EXTENDED APPLICATION REPORT NO. 14652C

Owner of this report:

AGC Glass Europe sa
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References:

This extended application report concerns test results obtained for a non-loadbearing glazed wall – type: Pyrobel 17N IGU_Timber frame_silicone – in accordance with the test method EN 1364-1:1999: Fire resistance tests for non-loadbearing elements – Part 1: Walls.

The extended application process of the test results is carried out in conformity with standard EN 15254-4:2008+A1:2011: Extended application of results from fire resistance tests – Non-loadbearing walls – Part 4: Glazed constructions.

This extended application report consists of twelve pages and ten annexes. The report is drafted in accordance with the standard procedure as specified in the standards EN 15725:2010 and prEN 15254-1:2005.

1 Details of the building element concerned

1.1 Nature

Product technical specifications: Pyrobel 17N IGU in a timber frame.

Product family: Pyrobel Insulated Glass Unit.

Intended use: in a glazed assembly intended specifically to provide fire resistance.

End-use application: non load-bearing walls with laminated glass, intended to be used in buildings and construction works.

1.2 Product description

The element, Pyrobel 17N IGU, including edge and boundary conditions, is fully described in the test report in support of this extended application report listed in clause 2.1.

The drawings of test report 14652A , upon which this extended application report is based, are given in the annexes 1 till 5. The part numbers in these annexes refer to the part numbers in the test report.

2 Test report and test results in support of this extended application report

2.1 Test report

Name of the laboratory	Identification number of the test report	Owner of the test report	Date of the test	Test method
WFRGENT nv	14652A	AGC Glass Europe sa	28/10/2010	EN 1364-1:1999

Exposure conditions during the fire resistance test:

Temperature/time curve: standard as in EN 1363-1: 1999.

Direction of exposure: The fire resistant glazed element is an asymmetrical construction: the glazing system is asymmetrical and the framing system is symmetrical.

No load is applied.

One vertical edge is free, the other edges are fixed.

2.2 Test results in accordance with the test method

Parameter	Results
Loadbearing capacity	Not applicable
Integrity	
Time of ignition of a cotton pad	No failure at test termination
Time of occurrence of sustained flaming	73 minutes
Time of failure of gap gauge criterion	73 minutes
Thermal insulation	
Time after which the mean temperature rise at the unexposed side exceeds 140 °C	64 minutes
Time after which the maximum temperature rise at the unexposed side exceeds 180 °C	65 minutes
Radiation	
Time after which the radiation intensity exceeds 15 kW/m²	73 minutes
Mechanical action	
No impact test	Not applicable

The test duration was 73 minutes.

3 Extended application

3.1 Principle applied for the extension of the field of application

This extended application procedure is based on method 1: established influence of product and end use parameters and method 4: calculation methods, both in accordance with the extended application standard EN 15254-4:2008+A1:2011 concerning the extension of the application field of glazing.

3.2 Parameters

PARAMETER	FACTOR	CLAUSE (EN 15254-4)	RESULTS (EXAP-report)
Glazing system			
Change of glass type and thickness	Replacement of glasses with the same glass product group	§ 6.1	§ 3.3.1
Symmetry of the glass construction	Symmetric / asymmetric glasses	§ 6.2	§ 3.3.2
Rectangular panes	Increase in pane area and aspect ratio	§ 6.3	§ 3.3.3
Circular and three- and (non-rectangular four sided glass panes	Increase in area	§ 6.4	not applicable
Glass panes with EW classification	Increase in area	§ 6.5	§ 3.3.4
Timber beads	Exchange of timber species/ bead fixings / bead shape and dimensions	§ 6.6	§ 3.3.5
Metal beads	Exchange of bead fixing / bead shape and dimensions	§ 6.7	not applicable
Exchange of glazing materials	Gaskets/glazing strips/setting blocks	§ 6.8	not applicable
Bead surface coverings	Change or adding surface coverings	§ 6.9	not applicable
Framing System			
Symmetry of the framing construction	Symmetrical / asymmetrical frames.	§ 7.1	not applicable
Exchange of frames (general)	Type of material / junction types / edge cover	§ 7.2.1	§ 3.3.6
Timber frames	Thickness / profile / timber type (char rate / density)	§ 7.2.2	§ 3.3.7
Metal frames	Frame materials / sections / thickness of chamber walls	§ 7.2.3	not applicable
Frame surface coverings	Change or adding frame surface coverings	§ 7.3	not applicable
Supporting construction and fixing	High density, low density, rigid, flexible	§ 7.4	not applicable
Fire resistant glazed partitions			
Glazed partitions classified to E or EI	Increase in dimensions/area	§ 8.1	§ 3.3.8
Glazed partitions classified EW	Increase in dimensions/ area Replication of whole element with EW classification	§ 8.2 § 8.3	§ 3.3.9 § 3.3.10
Installation angle	Change in installation angle	§ 8.4	§ 3.3.11

3.3 Justification and results

3.3.1 Exchange of the fire resistant glass

a) Justification:

The exchange (replacement) of the glass, as tested in the reference test, for another fire resistant glass is allowed, provided that:

- Both glasses are in the same product group: Pyrobel IGU;
- The replacement glass has at least the same or increased nominal thickness: the number of layers and the thickness of each layer must be at least the same as the exchanged glass. However, the structural stability of the whole glazed element must be maintained;
- The replacement glass must have evidence that it achieves at least the same fire resistance classification.

If the replacement glass was tested at a smaller or the same size/area as in the reference test (before extension) then the replacement glass cannot be changed from its tested size area.

If the replacement glass was tested at the same size/area as is the reference test (after extension) then this size of replacement can be used to replace the reference glass.

If the replacement glass was tested at a larger size/area than in the reference test (after extension then the maximum size/area of the replacement glass can be no greater than the extended size/area of the glass as tested in the reference test.

b) Results:

The Pyrobel 17N IGU glass panes can be replaced by thicker Pyrobel *xx*N IGU glass panes, considering previous rules. (*xx*: nominal thickness of the pyrobel-segment)

3.3.2 Asymmetrical fire resistant glass

Tested glass (Pyrobel 17N IGU):

The fire resistant glass shall only be used in the orientation in which it was tested: the Pyrobel 17-layer exposed to the fire.

Exchanged glass with increased nominal thickness (Pyrobel xxN IGU):

The fire resistant glass shall only be used in the orientation in which it was tested.

3.3.3 Individual rectangular glass panes: aspect ratio and increase in area

a) Increase in dimensions:

An increase in the glass width, height and area is only allowed provided the length of overrun time in the reference test is as shown in the table below:

Classification time (minutes)	Overrun required
≤ 20	At least 3 minutes
30, 45 and 60	At least 6 minutes (*)
≥ 90	At least 10% of the classification time (**)
(*) for overrun times between 3 minutes and 6 minutes, the increase of any dimension is restricted to 50% of the calculated increase using the equations (1), (2) and (3). (**) for overrun times between 5% en 10% , the increase of any dimension is restricted to 50% of the calculated increase using the equations (1), (2) and (3).	

