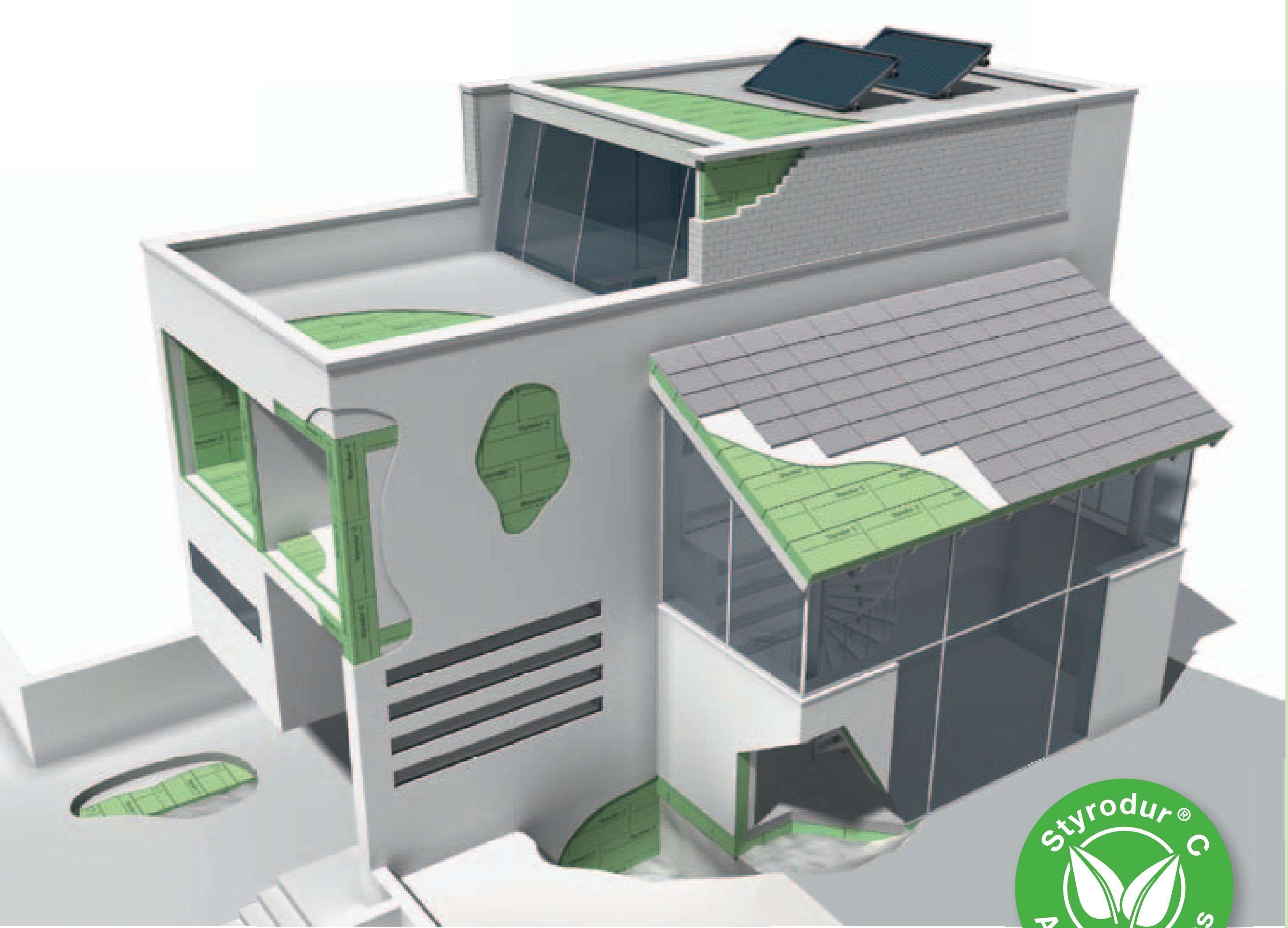
Styrodur® C
Europe's green insulation

Ceiling Insulation

BASF
The Chemical Company

Contents Overview



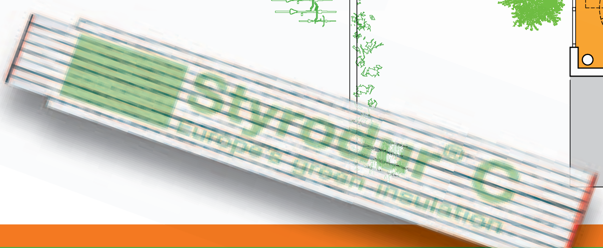
1. Styrodur® C Thermal Insulation

Styrodur® C is BASF's environmentally friendly, extruded polystyrene rigid foam. It is free of CFC, HCFC, and HFC and makes an important contribution toward reducing emissions of carbon dioxide (CO_2).

Due to its high compressive strength, low moisture absorption, durability, and resistance to decay, Styrodur C has become synonymous with XPS in Europe. The compressive strength is the main distinction between the various Styrodur C types.

Effective thermal insulation with Styrodur C reduces energy consumption with the result that the investment in thermal insulation can be offset within a short period of time. It makes for healthy and comfortable living and protects the building from the effects of moisture as well as high and low temperatures.

Styrodur C is manufactured in accordance with the requirements of the European standard DIN EN 13 164. In terms of fire protection, it has been classified as Euro-class E in accordance with DIN EN 13501-1. It is quality-controlled by Wärmeschutz e.V. and has been granted the approval no. Z-23.15-1481 by the DIBt, an institute of the Federal and Laender Governments for a uniform fulfillment of technical tasks in the field of public law.



2. Ceiling Insulation

For gyms, barns, fruit and vegetable storage, and warehouses for bottled wine you need ceilings that are

- easy to install,
- of little strain to the construction due to their minor net weight,
- visually appealing,
- well insulated.

Styrodur® C thermal insulation boards have excelled in such applications due to their excellent properties.

3. Applications

3.1 Gyms

With today's energy costs, a heat-insulating ceiling and insulated walls in spacious gyms pay off quickly. Styrodur C is easy to handle and install.

