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Installation manual for (German-type) PVC–windows opening to the inside

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Installation manual for windows

Instructions given in the installation manual guarantee high quality results in case the building is used for specific purposes only, and throughout the whole maintenance period normal indoor climate is guaranteed, i.e. the interior temperature does not fall below + 16 º C and humidity does not exceed 60% for longer periods of time.

GENERAL PRINCIPLES OF STRUCTURAL PHYSICS

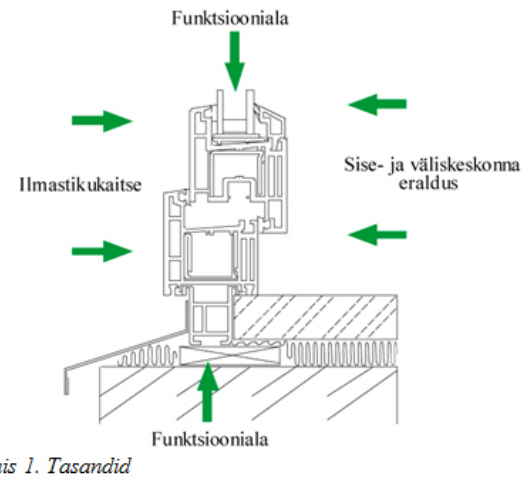
Structural physics is a branch of physics which focuses on thermal physics of the buildings and construction acoustics. These are directly related to construction and renovation jobs of all kind, including the ones connected with installation of windows.

To ensure avoidance of excessive heat loss and moistening window frames as well as the access of domestic noise into the room, the following principles need to be followed when sealing the wall construction, window, and the uniting joints between them.

The constructions need to ensure:

1. Air resistance
2. Minimum heat loss
3. Heavy rain resistance
4. UV-radiance resistance
5. Inside steam-diffusion density
6. Durability

The above-mentioned principles are ensured on the following three levels:



Joonis 1. Tasandid

Level 1. Separation of internal and external environment

The separation level of internal and external environment has to be continuous on the whole inner side of exterior wall and this cannot be disrupted. Separation level temperature has to be higher than the interior dew point temperature; otherwise condensate will appear on the surface of walls, windows, and doors, which in case of constant moistening creates favourable conditions for construction deterioration (mould, fungi, material decay, and corrosion), increased heat loss, and noise bridges.

Õhu temperatuur	Õhuniiskuse sisaldus										
	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%
30°C	12.9	14.9	19.8	18.4	20.0	21.4	22.7	23.9	25.1	26.2	27.2
28°C	11.1	13.1	15.0	16.6	18.1	19.5	20.8	22.0	23.2	24.2	25.2
26°C	9.4	11.4	13.2	14.8	16.3	17.6	18.9	20.1	21.2	22.3	23.3
24°C	7.6	9.6	11.3	12.9	14.4	15.8	17.0	18.2	19.3	20.3	21.3
22°C	5.9	7.8	9.5	11.1	12.5	13.9	15.1	16.3	17.4	18.4	19.4
20°C	4.1	6.0	7.7	9.3	10.7	12.0	13.2	14.4	15.4	16.4	17.4
18°C	2.3	4.2	5.9	7.4	8.8	10.1	11.3	12.5	13.5	14.5	15.4
16°C	0.5	2.4	4.1	5.6	7.0	8.2	9.4	10.5	11.6	12.6	13.5
14°C	-1.0	0.6	2.3	3.7	5.1	6.4	7.5	8.6	9.6	10.6	11.5
12°C	-2.6	-1.0	0.4	1.9	3.2	4.5	5.7	6.7	7.7	8.7	9.6
10°C	-4.2	-2.6	-1.2	0.1	1.4	2.6	3.7	4.8	5.8	6.7	7.6

Separation level temperature can be retained by the proper choice of wall, ceiling, floor, and opening filling construction with correct thermal conductivity. Thermal conductivity is an index showing the amount of heat in W-s that spreads through 1-meter-wide material layer of an area of 1 m² within an hour in case the difference of temperatures between the levels is 1 °C. The given index is marked by letter U (in case of opening fillings also by K) and this index should be included in all the project documentations of the constructions.

Level 2. Weather protection

Weather protection level has to avoid the wind and rain ingress into the constructions and the controlled drainage of the ingressed rainwater. At the same time, removal of the ingressed water from the functional area and sufficient ventilation of the construction has to be ensured.

