Microgeneration Installation Standard: MIS 3003

# REQUIREMENTS FOR CONTRACTORS UNDERTAKING THE SUPPLY, DESIGN, INSTALLATION, SET TO WORK COMMISSIONING AND HANDOVER OF MICRO AND SMALL WIND TURBINE SYSTEMS

Issue 3.0

This standard has been approved by the Steering Group of the Microgeneration Certification Scheme.

This standard was prepared by the Microgeneration Certification Scheme Working Group 3 ‘Micro and Small Wind Turbine Systems’.

**REVISION OF MICROGENERATION INSTALLATION STANDARDS**

Microgeneration Installation Standards will be revised by issue of revised editions or amendments. Details will be posted on the website at www.microgenerationcertification.org

Technical or other changes which affect the requirements for the approval or certification of the product or service will result in a new issue. Minor or administrative changes (e.g. corrections of spelling and typographical errors, changes to address and copyright details, the addition of notes for clarification etc.) may be made as amendments.

The issue number will be given in decimal format with the integer part giving the issue number and the fractional part giving the number of amendments (e.g. Issue 3.2 indicates that the document is at Issue 3 with 2 amendments).

Users of this Standard should ensure that they possess the latest issue and all amendments.

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## FOREWORD

This standard identifies the evaluation and assessment practices undertaken by the certification bodies of the Microgeneration Certification Scheme (MCS) for the purposes of approval and listing of contractors undertaking the supply, design, installation, set to work, commissioning and handover of micro and small wind turbine systems. The listing and approval is based on evidence acceptable to the certification body:

- that the system or service meets the standard
- that the contractor has staff, processes and systems in place to ensure that the system or service delivered meets the standard

And on:

- periodic audits of the contractor including testing as appropriate
- compliance with the contract for the MCS listing and approval including agreement to rectify faults as appropriate

This standard shall be used in conjunction with MCS 001 scheme document and any other guidance and / or supplementary material available on the MCS website specifically referring to this Microgeneration Certification Standard (MIS 3003). A catalogue of guidance and supplementary material to be read in conjunction with MIS 3003 can be found on the MCS website, www.microgenerationcertification.org.

Government defines Microgeneration as the production of heat and/or electricity on a small-scale from a low carbon source. The various technologies have the potential to help us achieve our objectives of tackling climate change, ensuring reliable energy and tackling fuel poverty.

The objective of Government's Microgeneration strategy is to create conditions under which Microgeneration becomes a realistic alternative or supplementary energy generation source for the householder, for the community and for small businesses.

NOTES:-

Compliance with this Microgeneration Installation Standard does not of itself confer immunity from legal obligations.

Users of Microgeneration Installation Standards should ensure that they possess the latest issue and all amendments.

The MCS Steering Group welcomes comments of a technical or editorial nature and these should be addressed to "The Secretary" at mcs@gemserv.com.

Listed products and services may be viewed on our website: www.microgenerationcertification.org

# 1 SCOPE

This standard specifies the requirements the Microgeneration Certification Scheme (MCS) for Contractors undertaking the supply, design, installation, set to work, commissioning and handover of micro and small wind turbine systems located on dedicated free-standing / guyed towers or building-mounted; supplying permanent buildings; and either linked to the electricity distribution grid or off-grid battery charging systems. For the purposes of this standard, Micro and Small Wind Turbine systems are defined as those having an electrical output up to 50kW (measured at a wind speed of 11.0 metres per second as defined in BWEA etc).

# 2 DEFINITIONS

| | |
|---|---|
| Contractor | An individual, body corporate or body incorporate, applying for or holding certification for the services detailed in the Scope, Clause 1, above. |
| Contract | A written undertaking for the design, supply, installation, set to work and commissioning of Microgeneration systems and technologies |
| Design | The formulation of a written plan including a specific list of products and fixings to form a completed system for a defined Microgeneration technology. Including extensions and alterations to existing Microgeneration systems. |
| HAWT | Horizontal axis wind turbine |
| VAWT | Vertical axis wind turbine |
| Installation | The activities associated with placement and fixing of a Microgeneration system. |
| Set to work | The activities necessary to make the Microgeneration system function as a completed system. |
| Commissioning | The activities to ensure that the installed system operates within the boundaries and conditions of the design and the product manufacturers' claims. |
| Sub-contract | A written contract between a certificated contractor and another Firm for supply of products and services in connection with the fulfilment of a contract. |
| Handover | The point in a contract where commissioning and certification of the system have been satisfactorily completed to the contract specification so enabling the installation to be formally handed over to the client. |

# 3 REQUIREMENTS FOR THE CERTIFICATED CONTRACTOR

## 3.1 Capability

Certificated contractors shall have the capability and capacity to undertake the supply, design, installation, set to work, commissioning and handover of micro and small wind turbine systems.

Where contractors do not engage in the design or supply of micro and small wind turbine systems, but work solely as an installer for a client who has already commissioned a system design; then the contractor must be competent to review and verify that the design would meet the design requirements set out in this standard and this should be recorded.

## 3.2 Quality management system

Contractors shall operate a satisfactory quality management system which meets the additional requirements set out in the scheme document MCS 001.

## 3.3 Sub contracting.

In installations for private customers, any work within the scope of the scheme not undertaken by employees of the Contractor shall be managed through a formal subcontract agreement between the two parties in accordance with the policies and procedures employed by the certificated Contractor. These procedures shall ensure that the subcontractor undertakes the work in accordance with the requirements of this standard.

In other situations (for example new build, or for commercial customers), it is permissible for the physical installation, setting to work and commissioning to be undertaken by others (i.e. not sub-contracted to the Contractor) provided that:

3.3.1 A contract between the Contractor and the commercial client details obligations on the client to include that evidence of skills and training of those employed by the client to do elements of work not undertaken by the Contractor are to be made available to the Contractor to ensure that the competence requirements of this standard are met and that access to the site for training and supervision in accordance with the following sections is agreed in advance.

3.3.2 The certificated Contractor provides additional product-specific training for those undertaking the work not undertaken by the certificated Contractor.

3.3.3 The certificated Contractor assesses a sample number of installations under the contract which is not less than the square root of the number of installations rounded up to the nearest whole number (e.g. a new build site of 50 installations then a minimum of 8 are assessed).

3.3.4 The certificated Contractor assumes responsibility at handover that the installation is in full compliance with the standard.

