

Standard Hi-MO X10 modules at Ahlsell Norge's 7.6 MWp rooftop installation, Norway

Beyond Class A: understanding PV module fire performance

A Class A fire designation carries considerable weight when photovoltaic (PV) modules are specified for rooftops. It can be taken as an indication of the highest level of fire safety. The technical meaning is narrower.

Fire classifications are tied to defined standards, test methods and acceptance criteria. They establish how a product performed under specified conditions. They do not necessarily describe every aspect of its behaviour in a fire, nor do they establish that two products carrying the same classification will respond identically.

That distinction is becoming increasingly relevant as PV moves onto buildings where the consequences of fire extend well beyond the solar installation. Warehouses contain valuable inventory, factories depend on uninterrupted production and hospitals, data centres and other critical facilities have particularly low tolerance for disruption.

For developers, asset owners and specifiers, the question is therefore not only whether a module carries a Class A designation, but how much that rating reveals about its fire performance compared with another module carrying the same classification.

The answer starts with understanding what Class A actually tests.

What Class A establishes and why it does not always mean the same thing

'Class A' is not a universal description of fire safety. Fire classifications are tied to specific standards and test methods, and those standards assess different aspects of fire behaviour. Two products carrying a Class A designation may therefore have been tested for different risks.

Under UL 790, a standard developed by the US-based organisation Underwriters Laboratories (UL), Class A relates to performance under severe external fire exposure. The standard includes four fire-exposure test methods: intermittent-flame exposure, spread of flame, burning brand and flying brand. The module-level assessment discussed here uses two of these methods: spread of flame and burning brand.

The tests examine how far flames spread, whether fire penetrates the module and roof covering, whether sustained flaming occurs and whether burning or glowing material falls



from the test deck. Passing establishes that the tested product met the defined Class A criteria under those conditions.

IEC 61730, developed by the International Electrotechnical Commission (IEC), is the international safety qualification standard for PV modules. It covers electrical, mechanical and fire-related safety, giving it a broader scope than UL 790. The fire test designated MST 23 in IEC 61730-2 uses methods based on UL 790.

This distinction also defines what Class A does not establish. A UL 790 Class A result does not certify that a module cannot ignite internally. It describes how the tested product responded to an external fire under defined test conditions. Potential causes of fire within a PV module or system, such as localised overheating, electrical connection faults or arcing, require separate consideration and supporting evidence.

European standards add another layer. EN 13501-1 classifies the reaction to fire of construction products, while EN 13501-5 addresses the external fire performance of roofs and roof coverings. These standards assess different aspects of fire behaviour and use their own classification systems. A UL 790 Class A result therefore cannot simply be translated into a European fire classification.

Class A is consequently a meaningful classification, but not a synonym for 'fireproof'. Nor is the letter A, on its own, enough to compare two products assessed under different standards. UL 790 Class A, European reaction-to-fire classes and European roof-fire classifications assess different properties and cannot simply be substituted for one another.

Project developers, engineering, procurement and construction (EPC) contractors and asset owners need to ask which standard applies, what was tested and how the module performed. Was the complete module tested? Were the test samples specially submitted or randomly selected from normal production? And does the certification cover the product that will actually be supplied?

Performance differences within Class A

A fire classification is a threshold, not a complete description of fire behaviour. Two modules can meet the same acceptance criteria without behaving identically throughout the test. The classification does not express every difference in flame spread, integrity or the sequence in which components fail.

For example, a report may confirm that flame spread remained within the Class A limit without stating the exact distance reached. It may confirm that a burning brand caused no penetration without recording how much longer the specimen could have resisted exposure. Both are successful results, but neither supports an unmeasured performance claim.

More detailed testing can record the timing of glass failure, fire penetration, rear-side flaming or the release of burning material. Such observations provide a more complete picture of fire behaviour, without creating a category above Class A.

Fire resistance cannot be reduced to thicker glass

Glass is one of the most visible elements of a module's response to external fire. Its type, construction and resistance to thermal stress influence how long the module surface maintains its integrity. But thicker glass alone does not establish better fire performance.

A PV module is a system of glass, cells, encapsulants, electrical connections, junction boxes and other materials. Their interaction determines how the module behaves when exposed to fire or when a fault develops within it. Fire performance is therefore the result of the complete physical system, not a single component.

These elements address different aspects of fire risk. Flame-retardant polymers and fire-resistant glass can influence how a module responds once exposed to fire. Electrical connections, connectors and junction-box design, together with connection quality and manufacturing controls, can influence the risk of faults and arcing. Cell behaviour under partial shading can affect localised temperatures and hot-spot formation.

The evidence for individual components also has a defined scope. A flammability rating for



Another view of Ahlsell Norge's rooftop installation with standard Hi-MO X10 modules

an encapsulant or junction-box material, for example, cannot automatically be applied to the assembled module. Component-level evidence and module-level fire classification answer different questions.

The same applies to the mechanisms being addressed. Reducing potential sources of ignition, such as hot spots or arc-related faults, is different from limiting fire propagation after external exposure. A module can incorporate measures for both, but the supporting tests answer separate questions.

A Class A designation tells buyers that the complete tested construction met the specified classification criteria. It does not explain which design features produced that result or what additional measures the module incorporates to address fire risks outside the scope of the classification. Evaluating fire resistance therefore requires looking beneath the Class A label at the module construction, the individual safety measures and the evidence supporting them.

Beyond Class A

The Hi-MO X10 Guardian Fire-Resistant from LONGi combines measures designed to resist external fire exposure with features intended to reduce potential sources of ignition within the module. The testing reported by the manufacturer covers several aspects of fire behaviour that a single classification cannot describe.

According to LONGi's reported test results, the module has a Class A fire rating under UL 790 and passed spread-of-flame and burning-brand testing under IEC 61730-2 MST 23. Flame spread remained within the Class A limit, with no significant lateral spread and no flaming or glowing parts falling from the test assembly. In the burning-brand test, the burning source did not penetrate the module and roof covering and the module showed no sustained flaming.

The reported results also include Class B under EN 13501-1, indicating a very limited contribution to fire under the prescribed test conditions. This result complements the external fire performance assessed under UL 790.

The module has also achieved B_{roof}(t4) under EN 13501-5, according to the manufacturer's results. This is the highest classification under the t4 method for assessing the performance of roof systems exposed to external fire. The result applies to the roof construction and installation conditions covered by the assessment.

The modules used for the TÜV Rheinland Class A tests were randomly selected from a normal production batch, according to LONGi. This provides evidence that the tested specimens were representative of normal production, addressing a question that the classification alone cannot answer.

The fire-resistant design itself addresses several mechanisms. Fire-resistant glass and flame-retardant encapsulation materials are designed to help limit fire propagation when the module is exposed to fire. At cell level, current-management features are intended to limit localised overheating under partial shading, while reinforced electrical connections, connectors with enhanced sealing and the junction-box design address potential fault and arcing risks.

Fire resistance is therefore not treated as a property of the glass alone, but as a combination of glass, encapsulation materials, electrical components and cell-level design.

Additional high-temperature testing examines behaviour beyond the conditions expressed by the Class A classification. In LONGi's internal laboratory testing, the module was exposed to flame temperatures approaching 1,000 °C for up to 1.5 hours under controlled conditions without structural burn-through.

For buildings where fire can result in substantial asset loss, business interruption or risks to people, this distinction has practical consequences. A Class A designation remains an important starting point, but increasingly it should prompt a second question: what evidence sits behind it?

For specifiers, this means examining the test standard, the behaviour observed during testing, the origin of the test samples and the controls that connect certification with series production.

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