Chapter

8.2

Electrical generating technologies

This chapter provides guidance for outgoing utilities that generate electricity from low or zero carbon sources (LZC) for home use, storage or export. Other LZC systems that follow the general principles of this chapter may also be acceptable, subject to specific agreement with NHBC.

This chapter contains the following sections:

Chapter

8.2.1

Solar photovoltaics (PV)

Systems which convert solar radiation into electricity.

Figure reference table

Figure Reference Table 8.2.1			
Fig No	**Title/Description**	**Chapter/Clause**	**Page**
Figure 1	Solar PV schematic	8.2.1	2
Figure 2	Solar PV schematic with battery	8.2.1	2
Figure 3	Solar PV types	8.2.1.4	5

Figure 1: Solar PV schematic

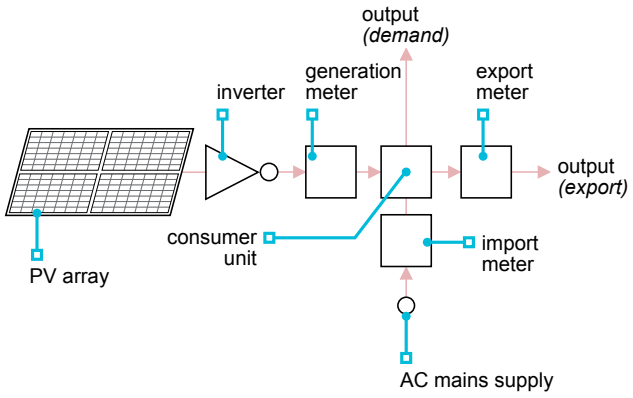
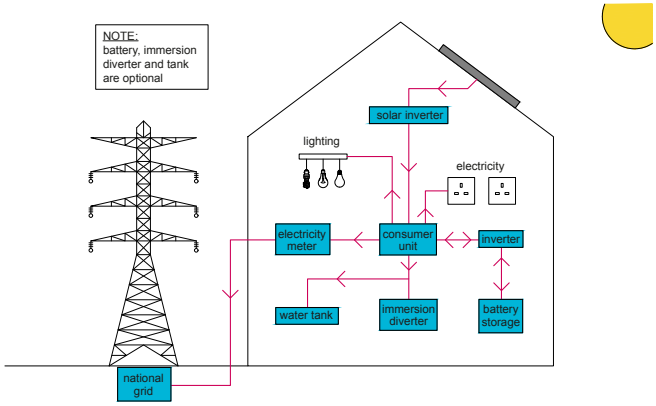


Figure 2: Solar PV schematic with battery



Definitions for solar PV

Coastal locations	A site within a distance of 500m from the general coastline of the United Kingdom.
Controls	Used to operate and/or regulate the system, and may be electrical or mechanical.
Exclusion zone	An area where entry is restricted during periods when maintenance is in progress, to prevent risk of injury or loss of life.
Inverter	A device that converts direct current into alternating current.
Islanding (island mode operation)	Where an LZC technology feeds the network or local distribution system during a planned or unscheduled loss of mains supply.
Low or zero carbon (LZC) technologies	A term applied to renewable sources of energy, and also to technologies which are significantly more efficient than traditional solutions, or which emit less carbon in providing heating, cooling or power
Parallel electrical generation	A system in which building loads can be fed simultaneously from the national grid or electricity supply grid and on-site sources such as wind turbines and PV panels.
Performance	The manner or quality of functioning for a material, product or system.
Renewable energy	Energy from naturally available sources that can be replenished, including energy from the sun, wind and tides, and from replaceable matter such as wood or other plant material.
Switchgear	The combination of electrical switches, fuses and/or circuit breakers used to isolate electrical equipment.

