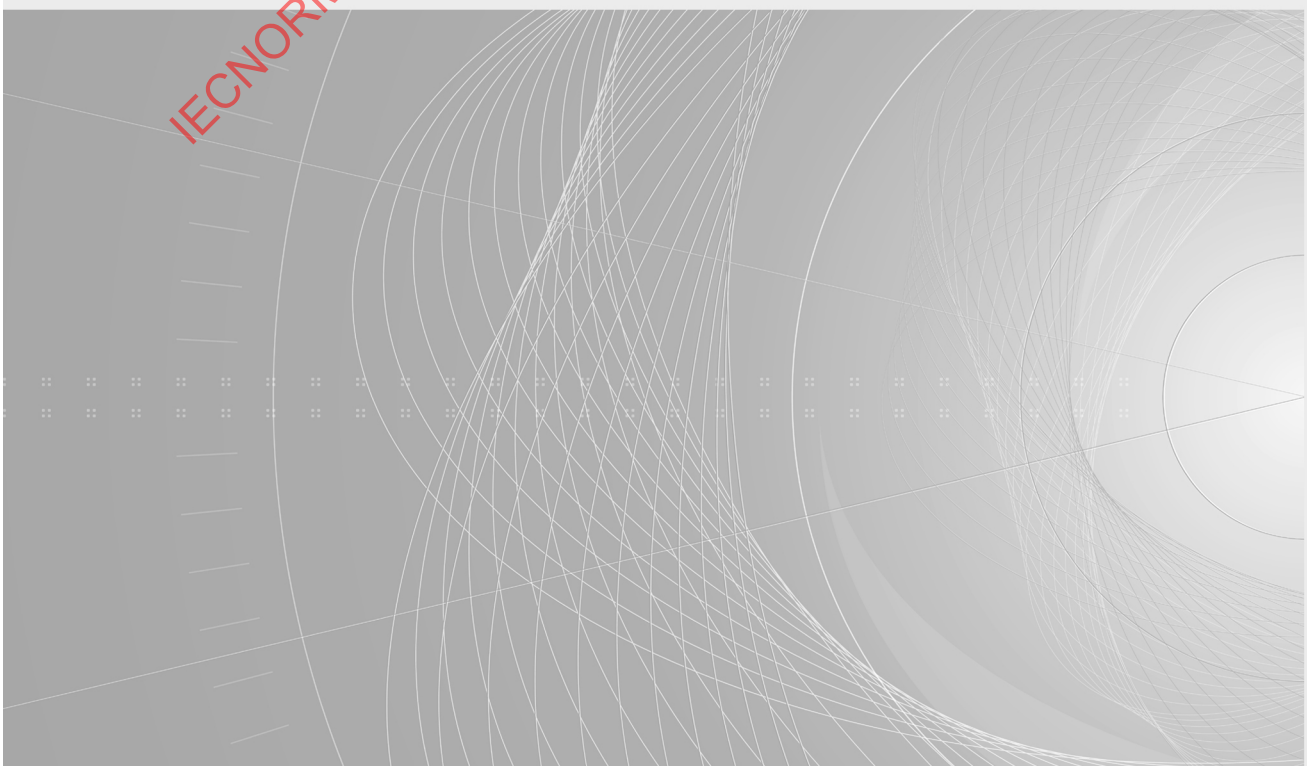
IEC 63092-2

Edition 1.0 2020-09

INTERNATIONAL STANDARD

colour inside

Photovoltaics in buildings –
Part 2: Requirements for building-integrated photovoltaic systems



IEC 63092-2:2020-09 (en)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

Electropedia - www.electropedia.org
The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary
67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC 63092-2

Edition 1.0 2020-09

INTERNATIONAL STANDARD

Photovoltaics in buildings –
Part 2: Requirements for building-integrated photovoltaic systems

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 27.160

ISBN 978-2-8322-8877-1

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

PHOTOVOLTAICS IN BUILDINGS –

Part 2: Requirements for building-integrated photovoltaic systems

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 63092-2 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems, in collaboration with ISO technical committee 160: Glass in building.

This standard is based on EN 50583-2.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
82/1768A/FDIS	82/1793/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 63092 series, published under the general title *Photovoltaics in buildings*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

PHOTOVOLTAICS IN BUILDINGS –

Part 2: Requirements for building-integrated photovoltaic systems

1 Scope

IEC 63092-1 specifies BIPV (building-integrated photovoltaic) module requirements while this document specifies BIPV system requirements. Both parts specify building requirements and the applicable electrotechnical requirements (both in general and specific with respect to module assembly and application category).

This document applies to photovoltaic systems that are integrated into buildings with the photovoltaic modules used as building products. It focuses on the properties of these photovoltaic systems relevant to basic building requirements and the applicable electrotechnical requirements. This document references international standards, technical reports and guidelines. For some applications, national standards (or regulations) for building products may also apply in individual countries, which are not explicitly referenced here and for which harmonized International Standards are not yet available.

This document is addressed to manufacturers, planners, system designers, installers, testing institutes and building authorities.

This document does not apply to concentrating photovoltaic systems or photovoltaic systems using concentrating photovoltaic modules.

