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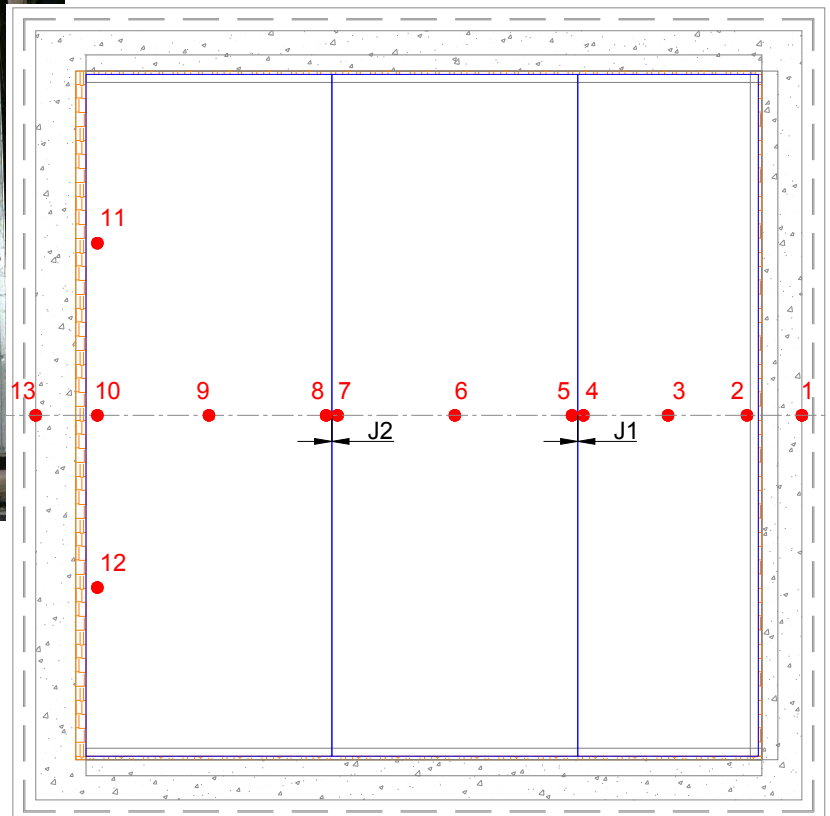
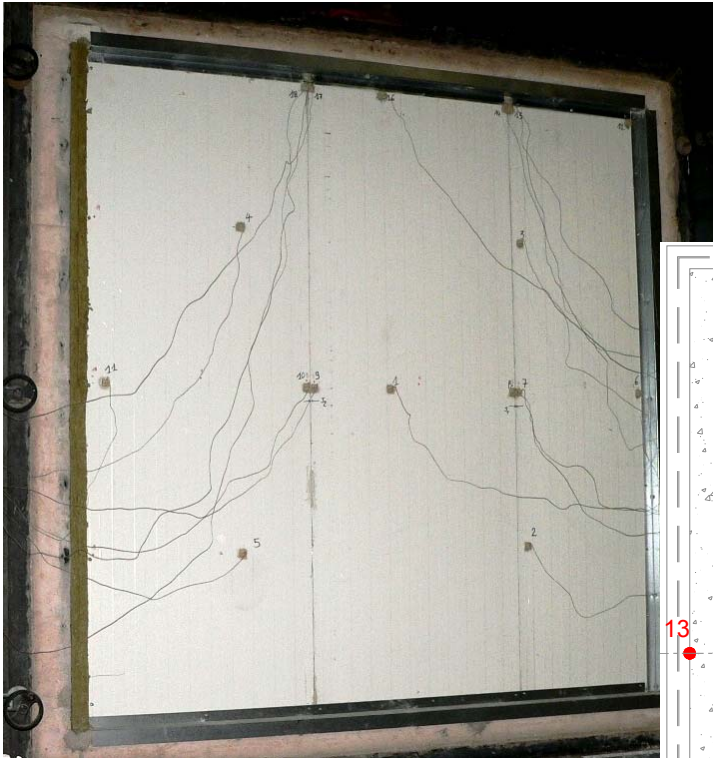
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## 1 CONTEXT

### 1.1 TEST SPECIMENS

Non-loadbearing walls - Metal sandwich panel construction



In this document, we only process data from our available database of tests on vertically oriented panels.

Our data from tests on horizontally oriented panels show that joints behaviour are not relevant parameters to predict the performances of the products.

