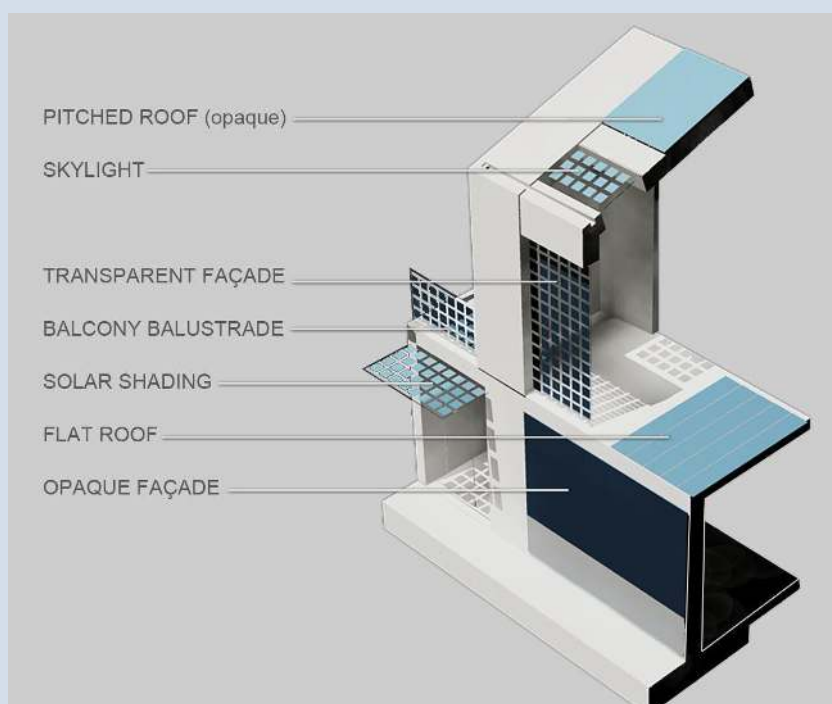


Analysis of requirements, specifications and regulation of BIPV



Report IEA-PVPS T15-08: 2019

PVPS

PHOTOVOLTAIC
POWER SYSTEMS
PROGRAMME

INTERNATIONAL ENERGY AGENCY
PHOTOVOLTAIC POWER SYSTEMS PROGRAMME

**Analysis of requirements, specifications
and regulation of BIPV**

IEA PVPS Task 15

Subtask C – International framework for BIPV specifications

Draft Report IEA-PVPS T15-08: 2019

July 2019

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Cover photo: Possible types of integration of photovoltaics as building elements. Copyright: SUPSI

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Contents

Contents	4
Foreword	5
1 Introduction	6
2 Analysis of specifications and regulations	7
2.1 Overview of specifications and regulations	7
2.1.1 International standardisation of BIPV	7
2.1.2 Standards which address BIPV but are not dedicated BIPV standards	9
2.2 Analysis of existing international standards (including drafts)	12
2.2.1 History of BIPV standardization	12
2.2.2 Technology mapping of BIPV standards	13
2.2.3 Relevant international standards corresponding to European standards in EN50583	14
3 Requirement analysis	17
3.1 Requirement items for BIPV	17
3.2 Requirement categorization	25
3.3 Requirement level for international standardization of BIPV	25
4 Summary	31
5 References	32
6 Referenced standards	32
7 Abbreviations and Acronyms	38

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9th July, 2019

Seiji Inoue and Helen Rose Wilson

Corresponding authors of this report

Foreword

The International Energy Agency (IEA), founded in November 1974, is an autonomous body within the framework of the Organization for Economic Co-operation and Development (OECD), which carries out a comprehensive programme of energy co-operation among its member countries.

The IEA Photovoltaic Power Systems Programme (PVPS) is one of the technological collaboration programmes (TCP's) on research and development within the International Energy Agency (IEA). IEA PVPS has been established in 1993, and participants in the programme have been conducting a variety of joint projects regarding applications of photovoltaic (PV) conversion of solar energy into electricity.

The mission of the PVPS is "...to enhance the international collaboration efforts which accelerate the development and deployment of photovoltaic solar energy as a significant and sustainable renewable energy option...". The underlying assumption is that the market for PV systems is gradually expanding from the niche-markets of remote applications and consumer products to rapidly growing ones for building-integrated and centralised PV generation systems.

Building Integrated PV (BIPV) is seen as one of the five major tracks for large market penetration of PV, besides price decrease, efficiency improvement, lifespan, and electricity storage. IEA PVPS Task 15 is an international collaboration to create an enabling framework and to accelerate the penetration of BIPV products in the global market of renewables and building envelope components, resulting in an equal playing field for BIPV products, Building Applied PV (BAPV) products and regular building envelope components, respecting mandatory, aesthetic, reliability and financial issues.

To reach this objective, an approach based on five key developments has been developed, focussed on growth from prototypes to large-scale producible and applicable products. The key developments are dissemination, business modelling, regulatory issues, environmental aspects, and research and development sites.

This Task contributes to the ambition of realizing zero energy buildings and built environments. The scope of this Task covers new and existing buildings, different PV technologies, different applications, as well as scale difference from single-family dwellings to large-scale BIPV application in offices and utility buildings.

The current members of IEA PVPS Task 15 include: Austria, China, Belgium, Canada, Denmark, France, Germany, Italy, Japan, Korea, Norway, The Netherlands, Spain, Sweden and Switzerland.

Further information on the activities and results of the Task can be found at www.iea-pvps.org.

Michiel Ritzen, operating agent IEA PVPS Task 15

July 2019

1 Introduction

This report focuses on the requirements, specifications and regulations relevant to the development of BIPV performance and safety standards. After presenting a comprehensive list of possible requirement items and analysing specifications and regulations related to BIPV, this report provides information and proposals to support the development of international BIPV standards, one of the key elements that can contribute to accelerate the market uptake of BIPV.

2 Analysis of specifications and regulations

2.1 Overview of specifications and regulations

2.1.1 International standardisation of BIPV

Building integration of photovoltaics always has to deal with two different standardization and regulation schemes: one derived from the requirements from the building side, often regulated in local building codes, and international ISO standards; the other from the electrical side, with international IEC standards, and also mandatory, not fully harmonized local regulations.

While one standard, the EN 50583 series “Photovoltaic in Buildings”, was issued in 2016 at the European level, different new work item proposals were launched internationally, the ISO/TS 18178 (Laminated Solar PV glass) by ISO TC160 (Glass in building), and several within the IEC technical committee TC82 (Photovoltaics). 82/1055/NP (PV roof applications, 2015), resulting in pr IEC 63092, and 82/888/NP (PV curtain wall applications, 2014), resulting in pr IEC 62980, were not successful, or made very slow progress over several years. Therefore, in 2017, a new attempt was made within IEC TC82 (82/1339/DC) to establish a project team¹, the PT 63092 “Building Integrated Photovoltaics (BIPV)”, which included experts from ISO, IEC, and the IEA PVPS Task 15. This project team comprises 40 members from 15 different countries.

In the following, these four standards proposed at the international level (ISO and IEC) and at the regional level (EN) will be briefly described.

2.1.1.1 EN 50583: Photovoltaics in building

Status: The document was prepared by CENELEC TC 82 “Solar photovoltaic energy systems” and was published in January 2016.

EN 50583 applies to photovoltaic systems integrated into buildings with the photovoltaic modules used as construction products. Because the definition of BIPV addresses the photovoltaic modules and their mounting and electrical systems, EN 50583 consists of *Part 1 BIPV modules* and *Part 2 BIPV systems*.

It is a two-part umbrella standard that focuses on the following requirements for products and systems.

