PU Europe

Factsheet

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Fire performance of thermal insulation products in end-use conditions

Roof insulation under bituminous waterproofing membranes

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. This factsheet summarises the results for insulation materials (PU and MW) used in roofing in case of external fire attack.

The tests were conducted and supervised by a notified body (L.S. Fire Testing Institute) using the B_{roof} (t2) test and comparing build-ups with largely similar U-values. The method is used in the market to evaluate the performance of roofings and allows the extrapolation of results to other similar roof configurations. Because of its high thermal performance, the PU build-up was considerably thinner than the stone wool solution.

Despite the different classifications - A1 for the mineral wool board and B s1 d0 for the PU board - the PU build-up passed the test (classified as B_{roof}), whereas the stone wool build-up failed (classified as F_{roof}) due to the propagation of fire.

The flame spread on the tested PU boards was well below the limit required to achieve B_{roof} (t2) classification whereas the behaviour of the SW board, despite its fire classification and being considered non-combustible, in these specific test conditions (designed to simulate real end-use applications), the SW panel did not hinder the fire, allowed flame spread and persistent flaming.

References

- *Fire behaviour in end use conditions – Research project 2014*, ANPE, L.S. Fire Testing Institute
- EN13501-5: *Fire classification of construction products and building elements. Classification using data from external fire exposure to roofs test*
- CEN/TS1187: *Test methods for external fire exposure to roofs*

Glossary

- ANPE: Associazione Nazionale Poliuretano Espanso rigido (Italian association for PU rigid foam)
- PU: Polyurethane (PUR/PIR)
- SW: Stone wool

Tested materials

A PU board and a stone wool board were tested.

Waterproofing membrane
In order to assess the fire behaviour of the roof build-up, a 2 mm thick bituminous membrane was used. This membrane is free from fire retardant agents and is classed as F_{roof} (t2) configuration.

PU board
The tested product is a PU board with flexible facings. One side is faced with fibreglass saturated with mineral coating while the upper side, designed with the consideration of the board coming into contact with a major fire, is covered by a special facer which is fibreglass with mineral coating.

Stone wool board
The tested product is a SW board. The

board is not protected by facers and is characterised by a double density that makes it especially suitable to insulate inclined roofs.

	PU board	Stone wool board
Declared thermal conductivity (λD) (W/mK)	0.028 (thickness from 20 to 70 mm)	0.036
Thickness applied for testing (mm)	70	100
Thermal resistance – board only (m^2K/W)*	2.5	2.75
Fire performance/Euroclass	B s1 d0	A1

Product characteristics
** Differences are due to the availability of the products in the market*

Test method

"The test can be performed under four different test conditions [...]. Each test stands on its own without the possibility to be replaced one by the other".

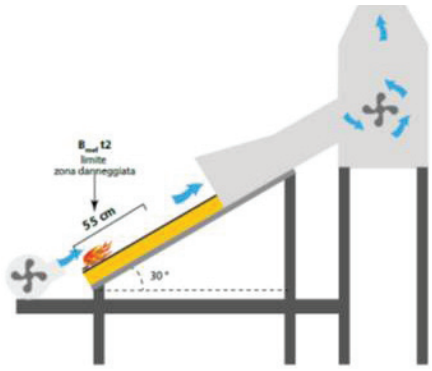
In case of external fire attacks on a roof, the evaluation of the insulation material is done according to the harmonised standard EN13501-5.

The test can be performed under four different test conditions (t1 to t4) as described in CEN/TS 1187 and Member States can use one or more test conditions. The four methods do not imply any ranking. Each test stands on its own without the possibility to be replaced one by the other.

The comparative tests have been performed according to CEN/TS 1187 (t2).

The test kit is composed of a support with an inclination of 30°, an insulation layer, and a free-standing waterproof membrane.

A wooden crib is set alight over the membrane and an extractor with 6 m/s air speed generates a ventilation of 2 and 4 m/s.



B_{roof} (t2): equipment and test method

When the fire has self-extinguished, or after 15 minutes (the maximum duration of the test), the spread of the flames is measured.

