

Smoke and fire regulations

Smoke and fire regulations are numerous and depend on the environment in which the products are used. For example, the harder it is to get out of a vehicle, the more demanding and strict the regulations are. This is why the smoke and fire tests used in planes are a lot stricter than those used in cars. A difference also exists on the railway, by, for example, comparing high speed trains which can stop easily in nature and the metro/tram/RER which like the tube in London have a limited number of emergency exits.

Yet these regulations are forced to evolve to take into account new knowledge, new production technologies, new materials and regulatory changes, notably linked to Europe.

We will see here two major changes in the smoke and fire regulations: the one linked to construction with the passing of the regulation for construction products and that linked to railways with the appearance of EN 45545-2.

New building regulation: the CE marking

The CE marking is part of the convergence of regulations and national technical standards. It is the now compulsory guarantee of your construction products' conformity to the requirements of one or several European directives. The CE marking opens up market access to all the countries of the Union.

However, you must note that each state conserves their autonomy to set acceptance criteria for works on a national scale.

Each product must adhere to a level of conformity certification. There are 6 levels defined in the decrees which details the division of tasks between the manufacturer and the body notified: from the declaration of material up to the testing of production.

The levels of compliance certification are the following:

Level 1: Certification of the product

Level 1+: Level 1 + tests by product surveys taken from the factory or the market

Level 2: Initial inspection of the factory production control

Level 2+: Continuous monitoring of production

Level 3: Initial test of the product kind by a notified body

Level 4: Self-declaration from manufacturer

The publication in the OJRF of 9th March 2011 of the new European regulation of construction products (RCP), has brought about, since 1st July 2013, concrete changes to the requirements regarding construction products.

In addition, the European regulation on construction products require the manufacturer to make a declaration on the performance, enabling the CE marking if

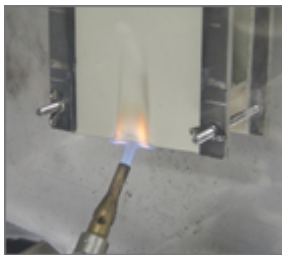
there is a standardised norm in which the material can be classed or if the product is in accordance with an ETA request by the manufacturer.

The system of EUROCLASSES aims to evaluate construction products' contribution in the development of a fire via 5 fire reaction tests. The construction products concerned are, among others, wall coverings and flooring, paints, varnishes, seals and draught proof systems, insulating products, etc.

The M classifications (French system) will therefore now be replaced by EUROCLASSES classifications going from A1, A2, B up to F (note that in the particular case of flooring there is A1FL, A2FL, BFL up to FFL and insulation products for linear conduits go from A1L to FL) for all products subject to a standardised norm or an ETA. As a complement the production of smoke (s1, s2, s3) as well as flaming droplets (d0, d1, d2) are now part of the final classification.

Tests that are involved in the EUROCLASSES simulate 3 levels of thermal stress: the isolated attack from a small flame (classification E to B), the contact from an object that is on fire (classification D to A2) and a completely developed fire on an item (classification A2 and A1).

The five Euroclasses tests enabling this classification are the following:



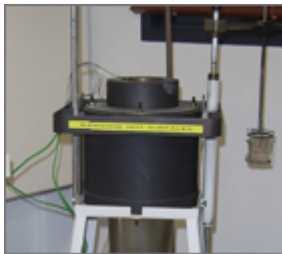
Test with a small flame: NF EN ISO 11925-2

The flammability of construction products via a direct contact with a small flame is evaluated by using samples submitted to the test in a vertical position.



Single Burning Item (SBI) test: NF EN 13823

The aim is to measure the performance of a construction product exposed to a thermal load caused by a Single Burning Item via the heat flow the propagation of the front of the flame and the rate of smoke development.



Fireproof test: NF EN ISO 1182

It lets you determine, in specific conditions, the fireproof performance of standard and assorted construction products.