## 1.2 EXTENDED APPLICATION RULE

### **EN 15254-5 “Extended application of results from fire resistance tests - Non-loadbearing walls - Part 5: Metal sandwich panel construction”**

#### **Annex B (normative) “Evaluation of extension of span length”**

- Extension in the span length above 4 m requires an overrun of at least 20% subject to a minimum 10 min compared to the classification
- The opening up of the joint at midspan shall be measured during the test. This opening is called  $\Delta c$  (se Figure B.2) :
  - Extensions are allowed only if  $\Delta c < 0,5$
- The deflection difference at midspan between the joint and the centres of the adjoining panels shall be measured during the test. This difference is called  $\Delta f$  (see Figure B.1) :
  - If  $\Delta f < 0,01$  the span may be increased up to 12 m with the same classification as the tested one
  - If  $\Delta f > 0,06$  the span may be increased up to 4 m with the same classification as the tested one
  - If  $\Delta f$  lies between 0,01 and 0,06 the span may be increased by linear interpolation

#### **→ Importance of measurements on joint behaviour during the tests**

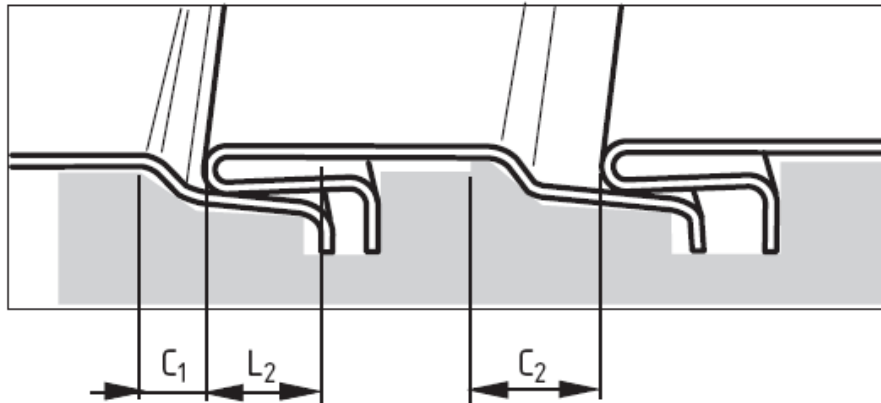
The question raised by EGOLF TC2 Helpdesk 2012-16 is :

A set of tests has been realised on panels of different thicknesses, but no measurement has been carried out on joints during these tests. Would it be relevant to proceed as follows :

1. redo only the tests on panels of minimum and maximum thicknesses and carry out the measurement on joints ;
2. deduce the extended height allowed for these tests ;
3. interpolate these results to panels of intermediate thicknesses.