This document addresses requirements on the BIPV systems in the specific ways they are intended to be mounted and the mounting structure, but not the BIPV module itself, which is within the scope of IEC 63092-1.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60364-1, *Low-voltage electrical installations – Part 1: Fundamental principles, assessment of general characteristics, definitions*

IEC 60364-4-41, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60364-4-42, *Low-voltage electrical installations – Part 4-42: Protection for safety – Protection against thermal effects*

IEC 60364-4-43, *Low-voltage electrical installations – Part 4-43: Protection for safety – Protection against overcurrent*

IEC 60364-4-44, *Low-voltage electrical installations – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances*

IEC 60364-5-51, *Electrical installations of buildings – Part 5-51: Selection and erection of electrical equipment – Common rules*

IEC 60364-5-52, *Low-voltage electrical installations – Part 5-52: Selection and erection of electrical equipment – Wiring systems*

IEC 60364-5-53, *Low-voltage electrical installations – Part 5-53: Selection and erection of electrical equipment – Devices for protection for safety, isolation, switching, control and monitoring*

IEC 60364-5-54, *Low-voltage electrical installations – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements and protective conductors*

IEC 60364-5-55, *Electrical installations of buildings – Part 5-55: Selection and erection of electrical equipment – Other equipment*

IEC 60364-5-56, *Low-voltage electrical installations – Part 5-56: Selection and erection of electrical equipment – Safety services*

IEC 60364-6, *Low-voltage electrical installations – Part 6: Verification*

IEC 60364-7-712, *Low-voltage electrical installations – Part 7-712: Requirements for special installations or locations – Solar photovoltaic (PV) power supply systems*

IEC 61082-1, *Preparation of documents used in electrotechnology – Part 1: Rules*

IEC 61215-1, *Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 1: Test requirements*

IEC 61215-2, *Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 2: Test procedures*

IEC 61724-1, *Photovoltaic system performance – Part 1: Monitoring*

IEC TS 61724-2, *Photovoltaic system performance – Part 2: Capacity evaluation method*

IEC TS 61724-3, *Photovoltaic system performance – Part 3: Energy evaluation method*

IEC 61730-2, *Photovoltaic (PV) module safety qualification – Part 2: Requirements for testing*

IEC TS 61836, *Solar photovoltaic energy systems – Terms, definitions and symbols*

IEC 62446-1, *Photovoltaic (PV) systems – Requirements for testing, documentation and maintenance – Part 1: Grid connected systems – Documentation, commissioning tests and inspection*

IEC 62548, *Photovoltaic (PV) arrays – Design requirements*

IEC 63092-1, *Photovoltaics in buildings – Part 1: Requirements for building-integrated photovoltaic modules*

IEC/IEEE 82079-1, *Preparation of information for use (instructions for use) of products – Part 1: Principles and general requirements*

ISO 2394, *General principles on reliability for structures*

ISO 3010, *Bases for design of structures – Seismic actions on structures*

ISO 4354, *Wind actions on structures*

ISO 4355, *Bases for design of structures – Determination of snow loads on roofs*

ISO 4356, *Bases for the design of structures – Deformations of buildings at the serviceability limit states*

ISO 6946, *Building components and building elements – Thermal resistance and thermal transmittance – Calculation methods*

ISO 9050, *Glass in building – Determination of light transmittance, solar direct transmittance, total solar energy transmittance, ultraviolet transmittance and related glazing factors*

ISO 12543-1, *Glass in building – Laminated glass and laminated safety glass – Part 1: Definitions and description of component parts*

ISO 12494, *Atmospheric icing of structures*

ISO 12631, *Thermal performance of curtain walling – Calculation of thermal transmittance*

ISO 13033, *Bases for design of structures – Loads, forces and other actions – Seismic actions on nonstructural components for building applications*

ISO 15099, *Thermal performance of windows, doors and shading devices – Detailed calculations*

ISO 15821, *Doorsets and windows – Water-tightness test under dynamic pressure – Cyclonic aspects*

ISO 16813, *Building environment design – Indoor environment – General principles*

ISO 19467, *Thermal performance of windows and doors – Determination of solar heat gain coefficient using solar simulator*

ISO 22111, *Bases for design of structures – General requirements*

ISO 28278-1, *Glass in building – Glass products for structural sealant glazing – Part 1: Supported and unsupported monolithic and multiple glazing*

ISO 28278-2, *Glass in building – Glass products for structural sealant glazing – Part 2: Assembly rules*

ISO 29584, *Glass in building – Pendulum impact testing and classification of safety glass*

ISO 52022-1, *Energy performance of buildings – Thermal, solar and daylight properties of building components and elements – Part 1: Simplified calculation method of the solar and daylight characteristics for solar protection devices combined with glazing*

ISO 52022-3, *Energy performance of buildings – Thermal, solar and daylight properties of building components and elements – Part 3: Detailed calculation method of the solar and daylight characteristics for solar protection devices combined with glazing*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61215-1, IEC 61215-2, IEC 61724-1, IEC TS 61724-2, IEC TS 61724-3, IEC TS 61836, IEC 63092-1 and ISO 12543-1 (in case the module contains one or more glass panes), together with the following, apply.

NOTE Annex A-specific definitions are included in the Annex itself.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
building-integrated photovoltaic system
BIPV system
photovoltaic system in which the PV modules satisfy the definition of IEC 63092-1 for BIPV modules. It includes the “PV array” as defined by IEC 62548 and the mechanical mounting systems needed to integrate the BIPV modules into the building

Note 1 to entry: Inverters are not addressed here, as they are adequately covered by International Standards applying to inverters in PV systems. Building integration of a PV system does not change the requirements on the inverters.

3.2
optically representative area of the system
selected surface area of the system that includes all the components of the system which have a significant effect on its optical properties and g value. The ratio of electrically active area (i.e. area covered by PV cells and interconnectors) to electrically inactive area within the optically representative area should not differ by more than 5 % from the ratio of the total electrically active area to the total electrically inactive area for the complete system (see Figure 1)

Note 1 to entry: The figure of 5 % was determined to result in an error of 3 % or less in the g value for BIPV modules consisting of crystalline silicon PV cells spaced in a light-transmitting medium.

Note 2 to entry: The g value refers to the solar heat gain coefficient (SHGC) as defined in ISO 19467.

Note 3 to entry: If the solar cells themselves consist of opaque and transparent areas, or there are inhomogeneous layers such as ceramic frits or coloured interlayers in front of the solar cell layer, special care shall be taken in the selection of the "optically representative area" to ensure that it represents the proportions of all optically different areas of the BIPV system to within the specified tolerance.

