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## **EnerPHit**

**Certification as "Quality-Approved Energy Retrofit with Passive House Components"**

### **Criteria for Residential-Use Refurbished Buildings**

If the criteria for Passive Houses are met by an energy relevant modernisation, an old building can also be certified as a "Quality-Approved Passive House", based on the same criteria as for new buildings.

Nevertheless, due to various reasons, for older buildings it is often difficult to achieve the Passive House standard with reasonable effort. The use of Passive House technology for each building component in such buildings, however, does lead to considerable improvement in respect of comfort, structural protection, cost-effectiveness and energy requirements.

For quality assurance and verification of the specific energy values achieved, buildings that have been modernised using Passive House components and that do exceed the Passive House boundary values (for existing building substance reasons), can receive the "EnerPHit – Quality-Approved Modernisation with Passive House Components" certificate. The certification criteria applicable to residential buildings are described below.

#### **1 General requirements**

The current certification criteria (to be found at [www.passiv.de](http://www.passiv.de)) are applicable initially; the calculation method described in the PHPP handbook and the PHPP programme are subordinate to this.

Due to the numerous different requirements and conditions for the modernisation of old buildings, it is possible that exact requirements for individual energy-related measures may not be included in these certification criteria. In this case, the measures should be carried out in consultation with the certifier in such a way that maximum energy efficiency can be achieved, provided that, for the duration of their life cycle, the measures result in a financial net profit under the normally expected boundary conditions for the building owner and users



collectively. The thermal protection standard necessary for the building component will be determined by the certifier in each case.

## **1.1 Energy balance**

The energy balance of the modernised building must be verified using the latest version of the Passive House Planning Package (PHPP). This also applies for certification based on the building component method (Section 2). For the specific space heat demand, the monthly as well as the annual method can be applied. If the ratio of free heat to heat losses is more than 0.70 in the annual method, the monthly method should be used.

The reference value (treated floor area TFA) is the net living area within the building's thermal envelope based on the living space regulations in Germany (WoFIV).

The whole of the enclosing building envelope, e.g. a row of terraced houses or multi-storey building, can be considered for calculating the specific values. An overall calculation or weighted average values of several partial zones can be used to verify this.

Combining thermally separated buildings together is not permissible. Buildings that adjoin other buildings (e.g. in city housing) must have at least one external wall, one roof surface and a floor slab or basement ceiling in order to certify them individually.

## **1.2 Time of certification**

All requirements for the building must be met at the time of issuing of the certificate. Certificates prior to modernisations that are being carried out in several steps are not being issued at the moment.

## **1.3 Restriction to existing buildings**

Only such buildings will be certified (EnerPHit certification) for which the continued use of existing building elements would pose such substantial problems for the energy relevant modernisation that modernising to Passive House level would not be practicable or cost effective.

## **1.4 Location of building**

Currently, only buildings located in the cool and moderate Central European Climate are being certified.

## 1.5 Heating demand

$$Q_H \leq 25 \text{ kWh}/(\text{m}^2\text{a})$$

Certification can be issued alternatively if the criteria for individual building components as given in Section 2 are met. In this case the requirement for the heating demand does not apply.

## 1.6 Primary energy demand

$$Q_P \leq 120 \text{ kWh}/\text{m}^2\text{a} + ((Q_H - 15 \text{ kWh}/(\text{m}^2\text{a})) * 1.2)$$

The requirements apply to the total sum of the heating, hot water, cooling, auxiliary and household electricity.

## 1.7 Summertime comfort

$$\text{Excessive temperature frequency } (> 25 \text{ }^\circ\text{C}) \leq 10 \%$$

If calculating the excessive temperature frequency is not possible due to very high daily temperature fluctuations, a warning appears in the PHPP "Summer" sheet. In case of doubt, other suitable evidence of summertime comfort should be provided.

## 1.8 Moisture protection

All standard sections and connection details must be invariably planned and implemented so that there is no excessive moisture on the interior surfaces or in the building component build-ups. The water activity<sup>1</sup> of the interior surfaces must be kept at  $a_w \leq 80 \%$ . In case of doubt, evidence for moisture protection based on established techniques must be provided.

