

TECHNICAL INFORMATION

Published EUMEPS
on June 2025

PV Systems on EPS Flat Roofs

Reduced Fire Spread through Glass Fleece Installation

Background

Recent fire incidents involving photovoltaic (PV) systems installed on flat roofs have raised critical concerns regarding the fire safety of such roofing configurations, both in new constructions and during retrofitting projects. In response, the IVH, in collaboration with EUMEPS, has undertaken a series of comprehensive, large-scale fire performance tests.

This paper specifically examines the effectiveness of adding a glass fleece layer beneath the waterproofing membrane as an extra fire protection measure for Building Applied Photovoltaic Systems (BAPV) on flat roofs.

The results indicate that expanded polystyrene (EPS) flat roof systems, when properly configured, can achieve safe fire safety performance even when PV systems are installed. These findings provide validated design strategies for improving the fire safety of EPS-based flat roofs in both new buildings and refurbishment projects..

Introduction



Figure 1: Flat roofs insulated with EPS are ideal for the installation of PV systems.

PV systems can sometimes pose a fire hazard to the flat roof below. This is primarily caused by incorrectly installed or inadequately maintained PV systems. In view of the Industrieverband Hartschaum (IVH) and EUMEPS, Association of the European Manufacturers of Expanded Polystyrene, it is not primarily relevant which insulation materials the flat roof is insulated with.

The layers of materials laid over the insulation layer, such as the top waterproofing layer or the protective and separation layers between the insulation and the top waterproofing, are far more critical in determining a flat roof's fire behaviour, including the spread of fire in a vertical direction (fire spreading from the roof into the building) and the horizontal fire spread on the roof.

In the view of EUMEPS and the IVH, the replacement of combustible insulation with non-combustible insulation, which has been proposed on various occasions, does not generally lead

to an improvement in reducing the spread of fire on flat roofs. Such recommendations often create uncertainty among clients, planners, and contractors, leading to unnecessarily costly construction methods that are not economically viable, ecologically sound, or building-physically sensible. Additionally, these changes do not necessarily result in enhanced fire safety. This is because a roof structure functions as a system, where various components interact in complex ways. A system is more than just the sum of its parts, and a holistic approach should be taken into consideration.

Installing a PV system on a roof adds additional fire load due to the PV components themselves. Simultaneously, the heat reflection from a fire underneath a PV module increases the stress on the underlying roof structure.

Flat roofs insulated with EPS have proven to be reliable constructions for both new and existing buildings for decades. They continue to represent a safe option for lightweight industrial roofs as well as flat roofs with reinforced concrete structures.

Applied Testing Methodology

The Industrieverband Hartschaum e. V. (IVH) commissioned large-scale fire tests under real-scale conditions as described below. These tests were conducted and evaluated by the Dutch testing institute Kiwa BDA Testing B.V.¹

Flat roof systems with EPS in Germany were tested according to Technical Specification 1187², which evaluates the resistance of roofing systems to flying sparks and radiant heat.

To date, there is no standardised test method in Germany for additional fire exposure caused by PV systems. For this reason, the tests described below were carried out as per the CLC/TR 50670 test method³. The test method was chosen to enable comparability with fire tests previously carried out in other industries^{4,5}.

In this test, a 15 kW gas burner was used to generate a test fire lasting 10 minutes, followed by an observation period of 50 minutes. The goal of the test was to assess fire spread over a 7 m x 7 m roof area.

¹ 24L0474/2: comparative test on fire behaviour of flat roof waterproofing systems with different roof buildup and equipped with identical photovoltaic systems.

² TS 1187: test method for exposure of roofs to external fire

³ CLC/TR 50670: External fire exposure to roofs in combination with photovoltaic (PV) arrays - Test method(s)

⁴ European association of the polyurethane (PUR/PIR) insulation industry. 0151-L-20/4, Additional test report, Kiwa BDA Testing B. V.: Comparative tests on the fire behaviour of a flat roof waterproofing with different thermal insulation materials and equipped with identical photovoltaic systems, February 2022; Photovoltaics on flat roofs: Comparative fire tests on roof structures, IVPU (Industrieverband Polyurethan-Hartschaum), 2022

⁵ 0151-L-20/4: Comparative test on fire behaviour of flat roof waterproofing systems with different thermal insulation materials and equipped with identical photovoltaic systems.

Test with Single-Layer Glass Fleece Installation Between PVC Membrane and EPS Foam (Standard Setup)

In an initial test, the influence of the fibreglass fleece, which is typically used in EPS flat roof constructions underneath the PVC membranes, was examined. This test already demonstrated very limited horizontal fire spread on the PVC membrane compared to tests conducted with other insulation materials. During the observation period (50 minutes) the fire self-extinguished.