Ratio of electrically active area to electrically inactive area for the complete system, including frame:

$$r_{\text{total,sys}} = \frac{A_{\text{cell,total}} + A_{\text{intercon,total}} + A_{\text{jb,total}}}{A_{\text{inact,total}} + A_{\text{frame,total}}} \quad (1)$$

Ratio of electrically active area to electrically inactive area for the optically representative area of the system, including frame:

$$r_{\text{rep,sys}} = \frac{A_{\text{cell,rep}} + A_{\text{intercon,rep}}}{A_{\text{inact,rep}} + A_{\text{frame,rep}}} \quad (2)$$

Relation between the ratios associated to the complete system ($r_{\text{tota,sys}}$) and the optically representative area of the system ($r_{\text{rep,sys}}$):

$$\frac{r_{\text{total,sys}} - r_{\text{rep,sys}}}{r_{\text{total,sys}}} = \pm 5\ \% \quad (3)$$

where

$r_{total,sys}$ is the ratio of electrically active area to electrically inactive area for the complete system, including frame;

$A_{cell,total}$ is the surface area covered by cells within total system area;

$A_{intercon,total}$ is the surface area covered by interconnectors within total system area;

$A_{jb,total}$ is the surface area covered by junction box, if within area of light-transmitting medium (otherwise $A_{jb,total} = 0$);

$A_{inact,\ total}$ is the electrically inactive surface area within total system area;

$A_{frame,\ total}$ is the surface area of the frame within total system area;

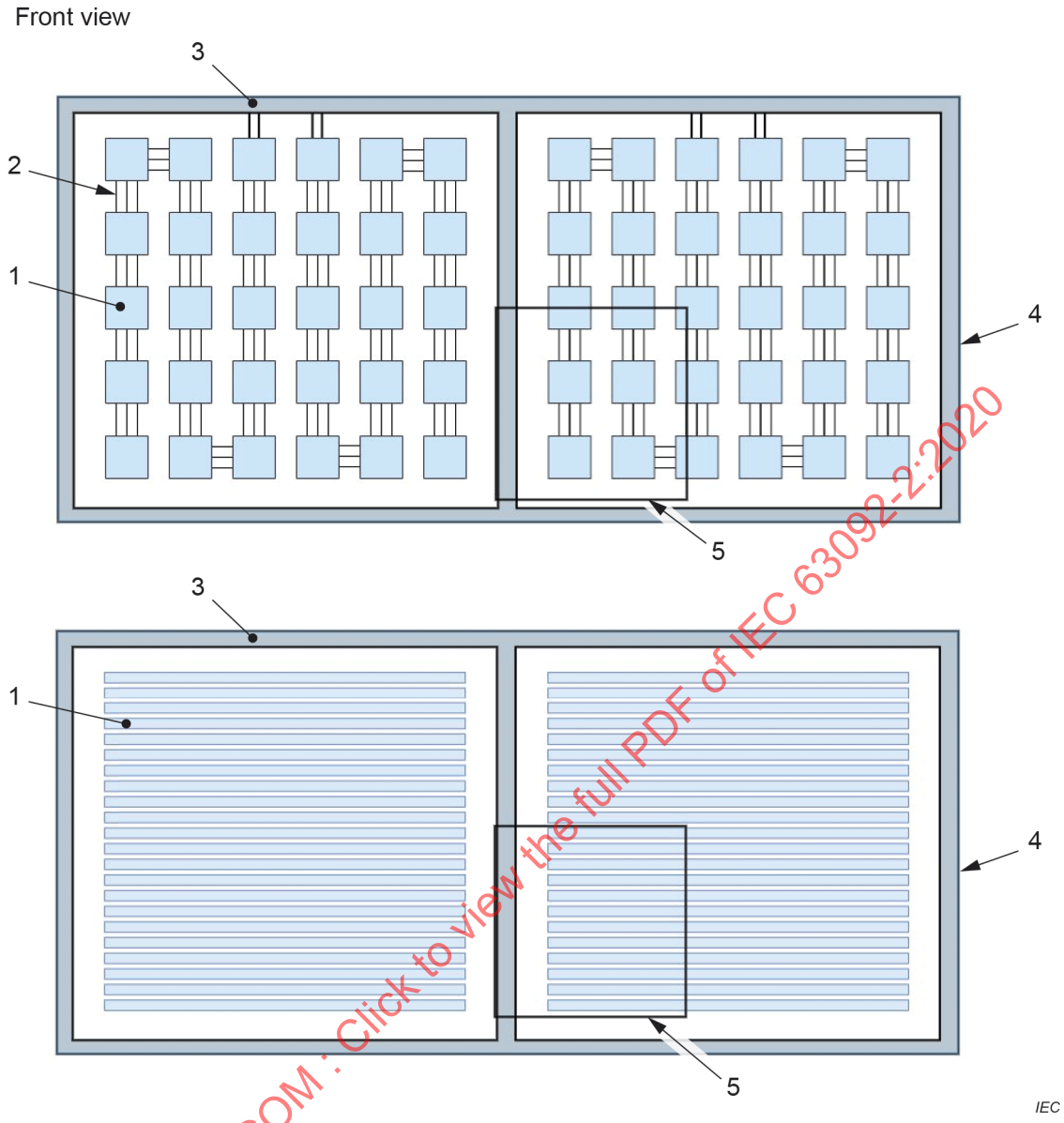
$r_{rep,sys}$ is the ratio of electrically active area to electrically inactive area for the optically representative area of the system;

$A_{cell,rep}$ is the surface area covered by cells within optically representative area;

$A_{intercon,rep}$ is the surface area covered by interconnectors within optically representative area;

$A_{inact,rep}$ is the electrically inactive surface area within optically representative area;

$A_{frame,\ rep}$ is the surface area of the frame within optically representative area.