## 1.9 Airtightness

$$\text{Limit value: } n_{50} \leq 1.0 \text{ h}^{-1}$$

$$\text{Target value: } n_{50} \leq 0.6 \text{ h}^{-1}$$

The airtightness of the building must be verified using a pressurisation test based on DIN EN 13829. If the value  $0.6 \text{ h}^{-1}$  is exceeded, a comprehensive search for leakages must be carried out within the framework of the pressurisation test and each relevant leak, which can cause building damage and affect thermal comfort, should be rectified. This must be confirmed in writing as stated in Section 6.2.

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<sup>1</sup> The water activity of a building material is ideal as a criterion for the probability of mould growth. The  $a_w$ -value provides information about the water which is not chemically bound. It is defined as the equilibrium moisture content occurring in an enclosed space that consists of a smaller amount of air in proportion to solid matter. In such a space the free water present in the solid matter determines the relative humidity of the surrounding air. The water activity can range from 0 (0 % relative humidity) to 1 (100 % relative humidity). If the  $a_w$ -value is less than 0.8, the probability of mould growth even on contaminated old plaster is small.



## 1.10 Windows

It is strongly recommended that window frames which have been certified as "Passive-House-suitable components", and triple low-e glazing (or equivalent) are implemented – using the installation principles<sup>2</sup> recommended by the Passive House Institute (PHI). If this recommendation is not complied with, evidence of the comfort according to the conditions in DIN EN ISO 7730 should be provided or the low temperatures occurring near the window areas should be compensated for by heaters.

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<sup>2</sup> i.e. installation in the insulation level and overinsulation of the external facing area of the frame as much as possible.

## 2 Certification according to criteria for individual components

If the specific heating demand of 25 kWh/(m<sup>2</sup>a) given in Section 1.4 is exceeded, certification based on the following criteria for individual components is possible instead. All other general requirements of section 1 must still be fulfilled.

In this case it must be proved that all energy-relevant building components for which criteria for certification by the PHI for "Passive-House-suitable components" apply, comply with these criteria. The criteria for components as published on the internet at [www.passiv.de](http://www.passiv.de) apply, provided that no other arrangements have been made in the EnerPHit requirements. For products, which have not been certified by the PHI as "Passive-House-suitable Components", the applicant is obliged to provide admissible proof of compliance with the criteria.

If there are no products available which comply with the criteria for "Passive-House-suitable components", regarding certification for individual cases, in agreement with the certifier, a product should be selected which complies with the criteria as much as possible.

The required boundary values must be observed at least as an average value<sup>4</sup>. Exceeding this value is admissible for partial areas if it can be fully compensated for by better values elsewhere.

Reasonable proof of the thermal transmission resistance (R-value) of the existing building components must be provided if it contributes more than 5 % to the thermal transmission resistance of the modernised component. For this it suffices to adopt the approximate thermal conductivity of existing building materials from suitable tables. If existing building element structures are not clearly identifiable, standardised assumptions from component catalogues<sup>4</sup> based on the construction year can be used, provided that they appear reasonable.

In the event of an exceptional rule if a standard required specific value is exceeded, suitable documents should be presented to prove clearly that the conditions for the exception have been fulfilled.

A selection of the most important boundary values for components (without claiming completeness) and the supplementary regulations for the EnerPHit certification in the component method have been listed in Sections 2.1 to 2.11 as follows.

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<sup>3</sup> Note: when calculating the average values for insulated component structures, the area-weighted average of the U-value and not the average insulation thickness should be applied. Thermal bridges must only be taken into account if they are part of the regular component construction.

<sup>4</sup> E.g. the German-language publication "Altbaumodernisierung mit Passivhaus-Komponenten", PHI 2010 (download from [www.passiv.de](http://www.passiv.de))



## 2.1 External wall and storey ceiling above outside air

Exterior insulation:  $U \leq 0.150 \text{ W}/(\text{m}^2\text{K})$

Interior insulation:  $U \leq 0.300 \text{ W}/(\text{m}^2\text{K})$

deviating from the criteria for "Passive-House-suitable components"

The external wall insulation must be carried out externally on at least 75 % of the area. Insulation on the interior of up to 25 % of the area is only permissible if external insulation is not practicable, not allowed or definitely not cost-efficient.

