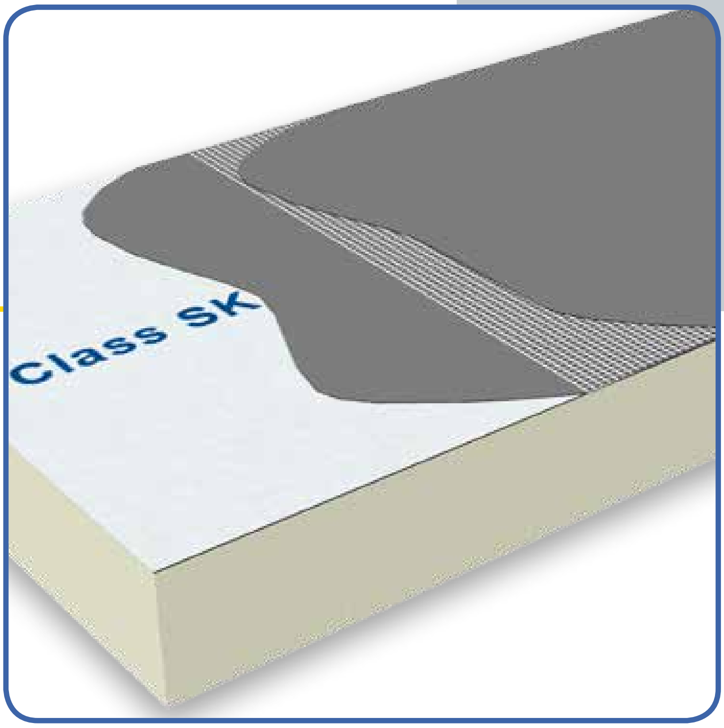
None.

stiferite® thermal insulation

Test End Use Condition

Class SK

plastered for ventilated walls



Euroclass reaction to fire

B s2 d0

Description

STIFERITE's Class SK plastered for ventilated walls is an application of STIFERITE'S Class SK panel. It is made of Polyiso (PIR) foam using Pentane as the blowing agent. It is covered on both sides of the surface by a saturated fibreglass facer and plastered with 5-6 mm thick cement based Klebocem F with a fibreglass mesh.

Main applications

Insulation of ventilated walls

Installation warnings

One side of the panel is glued and/or mechanically fixed to the structure's wall. Two layers of 2-3 mm thick Klebocem F must be applied to the external surface of STIFERITE'S CLASS SK panels.
The fibreglass mesh is immersed into the first layer of cement followed by the second layer.

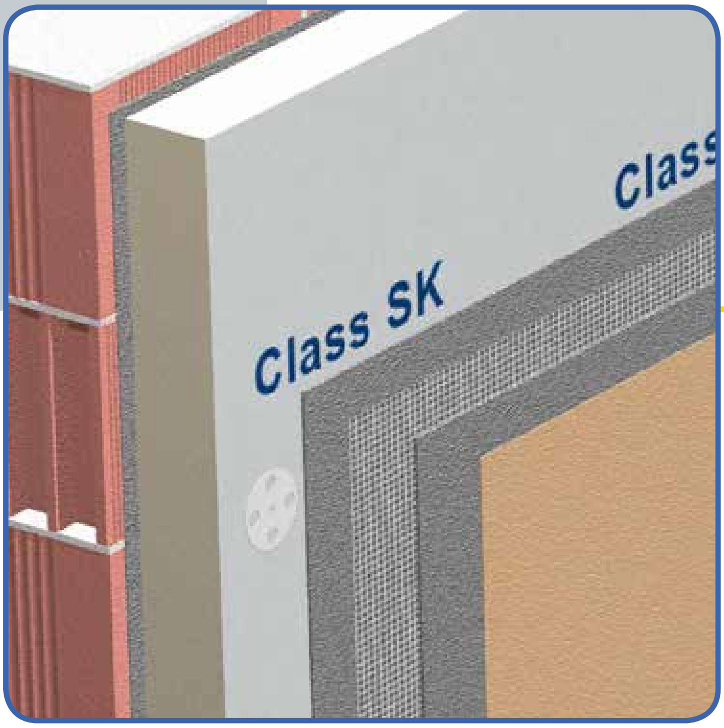
Insulation performance

From 120 to 140 mm thick:
λ_D = 0,025 W/mK

From 80 to 110 mm thick:
λ_D = 0,026 W/mK

From 20 to 70 mm thick:
λ_D = 0,028 W/mK

![stiferite thermal insulation]