- General requirements
- Electrical requirements
- Building-related requirements
- Requirements for products with glass panes
- Requirements for products without glass panes
- Labelling requirements

¹ A Project Team (PT) is a team dedicated to preparing a specific document within a technical committee (TC). In contrast to a Working Group (WG) dealing with many standards in different stages, a PT is organized temporarily for developing a specific standard. The PT format was chosen as it was clear that it is not only a WG2 (PV Modules) issue, since system aspects (WG3) and topics from other working groups must be addressed. For current information about the scope, and membership of PT 63092 see:

https://www.iec.ch/dyn/www/f?p=103:38:8299336743964:::FSP_ORG_ID,FSP_APEX_PAGE,FSP_PROJECT_ID:1276,23,23167

- System documentation, commissioning tests and inspection requirements

The requirements on modules containing glass panes are further categorised according to the modules' mounting position in the building envelope.

In addition to referencing international electro-technical photovoltaic standards such as IEC 61215, IEC 61646 and IEC 61730, typical standards from the building sector are also included, such as: EN 13501 (Safety in case of fire); EN 13022 (Safety and accessibility in use); EN 12758 (Protection against noise). As the BIPV modules and systems are construction products and contain electrical components, they are subject to the European Construction Product Regulation CPR 305/2011, the Low Voltage Directive LVD 2014/35/EU and the Electromagnetic Compatibility Directive ECD 2014/30/EU.

2.1.1.2 ISO/TS 18178: Glass in building - Laminated solar photovoltaic glass for use in buildings

Status: ISO/FDIS 18178 was disapproved in November 2016, and re-proposed as an ISO/TS (technical specification) in September 2017. The ISO/TS was issued in October 2018. ISO TC160 SC1 WG9 plans to upgrade this TS to an IS.

This document specifies requirements for appearance, durability and safety as well as test methods and designation for laminated solar photovoltaic (PV) glass for use in buildings.

Laminated solar photovoltaic glass is defined as laminated glass that integrates the function of photovoltaic power generation.

ISO 12543 (Glass in building — Laminated glass and laminated safety glass) is referenced for many of the requirements other than electrical properties.

IEC 61215 (Terrestrial photovoltaic (PV) modules — Design qualification and type approval) is referenced for many of the electrical requirements.

This standard allows the use of various types of glass (float glass, patterned glass, etc.), solar cells (crystalline silicon solar cells, thin-film solar cells, etc.) and interlayers (polyvinyl butyral, ethylene vinyl acetate, etc.).

2.1.1.3 Former pr IEC 62980: Photovoltaic modules for building curtain wall applications

Status: Project IEC 62980 started in 2014 with the new work item proposal 82/888/NP for PV curtain wall applications, and was implicitly cancelled and incorporated into the new IEC 63092 project at the IEC/TC82 plenary meeting that took place in Nara (Japan) in May 2017, where it was decided: “ On the basis of the approved projects 63092 and 62980, [to] form a new Project Team for Building Integrated Photovoltaics (BIPV), with participation from ISO TC 160 and IEA (PVPS Task 15) through existing liaisons, and CENELEC, through the relevant IEC national committees”.

Original scope: This former project defined the major technical characteristics of photovoltaic systems installed in buildings with the construction method of curtain walls, and included performance requirements and test criteria to ensure structural stability and electrical safety. It included a classification of curtain walls. The test method included ground continuity, insulation, wind load (preliminary test), air leakage, water resistance (static and dynamic), structural performance, seismic movement, thermal cycling, soundproof performance, fire resistance, thermal insulation and visual inspection before and after the tests. PV modules were required to meet the performance criteria specified in this former draft.

2.1.1.4 Former pr IEC 63092: Photovoltaics on roof

Status: This project started with the new work item proposal 82/1055/NP for PV roof applications in 2015, and was restructured after the IEC/TC82 TC 82 plenary meeting in Nara, Japan, in May 2017. A new approach for IEC 63092 now replaces the previous IEC projects 63092 and 62980.

This former project addressed the photovoltaic modules and systems that are to be installed on a building's roof and constitute the whole or part of the roof. It specified the performance requirements for the PV modules and for the roof into which the PV modules are integrated, and included a test procedure and criteria for the PV modules with the complete assembled units, including the frames and anchors for installation in the building. Tests included wind resistance, load strength, impact resistance, fire resistance, ground continuity, impulse voltage, IP rating and initial and final visual inspections.

2.1.1.5 Current pr IEC PT 63092: Photovoltaics in buildings

Status: The IEC project team PT 63092 is currently responding to comments by national committees on the CDs of Parts 1 and 2.

EN 50583 was taken as the starting point for this proposed standard, which also consists of two parts, Part 1: Building integrated photovoltaic modules and Part 2: Building integrated photovoltaic systems. Explicit references to Directives and Regulations of the European Union have been replaced by more general language and references to EN standards have been replaced by those to international standards wherever possible. Classification schemes prepared within IEA-PVPS Task 15, Subtask C, Activity C2 and documented in this present report were taken into account in preparing pr IEC PT 63092. In particular, the lists of equivalent standards and the classification schemes presented in the Tables (Table 1 to Table 5) of the present report provided important guidance.

2.1.2 Standards which address BIPV but are not dedicated BIPV standards

The following standards are quoted frequently in BIPV standards in Section 2.1.1, although they are not dedicated specifically to BIPV. From the viewpoint of PV, BIPV should comply with the standards for conventional PV modules such as IEC 61215 (design qualification, etc.) and IEC 61730 (construction requirements, etc.). Many BIPV modules have a laminated glass configuration. In this case, BIPV should comply with the construction materials standards for laminated glass such as ISO 12543.

2.1.2.1 IEC 61215: Terrestrial photovoltaic module - Design qualification and type approval

Status: Currently valid standard, last revision in 2016.

The commercial success of PV (conventional photovoltaics) is based on long-term reliability of the modules. Several tests have been developed in the past decades in order to provide enough information to module manufacturers and users. Today's "conventional" modules are typically qualified/certified according to the IEC 61215:2016 Series: Terrestrial photovoltaic (PV) modules - Design qualification and type approval.

The IEC 61215:2016 series is structured in several parts: giving general requirements for all module types in Part 1, and requirements specific to cell technology in Sub-Parts 1-1 (crystalline silicon), and 1-2 to 1-4 (thin-film based module types), and defining the test procedures in Part 2.

The requirements and test procedures of IEC 61215-1:2016 qualify module types for long-term operation under specified climatic conditions, as defined in IEC 60721-2-1. The objective is to determine the electrical and thermal characteristics of the module and to show, as far as possible

within reasonable constraints of cost and time, that the module is capable of withstanding prolonged exposure in climates described in the scope. The actual lifetime expectancy of qualified modules will depend on their design, their environment and the conditions under which they are operated.

To summarise, if a crystalline photovoltaic module has been certified according to IEC 61215, this standard represents a quality characteristic with regard to the module's long-term mechanical stability for non-BIPV applications, i.e. ground-based or rooftop BAPV, and compliance with electrical requirements.

2.1.2.2 IEC 61730: Photovoltaic module safety qualification

Status: Currently valid standard, last revision in 2016.

In brief, the standard IEC 61730 addresses requirements to ensure that PV modules provide electrical and mechanical operating safety during their entire expected service life. It has two parts: 1 and 2.

IEC 61730-1:2016 specifies and describes the fundamental construction requirements for photovoltaic (PV) modules in order to provide safe electrical and mechanical operation. Specific topics address the prevention of electrical shock, fire hazards, and personal injury due to mechanical and environmental stresses. This part of IEC 61730 pertains to the particular requirements of module construction. This standard is intended to apply to all terrestrial flat plate module products such as crystalline silicon and thin-film modules.

IEC 61730-2:2016 provides the testing sequence descriptions intended to verify the safety of PV modules whose construction has been assessed by IEC 61730-1. The test sequence and pass criteria are designed to detect the potential breakdown of internal and external components of PV modules that would result in fire, electric shock, and/or personal injury. The standard defines the basic safety test requirements and additional tests that are a function of the PV module end-use applications. Test categories include general inspection, electrical shock hazard, fire hazard, mechanical stress, and environmental stress.

