THERMOSTOP®-PLUS

Thermal insulation liner for mounts for rear-ventilated external wall cladding

- inexpensive
- thermally insulating
- compression-proof
- corrosion-resistant

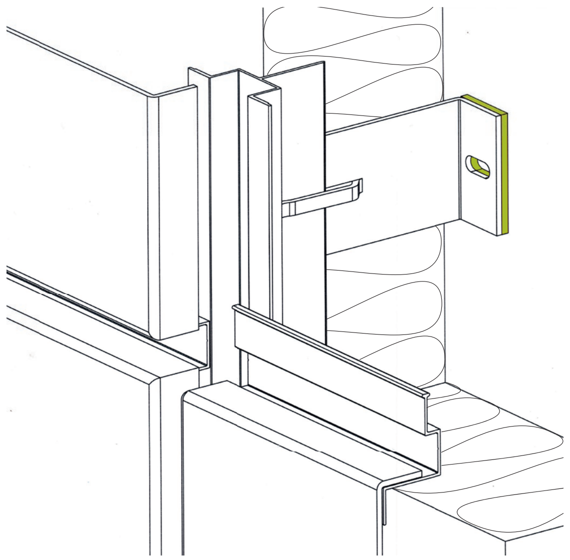
Protection against heat and corrosion
for structural facings between wall mounts and external wall

• **Thermally insulating**	0.08 – 0.09 W/mK
• **Elastic area according Hook**	6 – 14 N/mm^2 (elastic range)
• **Lightweight**	4.2 kg/m^2 for 6 mm thickness)
• **Viscoelastic**	Impact strength = 15 kJ/m^2
• **Closed-cell**	Water absorption < 0.3 %
• **Ready to install**	No additional treatment
• **Thin**	4 – 6 mm, no additional bending moment on plug
• **Push-through**	Fast installation
• **Compensating**	For small uneven areas
• **Self-extinguishing**	Fire class B1 per DIN 4102; for Switzerland: V.3 per VKF
• **Recyclable**	Fully recyclable
• **Rot-proof**	High chemical resistance

THERMOSTOP®-PLUS is available in customer-specific sizes with suitable hole patterns for push-through or slide-in installation. Packaging, units, and labelling are provided by arrangement.

THERMOSTOP®-PLUS is also available in a self-adhesive version.

6 mm THERMOSTOP®-PLUS achieves the same thermal effect as 12 mm hard PVC or 15 mm laminate (Trespa, Resoplan etc.).



Thermal conductivity of wall mounts

Aluminium	200 W/mK
Steel	60 W/mk
Stainless steel	15 W/mk

Thermal conductivity of liners

HDPE (polyethylene) hard	0.38 W/mk
PP (polypropylene)	0.20 W/mk
Laminated paper	0.20 W/mk
PVC (polyvinylchloride)	0.17 W/mk
THERMOSTOP®-PLUS	**0.08 – 0.09 W/mk**

Technichal data for THERMOSTOP®-PLUS thermal isolator
(1 – 10 mm)

Material: hard PVC with closed-cell foam

Thickness	Compressive strength, elastic range based on DIN EN ISO 844	Compressive stress at 30% compression based on DIN EN ISO 844
1 – 2 mm	> 6 N/mm^2	> 12 N/mm^2
3 mm	> 8 N/mm^2	> 15 N/mm^2
4 mm	> 11 N/mm^2	> 18 N/mm^2
5 mm	> 11 N/mm^2	> 18 N/mm^2
6 mm	> 13 N/mm^2	> 18 N/mm^2
8 mm	> 13 N/mm^2	> 18 N/mm^2
10 mm	> 14 N/mm^2	> 19 N/mm^2

Bulk density	> 0.70 g/cm^3	Per DIN EN ISO 1183-1
Elastic modulus (from tensile tests)	1000 N/mm^2	Per ISO 527-2
Linear coefficient of expansion –30˚C to +50˚C	0.08 mm/m˚C	Per ISO 11359-2
Shore hardness	~ 60	Per DIN ISO 48-4
Vicat softening temperature VST Vicat A	76 ˚C	Per ISO 306 method A50
Thermal conductivity	0.08 – 0.09 W/mK	Per DIN EN 22007-4
Water absorbtion after 7 days	< 0.3%	Per DIN EN ISO 62
Fire class	B1 S.3 Class 1 M1 Classe 1 V0-5V C-s3, d0	Per DIN 4102-1 (DE) Per VKF (CH) Per BS 476, Part 7 (UK) Per NFP 92-501 (FR) Per UNI 8457 & 9174 (IT) Per UL 94 (USA) Per DIN EN 13501-1 (Europe)

All values are approximate and may vary depending on the processing methods used and the sample or test item.