Test with Glass Fleece and Maximum Overlap of Individual Strips Between PVC Membrane and EPS Foam

The influence of the fibreglass fleece, typically used in EPS flat roof constructions underneath the PVC membranes, was further investigated in an additional test.⁵ This time, the individual glass fleece strips were laid with up to one metre between the PVC membrane and the EPS insulation. The maximum overlap was chosen to ensure the functionality of the glass fleece even with the thicker insulation layers in modern roofs.

A PV system with glass-film modules and an east-west orientation was tested on a 7 m x 7 m EPS flat roof surface (**Figure 2**).



Figure 2: Tested PV system consisting of four glass-film modules in an east-west orientation.

As a flat roof construction (**Figure 3**), a trapezoidal sheet metal roof was selected, with a 12 mm thick cement-bonded particleboard laid on top. This setup allows assessment as both a classic concrete roof and an industrial lightweight roof with steel trapezoidal profiles within a single test.

On top of the cement-bonded particleboard, a polyethylene vapour barrier was installed. This was followed by a two-layer thermal insulation system made of EPS with a total thickness of 220 mm and a compressive strength of 150 kPa (DAA dh), and a PVC waterproofing membrane with a thickness of 1.8 mm.

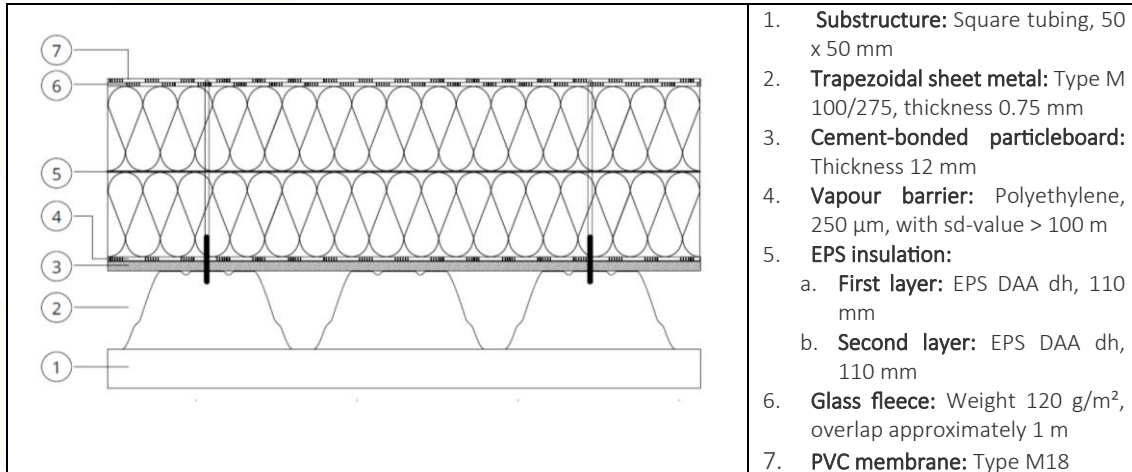


Figure 3: Cross-section of the roof structure: Tested industrial lightweight roof construction with EPS foam and maximally overlapping glass fleece installation (Layer 6) beneath the PVC roof membrane.



Figure 4: Flat roof with EPS foam and maximally overlapping glass fleece installation – The damage pattern demonstrates the effectiveness of the glass fleece and minimal fire spread underneath the completely destroyed PV system.



Figure 5: After the collapsed glass fleece and melted EPS insulation residues were removed, the undamaged vapour barrier (blue) on the cement-bonded particleboard was revealed.



Figure 6: Below the undamaged cement-bonded chipboard, the trapezoidal sheet metal is also undamaged. The trapezoidal sheet has not been burned through.

Summary of Results

The highest overlapping installation of glass fleece sheets led to a reduced horizontal spread of fire on the flat roof in the test setup than the test with single-layer glass fleece installation between PVC waterproofing and EPS insulation.

The cement-bonded particleboard, which was installed as the lower layer of the flat roof, effectively prevents fire from penetrating through the roof into the building, thereby stopping vertical fire spread.

The fire self-extinguished during the observation period.

The tests conducted with the specific described setup and materials demonstrated that the fire risk associated with an EPS flat roof system, with BAPV systems installed, can be mitigated. This can be achieved by adding an additional layer of glass fleece or by maximizing the overlap (by overlapping the sheets by half their width) between the PVC waterproofing and EPS insulation. These findings apply to both solid flat roof constructions and lightweight industrial roofs. The results reveal feasible solutions to enhance fire safety on EPS flat roofs equipped with PV systems. Therefore, EPS can be utilized for safe, efficient, and cost-effective new construction and modernization projects.

Legal Notice

All information is provided to the best of our knowledge and belief, without guarantee. Liability is excluded.

EUMEPS, Association of the European Manufacturers of Expanded Polystyrene
71 Avenue Cortenbergh, B-1000 Brussels, Belgium

IVH, Industrieverband Hartschaum
Friedrichstraße 95 / Pb 48, 10117 Berlin, Germany