## 2.2 External wall to ground

$f * U \leq 0.150 \text{ W}/(\text{m}^2\text{K})$

with f: "reduction factor ground" in the PHPP's "Ground" sheet

## 2.3 Roof or top floor ceiling

$U \leq 0.120 \text{ W}/(\text{m}^2\text{K})$

deviating from the criteria for "Passive-House-suitable components"

## 2.4 Roof terrace

$U \leq 0.150 \text{ W}/(\text{m}^2\text{K})$

## 2.5 Ceiling of unheated basement

$f * U \leq 0.150 \text{ W}/(\text{m}^2\text{K})$

with f: "reduction factor ground" in the PHPP's "Ground" sheet

### Exceptions

If compliance with the thermal transmittance coefficient given above using conventional insulating materials ( $\lambda \geq 0.032 \text{ W}/(\text{mK})$ ) leads to clear room heights of  $< 2.00 \text{ m}$  or to room heights lower than those specified in the building regulations for the ground floor, the thermal transmittance coefficient given above may be exceeded as is strictly necessary for the relevant partial areas, in consultation with the certifier. For thermal transmittance coefficients  $\geq 0.300 \text{ W}/(\text{m}^2\text{K})$ , the maximum possible insulation thickness with an insulation material conductivity of  $\lambda \leq 0.025 \text{ W}/(\text{mK})$  should be implemented, provided that insulation materials suitable for the respective application are available on the market. Due to reasons of comfort, the interior surface temperatures of the ground floor flooring must be at least  $17 \text{ }^\circ\text{C}$  for the design conditions (PHPP: "Ground" sheet, "design ground temperature for heat load sheet"; indoor temperature  $20^\circ\text{C}$ ).

## 2.6 Basement stairs

A continuous space between the heated area and the unheated basement is not permissible. As a rule, either a closed, airtight and insulated door must be present or the basement must be accessible from outside the thermal envelope of the building (e.g. staircase from the garden). The same criteria apply for the enclosing building components of the basement exit as for the basement ceiling (Section 2.5).

The door between the living area and the unheated basement must have  $U_D \leq 1.60 \text{ W}/(\text{m}^2\text{K})$ .

### Exception

Reducing the insulation thickness of the enclosing building components of the basement exit is permissible in consultation with the certifier, if the usability of the basement exit or the adjacent rooms is unduly restricted.

## 2.7 Floor slab on ground

$$f \cdot U \leq 0.150 \text{ W}/(\text{m}^2\text{K})$$

with f: "reduction factor ground" in the PHPP's "Ground" sheet

Because the insulation on the floor slab is interior insulation, it must be checked whether problematic moisture accumulation can occur in the floor build-up.

### Exceptions

If insulation on the floor slab with the required thermal transmittance coefficient is not possible using conventional insulation materials ( $\lambda \geq 0.032 \text{ W}/(\text{mK})$ ) due to practical reasons (e.g. room height, door lintels), the insulation thickness may be reduced to the level still possible. For thermal transmittance coefficients  $\geq 0.300 \text{ W}/(\text{m}^2\text{K})$ , the maximum possible insulation thickness with an insulation material conductivity of  $\lambda \leq 0.025 \text{ W}/(\text{mK})$  should be implemented, provided that insulation materials suitable for the respective application are available on the market. In this case the additional application of an insulation apron around the floor slab should be considered and if applicable, implemented.

Due to reasons of comfort, the interior surface temperatures of the ground floor flooring must be at least  $17 \text{ }^\circ\text{C}$  for the design conditions (PHPP: "Ground" sheet, "design ground temperature for heat load sheet"; indoor temperature  $20 \text{ }^\circ\text{C}$ ).

## 2.8 Windows

$$U_{w,\text{installed}} \leq 0.85 \text{ W}/(\text{m}^2\text{K})$$

$$g \cdot 1,6 \text{ W}/(\text{m}^2\text{K}) \geq U_g$$



## Explanation

The requirements for  $U_{w,installed}$  are considered to have been fulfilled if the average value for all windows given in the PHPP "Windows" sheet complies with the limit value given above. If the  $U_{w,installed}$  value for individual windows in living areas is greater than  $0.85 \text{ W}/(\text{m}^2\text{K})$ , evidence of the comfort conditions according to DIN EN ISO 7730 should be provided or the low temperatures occurring at the windows should be compensated for by heaters.

## 2.9 External doors

$$U_{D,installed} \leq 0.80 \text{ W}/(\text{m}^2\text{K})$$

According to the supplementary sheet, standard values for the recommended installation situations can be used for the installation thermal bridges if applicable.