The low-cost solution for reducing thermal bridges at anchors for rear-ventilated external wall cladding

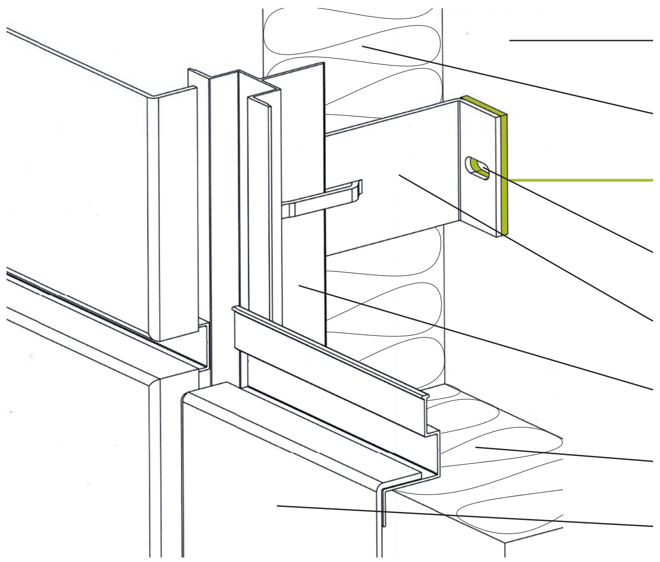
1. Initial situation
Rear-ventilated external wall cladding meets very high requirements in terms of aesthetics, material selection, and building physics. Its structural design consists of a load-bearing inner shell, an outer thermal insulation layer, a ventilation space, and external wall cladding in front of this as weather protection and for the visual design of the façade.

The external wall cladding is attached to the inner shell by means of mounting rails, brackets, and anchors. The brackets penetrate the thermal insulation layer and lead to increased thermal losses of 15%–60% in comparison with undisturbed insulation. As requirements for thermal protection increase and thermal insulation becomes thicker, the additional losses at specific points become even more significant in percentage terms and can no longer be considered negligible[1].

The Energy Saving Ordinance (*Energieeinsparverordnung*, EnEV) requires that local thermal bridges be taken into account when verifying the annual heating requirements of buildings.

2. Thermal bridges at anchors
Local thermal bridges occur at anchors. They are largely influenced by
- the thermal conductivity and layer thickness of individual components
- the thermal conductivity of component layers and their contact surfaces on both sides of the insulation layer, owing to the "dissipation effect" (range of influence).

The insulator THERMOSTOP®-PLUS efficiently stops the flow of heat between the brackets and substrate, and prevents condensation from forming in the winter between the warm substrate and the cold brackets. The insulator also provides corrosion protection for the brackets.



[1] Dr. Joachim Achtziger: *Neue Erkenntnisse über den Wärmebrückeneinfluss von Wärmedämmstoffhaltern und Verankerungen* [New insights on the influence of thermal insulation brackets and anchors on thermal bridges], IBK Baufachtagung 202, 29/30 November 1995
[2] Ch. Tanner: *Hinterlüftete Fassaden* [Rear-ventilated façades], Schlussbericht F+E Nr. 127378, Sept. 92
[3] *Wärmebrücken von hinterlüfteten Fassaden* [Thermal bridges in rear-ventilated façades], Schlussbericht Nr. 158740, Sept. 96
[4] FVHF – Focus Nr. 15: *Bestimmung der Wärmetechnischen Einflüsse von Wärmebrücken bei vorgehängten hinterlüfteten Fassaden* [Determining the thermal influences of thermal bridges in rear-ventilated curtain façades]

3. Thermal conductivity of materials
Materials in current use for brackets and insulators have the following thermal conductivities:

Brackets/substructure

Aluminium	200 W/mK
Steel	60 W/mk
Stainless steel	15 W/mk
Wood	0.14 W/mk

Insulator

HDPE (polyethylene) hard	0.38 W/mk
PP (polypropylene)	0.20 W/mk
Laminated paper	0.20 W/mk
PVC (polyvinylchloride)	0.17 W/mk
THERMOSTOP®-PLUS	**0.08 – 0.09 W/mk**

Substructures made of wood (single layer or cross-laid) cause additional thermal losses of about 10%–20%. DIN 4108 Part 5 can also be used to perform calculations for structures of this kind.