## 2 INCREASE IN OPENING OF THE METAL SHEET JOINT ( $\Delta c$ )

### 2.1 DEFINITION

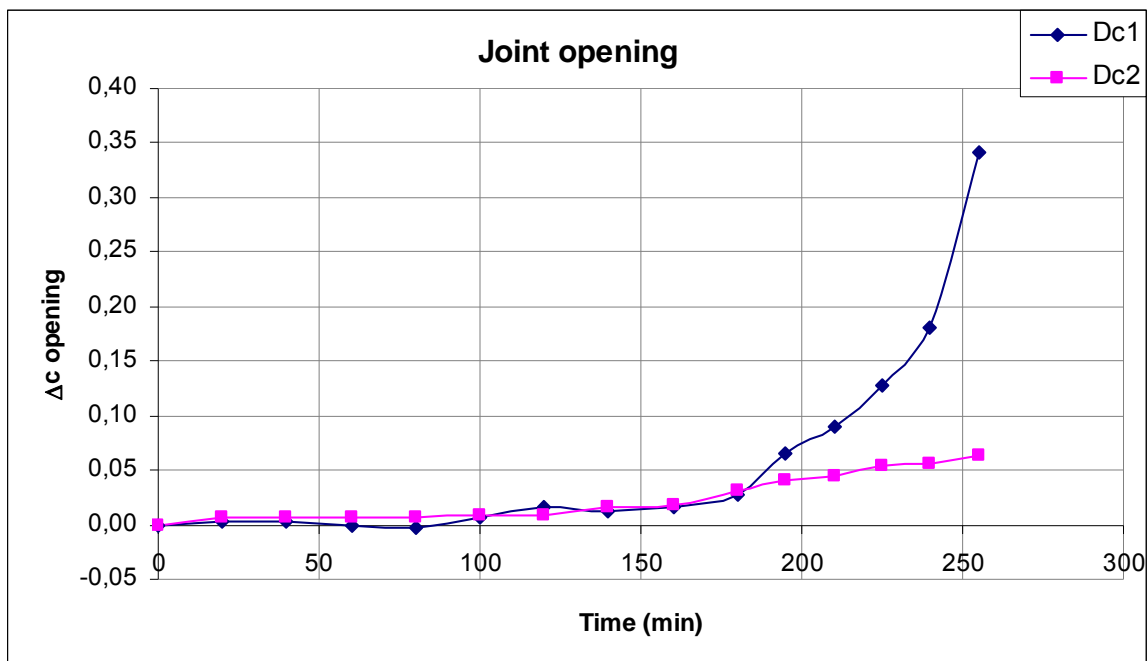


$$\Delta c = (c_2 - c_1)/L_2$$

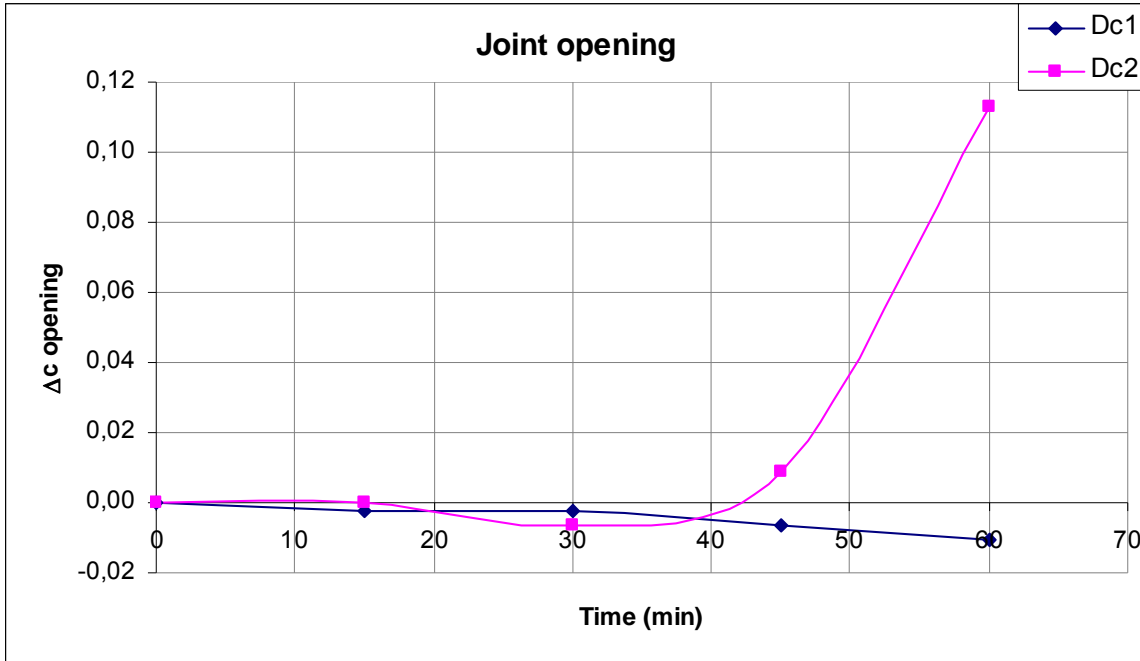
$c_1$  opening in adjacent metal sheet joints at normal room temperature on non exposed side  
 $c_2$  opening in adjacent metal sheet joints during the reference test on non exposed side  
 EN 15254-5 (Figure B.2 – Calculation of  $\Delta c$ )

### 2.2 EXAMPLES

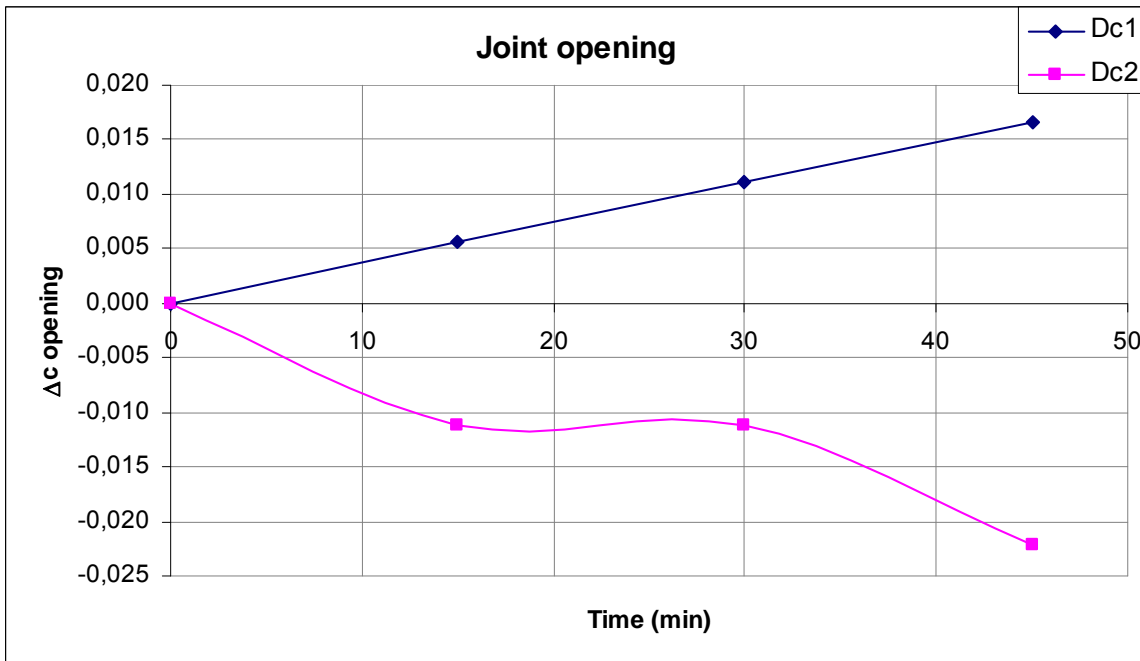
Orientation	Vertical	Performance	Minute	Criteria - Comment
Thickness	180 mm	E	264	Sustained flaming through J1
		I	240	Mobile th. near J1 >180°C



