Criteria and Algorithms for Certified Passive House Components: Glazing Edge Bond (Spacer and secondary seal) in Insulated Glazing

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Content

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Criteria

Passive Houses provide optimal thermal comfort with minimal energy costs, as well as high internal surface temperatures; in addition, in functioning market conditions and with competent design and availability of the required components, they are within the economically optimal range with reference to their lifecycle costs.

The edge bond of insulated glazing is of particular importance, as this generally speaking represents the weakest point in the thermal envelope. Taking this relevance into account, the Passive House Institute offers certification of glazing edge bonds over two categories:

- Spacer
- Secondary Seal

In order to achieve a high level of thermal comfort, high internal surface temperatures and thereby a markedly reduced condensation and mould growth risk, as well as low lifecycle costs, stringent requirements in terms of thermal efficiency apply for the components used in Passive Houses. The Criteria for Certified Passive House Components: Glazing Edge Bond are derived from the Passive House hygiene criterion and the efficiency criterion, with the former depending on the climate.

1.1 Hygiene criterion

Maximum water activity (interior surfaces): **$a_w \leq 0.80$**

This criterion limits the minimal individual temperature at the window surface (glass edge in this case) due to reasons of hygiene. Mould may form at water activities above 0.80, therefore these conditions must be consistently avoided. The water activity is the relative air humidity inside the pore of a material or directly at the surface of the material.

For different climates, this results in the temperature factors $f_{Rsi=0.25\ m^2K/W}$ mentioned in Table 1 as effectual certification criteria. f_{Rsi} is the temperature factor at the glass edge.

Compliance with this criterion must be verified for at least three of the reference frames defined by the Passive House Institute (cross-section lateral/above) for the corresponding climatic region.

Table 1: Temperature factors to be achieved

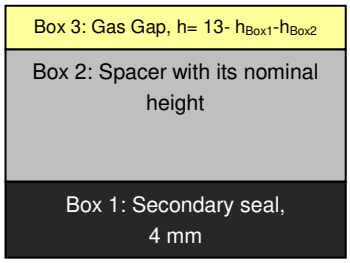
Re-gion	Description	$f_{Rsi=0.25\ m^2K/W}$	$U_{g\ reference}$ [W/(m²K]	Assembly of reference glazing
1	Arctic	0.80	0.35	4/12/3/12/3/12/4
2	Cold	0.75	0.52	6/18/2/18/6
3	Cool, temperate	0.70	0.70	6/16/6/16/6
4	Warm, temperate	0.65	0.70	6/16/6/16/6
5	Warm	0.55	1.20	6/16/6
6	Hot	In development		
7	Very hot			

1.2 Efficiency criterion

Edge resistance:

Spacer **$R_E \geq$ 1.5 mK/W**

Secondary seal **$R_E \geq$ 3.5 mK/W**



For spacers in low-e triple-glazing, low energy losses are also crucial for the proper functioning of Passive Houses, in addition to the hygiene criterion. For quantification and evaluation of these losses, the PHI has introduced the edge resistance R_E [mK/W], which is determined independently of the climate zone. The edge resistance of certified spacers may not be less than 1.5 mK/W and that of secondary seals must not be less than 3.5 mK/W (in conjunction with the Passive House Institute's phA reference spacer). For evaluation, the Passive House Institute refers to the 2-box model of the "Warm Edge" Working Group (Arbeitskreis Warme Kante). This model consists of 2 boxes, where Box 1 represents the secondary seal. The PHI usually assigns λ_{Box1} = 0.40 W/(mK) and, deviating from the Working Group h_{Box1} with a sealant height of 4 mm. Box 2 represents the spacer with its equivalent thermal conductivity and its nominal height. These two boxes can assume different heights in total. In order to use the same height for all models, the PHI uses Box 3, the thermal conductivity of which corresponds with an equivalent thermal conductivity of triple-glazing with a glass assembly of 4/18/4/18/4 and a U-value of 0.70 W/(m²K) (Lambda Gas = 0,0254 W/(mK)). The height of the three boxes together is a constant 13 mm. The edge resistance is therefore as follows:

$$R_E = \frac{\Sigma h}{\lambda_{Box1} \cdot h_{Box1} + \lambda_{Box2} \cdot h_{Box2} + \lambda_{Box3} \cdot h_{Box3}}$$

Where $h_{Box3} = \Sigma h\text{-}(h_{Box1} + h_{Box2})$

2 Passive House efficiency classes

Spacers are classified into Passive House efficiency classes based on the edge resistance. The higher the edge resistance is, the better the efficiency class will be.

