

## Classification of reaction to fire of glass products

### Recommendation from Glass for Europe

Glass for use in buildings and construction works shall declare a reaction to fire performance in their declaration of performance (DoP) established according to Regulation (EU) 305/2011 (Construction Product Regulation).

The declaration of a reaction to fire performance depends on the type of glass products for use in buildings. Two types of products need to be distinguished.

- ▶ First, **glass not containing organic materials**, i.e. basic glass, coated glass, toughened glass, heat strengthened glass, chemically strengthened glass, mirrors, glass blocks and paver units, are classified A1 according to Commission Decision 96/603/EC, as amended 2000/605/EC.
- ▶ Second, **glass containing a certain amount of organic materials**, i.e. laminated (safety) glass and insulating glass units, should be classified for their reaction to fire according to EN 13501-1<sup>1</sup>. For these products, a single burning item test (SBI) according to EN 13823 should be performed. However for the reasons explain on the next pages, Glass for Europe recommends indicating "No Performance Declared, NPD" in the declaration of performances for the reaction to fire performances of laminated (safety) glass and insulating glass units

Glass for Europe urges European authorities to further engage with the industry in order to re-evaluate the issue in light of available scientific evidence and the non-contribution of glass to real fire hazards. The European glass industry and Glass for Europe eagerly awaits a final workable decision from the European Commission on the classification for glass containing a certain amount of organic materials.

*Glass for Europe is the trade association for Europe's flat glass sector. Flat glass is the material that goes into a variety of end products, primarily in windows and facades for buildings, windscreens and windows for automotive and transport as well as solar energy equipment, furniture and appliances. Glass for Europe brings together multinational firms and thousands of SMEs across Europe, to represent the entire building glass value-chain. It is composed of flat glass manufacturers, AGC Glass Europe, Guardian, NSG-Group, Saint-Gobain Glass Industry and Siseçam-Trakya Cam, and works in association with national partners gathering thousands of building glass processors and transformers all over Europe.*

<sup>1</sup> EN 13501-1: Fire classification of construction products and building elements – Part 1: classification using test data from reaction to fire tests.



## 1. Testing of the reaction to fire of glass containing a certain amount of organic materials, i.e. laminated (safety) glass and insulating glass units

For these products, **a single burning item test (SBI) according to EN 13823** shall be performed. In the SBI test, the glass piece is placed at very small distance from an opaque, solid, fire resistant wall. Two pieces of glass are placed at an angle, where a burner is placed. During the test, released heat and smoke is measured, and the possible droplets are recorded. As the test cell is perfectly tight, no smoke or heat can escape to the outside.

In real buildings and constructions, insulating glass units and laminated (safety) glass are never placed against a wall. They are making the partition or the façade. This means that, as the glass breaks rapidly in the event of fire, smoke and heat can escape to the outside, in case of glass façades, or to the adjacent room in case of internal partitions. The amount of heat and smoke that remains in the room is automatically considerably reduced.

**CEN TC 129 and the glass industry, represented by Glass for Europe, consider therefore that EN 13823 (SBI test) is not appropriate** to classify the performances in reaction to fire of glass products. An appeal procedure was developed in the former Guidance paper G. This procedure foresees to perform a large scale test.

CEN TC 129, Glass for Europe and Eastman Europe commissioned WarringtonFire Gent to perform a full-scale room test according to ISO 9705:1993 and EN 14390:2007 on 12 March 2013. Laminated safety glazings made of 2 x 4mm glass and 4 PVB (1,56 mm) were placed as wall of a test cell. The results have shown that an opening in the glass appears after 4 minutes of the test allowing smoke and heat to escape. The amount of heat and smoke collected being lower than the ones emitted by the burner, it was not possible to classify according to the standard.

**CEN TC 129 and the glass industry, represented by Glass for Europe, consider that the full-scale room test illustrates better the behaviour of glass products.**

The detailed results of this test were presented to EU authorities. For the time being, no final decision on the issue was made by the European Commission. Further investigations are still on-going, to insure that all aspects of the issue are thoroughly evaluated.