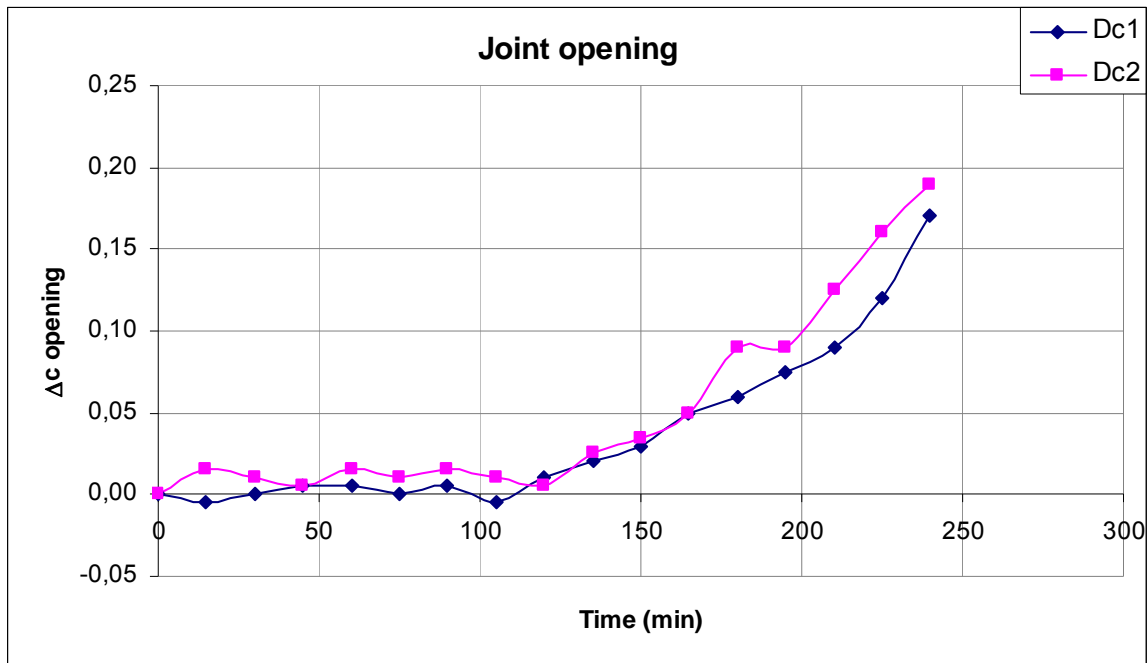
		Performance	Minute	Criteria - Comment
Orientation	Vertical	E	67	Sustained flaming through J2
Thickness	140 mm	I	67	Sustained flaming through J2



		Performance	Minute	Criteria - Comment
Orientation	Vertical	E	62	Sustained flaming through J2
Thickness	120 mm	I	38	Top mobile th. >180°C