2.1.2.3 ISO 12543:2011 Glass in building — Laminated glass and laminated safety glass

Status: Currently valid standard, but due for regular ISO review.

This standard consists of six parts, under the general title Glass in building - Laminated glass and laminated safety glass. All parts are currently under review to include various types of active solar fenestration systems such as building-integrated PV systems (BIPV).

- Part 1: Definitions and description of component parts

This document defines terms and describes component parts for laminated glass and laminated safety glass for use in building.

- Part 2: Laminated safety glass

This document specifies performance requirements for laminated safety glass.

- Part 3: Laminated glass

This document specifies performance requirements for laminated glass.

- Part 4: Test methods for durability

This document specifies test methods addressing resistance to high temperature, humidity and radiation for laminated glass and laminated safety glass for use in buildings.

- Part 5: Dimensions and edge finishing

This document specifies dimensions, limit deviations and edge finishes of laminated glass and laminated safety glass for use in buildings.

- Part 6: Appearance

This document specifies defects of finished sizes and test methods with regard to the appearance of laminated glass in transmission.

2.1.2.4. IEC TR 63226:2018 Solar photovoltaic energy systems - Managing fire risk related to photovoltaic (PV) systems on buildings

Status: Technical report committee draft (CD)

While not a standard, this technical report currently under development discusses fire prevention measures during the design, installation, commissioning and maintenance of PV systems (including BIPV) on buildings. It also addresses measures to support firefighters during intervention on buildings with PV systems and provides guidance on how to handle the PV systems after a fire or structural collapse. The objective of this technical report is to assist local building and fire codes by guiding the development of a risk assessment (regarding fire, people's safety, and financial) for buildings with PV systems, based on building use, PV location and on-site conditions.

2.2 Analysis of existing international standards (including drafts)

2.2.1 History of BIPV standardization

Figure 1 shows the history of BIPV standardization. Only EN 50583 and ISO TS 18178 are valid as of 2018.

As an outcome of the long ongoing discussions within and among different organizations, and stakeholders, within IEC TC82 on Photovoltaics, a new attempt to go forward with the international standardization for the integration of photovoltaics in the built environment was started. At the 2017 spring meeting of IEC TC82, at the plenary session in Nara, Japan, it was proposed to form a new joint project team (PT), and to ask the national committees to nominate project members. This proposal is recorded in IEC document 82/1339/DC of September 2017. For the collaboration within this PT, experts were invited from TC82 working groups, as well as from ISO TC 160 Glass in Building, CENELEC, and IEA-PVPS Task 15, and it was proposed to take the existing European standards EN 50583-1 and EN 50583-2 as a starting point. The IEC document 82/1359/INF records that the national committees strongly supported the proposal, accepted the candidates Tom Moran and Hyun-A Kim as leaders of PT 63092, and nominated 40 experts from 15 countries, including also two members of ISO TC160.

Thus, the intended international BIPV standard will be based on the structure and contents of EN 50583, formally consolidating the former IEC 63092 and IEC 62980. IEC 63092 will be the resulting standard. This project team issued a committee draft (CD) in 2018, and plans to release an IS in 2019, with necessary revisions or additions based on EN 50583 and in harmony with ISO/TS 18178.

Project/ Standard	2012	2013	2014	2015	2016	2017	2018	2019
ISO 18178	NP			DIS: approved	FDIS: disapproved	NP: Proposed as TS	TS: Issued	
EN 50583 -1 & 2					Issued			
IEC 62980			NP	CD				
Old IEC 63092					NP		Consolidated as IEC 63092	
New IEC 63092 -1 & 2						NP		CD: On ballot (Formulated joint project team with ISO)

Figure 1: History of BIPV standardization.

2.2.2 Technology mapping of BIPV standards

The standards in Figure 1 have different scopes, as is illustrated in

Figure 2, where the complexity level from material through components to the system is represented by the vertical axis and architectural applications by the horizontal axis. EN 50583 was structured into its two parts by complexity level, with further sub-structure defined by materials and architectural integration, ISO 18178 addressed a single type of component, while pr IEC 62980 and pr IEC 63092 treated specific architectural applications, roofs and facades (curtain walls), respectively. The new IEC 63092-1 and IEC 63092-2 will have the same scopes as EN 50583-1 and EN 50583-2, respectively.

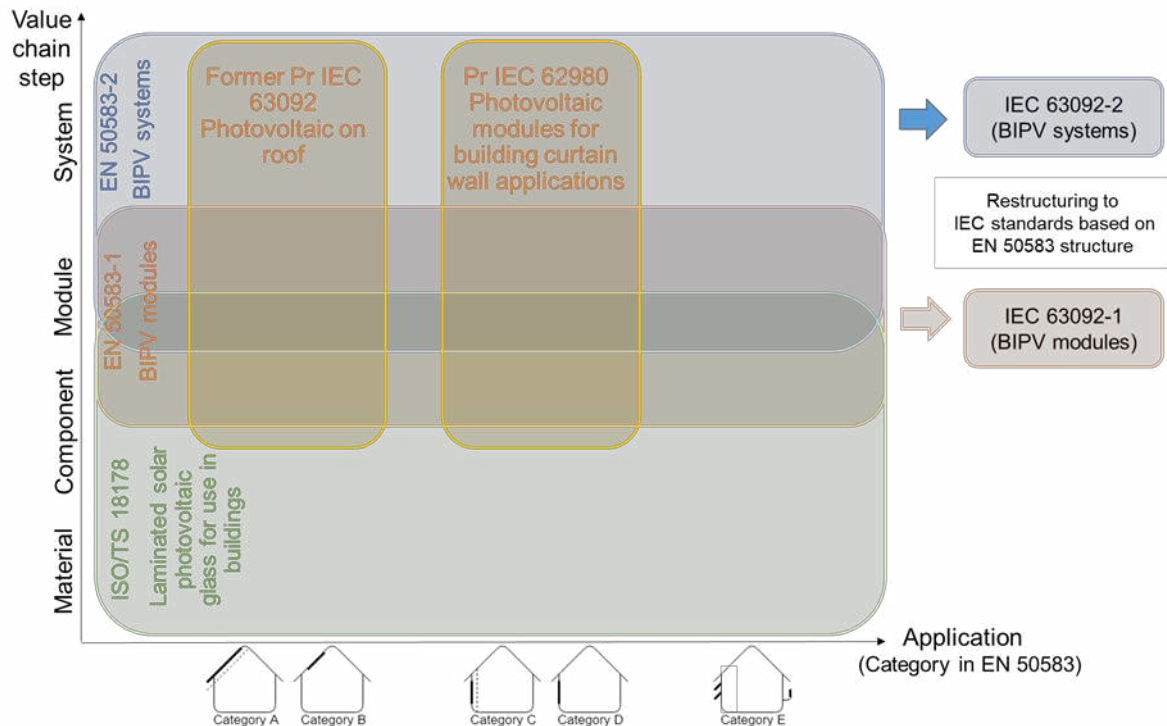


Figure 2: Scope of past and existing BIPV projects/standards as background to the planned new IEC 63092-1 and IEC 63092-2.

2.2.3 Relevant international standards corresponding to European standards in EN50583

IEC TC 82 decided to take EN 50583 as the basis for a new international BIPV standard. However, it quotes many European standards. In the new IEC 63092, the objective is to refer to international standards such as IEC or ISO wherever possible. Table 1 shows relevant international standards which could replace the European ones in EN 50583 and be referenced in the new IEC 63092.