Table 2: Passive House efficiency classes for spacers in low-e triple glazing

Edge resistance R_E		**Passive House efficiency class**	**Designation**
Spacer	Secondary Seal[1]		
< 1,5 mK/W	< 3,5 mK/W		Not certifiable
≥ 1,5 mK/W	≥ 3,5 mK/W	phC	Certifiable component
≥ 3,0 mK/W	≥ 4,5 mK/W	phB	Basic component
≥ 4,5 mK/W	≥ 5,5 mK/W	phA	Advanced component
≥ 6,0 mK/W	≥ 6,5 mK/W	phA+	Very advanced component
[1] With phA-reference spacer: λ_{Box2} = 0,20 W/(mK) h_{Box2} 7 mm			

3 Verification of certifiability, certificate

There is no entitlement to certification.

Certifiability is to be verified as follows:

1. by meeting the hygiene criterion for at least three of the example components shown in Table 3 for the respective climatic zone, and
2. by meeting the efficiency criterion

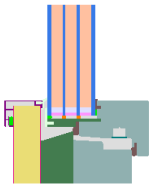
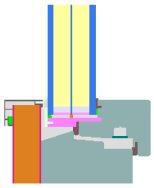
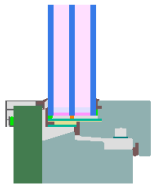
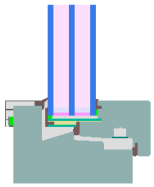
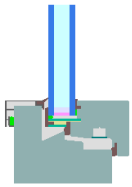
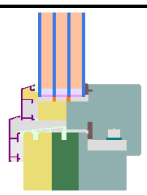
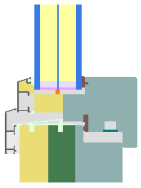
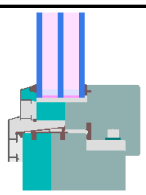
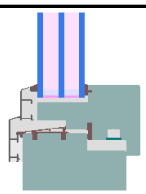
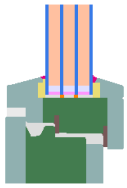
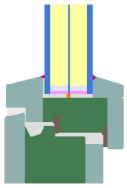
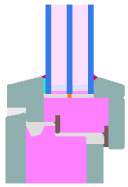
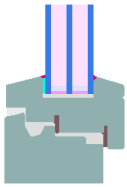
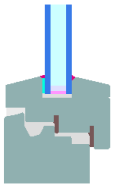
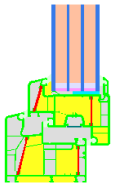
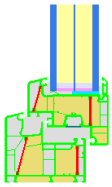
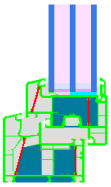
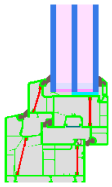
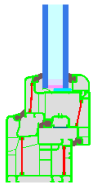
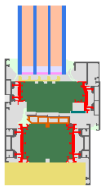
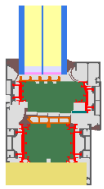
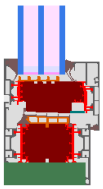
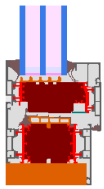
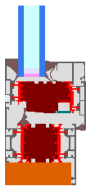
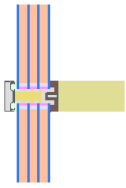
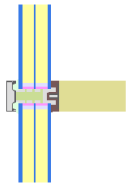
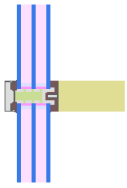
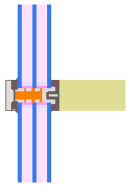
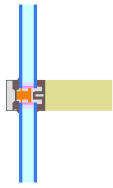
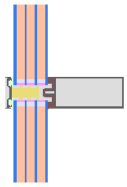
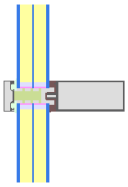
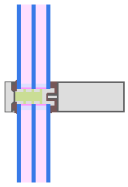
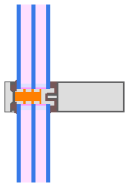
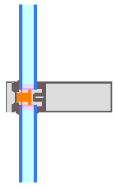
The temperature factor and the glass edge thermal bridges are verified in accordance with the currently valid version of the "Criteria and Algorithms for Certified Passive House Components - Transparent Building Components" (free download from www.passiv.de).

Efficiency classes are also defined for information purposes, see Section 2.