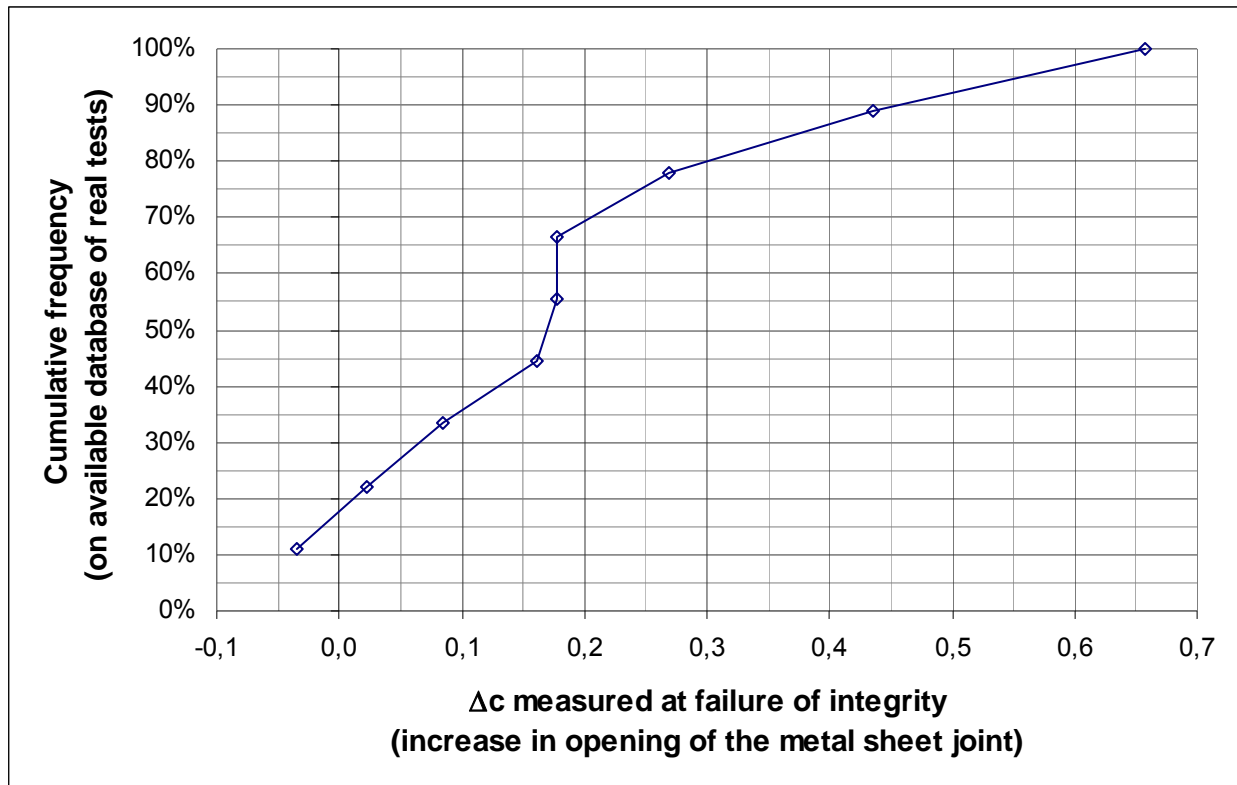


Orientation	Vertical	Performance	Minute	Criteria - Comment
Thickness	200 mm	E	>250	Not reached
		I	101	Mobile th. on panel > 180°C



### 2.3 OBSERVATIONS

- In many cases, we have seen that parameter  $\Delta c$  can help to predict the failure of integrity.
- More precisely, we have seen that the difference in the behaviour between the joints suggests the occurrence and the location of failure of integrity.



- 25% of failure of integrity occurs for  $\Delta c \leq 0,04$
- 50% of failure of integrity occurs for  $\Delta c \leq 0,17$
- Almost 70% of failure of integrity occurs for  $\Delta c \leq 0,20$
- 75% of failure of integrity occurs for  $\Delta c \leq 0,25$
- 92% of failure of integrity occurs for  $\Delta c \leq 0,50$

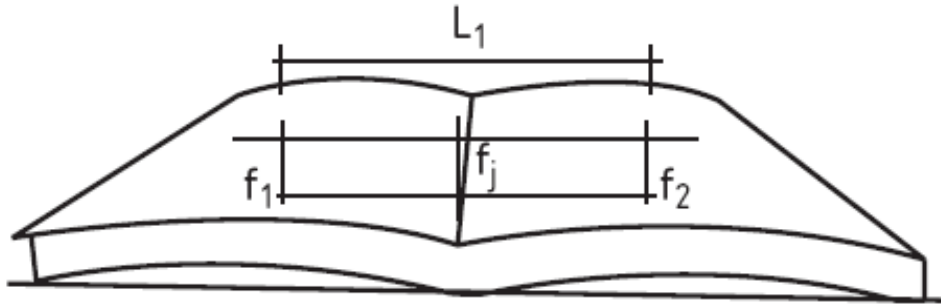
EN 15254-5 Annex B :  
**Extensions are allowed only if  $\Delta c < 0,5$**   
 → Over 90% of cases  
 → **Criterion  $\Delta c < 0,5$  is not very restrictive**

Note :

In addition, our available database of tests also contains 5 other tests that didn't reach failure of integrity. In these tests, parameter  $\Delta c$  didn't exceed 0,21.