Table 1: Standards referenced in EN 50583 and equivalent international standards

Requirement	Allocation to Module and/or System	Reference included in EN 50583-1&2	Identical/Equivalent international standard (ISO/IEC) for European one in EN50583	Identical (direct transfer from EN standard) or Equivalent (i.e. same physical quantity, different boundary conditions)?	
Mechanical resistance and stability	Structural design requirements	Module and system	EN 1990	ISO 2394	In part contained in EN 1990. It refers to EN 1990. Important to consider.
				ISO 2631	N/A to BIPV
				ISO 3898	In part contained in EN 1990. Not exactly the same definitions of terms.
				ISO 6707-1	Vocabulary applicable to buildings and civil engineering works. Very small part of it contained in EN 1990.
				ISO 9001	General standard related to quality management.
				ISO 10137	N/A
				ISO 22111	Corresponds to Section 6 of EN 1990 ('Verification by the partial factor method')
				ISO 4356	In part included in EN 1990
				ISO 12491	Referenced in EN 1990. Part of it is in EN 1990.
	Resistance to actions on structures	Module and system	EN 1991	ISO 3010	Not equivalent
				ISO 4354	Equivalent, but not identical
				ISO 4355	Identical, but not same as they have a few values different
				ISO 12494	Not equivalent - no ice loads considered in EN 1991
				ISO/TR 12930	Not equivalent
				ISO 13033	Not equivalent
	Structural design requirements on steel structures	Module and system	EN 1993	ISO 10721-1	Not equivalent on basis of tables of contents
	Structural design requirements on timber structures	System		none available	—
Structural design requirements on aluminum structures	Module and system	EN 1999	none available	—	
Structural requirements on roof structural connections for renewable energy systems	System	CEN-TC128-WG3-N0068 TR	none available	—	
Assembly rules for sloped and vertical glazing	Module and system	EN 12488	ISO 28278-2	Not equivalent at all	
Mechanical requirements on BIPV modules containing glass	Module	EN 50583-1, Annex A.1	none available	—	

Table 1: Standards referenced in EN 50583 and equivalent international standards – continued (1)

Requirement		Allocation to Module and/or System	Reference included in EN 50583-1&2	Identical/equivalent international standard (ISO/IEC) for European one in EN50583	Identical (direct transfer from EN standard) or Equivalent (i.e. same physical quantity, different boundary conditions)?
Safety in case of fire	Reaction of construction products and building elements to fire tests	Module	EN 13501-1	ISO 10294-1,2,3,4,5 ISO 10295-1,2,3	Not equivalent
				ISO 12468-2	A bit equivalent, also has classification, but with different parameters
	Data for construction products and building elements from fire resistance tests	Module and system	EN 13501-2	ISO 10294-1,2,3,4,5 ISO 10295-1,2,3 ISO 12468-1,2	Not equivalent
	Data for construction products and building elements from external fire exposure to roofs tests	Module and system	EN 13501-5	ISO 12468-1,2	Equivalent to some extent, but not fully. EN standard is more detailed. Classification of roofs differs between EN and ISO.
	External fire performance for roof windows	Module and system	EN 14351-1	ISO 3008	Not equivalent
Hygiene, health and the environment	Waterproofing Membrane for Roofing	Module	EN 13956	none available	–
	Rain penetration	System	EN 1027	ISO 15821	Equivalent
			EN 50583-2, Annex A	none available	–
	Product requirements of metal roofing sheet	Module and system	EN 14782	none available	–
EN 14783			none available	–	
Safety in use	Wind load resistance of curtain walling	Product	EN 12179	none available	–
	Resistance to impact (pendulum)	Module and system	EN 12600	ISO 29584	Equivalent
				IEC 61730	Equivalent (referring ANSI Z97.1)
	Requirements on glass products for structural sealant glazing systems for supported and unsupported monolithic and multiple glazing	Module	EN 13022-1	ISO 28278-1	Equivalent (Both based on ETAG002)
	Resistance to wind load of curtain walling	Module and system	EN 13116	none available	–
	Assembly rules for structural sealant glazing	System	EN 13022-2	ISO 28278-2	Equivalent ISO 28278 is affected by ASTM C 1401-14 and ETAG002
	Waterproofing properties of flexible polymer roofing sheets	Module and system	EN 13956	none available	–
	Performance characteristics of windows and doors	Module	EN 14351-1	ISO 8274	Identical to EN 1191; effectively identical to only one small part §4.21 of EN 14351-1 that refers to EN 1191
				ISO 8271	Addresses hard body impact test; effectively equivalent to only one small part §4.17 of EN 14351-1 that refers to EN 950
				ISO 15821	Addresses water tightness as does §4.5 of EN 14351-1 but under dynamic rather than static loads. However, is recommended for inclusion in international references
				ISO 6612	Addresses wind load; effectively equivalent to only one small part §4.2 of EN 14351-1 that refers to EN 12211
	Requirements on self-supporting metal roofing sheets	Module and system	EN 14782	none available	–
	Requirements on fully supported metal roofing sheets	Module and system	EN 14783	none available	–
	Resistance to wind load of mechanically fastened flexible sheets for roof waterproofing	Module and system	EN 16002	none available	–
Glazing requirements regarding glazing wedges	System	prEN ISO 14439	none available	-	
Technical properties of structural sealant glazing systems	System	ETAG 002	ISO 28278-1,-2	Equivalent ISO 28278 is affected by ASTM C 1401-14	

Table 1: Standards referenced in EN 50583 and equivalent international standards - continued (2)

Requirement		Allocation to Module and/or System	Reference included in EN 50583-1&2	Identical/equivalent international standard (ISO/IEC) for European one in EN50583	Identical (direct transfer from EN standard) or Equivalent (i.e. same physical quantity, different boundary conditions)?
Protection against noise	Glazing and airborne sound insulation	Module and system	EN 12758	ISO 22897 ISO 16940 ISO 10140 ISO 717 ISO 12543 IEC 60942	Equivalent to ISO 22897:2003 (which is based on EN 12758:2002, the old version of EN 12758:2011) Related to: ISO 16940
	g value of glazing	Product	EN 50583-1, Annex A.3	ISO 19467 windows and doors, Annex F.3	Equivalent
Energy economy and heat retention	Luminous and solar characteristics of glazing	Module and system	EN 410	ISO 9050 (JIS R3106)	Equivalent
	Thermal transmittance (U value) of glazing (calculation)	Module	EN 673	ISO 10292	Equivalent N.B. ISO 10292 is currently under revision
		Module and system		ISO 10077	Equivalent
		Module and system		ISO 15099	Equivalent
	Thermal transmittance (U value) of glazing (Guarded hot plate)	Module	EN 674	ISO 10291	Equivalent
	Thermal transmittance (U value) of glazing (Heat Flow Method)	Module	EN 675	ISO 10293	Equivalent N.B. ISO 10293 is currently under revision
	Thermal resistance and thermal transmittance of building components and building elements	System	EN ISO 6946	ISO 6946	Identical
	Solar and light transmittance of solar protection devices combined with glazing	System	EN 13363	ISO 52022	Equivalent
	Thermal transmittance (U value) of curtain walling (Calculation)	Module and system	EN 13947	ISO 12631	Equivalent
	Thermal and visual comfort due to blinds and shutters	Module and system	EN 14500	ISO 16813	Not equivalent at all
Sustainable use of natural resources	Core sustainability rules for construction products	Module and system	EN 15804	ISO 21930	Might be equivalent to ISO 21930 (Sustainability in building construction. Environmental declaration of building products)
				ISO 15392	Not equivalent to EN15804. It might be equivalent to EN 15643-1 (General principals on sustainability assessment of buildings)
	Environmental product declarations (EPD)	System	EN 15942	ISO 21930	EPD format specified by ISO 15942 §9 and EN 21930 differs
	Generic sustainability data selection for construction products	Module and system	CEN TR 15941	ISO 21929	Not equivalent at all; ISO 21929 addresses indicator selection, not generic data
Environmental performance of buildings - assessment by calculation	Module and system	EN 15978	ISO 21931	Generally equivalent but EN 15978 is much more detailed	
Electrical properties	Protection against hazards to and from electrical equipment	Module and system	Low Voltage Directive 2014/35/EU	none available	–
	Protection against electromagnetic disturbance to and by electrical equipment	Module and system	Electromagnetic Compatibility Directive ECD 2014/30/EU	none available	–
	Voltage restrictions on PV systems at system level	System	HD 60364-7-712 (now IEC 60364-7-712:2017)	IEC 60364-7-712	Equivalent