The certificate consists of the actual certificate in which the most important product data are summarised, and the data sheets with further characteristic values. If desired, the previously mentioned characteristic values for the spacer category can be stated additionally for other permissible secondary seals; for the secondary seal category, the characteristic values for further reference spacers can be shown.

4 Reference frames

Table 3: Reference frames with glazing, glass assembly, glazing U-value and frame U-value.

Type/Region	**Arctic**	**Cold**	**Cool,temperate**	**Warm,temperate**	**Hot**
Glazing, Glass assembly, Glazing U-value	quadruple 4/12/3/12/3/12/4 0.35 W/(m²K)	triple 6/18/2/18/6 0.52 W/(m²K)	triple 6/16/6/16/6 0.70 W/(m²K)	triple 6/16/6/16/6 0.70 W/(m²K)	double 6/16/6 1.20 W/(m²K)
Wood/aluminium integral					
U_f [W/(m²K)]	0.48	0.62	0.73	0.87	1.03
Wood/aluminium					
U_f [W/(m²K)]	0.54	0.57	0.75	0.97	1.19
Wood					
U_f [W/(m²K)]	0.51	0.53	0.78	0.86	0.99
PVC					
U_f [W/(m²K)]	0.70	0.75	0.82	1.02	1.16
Aluminium					
U_f [W/(m²K)]	0.60	0.61	0.71	0.73	1.17
Curtain wall Wood					
U_f [W/(m²K)]	0.60	0.65	0.66	0.71	1.11
Curtain wall Aluminium					
U_f [W/(m²K)]	0.67	0.73	0.75	0.79	1.33

5 Division according to regions with the same criteria (glazing and transparent building components

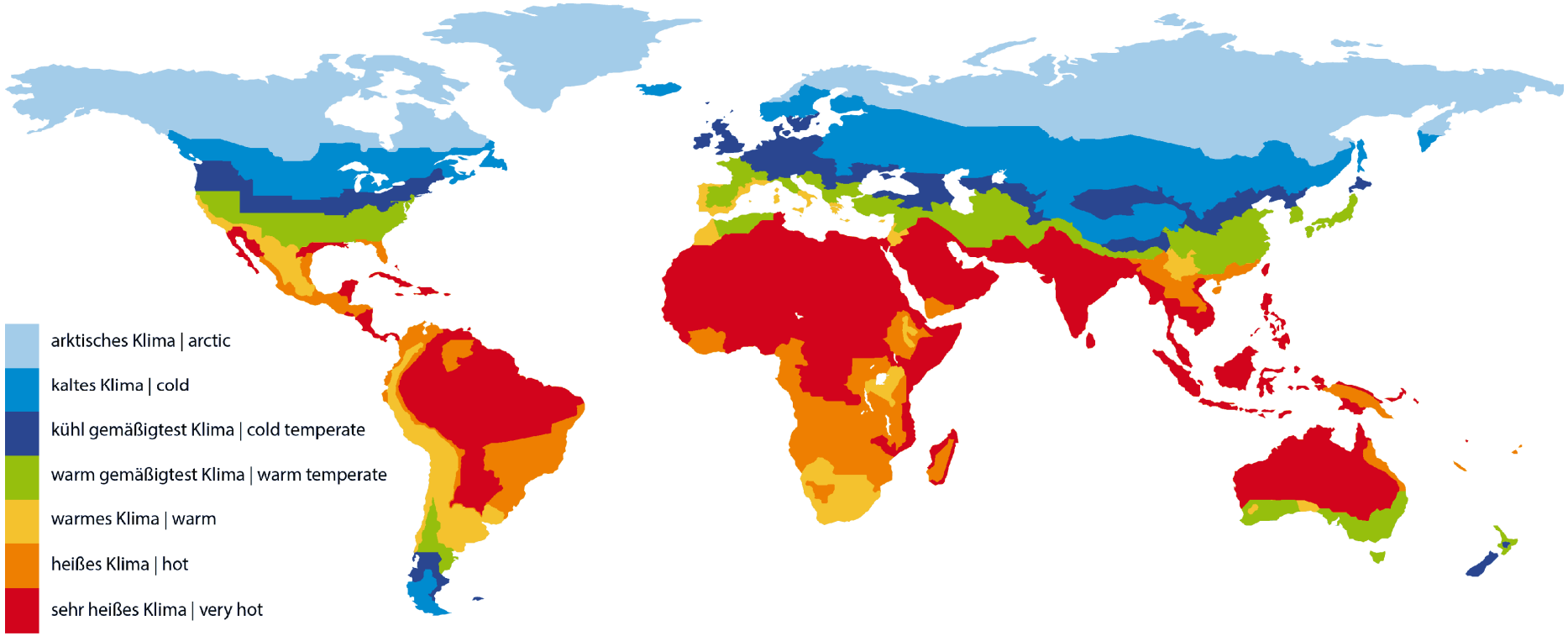
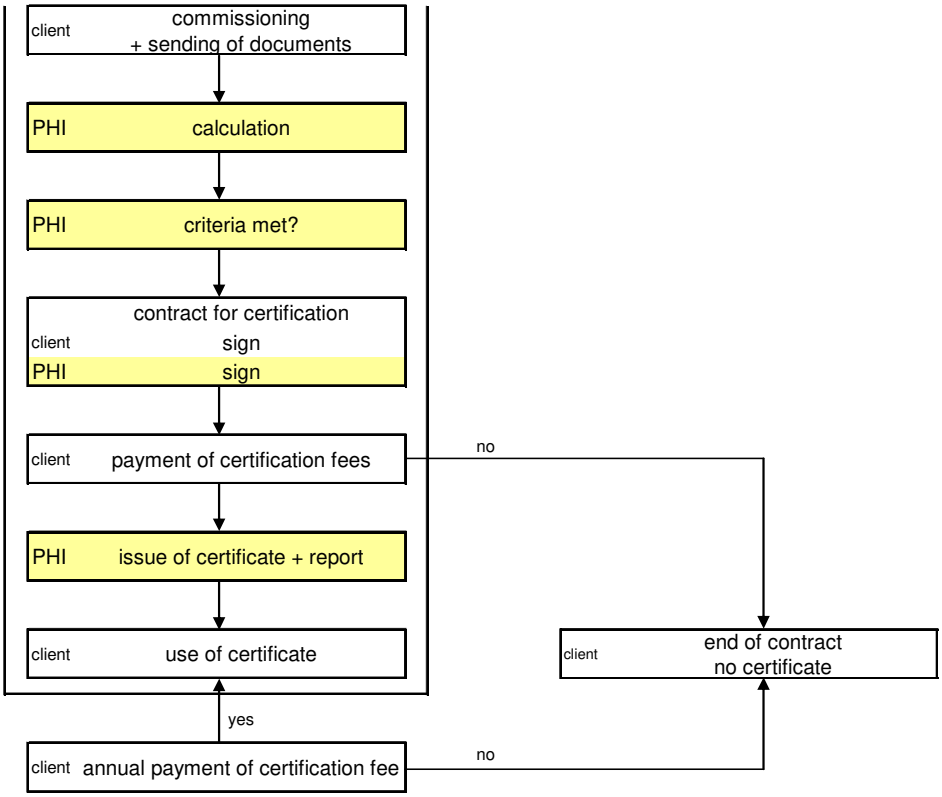


