

Fire Tests and Classification

Many countries have brought requirements based on provisions in order to form the acceptable minimum level for the purpose of protecting from fire. These guiding requirements prepared by the designers may not answer all questions, but they guide the whole way. The legislation on fire, which is not deeply emphasised in Turkey, is taken into fair consideration by the European Union. The safety issue in case of fire has been prepared in the legislations briefly through considering the requirements given below.

- The occurrence of fire within the building, the spreading of the fire and smoke must be limited (Reaction to Fire).
- The load bearing capacity of the constructed building must not reduce for a certain period of time (Fire Resistance).
- The spreading of the fire to the surrounding buildings must be limited (Active Security Systems).
- The residents of the building must leave the building or must be saved by means of other methods (Detection Systems).
- The safety of the rescuing teams must be ensured.

As before and after the fire, each safety parameter carries great importance in terms of precaution. However, the reaction to fire characteristics (Fire Performance) of the building materials under the architectural discipline must be particularly considered. The contribution of the material in the expansion of the fire, even the resistance shown by the material against the fire, which is also qualified as flammability capacity, is called fire performance.

The Reaction to Fire tests are conducted on small scaled models that are appropriate for recent utilization. The wall and roof lines where the fire grows the most in the building are modeled and they are subjected to fire test.

All the standards and test methods concerning the polyurethane-filled sandwich panels have been listed in details in TS EN 14509. In this standard that also contains the fire performance, the building materials have been classified in six different classes from A1 to F. The other classes of the material can be determined according to the smoke and dripping amounts after the fire. Yapı malzemelerinin yangına tepki sınıflarının belirlenebilmesi için özet tablo.

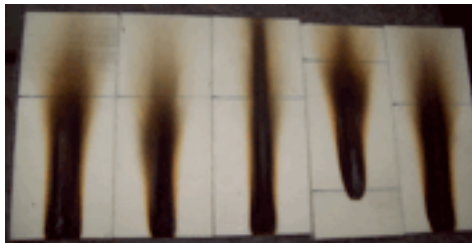
Summary table for identifying the building materials' class of reaction to fire.

Test Methods	Reaction to Fire Class			
	E	D,C,B	A2	A1
EN ISO 1182 (Flammability Test Flammability Test)			Flammability Test	Flammability Test
			or	and
EN ISO 1716 (Calorific Potential Test-PCS)			PCS	PCS
TS EN 13823 (Single Burning Item Test-SBI)		SBI	SBI	
TS EN ISO 11925-2 (Small Flame Test)	Tutuşabilirlik 15 sn	Tutuşabilirlik 30 sn		

TS EN ISO 11925-2: Small Flame Test (SFI): It is the test method simulating the application of flame source at the size of a lighter from the corner or surface of the sample for 15 or 30 seconds. Fire Tests and Classification YS|03|092 The time is recorded until the ignition occurs or the fire exceeds 150 mm. D, E or potentially F classes are identified according to the results of the test. The materials under classes B, C and D can only be identified through using this test method, additionally SBI test must be conducted.



Resim 1

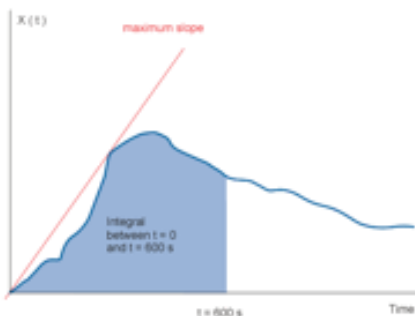


Resim 2



Resim 3

TS EN 13823: Reaction to Fire Tests (SBI): With these test method principles, the reaction to fire of the materials under the classes B, C and D can be identified. It must be conducted in addition to the SFI test. SBI test is a test method that is conducted by directing a flame source at the size of 30 KW to the material from the corner of the room. Although the internal corner detail is rarely used in the external wall applications in real life, it is simulated and the test results are obtained just as if there is an internal corner detail. The oxygen consumption, carbon dioxide release and temperature values are identified in SBI test. By calculating these obtained results, the data on the Total Heat Release (THR) and Fire Growth Rate (FIGRA) of the sample, which has been exposed to fire, for the first 10 minutes, are obtained. It gives significant ideas concerning the development of the fire within the first 10 minutes and the reaction of the material within the buildings. The classes of the material (B, C and D) are identified according to the obtained data.