Its surface is clean and even looks appealing, making for a neutral background, which is particularly important for many indoor ball games.

Styrodur C green boards create just the right climate in every season for any sport—in new constructions as well as in renovated buildings.

Fig. 1: Insulation of a gym with Styrodur® C.

3.2 Fruit and Vegetable Storage

Fruit and vegetable storage warehouses maintain a certain operating temperature by means of cooling units. The need for good insulation becomes apparent when you consider that cooling cost are four times as high as heating costs.

3.3 Distributing Warehouses for Bottled Wine

Contrary to barrel storage, distributing warehouses for bottled wine are usually above ground and should maintain a room temperature of approx. 12–14°C.

If ceilings and walls are insulated with Styrodur C, mere controlled ventilation is sufficient to keep temperatures stable at that level.

Fig. 2: Insulation of a wine cellar.

3.4 Heated Barns

Heated barns require thermal insulation in order to maintain a healthy climate. Usually, barns are insulated in such a way that the body heat of animals compensates for the heat loss of the building.

The humidity and concentration of gas (carbon dioxide from breathing and ammonia and hydrogen sulfide from excreta) is kept in balance by controlling the incoming and outgoing air. By means of a thermal balance, it can be determined how well the ceiling of the barn has to be insulated in order to sustain a comfortable temperature for the animals even during the wintertime.

Fig. 3: Insulation of a barn.

4. Renovation with Styrodur© C

4.1 Insulation of Second-floor Ceilings

In most houses built before the end of the 1970s, the second-floor ceiling is either insulated poorly or not at all, which leads to a lot of heat energy evaporating through the attic. Not surprisingly, the ratio between investment costs and savings in energy costs is very favorable. All it takes is some basic information and a few mechanical skills in order to implement the necessary modifications by yourself.

