

# Photovoltaic systems in building Regulation and testing (Europe)

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# DEFINITIONS

- Photovoltaic (PV) modules and systems are yet covered by a series of European harmonized standards established jointly between CEN and CENELEC, known as EN 50583 parts 1 and 2
- BIPV (Building Integrated Photovoltaic modules)
- BAPV (Building Attached photovoltaic module)

BIPV tiles on a roof



# BIPV

- BIPV are defined as providing a function in a building as defined in the European Construction Product Regulation.
- The BIPV modules must be able to perform one or more of the following functions:
  - mechanical rigidity and structural integrity;
  - primary weather impact protection: rain, snow, wind, hail;
  - energy economy, such as shading, daylighting, thermal insulation;
  - fire protection;
  - noise protection.
- BIPV take parts for the integrity of the building's functionality. If an integrated PV module is dismounted, it would have to be replaced by an appropriate building component.



# BAPV

- ❑ BAPV are defined as when the PV modules are mounted on a building envelope and do not fulfil the criteria of a BIPV for building integration.
- ❑ The integrity of the building functionality is independent of the existence of a building-attached photovoltaic module.

BAPV module on tile roof



# IGNITION SCENARIOS

## □ Causes of electrical fire ignition: overload and short circuit

- Mitigated by respect of national electric codes

## □ Internal sources to PV components and systems

- arcing
- hot spots. A hot spot on a PV module produces localized heating on the back sheet of the module that could ignite and start a fire.
- PV cell misalignment or the used of reverse currents in a module (both called mismatch) are responsible for another mechanism of fire ignition.
- Lack or bad connection among modules, strings (a series connection of two or more modules) and inverter could generate enough heat that could start a fire.

## □ External sources (PV modules promotes the fire spread or the fire risk).

- include classical building fires such fire from windows, through facades and roofs, but also external ones such fires from adjacent buildings, fires from wildland areas, etc.
- in the first case, ignition can be caused by direct flame impact, heat transmission across materials, etc. In the second case, ignition can occur from radiation, combination of convection and radiation or firebrands.



# PERFORMANCE REQUIREMENTS - MODULES

- The modules may have to comply to IEC/EN 61730-2. In this standard, the fire test MTS 23 could be performed only if requested by the manufacturer of the PV modules.
- The MTS 23 test is carried out according to the ANSI UL/790 standard, and the fire performance classification of PV module ranges from Class C – “fundamental fire rating”, to Class B or Class A – “highest fire rating”. The standard also requires a minimum fire resistance rating of Class C for any building-mounted module.
- Furthermore, UL 790 Standard addresses two fire protection concerns: flame spread along the roof and fire penetration.
- The EN 61730-2 standard also states that the MTS 23 test specifies fundamental requirements and may not be sufficient to satisfy the needs for a module intended for building applications according to local or national building fire code requirements.



# PERFORMANCE REQUIREMENTS – PRODUCTS

- EN 50583 series refers to the EN13501-1 standard, having a minimum requirement of Euroclass E
  - Category C façade PV elements as defined in EN 50583-2 should be performed according to EN 13501-2 and EN 13501-5
  - Category D requires only EN 13501-2 Fire classification.
- For PV flexible plastic and rubber sheets, the fire performance could require B<sub>roof</sub> classification according to EN TS 1187 and EN 13501-5 (testing options T1, T2, T3 or T4 depend to the national requirements).
- BIPV glass in façade: both the IEC certification for PV products and the certification in accordance with the EN 14449, which covers both fire resistance according to EN 13501-2 and reaction-to-fire E class according to EN 13501-1.
- Other provisions may be included in local or national building fire code requirements.



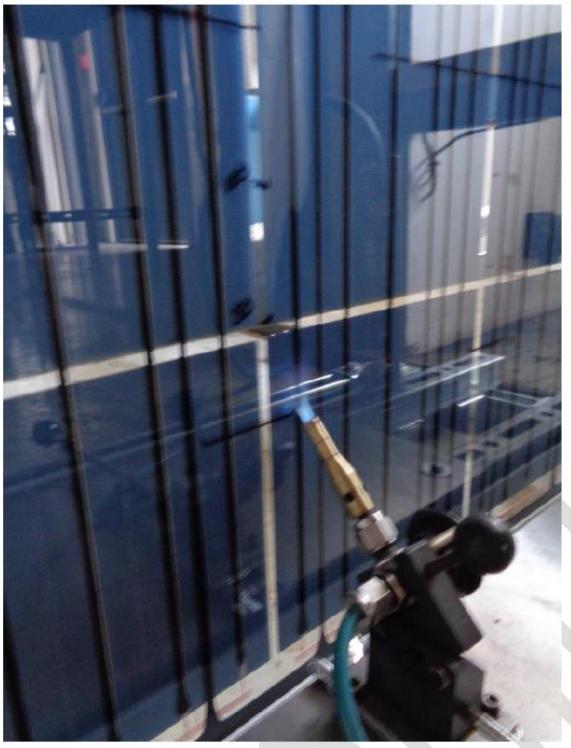
# TESTS - EXAMPLES

- CLC/TR 50670
- Normally on dummy inert roof
- May be also used to check at the interaction between roof complex and PV module



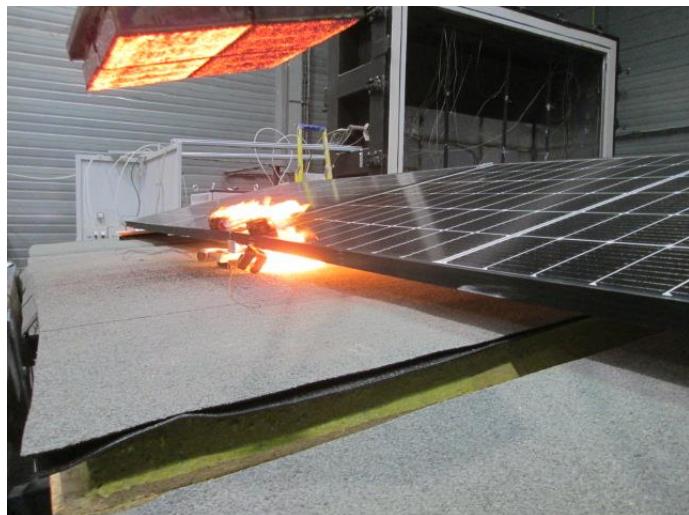
# TESTS - EXAMPLES

- EN ISO 11925-2 and EN 13823 (Euroclass) tests



# TESTS - EXAMPLES

- B<sub>roof</sub> T3 (EN TS 1187): firebrands + radiation + wind
- Test according to French protocole





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