

<b>THERM<sup>+</sup></b> <b>Glass roof constructions</b> <b>Roof sections</b>	<b>System benefits</b> <b>Sections with curtain wall system THERM<sup>+</sup></b> <b>Sections with rooflight window FRAME<sup>+</sup></b> <b>Sections with rooflight window WING</b>	<b>Roof sections</b>
<b>THERM<sup>+</sup></b> <b>Glass roof constructions</b> <b>Building connections</b>	<b>Ridge connections</b> <b>Eaves sections</b> <b>Verge sections</b>	<b>Building connections</b>
<b>THERM<sup>+</sup></b> <b>Glass roof constructions</b> <b>Assembly options</b>	<b>Supporting structure</b> <b>Sealing system</b> <b>Screw selection</b> <b>Accessories</b>	<b>Assembly options</b>
<b>THERM<sup>+</sup></b> <b>Glass roof constructions</b> <b>Thermal insulation</b>	<b>Basic information</b> <b>Tables of U<sub>m,t</sub> values</b>	<b>Thermal insulation</b>
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## ■ System benefits

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## ■ Roof sections

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The **Product range THERM<sup>+</sup>** gives you a quick and comprehensive overview of our entire product portfolio. For ordering the printed version please use no. 002052. The pdf-files you will find in the download area of [www.raico.de](http://www.raico.de).



■ **Outstanding product properties**

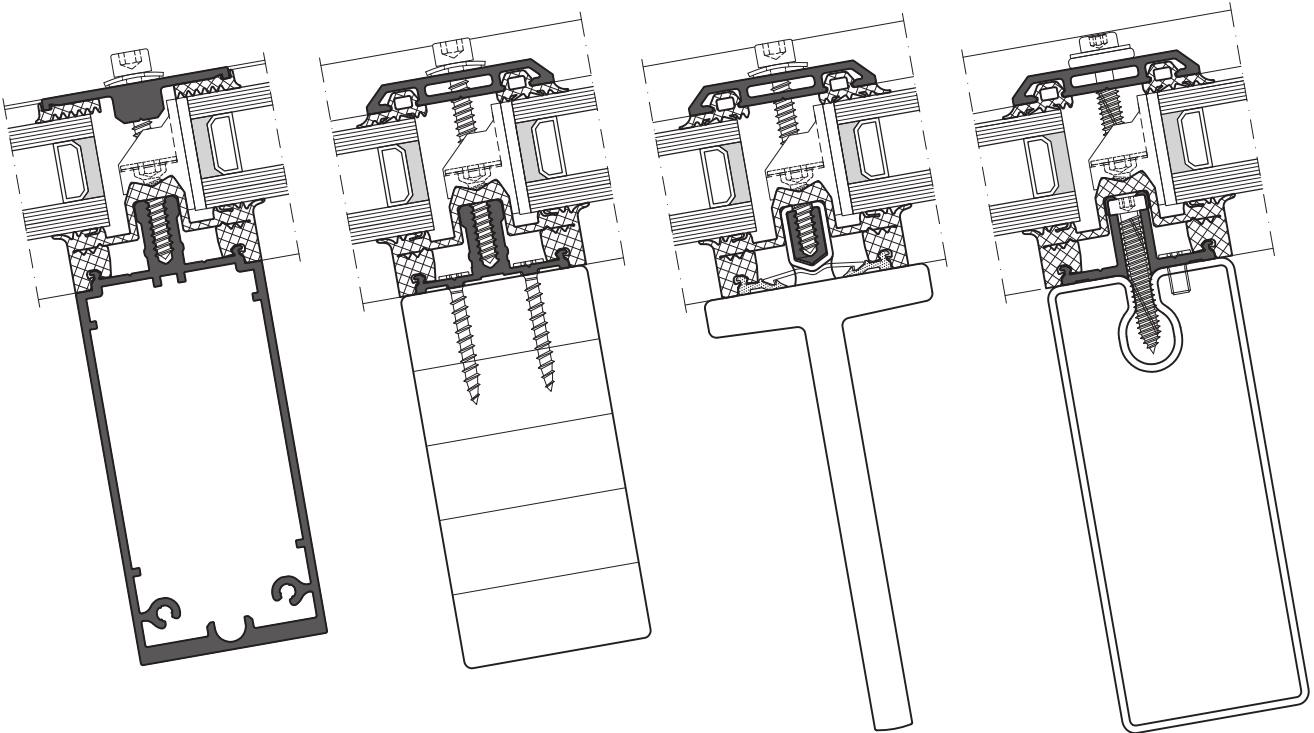
- Tested with an inclination of only 2°, with outstanding results and classifications. (accessories such as sun protection devices and building connection components were included in the testing.)
- Increased form fit of transom gasket thanks to special sealing pieces for the cross point area in the roof. Guarantee for a stable fixation and a durable sealing.
- Openings at the end of the pressure profiles drain screens and avoid stagnant water.