Key

1 photovoltaic cell or thin film
2 interconnection
3 framing
4 perimeter of total system area
5 optically representative area of the system

The same principles apply to modules consisting of other types of solar cell.

Figure 1 – Example of optically representative area of a crystalline silicon-based (top) and a thin-film (bottom) BIPV system for the calculation method based on spectral measurements

4 Requirements

4.1 Electrotechnical requirements (for system)

BIPV systems shall comply with the applicable electrotechnical requirements as stated in IEC 60364-1, IEC 60364-4-41, IEC 60364-4-42, IEC 60364-4-43 and IEC 60364-4-44, IEC 60364-5-51, IEC 60364-5-52, IEC 60364-5-53, IEC 60364-5-54, IEC 60364-5-55 and IEC 60364-5-56 and IEC 60364-6.

BIPV systems shall be designed to comply with the requirements of IEC 60364-7-712.

If the system is grid-connected, the following standard shall apply:

– IEC 62446-1.

Also, BIPV systems may be required to comply with national, regional or local standards or electrical codes for buildings, including electromagnetic compatibility requirements.

NOTE An example of such requirements can be found under the European Electromagnetic Compatibility Directive EMCD 2004/108/EC that states the following:

Protection requirements

Equipment shall be so designed and manufactured, having regard to the state of the art, as to ensure that:

a) the electromagnetic disturbance generated does not exceed the level above which radio and telecommunications equipment or other equipment cannot operate as intended;

b) it has a level of immunity to the electromagnetic disturbance to be expected in its intended use which allows it to operate without unacceptable degradation of its intended use.

Specific requirements for fixed installations

Installation and intended use of components

A fixed installation shall be installed applying good engineering practices and respecting the information on the intended use of its components, with a view to meeting the protection requirements set out under protection requirements. Those good engineering practices shall be documented and the documentation shall be held by the person(s) responsible at the disposal of the relevant national authorities for inspection purposes for as long as the fixed installation is in operation.

4.2 Building-related requirements (for system)

4.2.1 General

This document distinguishes between BIPV systems using modules with at least one glass pane and those that do not. In addition to naming the aforementioned electrical requirements, this document classifies BIPV systems into five different application categories. Specific normative references are listed for each of the following categories (A to E) as defined in IEC 63092-1:

– Category A: Sloping, roof-integrated, not accessible from within the building;
– Category B: Sloping, roof-integrated, accessible from within the building;
– Category C: Non-sloping, (vertically) envelope-integrated, not accessible from within the building;
– Category D: Non-sloping, (vertically) envelope-integrated, accessible from within the building;
– Category E: Externally integrated, accessible or not accessible from within the building.

NOTE For more information on definitions and pictograms associated with the five application categories, see IEC 63092-1.

BIPV systems shall be designed to comply with the general principles of reliability contained in ISO 2394 and ISO 22111 (for verification by the partial factor method), the criteria of deformation in ISO 4356 and the general principles in ISO 16813 regarding the design that takes into account healthy indoor environment for the occupants, and protecting the environment for future generations.

BIPV systems shall be designed and built in such a way that the loadings that are liable to act on them during their construction and use will not lead to any of the following:

a) collapse of the whole or part of the BIPV system;
b) major deformation to an inadmissible degree;
c) damage to other parts of the building or to fittings or installed equipment as a result of major deformation of the load-bearing system;

d) damage by an event to an extent disproportionate to the original cause.

Regarding environmental loads, BIPV systems shall comply with the following standards, when applicable:

– ISO 3010
– ISO 4354
– ISO 4355
– ISO 12494
– ISO 13033

National, regional or local standards or codes may also apply.

4.2.2 Requirements for systems using modules with at least one glass pane

4.2.2.1 General

Requirements specific to BIPV systems using modules with at least one glass pane are discussed in more detail in the following subclauses. Table 1 summarizes the building-related requirements specific to BIPV systems using modules with at least one glass pane.

4.2.2.2 Mechanical resistance and stability

BIPV systems shall withstand the loads that are expected at the location (including position with regard to the building) of their application. Compliance can be verified either by calculation or by testing.

Until international standards are harmonized, national, regional or local standards or codes may apply.

NOTE 1 One example of national or local codes or standards that may apply is:

– EN 12488

In addition, BIPV systems may be required to comply with building requirements concerning wind, snow, mechanical and other loads given in national, regional or local building codes.

NOTE 2 One example of national or local codes or standards that may apply is:

– EN 13116

4.2.2.3 Safety in case of fire

As part of the building envelope, the fire safety of BIPV systems shall be considered with regard to minimizing the risk of both fire propagation and fire penetration into the building.

Until international standards are harmonized, national, regional or local standards or codes may apply.

NOTE One example of national or local codes or standards that may apply is:

– EN 13501-5

4.2.2.4 Hygiene, health and the environment

For rain penetration test for roofs (application category A), Annex A may apply.

For rain penetration test for doorsets and windows (application category D) that are subject to severe weather, e.g. driving rain and wind, including typhoons, hurricanes, cyclones and other severe climatic conditions, the following standard shall apply:

– ISO 15821

National, regional or local standards or codes may also apply.

NOTE Examples of national or local codes or standards that may apply include:

– CEN/TR 15601

– EN 1027

4.2.2.5 Safety and accessibility in use

4.2.2.5.1 General

BIPV systems shall be designed and built in such a way that they do not present unacceptable risk of accidents or damage in service or in operation such as slipping, falling, collision, burns, electrocution, injury from explosion and burglary. In particular, they shall be designed and built taking accessibility and use by people with disabilities into account. Their needs have also been translated into different requirements, both from the perspective of electrical safety and of construction/mechanical safety.

The impact testing according to ISO 29584 shall be carried out on representative samples of the BIPV end-product. Representative samples shall be operational PV modules containing all the relevant parts, but not the full-size dimensions used in the building. The area of the representative samples shall be at least 1 m x 1 m, with the same thickness and support structure around the edges as the BIPV end-product.