Table 1

The width or height may be increased in accordance with equations (1) or (2) respectively. Where both width and height are increased the maximum extended area shall be in accordance with equation (3).

(1) $w_{ext} \leq w_{max} = w0 \times 1.20$

(2) $h_{ext} \leq h_{max} = h_0 \times 1.20$

(3) $A_{ext} \leq A_{max} = A_0 \times 1.21$

Where:

w_0,h_0, A_o is the width height and area of the tested pane;
w_{ext}, h_{ext}, A_{ext} is the radiation intensity after extension;
w_{max}, h_{max}, A_{max} is the maximum extended width, height and area of the pane.

For the classification times:

- EI20, EI15 and E20: the required overrun time of 3 minutes is achieved.;
- EI45, EI30, E60 and E30: the required overrun time of 6 minutes is achieved.

The following table shows the calculated extended sizes/areas:

Tested sizes/areas			**Extended sizes/areas**		
Width (mm)	**Height** (mm)	**Area** (m²)	**Width** (mm)	**Height** (mm)	**Area** (m²)
714	956	0.682	856	1147	0.825
1483	850	1.261	1780	1020	1.525
1300	2874	3.736	1560	3449	4.521

Table 2

For the classification time:

- EI60, an overrun time between 3 and 6 minutes is achieved.

The following table shows the calculated extended sizes/areas:

Tested sizes/areas			**Extended sizes/areas**		
Width (mm)	**Height** (mm)	**Area** (m²)	**Width** (mm)	**Height** (mm)	**Area** (m²)
713.5	956	0.682	784.9	1051.6	0.754
1483	850	1.261	1631.3	935.0	1.393
1300	2874	3.736	1430.0	3161.4	4.129

Table 3

b) Change in aspect ratio:

A change in aspect ratio of rectangular panes is allowed provided that the pane fits within the extended pane dimensions defined above. Additionally, a change in the aspect ratio of panes from portrait format into landscape format and vice versa, and change in area, is allowed, provided that:

- All panes covered by the reference tests were tested in an identical glazing system;
- The largest tested width as well as the largest tested height are not exceeded (width and height of different panes);
- The area of the "new pane" does not exceed the average of the largest tested portrait and landscape format panes: $A_{new} \leq ½ (A_{portrait} + A_{landscape})$.

c) Other:

- Circular, triangular or 4 sided shapes can be cut from within the extended rectangular pane size. All other non rectangular shapes, can only be cut from the original rectangular pane as described in 14652A, and cannot be extended further.
- The framing system must be able to support the additional weight due to the increased pane area.

d) Results:

The results are given in the following annexes:

Annex 6: The extended glass sizes for the indicated classification times, according to table 2.

Annex 7: The extended glass sizes with restricted increase for the indicated classification times, according to table 3.

3.3.4 Individual panes in a wall: radiation

For fire resistant glass with an EW classification the rules 3.3.1, 3.3.2 and 3.3.3 apply together with the following:

$W_{ext} = W_0 \times [\varphi_{ext}/\varphi_0] \leq w_{max}$

Where:

W_0 is the measured radiation intensity from the test specimen at the time of classification;
W_{ext}, is the radiation intensity after extension;
W_{max} is the maximum allowed radiation intensity

For the classification times:

- EW 60, EW 30 and EW 20, the required overrun time of 6 minutes is achieved.

Additionally, the radiation intensity after extension of the glazed wall is less than 15 kW/m² (*) for each mentioned classification time.

The following table shows the calculated extended sizes/areas:

Tested sizes/areas			**Extended sizes/areas**		
Width (mm)	**Height** (mm)	**Area** (m²)	**Width** (mm)	**Height** (mm)	**Area** (m²)
713.5	956	0.682	856.2	1147.2	0.825
1483	850	1.261	1779.6	1020.0	1.525
1300	2874	3.736	1560.0	3448.8	4.521

Table 4

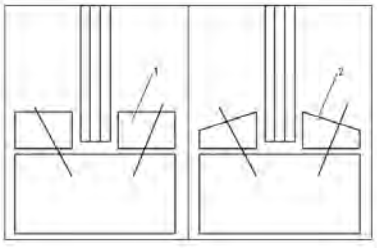
Annex 6: The extended glass sizes for the indicated classification times, according to table 4.

(*) the radiation intensity is calculated in annex 10 of this report and represents the worst case.

3.3.5 Exchange of timber glazing beads

In all cases, the exchange of timber species should be on the basis of density and/or comparative char rate tests (when available), calculations according to EN 1395-1-2 or reference values. These shall demonstrate that the fire performance of the replacement timber bead is either the same or better than that used in the reference test.

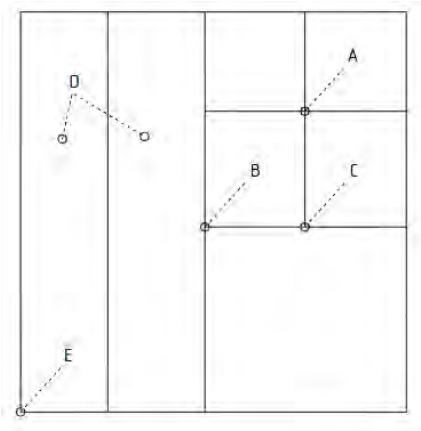
- For EI classification of fire resistant glazed elements, exchange of the bead profile from a sloped or chamfered bead to a flat bead of the same height is allowed.
- The bead depth may be increased without restraint: the bead depth must be at least 30 mm.



3.3.6 Exchange of frames

Frames can be manufactured using some or all of the tested junction types:

Type A: four panes joining together;
Type B: three panes joining together at one point including a full height vertical pane;
Type C: three panes joining together at one point including a full width horizontal pane;
Type D: two full panes side by side (horizontal and vertical) is not allowed;
Type E: corner junction.



3.3.7 Timber frames

Exchange of the type of timber species used for the frame is allowed for fire resistant glass from the same glass product group as follows:

- Timber with the same or higher density and/or moisture content, with the same or lower char rate and identical profile: the density must have at least a nominal value of 550 kg/m³;
- Increased thickness of the frame: the thickness of the frame must be at least 111 mm.

3.3.8 Increase in overall dimensions and area of the partition

An increase in the width, height and area is only allowed provided that the length of overrun time in the reference test is as shown in table 1 in paragraph 3.3.3.

The width or height may be increased in accordance with equations (1) or (2) respectively. Where both width and height are increased the maximum extended area shall be in accordance with equation (3).

(1) $w_{ext} \leq w_{max} = w_0 \times 1.20$
(2) $h_{ext} \leq h_{max} = h_0 \times 1.20$
(3) $A_{ext} \leq A_{max} = A_0 \times 1.21$

Where:

w_0,h_0, A_o is the width height and area of the tested pane;
w_{ext}, h_{ext}, A_{ext} is the radiation intensity after extension;
w_{max}, h_{max}, A_{max} is the maximum extended width, height and area of the pane.

