COMPARISON BETWEEN SOME EXISTING PERFORMANCE REQUIREMENTS FOR AIR PERMEABILITY AND WATER-TIGHTNESS IN BUILDINGS

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This paper compares some existing performance requirements for the air permeability and watertightness of windows, and illustrates the necessity of further work towards harmonisation.

1 Air permeability of windows

The performance of air permeability is the flow of air blowing through the joints of the window.

Table 1 gives a list of the performance assessment methods, grading systems and requirements considered. The assessment methods are basically the same for all.

The grades (or classes) are drawn on Figures 1 and 2.

Both figures represent the flow Q depending on the static pressure difference Δp but on Figure 1, the flow Q is expressed in $m^3/h.m$ of joint, and in Figure 2 in $m^3/h.m^2$ of surface.

The figures define UEAtc classes A1, A2 and A3, and some other systems of classes have been added for comparison:

- The Danish Building Research Institute banded levels (defined at a pressure of 700 Pa) on both figures
- The British Interdepartmental Sub-Committee for Component Co-ordination grades on both figures.
- The French Standard NF P20–302 on Figure 1 (same as UEAtc classes)
- The Belgian STS 52 draft of 1979 on Figure 1 (UEAtc grade Al has been considered as not sufficiently severe and a subdivision of grade A2 has been considered necessary).
- The Dutch standard NEN 3661 on Figure 1
- The Norwegian Building Research Institute specifications on Figure 2
- The Israeli specifications on Figure 2

The UEAtc, the French, the Belgian and the Norwegian classes are defined according to the physical law $Q = m\Delta_p{}^{2/3}$ ie by the coefficient $m = \dfrac{Q}{\Delta_p{}^{2/3}}$ (assuming the the joint profiles do not change with variation in pressure). The others are classes of flow Q defined for a constant pressure Δ_p (DK, NL) or classes of pressure Δ_p defined for a constant flow Q (GB, IS).

Air permeability or tightness is not a user requirement as such: this performance is required from a window to satisfy the three following user requirements:

1 control of air temperature and velocity of the flow from the windows inside the rooms
2 heating energy saving
3 ventilation of the rooms (if no other installation provides it)

The *third requirement* is obviously in contradiction to the two first ones; therefore, if there is no ventilation installation, the final requirement for the air permeability of the window will need to be a compromise. The air permeability requirement for a closed window, being a function of the wind pressure, depends on the return period considered, the region (see the difference between Norway and Israel), the height above ground, the roughness of the terrain and the protection of the window from the wind by other parts of the same building or by other buildings.

The following example gives the proposed Belgian requirements for the new draft of STS 52 (1979):

a **non-opening parts:**
$Q \leqslant 0.3\ m^2/h.m^2$ at $\Delta p = 100Pa$

b **opening parts** (windows, doors)

Height above ground	normal insulation (single glazing)	improved insulation (double glazing)
0 to 10 m	PA1	PA2
10 to 25 m	PA2	PA3
> 25 m and sea shore	PA3	PA3

2 Water-tightness of windows
The performance of water-tightness is expressed by the highest air pressure for which there is no infiltration of driving rain water in the room.

Table 2 gives the list of performance assessment methods, grading systems and requirements considered. Figure 3 shows the differences in the assessment methods: the Danish and Norwegian methods use pulsation of air and a small quantity of water representing driving rain, whereas the other five use static pressure and a larger quantity of driving rain.

Large differences are also to be noticed in the grading systems.

The following example gives the proposed Belgian requirements for the new draft for STS 52 (1979):

Height above ground	Protected facade (protrusions of 1.2 m)	Non-protected facade (no protrusion)
0 to 10 m	E2	E3
10 to 25 m	E3	E4
> 25 m and sea shore	E4	E5

For E4 and E5, there may be no water penetration inside the building under 250 pulsations of air from 0 to 250 Pa.

For curtain walls and h > 25 m, the test pressure is the pressure of the maximum normal wind according to NBN 460 (≃ wind obtained every year).