NOTE National regulations may define restrictions or additional requirements (e.g., calculation of glass thickness as specified by applicable building code).

4.2.2.5.2 Pendulum test for systems

BIPV systems shall meet the impact requirements of IEC 61730-2 MST 32, and ISO 29584 together with those of the local national building code (or similar) for the building function they provide. It should be noted that additional testing for impact from both sides of the system may be required.

4.2.2.5.3 Structural sealant glazing systems

For BIPV systems consisting of BIPV modules or PV insulating glass units to be bonded adhesively to the substructure, and which are sold separately from the substructure and installed under the responsibility of the designer and assembler, the following standards shall apply:

– ISO 28278-1

– ISO 28278-2

4.2.2.6 Protection against noise

No requirements are specified.

Until an international standard is published, national or local codes or standards may apply.

4.2.2.7 Energy economy and heat retention

4.2.2.7.1 General

Buildings and their heating, cooling, lighting and ventilation installations should be designed and built in such a way that the amount of energy they require in use is low, when account is taken of the occupants and the climatic conditions at the building location. Buildings should also be energy-efficient throughout their entire life cycle, using as little energy as possible during their construction and dismantling.

4.2.2.7.2 Light transmittance, solar direct transmittance and total solar energy transmittance

4.2.2.7.2.1 General

The purpose of these methods is to determine light and energy transmittance of solar radiation for glazing systems in buildings. These characteristic data can serve as a basis for lighting, heating and ventilation calculations of rooms and can permit comparison between different glazing systems. One or more of the following methods shall be used:

In addition to the procedures defined in the following clauses to determine the total solar energy transmittance of glazing systems, calculations or measurements are permitted that take account of the fact that some of the absorbed solar energy will be converted to electricity rather than heat, thus changing the value of the secondary heat transfer factor towards the inside.

NOTE 1 Total solar energy transmittance (TSET), g value and solar heat gain coefficient (SHGC) are physically equivalent quantities.

4.2.2.7.2.2 Calculation method based on spectral measurements

One or more of the following standards shall apply:

– ISO 9050
– ISO 15099

The transmittance of optically differing areas of the system shall be determined separately, each according to ISO 9050. The transmittance for the whole system is then calculated as an area-weighted average of the individual transmittance values.

Alternatively, the transmittance shall be measured with a large beam cross-section that covers a optically representative area of the system.

Depending on the application, compliance to ISO 52022-1 and ISO 52022-3 may also be required for application categories B and D when a solar protection device, such as a louver, venetian or roller blind, is incorporated parallel to the glazing. The position of the solar protection device can be interior, exterior or between individual panes in a multi-pane glazing system.

One or more of the following standards shall apply for solar protection systems combined with glazing (application category E):

– ISO 52022-1
– ISO 52022-3

4.2.2.7.2.3 Measurement method for solar heat gain coefficient using solar simulator

The following standard shall apply for solar-protection devices mounted parallel to doors or windows, under application category D:

– ISO 19467

NOTE The measurement procedures under maximum power point (MPP) are not yet established.

For other application categories, national or local codes or standards may apply.

4.2.2.7.3 Thermal transmittance

The purpose of this method is to determine the thermal transmittance (U value) of a glazing system with flat and parallel surfaces. The following standard shall apply:

– ISO 6946

The following standard shall also apply for curtain wall systems (application categories C and D, if relevant):

– ISO 12631

4.2.2.8 Sustainable use of natural resources

Until an international standard is published, national or local codes or standards may apply.

NOTE One example of national or local codes or standards that may apply is:

– EN 15978

Table 1 – Summary of building-related requirements from IEC 63092-2 specific to BIPV systems using modules with at least one glass pane

Application category based on IEC 63092-1	A	B	C	D	E
Mechanical resistance and durability	ISO 2394, ISO 22111 and ISO 4356 (if relevant) ISO 3010, ISO 4354, ISO 12494 and ISO 13033 (if relevant)				
	ISO 4355 (if relevant)				
Safety in case of fire	No requirements are specified				
Hygiene, health and the environment	ISO 16813				
				IISO 1821 (if relevant)	
Safety and accessibility in use	IEC 60364-1, IEC 60364-4 (all parts) and IEC 60364-5 (all parts) IEC 61730-2 and ISO 29584 ISO 28278-1 and ISO 28278-2 (if system with structural sealant glazing)				
Protection against noise	No requirements are specified				
Energy economy and heat retention	ISO 9050 and/or ISO 15099 ISO 6946				
			ISO 12631(if relevant)		ISO 52022-1, ISO 52022-3 (if relevant)
Sustainable use of natural resources	No requirements are specified				

Additionally, national or local codes or standards may apply.

4.2.3 Requirements for systems using modules without glass panes

4.2.3.1 Systems using BIPV modules based on polymer waterproofing sheet

4.2.3.1.1 General

This subclause addresses systems for use in building applications that use BIPV modules that typically include a polymer waterproofing sheet while Table 2 summarizes the specific requirements. The following subclauses are applicable for systems using BIPV modules based on polymer waterproofing sheet:

4.2.3.1.2 Mechanical resistance and stability

The general principles documented in 4.2.2.2 apply here also. There are no additional requirements specific to systems using BIPV modules based on polymer waterproofing sheet.

Until an international standard is published, national or local codes or standards may apply.

4.2.3.1.3 Safety in case of fire

Similarly to the systems using BIPV modules with glass panes, it is not possible to define specific requirements for fire safety in an international standard as international recognition of specific test results is not well established. The general principles documented in 4.2.2.3 apply here also.

Fire test requirements are to be included as national differences in this document.

4.2.3.1.4 Hygiene, health and the environment

Until an international standard is published, national or local codes or standards may apply.

4.2.3.1.5 Safety and accessibility in use

The general principles documented in 4.2.2.5 apply here also. Until an international standard is published, national or local codes or standards may apply.