## 3.4 Consumer code of practice

The Contractor shall be a member of and, when dealing with domestic consumers, comply with a code of practice (consumer code), which is relevant to the scope of their business in the Microgeneration sector and which is approved by the Office of Fair Trading (OFT). In the absence of any approved codes the MCS will accept codes that have completed stage 1 of the OFT approval process (e.g. REAL Code).

# 4 DESIGN AND INSTALLATION REQUIREMENTS

## 4.1 Regulations

All applicable regulations and directives must be met in full. It should be noted that regulations that must be applied may be different in England and Wales, Scotland and Northern Ireland. Some guidance on applicable regulations is given in the guidance document MCS 002. This guidance is not necessarily exhaustive and may change from time to time. Certificated contractors must ensure they have a system to identify all applicable regulations and changes to them.

All work, and working practices, shall be in compliance with all relevant Health and Safety regulations and a risk assessment shall be conducted before any work on site is commenced.

## 4.2 Design and installation

Wind Turbine systems shall be designed and installed in accordance with the Energy Saving Trust publication CE72 – 'Installing small wind-powered electricity generating systems', with the following exception and the additional requirements specified in this standard.

The scope of CE72 is defined as wind turbines with power outputs ranging from 500W to 25kW. For the purposes of this standard this range is extended to between 0W and 50kW (measured at a wind speed of 11.0 m s-1).

## 4.3 System performance

### 4.3.1 Annual Energy Production Estimate

An estimate of annual energy production shall be calculated using the standardised procedure detailed below. This standardised procedure is a simple method using freely available wind speed data (NOABL) and simple tabulated correction factors for the local terrain, obstructions and turbine height, and hence has a relatively high degree of uncertainty. However, it gives useful information, especially where full wind monitoring of the site is not considered financially viable.

As indicated below it is permissible to give estimates of annual energy production based on other procedures in addition to the standardised estimate. However, an estimate based on the standardised procedure shall be given in all cases to give preliminary information about the suitability of the site, to allow comparisons between different systems, and to provide a reality check for any other estimates that may be provided.

Step 1: Obtain raw NOABL wind speed data for the site:

Establish and record the 10m altitude mean wind speed (VN10) for proposed location using the NOABL (Numerical Objective Analysis of Boundary Layer) database. The national database of approximate wind speeds published by the UK government (referred to as NOABL) can be found at:

http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/renewable/explained/wind/windsp_databas/windsp_databas.aspx

Step 2: Determine category of the surrounding terrain of the proposed turbine location

Identify and record the category below, which best describes the terrain around the proposed location, paying particular attention to the regions about 1km upwind and 500m downwind for the prevailing wind direction1. If these regions include areas described by more than one of these categories then choose the category that is numerically highest:

Category 1: Flat grassland, parkland or bare soil, without hedges and only a few isolated obstructions.

Category 2: Gently undulating countryside, fields with crops, fences or low boundary hedges and few trees.

Category 3: Farmland with high boundary hedges, occasional small farm structures, houses and trees etc.

Category 4: Woodland or low rise urban/suburban areas (e.g. domestic housing) with a plan area density of up to about 20%.

Category 5: Dense urban areas and city centres (e.g. buildings of four-stories or higher) with a plan area density of greater than about 20%.

[1] Where possible, the direction of the prevailing wind for the location should be found from local met office data. In the absence of any local wind data, the prevailing wind in the British Isles should be taken as coming from the South West. On many sites a significant percentage of winds result from directions other than the most dominant direction. The installer should advise about the implications of any obstructions from different directions. Unless specific local wind data is available, the more dominant wind in the British Isles is to be assumed as approx. 45% of wind from the compass quarter between South and West and approx. 25% from the compass quarter between North and East, 20% between West and North and 10% between East and South

**Note:** Some pictures showing examples of these categories are given in Appendix B

Step 3: Identify any significant local obstructions:

Identify and record if there are any significant obstructions to the wind in the upwind and downwind zones adjacent to a wind turbine as shown in Figure 1. Record the height (ho) of the highest obstruction within these zones

Notes:

The upwind and downwind directions are defined relative to the prevailing wind direction1.

Be aware that the extents of these zones in the up wind and downwind directions are determined relative to the height of the obstruction (ho), whereas the extent of the zones in the directions perpendicular to these directions are defined relative to the hub height of the turbine (ht).

A significant obstruction is considered to be any solid item (e.g. building, wall etc) or semi permeable item (e.g. trees or bushes) that is greater than 0.5m at its widest part and reaches to a height greater than 0.25 of the hub height of the turbine. **Note:** This includes any building on which the turbine is mounted.

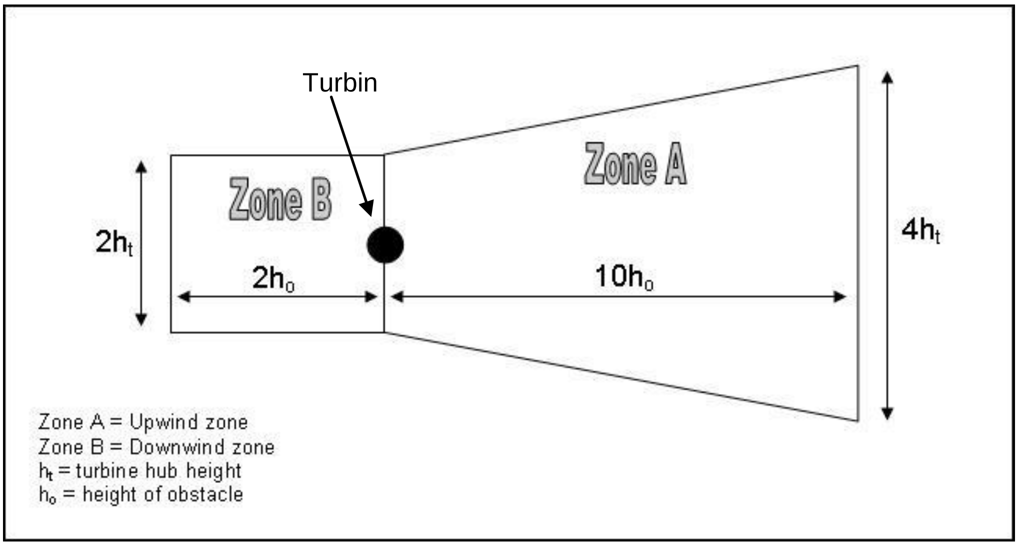


Figure 1: Diagram of upwind and downwind significant obstruction zones

Step 4: Correct the NOABL data for the surrounding terrain, obstructions & turbine height:

Determine the appropriate correction factor (Cf) from Table B.1 depending upon the applicable case below:

Case A: Where there is no significant obstruction(s) identified in Step 3

Record the correction factor (Cf) from the column for the applicable terrain category identified in Step 1, and the row for hc = ht.