8.2.1.1 Compliance

Also see: Chapter 2.1

Solar PV and ancillary equipment shall comply with the Technical Requirements. Issues to be taken into account include:

1) **relevant standards**
2) **product certification**
3) **operative competency.**

8.2.1.1.1 Relevant standards

Solar PV and/or batteries should comply with relevant standards including where applicable:

BS EN 61215-1	Terrestrial photovoltaic (PV) modules. Design qualification and type approval
BS EN 61215-2	Terrestrial photovoltaic (PV) modules. Design qualification and type approval — Test procedures
BS EN 60068	Environmental testing
BS EN IEC 61730	Photovoltaic (PV) module safety qualification
BS EN IEC 62108	Concentrator photovoltaic (CPV) modules and assemblies. Design qualification and type approval
MCS 005	Product Certification Scheme Requirements: Solar Photovoltaic Modules
MCS 012	The Roof Fixing Standard (Product)
MCS 3002	The Solar PV Standard (Installation)
MIS 3012	The MCS Battery Standard (Installation)
PAS 63100	Electrical installations — Protection against fire of battery energy storage systems for use in dwellings

8.2.1.1.2 Product certification

Solar PV and/or battery technologies should have current certification confirming satisfactory assessment by an appropriate independent authority acceptable to NHBC.

Solar PV products that are certified through the Microgeneration Certification Scheme (MCS) will generally be acceptable to NHBC. Certification and test documentation should be made available to NHBC upon request.

Other certification bodies or test documentation may be acceptable where they are considered by NHBC to be a suitable alternative.

8.2.1.1.3 Operative competency

Solar PV systems should be installed by companies, organisations or operatives who are:

- competent and familiar with the system being installed, and
- MCS Certified, or
- certified to a standard acceptable to NHBC.

8.2.1.2 Provision of information

Designs and specifications shall be produced in a clearly understandable format, include all relevant information and be distributed to the appropriate personnel.

Provision of information is important as it allows for energy-efficient use of the building and common methods adopted to prevent overheating.

Clear and fully detailed drawings should be available on site to enable work to be carried out in accordance with the design. Design and specification information should be issued to site supervisors, relevant specialist subcontractors and suppliers, and where used include the following information:

- fixing schedule
- a full set of current drawings
- indication of which manufacturer and/or installer is responsible for each system and interface
- commissioning schedule
- manufacturers' specifications
- interface details
- on-site testing requirements
- type and spacing of clips and fixings
- type and location of ancillary components, including those used for fire safety and acoustic purposes
- commissioning certificates
- wind load calculations
- snow load calculations.

8.2.1.3 System design

Solar PV technologies shall be designed to ensure satisfactory performance. Issues to be taken into account include:

1) **location**
2) **system**
3) **compatibility**
4) **performance**
5) **diverters**
6) **battery and storage.**

8.2.1.3.1 Location

Solar PV systems should be correctly located, including ancillary components, and should be installed and identified in accordance with the manufacturer's recommendations.

The design and location of solar PV technologies should take account of factors such as:

- orientation
- roof pitch
- coastal location
- snow loading
- shading.

When installed in a coastal location, fixings and bracketry should be appropriate for the area, and stainless steel grade 316 should be used where appropriate.

8.2.1.3.2 System

Solar PV technologies should be designed in accordance with the manufacturer's recommendations, certification scheme requirements and appropriate standards.

Each system should generally be supplied from one manufacturer as a package, not as individual components or materials. However, where components from more than one manufacturer are used, they should be compatible to ensure satisfactory performance.

Mixing of electrical MC4 type connections (male and female) is not acceptable unless specifically allowed by the manufacturer.

8.2.1.3.3 Compatibility

Solar PV technologies should be installed so as not to adversely affect the performance of the building to which they are fixed, and in accordance with the manufacturer's recommendations.

Multiple systems should be compatible with each other.

The temperature rating of any roof underlay should be suitable for use with a solar PV system and accessories used.

When using roof integrated solar panels, ventilation must be maintained in accordance with BS 5250. Also see Clause 7.2.15.

8.2.1.3.4 Performance

Solar PV systems designed to contribute towards space and water heating should be designed in accordance with the performance requirements in Clauses 8.1.8 and 8.3.2.

8.2.1.3.5 Diverters

The provision of immersion diverters is discretionary. Where used, they should be designed by a competent person to prevent any adverse operation to the installed electrical installation either upstream or downstream, including RCD and islanding protection.