■ **Optimal planning**

- Roof inclination < 2° possible for object-related solution.
- The execution is feasible with special bevelled pressure profiles, flat pressure profiles, silicone joint or any combination of these.
- For ventilation or smoke and heat control the insertion window FRAME<sup>+</sup> 100/120 RI and WING 105 DI, also tested with an inclination of 2°, presents a technically viable and optically perfect solution.

■ **Efficient processing**

- Easy of use.
- Maximum system security.
- Sealing with sealant using an injection method.
- The system structure is identical to the THERM<sup>+</sup> standard system.



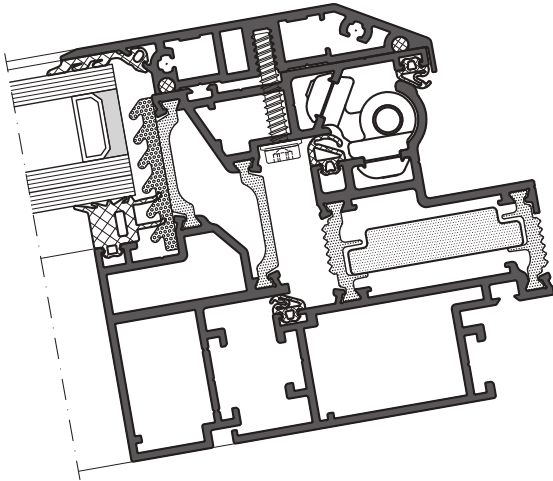
**THERM<sup>+</sup> Aluminium A-I**  
Flat pressure profile

**THERM<sup>+</sup> Timber H-I**  
Roof pressure profile

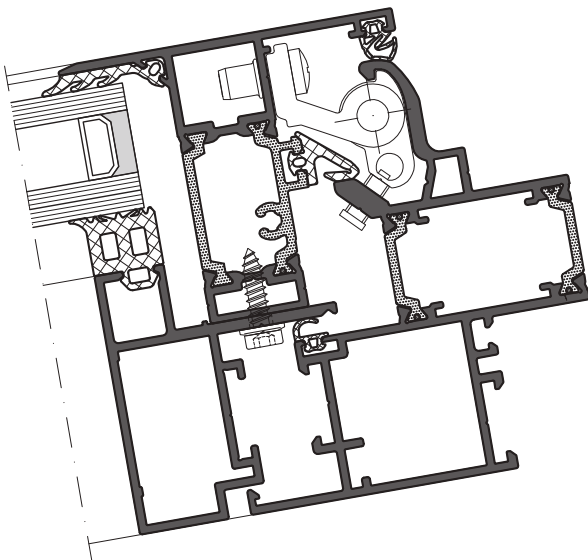
**THERM<sup>+</sup> Steel S-I**  
Roof pressure profile