Test End Use Condition

INSULATION “
Class SK

Euroclass reaction to fire

B s1 d0

Insulation performance Class SK

From 120 to 140 mm thick:
λ_D = 0,025 W/mK

From 80 to 110 mm thick:
λ_D = 0,026 W/mK

From 20 to 70 mm thick:
λ_D = 0,028 W/mK

Classification "ETICS INSULATION" systems based on the Technical Guide ETAG04

As projected from the Technical Guide ETAG 04, uninterrupted external thermal insulation around a building (ETICS Insulation - External Thermal Insulation System) can be tested in accordance to the harmonized European norm EN 13823 (SBI), therefore in end use condition.
Selecting STIFERITE'S Class SK is a safe choice, as shown by the numerous test reports in the packages where it is used as a thermal insulator, and where it obtained the European Technical Approval (ETA, see table).

<table>
<tr><th colspan="3">ETICS Systems - End Use Condition
Euroclass reaction to fire (EN 13823 - SBI)</th></tr>
<tr><td>Insulation material</td><td>ETIC System
Kit certified ETA</td><td>Reaction
to fire</td></tr>
<tr><td rowspan="4">STIFERITE's Class SK</td><td>Baumit
S026</td><td rowspan="3">B s1 d0</td></tr>
<tr><td>Capatect
PU Line Stiferite Class SK</td></tr>
<tr><td>IVAS
Termok8 Slim
Stiferite Class SK</td></tr>
<tr><td>Waler
Kleinwall</td><td>B s2 d0</td></tr>
</table>

General considerations and other technical norms

The behaviour to fires from STIFERITE Class SK panels of a synthetic nature, is essentially different from other plastic insulation material. This is because STIFERITE'S PIR foam is thermo hard, and therefore in the presents of a flame or high radiant heat, it will carbonize (char) and transform in a chemical structure that is not capable of burning. Such transformation is an effective

ETICS Insulation"

way to "pacify" the insulation material that effectively slows down the spread of fire by reducing the smoke, increasing the time for intervention so as to bring to safety the people and their personal valuables.
Other insulation material of synthetic nature, for example: Polystyrene (Styrofoam) is a thermo plastic polymer and therefore is subjected to transformations based on temperature variations.
Passing from a solid, to a liquid (fusion) and subsequently to a gas state or directly from a solid to a gas. In spite of this significant behaviour, the test method from which the European system of classification (EN 13823-SBI) is based,does not allow any differentiation, therefore External Thermal Insulation Systems of synthetic thermo hard or thermo plastic material normally obtain the class B sx dx classification.
In order to increase the safety level of these applications, some European countries like, Austria and Germany have adopted stringent technical norms that in effect limit the use of products of organic nature. In Austria, organic material used in External Thermal Insulation Sustems above 6 meters in height, must have a fire barrier made of inorganic material in every floor marking of the building installed on top of the window's beams. Such floor markings represent an element of safety, but since it is a critical element, it will add to installation costs and may also introduce installation problems. The possibility of not using a fire barrier is being considered whenever the kit of the system passes part 5 of the norm ONORM 3800. The grand scale test, described also in DIN 4102-20, calls for a 6 meter high wall and an 80x80cm window. The fire is ignited by 25kg of wood that generates around 250-300kW of power. The test lasts for 30 minutes, during which time, temperature measurements of the walls exposed to the flames and from the interior side of the insulation in reference to external probes, are taken. To pass the test, there must not be any red-hot droppings of the material and the measured temperatures on the inside of the insulator side glued to the brick, must not exceed the specified limits.
A sample of STIFERITE'S CLASS SK panel140mm thick appropriately plastered and finished with Baumit's S026 package (Artline Pulz finish, acrylic base with high percentage of resin) was tested by the institute of Magistat der Stadt Wien in Vienna to determine its' fire behaviour based on Onorm 3800 part 5 (see side photo).

The test on a 6 meter wall in conformation angle.

Ignition of the fire load made of 25kg of wood able to generate 250-300 kW.

Execution of the test.

Test End Use Condition

“ETICS INSULATION” Class SK

Turn-off phase at the end of 30’ as required by procedure.

Removal of the plaster layer in order to verify the state of the insulation. STIFERITE’s Class SK is charred only in the zone exposed to the flame.