Graphic1

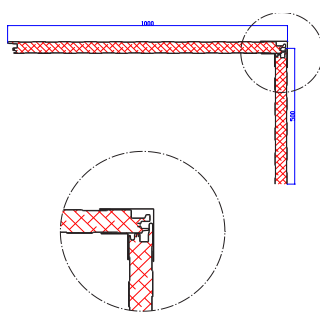


Image 4

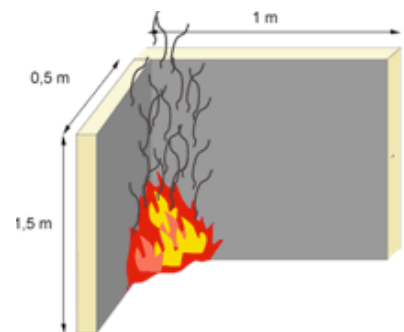


Image 5

Furthermore, Lateral Flame Spread (LFS) of the flame applied on the material is observed for 20 minutes. If spread occurs, then that material is classified as D.

On the other hand, classifications called d0, d1 and d2 are conducted according to whether there is any dripping within the first 10 minutes or not and whether the dripped particles burn for more than 10 seconds or not.

According to the smoke released within the first ten minutes, the Total Smoke Production (TSP) and Smoke Growth Rate (SMOGR) values are determined and then classification as s1, s2 and s3 is conducted according to these data.

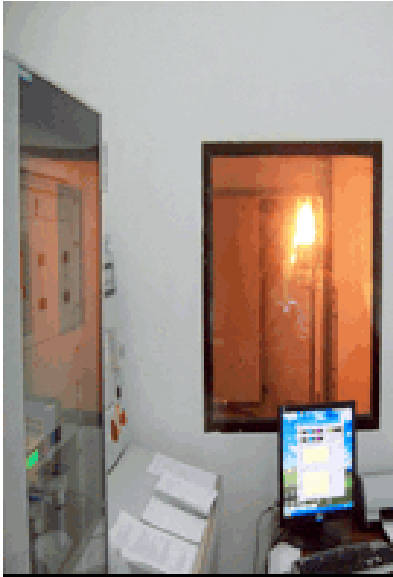


Image 6



Image 7



Image 8

List of Symbols

ΔT : Temperature increase

Δm : Loss of mass (%)

Fs: Flame spread (mm)

FIGRA: Fire growing speed index used for the purpose of classification

LFS: Lateral Fire Spread (m)

PCS: Total calorific potential (MJ/kg or MJ/m²)

SMOGRA: Smoke Growing Rate

Tf: Continuation time of fire (s)

THR600s: Total heat revealed within 600 s (MJ)

TSP600s: Total smoke production within 600 s (m²)