8.2.1.3.6 Batteries and storage

Also see: Clause: 8.1.6

The provision of battery storage is discretionary. Where used, it should be designed by a competent person and in conjunction with the IET Code of Practice for Electrical Energy Storage Systems and BS 7671 18th Edition wiring regulations and:

- the installation should be in line with MIS 3012 and manufacturer's installation instructions
- the inverters must be fully type tested to the standards required by the Energy Networks Association recommendations
- the batteries and storage equipment should not be located where they are at risk of accidental damage or where their enclosures are not designed for
- batteries intended for use in dwellings should be housed in a suitable enclosure meeting the relevant IPX rating
- batteries/storage should not be placed so that escape routes are impeded, and that any fire in the battery does not compromise protected escape routes
- where batteries are located they should have sufficient ventilation to prevent overheating and prevent explosive conditions of evolved gasses
- should not be designed and installed where foreseeable flood or water inundation conditions may occur.

Further guidance relating to battery installation can be found in PAS 63100 Electrical installations — Protection against fire of battery energy storage systems for use in dwellings.

8.2.1.4 Building integration

Also see: Clauses: 7.2.15, 7.2.17 and Chapter 8.6

Solar PV technologies shall be securely fixed and not adversely affect the weather resistance of the building.

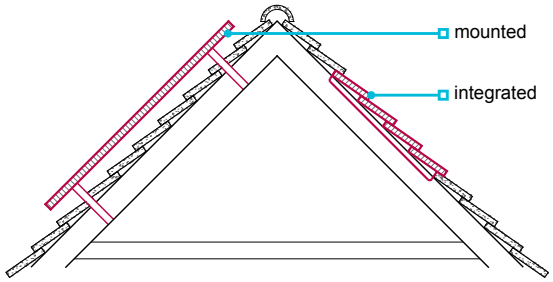
Foundations and anchor points for stand-alone LZC technologies should be designed by an engineer in accordance with Technical Requirement R5 to withstand the structural forces acting upon them.

The structure to which the LZC technology is attached should be assessed according to its ability to accept the loadings and prevent detrimental effects arising from movement or vibration.

The design of the structure should take account of:

- the self-weight of the LZC components
- imposed loads
- wind loads
- snow loads
- dynamic loading (where relevant)
- the atmospheric conditions ie, coastal locations.

Figure 3: Solar PV types



Notching, drilling or chasing of structural components to accommodate service pipes or cables should either comply with Chapter 8.6 Installation and commissioning or be designed by an engineer in accordance with Technical Requirement R5.

Fixings, supports, bracketry and mounting frames should:

- accommodate all static and dynamic loads in accordance with the manufacturer's recommendations
- have adequate protection against corrosion (grade 316 stainless steel is recommended for coastal locations)
- be compatible or isolated where two metals are to be joined to prevent bimetallic corrosion.

All interfaces between the LZC technology and the building should ensure adequate weather resistance, and be sealed to limit air leakage and prevent moisture from reaching the interior or any part of the structure that could be adversely affected by its presence. The envelope should be weatherproofed using appropriate flashings and fixings. Weatherproofing details that rely solely on sealant are not acceptable. Flashings should be formed from the materials listed in Table 1.

Table 1: Materials for flashings

Flashing material	Guidance
Rolled lead sheet	Minimum thickness 1.8mm, code blue (Code 4), to BS EN 12588
Aluminium and aluminium alloys	BS EN 485 and BS EN 573, 0.6-0.9mm thick and protected from contact with mortar by a coating of bituminous paint
Zinc alloys	BS EN 988 and 0.6mm thick
Copper	BS EN 1172 0.55mm thick and fully annealed. Where two metals are to be joined, they should be compatible and not cause bimetallic corrosion in that environment. Alternatively, they should be isolated from each other
Proprietary flashing, including plastic and composite	Assessed in accordance with Technical Requirement R3

To avoid potential surface or interstitial condensation, the design should take account of thermal bridging, particularly where any part of the system, including fixings, penetrates the thermal envelope.

All installations should take into consideration rodent/bird damage, connector corrosion and potential damage caused by follow-on trades.