Table 1 Air permeability – windows – References

Country	Assessment method	Grades	Requirements
CEN	EN 42	–	–
UEAtc	Directives pour l'agrement des fenetres	Directives pour l'agrement des fenetres Grades: A1, A2, A3	–
B	NBN B 25–204 (EN42)	–	–
	STS 36 : tome I – 00.38.10 (metalwork)	–	STS 36 : tome III 36.10.12
	STS 52 : tome I 00.38.10 (woodwork) (draft 1979)	STS 52 : tome III 52.04.12 (draft 1979)	STS 52 : tome III 52.04.12 (draft 1979)
DK	YEB 2	YEB 2 banded levels	–
F	NF P20–501 (EN 42)	NF P20–302 Grades : A1, A2, A3	DTU 36.1/37.1
GB	ISCC technical note no 1	–	ISCC technical note no 1
	BS 5368 Part 1 (EN 42)	DD4	DD4
IS	Performance specifications for building elements	Performance specifications for building elements grades : types 1, 2, 3	Performance specifications for building elements
N	Vinduer av tre (NBI anvisning 10)	Vinduer av tre (NBI anvisning 10) grades 1, 2, 3, 4	–
NL	NEN 3661	NEN 3661 grades B15, B40, B100, K15, K40, K100	NEN 3661

Table 2 Water-tightness – windows

Country	Assessment method	Grades	Requirements
CEN	EN 86	–	–
UEAtc	Directives pour l'agrément des fenêtres	Directives pour l'agrément des fenêtres grades E1, E2 E3, E4	–
B	NBN B25–209 (EB 86)	–	–
	STS 36 – tome I 00.38.20 Menuiseries métal – liques	–	STS 36 tome III 36.10.12
	STS 52 – tome I 00.38.20 Menuiseries extérieures en bois (draft 1979)	STS 52 – tome III 52.04.12 grades PEau 1, PEau 2 (draft 1979)	STS 52 – tome III 52.04.12 (draft 1979)
DK	YEB 2	YEB 2 banded levels	–
F	NF P20–501 (EN 86)	NF P20–302 grades E1, E2, E3, E_E	DTU 36.1/37.1
GB	BS 5368 Part 2 (EN 86)	DD4	DD4
IS	Performance specifications for building elements	Performance specifications for building elements	Performance specifications for building elements
N	Vinduer av tre NBI anvisning 10	Vinduer av tre NBI anvisning 10	Vinduer av tre NBI anvisning 10
NL	NEN 3661	NEN 3661 grades B15, B40, B100, K15, K40, K100	NEN 3661

3 Conclusions

This study of some existing performance requirements for air permeability and water-tightness of windows shows that for both performances, a large variety of methods of test and grading systems is used.

This situation makes the comparison of the performance of products tested in different countries very difficult. Therefore a search for harmonisation is necessary. A first step has been the drafting of the European Standard for the methods of test for air permeability (EN42) and for water-tightness (EN86).

A further step should be taken to unify the grading systems, taking into account the large variety of climatic conditions existing throughout the world.

This could be a task for CEN, or even better for ISO.