When attaching heavy external wall cladding, such as natural stone, a large number of anchors per m² are required. Testing by EMPA[2] showed back in 1992 that using 3.5 stainless steel anchors per m² leads to additional thermal losses of 23%, with a figure as high as 42% for carelessly applied insulation. A significant reduction in thermal losses is demonstrated in the above report by the use of a plastic liner between the structural wall and the bracket. Meanwhile, the project "Thermal bridges of rear-ventilated façades" is supported by a wide range of sponsors and has been reviewed by the EMPA[3]. The Fachverband Baustoffe und Bauteile für vorgehängte hinterlüftete Fassaden e.V. (Association for Materials and Components for Rear-Ventilated Façades, FVHF) published a special document on this topic[4]. The EMPA investigations tested our insulator THERMOSTOP®-PLUS with a thickness of 6 mm.

The following results summarise the findings of the above report:

Measurement / **Designs**	K-value measured **W/m²K**	Additional loss for 1 bracket per m² **W/K**	Additional loss for 1 bracket (%) *
1. 0-value measurement, undisturbed wall, 100 mm mineral wool with λ = 0.03 W/mK	0,263	-	0
2. Ditto wooden slats, single layer (a = 60 cm)	0,318	0,055	21
3. Ditto wooden slats, cross-laid (a = 60 cm)	0,296	0,033	13
4. Ditto with steel brackets, cross section 2 x 60 mm	0,333	0,042	16
5. Ditto with steel brackets, cross section 2 x 60 mm, **with THERMOSTOP®-PLUS 6 mm**	0,313	0,030	**11**
6. Ditto with aluminium brackets, cross section 4 x 60 mm	0,395	0,079	30
7. Ditto with aluminium brackets, cross section 4 x 60 mm **with THERMOSTOP®-PLUS 6 mm**	0,324	0,037	**14**

For designs 4–7, 1.7 brackets per m² were used.
* Additional loss in % for 1 bracket/m². For twice as many brackets per m², the additional loss per m² and the percentage additional loss are also doubled.

- Single-layer or cross-laid wooden slats increase the thermal loss of rear-ventilated façades by 21% and 13% respectively. .
- Aluminium brackets exhibit around twice the thermal losses of steel brackets.
- **Our insulator THERMOSTOP®-PLUS reduces local thermal losses significantly, by 35%–60%.**

4. THERMOSTOP®-PLUS

4.1. Application

THERMOSTOP®-PLUS was developed in 1990 for the Swiss market and has successfully withstood tough, real-world conditions ever since, with over 60 million components installed. In Germany, the first projects were completed in 1996; since then, over 50 million components have been installed with very good results. THERMOSTOP®-PLUS is installed between the substrate and bracket. Typically, push-through or slide-in installation are used, or a self-adhesive THERMOSTOP®-PLUS is attached to the base of the bracket prior to installation.

4.2. Technical data

The specific properties of THERMOSTOP®-PLUS are as follows:

Thick-nesses	Compressive strength, elastic range based on DIN EN ISO 844	Compressive stress at 30% compression based on DIN EN ISO 844
1 – 2 mm	> 6 N/mm²	> 12 N/mm²
3 mm	> 8 N/mm²	> 15 N/mm²
4 mm	> 11 N/mm²	> 18 N/mm²
5 mm	> 11 N/mm²	> 18 N/mm²
6 mm	> 13 N/mm²	> 18 N/mm²
8 mm	> 13 N/mm²	> 18 N/mm²
10 mm	> 14 N/mm²	> 19 N/mm²

Bulk density: **> 0,70 g/cm³ for 1–10 mm thickness (lower densities are not recommended!)**
Water absorption: < 0.3% DIN EN ISO 62
Fire class: B1 DIN 4102-1

Additional data is provided on page 3 under "Technical data".

4.3. Long-term behaviour

The THERMOSTOP®-PLUS insulator is subject to low thermal loads because it is located behind the insulation. However, this component is under compressive stress. Tests have shown that the insulator has very good long-term behaviour, with low creep (see table). To distribute the compressive loads that arise at the screw head, it is recommended to use large washers and/or sufficiently thick material in the bracket base.