In this context and until the issue and situation has been clarified, Glass for Europe recommends indicating "NPD" in the declaration of performances for the reaction to fire performances of laminated (safety) glass and insulating glass units.



## Annex

### Reaction to fire classification of glass products

#### A) Glass products containing only glass.

Glass products containing only glass (annealed, toughened or heat strengthened glass pane, coated glass pane...) are classified following a European decision<sup>2</sup> as deemed to satisfy (A1).

#### B) Glass products containing organic components.

Where glass product contains an organic component, it may be excluded from the scope of the European decision when:

- ▶ Organic material is not homogeneously distributed
- ▶ It contains more than 1 % by weight or volume, whichever is the lower, of homogeneously distributed material

Laminated glass and IGU are then to be evaluated and classified following EN 13501-1.

#### C) Laminated glass

Laminated glass is usually produced by laminating one or more PVB, EVA, PC, PET, PU or PVC foils between two or more glass panes. Characteristics PCS of these materials are the following (table 1):

Interlayer type	density	Minimum specification thickness (mm)	PCS (MJ/kg)
PVB	1,0	0,38	30 to 32
EVA	0,95	0,40	40
PC	1,2		31
PVC	1,2		18
PET	1,2		24

Table 1: Typical interlayer density and PCS/kg or PCS/m<sup>2</sup>

Such organic components are defined mainly as internal non-substantial components<sup>3</sup> as density is generally below 1,0 kg/m<sup>2</sup> and thickness below 1,0 mm. Class A1 or A2 classification criteria of EN 13501-1 specify that :

- ▶  $PCS \leq 1,4 \text{ MJ/m}^2$  gives A1 classification
- ▶  $PCS \leq 4 \text{ MJ/m}^2$  gives A2 classification

<sup>2</sup> Commission Decision 96/603/EC of 4 October 1996

<sup>3</sup> See EN 13501-1, §3 : definition





Special products such as anti-burglar, bullet resistant or anti-explosion glass could present thicker PVB thickness. PVB component is then defined as **internal substantial components**. Class A1 or A2 classification criteria of EN 13501-1 specify that the product as a whole should follow:

- PCS  $\leq$  2 MJ/kg gives A1 classification
- PCS  $\leq$  3 MJ/kg gives A2 classification

As the PCS/m<sup>2</sup> of these products is above 15 MJ/m<sup>2</sup> whatever the thickness of interlayer, **laminated glass may never be classified A2. It will be at least B.**

Laminated glass should be tested following EN 13823 (SBI).

PVB laminated glass results (see figure 1) show that a very good linear correlation is found when, on the same glass composition, the number of PVB foil is increased from 1 PVB foil to 6 PVB foil. The increment resulting from the number of PVB foil is also linear.