**THERM<sup>+</sup> Steel FS-I**  
Roof pressure profile

**The perfect complement - RAICO rooflight windows**



**FRAME<sup>+</sup> 100 RI** isolated with double insulating glass



**WING 105 DI** Integration element

■ **FRAME<sup>+</sup> 100/120 RI**

**Passive house certified with complete flexibility**

- First “Opening element in a glass roof” certified by the Passive House Institute – therefore a building envelope in the roof from one source completely certified for passive houses.
- $U_{ocw,i}$  value = 0.98 W/(m<sup>2</sup>K) (in curtain wall THERM<sup>+</sup> A-I)
- $U_{ocw,i}$  value = 1.00 W/(m<sup>2</sup>K) (in curtain wall THERM<sup>+</sup> H-I)
- $U_{ocw,i}$  value = 1.00 W/(m<sup>2</sup>K) (in curtain wall THERM<sup>+</sup> S-I)
- All  $U_{ocw,i}$  values with  $U_g = 0.72$  W/(m<sup>2</sup>K),  $\Psi_g = 0.035$  W/(mK), dimensions 1.20 m x 2.50 m.
- Tested with a roof inclination of up to 2°, therefore the perfect complement to the THERM<sup>+</sup> glass roof systems.
- Maximum airflow effect due to an opening angle of up to 90°. Tested for natural ventilation as well as a smoke and heat exhaust ventilator acc. to DIN EN 12101-2.

**Versatile options of creative solutions**

- Two different glazing variants due to the option for the screw connection of the cover profile (visible or concealed).
- Stepped glass variant optionally available either in unilateral design or with circumferential full glass finish with identical outer and sash frame.
- Various glass step variants available for a circumferential glass step (F-strip, suction disc).

■ **WING 105 DI**

**Tested system solution for rooflight window**

- WING 105 DI glazing systems are tested with 2° inclination.
- Special geometry of the profile for reliable drainage even in extremely shallow rooflight inclinations.
- First drainage level on top of the medial gasket leads water back outside above the glazing of the rooflight.
- Ideal for ventilation in glass roofs.
- Also tested as natural smoke and heat exhaust ventilator.
- Maximum aerodynamic efficiency due to a wide opening angle of max 65° (possible up to 90°) and sash surfaces up to 4 m<sup>2</sup>.
- Possibility of big window dimensions (width up to 2.50 m, height up to 2.50 m, weight up to 165 kg).
- Possible as rooflight window, exit or natural smoke and heat exhaust ventilator.

**Slim window structure**

- Very compact construction.
- Only 37 mm offset between fixed and window glazing.
- Two-frame sash design without any visible screws or glazing beads on the outside.
- Completely concealed hinges mountable on any side.



For detailed information about the rooflight systems please check the planning manuals  
**FRAME<sup>+</sup> Rooflight window 100/120 RI**, no. 002050  
**WING Rooflight window 105 DI**, no. 002006. The pdf-files you will find in the download area of [www.raico.de](http://www.raico.de).

## Roof waterproofing – introduction, argumentation and summary

Roof glazing is a component that generally places higher demands on everyone involved, from the architectural planning through to the regular care and maintenance during use.

The flatter the roof pitches and the larger the roof areas, the higher the requirements for tendering, planning, manufacture and installation. Responsible care and maintenance at regular intervals are the basis for the permanent functionality and retention of the value of these glass roof structures.

The following provides an overview of the principles of RAICO systems in the roof area, subdivided into individual points.

### ■ Structural systems made of steel/wood/aluminium

The basic principles for the dimensioning of the structures are the applicable standards and directives, in particular the Eurocodes. Connections/structures that cannot be dimensioned using these standards, e.g. T-connectors in the case of aluminium structures, must have a general building authority approval or a European Technical Approval (ETA) and must be dimensioned accordingly. The values of the Eurocodes as well as the maximum deflections of the glazing elements are to be adhered to as deflection limits for the rafters/mullions. The minimum roof pitch for the roof structures in the loaded state is 2°.

In case of low roof pitches, the deflection in the transom area is to be mathematically limited to < 3 mm by dead weight (no live loads, snow loads) in order to minimise the accumulation of water in the area of the internal gaskets as well as the pressure profiles. Longer transoms must be superelevated. Ideally, the superelevation is executed such that the transoms are horizontal or curved slightly upwards under their own weight. The flush fitting of the structures is to be executed with an accuracy of ± 0.5 mm in deviation from the applicable tolerances.