Level 3. Functional area

In this area, warmth and sound resistance needs to be ensured. In order to make those functions work, the mentioned area needs to be dry and separated from inner climate. Since the absorbed moisture in warm air starts condensing at a temperature of ca 10 ºC , there has to be a way for the effective condensate removal. There, the principle "inside tighter than outside" needs to be followed. At the same time, it has to be considered that the functional area is influenced by general movements of the construction, increase and decrease of window materials, the force caused by the weight of the window, and the force caused by using the window. Therefore, sealing materials have to be adherent and plastic; respective instructions have to be followed at fastening.

Presuming that the wall constructions have been built in accordance with all the valid construction standards and "good building practices" and the windows are of high quality, it is up to the specialist to connect the window set with the wall construction and seal the connection joint according to the requirements.

Materjal	Profiili pikkus			
	≥ 1,5 m	≥ 2,5 m	≥ 3,5 m	≥ 4,5 m
	Vuugi laius (mm)			
Valged PVC-aknad	10	15	20	25
Värvilised PVC-aknad	15	20	25	30
Puitaknad	12-45			

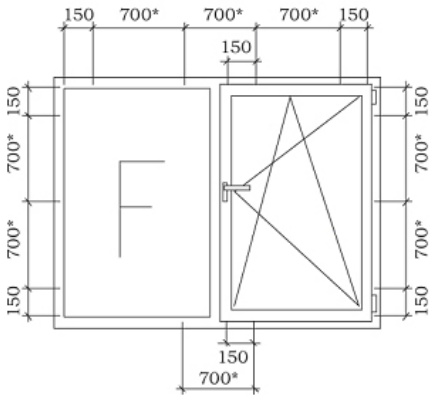
Tabel 2. Minimaalsed vuugi laiused aknalengi ja ava külgede vahel

The described joint width can be guaranteed in case of new buildings but for ensuring correct joint width in case of window replacement it is necessary to use either additional profiles or adjusting the openings. Additional profiles are generally used in case the joint widths need to be adjusted from the sides or at the upper part of the window. Before implementing additional profiles, the situation needs to be discussed with either a project manager or a sales consultant. Adjusting the openings is usually performed by using combination of impregnated beams. In accordance with the size of the opening, the beams with suitable cross-section will be chosen and a wooden frame will be constructed into the opening. The deviation between side lengths may be maximum ± 5 mm. The wooden frames will be levelled using the wedges and statically fastened with the nail dowels or screws. The pitch of the fastenings is chosen in accordance with the pitch of the window fastening clips. The area between wall and frame is to be fully insulated either with rock wool, glass wool, or polyurethane foam. In case of using the foam, it has to be made sure that the width of the joint being insulated would not exceed the maximum width allowed by the producer, and the foam expansion would not deform the sash.

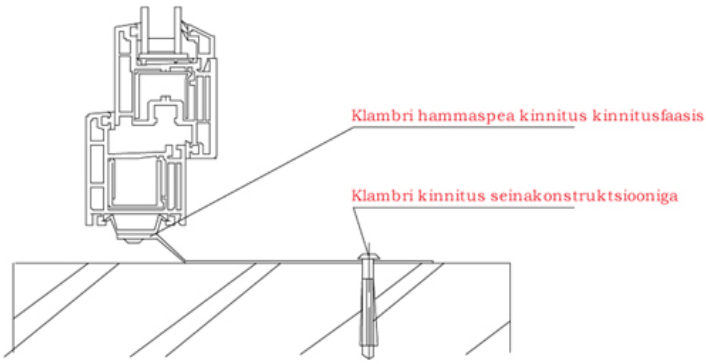
PREPARING THE FRAME

After making sure the opening is correct and fit for the produced window, complexity of the window and proper fastening of opening mechanisms will be checked. Opening sashes will be removed. In case the window opening has an exterior jamb covering the frame, the outer protective plastics are removed (in case there is not a special agreement with the customer for preserving protection plastics or providing additional protection for frames). Thereupon, fastening clips are inserted (in case the fastening through frame is not used). The correct location for fastening clips and frequency ensure even increase/decrease of the frame and the final strength in the opening. Therefore, the installation specialist is obliged to observe following instructions when inserting the clips.

In case of windows wider than 2500 mm and band windows, fastening clips can be inserted into the lower side of the frame at the muntins and with the pitch not over 700 mm.
For connecting single window elements in case of band windows, special connecting profiles are used. In this case, window frames are connected to each other or to the connecting profile with screws, whereas the locations of the fastening screws are identical with the locations of the frame fastening clips.