Where ht is the height of the turbine hub above the ground.

Case B; Where there is one or more significant obstruction(s) identified in Step 3

Record the correction factor (Cf) from the column for the applicable terrain category identified in Step 1, and the row for hc = ht – 0.8 ho.

Where ht is the height of the turbine hub above the ground.

ho is the height of the highest significant obstruction within zones A or B.

Case C A special case for turbines mounted on isolated tall buildings

The special case C described below can be applied for micro/small wind turbines mounted on top of isolated tall buildings where the following conditions apply:

- The building height (hb) exceeds 20m;
- There are no other buildings or obstructions within zones A or B (figure 1) that would be identified as significant obstructions in accordance with Step 3;
- The turbine is mounted so that the lowest point of the turbine blades are at least 0.1 hb above the highest part[2] of the building.

Where these conditions apply, record the correction factor (Cf) from the column for the applicable terrain category identified in Step 1, and the row for hc = ht where ht is the height of the turbine hub above the ground.

**Note:** Where the above conditions do not apply, Case B should be applied. However, it should be noted that close to the roof surface the wind conditions are likely to be chaotic with low average wind speeds but high peak values (gusts) and turbulence levels, which can be damaging to the turbine.

Having identified the correction factor to be applied, calculate estimated mean annual wind speed (Ve) for the turbine position as follows:

Ve = Cf x VN10

Step 5: Derive the estimated Annual Energy Performance

Apply the estimated mean annual wind speed (Ve) at the turbine from step 4 to the wind turbine manufacturer's Annual Energy Performance Curve (**note:** this is not the Power Curve) to obtain an estimate of the annual energy output. At the discretion of the system designer, further factors to reduce the estimated annual energy output, due to turbulence, underlying topography or obstructions in other directions, may be applied.

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[2] Excluding lightning conductors, flag poles & aerials etc which are less than 0.5m at their widest point and more than 4 times the turbine blade diameter from the turbine.

This information should be communicated to the client before the point that the contract is awarded and shall be accompanied by the following disclaimer:

“This energy performance estimate is based upon a standardised method using publicly available information. It is given as guidance only and should not be considered to be a guarantee. The energy performance of wind turbine systems is impossible to predict with a high degree of certainty due to the variability in the wind from location to location and from year to year.

For a greater level of certainty, it is recommended that on-site wind speed monitoring is undertaken ideally for at least a year. **Note**: it may be useful to monitor for shorter periods, especially if the acquired data is then correlated with other sources in order to estimate an annual mean wind speed.”

In addition to the above standard estimate of annual energy performance, additional estimates may be provided using alternative methodologies or additional adjustment factors in the standard methodology. Any such estimates must clearly describe and justify the approach taken and factors used, must not be given greater prominence than the standard estimate and must have an associated warning that they should be treated with caution if they are significantly greater than the result given by the standard method.

The details of the standardised and any additional estimates of the annual energy performance shall be recorded and retained in the project file.

### 4.3.2 Acoustic performance estimate

An estimate of the acoustic performance shall be calculated using the procedure detailed below:

a) Establish 10m altitude mean wind speed for proposed location using the NOABL (Numerical Objective Analysis of Boundary Layer) database. The national database of approximate wind speeds published by the UK government (referred to as NOABL) can be found here:

http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/renewable/explained/wind/windsp_databas/windsp_databas.aspx

b) Use NOABL to get the mean average annual wind, Vavg,10 at 10m height for the location.

c) Assume a Rayleigh wind distribution, calculate the 90% wind V90,10 for 10 m height as:

$V_{90,10} = 1.72 * V_{avg,10}$

d) Apply a wind correction factor from 10m height using a power law (in accordance with IEC 61400-2) to get an estimate of wind at the installed rotor centre height, H, as:

$$V_{90,H} = V_{90,10} * \left(\frac{H}{10}\right)^{0.2}$$

e) Draw a horizontal line on the Immission Noise Map in the BWEA Noise Label (per BWEA Small Wind Turbine Safety & Performance Standard) at the V90,H wind speed.

f) Read-off the distance for the acoustic dB(A) values of interest.

g) Compare these distances with the slant distance from the turbine hub to the nearest noise sensitive location(s) for the planned installation.

This information should be communicated with the client at or before the point that the contract is awarded and shall be accompanied by the following disclaimer:

"This acoustic performance estimate is based upon a standardised method using publicly available information. It is given as guidance only and should not be considered to be a guarantee. The acoustic performance of wind turbine systems is impossible to predict with a high degree of certainty due to the variability in the wind from location to location and from year to year

For a greater level of certainty, it is recommended that on-site wind speed monitoring is undertaken ideally for at least a year. **Note**: it may be useful to monitor for shorter periods, especially if the acquired data is then correlated with other sources in order to estimate an annual mean wind speed."

In addition to the above standard estimate of acoustic performance, additional estimates may be provided using an alternative methodology or additional adjustment factors in the standard methodology. Any such estimates must clearly describe and justify the approach taken and factors used, must not be given greater prominence than the standard estimate and must have an associated warning that it should be treated with caution if it is significantly less than the result given by the standard method.

The details of the standardised and any additional estimates of the acoustic performance shall be recorded and retained in the project file.

#### 4.3.3 CNS assets

The proposed location of the turbine shall be compared with the register of aircraft Communications, Navigation, and Surveillance assets (CNS assets) to establish whether there is a requirement to seek permission for installation of a turbine in respect of the CNS assets. The CNS assets are important for the safety of aircraft which is why this is necessary.

An online version of the CNS assets register is expected to be made available in the near future by the UK government. The proposed location of the turbine is to be entered into this online tool together with any other relevant information and the tool will indicate whether permission needs to be sought.

If the online version of this CNS assets register is not available then an enquiry must be made to the local planning authority.