### 3 RELATIVE DEFLECTION OF THE JOINT COMPARED TO THE ADJACENT PANELS ( $\Delta f$ )

#### 3.1 DEFINITION



$$\Delta f = (f_j - 0.5 \cdot (f_1 + f_2)) / L_1$$

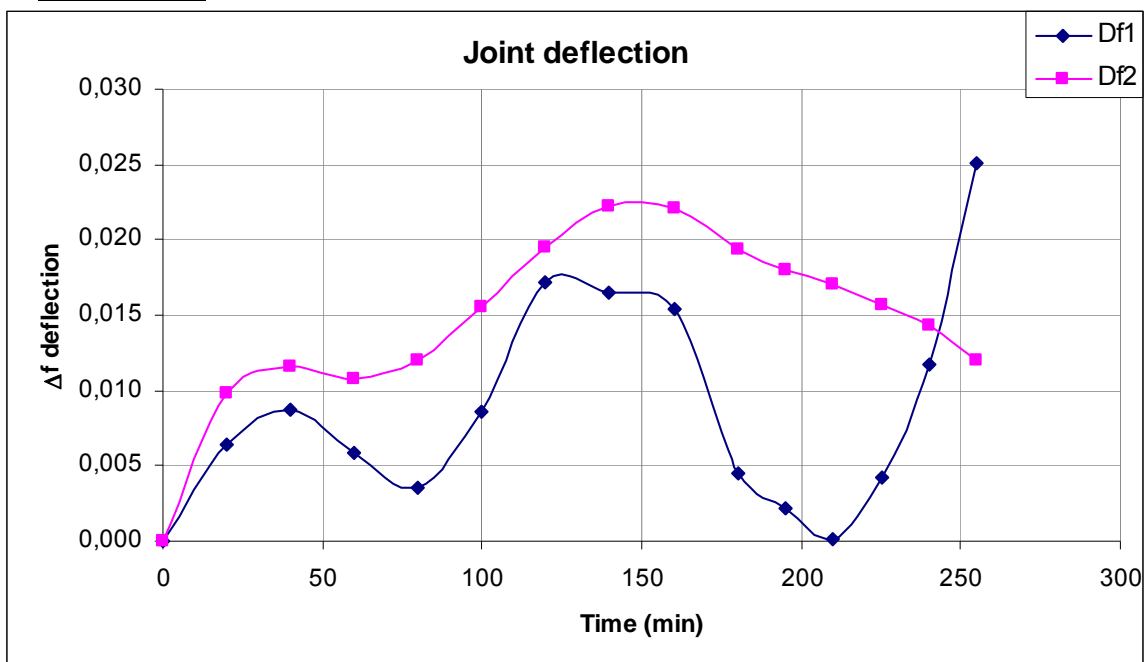
$f_j$  deflection of panel to panel joint

$f_1$   $f_2$  deflection of two adjacent panels at midspan

EN 15254-5 (Figure B.1 – Calculation of  $\Delta f$ )

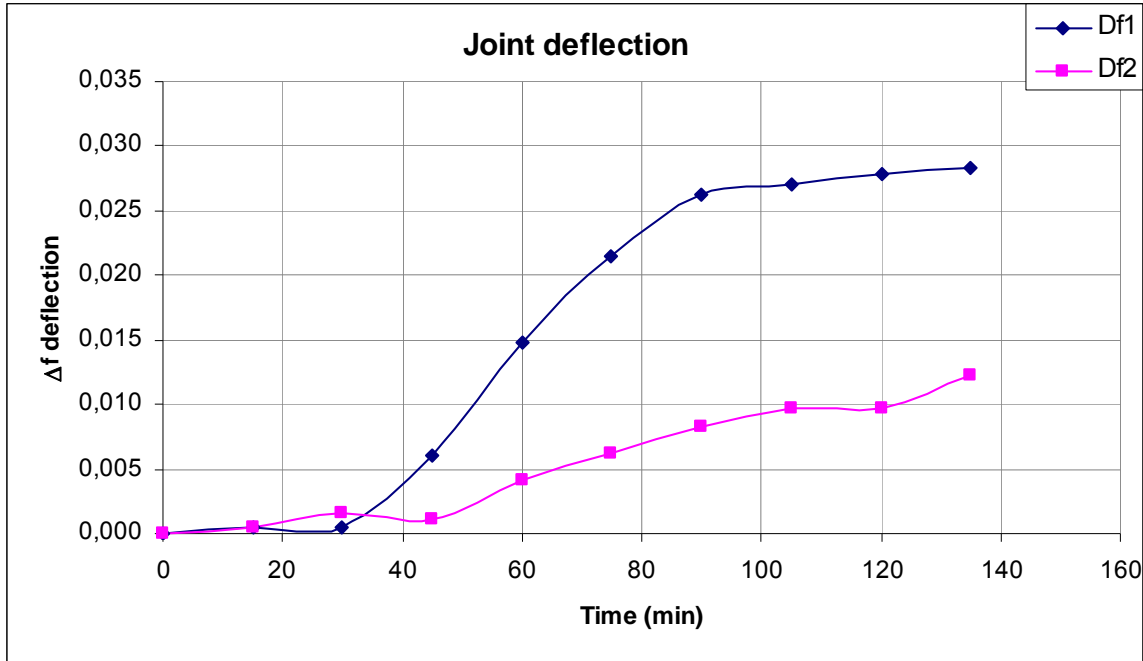
#### 3.2 EXAMPLES

Orientation	Vertical	Performance	Minute	Criteria - Comment
Thickness	180 mm	E	264	Sustained flaming through J1
		I	240	Mobile th. near J1 >180°C