4.2.3.1.6 Protection against noise

There are no additional requirements specific to systems using BIPV modules based on polymer waterproofing sheet. Until an international standard is published, national or local codes or standards may apply.

4.2.3.1.7 Energy economy and heat retention

The general principles documented in 4.2.2.7 apply here also. There are no additional requirements specific to systems using BIPV modules based on polymer waterproofing sheet. Until an international standard is published, national or local codes or standards may apply.

4.2.3.1.8 Sustainable use of natural resources

The general principles documented in 4.2.2.8 apply here also.

Until an international standard is published, national or local codes or standards may apply.

4.2.3.2 Systems using BIPV modules based on metal sheet

4.2.3.2.1 General

This subclause addresses systems for use in building applications that typically include BIPV modules based on metal sheet as the back cover while Table 2 summarizes the specific requirements. The following subclauses are applicable for systems using BIPV modules based on metal sheet:

4.2.3.2.2 Mechanical resistance and stability

The general principles documented in 4.2.2.2 apply here also. There are no additional requirements specific to systems using BIPV modules based on metal sheet. Until an international standard is published, national or local codes or standards may apply.

4.2.3.2.3 Safety in case of fire

Similarly to the systems using BIPV modules with glass panes, it is not possible to define specific requirements for fire safety as recognition of test results is commonly not practiced. The general principles documented in 4.2.2.3 apply here also. Until an international standard is published, national or local codes or standards may apply.

4.2.3.2.4 Hygiene, health and the environment

Until an international standard is published, national or local codes or standards may apply.

4.2.3.2.5 Safety and accessibility in use

The general principles documented in 4.2.2.5 apply here also. Until an international standard is published, national or local codes or standards may apply.

4.2.3.2.6 Protection against noise

There are no additional requirements specific to systems using BIPV modules based on metal sheet. Until an international standard is published, national or local codes or standards may apply

4.2.3.2.7 Energy economy and heat retention

The general principles documented in 4.2.2.7 apply here also. There are no additional requirements specific to systems using BIPV modules based on metal sheet. Until an international standard is published, national or local codes or standards may apply

4.2.3.2.8 Sustainable use of natural resources

The general principles documented in 4.2.2.8 apply here also.

Until an international standard is published, national or local codes or standards may apply.

Table 2 – Summary of building-related requirements from IEC 63092-2 specific to BIPV systems using modules based on polymer waterproofing sheet or metal sheet

Application category based on IEC 63092-1	A	B	C	D	E
Mechanical resistance and durability	ISO 2394, ISO 22111 and ISO 4356 (if relevant) ISO 3010, ISO 4354, ISO 12494 and ISO 13033 (if relevant)				
	ISO 4355 (if relevant)				
Safety in case in fire	No requirements are specified				
Hygiene, health and the environment	ISO 16813				
Safety and accessibility in use	IEC 60364-1, IEC 60364-4 (all parts) and IEC 60364-5 (all parts)				
Protection against noise	No requirements are specified				
Energy economy and heat retention	No requirements are specified				
Sustainable use of natural resources	No requirements are specified				

Additionally, national or local codes or standards may apply.

4.2.3.3 Requirements for systems using modules based on other materials

Systems using BIPV modules based on other materials than those defined in 4.2.2, 4.2.3.1 and 4.2.3.2 have to comply with general requirements specified in 4.1 and 4.2. More specific requirements can be considered in future versions of this document.

5 Labelling

The following standard shall apply to facilitate traceability to the label information:

– IEC 62548.

– IEC 63092-1.

NOTE Traceability to the label information may be facilitated, e.g. by use of a QR code.

6 System documentation, commissioning tests and inspection

The following standard shall apply:

– IEC 62446-1.

The documentation shall be prepared by following the guidelines given in IEC 61082-1 (diagrams) and IEC/IEEE 82079-1 (instructions for use). Instructions for storage, handling, erection, fixation, operation, maintenance, dismounting and recycling of the BIPV modules are to be stated.

7 Reporting

Following type approval, a report of the qualification tests, with measured performance characteristics and details of any failures and re-tests, shall be prepared by the test agency. The report shall contain the detailed specification for the BIPV system. Each test report shall include at least the following information:

a) a title;

b) name and address of the test laboratory and location where the tests were carried out;

c) unique identification of the report and of each page;

d) name and address of client, where appropriate;

e) description and identification of the system tested, including the different application categories (A to E, as defined in IEC 63092-1) under which the system was tested;

f) characterization and condition of the test system, where appropriate;

g) date of receipt of test system and date(s) of test, where appropriate;

h) identification of test method(s) used, including method(s) based on national, regional or local standards or codes;

i) any deviations from, additions to, or exclusions from, the test method(s) and any other information relevant to specific tests (where relevant);

j) measurements, examinations and derived results supported by tables, graphs, sketches and photographs as appropriate;

k) any failures observed;

l) a summary of test results according to Clause 4;

m) a statement of the estimated uncertainty of the test results (where relevant);

n) a signature and title, or equivalent identification of the person(s) accepting responsibility for the content of the report, and the date of issue;

o) a statement to the effect that the results relate only to the systems tested (where relevant);

p) a statement that the report shall not be reproduced except in full, without the written approval of the laboratory.

Annex A
(informative)

Resistance to wind-driven rain of BIPV roof coverings with discontinuously laid elements – Test method

A.1 General

The test method characterizes the degree of wind-driven and deluge rain penetration through a BIPV roof with regard to rain intensity, roof angle and wind speed. The results indicate the boundary conditions for the use of a BIPV roof and provide an indication for selecting the appropriate layer underneath the BIPV modules (e.g. sarking membrane). The defined test method can be used for BIPV modules mounted as specifically defined in category A: Sloping, roof-integrated, not accessible from within the building, as defined in IEC 63092-1.