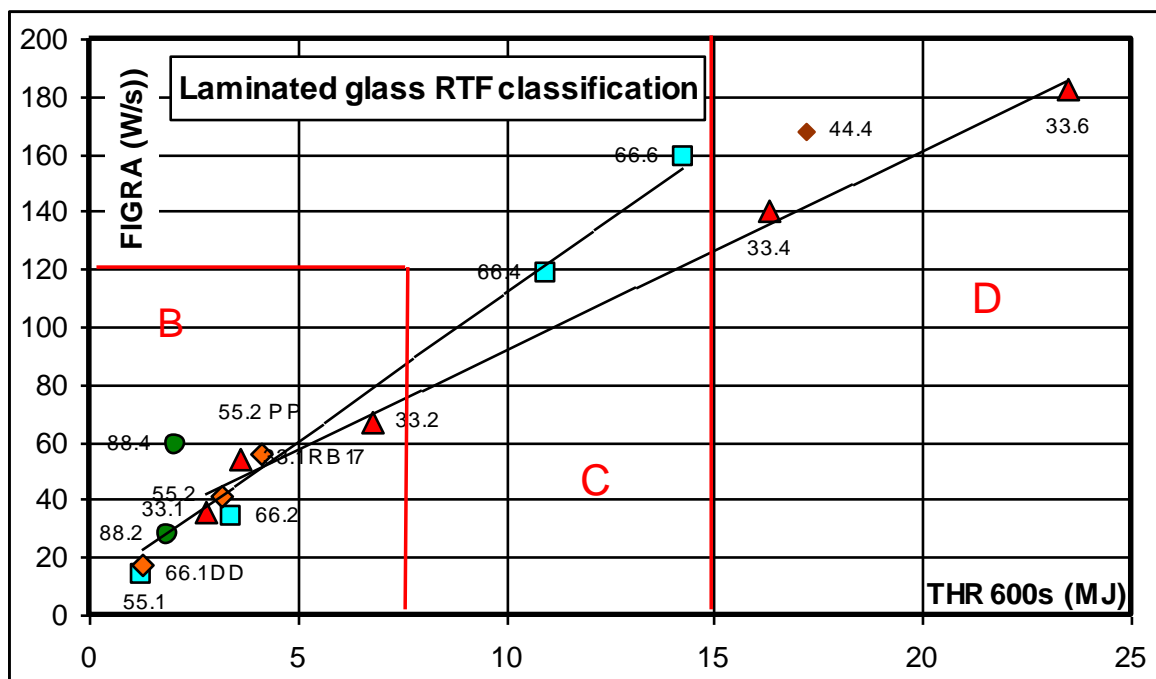


Figure 1: Laminated glass classification following EN 13823 (SBI); classification boxes Following EN 13501-1 is indicated in red color.





PVB, EVA, PC/PU or PVB/PET/PVB component has little influence on test result (figure 2).

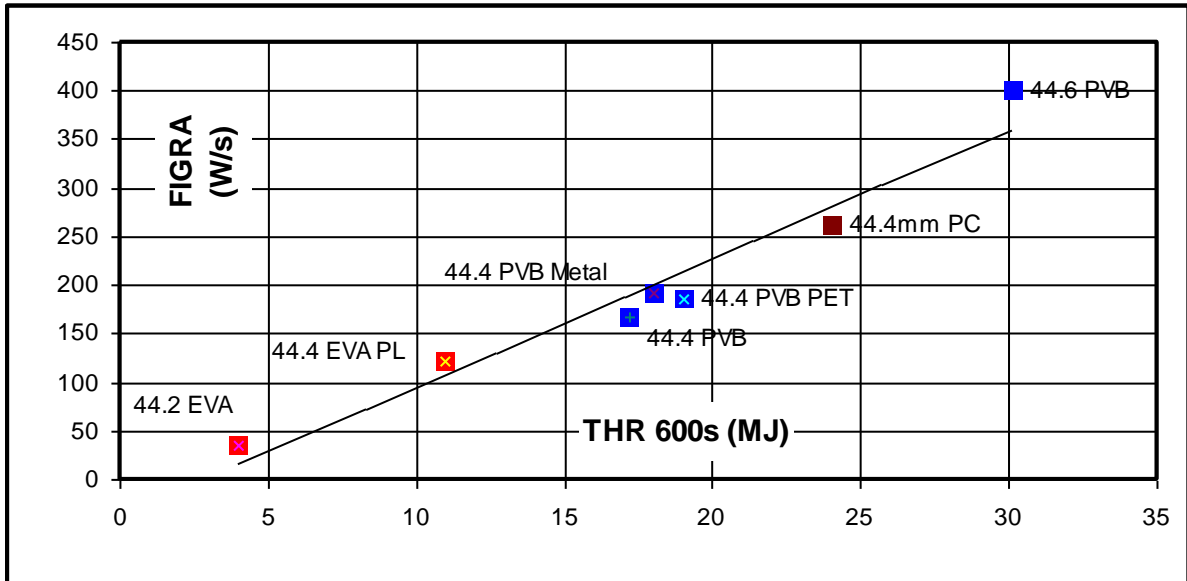


Figure 2: PVB, PC, EVA and PET Laminated glass classification following EN 13823 (SBI); classification boxes following EN 13501-1 are indicated in red color.