3 Requirement analysis

3.1 Requirement items for BIPV

After starting with the European BIPV standard EN 50583 as an initial list of “basic requirements” for BIPV modules and requirements from standards for construction products and electrical components, further requirements such as durability/reliability, water and air tightness and seismic resistance were extracted from existing regional or international standards addressing BIPV and added to the list. These “high-level” requirements were broken down into lists of concrete technical requirements on BIPV that can be addressed by standards and technical specifications. As far as possible, international standards that were equivalent to originally referenced EN standards were identified and tabulated.

These requirement items and additional possible items were collected in the initial stage of the Task activity documented in Section 3.1, regardless of the need or appropriateness for international standardization, which is then addressed in Sections 3.2 and 3.3. This report focuses on technical requirements because the intention is to specify and standardize them.

Requirements were listed by modules and systems in Table 2 and Table 3, respectively, using the numbering of the referenced standards (either existing or under development) and clauses which could specify the needs or functions of BIPV. The division into requirements on “modules” and “systems” reflects the existing structure of EN 50583, Parts 1 and 2, and the intended structure of IEC 63092, Parts 1 and 2.

As a guide to understand the intended meaning of these terms, the definition proposed by members of IEA-PVPS Task 15, Subtask C in one of its reports [1] is quoted here:

"A BIPV module is a PV module and a construction product together, designed to be a component of the building. A BIPV module is the smallest (electrically and mechanically) non-divisible photovoltaic unit in a BIPV system which retains building-related functionality. If the BIPV module is dismantled, it would have to be replaced by an appropriate construction product.

A BIPV system is a photovoltaic system in which the PV modules satisfy the definition above for BIPV products. It includes the electrical components needed to connect the PV modules to external AC or DC circuits and the mechanical mounting systems needed to integrate the BIPV modules into the building."

Table 2: Requirements for BIPV (Modules)

Requirement		Allocation to Module and/or System	Referred standard						
			EN 50583 -2016 (Photovoltaics in building)	ISO/TS 18178 -2018 (Glass in building — Laminated solar photovoltaic glass for use in buildings)	IEC 62980 -NP-2014 (Photovoltaic modules for building curtain wall applications)	IEC 63092 -NP-2015 (Photovoltaics on roof)	IEC 61215 -2016 (Terrestrial photovoltaic module - Design qualification and type approval)	IEC 61730 -2016 (Photovoltaic module safety qualification)	ISO 12543 -2011 (Glass in building — Laminated glass and laminated safety glass)
Mechanical resistance and stability	Structural design requirements	Module and System	EN 1990						
	Resistance to actions on structures	Module and System	EN 1991						
	Structural design requirements on steel structures	Module and System	EN 1993						
	Structural design requirements on aluminum structures	Module and System	EN 1999						
	Wind load resistance of curtain walling	Module	EN 12179						
	Resistance to wind load of curtain walling	Module and System	EN 13116		ASTM E330-2				
	Resistance to wind load of mechanically fastened flexible sheets for roof waterproofing	Module and System	EN 16002						
	Preliminary test (wind load) before structure safety test	Module			Clause 6.2.5				
	Mechanical requirements on BIPV modules containing glass	Module	EN 50583-1, Annex A.1						
	Mechanical load test	Module	IEC61215-2, 4.16			IEC61215-2, 4.16	IEC61215-2, 4.16		
	Resistance to impact (pendulum)	Module	EN 12600						
	Impact resistance (as building material)	Module and System		ISO 12543-2,4					ISO 12543-2,4
	Ball drop test	Module and System		Clause 5.12					
Hail test	Module	IEC61215-2, 4.17				IEC61215-2, 4.17			
Safety in case of fire	Reaction of construction products and building elements to fire tests	Module	EN 13501-1						
	Specific reaction to fire testing procedure for glass-glass products	Module	See https://glassforeurope.com/classification-of-reaction-to-fire-of-glass-products/						
	Data for construction products and building elements from fire resistance tests	Module and System	EN 13501-2						
	Data for construction products and building elements from external fire exposure to roofs tests	Module and System	EN 13501-5						
	External fire performance for roof windows	Module and System	EN 14351-1						
	Fire test	Module and System	IEC61730-2		EN1364-3	IEC 61730-2		IEC61730-2	
Managing fire risk related to photovoltaic (PV) systems on buildings	Module and System								

Table 2: Requirements for BIPV (Modules) – continued (1)

Requirement		Allocation to Module and/or System	Referred standard							
			EN50583 -2016	ISO/TS 18178 -2018	IEC 62980 -NP-2014	IEC 63092 -NP-2015	IEC 61215 -2016	IEC 61730 -2016	ISO12543 -2011	
Hygiene, health and the environment	Product requirements of metal roofing sheet	Module and System	EN 14782 EN 14783							
	Waterproofing properties of flexible polymer roofing sheets	Module and System	EN 13956							
Safety in use	Requirements on glass products for structural sealant glazing systems for supported and unsupported monolithic and multiple glazing	Module	EN 13022-1							
	Performance characteristics of windows and doors	Module	EN 14351-1							
	Requirements on self-supporting metal roofing sheets	Module and System	EN 14782							
	Requirements on fully supported metal roofing sheets	Module and System	EN 14783							
	Basic electrical safety checks	Module	IEC61730-2		(at least) One of IEC61215/61646/61730-1/61730-2	IEC 61730-2 (Impulse voltage test only)			IEC61730-2	
	Falling of module or parts	Module and System								
	Safety under shading	Module								
	Fire due to abnormal heating of junction box	Module								
	Robustness of terminations test	Module	IEC61215-2, 4.14	IEC61215-2, 4.14		IEC61215-2, 4.14	IEC61215-2, 4.14			
	Wet leakage current test	Module	IEC61215-2, 4.15	IEC61215-2, 4.15		IEC61215-2, 4.15	IEC61215-2, 4.15			
Bypass diode thermal test	Module	IEC61215-2, 4.18			IEC61215-2, 4.18	IEC61215-2, 4.18				
Protection against noise	Glazing and airborne sound insulation	Module and System	EN 12758							
Energy economy and heat retention	g value of glazing	Module	EN 50583-1, Annex A.2							
	Calculated g value of glass-glass PV modules	Module								
	Luminous and solar characteristics of glazing	Module and System	EN 410							
	Calculated equivalent conductivity and reference values for PV glass-glass modules	Module								
	Thermal transmittance (U value) of glazing	Module	EN 673 EN 674 EN 675		ISO12631					
	Thermal transmittance (U value) of curtain walling	Module and System	EN 13947							
	Thermal and visual comfort due to blinds and shutters	Module and System	EN 14500							
	Deterioration of heat insulation property due to PV cell	Module								

Table 2: Requirements for BIPV (Modules) – continued (2)