## 2.10 Thermal bridges

The thermal building envelope should not have any linear thermal bridges with  $\Psi > +0.01 \text{ W}/(\text{mK})$ , or punctiform thermal bridges with  $\chi > +0.04 \text{ W}/\text{K}$ .

### Exceptions

This limit value does not apply for thermal bridges which are part of the standard construction of a building component (e.g. statically relevant dowelling of a thermal insulation composite system). These are taken into account in the standard thermal transmittance coefficient of the building component.

If a thermal-bridge-free detail formation is clearly not economical or impracticable, the thermal bridge should at least be diminished as far as economically and practicably possible, in agreement with the certifier. Requirements for moisture protection (Section 1.8) must be complied with in every case.

## 2.11 Ventilation

$$\eta_{HR,eff} \geq 75 \%$$

Electrical efficiency of the ventilation system:  $\leq 0.45 \text{ Wh}/\text{m}^3$

All rooms within the heated building volume must be connected to a supply air and exhaust air system with heat recovery or be part of a transferred air zone. Exceeding the criteria for "Passive-House-suitable components",  $\eta_{HR,eff}$  must be adhered to for the whole ventilation system, i.e. the heat losses of the warm air ducts in the cool area or the cold ducts in the warm area should also be included.



### 3 Documents necessary for certification

#### 3.1 Signed PHPP with at least the following calculations

(Please also attach the calculation as Excel file or send via E-mail) **Worksheet  
from PHPP**

- Property data and specific demands ..... **Verification**
- Organisation of areas with allocation of U-values, radiation balance data,  
and thermal bridges ..... **Areas**
- Calculation of U-values of regular building elements ..... **U-values**
- List of building elements used ..... **U-list**
- Calculation of window U-values ..... **Windows**
- List of windows and glazing used ..... **WinType**
- Reduction factors for the ground, if used ..... **Ground**
- Calculation of the shading factors ..... **Shading**
- Calculation of the air quantity and the heat recovery efficiency  
as well as evaluation of the pressure test results ..... **Ventilation**
- Verification of the specific heat demand according  
to the PHPP annual method ..... **Annual Heat Demand**
- Verification of the heat demand according to the monthly method,  
if selected in the Verification Sheet ..... **Monthly Method**
- Verification of the heating load according to the PHPP ..... **Heating Load**
- Calculation of the frequency of overheating in summer ..... **Summer**
- Calculation of the summer shading factors ..... **Shading-S**
- Determination of the summer ventilation, if used ..... **SummVent**
- Calculation of the heat losses from heating and hot water  
distribution systems ..... **DHW+Distribution**
- If a solar collector is used, calculation of the solar fraction for  
domestic hot water ..... **SolarDHW**
- Verification of the annual utilisation factor for the  
heat generator ..... **Compact, Boiler oder District Heat**
- Calculation of the electricity demand ..... **Electricity**
- Calculation of the auxiliary electricity demand ..... **Aux Electricity**
- Calculation of the primary energy value ..... **PE Value**
- Selection of climate data, if not standard ..... **Climate Data**



## 3.2 Planning documents for design, construction, building services:

- Site plan including the building orientation, neighbouring constructions (position and height), prominent trees or similar vegetation, possible horizontal shading from ground level elevations; photographs of the plot and surroundings. The shading situation must be comprehensible.
- Design plans (floor plans, sections, elevations) as pre-construction plans 1:100, or implementation plans 1:50 with comprehensible dimensioning for all area calculations (room dimensions, envelope areas, unfinished window opening sizes).
- Location plan of envelope areas and windows, also thermal bridges if present, for allocation of the areas or thermal bridges calculated in the PHPP.
- Detail drawings of all building envelope connections, e.g. the external and internal walls at the basement ceiling or floor slab, external wall at the roof and ceiling, roof ridge, verge, installation situations of windows at sides, above and below, anchorage of balconies etc.. The details should be given with dimensions and information about materials and conductivities. The airtight level should be indicated and its connection points for the implementation should be described.
- Proof of  $a_w \leq 80 \%$  (in case of doubt)
- Building services plans – ventilation: representation and designing of ventilation units, volumetric flows (Specification Sheet Planning, see PHPP CD), sound protection, filters, supply and extract air valves, openings for transferred air, external air suction and exhaust air outlet, dimensioning and insulation of ducts, sub-soil heat exchanger (if present), regulation, etc..
- Building services plans – heating, cooling (if present), plumbing: representation of heat generators, heat storage, heat distribution (pipes, heat coils, heating surfaces, pumps, regulation), hot water distribution (circulation, single pipes, pumps, regulation), cold water pipes, drainage with aeration including their dimensioning and insulating standards.
- Building services plans – electrical (if used): illustration and designing of lighting and elevator.