8.2.1.5 Fixing

Also see: Chapter 2.1

Solar PV technologies shall be fixed using durable materials.

Fixings should comply with the types listed in Table 2.

Table 2: Materials suitable for fixings

Fixing material	Guidance
Phosphor bronze	NA
Silicon bronze	NA
Stainless steel	BS EN ISO 3506
Mild steel	Coatings to BS EN ISO 2081, BS EN ISO 2082, BS EN 1461 or other appropriate treatment in accordance with BS EN ISO 12944 or BS EN ISO 14713
Aluminium alloy	BS EN 573 and BS EN 755
Stainless steel	BS EN 10088
Mild steel	BS EN 10346
Other materials	Assessed in accordance with Technical Requirement R3

Materials that comply with recognised standards, which provide equal performance to (or better than) those above, are also acceptable.

The type, size, number, position and fitting tolerance of fixings should be in accordance with the manufacturer's recommendations.

Issues that should be taken into account include:

- the provision of suitable locking nuts and washers
- the isolation of dissimilar metals
- the isolation of aluminium from cementitious material.

All components, including integrated roof trays, panels, flashings, electrical connectors and wiring, that penetrate the roof structure to the space below should be appropriately flashed and comply with the requirements of R3.

8.2.1.6 Access

Appropriate arrangements shall be provided for the purposes of cleaning, inspection, maintenance and repair or replacement of solar PV technologies.

Safe access should be provided to solar PV technologies, including switchgear, inverters, meters and controls. This is to enable the cleaning, inspection, maintenance and repair of systems. Access should be provided in accordance with the manufacturer's recommendations.

Where plant is to be installed in a loft or roof void, guidance is provided in Clause 7.2.12.

8.2.1.7 Electrical installation requirements

Also see: Clause 8.1.6

The electrical installation shall be in accordance with relevant regulations.

Electrical installations should comply with BS 7671 18th Edition wiring regulations.

Where parallel electrical generation occurs, inverters should have a relevant Engineering Recommendation G83/2 type test certificate and comply with all other parts of ER G83/2 for standard installations. Larger installations should comply with ER G59/3-2.

The electrical installation should be capable of being isolated from all other electrical sources when required, for maintenance or testing.

LZC technologies which generate electricity and are connected to the mains should automatically disconnect when there is a mains power failure. This is to prevent them from feeding the network or local distribution system during a planned or unscheduled loss of mains supply. This is known as 'islanding'.

Where lightning protection is included it should be installed in line with the standards listed in Table 3.

Table 3: Lightning protection standards

BS EN 62305-1-5	Protection against lightning
PD 62305-2:2014	Flash density map 2014. Supplement to BS EN 62305-2. Protection against lightning. Risk management
BS EN IEC 62561-1	Lightning protection system components
BS EN IEC 62561-2	Lightning protection system components
IEC 60068-2-52	Environmental testing: Salt mist, cyclic (sodium chloride solution)
IECISO 6957	Copper alloys: ammonia tests for stress corrosion resistance
ISO 22479	Corrosion of metals and alloys — sulfur dioxide test in a humid atmosphere

8.2.1.8 Handling and storage

Materials, products and systems shall be handled, stored and protected in a satisfactory manner to prevent damage, distortion, weathering and degradation.

Solar PV systems should be:

- transported, lifted, handled and stored in accordance with the manufacturer's recommendations
- delivered in sequence to avoid storage
- protected to avoid the risk of damage.

8.2.1.9 Sequence of work

Solar PV systems shall be installed in accordance with a suitable schedule.

To ensure performance, solar PV systems and ancillary components should be installed in a logical and timely sequence in accordance with the manufacturer's recommendations.

Chapter

8.2.2

Wind turbines

Systems which convert wind into electricity.