### 4.4 Site specific issues

The following issues shall be addressed in the design of the wind turbine system for each installation:

1. The suitability of a given site shall be assessed by a competent person experienced in micro and small wind systems, using a site survey form including at least the details given in Appendix A. All contractors shall make their customers aware of all permissions and approvals required for the installation. Where required, planning and/or building control approval should be obtained before work is commenced.
2. The class of turbine selected for installation shall be appropriate for the conditions at the proposed site as identified through the site survey (see Appendix A).
3. For ground-mounted or roof mounted wind turbines utilising concrete foundations or steel support structures, installers shall have a documented method of controlling the quality of foundations according to the turbine manufacturers' specifications, or in the absence of manufacturer's specifications this shall be in accordance with CE 72 section 3.1.

**Note:** An installer who has not received sufficient information from the manufacture should seriously question whether it is the appropriate product for the customer in question.

In instances when a 3rd Party contractor is instructed to undertake the design and installation works of the foundation or support structure attention is drawn to the contractual obligations detailed in Clause 3.3.

Regardless of which party performs the foundation or support structure installation, the installer shall undertake a quality control assessment, which should take the form of a documented site inspection, or photographs of any excavations, reinforcing structure and concrete pouring process, along with a copy of a certificate of conformance for the concrete composition. The installer shall satisfy himself that both the design and installation works have been undertaken by an appropriately qualified and skilled person or company and that 3rd parties have been provided with all relevant information.

1. For wind turbines mounted directly on a building, in addition to section 3.1 of CE72, the fixing method used shall not compromise the weather resistance or structural integrity of the building. If there is any doubt, a structural engineer must be consulted.
2. Wind turbines, especially those mounted on buildings, shall not be located in such a way as to have an adverse effect on the performance of any flue which serves fuel burning equipment (e.g. gas fire).

**Note:** where any flue exists above gutter level (e.g. from a chimney) and a wind turbine is to be mounted on the building then additional analysis shall be undertaken and documented.

1. Wind turbines shall not be mounted so as to cause unacceptable levels of flickering shadows. These shadows from rotating wind turbine blades may be cast long distances from the turbine, depending on tower height and possibly the slope of the ground. The severity and the duration of exposure generally decrease with increasing distance. Shadows occur to the north of the turbine at mid-day (most relevant for offices) and to the West and East in the early morning and late evening respectively (more relevant for houses). An exposure limit of up to 30 hours per year has been established as reasonable (see Annex D). Unless a site specific and turbine specific assessment is carried out the wind turbine shall be sited in accordance with the guidelines in Figure 2 below, or other suitable mitigating measures applied (for example using a timer system to shut down the

turbine during the hours of the day when there might be an issue on a few weeks of the year).

**In the Figure 2 below the wind turbine is at the centre of the image and North is at the top of the image. Figure 2 is suitable for turbines mounted at hub heights of 3-4 time rotor diameter (Bd, where Bd is blade diameter for a HAWT or blade length for a VAWT) and reference should be made to Annex D for other cases.**

Red area = Significant shadow flicker effects can be expected: windows or other sensitive points are to be avoided in this area.

Pink area = Significant shadow flicker effects may occur: the consequences for any windows or other sensitive points in this area needs to be assessed.

Green area= No shadow flicker effects are expected

White area (> 10 x $B_d$) = Any shadow flicker effects are expected to be minor and of short duration.

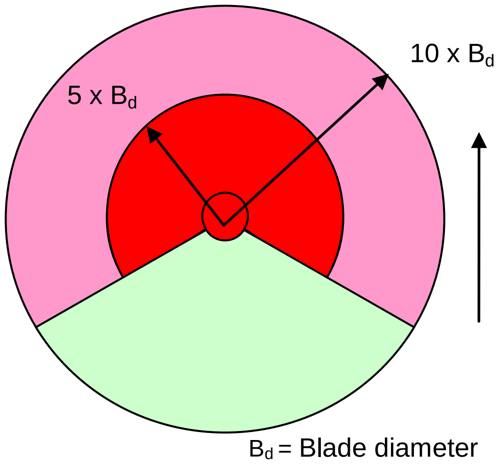



**Figure 2: Diagram of shadow flicker zones of interest for UK**

**(Note: The wind turbine is at the centre, and that this diagram is appropriate for UK latitudes in the Northern hemisphere where the green sector forms an arc of approximately 100 degrees)**

2 The Contractor shall ensure that the customer is aware from the outset that metering will be required if the customer wishes to access certain financial incentive schemes. The contractor will ensure the customer has the opportunity to take account of this when awarding the contract.

Note: for guidance on metering requirements please follow the MCS Metering Guidance v1.0 available from the Standards section of www.microgenerationcertification.org

## 4.5 Responsible siting guidance

The installer shall undertake a risk assessment for the turbine's operation on the proposed site. This risk assessment must be in accordance with manufacturer's siting guidelines unless additional mitigation measures are deployed and the customer has been made aware of the risks and additional mitigation measures. The customer must sign acceptance in these instances. Risk assessments shall include at least the following risks:

| Zone | Extent | Typical hazard |
|---|---|---|
| 1 | Circle around base | Fall zone:<br>Hazard if anything fell from turbine. |
| 2 | Hemisphere around base | Topple zone:<br>Hazard if the mast were to topple. |
| 3 | Circle around base | Ejection zone:<br>Hazard if something were to be ejected from the spinning rotor. |
| 4 | Reachable area | Vandalism:<br>Lowest point of rotating parts above the ground or easily accessible point. |
| 5 | Varies | Impact:<br>Hazard from vehicle impacts. |

The risk assessment(s) carried out shall consider at least the following hazards:

- Falling objects – anything that could fall from the turbine including structural or mechanical parts or natural phenomena (e.g. ice);
- Tower/mast failure – the potential for structural failure leading to a full or partial collapse of the tower/mast;
- Thrown or ejected objects – anything that could be thrown or ejected from the rotating blades including structural or mechanical parts or natural phenomena (e.g. ice)
- Dangerous mechanical parts – potential of accidental of intentional contact with rotating parts taking account lowest point of rotating parts and any points that are easily accessible;
- Electrical – potential for accidental or intentional contact with electricity including underground services;
- Slips/trips/falls- potential for slip trip and falls associated with the turbine including the sitting of wires, guy ropes etc.