Requirement		Allocation to Module and/or System	Referred standard							
			EN50583 -2016	ISO/TS 18178 -2018	IEC 62980 -NP-2014	IEC 63092 -NP-2015	IEC 61215 -2016	IEC 61730 -2016	ISO12543 -2011	
Sustainable use of natural resources	Core sustainability rules for construction products	Module and System	EN 15804							
	Generic sustainability data selection for construction products	Module and System	EN 15941							
	Environmental performance of buildings	Module and System	EN 15978							
Electrical properties	Protection against hazards to and from electrical equipment	Module and System	Low Voltage Directive 2014/35/EU							
	Protection against electromagnetic disturbance to and by electrical equipment	Module and System	Electromagnetic Compatibility Directive ECD 2014/30/EU							
	Measurement of temperature coefficients	Module	IEC61215-2, 4.4		IEC 61215/61730	IEC61215-2, 4.4	IEC61215-2, 4.4			
	Electrical Insulation test	Module	IEC61215-2, 4.3	IEC61215-2, 4.3	IEC61215-2, 4.3	IEC61215-2, 4.3	IEC61215-2, 4.3			
	Maximum power determination	Module	IEC61215-2, 4.2		IEC 61215/61730	IEC61215-2, 4.2	IEC61215-2, 4.2			
	Measurement of nominal module operation temperature (NMOT)	Module	IEC61215-2, 4.5	IEC61215-2, 4.5	IEC 61215/61730	IEC61215-2, 4.5	IEC61215-2, 4.5			
	Performance at NMOT	Module	IEC61215-2, 4.6		IEC 61215/61730	IEC61215-2, 4.6	IEC61215-2, 4.6			
	Performance at low irradiance	Module	IEC61215-2, 4.7		IEC 61215/61730	IEC61215-2, 4.7	IEC61215-2, 4.7			
	Light-soaking	Module	IEC61215-2, 4.10		IEC 61215/61730	IEC61215-2, 4.10	IEC61215-2, 4.10			
	Electric performance under shading	Module and System								
	Deterioration of electric performance due to PV cell bending	Module								
	Electric Performance on vertical wall	Module and System								
Durability/ Reliability	Outdoor exposure test	Module	IEC61215-2, 4.8		IEC 61215/61730	IEC61215-2, 4.8	IEC61215-2, 4.8			
	Hot-spot endurance test	Module	IEC61215-2, 4.9	IEC61215-2, 4.9	IEC 61215/61730	IEC61215-2, 4.9	IEC61215-2, 4.9			
	Long-term durability (including electric parts, aesthetics of interlayer film)	Module and System								
	Long time radiation	Module								
	Influence of module temperature rise	Module								
	Bypass diode thermal runaway	Module								
	Durability under multiple environmental load	Module								
	Long-term load (self weight, snow)	Module and System								
	PID durability	Module and System								
	Thermal cycling test	Module and System	IEC61215-2, 4.11	IEC61215-2, 4.11	AAMA 501.5.07	IEC61215-2, 4.11	IEC61215-2, 4.11			
	UV preconditioning test	Module	IEC61215-2, 4.10	IEC61215-2, 4.10		IEC61215-2, 4.10	IEC61215-2, 4.10			ISO 12543-4, 7
	Damp-heat test	Module	IEC61215-2, 4.13	IEC61215-2, 4.13		IEC61215-2, 4.13	IEC61215-2, 4.13			ISO 12543-4, 6
	Humidity-freeze test	Module	IEC61215-2, 4.12	IEC61215-2, 4.12		IEC61215-2, 4.12	IEC61215-2, 4.12			
High temperature test	Module		Clause 5.4						ISO 12543-4, 5	

Table 2: Requirements for BIPV (Modules) – continued (3)

Requirement		Allocation to Module and/or System	Referred standard						
			EN50583 -2016	ISO/TS 18178 -2018	IEC 62980 -NP-2014	IEC 63092 -NP-2015	IEC 61215 -2016	IEC 61730 -2016	ISO12543 -2011
Water tightness	Water tightness	Module and System				IEC 60529			
	Waterproofing properties	Module	EN 13956						
	Water penetration into inside module	Module							
Air/Dust tightness	Air/Dust tightness	Module and System				IEC 60529			
Seismic resistance	Soundness of cables	Module and System							
Others	Easy certification procedure for various sizes of PV panel	Module							
	Glare from outside	Module							
	Specific considerations for bifacial solar cells testing in glass-glass configuration for BIPV	Module							
	Specific considerations for testing curved laminated photovoltaic glass	Module and System							

Table 3: Requirements for BIPV (System)

Requirement		Allocation to Module and/or System	Referred standard						
			EN 50583 -2016 (PV in building)	ISO/TS 18178 --2018 (Glass in building — Laminated solar photovoltaic glass for use in buildings)	IEC 62980 -NP-2014 (Photovoltaic modules for building curtain wall applications)	IEC 63092 -NP-2015 (Photovoltaics on roof)	IEC 61215 -2016 (Terrestrial photovoltaic module - Design qualification and type approval)	IEC 61730 -2016 (Photovoltaic module safety qualification)	ISO 12543 -2011 (Glass in building — Laminated glass and laminated safety glass)
Mechanical resistance and stability	Structural design requirements	Module and System	EN 1990						
	Resistance to actions on structures	Module and System	EN 1991						
	Structural design requirements on steel structures	Module and System	EN 1993						
	Structural design requirements on timber structures	System	EN 1995						
	Structural design requirements on aluminum structures	Module and System	EN 1999						
	Structural requirements on roof structural connections for renewable energy systems	System	CEN-TC128-WG3-N0068 TR						
	Assembly rules for structural sealant glazing	System	EN 13022-2						
	Wind load resistance of curtain walling/roof	Module and System	EN 12179		ASTM E330-2	Clause 6.2.4			
	Resistance to wind load of mechanically fastened flexible sheets for roof waterproofing	Module and System	EN 16002						
	Resistance to impact (pendulum)	System	EN 12600	ISO/TS 29584		KS F 1010			
	Impact resistance (as building material)	Product and system		ISO 12543-2, 4					ISO 12543-2, 4
Ball drop test	Module and System		Clause 5.12						
Safety in case of fire	Data for construction products and building elements from fire resistance tests	Module and System	EN 13501-2						
	Data for construction products and building elements from external fire exposure to roofs tests	Module and System	EN 13501-5						
	External fire performance for roof windows	Module and System	EN 14351-1						
	Fire resistant test	Module and System			EN1364-3	IEC61730-2		IEC61730-2	
	Managing fire risk related to photovoltaic (PV) systems on buildings	Product and system							

Table 3: Requirements for BIPV (System) – continued (1)

Requirement		Allocation to Module and/or System	Referred standard						
			EN50583 -2016	ISO/TS 18178 -2018	IEC 62980 -NP-2014	IEC 63092 -NP-2015	IEC 61215 -2016	IEC 61730 -2016	ISO12543 -2011
Hygiene, health and the environment	Product requirements of metal roofing sheet	Module and System	EN 14782						
	Product requirements of metal roofing sheet	Module and System	EN 14783						
	Rain penetration	System	EN 50583-2, Annex A						
Safety in use	Waterproofing properties of flexible polymer roofing sheets	Module and System	EN 13956						
	Requirements on self-supporting metal roofing sheets	Module and System	EN 14782						
	Requirements on fully supported metal roofing sheets	Module and System	EN 14783						
	Glazing requirements regarding glazing blocks	System	prEN ISO 14439						
	Technical Properties of Structural Sealant Glazing Systems	System	ETAG 002		KS F 4910 KS F 2621				
	Safety requirements for PV systems	System	IEC 62548						
	Falling of module or parts	Module and System							
	Electric short due to rain water on draining pathway	System							
Ground continuity	System			Clause 6.2.3	IEC61730-2		IEC61730-2		
Protection against noise	Glazing and airborne sound insulation	Module and System	EN 12758		ISO 10140-2 and KS F 2808				
Energy economy and heat retention	Luminous and solar characteristics of glazing	Module and System	EN 410						
	Thermal resistance and thermal transmittance of building components and building elements	System	EN ISO 6946						
	Solar and light transmittance of solar protection devices combined with glazing	System	EN 13363						
	Thermal transmittance (U value) of curtain walling	Module and System	EN 13947						
	Thermal and visual comfort due to blinds and shutters	Module and System	EN 14500						
Sustainable use of natural resources	Core sustainability rules for construction products	Module and System	EN 15804						
	Generic sustainability data selection for construction products	Module and System	EN 15941						
	Environmental performance of buildings	Module and System	EN 15978						