Under the "Energieeinsparverordnung EnEV" (Energy Saving Ordinance) many homeowners are legally obligated to improve the thermal insulation of their second-floor ceilings by the end of 2006, mainly for economical reasons. This obligation to retrofit the second-floor ceiling above any heated living space concerns all apartment buildings as well as all houses with accessible but non-walk-on areas. After a change of proprietorship, these requirements also apply to single-family and duplex houses after a term of two years. The thermal transmission coefficient of the second-floor ceiling must not exceed 0.30 W/(m²·K).

Apart from legal regulations, it is recommendable for all homeowners to check the heat insulation of their second-floor or attic ceiling. Especially in this part of the house, heating costs can be reduced drastically by installing additional insulation in a simple and economical manner. In addition, the comfort of living in the adjoining rooms will rise noticeably.

The insulation of the second-floor ceiling with Styrodur® C 3035 CS can vary in thickness or in the number of layers used. The EnEV's requirement of a thermal transmission coefficient of 0.3 W/(m²·K) can be met with installing just 80 mm Styrodur 3035 CS (two layers of 40 mm).

Fig. 4: Insulation of an attic with Styrodur® C.

In order to fully avail oneself of the potential savings, it is advisable to install two layers of 80 mm Styrodur C 3035, thus complying with the heat insulation requirements for new constructions (thermal transmission coefficient of 0.17 W/(m²·K)).

4.2 Insulation of Ceilings in Unheated Basement

Many houses have solid basement ceilings without additional insulation. According to today's standards, the properties of such ceilings — with a thermal transmission coefficient of approx. 1.1 W/(m²·K) — are no longer adequate. This leads to an increase of heat loss, unnecessarily high heating costs, and uncomfortable drafts. The current EnEV benchmark for insulated basement ceilings is a thermal transmission coefficient of 0.4 W/(m²·K).

In unheated basements, the insulation can be installed underneath the basement ceiling. Insulation of basement ceilings is a simple and economic method to improve your heat insulation.

Due to the rather small difference in temperature between living space and basement, the potential savings are rather limited in comparison to similar measures taken in insulating roofs or facades. Taking into account the comparatively low costs, one should nevertheless consider these measures. Depending on the height of the basement, Styrodur 2800 C insulating boards of 6–12 cm can simply be glued onto or, if necessary, plugged underneath the basement ceiling. All these measures are easy to implement without any professional help.

For vaulted ceilings or similar ceilings with an uneven surface, it is recommendable to install the insulation on top of the construction, just under the ceiling.

Insulating your basement ceiling is a simple and economic measure, which can help you save up to 5–10% of the original energy demand.

Attention:
For wood-beam ceilings, it might be necessary to install a vapor barrier underneath the insulation. In such cases, it is advisable to evaluate each construction and decide accordingly.

In case the attic is supposed to be a walk-on area, e.g., for maintenance purposes, particle boards can be put on top of the insulation layer.

5. Construction

5.1 Direct Fixation

The easiest way is to nail the insulation board directly onto the substructure.

Attention:
Wooden constructions can show dimensional changes due to the exposure to changing temperature and moisture throughout the year. This can lead to the formation of grooves in between the Styrodur® C boards. To cover up these grooves, one can add special coverbars between the boards.

Due to the threat of corrosion, clout nails made of noncorrosive metal (galvanized iron, aluminum, rustproof steel) should be used. For optimum load transmission, plastic shims can be placed underneath the nail heads. Occasionally disrupting thermal bridges, caused by metal pegs (drop formation), can be eliminated by using plastic nails with big heads that should be inserted in predrilled holes, or plastic bolts with a steel nail in their shank.

For a perfectly plane slab underside without any nail heads sticking out, fixate the boards with metal clamps engaging into the material from the sides. Such clamps need to be adjusted to the insulation boards and potential weight with regard to their penetration and width.

Research has shown such high pull-out strengths for these clamps—combined with the solid Styrodur C tongue-and-groove boards—that the fixation is generally snow- and windproof.

