

Criteria and Algorithms for Certified Passive House Components: Spacers in Low-e Glazing

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This document is provisional and is therefore subject to specific changes.

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1 Criteria

Passive Houses provide optimal thermal comfort with minimal energy costs; in addition, with competent planning and availability of the required building components in functioning market conditions, they are within the economically optimal range with reference to their lifecycle costs. In order to achieve this level of thermal comfort and 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: Spacers in Low-e Glazing 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 $f_{Rsi=0.25} \text{ m}^2\text{K/W}$ 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	$f_{Rsi=0.25} \text{ m}^2\text{K/W}$	$U_g \text{ reference}$ [W/(m ² K)]	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	Hot	0.55	1.20	6/16/6

1.2 Efficiency criterion

Edge resistance:

$$R_E \geq 1.5 \text{ mK/W}$$

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]. The edge resistance of certified spacers may not be less than 1.5 mK/W.

For evaluation, the Passive House Institute refers to the 2-box model (measured values) of the "Warm Edge" Working Group (Arbeitskreis Warme Kante). This model consists of 2 boxes, where Box 1 represents the secondary seal

(constantly $\lambda_{\text{Box1}} = 0.40 \text{ W/(mK)}$, $h_{\text{Box1}} = 3 \text{ mm}$) and Box 2 represents the spacer with its equivalent thermal conductivity. These two boxes can assume different heights in total. In order to use the same height for all models, the PHI uses Box 3, which is a gas box, 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 $0.70 \text{ W/(m}^2\text{K)}$. Σh is a constant 12 mm. The edge resistance is therefore as follows:

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

with $h_{\text{Gas}} = \Sigma h - (h_{\text{Box1}} + h_{\text{Box2}})$

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	Description
< 1.5 mK/W		Not certifiable
$\geq 1.5 \text{ mK/W}$	phC	Certifiable component
$\geq 3.0 \text{ mK/W}$	phB	Basic component
$\geq 4.5 \text{ mK/W}$	phA	Advanced component
$\geq 6.0 \text{ mK/W}$	phA+	Very advanced component

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).

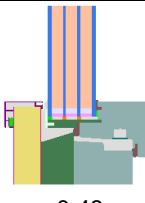
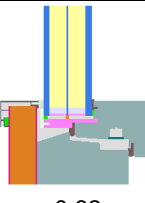
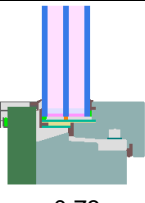
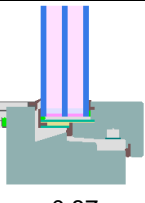
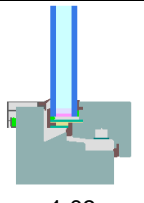
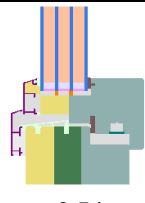
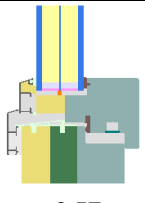
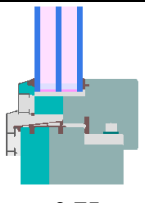
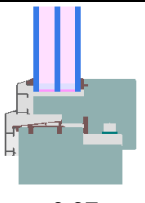
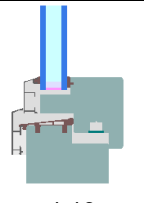
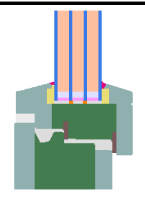
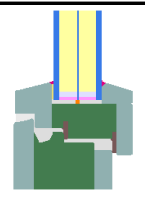
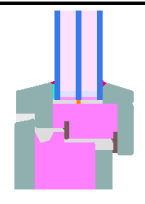
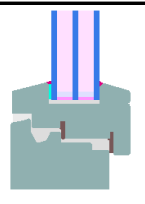
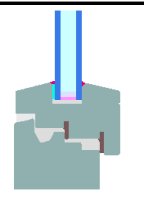
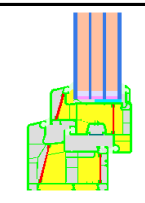
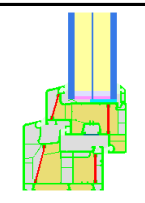
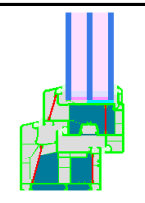
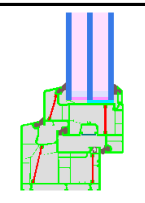
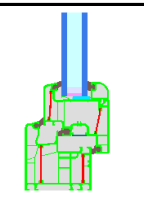
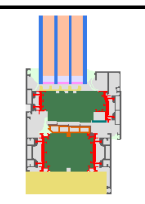
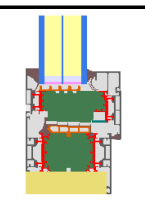
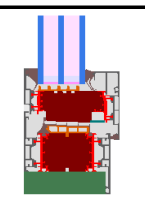
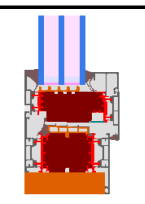
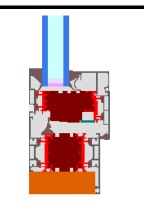
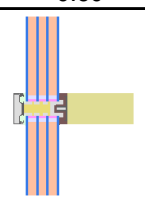
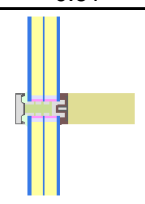
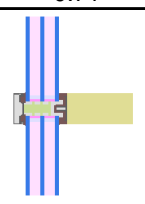
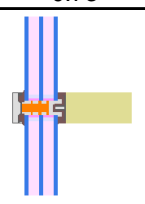
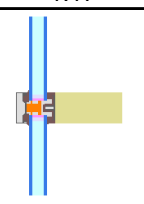
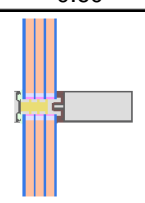
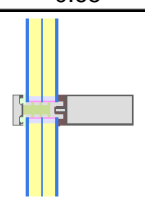
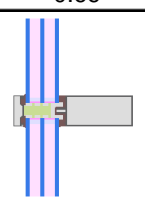
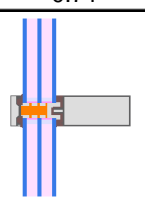
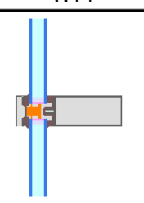
Efficiency classes are also defined for information purposes, see Section 2.