For the classification times:

- EI 20, EI 15 and E 20, the required overrun time of 3 minutes is achieved.
- EI 45, EI 30, E 60 and E 30, the required overrun time of 6 minutes is achieved.

The following table shows the calculated extended size/area:

Tested size/area			**Extended size/area**		
Width (mm)	**Height** (mm)	**Area** (m²)	**Width** (mm)	**Height** (mm)	**Area** (m²)
3000	3000	9,000	3600,0	3600,0	10,890

Table 5

For the classification time:

- EI60, an overrun time between 3 and 6 minutes is achieved.

The following table shows the calculated extended size/area:

Tested size/area			**Extended size/area**		
Width (mm)	**Height** (mm)	**Area** (m²)	**Width** (mm)	**Height** (mm)	**Area** (m²)
3000	3000	9.000	3300.0	3300.0	9.945

Table 6

Annex 8: The extended overall sizes for the indicated classification times, according to table 5.

Annex 9: The extended overall sizes with restricted increase for the indicated classification times, according to table 6.

3.3.9 Increase in dimensions for fire resistant glazed partitions: radiation

An increase in the width, height and area is only allowed provided that the length of overrun time in the reference test is as shown in table 1 in paragraph 3.3.3.

For the classification times:

- EW 60, EW 30 and EW 20, the required overrun time of 6 minutes is achieved.

Additionally, the radiation intensity after extension of the glazed wall is less than 15 kW/m² (*) for each mentioned classification time.

The following table shows the calculated extended size/area:

Tested sizes/areas			**Extended sizes/areas**		
Width (mm)	**Height** (mm)	**Area** (m²)	**Width** (mm)	**Height** (mm)	**Area** (m²)
3000	3000	9.000	3600.0	3600.0	10.890

Table 7

Annex 8: The extended overall sizes, with increased dimensions according to table 7.

(*) the radiation intensity is calculated in annex 10 of this report and represents the worst case

3.3.10 Replication of the fire resistant glazed partition with reference to radiation

A wider construction achieved by replicating the fire resistant glazed partition as tested, by adding more units of the same fire resistant glazed partition side by side is allowed for E and EI classified elements.

A wider construction achieved by replicating the fire resistant glazed partition as tested, by adding more units of the same fire resistant glazed partition side by side, is allowed for EW classified elements, providing that $W_{ext} \leq 15$ Kw/m² according to the calculations in the annex listed below.

Annex 10: radiation calculations.

3.3.11 Changing in installation angle

A change in the angle of installation of up to ± 10 degrees from the vertical is allowed. No further increase in the angle of installation is allowed.

4 Extended application results

4.1 Application range – product family

This extended application is valid for the product as described in clause 1 of this report.

4.2 Fire performance parameters

The results are reproduced in clause 3.3 of this extended application report.

5 Duration of the validity of the extended application report

At the time the standard EN 15254-4:2008+A1:2011 was published, no decision was made concerning the duration of validity of the extended application document.

6 Warning

The extended application results relate to the behaviour of a product/product family under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product/product family in use.

SIGNED

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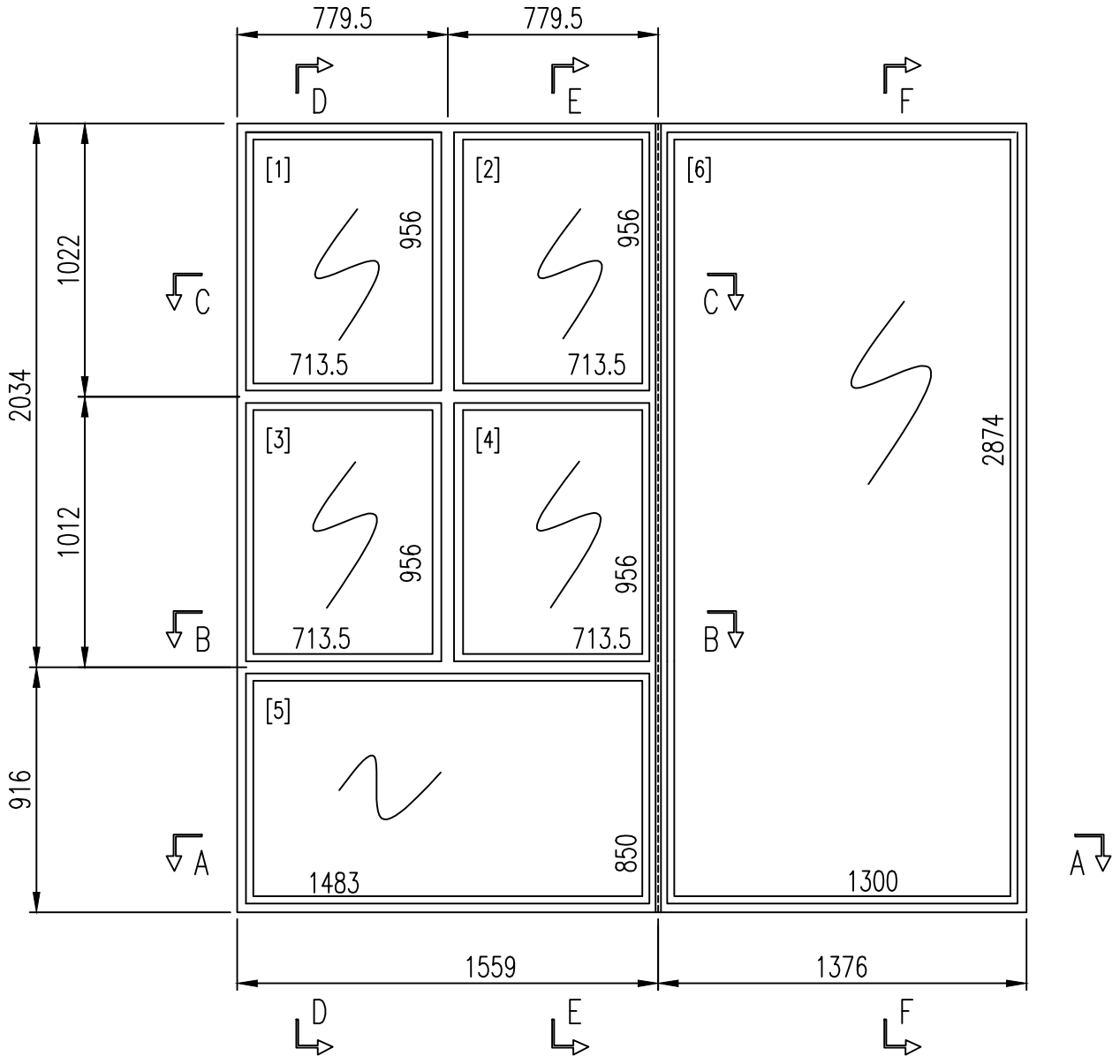
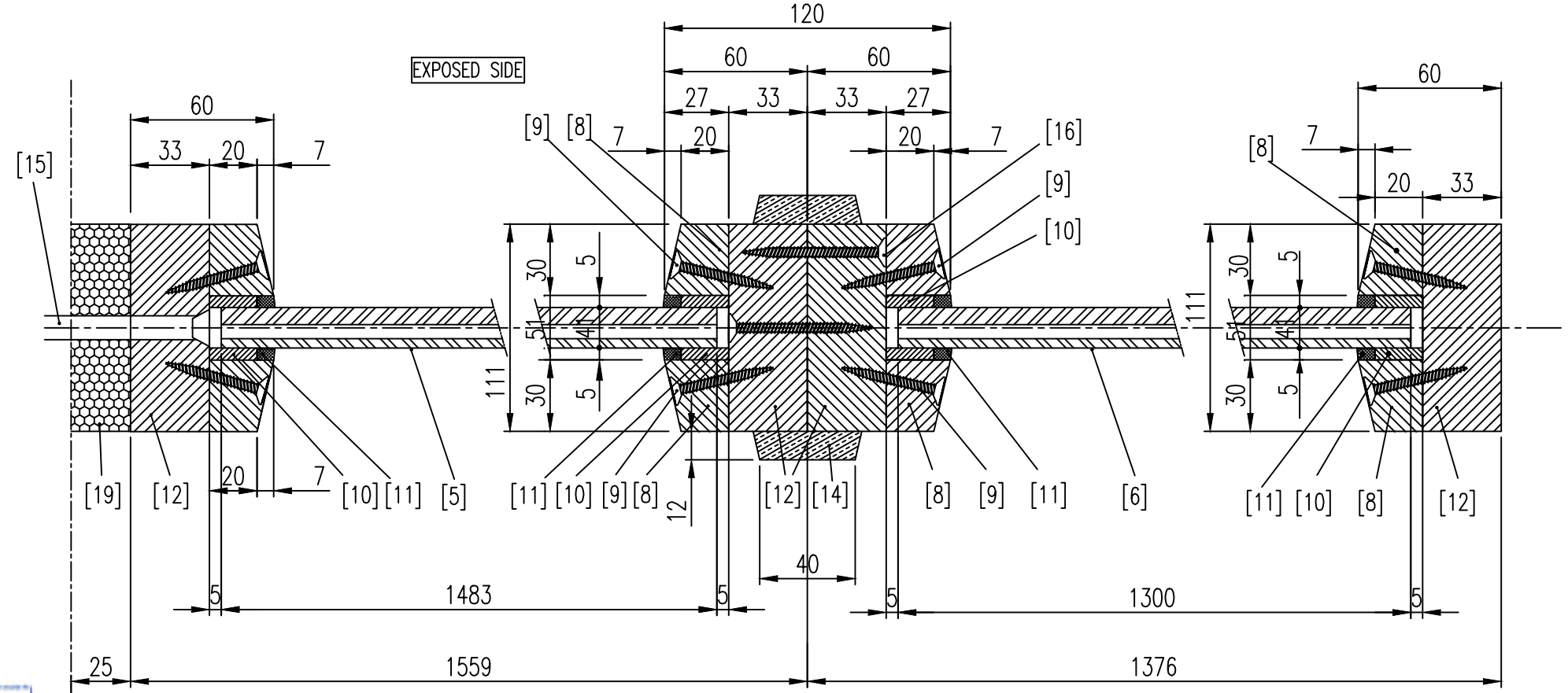
This document is the original version of this report and is written in English.