## 3.3 Proofs, technical information, with product information sheets if applicable:

- Manufacturer, type and technical information sheets, especially of insulation materials with very low conductivity ( $\lambda < 0.035 \text{ W/(mK)}$ ).
- Itemisation of a comprehensible calculation of the treated floor area.
- Information about the window and door frames to be installed: manufacturer, type,  $U_w$  value,  $\Psi_{\text{Install}}$ ,  $\Psi_{\text{Glazing Edge}}$ , graphical representation of all planned installation situations in the external wall. The calculation values should be mathematically computed according to DIN EN 10077-2. For products which have been certified<sup>6</sup> by the Passive House Institute, these verifications are available.

<sup>5</sup> Data sheets for certified components can be found on the internet at [www.passiv.de](http://www.passiv.de)

- Information about the glazing to be fitted: manufacturer, type, build-up,  $U_g$  value according to DIN EN 673 (to two decimal places) g-value according to DIN EN 410, type of edge spacer.
- Evidence of the thermal bridge losses coefficients used in the PHPP according to DIN EN ISO 10211. Alternatively, comparable documented thermal bridges can be referred to (e.g. from certified Passive House construction systems, PHI publications, Passive House thermal bridge catalogues).
- Short description of the planned building-technical supply systems, with schematic drawings if applicable.
- Manufacturer, type, technical data sheets of all building-technical components: ventilation system, heat generator for heating and hot water, heat storage, insulation of ductwork and pipes, heater coils, frost protection, pumps, elevator, lighting etc..
- Information about the sub-soil heat exchanger (if present): length, depth and type of installation, soil quality, size and material of tubing, verification of the heat recovery efficiency (e.g. with PH-Luft<sup>7</sup>). For sub-soil brine heat exchangers: regulation, temperature limits for winter/summer, verification of the heat recovery efficiency.
- Information about the length, dimensioning and insulation level of the supply pipelines (hot water and heating) as well as the ventilation ducts between the heat exchanger and thermal building envelope.
- Concept for efficient electricity utilisation (e.g. specified devices, explanation and incentives for the house or apartment owner). If efficient electricity utilisation is not verified, average values of devices available on the market will be set (standard values of PHPP).

Proof of summertime comfort must be provided for the buildings which are to be certified. The PHPP procedure for determination of summertime overheating only shows the average value for the whole building – however, individual parts can get overheated. If this is suspected, a detailed analysis should be carried out.

### **3.4 Verification of the airtight building envelope according to DIN EN 13829**

In variation from DIN EN 13829, a series of measurements each for overpressure and underpressure is necessary. The pressure test is to be carried out only for the heated building envelope (basement, porches, conservatories etc., which are not integrated into the thermal building envelope, should not be included in the test). It is recommended that the test be carried out when the airtight level is still accessible and eventual improvements can be carried out. The calculation of the indoor air volume should also be documented in the pressure test report.

Basically, an institution or person independent of the contractor or building owner should carry out the pressure test. A pressure test which is carried out by the contractor will only be accepted if a person signs the test report for the accuracy of the information on his own responsibility.

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<sup>6</sup> PH-Luft: A programme which assists planners of Passive House Ventilation systems. Free download from [www.passiv.de](http://www.passiv.de).



### **3.5 Adjustment protocol of the ventilation unit**

The protocol must at least include the following: description of the property, location address, name and address of the tester, time of adjustment, manufacturer and model of ventilation unit, adjusted volumetric flows per valve for normal operation, mass flow/volumetric flow comparison for outdoor air and exhaust air (maximum disbalance of 10%). Recommendation: Use "Final Protocol Worksheets Ventilation", source PHPP CD or [www.passiv.de](http://www.passiv.de).

### **3.6 Construction manager declaration**

Implementation according to the certified PHPP project planning must be documented and confirmed with the construction manager's declaration. Any variation in implementation should be mentioned, for deviant products relevant evidence must be provided.

### **3.7 Photographs**

Photographs which document the progress in construction should be provided; digital images are preferable.