The slope of this correlation is increasing with the glass component thickness. Increasing the glass thickness gives a lower FIGRA and THR results. Minimum glass specification is considered as the worse case. Tinted glass or PVB do not influence tests results.

Test results could be summarized in the table 2 giving the combination of glass<sup>4</sup> thicknesses in mm (rows) and the number of PVB films (columns).

Fully colored boxes indicate tested compositions.

PVB Glass	1	2	3	4	5	6
3	B	B		D		D
4	B			D		D
5	B	B				
6	B	B		C		C
8		B		B		

<sup>4</sup> Only symmetrical composition have been investigated as the test method concerns the component thickness facing to fire.





## D) Insulating glass

Insulating glass unit (figure 3) is usually designed with 2 glass panes, a metallic spacer bar (from 6 to 32 mm large), and an external sealant barrier made of polysulfide (PS), polyurethane (PU) or silicone (SIL) adhesive (3 to 8 mm thick).

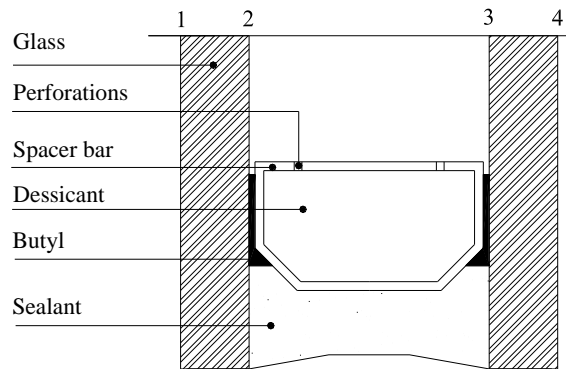


Figure 3: Insulating glass unit (IGU) section on the border

Additional composition may include an organic spacer (so-called "warm-edge") or a monolithic organic spacer-adhesive.

Typical sealant density and PCS/kg used for calculation are reported in table 3.

Polymer type	Density	PCS (MJ/Kg) EN ISO 1716
PS		10,0
PS		10,2
PS	1,78	11,0
PS		9,9
PS		10,8
		10,4
PU	1,59	13,36
PU	1,59	12,4
PU		11,3
PU without Hg		11,8
PU without Hg		10,4
		11,9
SI	1,36	14
SI	1,53	14
SI		17,03
SI		14,16
SI		14,2
		14,7

Table 3: Typical sealant density and PCS/kg





Where glass product contains an organic component, it may be excluded from the scope of the European decision 96/603/EC to give a deemed to satisfy classification (A1) to glass when:

- Organic material is not homogeneously distributed
- It contains more than 1,0% by weight or volume, whichever is the lower, of homogeneously distributed material

A clear interpretation of this statement has to be given to decide if some IGU composition may be classified as A1\*.

To classify the product two criteria may be used: the PCS/m<sup>2</sup> or PCS/kg. FSG stated recently that the correct criteria is PCS/m<sup>2</sup><sup>5</sup>.

1. PCS/m<sup>2</sup> calculation:

If we consider the PCS/m<sup>2</sup>, we made the following assumptions (see annex A):

- Cavity volume is not taken into consideration. Only solid product part is included. Organic content is evaluated on the basis of ratio between sealant and glass part; see annex A, column "% wt" and "% vol". Decision is taken on the most unfavorable case.
- Organic sealant is an internal component. It is discontinuous. It is here assimilated to a virtual continuous layer, see annex A, column PCS/m<sup>2</sup>. Such calculation shows a virtual thickness in all calculated cases below 1 mm. It should be treated as an **internal non-substantial component**.

Calculation results (annex A and figure 4) show that insulating glass unit with a 15-16 mm spacer with two glass panes, whatever the glass pane thickness, can be classified A2 only when glass panes dimensions are above 2000 X 1000 mm with 3mm sealant thickness.