Front view (unexposed side) – dimensions.



Section AA.



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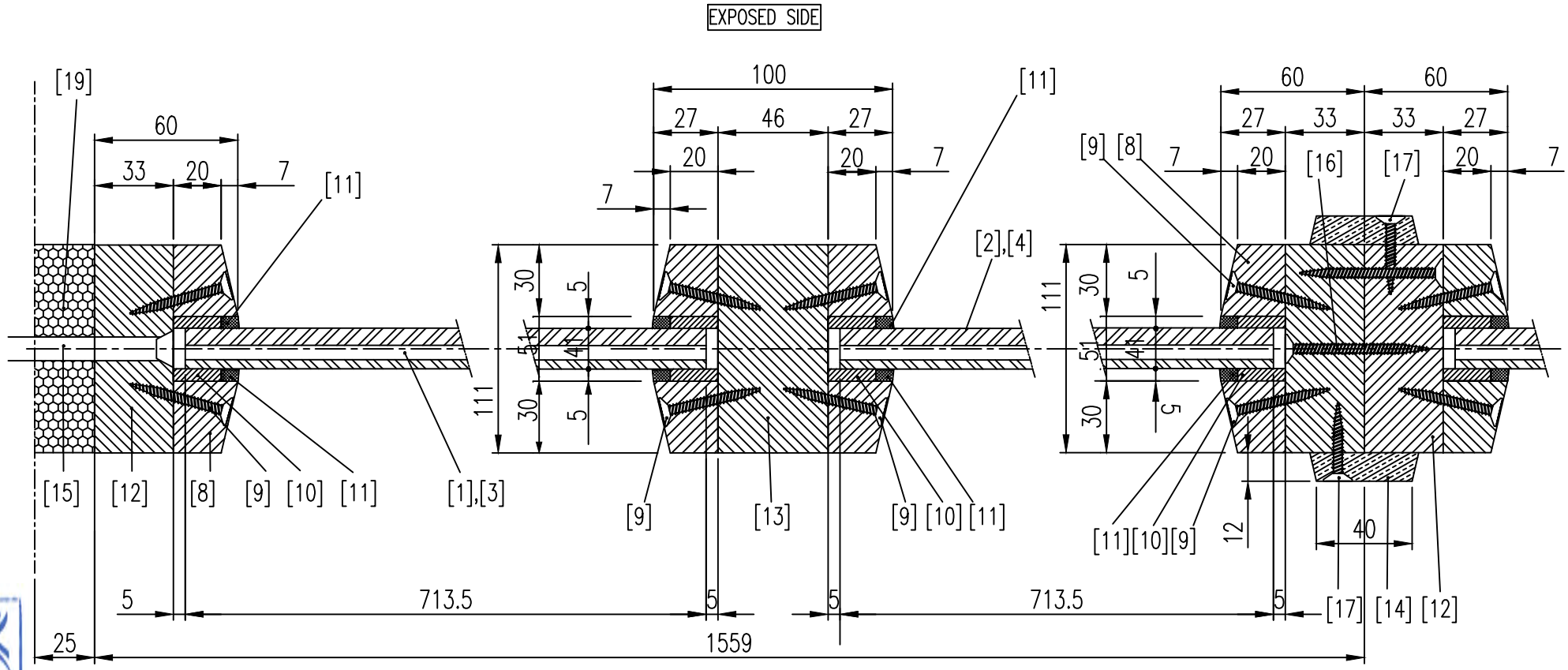