This list is not exhaustive. In conducting the risk assessment the installer should also take account other factors that may inform and influence the conclusion of the risk assessment. These include (but are not limited to):

- The potential risks to the turbine and any supporting structures or equipment from commercial (e.g. contractor) or public vehicles (e.g. crashing into tower);
- Environmental phenomena including lightning, ground stability, trees etc.;
- Vandalism to the structure and/or safety critical components;
- The potential risks to the turbine and any supporting structures or equipment from adjacent premises or commercial and industrial activities.

Installers should ensure that the risk assessment is documented and is able to demonstrate compliance with the relevant statutory requirements set out in general and specific health and safety legislation. There is no standard format to record the risk assessment. However it is good practice for micro and small system installations that in addition to the written risk assessment that the findings can be additionally categorised using a zonal approach which identifies the away from the base of the tower/mast. This may also be visually presented to assist the communication of the risk assessment any mitigation measures to the customer.

### 4.6 Electrical connections

The wind turbine system shall be installed in accordance with the latest version of BS7671 Requirements for Electrical Installations and CE72. **Note:** it is acceptable that BS7671 overrides CE72 in that it does not require the installation of a dedicated circuit to a dedicated fuseway or circuit breaker in some circumstances.

### 4.7 Commissioning

The wind turbine system shall be commissioned according to a documented procedure to ensure that the system is safe, has been installed in accordance with the requirements of this standard and the manufacturers' requirements, and is operating correctly in accordance with the system design. A record of completion of the commissioning procedure for each installation shall be retained in the customer file containing any items recommended by the turbine manufacturer, or in the absence of any such recommendations it shall cover the items in Clause 5 of the Energy Saving Trust publication CE72.

### 4.8 Equipment

Wind turbine systems used in installations shall be listed under the MCS.

Equipment shall be suitable for its application and have a manufacturer's declaration of conformity for the appropriate standards & directives.

## 5 COMPETENCE OF STAFF

All personnel employed by, or sub-contracted to, the contractor must be able to demonstrate that they are trained and competent in the disciplines and skills, appropriate to the activities required for their role, in accordance with this standard.

Complete records of training and competence skills of personnel must be maintained by the certificated contractor, in particular:

- Design staff, carrying out full conceptual design, must be able to demonstrate a thorough knowledge of the technologies involved and the interaction of associated technologies.
- All personnel engaged in the actual installation are expected to have technical knowledge and installation skills, to install components and equipment within the designed system, in accordance with all appropriate codes of practice, manufacturer's specifications and regulations.
- All personnel engaged in the final inspection, commissioning, maintenance or repair, must have a comprehensive technical knowledge of the products, interfacing services and structures to complete the specified processes.

Examples of the underpinning knowledge areas required to show competence are given in Appendix C.

**Note:** Due to the current development of the Sector Skills Agreement and the review in progress of the National Occupational Standards for this technology, the indicated suggested scope in Appendix C, may change.

# 6 HANDOVER REQUIREMENTS

At the point at which the micro and small wind turbine system is handed over to the client or as soon as practicable after installation (within at least 10 working days of the commissioning date), the documentation detailed below should be provided and explained:

1. a documentation pack in accordance with CE72;
2. the maintenance requirements and maintenance services available;
3. a certificate signed by the contractor containing at least the following:

    a) a statement confirming that the installed wind turbine system meets the requirements of this standard (being MIS 3003);
    b) client name and address;
    c) site address (if different);
    d) contractors name, address etc;
    e) list of key components installed;
    f) estimation of system performance, calculated according to 4.3.1;

4. the structural engineer's report for a building mounted wind turbine or for the generic fixing system for the wind turbine and type of construction of the building;
5. advice to the customer that the customer should advise their insurer(s) of the installation of a wind turbine;
6. a copy of the certificate obtained from the MCS Installation Database, showing that the installation has been registered with the scheme.

**Note:** all MCS Installations must be notified to the MCS Licensee through the MCS Installation Database, where a certificate will be generated and sent to the customer. There is an installation fee levied on installers for each installation added to the database.

# 7 REGIONAL OFFICES

Where the contractor wishes to design and commission under the Certification Scheme in regional offices, then these offices shall meet the requirements of this standard to be eligible for Certification.

# 8 PUBLICATIONS REFERRED TO

In the following list reference to undated publications implies the latest edition and amendments unless a specific date or edition is indicated:

- British Wind Energy Association Small Wind Turbine Safety & Performance Standard (revision 29 February 2008).
- NOABL (Numerical Objective Analysis of Boundary Layer) database. The national database of approximate wind speeds published by the UK government (referred to as NOABL) is available as a free download at:

***http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/renewable/explained/wind/windsp_databas/windsp_databas.aspx***

- EN 61400-2: 2006 Wind Turbines – Part 2: Design requirements for small wind turbines. Available from British Standards Institution (BSI): www.bsi-global.com
- BS 7671 Requirements for Electrical Installations. Available from: The Institution of Engineering and Technology: www.iee.org/Shop/
- CE 72 – Installing small wind-powered electricity generating systems (November 2004) Available from: www.est.org.uk/download.cfm?p=1&pid=336
- G59: Recommendations for the connection of embedded generating plant to the public electricity suppliers' distribution systems. Available from The Energy Networks Association: www.energynetworks.org
- G83: Recommendations for the connection of small scale embedded generators (up to 16 A per phase) in parallel with public low voltage distribution networks. Available from The Energy Networks Association: www.energynetworks.org
- MCS 001 –Microgeneration Certification Installer Certification Scheme. Available from www.microgenerationcertification.org
- MCS 002 – Guidance on regulations and directives for microgeneration installations. Available from www.microgenerationcertification.org
- MCS 020 – Planning Standard. Available from www.microgenerationcertification.org

# APPENDIX A: Site Survey Form

The site survey form used by contractors prior to the preparation of a quotation shall include at least the following elements:

A. 1. Customers name, address and contact details
A. 2. Site address, grid reference and site usage (e.g. residential, agricultural, commercial, school etc.)
A. 3. Client expressed preferences, where applicable, to include:
- a. make / model of wind turbine
- b. Electrical connection type (grid connect, battery charging etc.)
- c. building or mast mounted
- d. location on building if building mounted or location on site if tower mounted
- e. comment regarding limitations of client preferences as discussed with the client

A. 4. An assessment of the wind resource to include:
- a. Average wind speed according to NOABL for the height above ground nearest to the proposed hub height (10m or 25m)
- b. Appropriate highest class of wind turbine in accordance with EN 61400-2, from the following table

| Class | I | II | III | IV |
|---|---|---|---|---|
| $V_{ave}$ (m/s) | 10 | 8.5 | 7.5 | 6 |

**Note:** $V_{ave}$ is the average annual wind speed at hub height and highest class means a Class I would be suitable for all sites but Class III would not be suitable where the average annual wind speed is likely to be greater than 7.5 m/s. Please refer to EN61400-2 for the full table of information.