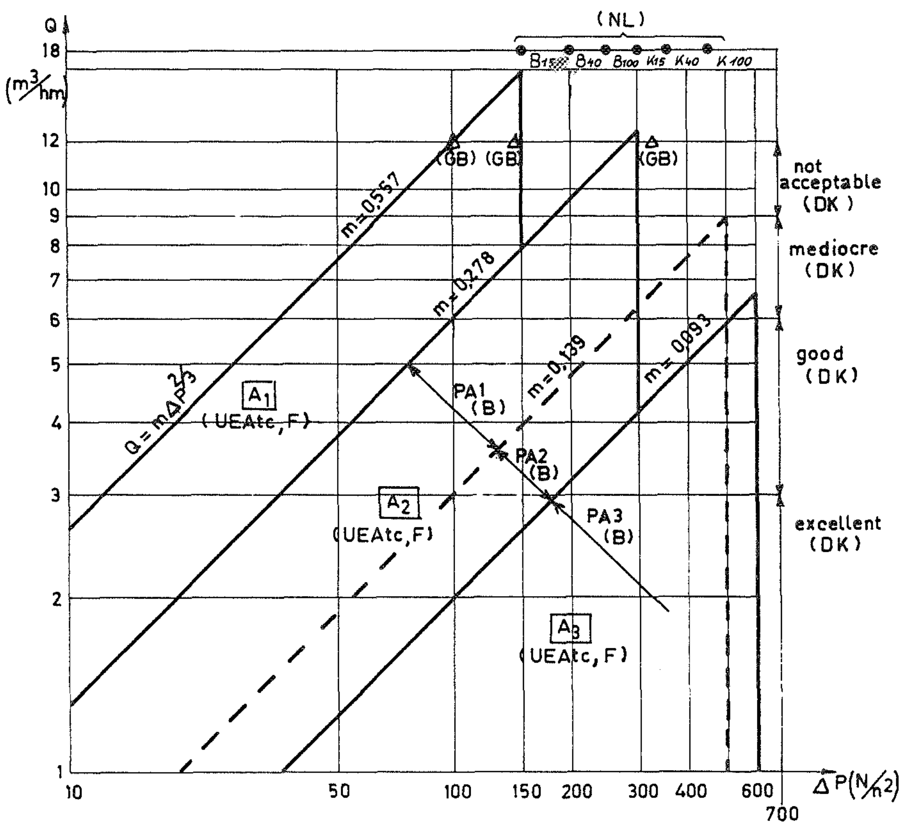

Figure 1

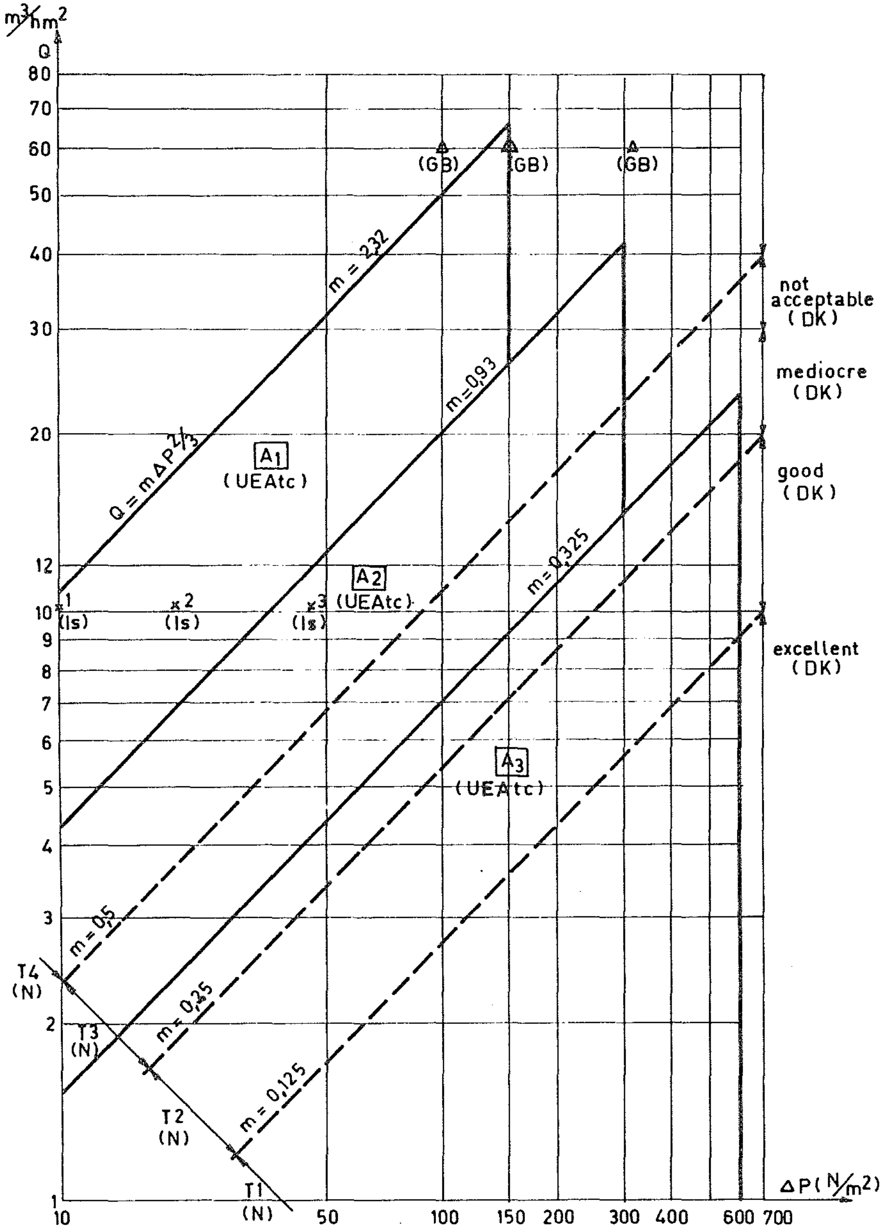

