PU Europe
Factsheet

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Fire performance of thermal insulation products in end-use conditions

Insulation of façades with External Thermal Insulation Composite System (ETICS)

Executive summary

Ensuring fire safe buildings are one of the major priorities for the PU industry. PU Europe strongly believes that discussions should not be limited to the reaction to fire of individual construction products as this is a poor indicator for the fire safety of complete buildings or building elements. In this sense, ANPE launched a test programme, co-sponsored by PU Europe, comparing the performance of combustible and non-combustible thermal insulation products in real-life scenarios, i.e. in typical end-use conditions. The insulation of outer walls from the external side using insulation materials, adhesive mortars, meshes and plaster, has become an increasingly important solution in Europe. Ensuring a standard of fire safety for this type of application is therefore an urgent objective that regulators must meet. In Italy, were the test was performed, the fire behaviour of façades, including the external cladding insulation system, is dealt with in a document published by the Ministry of Interior in conjunction with the department of Fire Brigades. In other European countries (Austria, France, Germany, United Kingdom) specific large-scale testing under defined conditions have been adopted to evaluate the fire performance of the entire ETICS system.

The test described in this factsheet was based on a large-scale experimental test method developed by ANPE to represent a scenario caused by the fire of cars or waste urban bins in places adjacent to the façade of the buildings. This factsheet summarises the results for ETICS made with PU and SW boards. Since an experimental test method was used with no classification levels available and no possible extrapolation to other large-scale façade tests, the evaluation of the results can only be qualitative.

Despite the different classifications – E for the PU ETICS board (B s1 d0 for the full kit) and A1 for the SW ETICS board (A1 for the full kit) – both the PU and the stone wool ETICS build-ups maintained their structural integrity and passed the large-scale façade test (Italian protocol). In both samples, the fire remained confined within the area affected by the burner and was self-extinguished after 10 minutes.

References

- *Fire behaviour in end use conditions - Research project 2014,* ANPE, L.S. Fire Testing Institute
- Cortexa installation manual

Glossary

- ANPE: Associazione Nazionale Poliuretano Espanso rigido (Italian association for PU rigid foam)
- Cortexa: Cortexa Consortium per la cultura del Sitema a Cappotto (Italian consortium for ETICS)
- ETA: European Technical Approval
- ETICS: External Thermal Insulation Composite System
- PIR: Polyisocyanurate
- PU: Polyurethane (PUR/PIR)
- SW: Stone wool

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Tested materials

"The materials and assembly procedures follow the instructions given in the European Technical Approvals (ETAs) and the Cortexa installation manual".

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External insulated cladding (ETICS)

- **Adhesive:** Cement powder based on common cement requiring an addition of 22-24 % water; particle Size: 0.6 mm; consumption: 2.5 - 3.5 kg/m^2.
- **Insulation:** PU boards and SW boards specifically for ETICS applications.
- **Base layer:** Cement powder based on common cement requiring an addition of 22-24 % water; particle size: 0.6 mm; consumption: 2.5 - 3.5 kg/m^2; Thickness: 2.5 - 3.5 mm.
- **Mesh as reinforcement:** Network fibreglass; mesh size: 4 x 5 mm.
- **Finishing layer:** Ready-to-use paste based on styrene-acrylic resins; consumption: 2.5 - 3.5 kg/m^2 when product is prepared; thickness: 1.5 ± 0.1 mm.
- **Plastic anchors:** Mono-piece anchors consisting of a head and a nail of different lengths; trade Name: "Anchor Fixing C1 CS"; consumption: 4 - 6 pieces/m^2; Ø head: 4.7 cm, diameter of the nail: 1.0 cm.

PU board

The PU board was specifically designed for ETICS, PIR core (Euroclass: E) and faced on both sides with saturated fiberglass.

Stone wool board

The SW board was made of non-faced stone wool with double density and designed for ETICS.

	PU board	Stone wool board
Declared thermal conductivity (λD) (W/mK)	0.026 (thickness from 80 to 110 mm)	0.036
Thickness applied for testing (mm)	100	140
Thermal resistance (m^{2}K/W)	Board only: 3.85	Board only: 3.85
Fire performance/Euroclass	Board: E	Board: A1
Fire performance/Euroclass full kit (ETICS)	B s1 d0	A1

Product characteristics

Test method

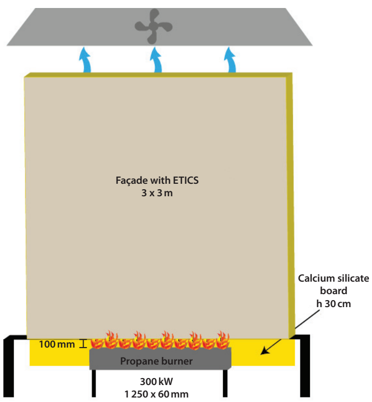
"The wall was submitted to a thermal attack of 300 kW for over 600 seconds".

The test method used was experimental and was performed on a thermal insulation composite system which was installed on a 3 x 3 m wall. The wall was submitted to a thermal attack of 300 kW for over 600 seconds. The linear diffusion burner (1 250 x 60 mm), fuelled with propane, was positioned at the centre of the vertical axis of the sample at a distance of 100 mm below the inferior edge of the sample.

