Position paper for the development of component certification criteria of industrial doors

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1. Preface

Industrial doors are mainly used in commercial and industrial settings due to their robust construction, efficiency, and high durability. They can also be found in warehouses, factories, commercial garages, and other such environments.

Passive House buildings provide optimal thermal comfort with very low energy costs, and they lie within the economically profitable range with reference to their life-cycle costs. In order to achieve this level of comfort and the low life-cycle costs, the thermal quality of the components used in Passive Houses must meet stringent requirements. These requirements are directly derived from Passive House criteria for hygiene and comfort as well as from feasibility studies and energy demand criteria. The Passive House Institute has established component certification in order to define quality standards, facilitate the availability of highly efficient products, promote their widespread application, and provide designers and building owners with reliable characteristic values for input into energy balancing tools.

2. Scope

This paper deals with industrial doors and components for unconditioned zones or areas with lower air temperature set points. These components shall only be used for zones with lower air temperature requirements, such as fire halls, storage halls, work halls, plants, logistic centres or hallway areas, elevator/ staircase shafts, car workshops, factories or cargo entrance for supermarkets. Hence these products are not be used for conventionally conditioned zones with indoor temperatures of 20°C in Winter and 25°C in Summer.

The components described may only be used for industrial and commercial purposes. In the event of component certification, this will be made clear with a certificate in writing and verbally, as well as graphically. The impression must not be created that these components can be used for common rooms in residential units or offices. Components that can be used for residential buildings, such as conventional windows, doors, curtain walls etc. cannot be certified within this scope.

The described component qualities and certification targets are applicable for heating dominated climate zones, for the time being only cold and cool-temperate zones since in other climates those spaces would very likely be left unconditioned and outside of the thermal envelope. Arctic climates might require additional assessment.

For such areas, the temperatures should be chosen in accordance with the currently valid workplace regulations to set legal requirements for a healthy climate in the workplace. The components defined here, are intended for areas with design air temperatures between 10 ° and 17 °C. If there are no specifications, the relative humidity lies in a range of 30 % to 70 %. In order to determine condensation temperatures, the requirements need to be achieved for different boundary conditions.

Components that can be assessed within this scope are:

- Rolling / sectional / overhead doors / spiral doors
- Lock and dock gates
- Elevator doors
- Double lift doors (in external walls)
- Armoured doors

3. Airtightness

Airtight industrial doors minimize the leakage of conditioned air, thereby improving energy efficiency. This results in cost savings on heating and cooling and contributes to sustainability efforts and help maintain a consistent indoor climate, providing a comfortable environment for the users of the building. They also prevent the entry of pollutants, improving indoor air quality. In industries where cleanliness is vital, such as food processing or pharmaceutical, airtightness prevents contaminants such as dust or insects from entering the facility. The simulation and calculation of the influence of airtightness show a relevant influence on the energy balance as well as on the design of the ventilation concept. All components to be certified being part of the thermal envelope and of the main airtightness layer need to achieve airtightness requirements, depending on their category.

Industrial, commercial, garage doors and gates – as defined in the EN 13241 need to achieve a class 2 classification in accordance to the EN 12426 or comparable, resulting in an area weighted airtightness of 12 m^3 / (h m^2) at 50 Pa pressure difference.