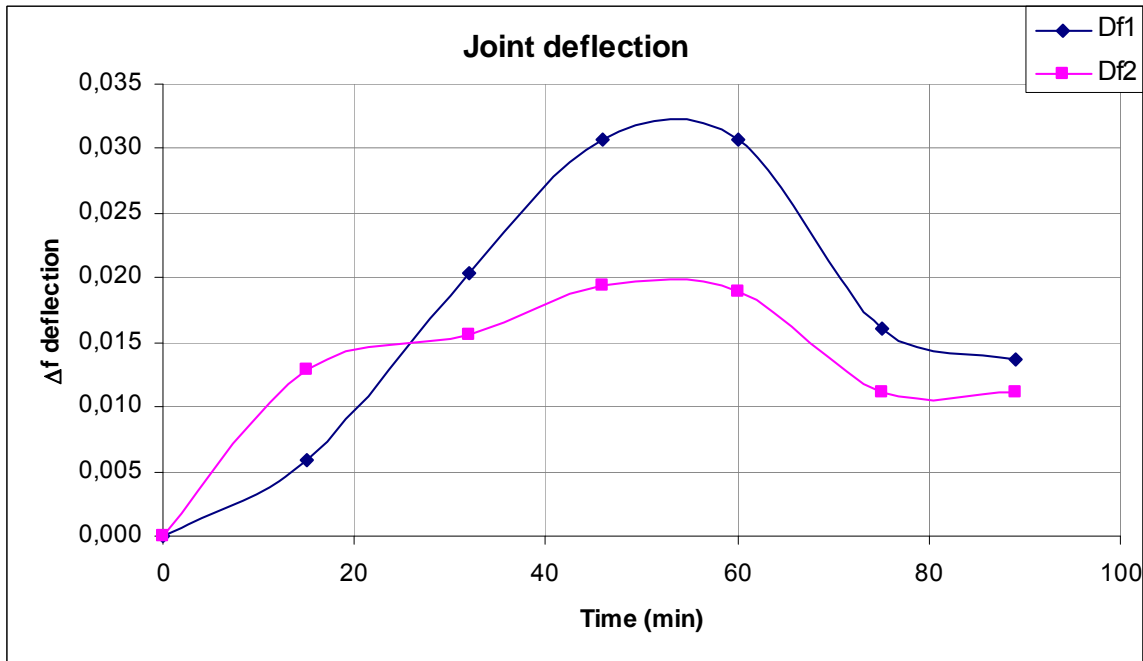




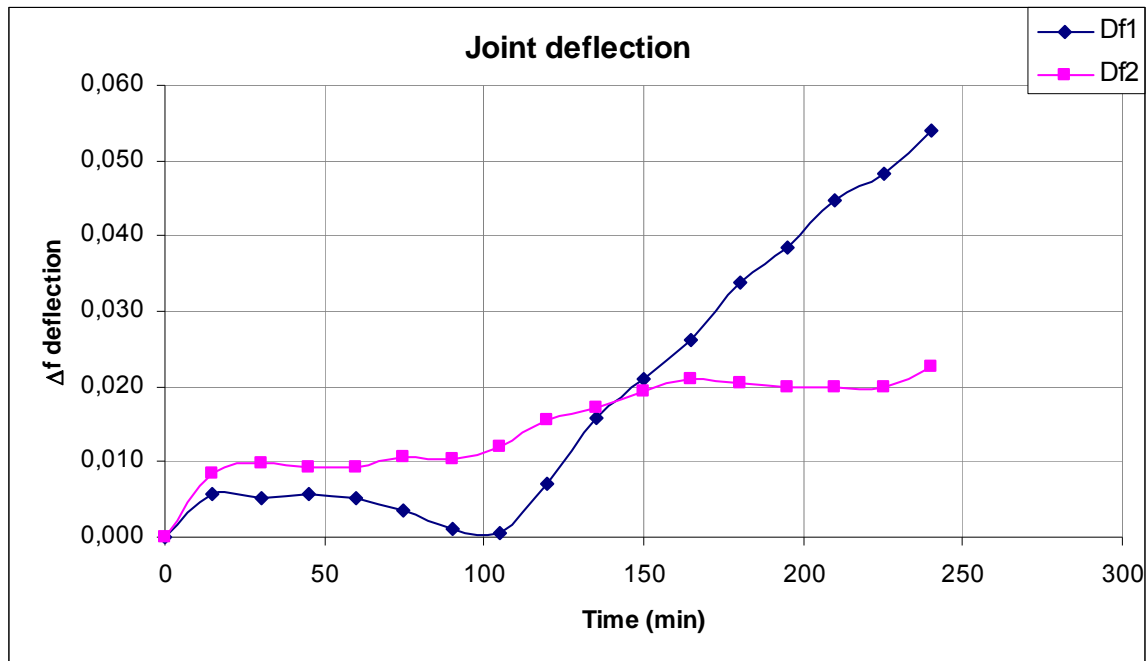
Orientation	Vertical	Performance	Minute	Criteria - Comment
Thickness	140 mm	E	67	Sustained flaming through J2
		I	67	Sustained flaming through J2



Orientation	Vertical	Performance	Minute	Criteria - Comment
Thickness	100 mm	E	>89	Not reached
		I	57	Mean temperature >140°C



Orientation	Vertical	Performance	Minute	Criteria - Comment
Thickness	200 mm	E	>250	Not reached
		I	101	Mobile th. on pannel > 180°C



### 3.3 OBSERVATIONS

In most cases, we have seen that the  $\Delta f$  curves of the joints crosses each others during the test  
→ Monitoring the behaviour of only one joint is not sufficient

→ **All joints should be monitored and the worst case at any time should be considered**

In most cases, we have seen that the direction of the variation of  $\Delta f$  changes many times during a test.