The dimensional specifications for the execution of the timber facade base profiles or the weld-on base profiles can be found in this document.

Our THERM<sup>+</sup> systems are tested to a roof pitch of 2°. Roof pitches of less than 2° can be given building-related approval. Please enquire to us about these.

**Notice:** Roof executions with the structural steel construction THERM<sup>+</sup> FS-I are **not suitable** for swimming pools, for outdoor applications and for rooms with considerably increased humidity.

### ■ System widths

Possible system widths in the roof area are the face widths 50, 56, 76 and 96 mm as a standard solution.

The following points should be considered when selecting the appropriate system width:

- Dimensions of the roof glazing, field widths and field heights
- Drainage and ventilation concept/type of insulating blocks
- Rafter lengths, transom lengths and roof pitch
- Insulating glass/insertion elements – thickness tolerances as well as edge offset
- Type of the outer seals (pressure profiles, SG-joints or combination of both)

A suitable system is to be selected for the object in question on the basis of these points.

A larger system width in the rafter area has a positive effect in case of higher dimensions, lower roof pitches as well as higher tolerances in the area of the glass panes and insertion elements. The same applies to the transom area, but in this case the type of outer seal (pressure profile or SG-joint) and the corresponding crosspoint seal should also be considered.

### ■ Glazing/insertion elements/panel fields

With glazing, infills and insertion elements, it must always be ensured that the clamping thickness/glass thickness is suitable. In particular in the case of triple glazing – higher glass thickness tolerances are permissible here – these should be limited after consultation with the glass supplier.

Normal glass thickness tolerances are

- ± 1 mm for double glazing
- ± 2 mm for triple glazing

These tolerances should be limited to a maximum thickness tolerance of 1 mm. With larger roof pitches the panes should be manufactured on the stand edge in order to ensure that the full surface of the glass edge rests on the setting block/glass support. The glass thicknesses must be checked before installing the insulating glass units.

With insertion elements (rooflights), care must be taken that the main drainage (areas outside the medial gasket) takes place on the roof area and not into the system.

Compensation of the glass thickness on the inside of glass roof structures is permitted only using gaskets with integrated compensation and EPDM compensation gaskets. Please enquire in this case about our object solutions.

The use of internal compensation profiles made of aluminium or PVC, such as compensation profile 7/23, no. 116005, or connection profile 45/42, no. 168060, is not permissible.

Please enquire in this case also about our object solutions.

### ■ Connection areas/sheet metal claddings

In all connection areas such as sheet metal claddings, connecting plates to roof ridge, eaves, flashing or panel fields in the roof area, the same requirements for watertightness and air-tightness apply as to the glazed areas.

For example, uncovered or unsealed connecting plate joints, especially in the roof ridge area, inevitably lead to the entry of water into the system.

Structural suggestions for the execution of various details can be taken from this manual.

### ■ Ventilation/drainage concepts for roof structures

The basis for the functionality and durability of glass roof structures is a functioning ventilation and drainage concept.

Even with more complex roof shapes, a multitude of geometries and designs can be covered with standard articles from the THERM<sup>+</sup> systems. If system-compliant drainage is not possible with standard items, just ask us about these geometries and roof shapes – we will be glad to suggest a suitable drainage concept.

When determining the drainage concept, not only are the correct drainage levels to be considered and structurally adapted to the object, but also the

## Roof waterproofing – introduction, argumentation and summary

- Mullion lengths
- Transom lengths
- Channel lengths in the interior gasket area
- System widths
- Roof geometries, roof pitches
- Static deformations/twisting of the system
- Connection areas

Exemplary structural suggestions for the execution of detail points, including for flat roof pitches, can be found in this manual.

Ventilation of the roof is necessary for the following reasons:

- Functioning drainage of minimal quantities of penetrating surface water or condensate – openings must be provided at the highest point and the lowest point of the roof to enable this drainage.
- Functioning aeration and ventilation
  - For reasons of the warranty on insulating glass – the edge seal must be protected against moisture and permanently high humidity.
  - With flat roofs or wide transoms, water in the system caused, for example, by condensate or minimal quantities of penetrating surface water no longer runs off, but evaporates.