Figure reference table

Figure Reference Table 8.2.2			
Fig No	**Title/Description**	**Chapter**	**Page**
Figure 1	Wind turbine schematic	8.2.2	10
Figure 2	Wind turbine schematic with battery	8.2.2	10

Figure 1: Wind turbine schematic

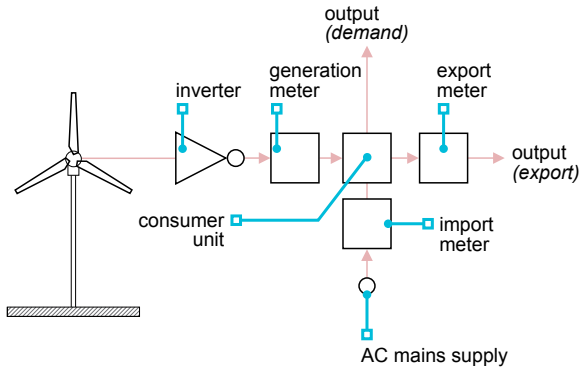
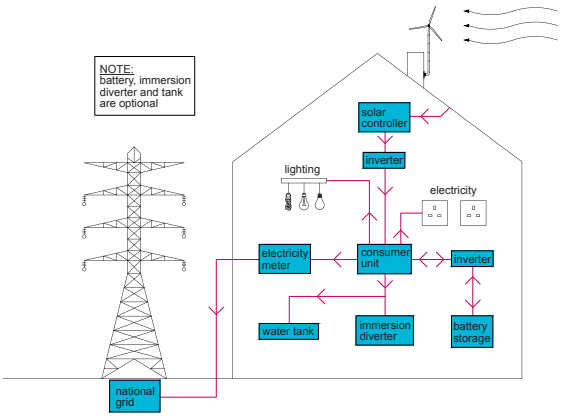


Figure 2: Wind turbine schematic with battery



Definitions for wind turbines

Coastal locations	A site within a distance of 500m from the general coastline of the United Kingdom.
Controls	Used to operate and/or regulate the system, and may be electrical or mechanical.
Exclusion zone	An area where entry is restricted during periods when maintenance is in progress, to prevent risk of injury or loss of life.
Inverter	A device that converts direct current into alternating current.
Islanding (island mode operation)	Where an LZC technology feeds the network or local distribution system during a planned or unscheduled loss of mains supply.
Low or zero carbon (LZC) technologies	A term applied to renewable sources of energy, and also to technologies which are significantly more efficient than traditional solutions, or which emit less carbon in providing heating, cooling or power.
Parallel electrical generation	A system in which building loads can be fed simultaneously from the national grid or electricity supply grid and on-site sources such as wind turbines and PV panels.
Performance	The manner or quality of functioning for a material, product or system.
Renewable energy	Energy from naturally available sources that can be replenished, including energy from the sun, wind and tides, and from replaceable matter such as wood or other plant material.
Switchgear	The combination of electrical switches, fuses and/or circuit breakers used to isolate electrical equipment.

8.2.2.1 Compliance

Also see: Chapter 2.1

Wind turbines shall comply with the Technical Requirements, and shall be securely fixed and not adversely affect the weather resistance of the building. Issues to be taken into account include:

1) **relevant standards**
2) **product certification**
3) **operative competency.**

8.2.2.1.1 Relevant standards

Wind turbines should comply with relevant standards, including, where applicable:

BS EN 61400-1	Wind turbines — Design requirements
BS EN 61400-2	Wind turbines — Small wind turbines
BS EN 61400-11	Wind turbines — Acoustic noise measurement techniques
BS EN 61400-12	Power performance measurements of electricity producing wind turbines
BS EN 60068	Environmental testing
BS EN IEC 62108	Requirements for assessing the products capacity for long term operation in general open-air climates
MIS 3003	Requirements for MCS Contractors Undertaking the Supply, Design, Installation, Set to Work, Commissioning and Handover of Micro and Small Wind Turbine Systems
MCS 006	Micro and small wind turbines

8.2.2.1.2 Product certification

Wind turbines technologies should have current certification confirming satisfactory assessment by an appropriate independent authority acceptable to NHBC.

Systems, products and installations that are assessed through the Microgeneration Certification Scheme (MCS) will generally be acceptable to NHBC. Certification and test documentation should be made available to NHBC upon request.

Other certification bodies or test documentation may be acceptable where they are considered by NHBC to be a suitable alternative.