To achieve B_{roof} (t2) classification, the damaged area shall not exceed 55 cm.

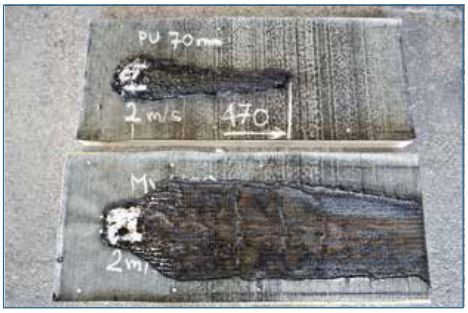
Test results

Results for 1st phase Air speed 2 m/s

"The PU build-up passed both phases of the test [...]".

	PU board Euroclass B s1 d0	Mineral wool board Euroclass A1
Damaged area on the membrane surface	480 mm	>900 mm
Substrate damages	Substrate was not damaged by flames but "blowing" of the intumescent layer was noted	Substrate was not damaged by flames, but smeared with soot
Extinguishing	Self-extinguished in 9 mins and 37 seconds	For safety reasons the kit was manually extinguished after 15 mins
End of smouldering (membrane)	9 mins and 37 seconds	Coincident with manual extinguishing

1st phase – Air speed 2 m/s



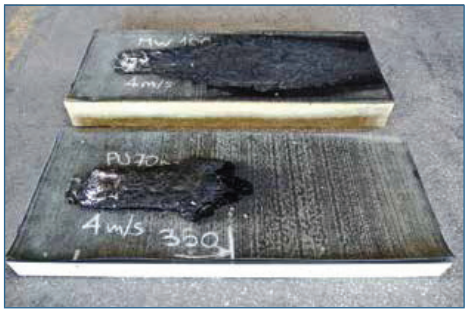
Top: PU board
Bottom: MW board

Results for 2nd phase Air speed 4 m/s

"[...], the tested PU boards constitute an effective barrier against flame spread and succeeded in minimizing damages on the membrane surface."

	PU board Euroclass B s1 d0	**Mineral wool board** Euroclass A1
Damaged area on the membrane surface	350 mm	>900 mm
Substrate damages	Substrate was not damaged by flames but "blowing" of the intumescent layer was noted	Substrate was not damaged by flames, smeared with soot
Extinguishing	Self-extinguished in 6 mins and 42 seconds	For safety reasons the kit was manually extinguished after 4 mins and 53 seconds
End of smouldering (membrane)	9 mins and 37 seconds	Coincident with manual extinguishing

2nd phase – Air speed 4 m/s



Top: MW board
Bottom: PU board

The PU build-up passed both phases of the test – classified as B_{roof} (t2) –, whereas the stone wool build-up failed – classified as F_{roof} (t2) – due to the propagation of the fire.

Due to char formation on the foam surface and the contribution of the specialized facer, the tested PU boards constitute an effective barrier against flame spread and succeeded in minimizing damages on the membrane surface. The flame spread was well below the limit required to achieve B_{roof} (t2) classification.

The behaviour of the MW panel board was completely different. Despite its fire classification and being considered as non-combustible, in these specific test conditions (designed to simulate real end-use applications), the panel did not hinder the fire, allowed flame spread and persistent flaming. The tests results show the need for further research and testing to determine the performance of products reflecting real-life use conditions. It is obvious that the behaviour of these materials during a fire can be better or worse than expected on the basis of the tests carried out on individual materials.

The classes assigned to the build-ups according to EN13501-5 were as follows:

- PU board: B_{roof} (t2)
- MW board: F_{roof} (t2)

Conclusions

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

In some countries, no B_{roof} test is required when "non-combustible" insulation is used (for example Finland). These test results show that such derogations are not always justified.

- The reaction to fire performance of individual insulation products does not provide a complete picture of how these products perform in different end-use applications and, even less so, how insulated building elements or entire buildings perform in a fire. In fact, the test has shown that build-ups with combustible insulation can achieve a performance which is similar or even superior 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.