→ EN 15254-5 Annex B :

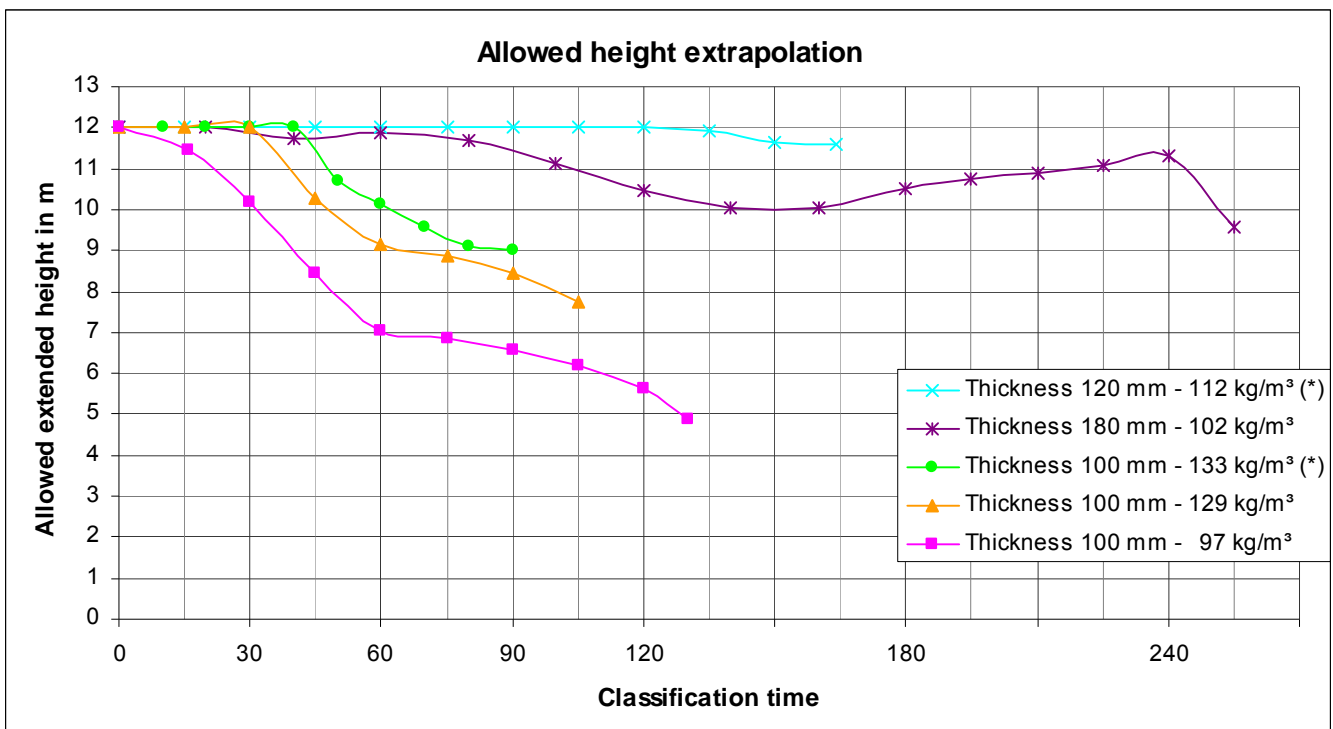
“For  $\Delta f$  between 0,01 and 0,06, span may be increased by linear interpolation. When evaluating the allowable spans the measurements at the time of the appropriate fire class shall be used. This means that for the same panel different spans can be allowed in different classes.”

That could lead to paradoxal extensions such as :

- 12 m allowed at 30 minutes
- 10 m allowed at 60 minutes
- 11 m allowed at 90 minutes

→ It should be understood as :

“For  $\Delta f$  between 0,01 and 0,06, span may be increased by linear interpolation. When evaluating the allowable spans the measurements at up to the time of the appropriate fire class shall be used, and only the worst case encountered up to this point should be considered. This means that for the same panel different spans can be allowed in different classes.”



(\*) Test ended before failure of integrity

Chart here above shows data from available database of tests for panels with **the same joint construction**. On this example :

- Extended height for 120 mm > Extended height for 180 mm > Extended height for 100 mm
- The lowest thickness and the lowest density leads to the weakest height extension

→ Tests on different panels thicknesses run up to different times

→ **A safety choice would be to test the lowest thickness and the lowest density, and to only allow the height extension thus obtained. But what about the height extension beyond that test time ?**

→ **Is there any scientific argument to interpolate the extended heights obtained from different panel thicknesses and at different test times ?**

Example :

Given an extended height at 90 minutes for 100 mm thickness, and given another extended height at 180 minutes for 180 mm thickness, what extended height could be reasonably allowed at 120 minutes for 120 mm thickness ?