* - maksimaalne lubatud kaugus klambrist klambrini



Joonis 3. Kinnitusklambri kinnitus

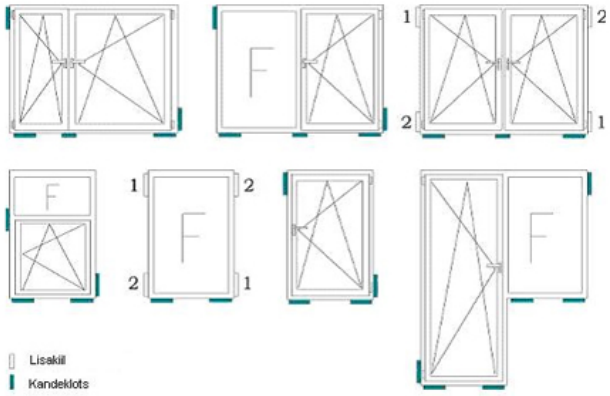
WEDGING AND FASTENING THE WINDOWS

After preparing the opening and the frame, support blocks will be inserted into the opening and preliminary approximate levelling will be done. After that window frame will be placed, wedging and final levelling will be done. While wedging, potential expansion of plastic profiles has to be taken into consideration – expansion must not cause extra tension.
Profile length changes caused by temperature:

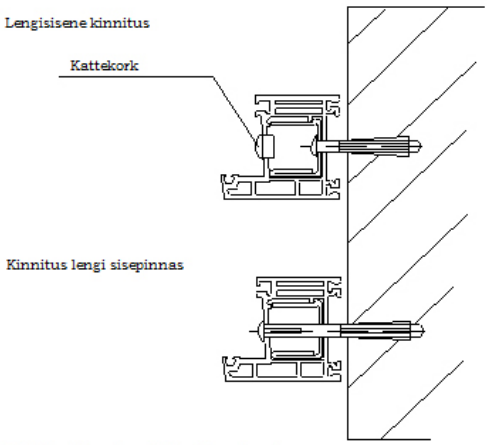
- White PVC profiles up to 1.6 mm/m
- Coloured PVC profiles up to 2.4 mm/m

To guarantee window's self-weight and proper distribution of influencing forces, the following drawing should be followed when installing support blocks and additional wedges.

In case the frame is slanted to the left, the pairs 1-1 of additional wedges are to be installed. In case of slanting to the right, the pairs 2-2 of additional wedges are to be installed.
NB! Removing support blocks is forbidden throughout the whole exploitation period.
For levelling the window, assisting wedges can be used that have to be removed after the window is levelled and fastened.



After wedging and check levelling, window is immediately fastened. In case of using clips, the fastening is performed with nail dowels or screws depending on the wall construction. In case of using nail dowels, it should be made sure that the dowel was attached at least at a depth given in the producer's installation manual and that the fastening depth was 40 mm at minimum.
When levelling large windows, it is reasonable to perform the preliminary fastening of the frame already before levelling, using the regulating opening of the fastening clip. In this case, the final fixation of the clip with additional screw or dowel will be done after levelling.



Joonis 5. Kinnitamine läbi akna lengi

Sometimes also fastening with screws or nail dowels through the frame is used, usually when it is not possible to cover the fastening clips when finishing the jambs later. The fastening pitch in case of this fastening type is identical with the pitch of clip fastenings. When drilling extra holes for fastenings, it is important to make sure that the gaskets or exterior surface of the frame profile would not be damaged, the head of fastening dowel or screw must not endanger the glass package in case of non-opening windows.
After the window is wedged and fastened, check levelling and fastening rigidity control is performed. After finishing fastening works, the frame has to be statically fixed in the opening; the appeared backlashes have to be removed before starting sealing the joints.

After checking rigidity of the fastening, the previously removed sash is inserted back into the frame. Special distance blocks are placed between the sash and frame of PVC window, in order to avoid frame deformation due to installation foam expansion. Thereupon, the void between wall construction and window frame is filled with installation foam in accordance with user manual. After the final hardening of the installation foam, distance blocks are removed from the void between the frame and sash and sash regulation is performed according to the user and maintenance manual of the window.