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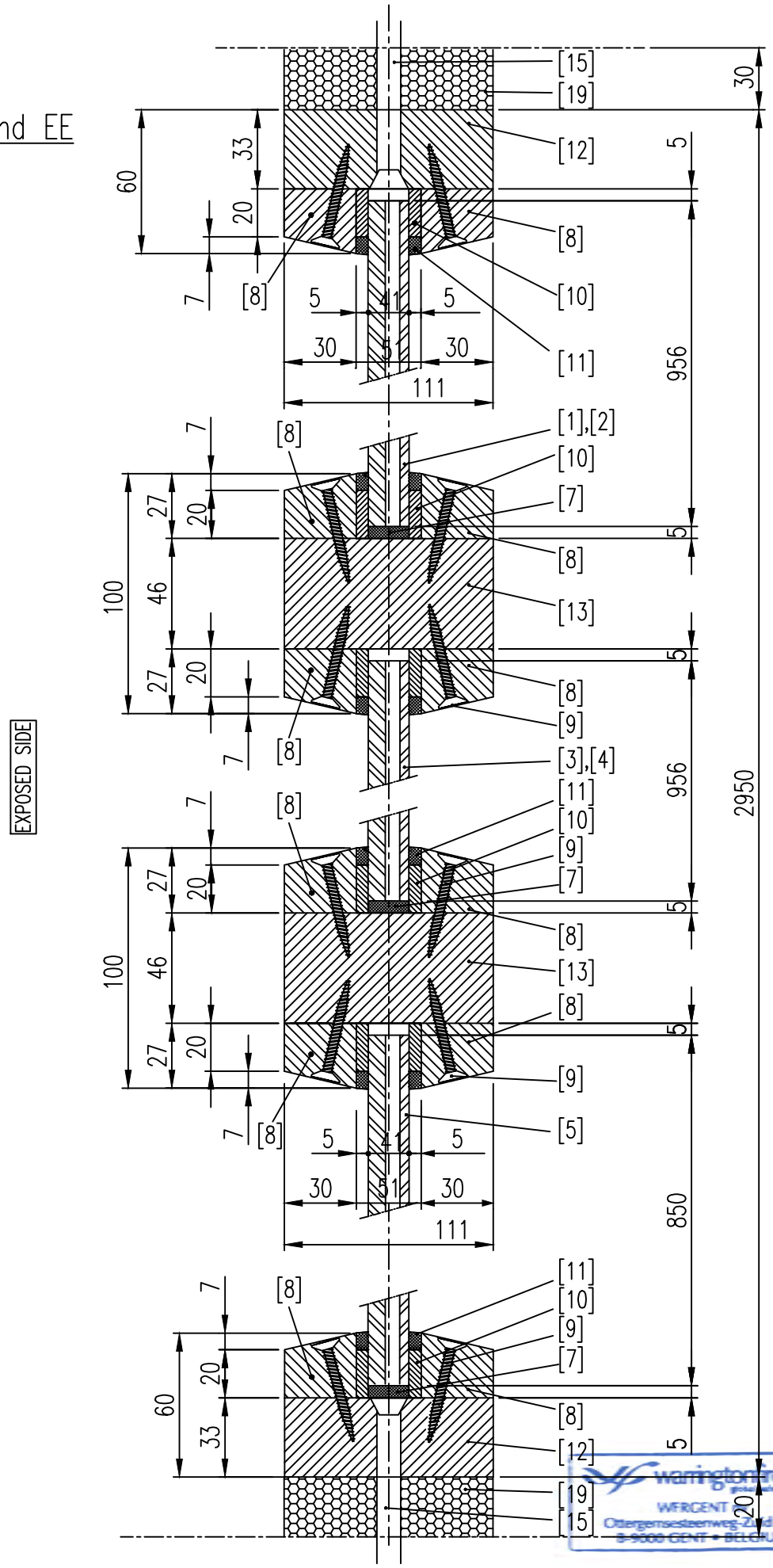