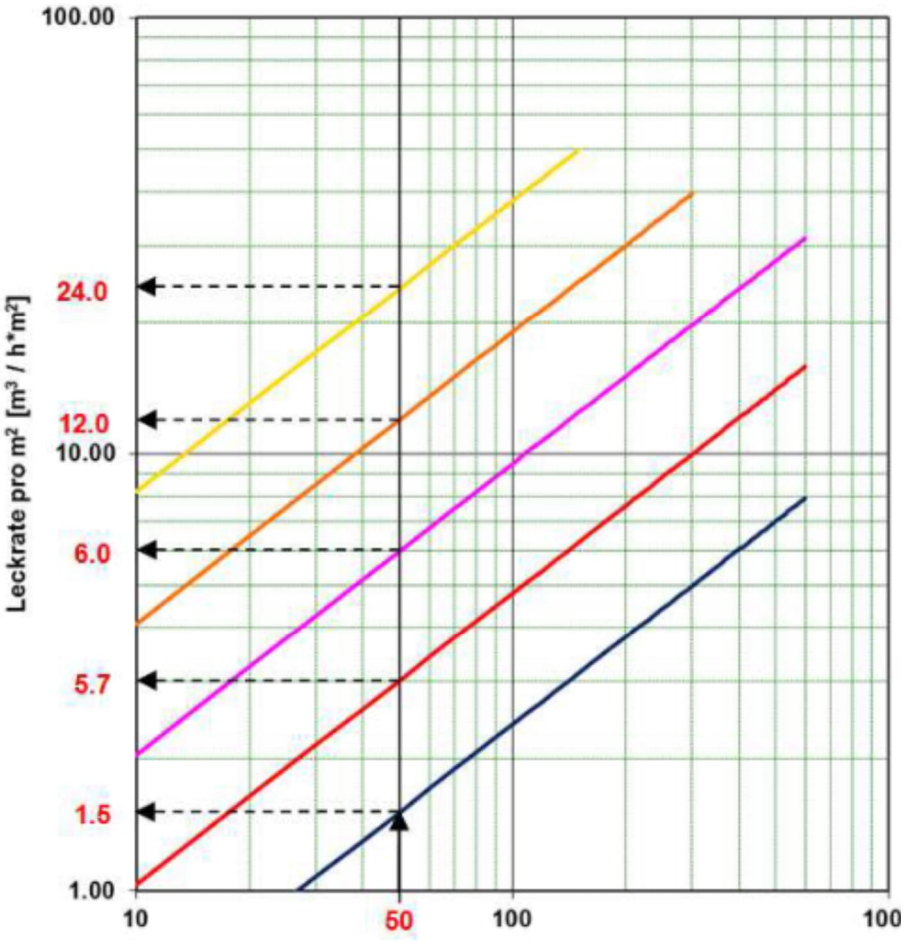


Figure 1 - Requirements airtightness industrial doors (Class II represented by orange line) - abscissa representing pressure difference)

Smaller components, such as access doors, need to achieve the requirements of class III in accordance to the EN 12207 or comparable, resulting in an area weighted airtightness of 9 m³ / (h m²) at 100 Pa pressure difference (approx. 5.5 m³ / (h m²) at 50 Pa pressure difference), or the corresponding airtightness class with reference to the joint length, if applicable.

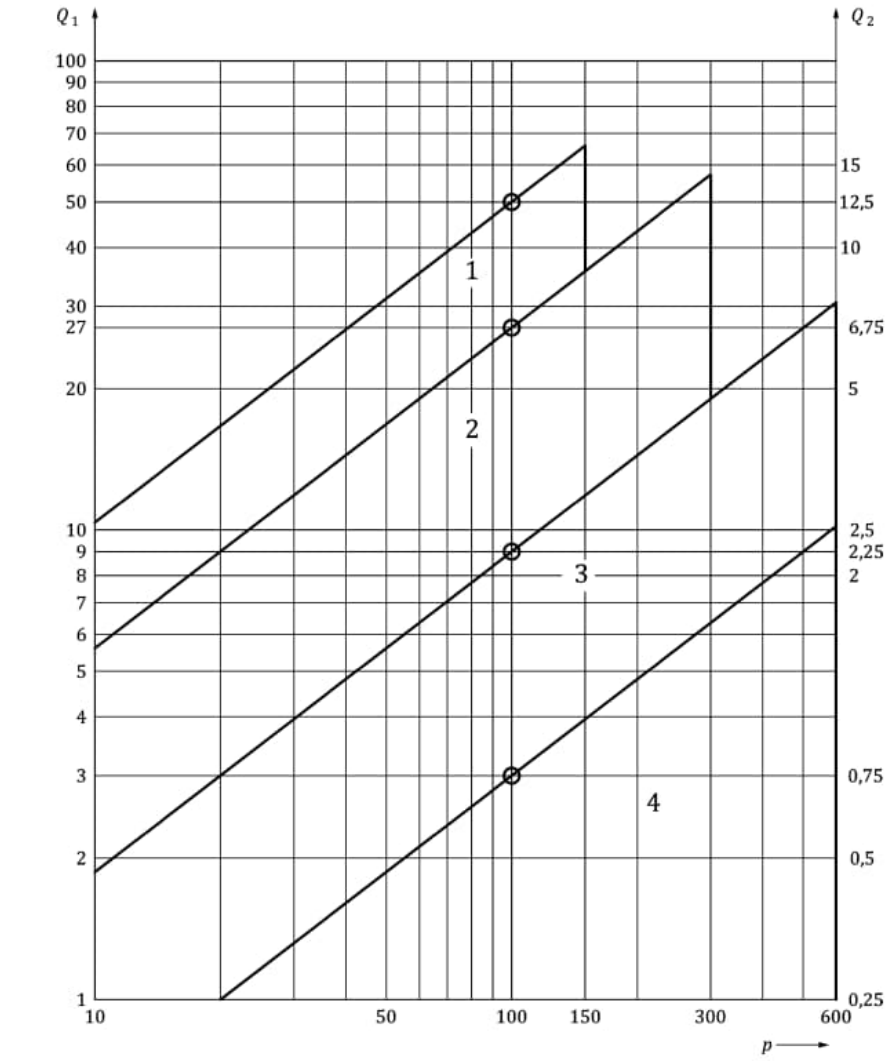


Figure 2 - Upper limit values of classes for windows and doors EN 12207, Q1 in m³/(hm²), Q2 in m³(hm)