**It may be possible that additional test reports or data sheets for the components used in the building are required. If values which are more favourable than those in the standard PHPP procedure are to be set, these should be supported by detailed evidence.**

## 4 Testing procedure

An informal application for the certificate can be made to the selected certifier. The required documents must be filled in completely and submitted to the tester. The documents must be checked at least once. Depending on the procedure, further testing may also be arranged.

Note: If possible, checking of the relevant documents should be carried out during the planning stage so that potential corrections or suggestions for improvement can be considered at an early stage.

After the assessment the contractor will receive the results, with corrected calculation and suggestions for improvement, if applicable. Reviewal of the construction work is not the object of the certification. However, evidence of the building's airtightness, the adjustment protocol of the ventilation unit and the construction manager's declaration and at least one photograph must be provided. If the technical accuracy of the necessary evidence for the building is confirmed and the criteria given above are adhered to, the following certificate will be issued:



Issuing only certifies the accuracy of the documents submitted, in accordance with the level of technological development of Passive House components. The assessment relates neither to the monitoring of the work, nor to the supervision of the user behaviour. The liability for the planning remains with the responsible technical planners, and the liability for the implementation lies with the appropriate construction management. The Passive House Institute logo may only be used in connection with certificates.

Additional quality assurance of the construction work by the certifying body is particularly expedient when the construction management has no experience with the modernisation of existing buildings using Passive House components.

We reserve the right to adapt criteria and calculation procedures to advancing technical development.



## 5 Calculation methods, conditions, standard reference

The following conditions or calculation rules should be used in the PHPP:

- Climate data: regional data set (suitable for location, for deviating altitudes with temperature correction of  $-0.6\text{ °C}$  per 100 m difference in altitude).
- Individual climate data: applicability is to be agreed previously with the relevant certifier.
- Designed indoor temperature:  $20\text{ °C}$  without night-time set-back.
- Internal heat sources:  $2.1\text{ W/m}^2$ , in case no other national values have been set by the PHI.
- Occupancy rates:  $35\text{ m}^2$ /person, deviating values of 20 -  $50\text{ m}^2$ /person are permissible if justified (actual occupancy or designed input)
- Domestic hot water demand: 25 litres per person per day,  $60\text{ °C}$ , cold water temperature  $10\text{ °C}$ , provided that no other values have been set by the PHI.
- Average ventilation volumetric flow: 20-30  $\text{m}^3/\text{h}$  per person, but at least a 0.30-fold air change with reference to the treated floor area multiplied by 2.5 m room height. The applied air mass flows must correspond to the actual adjustment values.
- Household electricity demand: standard values according to the PHPP, deviating values only if individually verified by the building constructor or by electricity planning.
- Thermal envelope area: Exterior dimension reference without exception.
- U-value of opaque building components: PHPP procedure according to EN 6946 with rated values of the conductivity according to national standards or building authority regulations.
- U-values of windows and doors: PHPP procedure according to EN 10077 with mathematically computed rated values for the frame U-value  $U_f$ , glass edge thermal bridge  $\Psi_g$ , installation thermal bridge  $\Psi_{\text{Install}}$ .
- Glazing: mathematically computed U-value  $U_g$  according to EN 673 (to two decimal places) and g-value according to EN 410.
- Heat recovery efficiency: testing method according to the PHI (see [www.passiv.de](http://www.passiv.de)), alternatively, testing according to the DIBt method (or equal) with a deduction of 12 %.
- Energy performance indicator of the heat generator: PHPP procedure or separate verification.
- Primary energy factors: PHPP dataset



## **6 Appendix**

### **6.1 External doors: recommended installation situations**

In progress



## 6.2 Confirmation of detection and sealing of leakages during the pressurisation test

(Only necessary for  $0.6 \text{ h}^{-1} < n_{50} \leq 1.0 \text{ h}^{-1}$ )

Standard text :

*It is hereby confirmed that during the pressurisation tests a search for leakages was carried out. All rooms within the airtight building envelope were entered for this purpose. All potential weak points were checked for leakages. This also applies for areas which were difficult to access (e.g. with large room heights). Any larger leaks that were found having a relevant share of the total leakage volumetric flow were sealed.*

The following information is necessary:

- Name, address, company of the person signing
  - Date and signature
  - Description and address of the construction project
  - Pressurisation test: date and name of the person carrying this out
-