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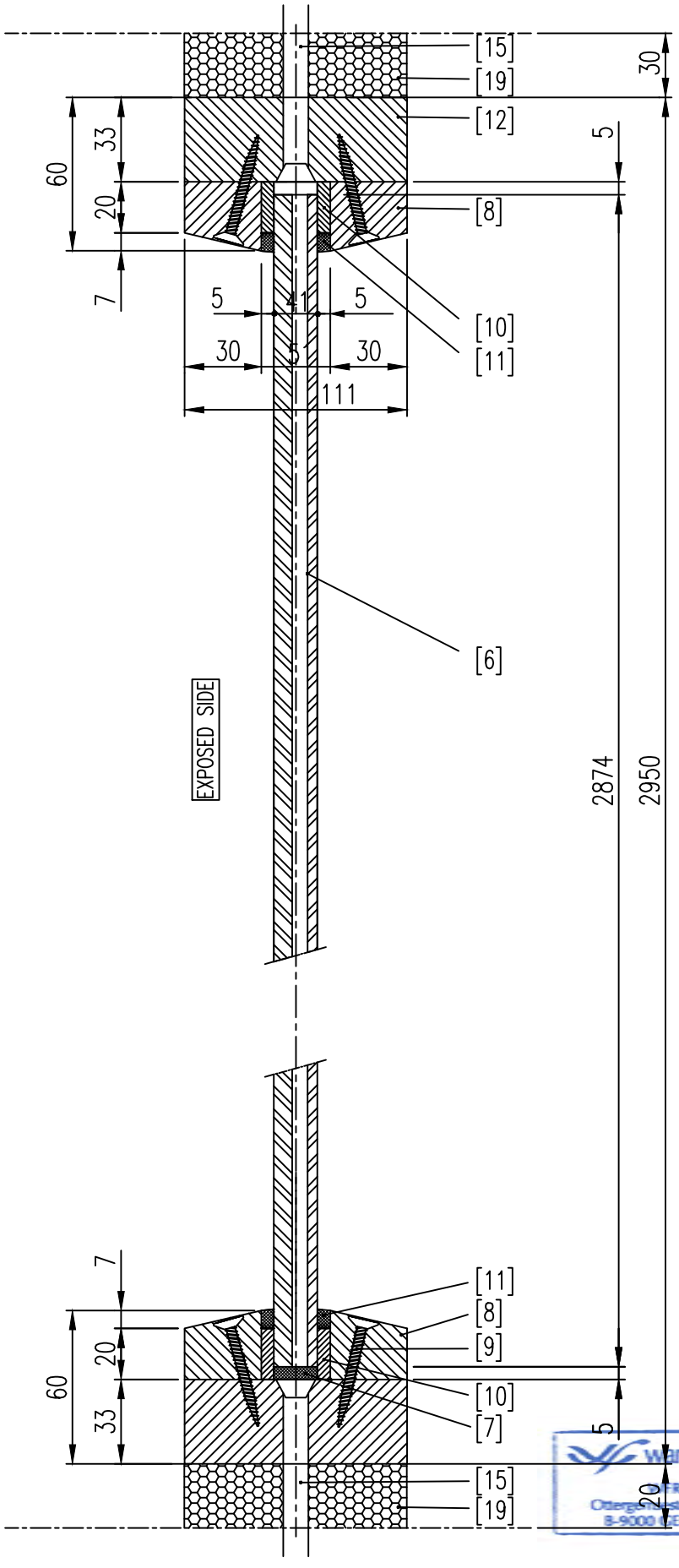
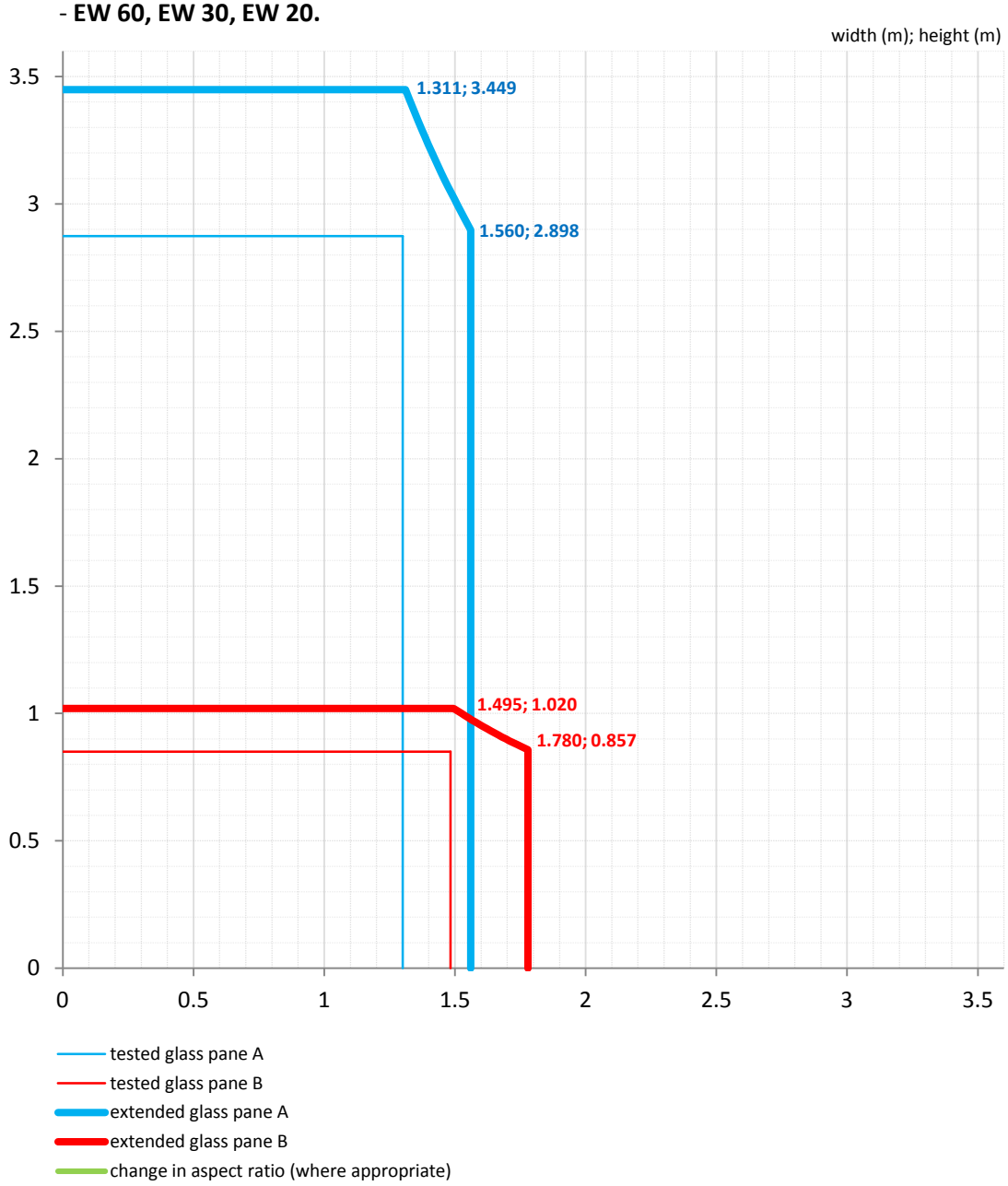


Individual rectangular glass panes: aspect ratio and increase in area

The extended dimensions are only valid for the following classification times:
- **EI 45, EI 30, EI 20, EI 15;**
- **E 60, E 30, E 20;**
- **EW 60, EW 30, EW 20.**