Tightening torque (Nm)	10	14	18	30
Creep distance* (mm) after 100 temperature cycles –20°C/+60°C	0.30	0.30	0.35	0.54

* Applies to 4 mm thick aluminium brackets and 6 mm thick THERMOSTOP®-PLUS insulators.
THERMOSTOP®-PLUS is also resistant to rot and chemicals.

4.4. Fire behaviour

THERMOSTOP®-PLUS meets the requirements of fire class B1 per DIN 4102 (flame retardant). In addition, THERMOSTOP®-PLUS insulators are fitted in the fire-protected area behind the thermal insulation. The material used is self-extinguishing in case of fire, does not drip when burning, and forms a stable carbon structure.

4.5. Environment and recycling

The material does not contain any toxic or harmful hazardous materials. The material does not contain CFCs, PCBs, PCP, asbestos, formaldehyde, biocides, or softeners.
Production residues and THERMOSTOP®-PLUS insulators are fully recycled at the end of their service life and used as regranulate in the production of new components. As a manufacturer, we agree to take back the products in accordance with the Circular Economy Act (*Wirtschaftskreislaufgesetz*, KrWG), which came into force in October 1996.

4.6. Energy savings

The amount of heating energy saved by using THERMOSTOP®-PLUS insulators is substantial.
Two sample calculations demonstrate this:

Example 1

Rear-ventilated façade with:	- 2 aluminium brackets per m² - 120 heating days with 30 K temperature differential
Additional energy for 2 brackets/m² with THERMOSTOP®-PLUS:	ΔE = 2 x 0.042 W/m²K x 30° K x 120 x 24h = 7.3 kWh/m² At 0.26 €/kWh, this represents a value of 2 €/m².

Example 2

As in Example 1, but:	- 2 steel brackets per m² - 120 heating days with 30 K temperature differential
Additional energy for 2 brackets/m² with THERMOSTOP®-PLUS:	ΔE = 2 x 0.012 W/m²K x 30° K x 120 x 24h = 2.1 kWh/m² At 0.26 €/kWh, this represents a value of 0.55 €/m².

The cost of THERMOSTOP®-PLUS has been recouped through savings in heating costs after about 6 months for aluminium brackets and 1.5 years for steel brackets. After that, you reap the benefit every day that you need to heat your building.

5. Summary

The following three criteria are decisive for the use of THERMOSTOP®-PLUS insulators in rear-ventilated curtain façades:

a) Thermal insulation: As the thickness of THERMOSTOP®-PLUS increases, the thermal insulation also increases, but less than proportionally to the material thickness. Tests at TU Berlin have shown the following potential savings[5]:

THERMOSTOP®-PLUS thickness	Percentage improvement in thermal insulation
5 mm	19,5 %
6 mm	21,0 %
10 mm	25,0 %
15 mm	28,0 %
20 mm	29,9 %

b) Structural strength: As the thickness of THERMOSTOP®-PLUS increases, the bending moment on the screw shaft of the plug fastening also increases because of the eccentric loading. With material thicknesses of >8 mm and upwards, a slight tendency to creep under high loads cannot be eliminated. This creep can only be reduced by the use of strong bracket bases (3–4 mm) and/or large washers.

c) Costs: THERMOSTOP®-PLUS insulators become more expensive as the material thickness increases. At a material thickness of 10 mm, the cost is about 50% higher than for a 6 mm thick THERMOSTOP®-PLUS insulator. Conclusion:

Considering the percentage improvement in thermal insulation, the structural issues, and the cost of the THERMOSTOP®-PLUS insulators with the corresponding brackets, the best cost-benefit ratio is achieved with the 6 mm thickness.

[5] Prof. Cziesielski: *Wärmebrücken im Bereich der Verankerungskonstruktionen* [Thermal bridges in anchoring structures], Baumesse München 15/01/97

Sales
Europe

Switzerland

TECAID

TECaid e.V.
Akazienweg 6
D-79798 Jestetten
Germany

Tel. +49 7745 919 539

info@thermostop-plus.com
www.thermostop-plus.com

LIECHTBLICK

Werkstätte Liechtblick
Amsler-Laffon-Strasse 1
CH-8200 Schaffhausen
Switzerland

Tel. +41 52 630 07 10

info@thermostop-plus.com
www.thermostop-plus.com

ECOLITE

Ecolite AG
Fosbergstrasse 16
CH-8633 Wolfhausen
Switzerland

Tel. +41 55 240 84 52

info@thermostop-plus.com
www.thermostop-plus.com