8.2.2.1.3 Operative competency

Wind turbine systems should be installed by companies, organisations or operatives who are:

- competent and familiar with the system being installed, and
- MCS Certified, or
- certified to a standard acceptable to NHBC.

8.2.2.2 Provision of information

Designs and specifications shall be produced in a clearly understandable format, include all relevant information and be distributed to the appropriate personnel.

Provision of information is important as it allows for energy-efficient use of the building and common methods adopted to prevent overheating.

Clear and fully detailed drawings should be available on site to enable work to be carried out in accordance with the design. Designs and specifications should be issued to site supervisors, relevant specialist subcontractors and suppliers, and include the following information:

- fixing schedule
- a full set of current drawings
- indication of which manufacturer and/or installer is responsible for each system and interface
- commissioning schedule
- manufacturers' specifications
- interface details
- on-site testing requirements
- type and spacing of clips and fixings
- type and location of ancillary components, including those used for fire safety and acoustic purposes
- commissioning certificates
- wind load calculations
- snow load calculations.

8.2.2.3 System design

Wind turbine systems shall be designed to ensure satisfactory performance. Issues to be taken into account include:

1) **location**
2) **system**
3) **compatibility**
4) **performance**
5) **diverters**
6) **battery and storage**
7) **acoustics.**

8.2.2.3.1 Location

Wind turbine systems, including ancillary equipment, should be correctly located and:

- installed in accordance with the manufacturer's instructions and MIS 3003
- not be obstructed to prevent incorrect and efficient operation
- for stand-alone wind turbine systems, suitable exclusion zones provided in accordance with the manufacturer's recommendations and geographical location.

The design and location of wind turbine technologies should take account of factors such as coastal location.

When installed in a coastal location, fixings and bracketry should be appropriate for the area, and stainless steel grade 316 should be used where appropriate.

8.2.2.3.2 System

Wind turbine systems should be designed in accordance with the manufacturer's recommendations, certification scheme requirements and appropriate standards.

Each system should generally be supplied from one manufacturer as a package, not as individual components or materials. However, where components from more than one manufacturer are used, they should be compatible to ensure satisfactory performance.

8.2.2.3.3 Compatibility

Wind turbine systems should be installed so as not to adversely affect the performance of the building to which they are fixed, and in accordance with the manufacturer's recommendations.

Multiple systems should be compatible with each other.

8.2.2.3.4 Performance

Wind turbine systems designed to contribute towards water heating should be designed in accordance with the performance requirements in Clause 8.1.8.

8.2.2.3.5 Diverters

The provision of immersion diverters is discretionary. Where used, they should be designed by a competent person to prevent any adverse operation to the installed electrical installation, either upstream or downstream, including RCD and islanding protection.

8.2.2.3.6 Batteries and storage

Also see: Clause: 8.1.6

The provision of battery storage is discretionary. Where used, they should be designed by a competent person and in conjunction with the IET Code of Practice for Electrical Energy Storage Systems and BS 7671 18th Edition wiring regulations, and:

- the installation should be in line with MIS 3012 and manufacturer's installation instructions
- the inverters must be fully type tested to the standards required by the Energy Networks Association recommendations
- the batteries and storage equipment should not be located where they are at risk of accidental damage or where their enclosures are not designed for
- batteries intended for use in dwellings should be housed in a suitable enclosure meeting the relevant IPX rating
- batteries/storage should not be placed so that escape routes are impeded, and that any fire in the battery does not compromise protected escape routes
- where batteries are located, have sufficient ventilation to prevent overheating and prevent explosive conditions of evolved gasses
- should not be designed and installed where foreseeable flood or water inundation conditions may occur.

Further guidance relating to battery installation can be found in PAS 63100 Electrical installations — Protection against fire of battery energy storage systems for use in dwellings.

8.2.2.3.7 Acoustics

Design and location should take account of:

- internal and external noise
- vibration
- the effect on neighbouring properties, particularly the positioning of the wind turbine system in relation to openings.

8.2.2.4 Building integration

Also see: Chapter 8.6

Wind turbine systems shall be securely fixed and not adversely affect the weather resistance of the building.