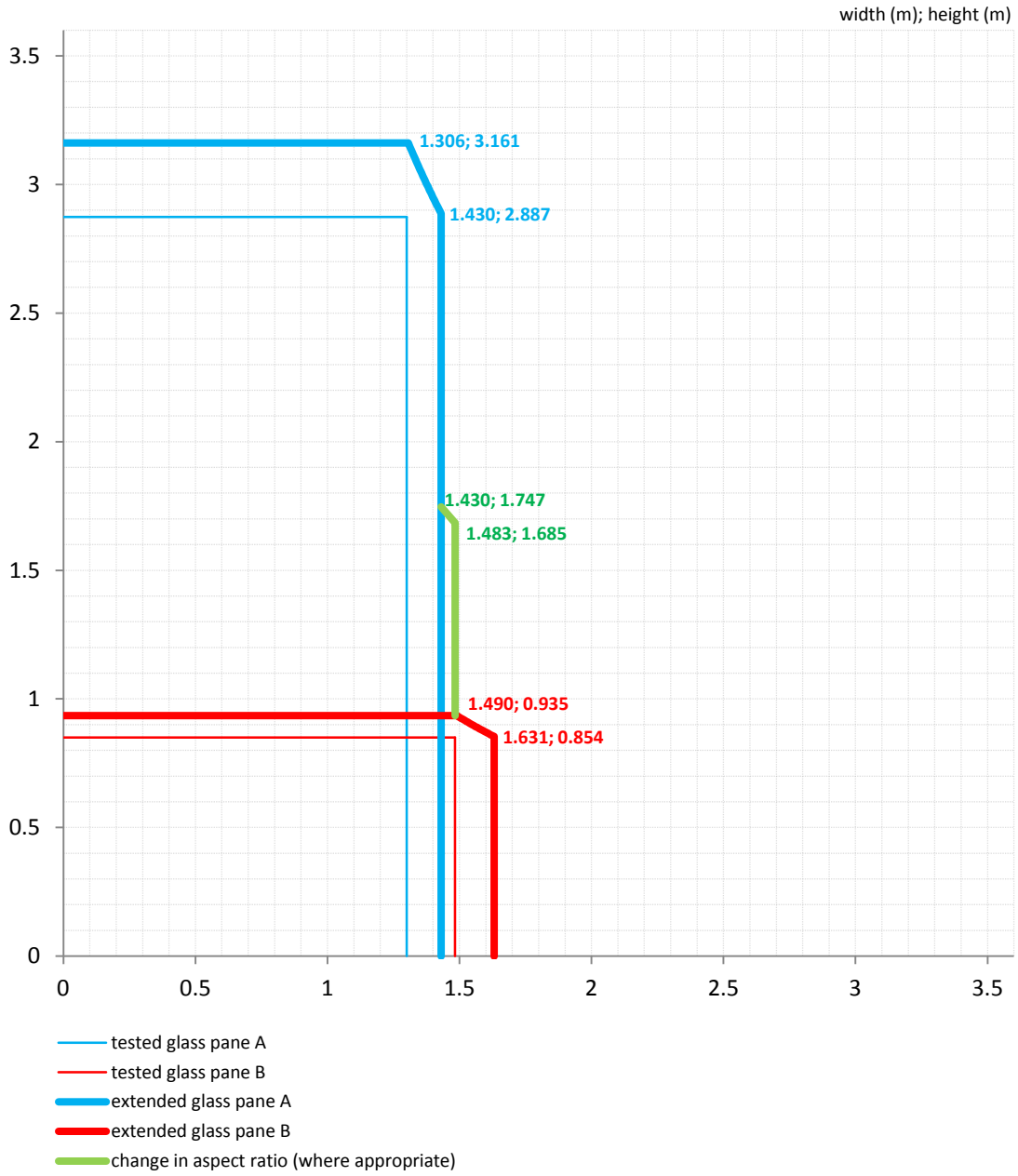


Note:

The maximum dimensions of all rectangular, triangular and four sided shaped glass panes are represented by the thickest lines (extended dimensions). The maximum dimensions of all other non rectangular glass panes are represented by the thinnest lines (tested dimensions).

Individual rectangular glass panes: aspect ratio and increase in area

The extended dimensions are only valid for the following classification times:
- **EI 60.**

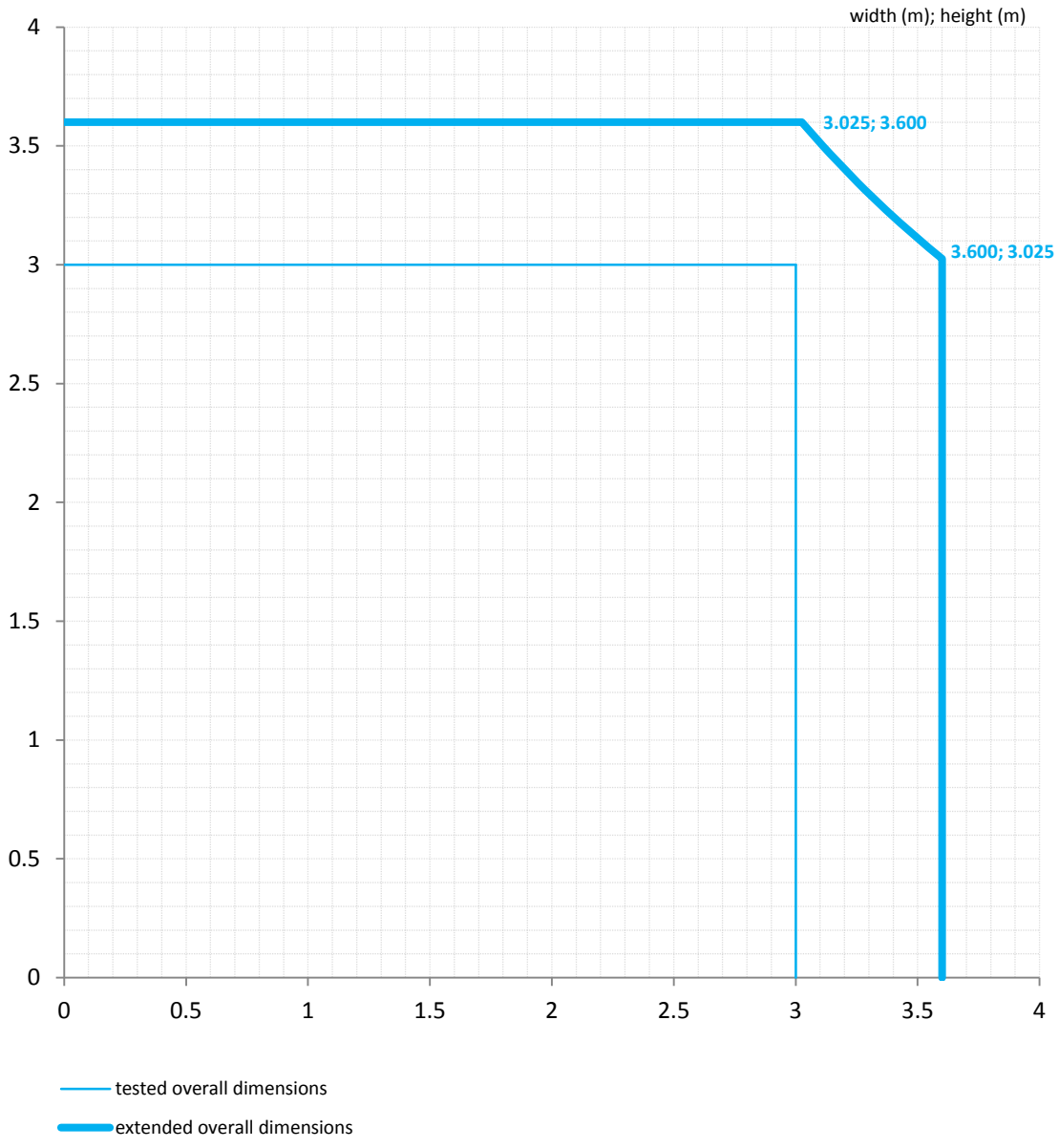


Note:

The maximum dimensions of all rectangular, triangular and four sided shaped glass panes are represented by the thickest lines (extended dimensions). The maximum dimensions of all other non rectangular glass panes are represented by the thinnest lines (tested dimensions).

Increase in overall dimensions and area of the partition as a whole

The extended dimensions are only valid for the following classification times:
- **EI 45, EI 30, EI 20, EI 15;**
- **E 60, E 30, E 20;**
- **EW 60, EW 30, EW 20.**