A.2 Scope

This test method describes a method to determine the resistance to wind-driven rain of a BIPV pitched roof system corresponding to category A: Sloping, roof-integrated, not accessible from within the building, as defined in IEC 63092-1.

The test method is applicable for a kit of discontinuously laid BIPV modules in combination with adjacent mounting-relevant fixtures, sealants, joints and connections to regular surrounding roofing/building components.

A.3 Terms and definitions

For the purposes of Annex A, the following terms and definitions apply.

A.3.1
test specimen
assembled array of roof-integrated PV modules as used for complete roof or roofing component replacement over which the rain penetration is to be observed or measured

A.3.2
samples
BIPV modules used for roof integration

A.3.3
reference leakage rate
leakage rate of (10 g/m^2)/5 min, where 5 min is the duration of a single test step in the sub-test

A.3.4
effective testing area
minimum testing area of the specimen

A.3.5
set of tests
sub-tests B and D, (and optionally sub-tests A and C), for an appropriate roof pitch and laying specification

A.4 Symbols and units

Symbol	Quantity	Unit
f	wind speed factor related to u and u_s	-
I_u	turbulence intensity	%
L	simulated additional rafter length above the test specimen	m
n	the total number of wind speed measurements	-
R_h	rainfall rate on a horizontal plane	mm/h
R_{ro}	run-off rate	l/min
R_t	rainfall rate on the roof surface	mm/h
u	wind speed approaching the roof	m/s
$\bar{u}$	mean wind speed approaching the roof	m/s
u_s	wind speed over test specimen	m/s
W	the effective width of the test specimen	m
α	roof pitch	degree°
θ	angle of incidence of rain	degree°
σ_g	standard deviation of the turbulent fluctuations in the wind speed	m/s

A.5 Principle

A test specimen is fitted into the wind-driven rain apparatus, the external surface of the test specimen is exposed to wind and continuously sprayed with water, and run-off water is continuously applied at the top of the specimen. At the same time, an air pressure difference between the upper and lower surfaces of the test specimen is increased or decreased in specific steps.

Water leakage through the test specimen, which can occur at certain air pressure differences, is observed and/or measured.

A.6 Test specimen

A.6.1 Test specimen samples

Samples for the test specimen shall comply, where relevant, with the appropriate product standard in respect of the appropriate sampling plan, or, in absence of a standard sampling plan, shall be selected at random from a representative production lot.

A.6.2 Dimension of the test specimen

The dimensions of the test specimen shall be as large as necessary to be representative of the intended use. The test specimen shall include at least one of every type of joint between the BIPV system to be tested and the surrounding roof surface (where appropriate). In some cases with large test specimens, it might not be possible to test all of the joints simultaneously. In such cases, the testing shall be repeated to ensure that each joint is fully tested.

Depending on the BIPV system to be tested, it may be necessary to seal the laps or joints of the adjacent elements, whereby these sealed elements are outside of the effective area of the test specimen.

A.6.3 Number of sets of tests

The number of sets of tests shall be at least one.

A.6.4 Preparation of test specimen

Construct the test specimen according to the roofing specification representative of its intended use (such as roof pitch, lap and the influence of fixing systems where appropriate).

The test specimen may be built in a surrounding frame to facilitate transport and fitting to the opening of the driving rain test apparatus. The joint between test specimen and surrounding frame shall be sealed to prevent water leakage during the test, without disturbance to the normal occurring gaps in the specimen.

If a frame is used, it shall be able to resist the pressures applied during the test without deflecting to an extent that would influence the test results. The surround shall be prepared and installed so that any water penetration through the unsealed area of the test specimen is readily detectable.

The test specimen shall be conditioned to be surface dry before each test.

A.7 Apparatus

A.7.1 General

The test apparatus shall consist of:

– a suction chamber sealed to the underside of the test specimen and connected to a suction fan, as specified in A.7.2;
– a fan system to create wind on the outside of the test specimen, as specified in A.7.3;
– an installation capable of generating rain on the outside of the specimen, as specified in A.7.4;
– provisions for creating run-off water on the outside of the test specimen, as specified in A.7.5;
– facility for observation and measurement of leakage as specified in A.7.6.

A.7.2 Suction chamber

The suction fan connected to the suction chamber shall be capable of creating a stable pressure difference, maintained for 5 min ± 10 s, across the test specimen. The pressure difference shall be measured with an uncertainty of no more than 1 % of the measured value or 2,5 Pa, whichever is greater. The height and shape of the suction chamber shall be sufficient to ensure uniform pressure conditions.

It shall be possible, when required, to seal the connection between the suction chamber and the suction fan (e.g. by providing a valve which can be closed or opened).

A water collector shall be provided, connected to the suction chamber, capable of recording the amount of water leakage during any pressure step in the test, with an uncertainty of no more than 2 % of the measured value or 1 g, whichever is greater. The surfaces of the suction chamber shall allow water leakage to flow freely into the water collector.

A.7.3 Fan system

The fan system shall be capable of generating wind in the direction of the eaves to the ridge. The wind flow shall be horizontal or parallel to the surface of the inclined test specimen.

Calibrate the fan system for spatial variation of the wind speed, by taking measurements at not less than nine (9) positions uniformly distributed over the effective testing area, at a height of (200 ± 10) mm over a flat boarded area which replaces the test specimen for the purposes of the calibration at the relevant pitch roof. The calibration wind speed shall be (10 ± 0,5) m/s at the centre of the test specimen.

The spatial variation of the wind speed shall be not more ± 15 % over the effective testing area.

Wind speed shall be measured with an uncertainty of no more than 0,5 m/s.

The turbulence intensity I_u (%) in the oncoming wind shall be less than 10 % at each position. The turbulence intensity I_u (%) is expressed as:

$$I_u = 100\ \sigma_g/\bar{u} \tag{A.1}$$

where

σ_g and $\bar{u}$ are the standard deviation of the turbulent fluctuation in the wind speed and mean wind speeds respectively, measured over a duration of not less than 5 min for this purpose.