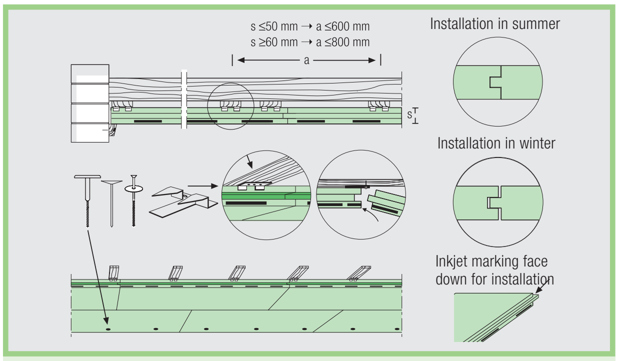


Fig. 5: Installation details for Styrodur® C in ceilings.

5.2 Indirect Fixation

For indirect fixation, the Styrodur C boards are inserted into a visible metal construction made of noncorrosive steel cables.

The advantages:

- Installation is very easy
- No visible butt joints
- Possibility to install ventilation and lighting systems

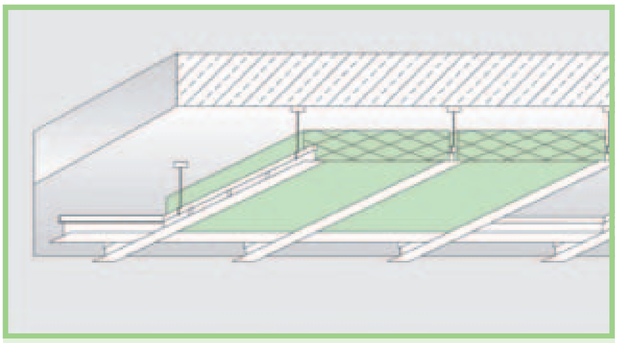


Fig. 6: Indirect fixation with Styrodur C.

6. Installation

The following laying systems have proved valuable:

- Between binders
- Underneath binders
- Hanging construction

Depending on the laying system, keep the following in mind:

- Avoid cross joints when installing the boards.
- The substructure as well as the thermal insulation boards can be subject to thermal elongations.

Generally, the thermal boards are press-fitted during the summer (high temperatures) and fitted with expansion joints during the winter (low temperatures). In addition, the use of coverbars has proved to be advantageous.

Fig. 7: Fixation of Styrodur C boards.

7. Technical Data Styrodur® C

Property	Unit[1]	Code according to DIN EN 13164	2500 C	2800 C	3035 CS	3035 CN	4000 CS	5000 CS	Standard
Edge profile									
Surface			skin	embossed	skin	skin	skin	skin	
Length x width	mm		1250 x 600	1250 x 600	1265 x 615	2515 x 615[2]	1265 x 615	1265 x 615	
Density	kg/m³		28	30	33	30	35	45	DIN EN 1602

Thermal conductivity λ_D [W/(m·K)] / Thermal resistance R_D [m²·K/W]	Code	2500 C λ_D	2500 C R_D	2800 C λ_D	2800 C R_D	3035 CS λ_D	3035 CS R_D	3035 CN λ_D	3035 CN R_D	4000 CS λ_D	4000 CS R_D	5000 CS λ_D	5000 CS R_D	Standard
Thickness 20 mm	–	0.030	0.65	0.030	0.65	–	–	–	–	–	–	–	–	DIN EN 13164
30 mm	–	0.031	1.00	0.031	1.00	0.031	1.00	0.031	1.00	0.031	1.00	–	–	
40 mm	–	0.032	1.25	0.032	1.25	0.032	1.25	0.032	1.25	0.032	1.25	0.032	1.25	
50 mm	–	0.033	1.55	0.033	1.55	0.033	1.55	0.033	1.55	0.033	1.55	0.033	1.55	
60 mm	–	0.034	1.80	0.034	1.80	0.034	1.80	0.034	1.80	0.034	1.80	0.034	1.80	
80 mm	–	–	–	0.035	2.35	0.035	2.35	0.035	2.35	0.035	2.35	0.035	2.35	
100 mm	–	–	–	0.037	2.80	0.037	2.80	–	–	0.037	2.80	0.037	2.80	
120 mm	–	–	–	0.038	3.30	0.038	3.30	–	–	0.038	3.30	0.038	3.30	
140 mm	–	–	–	–	–	0.038	3.70	–	–	0.038	3.70	–	–	
160 mm	–	–	–	–	–	0.038	4.20	–	–	–	–	–	–	
180 mm	–	–	–	–	–	0.040	4.55	–	–	–	–	–	–	