Table 3: Requirements for BIPV (System) – continued (2)

Requirement		Allocation to Product or System	Referred standard						
			EN50583 -2016	ISO/TS 18178 -2018	IEC 62980 -NP-2014	IEC 63092 -NP-2015	IEC 61215 -2016	IEC 61730 -2016	ISO12543 -2011
Electrical properties	Voltage restrictions on PV systems at system level	System	HD 60364-7-712						
	Protection against hazards to and from electrical equipment	Module and System	Low Voltage Directive 2014/35/EU						
	Protection against electromagnetic disturbance to and by electrical equipment	Module and System	Electromagnetic Compatibility Directive ECD 2014/30/EU						
	Electric performance under shading	Module and System							
	Electric Performance on vertical wall	System							
	Lightning protection	System							
Durability/ Reliability	Long-term durability (including electric parts, aesthetics of interlayer film)	Module and System							
	Long-term load (self weight, snow)	System							
	PID durability	Module and System							
	Thermal cycle test	Module and System			AAMA 501.5.07		IEC61215-2, 4.11		
Water tightness	Water tightness (resistance) Waterproofing properties(rain penetration)	Module and System			ASTM E 331-00(Static) AAMA 501.1.05 (Dynamic)				
Air/Dust tightness	Air/Dust tightness	Module and System			ASTM E 283-04				
Seismic resistance	Performance following displacement	System			AAMA 501.4.00				
	Soundness of cables	Module and System							

3.2 Requirement categorization

The requirement items of Table 2 and Table 3 can be categorized according to their character and the need for standardization as in Table 4.

Please note that the lists of examples are not exhaustive.

Table 4: Requirement categories for standardization

Category	Character of requirement	Example	Proposal for standardization
M	Internationally mandatory	<ul style="list-style-type: none"> - Mechanical resistance - Durability 	Test method & pass criteria to be standardized internationally
D	Useful to design BIPV	<ul style="list-style-type: none"> - Material - Mechanical structure - Electric shock protection (in AC) - Fire risk (main risk in DC) 	Design requirement to be standardized internationally
C	Useful to characterize BIPV, but no need for pass/fail criteria	<ul style="list-style-type: none"> - Power output - Optical or heat retention property (solar factor and light transmittance) - electromagnetic compatibility 	Test method to be standardized internationally
L	Local requirement	<ul style="list-style-type: none"> - Fire safety - Seismic resistance - Air permeability (windows) - Water tightness (windows) - Wind resistance (windows) 	Test method & pass criteria to be standardized locally
O	Others (less urgent)	<ul style="list-style-type: none"> - Maintenance and repair 	Low priority for the moment
N	Non-technical	<ul style="list-style-type: none"> - Aesthetic 	No need of standardization

3.3 Requirement level for international standardization of BIPV

The requirement categories of Table 4 are applied to classify all identified requirement items in Table 5 with respect to their need for international standardization. The result is to be provided to IEC PT 63092, the body preparing the new international BIPV standard.

Table 5: Requirement levels for all possible requirement items

	Requirement	Related standard/ document	Requirement category according to Table 4		Remarks
			Module	System	
Mechanical resistance and stability	Structural design requirements	EN 1990	D	D	
	Resistance to actions on structures	EN 1991	D	D	
	Structural design requirements on steel structures	EN 1993	D	D	
	Structural design requirements on timber structures	EN 1995	—	D	
	Structural design requirements on aluminum structures	EN 1999	D	D	
	Structural requirements on roof structural connections for renewable energy systems	EN 13022-2	—	D	
	Assembly rules for structural sealant glazing	EN 13022-2	—	D	
	Wind load resistance of curtain walling/roof	EN 12179 EN 13116 ASTM E330-2	D	D	
	Resistance to wind load of mechanically fastened flexible sheets for roof waterproofing	EN 16002	D	D	
	Preliminary test (wind load) before structure safety test	pr IEC 62980-6	O	—	
	Mechanical requirements on BIPV modules containing glass	EN 50583-1, Annex A.2	M	—	
	Mechanical load test	IEC61215-2, 4.16	M	—	
	Resistance to impact (pendulum)	EN 12600 ISO/TS 29584	M	M	Impact test or ball drop test is usually not mandatory for mounting categories A and C
	Impact resistance (as building material)	ISO 12543-2			
Ball drop test	ISO/TS 18178-5				
Hail test	IEC61215-2, 4.17				
Safety in case of fire	Reaction of construction products and building elements to fire tests	EN 13501-1	L	—	
	Specific reaction to fire testing procedure for glass-glass products	See remarks column	L	—	See: https://glassforeurope.com/classification-of-reaction-to-fire-of-glass-products/
	Data for construction products and building elements from fire resistance tests	EN 13501-2	L	L	
	Data for construction products and building elements from external fire exposure to roofs tests	EN 13501-5	L	L	
	External fire performance for roof windows	EN 14351-1	L	L	
	Fire resistant test	IEC61730-2 EN1364-3 (curtain walling); EN 16034 (doors and windows)	M	L	Sometimes fire resistant test is mandatory, which specifies minimum level for PV module.
	Managing fire risk related to photovoltaic (PV) systems on buildings	IEC TR 63226	O	O	To be considered after officially issued as a standard

Table 5: Requirement levels for all possible requirement items - continued (1)

Requirement		Related standard/ document	Requirement category according to Table 4		Remarks
			Module	System	
Hygiene, health and the environment	Product requirements of metal roofing sheet	EN 14782 (self-supported) EN 14783 (fully-supported)	D	D	
	Waterproofing properties of flexible polymer roofing sheets	EN 13956	D	D	
Safety in use	Requirements on glass products for structural sealant glazing systems for supported and unsupported monolithic and multiple glazing	EN 13022-1	D	D	
	Performance characteristics of windows and doors	EN 14351-1	C	C	
	Requirements on self-supporting metal roofing sheets	EN 14782	D	D	
	Requirements on fully supported metal roofing sheets	EN 14783	D	D	
	Glazing requirements regarding glazing blocks	pr EN ISO 14439	—	D	
	Technical Properties of Structural Sealant Glazing Systems	ETAG 002	—	D	
	Safety requirements for PV systems	IEC 62548	—	M	
	Basic electrical safety checks	IEC61730-2	M	—	
	Electrical installation to residential building "photovoltaic installations connected to the public distribution network"	UTE C 15-712-1	D, L	D, L	UTE is a national application guide based on main standards IEC 60364-7-712:2017 / NF C 15100, application for low voltage installation only < 1000 V AC
	Electrical installation to residential building "Stand alone photovoltaic installations not connected to the public distribution network with battery storage"	UTE C 15-712-2	D, L	D, L	
	Electrical installation to residential building "Photovoltaic installations with energy storage and connected to a public distribution network"	UTE C 15-712-3	D, L	D, L	
	Falling of module or parts	—	D	D	
	Safety under shading	—	M	—	
	Fire due to abnormal heating of junction box	—	M	—	
	Robustness of terminations test	IEC61215-2, 4.14	M	—	
	Wet leakage current test	IEC61215-2, 4.15	M	—	
	Bypass diode thermal test	IEC61215-2, 4.18	M	—	
	Electric short circuit due to rain water on draining pathway	—	—	D	
Ground continuity	IEC61730-2	—	M		
Protection against noise	Glazing and airborne sound insulation	EN 12758	D	D	

Table 5: Requirement levels for all possible requirement items - continued (2)