If we consider the horizontal axis, the burner was positioned in such a way that half of its thickness was positioned below the inferior edge of the sample.

This set up was chosen in order that the fire can directly attack the bottom of the insulation system

A 300 mm high calcium silicate board was used to protect the back of the sample with the purpose of directing the flames towards the outside of the wall.

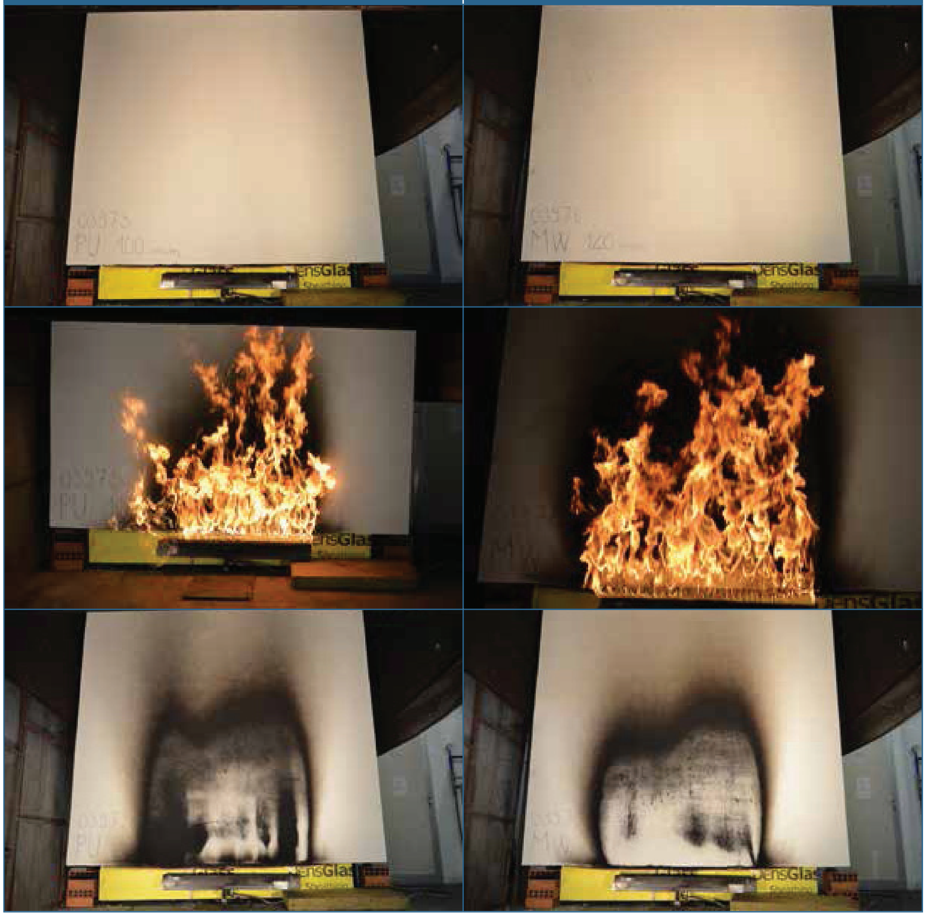


Experimental test method: equipment and test conditions

Test results

"[...], both the PU and the stone wool ETICS build-ups maintained their structural integrity and passed the test".

ETICS made with PU board Euroclass E	**ETICS made with SW board** Euroclass A1



Photos taken before, during and after the tests on two samples of the cladding systems

ETICS made with PU board Euroclass E	**ETICS made with SW board** Euroclass A1

Pictures taken after the removal of the render

In the large-scale façade test (Italian protocol), both the PU and the stone wool ETICS build-ups maintained their structural integrity and passed the test.

In both samples, the fire remained confined within the area affected by the burner and was self-extinguished after 10 minutes.

The main parameters evaluated by the test (the size of the damaged area and the total heat release) did not differ significantly between the two samples.

The result is significant when compared to the substantial differences in the reaction to fire classification of the two materials: Class A1 for stone wool and Class E for PU.

Also, in this case, the evaluation of the materials' behaviour in end-use conditions, which in all cases involves complex and non-homogeneous structures, is confirmed as an indispensable tool for the definition of fire safety criteria in buildings.

Conclusions

"It is recommended that all build-ups have to be tested [...] no matter whether they use combustible or non-combustible insulation".

- The reaction to fire performance of individual insulation products did not provide a complete picture of how these products perform in different end-use applications and, even less so, how entire buildings perform in a fire. In fact, the tests have shown that build-ups with combustible insulation can achieve a performance which is similar to that of build-ups with non-combustible insulation.
- Several build-ups with non-combustible insulation are "deemed to satisfy" in certain countries without any need to test. It is recommended that all build-ups have to be tested in these countries no matter whether they use combustible or non-combustible insulation.
- Europe should strive to adopt a harmonised large-scale test method for façades. The EOTA proposal comprising two scenarios should be finalised.