- c. Prevailing wind direction or wind rose
- d. Details and distances to any obstacles to the wind

A. 5. An assessment of the site for mechanical installation to include:
- a. For building mounted, full details of type of construction (e.g. brick/block with cavity, solid brick, timber frame etc.) including type of mortar (e.g. lime or cement mortar).
- b. For mast mounted, full details of ground conditions, cable distances and necessary types (e.g. armoured for buried cable runs)

A. 6. An assessment of the electrical systems to include:
- a. Method of connection to consumer unit (e.g. need for a dedicated fuseway)
- b. Earth testing
- c. Proposed location of inverter
- d. Metering arrangements (location, meter type)
- e. Details of electricity supplier and network operator

A. 7. Planning considerations
- a. proximity of proposed location to nearby residents and assessment of potential nuisance from noise or flicker
- b. details of listed buildings or if conservation area
- c. ecology (e.g. impact on bats' roost)

A. 8. Health and Safety considerations necessary for a risk assessment to include:
- a. access arrangements for working at height
- b. electrical hazards such as live overhead cables
- c. underground utilities (e.g. gas, electric, water, telephone)
- d. details of public access and any congregation zones
- e. locations of any flues serving fuel burning equipment.

A. 9. A place for both the surveyor and the customer to sign off the document.

# APPENDIX B: Data for the estimate of annual energy production

## B. 1. Correction factors for the standard estimate of annual energy production

Table B.1 Correction factors for NOABL 10m altitude mean wind speed data to account for local terrain and obstructions, and the turbine height above ground level

| $h_c$ | Terrain Categories | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| 1 | 0.74 | 0.60 | 0.43 | 0.24 | 0.05 |
| 1.5 | 0.80 | 0.67 | 0.51 | 0.33 | 0.14 |
| 2 | 0.85 | 0.72 | 0.56 | 0.39 | 0.20 |
| 2.5 | 0.89 | 0.76 | 0.60 | 0.43 | 0.25 |
| 3 | 0.92 | 0.79 | 0.64 | 0.47 | 0.29 |
| 3.5 | 0.94 | 0.82 | 0.67 | 0.50 | 0.33 |
| 4 | 0.96 | 0.84 | 0.69 | 0.53 | 0.35 |
| 4.5 | 0.98 | 0.86 | 0.71 | 0.55 | 0.38 |
| 5 | 1.00 | 0.88 | 0.73 | 0.57 | 0.40 |
| 6 | 1.03 | 0.91 | 0.77 | 0.61 | 0.44 |
| 7 | 1.05 | 0.94 | 0.80 | 0.64 | 0.48 |
| 8 | 1.08 | 0.96 | 0.82 | 0.67 | 0.51 |
| 9 | 1.09 | 0.99 | 0.84 | 0.69 | 0.53 |
| 10 | 1.11 | 1.00 | 0.86 | 0.71 | 0.56 |
| 11 | 1.13 | 1.02 | 0.88 | 0.73 | 0.58 |
| 12 | 1.14 | 1.04 | 0.90 | 0.75 | 0.60 |
| 13 | 1.16 | 1.05 | 0.92 | 0.77 | 0.62 |
| 14 | 1.17 | 1.06 | 0.93 | 0.78 | 0.63 |
| 15 | 1.18 | 1.08 | 0.94 | 0.80 | 0.65 |
| 16 | 1.19 | 1.09 | 0.96 | 0.81 | 0.66 |
| 17 | 1.20 | 1.10 | 0.97 | 0.83 | 0.68 |
| 18 | 1.21 | 1.11 | 0.98 | 0.84 | 0.69 |
| 19 | 1.22 | 1.12 | 0.99 | 0.85 | 0.70 |

| | | | | | |
|---|---|---|---|---|---|
| 20 | 1.23 | 1.13 | 1.00 | 0.86 | 0.71 |
| 25 | 1.24 | 1.14 | 1.01 | 0.87 | 0.72 |
| 30 | 1.24 | 1.14 | 1.02 | 0.88 | 0.74 |
| 35 | 1.25 | 1.15 | 1.03 | 0.89 | 0.75 |
| 40 | 1.26 | 1.16 | 1.03 | 0.90 | 0.76 |
| 45 | 1.26 | 1.17 | 1.04 | 0.91 | 0.76 |
| 50 | 1.27 | 1.17 | 1.05 | 0.91 | 0.77 |
| 60 | 1.28 | 1.18 | 1.06 | 0.92 | 0.78 |
| 70 | 1.28 | 1.19 | 1.06 | 0.93 | 0.79 |
| 80 | 1.29 | 1.19 | 1.07 | 0.94 | 0.80 |
| 90 | 1.30 | 1.20 | 1.08 | 0.95 | 0.81 |
| 100 | 1.32 | 1.23 | 1.11 | 0.98 | 0.84 |

Scaling factors derived from data given in Harris R I & Deaves D M, The structure of strong winds, Wind engineering in the eighties, proc. CIRIA conference, 12-13 November 1980, London, 1981

## B. 2. Illustrations of the terrain categories

Category 1: Flat grassland, parkland or bare soil, without hedges and only a few isolated obstructions.

Category 2: Gently undulating countryside, fields with crops, fences or low boundary hedges and few trees.

Category 3: Farmland with high boundary hedges, occasional small farm structures, houses and trees etc.

Category 4: Woodland or low rise urban/suburban areas (e.g. domestic housing) with a plan area density of up to about 20%.

Category 5: Dense urban areas and city centres (e.g. buildings of four-stories or higher) with a plan area density of greater than about 20%.