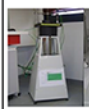
Tests on flooring: NF EN ISO 9239-1

The test with radiant flooring panels is the fire reaction test dedicated to flooring substituting the S.B.I It is about testing the burning behaviour, the propagation of the flame and the development of smoke in flooring exposed to a degree of energy flow.



Determining the combustion heat: NF EN ISO 1716

The calorimetric bomb test lets you determine the energy given off by the combustion of construction products: gross calorific value – GCV -, at a constant volume as well as the net calorific value – NCV.

| 3 thermal stress levels | E d2 | D C B s1,2,3 / d0,1,2 | A2 s1,2,3 / d0,1,2 | A1 |
|---|---|---|---|---|
| Small flame attack |  |  |  |  |
| Single burning item or fully developed fire in a proximate room |  |  |  |  |
| Fully developed fire in a room |  |  |  |  |

New Railway regulation: EN 45545-2

In order to facilitate the interoperability of trains throughout Europe, it was decided to standardise the different train management systems: whether it's signalling on tracks, electronic networks or smoke and fire standards.

The deployment of the EN 45545-2 standard took place over several stages and now the cohabitation between this standard and the previous standards is still going on.

The EN 45545-2 railway standard was published in 2013 by AFNOR (French industrial standards authority) and the technical specification for interoperability (TSI) shouldn't be far off. Since its publication and for a timescale of three years at the most (until 2016), this standard will be revised. The same process will be applied to the TSI.

From now on until the end of this revision period, each member state and each ordering person will be able to apply what they want, namely: responding to EN 45545-2 or responding to the national standard. In France for example, the EN 45545-2 standard is requested as a priority and if the material doesn't meet it there is no option of departing from the national standard.

At the end of this transitory period, this new railway standard will be obligatorily applicable unequivocally.

This new standard is structured in the following way: the first stage consists of identifying the end use of the item. Then from this information the requirement is obtained which in its turn defines the tests to be carried out as well as the experimental conditions. The philosophy is, just like for previous railway standards, to test the finished material.

Some test remain common but the majority have changed or have been completed: this is the case with analysis of the toxicity of the smoke emitted during the degradation of products which is now taken into account, as well as previously tested products, the NOx.

Having taken into account the results obtained, the products are sorted into four categories: unclassified, HL1, HL2 and HL3 which is the best classification.

For example here are two tests used to class products used on the railway:

ISO 5658-2, Radiant Panel – Propagation test



Principal: The samples are maintained vertically and exposed to a radiant panel fed with gas and a flame which doesn't make contact with their surfaces. The hottest extremity of the sample receives a radiant heat flow of 50.5kW/m² which reduces along the sample until it reaches a level of 1.2kW/m² at the coldest end.

Even if the flame doesn't touch the surface of the sample, it will play a role as an ignition source for the volatile gas emitted by the product. During the test, the maximum length of the flame which is reached along the sample is recorded. The parameter measured is the critical heat flux at extinguishment (CFE: Critical Heat Flux at Extinguishment).

ISO 5660-1, cone calorimeter test



Principal: The device is designed to measure the response in the vertical and/or horizontal position and relies on the fact that for a gram of material, the net combustion heat is proportional to the quantity of oxygen required for combustion. A small sample of the material is exposed to a resistance in the form of a truncated cone. The decomposition gas generated by the resistance is ignited by a spark and the resulting combustion gas is sucked up in a vacuum system containing numerous measuring devices.

Continuous measuring of oxygen, monoxide and carbon dioxide levels as well as suction power allows you to arrive at the heat given off in relation to the time. A range of exposure conditions is used going from 10 to 100kW/m². In each case, the sample is placed on a scale to monitor the development in the loss of mass which also constitutes another solution to determine the level of heat given off. A study of smoke and temperature can also be carried out in the output conduit. The value required under the European standards is MARHE which is directly linked to the heat level given off.

This article forms part of a series of technical articles aimed at industrial manufacturers wishing to increase their knowledge of the field of composite materials. It was produced within the Composites project (www.pluscomposites.eu).

Copyright of +Composites consortium partners.