Mean wind speed

$$\bar{u} = \frac{\sum_{i=1}^{n} u_i}{n} \tag{A.2}$$

Standard deviation

$$\sigma_g = \sqrt{\frac{\sum_{i=1}^{n} (u_i - \bar{u})^2}{n-1}} \tag{A.3}$$

where

u_i are the individual wind speed measurements [m/s];

n is the total number of wind speed measurements[-].

A.7.4 Rain generation installation

The installation shall be capable of supplying a stable rainfall rate (± 5 %) as given in Table A.2 for the roof pitch under test. The spatial variation shall be not more than ± 35 % over the effective testing area during a period of 5 min.

The rain droplet size shall be representative of natural rain, predominantly in the range of 0,6 mm to 2,5 mm diameter. It has to be ensured that the falling rain droplets have the appropriate velocity when hitting the test specimen.

To calibrate the rain falling directly on the test specimen, replace the test specimen with a flat board which incorporates rainfall-measuring devices in its upper surface. The measuring devices shall each be between 0,1 m^2 and 0,2 m^2 in plan area and arranged so that they do not collect any run-off water during calibration. The rain shall be measured with an uncertainty of no more than 3 % of the measured value or 0,2 mm/h, whichever is larger.

Calibrate the uniformity of rain distribution for each roof pitch and each test A, B, C and D (see Clause A.9) as appropriate.

A.7.5 Run-off water

In order to simulate the rafter length of the roof above the position of the test specimen, run-off water shall be evenly distributed across the top of the test specimen. Maximum deviation of not more than 10 % over the width of the test specimen shall be achieved, when measured at not less than 3 positions uniformly distributed over the width of the test specimen. The quantity of run-off water shall be measured with an uncertainty of no more than 3 % of the measured value.

Precautions should be taken to avoid non-representative distribution of run-off water on the uppermost course of roof-covering elements which, for example, could cause premature leakage through their sidelaps.

NOTE As a precaution, the sidelaps in the uppermost course of roofing elements may be sealed.

A.7.6 Observation and measurement of leakage

The pressure chamber shall be provided with:

– a transparent under-surface for clear visual observation of the nature and position of leakages which may appear on the underside of the test specimen during the test;
– an apparatus to continuously collect and measure the amount (by weight or by volume) of leakage water which may fall from the test specimen into the pressure chamber during the test.

To minimize surface tension, absorption and retention of water on the internal surfaces of the pressure chamber, the surfaces shall be smooth, non-absorbent and inclined at a vertical angle of not less than 10° from the horizontal towards the lower collecting apparatus during testing.

The degree of water penetration through the effective testing area shall be evaluated as:

a) No moisture at the rear of the specimen.
b) Entering of fine spray.
c) Moisture at the rear of the specimen.
d) Rain drops or rain penetration at the rear of the specimen.

A.8 Test procedure

A.8.1 General

Carry out the test in an environment with a temperature of between 5 °C and 35 °C with the test specimen installed in the apparatus at the specified roof pitch.

Seal the edges of the test specimen to prevent leakage of water or air into or out of the suction chamber. Such seals shall not affect the headlaps and sidelaps of the unsealed areas of the test specimen.

Select and continuously apply the relevant wind speed, rainfall rate, and amount of run-off water according to the conditions specified in A.8.2. The test specimen shall be surface dry before testing.

In the wind-driven rain sub-tests (A, B and C), measure initially the pressure difference with the suction chamber closed and adopt this pressure difference as the reference datum for subsequent pressure changes during the sub-test. Then reduce the pressure in the box in steps of not less than 10 Pa and maintain each pressure step for 5 min ± 10 s. Measure the amount of leakage water (if any) at each pressure step, or continuously, up to the reference leakage rate.

NOTE 1 The test can be continued to greater pressure differences to observe additional leakage rates.

In the deluge sub-test (D), apply the rainfall and run-off without wind (suction fan turned off) and with the suction chamber open to the atmosphere, for 2 min ± 10 s. Observe any leakage and measure the amount of leakage water.

Fine spray can enter through joints in certain types of discontinuously laid elements, producing small amounts of water on the test specimen or on the surface of the suction chamber. Its occurrence shall be recorded.

NOTE 2 Such fine spray may or may not be regarded as leakage depending on the performance requirements.

A.8.2 Test conditions

A.8.2.1 General

A set of tests shall consist of sub-tests B and D (and optionally sub-tests A and C), carried out with the following wind-rain combinations as defined in Table A.2:

– Sub-test A: Low wind speed with severe rainfall rate;
– Sub-test B: Low wind speed with high rainfall rate;
– Sub-test C: Severe wind speed with low rainfall rate;
– Sub-test D: No wind with maximum rainfall rate (deluge).

NOTE 1 The four sub-tests in Table A.2 represent the worst case conditions in different climate zones covered in EN 50583-2. However, national, regional or local standards or codes may define different wind-rain test conditions, especially for geographic locations subject to severe weather, e.g. that are heavily weather-beaten, stricken by driving rain and wind, including typhoons, hurricanes, cyclones and other severe climate.

To derive the wind speed over the test specimen u_s (m/s), a modification to the wind speed shall be applied to allow for the effect of roof pitch (see Table A.1).

$$u_s = u \times f \tag{A.4}$$

where

f is the wind speed factor [-]

NOTE 2 Values of f are given in Table A.1.

u is the wind speed approaching the roof [m/s];

u_s is the wind speed over test specimen [m/s].

A.8.2.2 Run-off water

The run-off rate R_{ro} (l/min) shall be calculated by the formula:

$$R_{ro} = R_t \cdot W \cdot L / 60 \tag{A.5}$$

where

R_t is the rainfall on the roof surface [mm/h];

W is the effective width of the test specimen [m];

L is the simulated additional rafter length above the test specimen [m].

Unless otherwise specified, L shall be not less than 5 m.