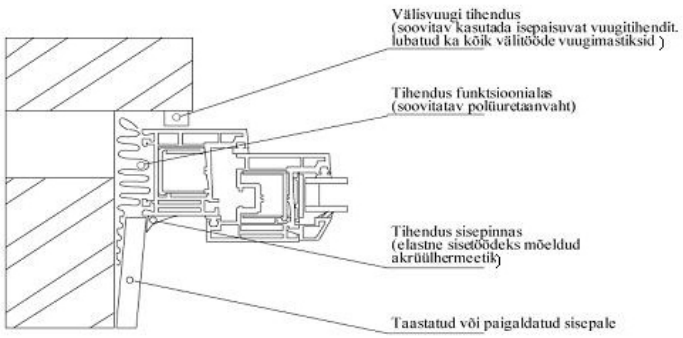
SEALING THE JOINTS

The wind and rain resistance of the window surroundings, general technical "health" and longevity depend on proper sealing of the joints. In case of sealing, it is important to pay attention to the fact that the absorbed moisture in warm indoor air should not get into the joints - due to the lower temperature there is a favourable environment for condensate water. In case the exterior joint is ventilated, condense water dries out after a while, but during the whole drying period there are cold bridges in the joint and the humid environment destroys the construction. In case the interior joint is properly closed and the functional area is insulated, the interior moisture does not affect the joint and the moisture can enter only through the exterior joint. Thanks to the relative uniformity of the exterior temperature and that of the exterior joint (which is achieved only in case the insulation does not let the warmth into the exterior joint), condensate appearance in the joint is less likely. Therefore, it is important to avoid the external water from getting into the joint, but at the same time the joint has to breathe well enough to dry out the possible moisture getting into the construction. The easiest way to achieve such a "breathing" joint is to use self-expanding joint seals that reject water but let in the air. In case of using joint mastics, it is recommended to leave the joint

partly open in places where getting the rain water into the joint is the least probable. In such a way, breathing of the joint is ensured. When sealing the joint, the principle "inside tighter than outside" has to be followed. From inside not even the air humidity can get into the joint, functional area has to be properly insulated, and the exterior joint needs to breathe but should not let in the water.

Next, some solutions to the more frequently occurring situations are presented:

Wall construction with exterior frame

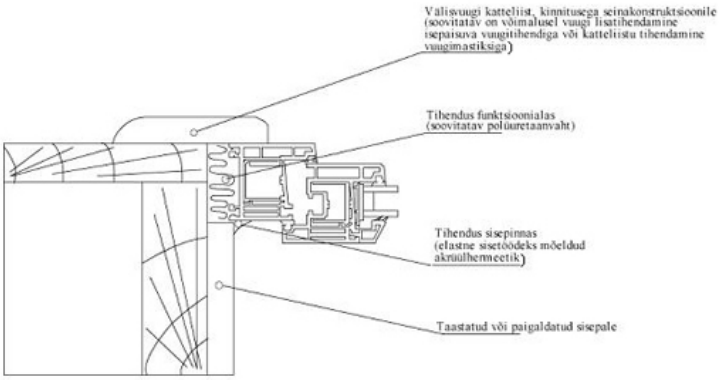


Joonis 6. Vuugi tihendamine välispalega seinakonstruktsiooni puhul

In case of both renovation projects and new buildings, we mostly see window openings with exterior frame. When installing the window into the opening of this type, it is easy to seal the joints because rain and wind affect only connecting joint of the window and exterior frame in the window exterior perimeter. The width of this joint is usually between 5 and 10 mm. It is also easy to seal this type of joint with polyurethane foam, since the foam sticks well into the joint and therefore it cannot spoil the facade. Plastering exterior frames does not guarantee wind and rain resistance because window surfaces do not stick to plaster (and PVC window profiles are moving as the temperature changes) – therefore, it is necessary to seal exterior joints with mastics or self-expanding foam also in case of plastering.

Wall construction without exterior frame

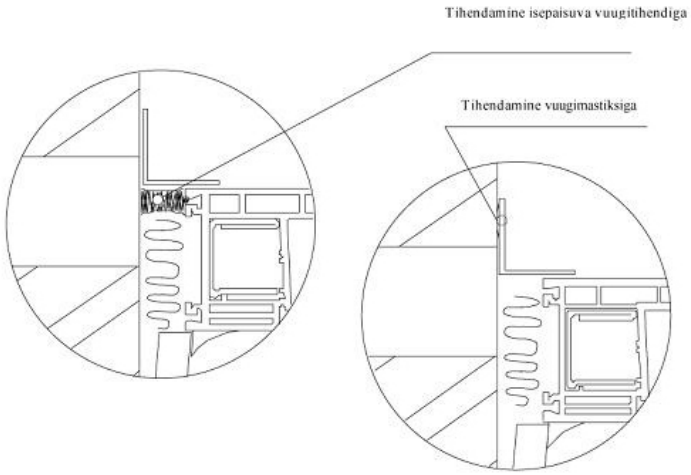
Many older panel and block buildings have window constructions without exterior frame. In this case, exterior joints were covered with wooden slats. When sealing a joint like that, it is important to keep in mind that the wooden slats installed should protect the joint not only from UV radiation but also from rain water, therefore additional sealing of the joint is recommended.