## B. 3. Notes concerning the estimation of annual energy production

1. The power available from the wind falls rapidly as the wind speed reduces (power is proportional to the cube of the wind speed). Therefore the location of a wind turbine is critical to its performance.
2. Any performance estimate calculated using the factors given here is for guidance only and will not be accurate for all situations..
3. The factors take no account of the particular building shape or size (apart from the height), which can affect the air flow significantly. The wind energy above flat roofs is particularly difficult to predict and is very sensitive to the location on the roof.
4. Turbulence of the wind reduces performance (and turbine life). If you suspect high turbulence levels at your site, consult an expert before installing a turbine.
5. Turbines mounted lower than the height of the roof or obstruction are likely to experience very low mean wind speeds but high turbulence.
6. Under certain circumstances, the shape of the roof can enhance the wind speed and thus the power available. To take advantage of this effect you will need expert advice and may need to measure the average annual wind at the proposed location on the roof.
7. Accurate measurement over a period of 1 year or for a sufficient period to obtain accurate correlation with local Met Office data, is the preferred method for determining the actual wind speed in a given location and should be considered where possible.

# APPENDIX C: Competence of Staff

Assessments of competence will cover the following underpinning knowledge areas:

C. 1. Mechanical Engineering (understanding of static and dynamic stresses and loads involved with wind turbines)

C. 2. Environmental impacts of wind turbines (e.g. noise, flicker)

C. 3. Concrete structures and processes

C. 4. Resource assessment and performance calculation (inc understanding of limitations of NOABL and impact of turbulence)

C. 5. Non-conventional AC output (variable voltage, variable current, variable frequencies) of wind turbine

C. 6. DC Electrical systems

C. 7. Conventional AC Electrical Systems (BS 7671)

C. 8. Grid connection requirements (G83 and/or G59)

C. 9. Battery systems for off-grid applications (sizing, depth of discharge, ventilation, dump loads etc.)

# APPENDIX D Detailed assessment of shadow and flicker

## D. 1. Shadow flicker

“problems caused by shadow flicker are rare” (PPS18)

Under certain combinations of geographical position and time of day, the sun may pass behind the rotors of a wind turbine and cast a shadow over neighbouring properties. When the blades rotate, the shadow flicks on and off; the effect is known as 'shadow flicker'.

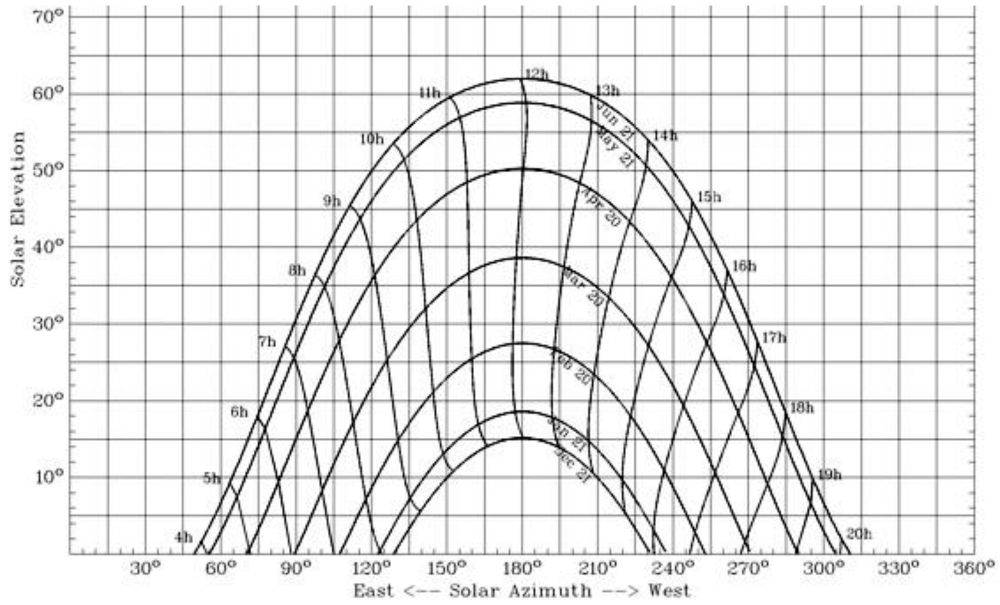
In order for a person in a property to experience flickering from a wind turbine the property would need to have a narrow window facing a wind turbine. The sun would need to be relatively low in the sky and be behind the tower. The turbine nacelle would need to be facing a certain direction so that the turbine blades were turning and casting the shadow in the direction of the property. Any flicker effect would only last while the sun is behind the tower and while the nacelle was facing in that one direction.

The seasonal duration of this effect can be calculated from the geometry of the machine and the latitude of the site. A single window in a single building is only likely to be affected for a few minutes at certain times of the day during short periods of the year.

The likelihood of this occurring and the duration of such an effect depends upon:

1. the direction of the residence relative to the turbine;
2. the distance from the turbine;
3. the turbine hub-height and rotor diameter;
4. the time of year;
5. the frequency of bright sunshine and cloudless skies (particularly at low elevations above the horizon);
6. the prevailing wind direction;
7. Any obstructions in the relevant direction.

In the UK it is only true for the equinoxes (Mar 21, Sept 21) that the sun rises in the East and sets in the West. During the summer, the sun rises North of East and sets North of West, in winter it rises South of East and sets South of West.




The sun path vertical projection diagram shows the sun path monthly, and the maximum and minimum annual declination for London.

It can be seen that a turbine mounted at +/- 45degrees from North will never cast a shadow onto the observer. Even within the potential shadow region the following have to be considered:

1. Is there a window facing that direction? A single window in a single building is only likely to be affected for a few minutes at certain times of the day during short periods of the year.
2. Will anyone be awake (or in the office)? The sun path diagram can be examined and may show any potential flicker could be occurring at 5am

The further the observer is from the turbine the less pronounced the effect will be. There are several reasons for this:

1. there are fewer times when the sun is low enough to cast a long shadow;
2. when the sun is low it is more likely to be obscured by either cloud on the horizon or intervening buildings and vegetation;
3. the centre of the rotor's shadow passes more quickly over the land reducing the duration of the effect.

Even if the potential for flicker is considered in “greenhouse mode” i.e. an open aspect in all directions, the size of small turbines means that flicker will be imperceptible at distances greater than 10 times the diameter of the turbine.