Property	Unit[1]	Code according to DIN EN 13164	2500 C	2800 C	3035 CS	3035 CN	4000 CS	5000 CS	Standard
Compressive stress or compressive strength at 10% deformation	(kPa)	CS(10\Y)	200	200	300	250	500	700	DIN EN 826
Compressive creep over 50 years at < 2% deformation	(kPa)	CC(2/1.5/50)	80	80	130	100	180	250	DIN EN 1606
Rated value of the compressive stress under foundation slabs (kPa)	σ_{perm}	–	–	–	130[3]	–	180	250	DIBT Z-23.34-1325
	f_{cd}		–	–	185	–	255	355	
Adhesive strength on concrete	kPa	TR 200	–	> 200	–	–	–	–	DIN EN 1607
Compressive modulus of elasticity (kPa)	Short-term E	CM	10,000	15,000	20,000	15,000	30,000	40,000	DIN EN 826
	Long-term E50		–	–	5,000	–	10,000	14,000	
Dimensional stability: 70°C; 90% r.h.	%	DS(TH)	≤ 5%	≤ 5%	≤ 5%	≤ 5%	≤ 5%	≤ 5%	DIN EN 1604
Deformation behavior: load 40 kPa; 70°C	%	DLT(2)5	≤ 5%	≤ 5%	≤ 5%	≤ 5%	≤ 5%	≤ 5%	DIN EN 1605
Linear coefficient of thermal expansion Longitudinal	mm/(m·K)	–	0.08	0.08	0.08	0.08	0.08	0.08	DIN 53752
Transverse		–	0.06	0.06	0.06	0.06	0.06	0.06	
Reaction to fire[4]	Euroclass	–	E	E	E	E	E	E	DIN EN 13501-1
Long-term water absorption by immersion	% v/v	WL(T)0.7	0.2	0.3	0.2	0.2	0.2	0.2	DIN EN 12087
Long-term water absorption by diffusion	% v/v	WD(V)3	≤ 3	≤ 5	≤ 3	≤ 3	≤ 3	≤ 3	DIN EN 12088
Water-vapor transmission (thickness-dependent)		MU	200–100	200–80	150–50	150–100	150–80	150–100	DIN EN 12086
Freeze-thaw resistance	% v/v	FT2	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	DIN EN 12091
Maximum service temperature	°C	–	75	75	75	75	75	75	DIN EN 14706

[1] N/mm² = 1 MPa = 1,000 kPa   [2] Thickness 30 and 40 mm: 2510 x 610 mm   [3] For multilayer laying: 100 kPa   [4] Building material class DIN 4102-B1

Further Information on Styrodur® C

- **Product Brochure: Europe's Green Insulation**

- **Applications**
  - Basement Insulation
  - Load-bearing Applications and Floor Insulation
  - Wall Insulation
  - Roof Insulation
  - Ceiling Insulation

- **Special Themes**
  - Reconstruction and Refurbishment
  - Thermal Insulation of Biogas Plants
  - Styrodur® 2500 CNS—Insulation for Underfloor Heating Systems

- **Technical Data**
  - Recommended Applications and Technical Data
  - Technical Data and Assistance Data for Dimensioning

- **Chemical Resistance**

- **Styrodur C Film: Europe's Green Insulation**

- **Website: www.styrodur.com**

KTFS 0802 BE - ENGLISH VERSION - March 2010

BASF SE

Performance Polymers Europe
67056 Ludwigshafen
Germany

www.styrodur.com