	Requirement	Related standard/ document	Requirement category according to Table 4		Remarks
			Module	System	
Energy economy and heat retention	g value of glazing	EN 50583-1, Annex A.3	C	—	Applicable to mounting categories B and D
	Calculated g value of glass-glass PV modules	—	C	—	
	Luminous and solar characteristics of glazing	EN 410	C	C	
	Calculated equivalent conductivity and reference values for PV glass-glass modules	—	C	—	Applicable to mounting categories A to D
	Solar and light transmittance of solar protection devices combined with glazing	EN ISO 52022	—	C	Only applicable to mounting category E
	Thermal resistance and thermal transmittance of building components and building elements	EN ISO 6946	—	C	
	Thermal transmittance (U value) of glazing	EN 673 EN 674 EN 675 ISO12631	C	—	
	Thermal transmittance (U value) of curtain walling	ISO 9869 ISO 12631	C	C	
	Thermal and visual comfort due to blinds and shutters	EN 14500	C	C	Only applicable to mounting category E
	Deterioration of heat insulation property due to PV cell	—	C	—	
Sustainable use of natural resources	Core sustainability rules for construction products	EN 15804	O	O	
	Generic sustainability data selection for construction products	EN 15941	O	O	
	Environmental performance of buildings	EN 15978	O	O	
Electrical properties	Voltage restrictions on PV systems at system level	IEC 60364-7-712	—	L	
	Protection against hazards to and from electrical equipment	Low Voltage Directive 2014/35/EU	L	L	
	Protection against electromagnetic disturbance to and by electrical equipment	Electromagnetic Compatibility Directive ECD 2014/30/EU	L	L	
	Voltage restrictions on PV systems at system level	IEC 60364-7	—	M	
	Measurement of temperature coefficients	IEC61215-2, 4.4	M	—	
	Electrical Insulation test	IEC61215-2, 4.3	M	—	
	Maximum power determination	IEC61215-2, 4.2	M	—	
	Measurement of nominal module operation temperature (NMOT)	IEC61215-2, 4.5	M	—	
	Performance at NMOT	IEC61215-2, 4.6	M	—	
	Performance at low irradiance	IEC61215-2, 4.7	M	—	
	Light-soaking	IEC61215-2, 4.10	M	—	
	Electric performance under shading	—	C	C	
	Deterioration of electric performance due to PV cell bending	—	O	O	
	Electric Performance on vertical wall	—	O	O	
Lightning protection	—	—	D		

Table 5: Requirement levels for all possible requirement items - continued (3)

	Requirement	Related standard/ document	Requirement category according to Table 4		Remarks
			Module	System	
Durability/ Reliability	Outdoor exposure test	IEC61215-2, 4.8	O	—	
	Hot-spot endurance test	IEC61215-2, 4.9	M	—	
	Long-term durability (including electric parts, aesthetics of interlayer film)	—	M	M	
	Long time radiation	—	M	—	
	Influence of module temperature rise	—	M	—	
	Bypass diode thermal runaway	—	D	—	
	Durability under multiple environmental load	—	M	—	
	Long-term load (self weight, snow)	—	M	M	
	PID durability	—	D	D	
	Thermal cycle test	IEC61215-2, 4.11 AAMA 501.5.07	M	M	Should be adapted to conform to similar test for building products
	UV preconditioning test	IEC61215-2, 4.10	M	—	
	Damp-heat test	IEC61215-2, 4.13	M	—	
	Humidity-freeze test	IEC61215-2, 4.12	M	—	
	High temperature test	pr ISO18178-5	M	—	Can be substituted by Thermal cycle test or damp heat test
Water tightness	Water tightness (resistance) Waterproofing properties(rain penetration)	IEC 60529 ASTM E 331-00(Static) AAMA 501.1.05 (Dynamic)	D	D	
	Water penetration into inside module	—	D	—	
Air/Dust tightness	Air/Dust tightness	IEC 60529 ASTM E 283-04	D	D	
Seismic resistance	Performance following displacement	—	—	D	
	Soundness of cables	—	D	D	

Table 5: Requirement levels for all possible requirement items - continued (4)

Requirement		Related standard/ document	Requirement category according to Table 4		Remarks
			Module	System	
Others	Easy certification procedure for different sizes of PV panel	-	M	M	
	Glare from outside Minimization of disturbing reflection	-	L	L	
	Specific considerations for bifacial solar cells testing in glass-glass configuration for BIPV	-	O	-	
	Specific considerations for testing curved laminated photovoltaic glass	-	O	O	
	Electricity for consumption by user	[2]	-	O	
	Ease of maintenance	[2]	D	D	
	Protection and safety against extreme conditions	[2]	L	L	
	Reliable prediction of power generated applying simulation	[2]	C	C	
	Flexibility in module dimensioning	[2]	N	N	
	BIPV self-sufficiency	[2]	N	N	
	Visible expression of "green" values / corporate image	[2]	N	N	
Aesthetically pleasing building appearance	[2]	N	N		

4 Summary

This report provided a review of current regional and international standards and drafts that are either dedicated to BIPV or are frequently referenced in BIPV standards/drafts. The European BIPV standard EN 50583 was taken as the basis to identify “basic requirements” for BIPV modules and standards as construction products and as electrical components, to which durability/reliability, water and air tightness, seismic resistance and other requirements were added. These “high-level” requirements were broken down into lists of concrete technical requirements for BIPV that can be addressed by standards and technical specifications. As far as possible, international standards that were equivalent to originally referenced EN standards were identified and tabulated. This information is already being used as input by the IEC Project Team PT 63092, that is currently preparing an international BIPV standard. During the search for equivalent standards, it became evident that there is not always a one-to-one correlation between EN and ISO standards with respect to construction products. Further close analysis by PT 63092 of the referenced standards will be needed to determine whether an identified ISO “equivalent standard” indeed addresses the topic intended by the BIPV standard.

Categories concerning the necessity and suitability of international standardisation for BIPV were defined. The authors recommend that three categories, “internationally mandatory”, “useful to design BIPV” and “useful to characterize BIPV, but no need for pass/fail criteria” be addressed at the international standardisation level. Other categories recognised that some technical requirements will continue to be addressed best at the national or local level, that the topic is not of immediate urgency or that some non-technical requirements are beyond the scope of standardisation efforts. Based on these categories, the identified technical BIPV requirements were categorized, providing a clear recommendation of topics that should be addressed by international standards on BIPV. These outcomes have been and will continue to be provided to the bodies such as IEC and ISO to support the development of international BIPV standards.

Proposals for modified or new test and calculation procedures will be addressed and reported in future work within IEA-PVPS Task 15.

5 References

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7 Abbreviations and Acronyms

AAMA	American Architectural Manufacturers Association
AC	Alternating Current
ANSI	American National Standards Institute
ASTM	American Society of Testing Materials
BIPV	Building Integrated Photovoltaic
BAPV	Building Attached Photovoltaic
CD	Committee Draft
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CPR	Construction Products Regulation
DC	Document for Comments
DC	Direct Current
DIS	Draft International Standard
EC	European Commission
ECD	Electromagnetic Compatibility Directive
EN	European Standard
ETAG	European Technical Approval Guidelines
FDIS	Final Draft International Standard
HD	Harmonization Document
IEA	International Energy Agency
IEC	International Electrotechnical Commission
IP	Ingress Protection
IS	International Standard
ISO	International Organization for Standardization
LVD	Low Voltage Directive
NP	New Work Item Proposal
PC	Project Committee
pr	Project (of standard)
PT	Project Team
PV	Photovoltaic
PVPS	Photovoltaic Power Systems Program
SC	Sub-Committee
TC	Technical Committee
TR	Technical Report
TS	Technical Specification

UTE Union Technique de l'Électricité (Technical Union of Electricity) (France)
WG Working Group

End of the report



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