This moisture must be ventilated via suitable openings.

If possible, structurally large-sized aeration and ventilation openings should be planned at the highest and lowest points of the roof. The ventilation openings at the lowest point similarly assume the task of drainage. Care must be taken when designing, however, that these points are considered from the point of view of heat (surface temperatures/condensate on the room side) and are executed

according to the state of the art. Depending on the rafter length, field width and number of fields above one another, additional ventilation openings may be necessary. The number and the positions of these ventilation openings should be agreed with the glass supplier according to the specific object. Ventilation openings in the transom area are to be avoided. The following pages provide you with an overview of the variability of the THERM<sup>+</sup> roof systems.



**THERM<sup>+</sup> - Certified quality in full compliance with the CE standards  
and approved by the building authorities**

■ **THERM<sup>+</sup> quality you can rely upon**

Extensive product tests with excellent results confirm the high quality in practical applications of the THERM<sup>+</sup> glass roof constructions.

**Product standard for curtain walling EN 13830:**

**Features and classification for CE-Labeling (tested with an inclination of 2°)**

No.	Test type/Standard	THERM <sup>+</sup> A-I	THERM <sup>+</sup> H-I	THERM <sup>+</sup> S-I/FS-I
4.1	Wind resistance (EN 13116)	Wind pressure up to 2.6 KN/m <sup>2</sup> Wind suction up to 2.7 KN/m <sup>2</sup>	Wind pressure up to 2.6 KN/m <sup>2</sup> Wind suction up to 2.7 KN/m <sup>2</sup>	Wind pressure up to 2.6 KN/m <sup>2</sup> Wind suction up to 2.7 KN/m <sup>2</sup>
4.4	Air permeability (EN 12152)	Class AE (2,100)	Class AE (2,100)	Class AE (2,100)
4.5	Water penetration (EN 12154)	Up to class RE 2,550 <sup>1)</sup>	Up to class RE 2,550 <sup>1)</sup>	Up to class RE 2,550 <sup>1)</sup>

<sup>1)</sup> Test deviant from EN 12155 with a water amount of 3.4 l/(m<sup>2</sup> min). The standard specifies a water amount of 2 l/(m<sup>2</sup> min).

**Notice**

- All features can be used for CE-labelling by the manufactures of glass roof constructions. It is mandatory that only RAICO products have to be used and the production process has to be monitored by an in-house production control system. The whole production process has to be compliant to the RAICO assembly instructions.
- Depending on the panel dimensions of the curtain wall and the structural connections the sound insulation value has to be calculated separately. The system testimonial can only be used for an overview.
- Depending on the different system options and the glass thickness the U<sub>m,i</sub>-value can be adapted step-by-step. The exact values based on DIN EN ISO 10077-2 are documented in the thermal insulation documentations by RAICO.