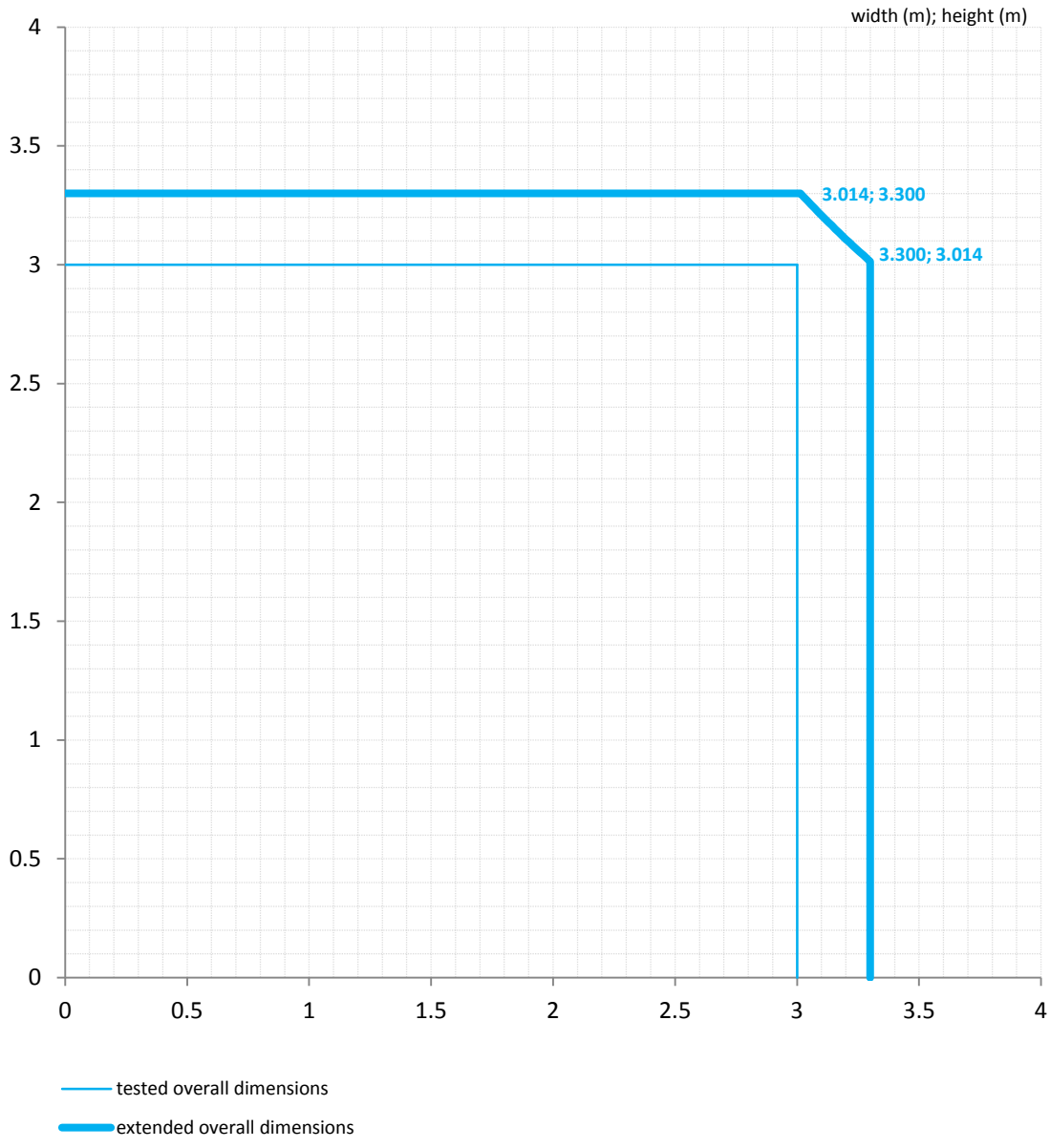


Note:

The maximum overall dimensions of the fire resistant glazed partition are represented by the thickest lines. A wider construction achieved by replicating the extended fire resistant glazed element is allowed.

Increase in overall dimensions and area of the partition as a whole

The extended dimensions are only valid for the following classification times:
- **EI 60.**



Note:

The maximum overall dimensions of the fire resistant glazed partition are represented by the thickest lines. A wider construction achieved by replicating the extended fire resistant glazed element is allowed.

RADIATION CALCULATIONS

An increase in radiation is not proportional to an increase in area of the test specimen. However, for a rectangular test specimen it can be calculated according to the following mathematical functions:

$$W_{ext} = W_0 \cdot \frac{\varphi_{ext}}{\varphi_0} \leq W_{max}$$

$$\varphi_0 = \frac{2}{\pi}\left[\frac{w_0}{\sqrt{w_0^2 + 4.d^2}} . \tan^{-1}\left(\frac{h_0}{\sqrt{w_0^2 + 4.d^2}}\right) + \frac{h_0}{\sqrt{h_0^2 + 4.d^2}} . \tan^{-1}\left(\frac{w_0}{\sqrt{h_0^2 + 4.d^2}}\right)\right]$$

$$\varphi_{ext} = \frac{2}{\pi}\left[\frac{w_{ext}}{\sqrt{w_{ext}^2 + 4.d^2}} . \tan^{-1}\left(\frac{h_{ext}}{\sqrt{w_{ext}^2 + 4.d^2}}\right) + \frac{h_{ext}}{\sqrt{h_{ext}^2 + 4.d^2}} . \tan^{-1}\left(\frac{w_{ext}}{\sqrt{h_{ext}^2 + 4.d^2}}\right)\right]$$

Where:

W_{ext}	= is the radiation of the test specimen after extension.
W_0	= is the measured radiation from the test specimen at the time of classification.
	= 0.66 kW/m² after 60 minutes.
W_{max}	= 15kW/m².
d	= is the distance between the test specimen and the sensor.
	= 1 m.
w_0,h_0	= is the width and the height of the test specimen.
w_{ext},h_{ext}	= is the extended width and the height of the test specimen.

For an extension of h_{ext} to 3.6 meter and an extension of w_{ext} to infinity (worst case):

$$\varphi_{ext} = \lim_{+\infty} \frac{2}{\pi}\left[\frac{w_{ext}}{\sqrt{w_{ext}^2 + 4.d^2}} . \tan^{-1}\left(\frac{h_{ext}}{\sqrt{w_{ext}^2 + 4.d^2}}\right) + \frac{h_{ext}}{\sqrt{h_{ext}^2 + 4.d^2}} . \tan^{-1}\left(\frac{w_{ext}}{\sqrt{h_{ext}^2 + 4.d^2}}\right)\right]$$

$$\varphi_{ext} = \frac{2}{\pi} . \left[0 + \frac{3.6}{\sqrt{3.6^2 + 4}} . \frac{\pi}{2}\right] = 0.8742$$

$$\varphi_0 = \frac{2}{\pi}\left[\frac{w_0}{\sqrt{w_0^2 + 4.d^2}} . \tan^{-1}\left(\frac{h_0}{\sqrt{w_0^2 + 4.d^2}}\right) + \frac{h_0}{\sqrt{h_0^2 + 4.d^2}} . \tan^{-1}\left(\frac{w_0}{\sqrt{h_0^2 + 4.d^2}}\right)\right]$$

$$\varphi_0 = \frac{2}{\pi}\left[\frac{3}{\sqrt{13}} . \tan^{-1}\left(\frac{3}{\sqrt{13}}\right) + \frac{3}{\sqrt{13}} . \tan^{-1}\left(\frac{3}{\sqrt{13}}\right)\right] = 0.7352$$

$$W_{ext} = W_0 \cdot \frac{\varphi_{ext}}{\varphi_0} = \ 0.66\ kW/m^2 \cdot \frac{0.8742}{0.7352} = 0.78 kW/m^2 \leq 15 kW/m^2$$