4. Hygiene

The components defined here, are intended for areas with design air temperatures between 12 ° and 18 °C. If there are no specifications, the relative humidity lies in a range of 30 % to 70 %. In order to determine condensation temperatures, the requirements need to be achieved for different boundary conditions (combination of temperature and relative humidity values within the ranges mentioned above).

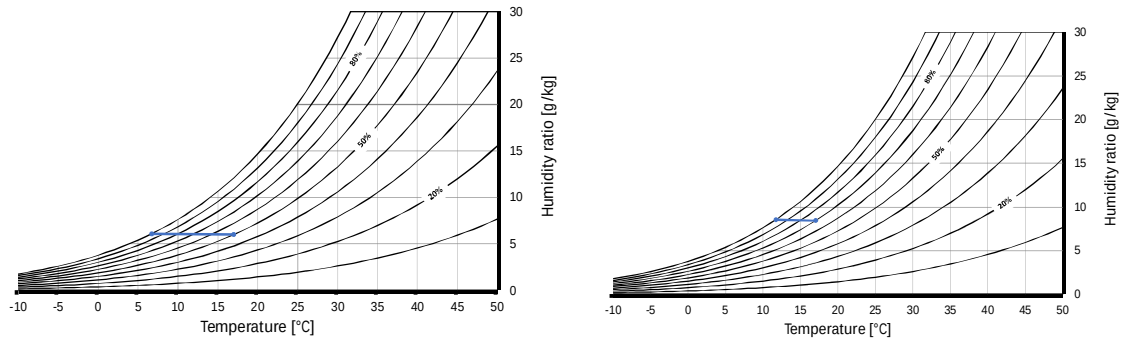


Figure 3 – Psychrometric evaluation of condensation points for different boundary conditions

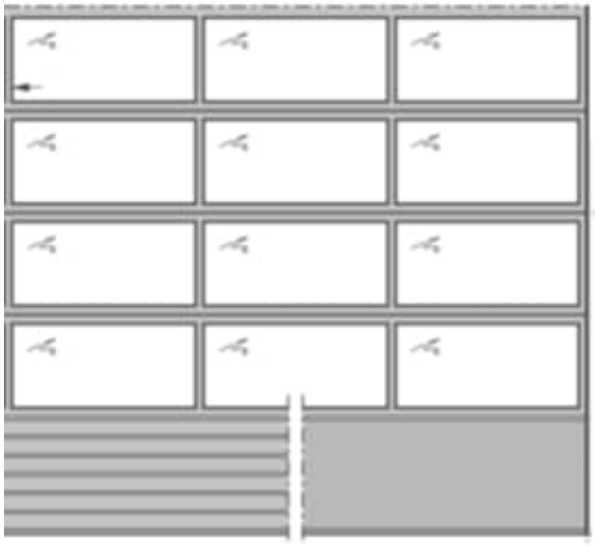
Depending on the purpose and workplace directive, different boundary conditions are tested to determine condensation points for different air temperatures and humidity levels. Based on minimum surface temperatures determined via FEM (Finite Element Method) Simulation and the corresponding f_{Rsi}-values, the condensation risk can be determined for different boundary conditions and restrictions can be formulated. No condensation should occur on surfaces. Depending on the set points and humidity levels to be expected, the condensation points are determined via approximation equations or with psychrometric charts. Threshold and bottom profiles can be exempted from the rule, in case a dedicated drainage system is considered or the profile achieves the requirements within the installed evaluation.

5. Heat transmission

The proposed heat transfer coefficients for industrial doors and components in zones with lower interior air temperatures, or with lower heating conditioning requirements, are based on energy aspects rather than global and local comfort requirements, unlike conventional Passive House components. This can be attributed to the following considerations. The slightly conditioned industrial areas are not primarily used as living spaces, as in residential and office buildings. Industrial workplaces have different comfort requirements due to the changed metabolism. Local effects such as discomfort due to radiation asymmetry, cold air drop, temperature gradients, etc. are not to be expected. Instead, the focus should be on hygiene, freedom from mould and condensation on the surfaces, as well as the reduction of the heating demand. Requirement values can be defined accordingly.