Figure 1: Division according to regions with the same criteria for certified Passive House components

6 Certification Procedure



7 Required documents

The following documents have to be delivered to the PHI.

1. **CAD drawings of the spacer** (format: dwg Version 14)
2. **Description of the spacer**, its characteristics and possible application procedures.
3. **"Warm Edge" Working Group data sheet,** based on measured values in accordance with the WA 17/1, ift Rosenheim guidelines.
4. If the data sheet mentioned under (3) is not available: verification of the equivalent thermal conductivity in accordance with the WA 17/1, ift Rosenheim guidelines, provided by one of these Institutes: ift Rosenheim, FIW München, Hochschule Rosenheim. Further institutes may be admitted after examination. Other procedures may be considered after consultation with the PHI.
5. Test report according to DIN EN 1279 2/3 with specification of the thickness of the secondary seal (back cover, edge cover).

8 Services provided by the Passive House Institute

1. Calculation of the R_E and classification into a Passive House efficiency class.
2. Calculation of the thermal bridge loss coefficients at the glass edge Ψ_g and the temperature factor $f_{Rsi=0.25\ W/(mK)}$ for each reference frame (cross-section side/top).
3. On clients demand repeating of (2) for the other secondary seal
4. Issue of the certificate including presentation of the certified product on the website of the Passive House Institute.

9 Coming into affect, provisional regulations, further development

The Criteria and Algorithms for Certified Passive House Components: Glazing Edge Bond (Spacer and secondary seal) in Insulated Glazing, come into effect to full extent with the publication of this document. The previous relevant criteria will become invalid with the coming into effect of these provisions. The Passive House Institute reserves the right to make any changes in the future.