**Nearly unlimited possibilities – THERM<sup>+</sup> roof systems**  
(possible system widths 50/56/76/96 mm)

Roof inclination / Component	2 to 10 degrees		>10 to <25 degrees		25 to 90 degrees		25 to 90 degrees <small>with burglar resistance</small>		Important notes
	Mullion	Transom	Mullion	Transom	Mullion	Transom	Mullion	Transom	
Supporting structure Timber / Steel / Aluminium	✓	✓	✓	✓	✓	✓	✓	✓	Deflection, deformation, flush appearance
Interior gasket system with 2 levels	✓	✓	✓	✓	✓	✓	✓	✓	Concept of drainage and ventilation
Interior gasket system with 3 levels	✓	✓	✓	✓	✓	✓	✓	✓	Concept of drainage and ventilation
Compensation of interior glass infill thickness	✓	✓	✓	✓	✓	✓	✓	✓	Only with EPDM-gaskets – ask for object related solutions
Standard cross glass carrier	✓	✓	✓	✓	✓	✓	✓	✓	Object related solution – ask for special articles
Glass thicknesses/ integration thicknesses	<b>12 to 64 mm</b>						<b>22 to 64 mm</b>		Observe min. glass thickness, depending on pressure profile and exterior gasket
Pressure and cover profiles in the roof area	✓	–	✓	–	✓	✓	✓	✓	Only use cover profiles no. 013471 and 013476 in the transom
Visible screwed pressure profiles in the roof area	✓	✓	✓	✓	✓	✓	–	–	Only use pressure profiles no. 013008, 013038, 013068 and 142770 in the transom
Flat pressure profiles in the roof area	✓	✓	✓	✓	✓	✓	–	–	Only with exterior gasket 3 mm
Pressure profile gasket 3 mm	–	✓	✓	✓	✓	✓	✓	✓	
Pressure profile gasket 4 mm	–	✓	✓	✓	✓	✓	✓	✓	Observe screw length
Pressure profile gasket 5 mm	✓	✓	✓	✓	✓	✓	✓	✓	Observe screw length
Pressure profile screw with sealing ring 10 (no. 012061)	–	–	✓	–	✓	✓	✓	✓	
Pressure profile screw with sealing washer 16 (no. 012050/910060)	✓	✓	✓	✓	✓	✓	✓	✓	Only for assembly with pressure and cover profile, see screw selection
Pressure profile screw with sealing washer 16 (visible screw)	✓	✓	✓	✓	✓	✓	–	–	
Pressure profile screw with sealing ring 10, not countersunk (visible screw)	–	–	–	–	–	–	–	–	Special solutions after consulting (not for burglar resistance)
Pressure profile screw with sealing ring 10, countersunk with end cap 11 S	–	–	–	–	–	–	–	–	Special solutions after consulting (not for burglar resistance)
Execution with SG joint and suction disc	✓	✓	✓	✓	✓	✓	–	–	
Execution with SG joint SG 2	✓	✓	✓	✓	✓	✓	–	–	Approval required in individual cases (Germany)

**Nearly unlimited possibilities – THERM<sup>+</sup> roof systems**  
(possible system widths 50/56/76/96 mm)

Component \ Roof inclination	2 to 10 degrees		>10 to <25 degrees		25 to 90 degrees		25 to 90 degrees with burglar resistance		Important notes
	Mullion	Transom	Mullion	Transom	Mullion	Transom	Mullion	Transom	
Maximum bevel of mullion in the system (per side)	– 5 to + 5 degrees		– 5 to + 45 degrees		– 5 to + 45 degrees		– 5 to + 45 degrees		Polygonal profiles not permitted, glass bite, check screw length and length of cross point sealing plates
Maximum bevel of transom in the system (per side)	– 2,5 to + 2,5 degrees		– 5 to + 5 degrees		– 5 to + 5 degrees		– 5 to + 5 degrees		Transom sealing piece for interior gasket as special article – fit to shape of bevel, fit cross point sealing plate to inclination. check detail by drawing Higher inclination executable as special solution
Polygonal profiles for pressure profiles	–	–	–	–	–	–	–	–	Not permitted
Compensation of interior glass infill thickness with compensation profile no. 116005 or connection profiles no. 168021 to 168033	–	–	–	–	–	–	–	–	Not permitted
Execution expansion mullion with interior half gaskets and insertion profile no. 168201	–	–	–	–	–	–	–	–	Not permitted
Timber connector TC	–	–	–	–	–	–	–	–	Not permitted
T-connector steel S-I	Calculation by structural engineer								
Steel connector SC	✓	✓	✓	✓	✓	✓	✓	✓	Loads occurring have to be calculated in accordance to the EUROCODES. Wind, snow and additional loads are to be taken into account.
Steel connector SCL	✓	✓	✓	✓	✓	✓	✓	✓	
<b>T-connector aluminium A-I</b> - Standard - Variabel - T-shaped profiles (T-transom on T-mullion) - Kombi (rectangular transom on T-mullion) - Expansion transom	✓	✓	✓	✓	✓	✓	✓	✓	
<b>T-connector Aluminium A-I</b> - Spring bolt - Posterior assembly	–	–	–	–	–	–	–	–	Not permitted