At closer distances the sun will still pass through the rotor area very rapidly meaning any potential flicker will be for a very short period.

To estimate the number of hours where both the wind is blowing and the sun is shining a calculation is made. This calculation is termed “the de-rating factor”. To determine the de-rating factor, historical meteorological data are used. In the UK the number of hours where both the wind is blowing and the sun shining is typically only 30% of daylight hours.

## D. 2. Photosensitive Epilepsy

Causes of photosensitive epilepsy are numerous; it is much more complex than simply flickering light.

About 1% of the population suffer one or more epileptic fits during their lifetime. Of those only about 4% suffer with epileptic fits that are triggered by photosensitivity. This equates to approx. 23,200 people in the UK, or 0.04% of the population. A town of 80,000 people will have approx. 32 people at risk.

For a wind turbine to present a potential hazard to someone who is at risk from photosensitive epilepsy, all of the following must be true:

1. The wind must be blowing and in the right direction.
2. The sun must be shining.
3. The observer must be within in the flickering light field
4. A large percentage of the individuals visual cortex must be stimulated [over 25%]
5. The rotor must be spinning at a speed that affects the specific photosensitive range of the observer.
6. The rotor spinning speed must stay in the specific range long enough to trigger a reaction.
7. The background illumination must be low
8. The contrast between shadow and light must be high
9. The colour spectrum of the light must be in the correct range to affect the individual
10. There must be nothing blocking out the flickering light, such as blinds or a tree outside the window.
11. The individual does nothing to remove themselves from the flicker light source before it begins to affect them.

## D. 3. Mitigation

Shadow flicker effects on properties are very rare and, due to their rotor size, will be even rarer with small wind turbines.

A rule of thumb has been adopted that 30 hours of shadow flicker per year is acceptable[3]. This is based on those times being when:

1. The building affected is likely to be occupied
2. The occupants are likely to be awake

The size of small turbines means that flicker will be imperceptible at distances greater than 10 times diameter and unlikely to be of concern at greater than 5 times diameter. However, if nuisance occurs; a sensor can be retrofitted which shuts down the wind turbine on the rare occasion the sun and wind direction conditions both occur at the appropriate time.

## D. 4. Sun path diagrams for shadow flicker

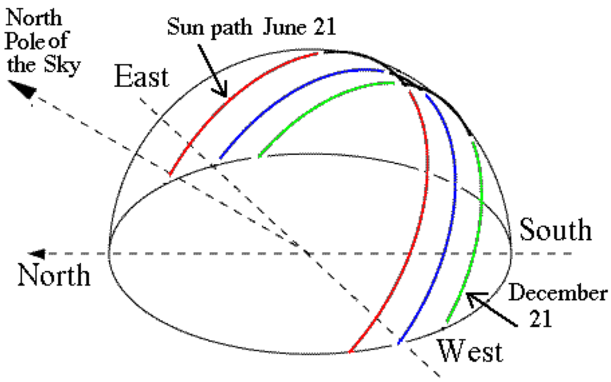
[3] The only known shadow flicker regulation to date was enacted in Germany, where a court ruled that the maximum allowable flicker would be 30 hours per year (Klepinger, 2007). In addition, Dobesch and Kury (2001) recommended that shadow flicker should not exceed 30 hours per year, and the guidelines for wind power development in the State of Victoria, Australia state that shadow flicker may not exceed 30 hours per year at any dwelling in the surrounding area (Sustainable Energy Authority Victoria, 2003).

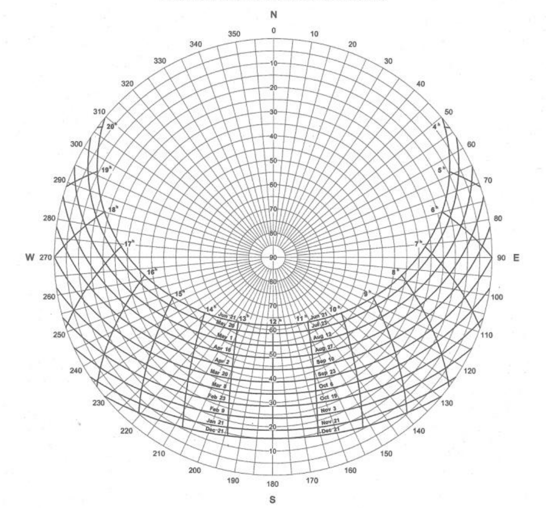
Ref: British Standard 8206: Part 2: 1992 - Code of Practice for Daylighting, which contains sunpath diagrams for London. The diagrams are all correct for solar time. In London this is the same as GMT, but it will vary across the width of the UK.

In all cases the diagrams are assuming the observer is at ground level. Upstairs windows and turbines on roofs are more difficult to evaluate.

Shadow flicker evaluation programs:

http://solardat.uoregon.edu/SunChartProgram.html; http://www.satel-light.com/core.htm



## AMENDMENTS ISSUED SINCE PUBLICATION

| Document Number: | Amendment Details: | Date: |
|---|---|---|
| 1.2 | Amended 3.4 Consumer Code of Practice wording<br><br>Updated e-mail and website addresses | 25/02/2008 |
| 1.3 | Gemserv details added as Licensee.<br><br>Document reformatted to reflect brand update.<br><br>References to BERR updated to DECC, MCS logo updated accordingly.<br><br>Website and email addresses updated to reflect new name. | 01/12/2008 |
| 1.4 | Quality review | 10/01/2009 |
| 1.5 | MCS Mark Updated | 25/02/2009 |
| 1.6 | Additional contracting options were added to clause 3.3 as agreed in the MCS Steering Committee on 27/10/2009 | 28/01/2009 |
| 2.0 | Addition of text under section 4.4 – site specific issue (see 4.4.5) re metering requirements, and also under section 6 – handover with regard to MCS Certificates and the MID, as agreed at MCS Steering Committee meeting of 27/05/2010. | 28/08/2010 |
| 3.0 | Substantial revision including:<br><br>Windspeed adjustment for turbine height.<br><br>Acoustic performance estimate.<br><br>Updated wind resource correction factors.<br><br>Change to size limits<br><br>Dedicated fuseway change<br><br>Revised NOABL link<br><br>Commissioning<br><br>Responsible siting guidelines<br><br>Shadow / flicker guidance<br><br>CNS assets<br><br>Terrain illustrations | 05/09/2011 |