In order to determine the impact on the heating demand, parametric studies for typical industrial building complexes with different temperature zones have been evaluated. Especially for buildings with a high fraction of industrial doors within the thermal envelope (such as fire halls), showed a significant impact on the heating demand, even with low heating design temperatures between 10° C – 14°C.

At the same time, a couple of special elements and technical requirements need to be addressed and taken into account when proposing a target value for such elements. The main considerations are listed below.



Components do not necessarily only consist of an opaque panel, and can contain transparent parts with punctiform and linear thermal bridges to be considered (thermal bridges of the glazing edge bond, interconnecting effects with transom and mullion structures, fixings, hinges etc.). Conventional IGU structures can often not be used for overhead and spiral doors and sealed double pane units with air space between are used.

Thermal bridges caused by hinges, mechanical elements, especially for overhead and spiral doors, joints between panels are to be considered. Reinforcements are found behind the skin and provide an anchor point. These reinforcements can be steel plates or a continuous strip of steel along the panel with wood end-blocks.

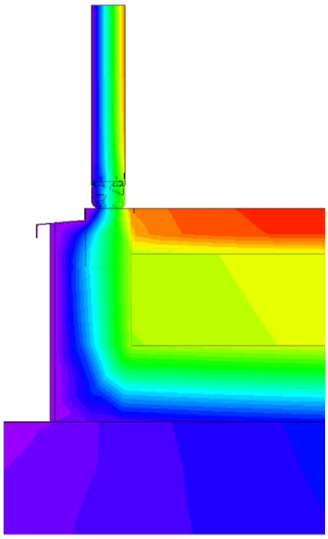
Opaque panels are limited in thickness due to weight, wind and speed requirements, as well having an impact on the transom and mullion design. Panel U-values lower than 0.30 W/m²K are hardly achievable.

Some overhead doors require the consideration of additional embedded access doors.

Some components are offset from the insulation layer in the installation. For example, overhead doors or smoke extraction flaps with a curb. The geometric thermal bridges must be taken into account accordingly, as must the running rails. The exact

determination of the installation thermal bridges is of high importance, for the overall performance and the hygienic evaluation.

Roller doors require the passage of heavy vehicles or forklifts, etc. The entrance is therefore subject to high loads and a consistent insulation layer cannot necessarily be created in the floor area either, or only with high-pressure-resistant insulation materials. A thermally separated threshold profile cannot usually be provided. Even if this thermal bridge cannot be avoided, it is very important to detect it. A drainage concept may also be provided.



For evaluating the overall performance and to make correct input values for the PHPP available, all elements and thermal bridges, correction factors and disturbances of the regular heat flow need to be determined. For the certification process, a typical configuration will be defined for each type. Considering the effects listed above, a maximum value of $U_{installed}$ < 1.5 W/(m²K) should be targeted for cool-temperate and cold climates. The reference area should be in accordance to the relevant product norm and will be defined for the first pilot certifications. For components with projected areas smaller than 1 m², the maximum heat transfer coefficient can be exceeded (to be specified for different component types).

For overhead and industrial doors, the following values need to be determined:

Type	Abbreviation	Unit
Heat transfer coefficient of an opaque panel	U_{pnl}	W/(m²K)
Heat transfer coefficient of a transparent panel	U_g	W/(m²K)
Heat transfer coefficients of connecting mullions and transoms	U_t / U_t	W/(m²K)
Heat transfer coefficients Window and access door frames	U_f	W/(m²K)
Joint thermal bridge between panels	ψ_{Joint}	W/(mK)
Thermal bridge panel connection to transom / mullion	Ψ_{pnl}	W/(mK)

Thermal bridge glazing edge bond	Ψ_g	W/(mK)
Thermal bridges hinges, mechanical elements, fixings	X_{mech}	W/K
Installation thermal bridges jamb and head	Ψ_{inst}	W/(mK)
Installation thermal bridges to the ground / sill / threshold	Ψ_{inst}	W/(mK)

6. Certification and further development

The Passive House Institute is now taking applications from manufacturers for pilot certifications and additionally prepare the first certification guidelines and explanatory notes for the PHPP Input.

This document serves as a first draft, a working document which will be expanded in scope and supplemented with further product specifications. There is no right to certification and we reserve the right to make changes and target value adjustments in the further process.

7. References

EN 13241:2003+A2:2016. Industrial, commercial, garage doors and gates – Product standard, performance characteristics. European Standard. Brussels: European Committee for Standardization.

EN 12207:2016. Windows and doors – Air permeability – Classification. European Standard. Brussels: European Committee for Standardization.