The testing of the Baumit S026 finish package with STIFERITE Class SK insulation panel of 140 mm thick, successfully passed and obtained validation from the Magistrat Institut of Vienna; therefore, it may be used without restriction and without the need of fire barriers in buildings up to 22 meters in height.
Despite reaching high external surface temperatures of 900° C, no open flame droppings were detected during the test, only the internal probe measured almost 50° C, while the other internal probes reported ambient temperatures.
It is important to underline that under precise instructions of the system’s fabricator, the test was made using high percentage levels of organic plaster, and finishing material, and therefore, with worse fire reaction rating. This penalizes the performance of the tested package, but the good results obtained can also be extended to a line of lower organic contains of plasters and finishing material.
In order to evaluate the positive effects of carbonization (charred) of PIR foam in a fire, a test using a finish package with EPS of 140 mm thick and elements of floor markings made of STIFERITE’S Class SK, was also made.
This test too successfully passed, which demonstrates that despite STIFERITE’s Class SK is an organic insulation of synthetic nature, it performed equally well in a fire as products of inorganic nature, for example, mineral wool (see photo).

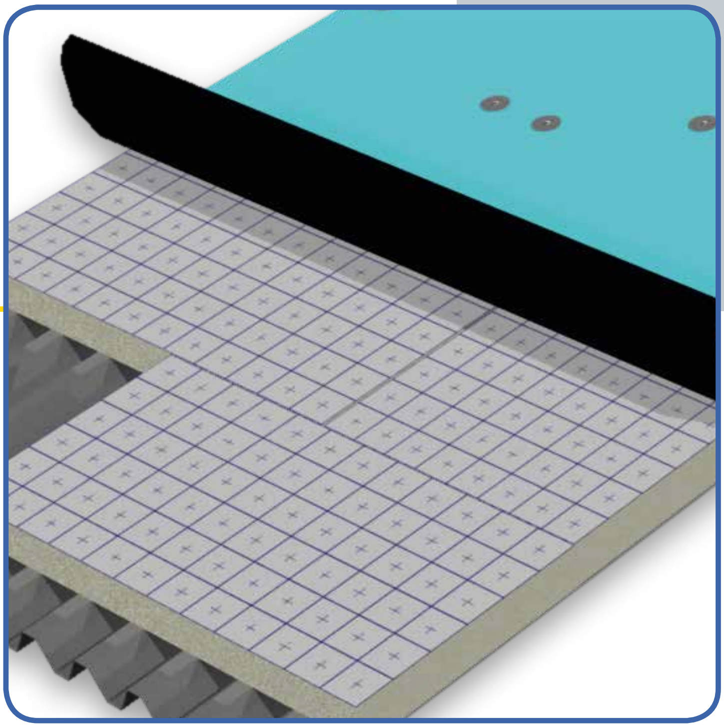
“ETICS Insulation” test in EPS with elements of floor marking in STIFERITE Class SK

While the floor marking material made of STIFERITE’S Class SK is partially charred in the area exposed to the flame, the 900°C temperatures developed during the fire have completely melted the EPS.

stiferite®
thermal insulation

Test End Use Condition

Roof covering in sheet metal GTE



Euroclass reaction to fire

B s1 d0

Description

STIFERITE'S GTE is a Polyiso (PIR) foam insulation panel expanded by pentane as the blowing agent. It is sandwiched on both sides by a multi-layer aluminium foil facer. The test was performed by installing STIFERITE'S GTE panel on top of 1.2 mm thick sheet metal covered by a synthetic waterproofing membrane in TPO.

Main applications

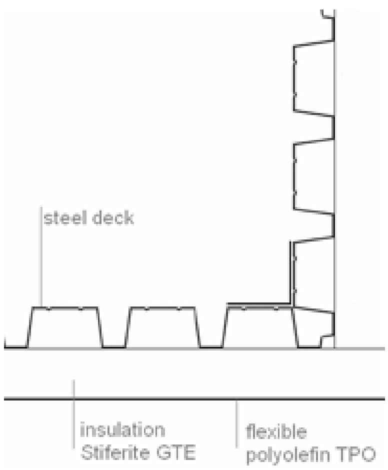
Roofs under sheet metal waterproofed by synthetic membranes in TPO.

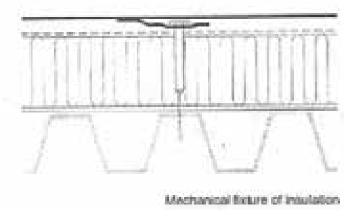
Installation warnings

STIFERITE'S GTE insulating panel was installed directly on top ofthe sheet metal and was mechanically attached through the same fixtures as those used for the synthetic membrane in TPO.

Insulation performance GTE

λ_D = 0,023 W/mK





stiferite®
thermal insulation

Stiferite Srl
Viale della Navigazione Interna, 54 - 35129 Padova (I)
Ph +39 049 8997911 - Fax +39 049 774727
email: info@stiferite.com
www.stiferite.com - www.stiferite.it
Tollfree Number **800-840012**