Figure 2

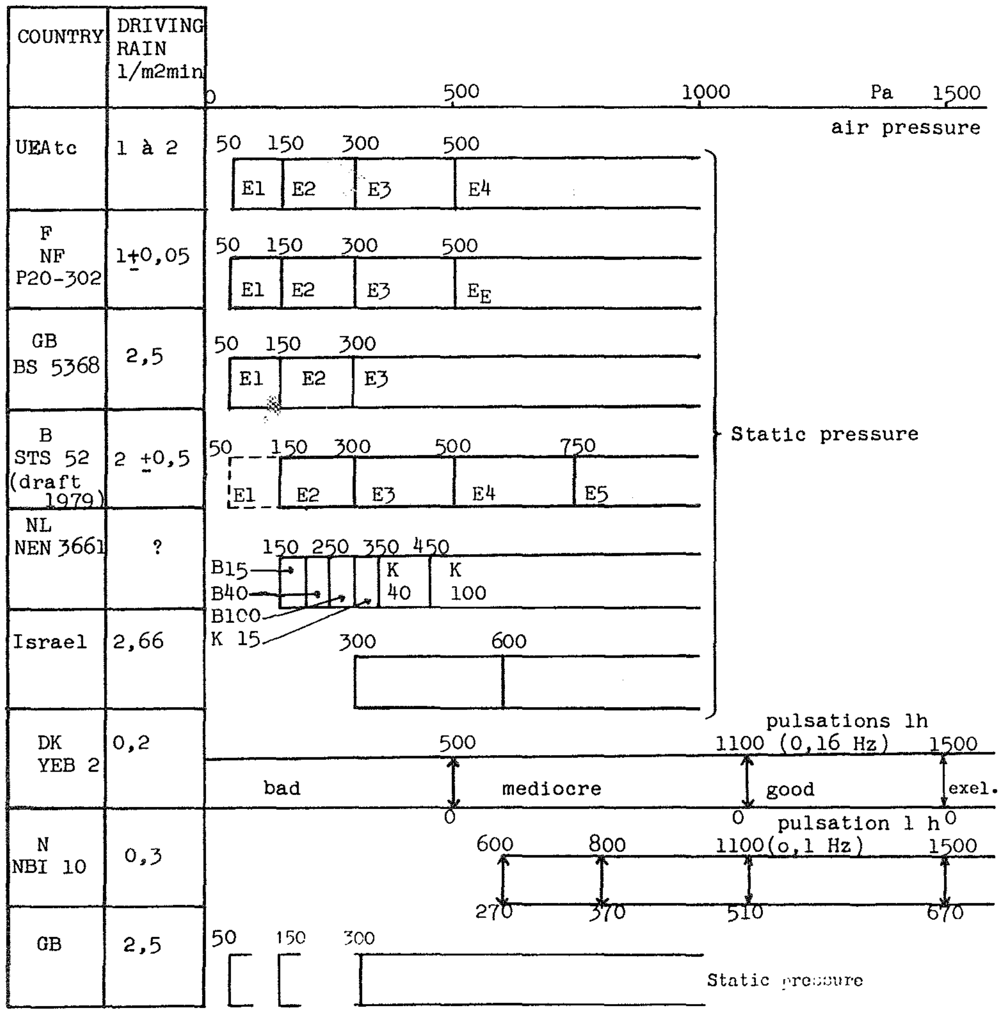

Figure 3 Water-tightness-windows