

Building Integrated Photovoltaic Systems (BIPV) Testing and Certification



Safety. Science. Transformation.™



Introduction

As solar photovoltaic (PV) technology continues to mature, it is being increasingly integrated into building construction. PV technology replaces conventional materials in parts of the building envelope, such as roofs, curtain walls, and windows. As traditional roof installation costs continue to increase and PV prices decrease, Building Integrated Photovoltaics (BIPV) are gaining popularity. Architects are now integrating the technology into their designs for aesthetic value while helping building owners save on their cost of electricity with

environmentally friendly generation. Furthermore, BIPV helps comply with energy conservation and sustainability requirements and helps achieve Leadership in Energy and Environmental Design (LEED) Building certification.

UL Solutions has taken an early leadership role in the testing and certification of buildings constructed with BIPV products and can help you maneuver the many complexities encountered with multiple safety certifications.

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What is BIPV?

BIPVs are products that incorporate photovoltaic modules that also function as a component of the building envelope. They are designed for the basic requirements of photovoltaic products and the construction materials they replace. BIPV products are for mounting integrally to the structure or protective surfaces of a building in one of two primary installation methods:



To serve as the roof or as a significant component of the roofing system of a building



To serve as part of a structural or non-structural component of a building, such as a curtain wall, facade, window, atrium, or skylight



Solar roofing

Solar roofs can be installed in place of traditional roofs using interconnecting solar sections or individual solar tiles. Some BIPV manufacturers have developed solar tiles that appear aesthetically similar to conventional roofing when viewed from the street level. Solar tiles are installed together to construct solar roofs with varying generation capacities. Solar tiles are made with tempered glass to make them stronger than standard roofing tiles that tend not to degrade over time, like asphalt or concrete tiles.¹

In-roof solar panels—Roof-integrated solar panels are similar to traditional on-roof panels, except that they are installed in place of a section of tiles and act as the roof covering. Traditional roofing tiles are used where solar energy generation is inefficient.

Complete solar roof—Integrated PV panels replace conventional roofing that covers the entire roof. Dummy panels are used where generation is not feasible.

Solar roof tiles—Solar PV tiles that emulate standard roof tiles are a fast-growing field. Dummy tiles are used in place of PV tiles where sunlight is not easily captured.





Solar facades or curtain walls

Most large multi-story buildings add curtain walls or façades to maximize energy efficiency or design. With the additional impact of free, renewable energy, BIPV facades will accomplish this function. While they can be built from crystalline plates, thin film solar is typically used at vertical angles and in the shade for its superior efficiency because the sides of tall buildings are usually vertical and often shaded. Also, the multi-layered BIPV materials allow it to provide noise insulation when used as a building cover.²



Solar glass

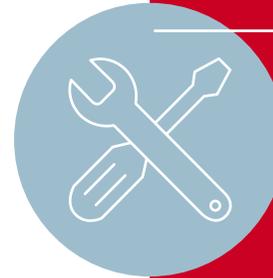
Conventional glazing is replaced with solar glass to generate energy where there is restricted roof space, as is often the case for multi-story buildings. Solar windows and skylights in various colors can be rendered fully opaque or translucent up to 50%. In addition to producing electricity, solar glass has the advantages of minimizing glare and enhancing insulation of temperatures – all of which are critical in large office buildings. PV glazing reflects infrared light, which reduces heat transfer through the glass and helps keep heat out during the summer.

Several types of PV materials can be integrated into glass. For example, special solar PV glass blocks can replace traditional glass blocks. These glass blocks contain solar cells with specialized optics that focus the light onto the PV material.¹

The BIPV modules described here can be used in many other building applications, including parking shelters, balconies, pergolas, eaves and greenhouses, to name a few.

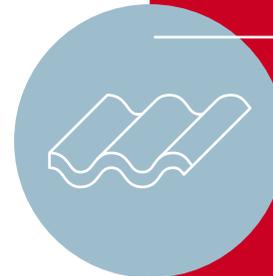
Safety certification for BIPV products is more stringent than for conventional PV modules

The National Electrical Code (NEC), International Building Code (IBC) and International Residential Code (IRC) require that all PV products that are installed on or around a building must be certified by a Nationally Recognized Testing Laboratory (NRTL). Because of these Code requirements, all BIPV products are subjected to the same electrical certification and safety testing standards as conventional PV modules.



Product installation concerns for PV panel systems include:

- Utility compatibility and interaction
- Environment (e.g., indoor, outdoor, hazardous location)
- The maximum number of modules (affecting voltage/current/short-circuit)
- Fire exposure ratings
- Wind and snow loading
- Mounting and attachment
- Grounding and bonding
- Shading



Since some BIPVs are designed to replace roofing material directly, a BIPV system must be evaluated not only as a PV module but also as a roofing material with additional Code required testing such as:

- Fire testing
- Impact testing
- Wind resistance
- Wind-driven rain
- Environmental testing for conditions like:
 - Temperature
 - Humidity



BIPV systems compliance with various safety standards

BIPV systems are connected to the grid and feed energy back into the grid or a local power supply, which is the key reason BIPV products must conform to both PV and building product standards. UL Standards and Engagement has developed PV building construction standards that have helped advance this new and growing industry.



UL 61730-1, the Standard for Photovoltaic (PV) Module Safety Qualification - Part 1: Requirements for Construction



UL 61730-2, the Standard for Photovoltaic (PV) Module Safety Qualification - Part 2: Requirements for Testing



UL 790, the Standard Test Methods for Fire Tests of Roof Coverings



UL 580, the Standard for Tests for Uplift Resistance of Roof Assemblies



UL 2703, the Standard for Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels

Subsequently, **UL 7103**, the Outline for Investigation for Building-Integrated Photovoltaic Roof Coverings, was developed as the overarching outline to certify a BIPV system. The Standards listed above are all referenced in UL 7103.

Engage early with UL Solutions Advisory Services for faster time to market

Advisory Services can help you navigate the complex world of conformity assessment and the associated requirements. We can help with early document review so you can manage all elements of project risk associated with mandatory, voluntary and customer approvals. These services more effectively support your project, intending to increase your speed to market.

A dedicated expert will work with you from project ideation through decommissioning. This focus eliminates interpretation issues that frequently happen when projects are handed off. We can support with the following:

- Conduct a preliminary investigation
- Clarifying certification, regulatory and standard (technical) requirements
- Referencing the need to comply with a standard or similar
- Conduct testing (including validation or performance testing) and report results
- Confirm compliance with the standard by construction evaluation and testing
- Explain findings
- Discuss product concepts and how the standard applies
- Discuss new product concepts to consider developing new certification requirements
- Evaluate installation instructions and user manuals
- Participate in design reviews with comments limited to compliance with applicable certification requirements
- Custom services are also available

Why UL Solutions for building integrated photovoltaic (BIPV) system testing and certification

Integration of PV systems into building products and architectural designs is growing. UL Solutions' safety science leadership, regulatory expertise and experience in the building and solar industries uniquely position us as the partner of choice for testing and certification of BIPV products into the building envelope.



Sources

1. EE Power, The Basics of Building-Integrated Photovoltaics (BIPV) Design, <https://eepower.com/technical-articles/the-basics-of-building-integrated-photovoltaics-bipv-design/#>
2. SolarLabs, The BIPV system: The Perfect amalgamation of Urban Development and Energy generation, <https://thesolarlabs.com/ros/bipv-system/>



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