Joonis 9. Võimalik vuugi tihendamine puitkonstruktsioonide puhul

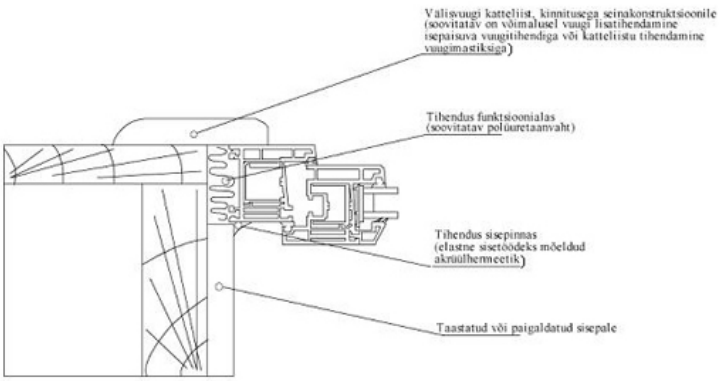
Two main solutions of additional sealing:

1. sealing the exterior joint with self-expanding joint seal (see drawing 8)
2. sealing the area between coating slat and frame and the part between the sash with joint mastics (see drawing 8)



Joonis 8. Võimalikud välisvuugi lisatihendamise meetodid

Be careful with sealing the functional area with polyurethane foam, since the foam coming out of the balloon is under pressure, it can fall out of the joint and spoil the facade. In case of wooden buildings of older type, the window opening construction without exterior frame is most common, which is identical to the construction of the stone building of the same type.



Joonis 9. Võimalik vuugi tihendamine puitkonstruktsioonide puhul

In case of sealing the exterior joint with the self-expanding joint seal, gasket thickness has to be about a half of the joint width. If joint mastics is used for additional sealing, it is important to leave some ca 2 cm wide non-sealed parts in the upper part of the exterior frame (where there is minimum danger of water getting into the joint) to guarantee joint ventilation.

NB! When sealing joints with polyurethane foam in the functional area, it is important to make sure that the gasket would not be disrupted throughout the whole perimeter, including around fastening clips, support blocks, and additional wedges.

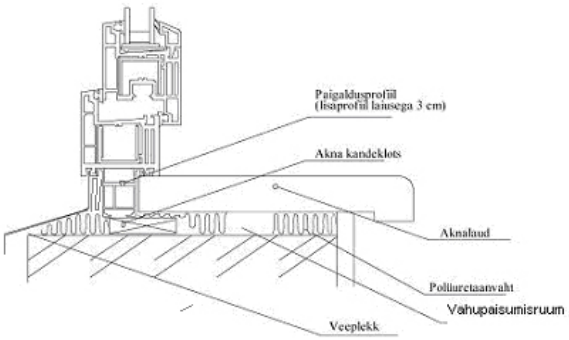
INSTALLING SUBSILLS AND WINDOW SILLS

In order to avoid the decay of lower exterior frame and dangerous wetting of the insulation, together with the windows also subsills are installed. The width of the subsill has to be chosen bearing in mind that the subsill nose would extend at least 3 cm over the facade (in this way the flowing water is directed further away from the facade surface), but not more than 6 cm (when it reaches too far, the wind may break the sill loose). The length of the subsill has to be chosen bearing in mind that even after milling the ends of the sill, the overlay of side frames to the sill would still make it possible to avoid the water from getting between the frame and ends of the sill. In case it is not possible to have the overlay of side frames to the sill, the touch-surface between subsill and frame has to be sealed with joint mass. Subsills are fastened with stain steel screws into the installation profile below the window. Additional fastenings into side or lower frame are done in case of necessity, according to each specific case. When installing the subsill, it is important to make sure that the slant of the subsill would be at least 5° towards outside.

Subsill installation is performed against installation profile from the inside.

Window sills are installed with ca 2° slant towards inside, to direct the random water away. Window sill is evenly wedged from the back side against the lower frame of the window and the front edge is supported by the support blocks. Long sills have to be fixed against the upper frame during the installation because in case of polyurethane foam expansion the sill can be deformed. After

supporting the window sill, it is insulated with polyurethane foam from below. Fixing the sill is ensured by wedges, polyurethane foam, and in the course of interior finishing by covering the edges of the sill., Additional support is performed depending on necessity in accordance with the producer's installation instructions.



Joonis 10 . Aknalaua ja veepleki paigaldamine

NB! When installing subsills and windowsills it is important to make sure that the previous sealings would not be disrupted.