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 can be stated additionally for other permissible secondary seals.

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	quaduple 4/12/3/12/3/12/4 0.35 W/(m ² K)	triple 6/18/2/18/6 0.52 W/(m ² K)	triple 6/16/6/16/6 0.70 W/(m ² K)	triple 6/16/6/16/6 0.70 W/(m ² K)	double 6/16/6 1.20 W/(m ² K)	
Wood/aluminium integral						
U_f [W/(m ² K)]	0.48	0.62	0.73	0.87	1.03	
Wood/aluminium						
U_f [W/(m ² K)]	0.54	0.57	0.75	0.97	1.19	
Wood						
U_f [W/(m ² K)]	0.51	0.53	0.78	0.86	0.99	
PVC						
U_f [W/(m ² K)]	0.70	0.75	0.82	1.02	1.16	
Aluminium						
U_f [W/(m ² K)]	0.60	0.61	0.71	0.73	1.17	
Curtain wall						
Wood	U_f [W/(m ² K)]	0.60	0.65	0.66	0.71	1.11
Curtain wall						
Aluminium	U_f [W/(m ² K)]	0.67	0.73	0.75	0.79	1.33

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

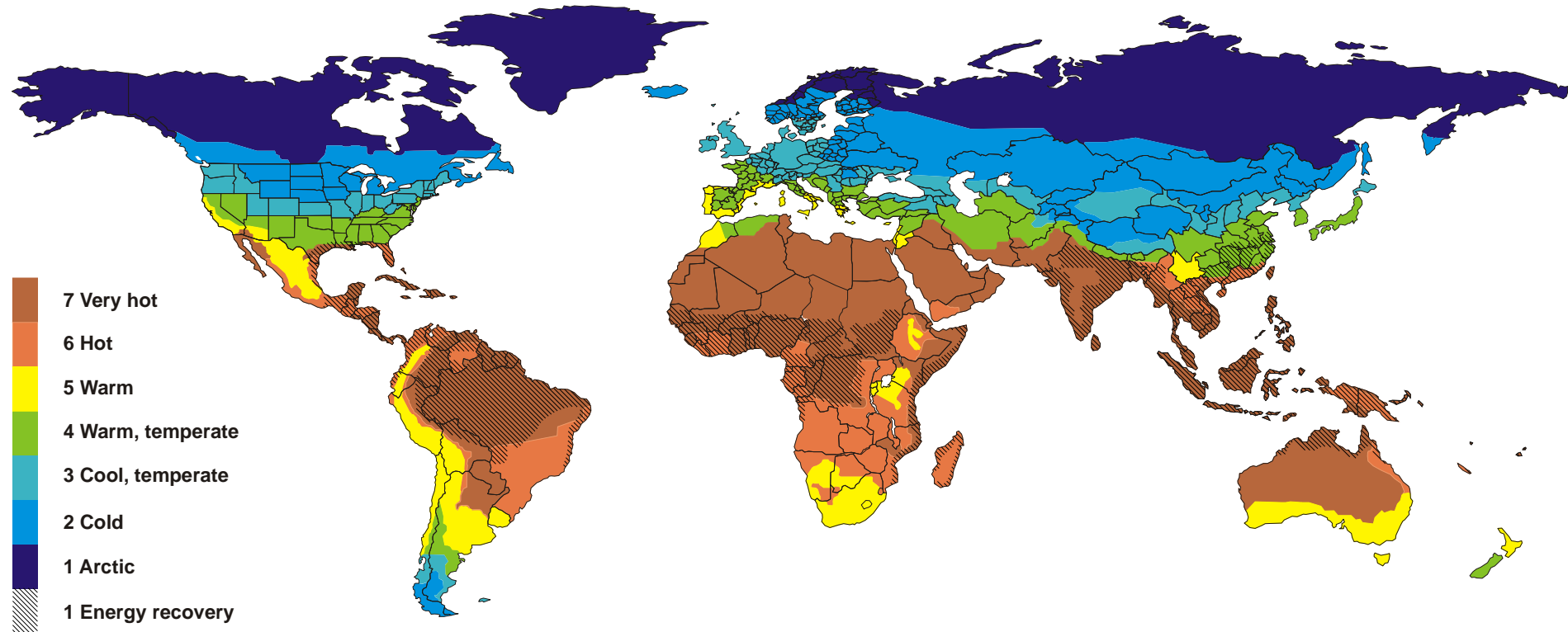
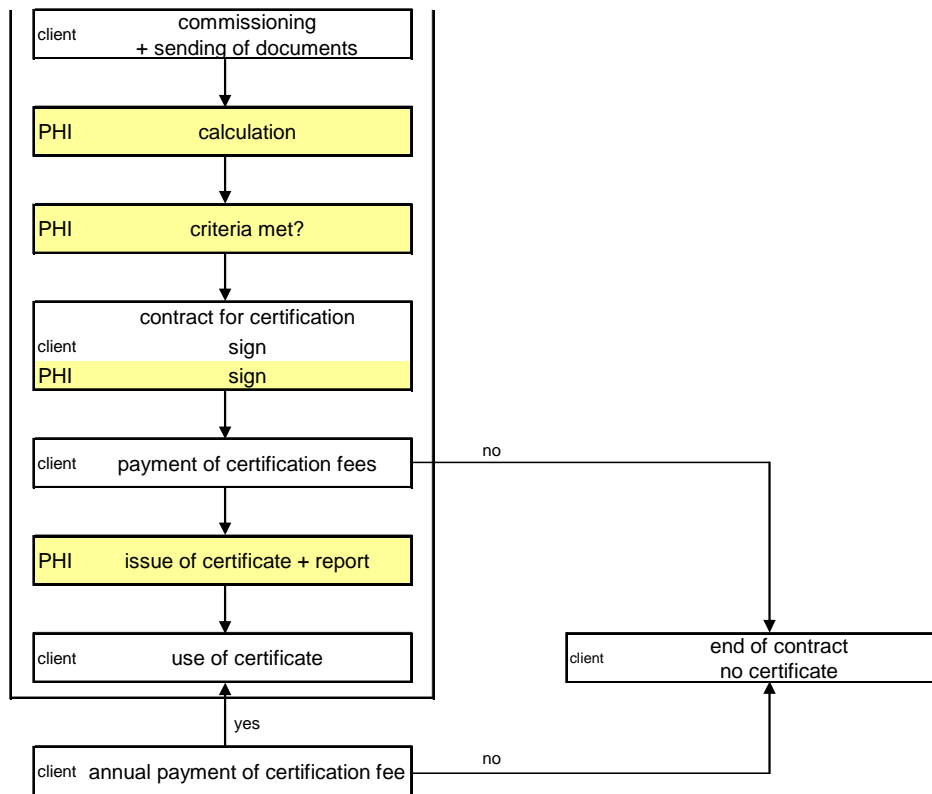


Figure 1: Division according to regions with the same criteria for certified Passive House components

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.

8 Services provided by the Passive House Institute

1. Calculation of the R_E and classification into a Passive House efficiency class based on the "Warm Edge" Working Group data sheet.
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 the reference frame (cross-section lateral/above).
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 internet website of the Passive House Institute.

9 Coming into affect, provisional regulations, further development

The Criteria and Algorithms for Certified Passive House Components: Spacers in Low-e 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.