Foundations and anchor points for stand-alone LZC technologies should be designed by an engineer in accordance with Technical Requirement R5 to withstand the structural forces acting upon them.

The structure to which the LZC technology is attached should be assessed according to its ability to accept the loadings and prevent detrimental effects arising from movement or vibration.

The design of the structure should take account of:

- the self-weight of the LZC components
- imposed loads
- wind loads
- snow loads
- dynamic loading (where relevant).

Notching, drilling or chasing of structural components to accommodate service pipes or cables should either comply with Chapter 8.6 Installation and commissioning or be designed by an engineer in accordance with Technical Requirement R5.

Fixings, supports, bracketry and mounting frames should:

- accommodate all static and dynamic loads in accordance with the manufacturer's recommendations
- have adequate protection against corrosion (grade 316 stainless steel is recommended for coastal locations)
- be compatible or isolated where two metals are to be joined to prevent bimetallic corrosion.

Aluminium and aluminium alloys should not come into contact with cementitious material.

All interfaces between the LZC technology and the building should ensure adequate weather resistance, and be sealed to limit air leakage and prevent moisture from reaching the interior or any part of the structure that could be adversely affected by its presence. The envelope should be weatherproofed using appropriate flashings and fixings. Weatherproofing details that rely solely on sealant are not acceptable.

8.2.2.5 Fixing

Also see: Chapter 2.1

Wind turbine systems shall be fixed using durable materials.

Fixings should comply with the types listed in Table 1.

Table 1: Materials suitable for fixings

Fixing material	Guidance
Phosphor bronze	NA
Silicon bronze	NA
Stainless steel	BS EN ISO 3506
Mild steel	Coatings to BS EN ISO 2081, BS EN ISO 2082, BS EN 1461 or other appropriate treatment in accordance with BS EN ISO 12944 or BS EN ISO 14713
Aluminum alloy	BS EN 573 and BS EN 755
Stainless steel	BS EN 10088
Mild steel	BS EN 10346
Other materials	Assessed in accordance with Technical Requirement R3

Materials that comply with recognised standards, which provide equal performance to (or better than) those above, are also acceptable.

The type, size, number, position and fitting tolerance of fixings should be in accordance with the manufacturer's recommendations.

Issues that should be taken into account include:

- the provision of suitable locking nuts and washers
- the isolation of dissimilar metals
- the isolation of aluminium from cementitious material.

8.2.2.6 Access

Appropriate arrangements shall be provided for the purposes of cleaning, inspection, maintenance and repair or replacement of wind turbine systems.

Safe access should be provided to the wind turbine systems, including switchgear, inverters, meters and controls. This is to enable the cleaning, inspection, maintenance and repair of systems. Access should be provided in accordance with the manufacturer's recommendations.

8.2.2.7 Electrical installation requirements

Also see: Clause: 8.1.6

The electrical installation shall be in accordance with relevant regulations.

Electrical installations should comply with BS 7671 Requirements for Electrical Installations.

Where parallel electrical generation occurs, inverters should have a relevant Engineering Recommendation G83/2 type test certificate and comply with all other parts of ER G83/2 for standard installations. Larger installations should comply with ER G59/3-2.

The electrical installation should be capable of being isolated from all other electrical sources when required, for maintenance or testing.

Wind turbine systems which generate electricity and are connected to the mains should automatically disconnect when there is a mains power failure. This is to prevent them from feeding the network or local distribution system during a planned or unscheduled loss of mains supply. This is known as 'islanding'.

Lightning protection must be installed as directed by the equipment manufacturer.

8.2.2.8 Handling and storage

Materials, products and systems shall be handled, stored and protected in a satisfactory manner to prevent damage, distortion, weathering and degradation.

Wind turbine systems should be:

- transported, lifted, handled and stored in accordance with the manufacturer's recommendations
- delivered in sequence to avoid storage
- protected to avoid the risk of damage.

8.2.2.9 Sequence of work

Wind turbine systems shall be installed in accordance with a suitable schedule.

To ensure performance, wind turbine systems and ancillary components should be installed in a logical and timely sequence in accordance with the manufacturer's recommendations.

Technical Disclaimer

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