Reaction to fire classes for building materials

Class	Test	Classification Criteria	Additional Classification
A1	EN ISO 1182 (1); EN ISO 1716	· $T < 30^{\circ}\text{C}$ and · $m < 50\%$ and $t_f = 0$ (seems it will not continue to be burned) $\text{PCS} < 2.0 \text{ MJ/kg}$ (1) ve $\text{PCS} < 2.0 \text{ MJ/kg}$ (2) (2a) and $\text{PCS} < 1.4 \text{ MJ/m}^2$ (3) and $\text{PCS} < 2.0 \text{ MJ/kg}$ (4)	- -
A2	EN ISO 1182 (1) or EN ISO 1716 EN 13823 (SBI)	· $T < 50^{\circ}\text{C}$ and · $m < 50\%$ and $t_f = 20 \text{ s}$ $\text{PCS} < 3.0 \text{ MJ/kg}$ (1) and $\text{PCS} < 4.0 \text{ MJ/m}^2$ (2) and $\text{PCS} < 4.0 \text{ MJ/m}^2$ (3) and $\text{PCS} < 3.0 \text{ MJ/kg}$ (4) $\text{FIGRA} < 120 \text{ W/s}$; and $\text{LFS} < \text{corner of sample}$ and $\text{THR600s} < 7.5 \text{ MJ}$	- - Formation of smoke (5) and fire droplets / particles (6)
B	EN 13823 (SBI) and EN ISO 11925-2 (6); Exposure = 30 s	$\text{FIGRA} < 120 \text{ W/s}$; and $\text{LFS} < \text{corner of sample}$ and $\text{THR600s} < 7.5 \text{ MJ}$ $F_s < 150 \text{ mm}$ within 60 s	Formation of smoke (5) and fire droplets / particles (6)
C	EN 13923 (SBI) and EN ISO 11925-2 (8); Exposure = 30 s	$\text{FIGRA} < 250 \text{ W/s}$; and $\text{LFS} < \text{corner of sample}$ and $\text{THR600s} < 15 \text{ MJ}$ $F_s < 150 \text{ mm}$ within 60 s	Formation of smoke (5) and fire droplets / particles (6)
D	EN 13823 (SBI): EN ISO 11925-2 (8); Maruz kalma = 30 s	$\text{FIGRA} < 750 \text{ W/s}$ $F_s < 150 \text{ mm}$ within 60 s	Formation of smoke (5) and fire droplets / particles (6)
E	EN ISO 11925-2 (8); Exposure = 15 s	$F_s < 150 \text{ mm}$ within 20 s	Fire droplets / particles (7)
F	F No performance assignment has been made.		
-1	For the main component of the homogeneous products and non-homogeneous products.		
-2	For any external auxiliary component of non-homogeneous products.		
(2a)	As an alternative, any external auxiliary component with $\text{PCS} \leq 2.0 \text{ MJ/m}^2$. This component must meet the following criteria listed in EN 13823 (SBI): $\text{FIGRA} \leq 20 \text{ W/s}$ and LFS test sample corner and $\text{THR600s} < 4.0 \text{ MJ}$ and s_8 and d_0 .		
-3	For any internal auxiliary components of non-homogeneous products.		
-4	For an entire product.		
-5	In the last phase of the execution of the test proceedings, the smoke measuring system has been modified in order to meet the advanced investigation requirements. For the evaluation of the smoke formation, the following values can be applied in the modification of the limit values and/or parameters: $s_1 = \text{SMOGRA} \leq 30 \text{ m}^2/\text{s}^2$ and $\text{TSP600s} \leq 50 \text{ m}^2$; $s_2 = \text{SMOGRA} \leq 180 \text{ m}^2/\text{s}^2$ and $\text{TLS 600s} \leq 200 \text{ m}^2$; s_3 is not = s_1 or s_2 .		
-6	(6) within $d_0 = 600\text{s}$, there is no fire droplet/particle according to EN 13823; within $d_1 = 600\text{s}$, there is no fire droplet/particle longer than 10 sec according to EN 13823; d_2 is not = d_0 or d_1 .		
-7	(7) Appropriate to the result of the test (passed) = Paper not burned (no classification); Not appropriate to the result of the test (failed) = Paper burned (class d2)		
-8	(8) If appropriate for exposing to flame on the surface and the last utilization of the product, also under the conditions for exposing to flame from the corner.		

In our country, the first section related to the reaction to fire of the standard on protecting the buildings from fire has been prepared by benefiting from the German DIN 4102 norms. By accepting the European fire classes, the member states had to regulate their national legislations according to the European fire classes. Therefore, the TS EN 14509 standard, which covers the fire issue of the Polyurethane-filled sandwich panels, has become effective in our country for the purpose of harmonizing the European Union technical legislation. Direct comparison of the reaction to fire classes listed in TS EN 13501-1 and DIN 4102 may not provide very accurate results since they are different standards, however, the following comparison table that has been prepared through basing on the flammability characteristics of the materials can be used as data.

TS EN 13501-1 and DIN 4102 Reaction to fire classes comparison table

Flammability Characteristic of Material	No Smoke Formation	No Fire Droplets / Particles	Reaction to Fire Classes according to TS EN 13501-1	Reaction to Fire Classes according to DIN 4102
Non-Flammable	✓	✓	A1	A1
Hard Flammable	✓	✓	A2-S1,d0	A2
Hard Flaring	✓	✓	B-S1,d0	B1
			C-S1,d0	
			A2-S2,d0	
			A2-S3,d0	
			B-S2,d0	
			B-S3,d0	
			C-S2,d0	
			C-S3,d0	
	✓		A2-S1,d1	
			A2-S1,d2	
			B-S1,d1	
			B-S1,d2	
			C-S1,d1	
			C-S1,d2	
			A2-S3,d2	
			B-S3,d2	
			C-S3,d2	
Normal Flaring		✓	D-S1,d0	B2
			D-S2,d0	
			D-S3,d0	
			E	
			D-S1,d1	
			D-S2,d1	
			D-S3,d1	
			D-S1,d2	
			D-S2,d2	
			D-S3,d2	
			E-d2	
Easy Flaring			F	B3