For panes with 6mm sealant thickness, an A2 class can be obtained only for glazing bigger than 2000 X 2000 mm.

**It results that the main part of European IGU building production will be classified B according to PCS per square meter calculation.**

This cannot be used in practice as it strongly depends on glass pane dimensions, shape factor (L x l), width (spacer) and thickness of sealant.

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<sup>5</sup> FSG recommendation 021 REV1, 2007-05-22 : "calculation of the properties for a layer, which constitutes a non-substantial component of a product".



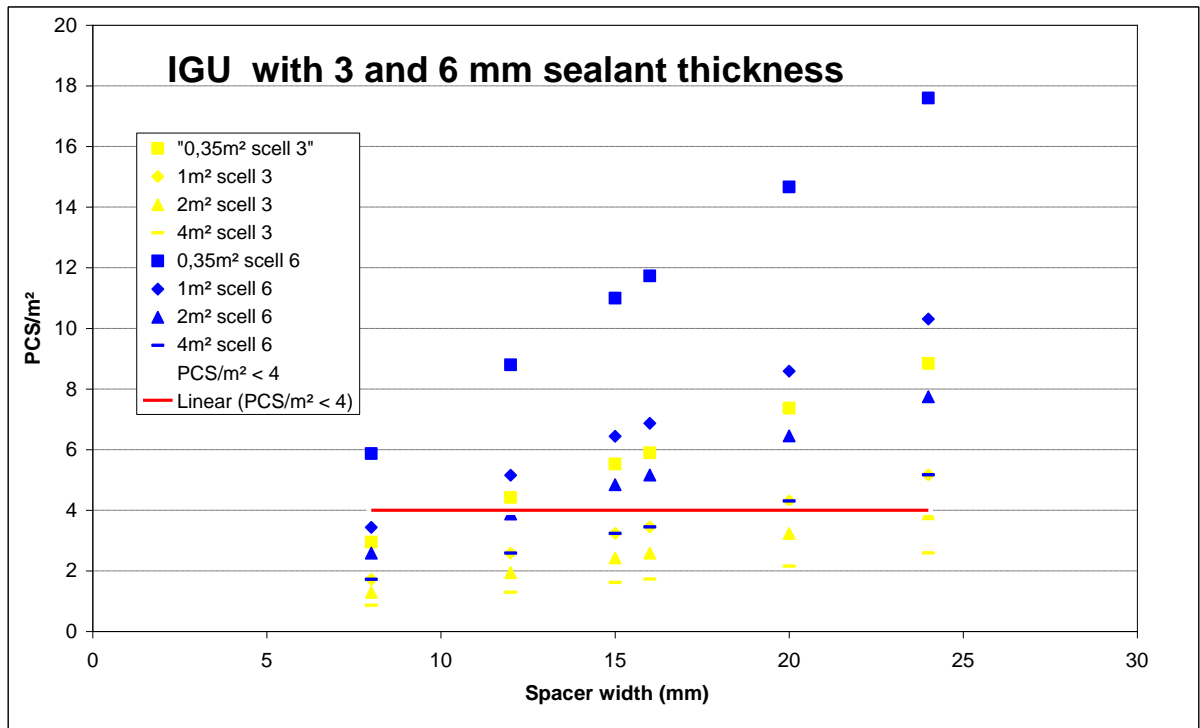


Figure 4 : IGU PCS/m² calculation result based on silicone PCS/kg value

## 2. PCS/kg calculation

Considering that the sealant is not a layer but a linear perimeter, the suitability of this first method is disputable. The second mode of calculation is considering the product as a whole and applies the criteria of PSC/kg., see annex A.

We observe that the results obtained with this second method are **far better and closer to the reality. Whatever the glass thickness and seal dimensions, all calculated commercial IGU are classified A1.** But it is not the official way to calculate the classification.

When insulating glass unit will include a laminated glass component, the resulting classification should be the laminated glass component class if the laminate is facing the fire.

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