



Solar America Board for Codes and Standards

Flammability Testing of Standard Roofing Products in the Presence of Stand-off Mounted PV Modules

A Solar ABCs Interim Report

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Overview

- In the Summer of 2009, the Solar America Board for Codes and Standards (Solar ABCs) in partnership with Underwriters Laboratories Inc. (UL) designed and conducted tests to characterize the effects of stand-off mounted (elevated, parallel to roof surface) PV modules on the fire rating of Class A rated roofing systems. All tests were conducted by UL in Northbrook, IL, with assistance from representatives of Solar ABCs. Funding for this research was provided by the U.S. Department of Energy.
- This testing was conducted in response to questions that arose during the development of the Cal Fire OSFM (Office of State Fire Marshall) *Solar Photovoltaic Installation Guidelines*. These questions were restated during discussions held in San Jose, CA on 20 March 2008 between members of the California Solar Energy Industries Association (CALSEIA) and Underwriters Laboratories (UL).

Test Description

- To assess flammability, UL 790 **Spread of Flame** and **Burning Brand** tests were used
- These tests are currently used on all roofing products and also on all PV modules (during UL 1703 certification)
- The tests reported here were conducted to evaluate *the combined results* of modules and roof coverings *as a system* when exposed to fire or flames.
- Tests evaluated different combination of modules, standoff heights and application of fire either directly to the roof covering or to the top of PV modules

Burning Brand Test Results

- Tests were conducted in which the Burning Brand was placed on top of the PV modules or directly on the roof covering (beneath the modules)
- In all cases, when Burning Brand was placed on top of either Class A or C modules (the standard geometry for UL 1703) the roof system remained compliant with Class A requirements
- In all cases, when Burning Brand was placed directly on the roof covering beneath Class A modules, the roof covering failed to meet Class A requirements
- When Burning Brand was placed directly on the roof covering beneath Class C modules, results were inconsistent (some tests resulted in compliance, others not)

Spread of Flame Test Results

- Spread of Flame tests were conducted in which the flame impinged directly on the roof covering (beneath the PV modules)
- It was observed that any panel (even a noncombustible panel) mounted in standoff position increases temperature and heat flux present on the roof surface when the flame is applied directly to the roof covering
- The “channeling effect” produced by the standoff module retained flame and hot gases close to the roof surface not allowing them to dissipate as they do when not confined
- Due to this effect, **in all cases**, the presence of either Class C or Class A modules mounted above Class A roof coverings resulted in roofing assemblies failing to meet the Class A Spread of Flame requirements (i.e. flame spread of greater than 6 feet in the allotted time)

Spread of Flame Test – Important Note

- Some of the spread of flame tests were conducted using noncombustible roof surfaces. It is important to understand that determination of fire class rating using the spread of flame test is based on the observed distance flame travels during the test and that ignition of the roof covering is not required for determination of results
- Not controlling the spread of flames represents a potential hazard to adjacent structures or exposed portions of the same structure

Summary of Test Results

Table E1. Results of Burning Brand Tests

Roof Rating	PV Rating	Brand Size / Position	Fire Performance Result
A	C	Class A / PV	Compliant
A	C	Class A / Roof	2 Compliant/ 1 not compliant
C	C	Class C / Roof	Not compliant
A	A	Class A / Roof	Not compliant

Table E2. Results of Spread of Flame Tests

Roof Rating	PV Rating	Flame Spread
A	C	Greater than 8 ft.
A	A	Greater than 8 ft.
C	C	Greater than 8 ft.
Noncombustible	C	Greater than 8 ft.
Noncombustible	A	Greater than 8 ft.

Solar ABCs Recommendations

- At present, field experience and thorough review of fire incident data do not indicate an urgent need to revise current practice with regard to code requirements. A major task in the next round of research will be to quantify the potential risk identified by the test results.
- Further tests should be conducted to refine a system fire performance test and the relevant pass/fail criteria that includes roof materials as well as the PV module, and to characterize mitigation methods. (These tests are presented in Interim Report.)
- Meetings should be held with fire safety authorities, the solar industry and other interested stakeholders to discuss these tests results and to consult with stakeholders to determine future test requirements, as needed.
- Results of these tests and of subsequent stakeholder meetings should be communicated to the UL 1703 Standards Technical Panel for their consideration regarding impact of these results on that test standard.

For More Information:

Full Report Available Online:

<http://www.solarabcs.com/flammability/>

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