INTERNATIONAL STANDARD

Wind turbines –
Part 11: Acoustic noise measurement techniques
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

WIND TURBINES –

Part 11: Acoustic noise measurement techniques

FOREWORD

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International Standard IEC 61400-11 has been prepared by IEC technical committee 88: Wind turbines.


The text of this standard is based on the following documents:

<table>
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<tr>
<th>FDIS</th>
<th>Report on voting</th>
</tr>
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<tbody>
<tr>
<td>88/436/FDIS</td>
<td>88/440/RVD</td>
</tr>
</tbody>
</table>

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.
This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 61400 series, under the general title Wind turbines, can be found on the IEC website.

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

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• withdrawn,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

A bilingual edition of this document may be issued at a later date.

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.
INTRODUCTION

The purpose of this part of IEC 61400 is to provide a uniform methodology that will ensure consistency and accuracy in the measurement and analysis of acoustical emissions by wind turbine generator systems. This International Standard has been prepared with the anticipation that it would be applied by:

- wind turbine manufacturers striving to meet well defined acoustic emission performance requirements and/or a possible declaration system (e.g. IEC/TS 61400-14);
- wind turbine purchasers for specifying performance requirements;
- wind turbine operators who may be required to verify that stated, or required, acoustic performance specifications are met for new or refurbished units;
- wind turbine planners or regulators who must be able to accurately and fairly define acoustical emission characteristics of a wind turbine in response to environmental regulations or permit requirements for new or modified installations.

This standard provides guidance in the measurement, analysis and reporting of complex acoustic emissions from wind turbine generator systems. The standard will benefit those parties involved in the manufacture, installation, planning and permitting, operation, utilization, and regulation of wind turbines. The measurement and analysis techniques recommended in this document should be applied by all parties to ensure that continuing development and operation of wind turbines is carried out in an atmosphere of consistent and accurate communication relative to environmental concerns. This standard presents measurement and reporting procedures expected to provide accurate results that can be replicated by others.
WIND TURBINES –

Part 11: Acoustic noise measurement techniques

1 Scope

This part of IEC 61400 presents measurement procedures that enable noise emissions of a wind turbine to be characterised. This involves using measurement methods appropriate to noise emission assessment at locations close to the machine, in order to avoid errors due to sound propagation, but far enough away to allow for the finite source size. The procedures described are different in some respects from those that would be adopted for noise assessment in community noise studies. They are intended to facilitate characterisation of wind turbine noise with respect to a range of wind speeds and directions. Standardisation of measurement procedures will also facilitate comparisons between different wind turbines.

The procedures present methodologies that will enable the noise emissions of a single wind turbine to be characterised in a consistent and accurate manner. These procedures include the following:

- location of acoustic measurement positions;
- requirements for the acquisition of acoustic, meteorological, and associated wind turbine operational data;
- analysis of the data obtained and the content for the data report; and
- definition of specific acoustic emission parameters, and associated descriptors which are used for making environmental assessments.

This International Standard is not restricted to wind turbines of a particular size or type. The procedures described in this standard allow for the thorough description of the noise emission from a wind turbine. A method for small wind turbines is described in Annex F.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60688, *Electrical measuring transducers for converting a.c. electrical quantities to analogue or digital signals*

IEC 60942:2003, *Electroacoustics – Sound calibrators*


IEC 61400-12-2, *Wind turbines – Part 12-2: Power performance verification of electricity producing wind turbines*¹

¹ To be published.
3 Terms and definitions

For the purposes of this standard, the following terms and definitions apply.

3.1 apparent sound power level

$L_{WA}$

A-weighted sound power level re. 1 pW of a point source at the rotor centre with the same emission in the downwind direction as the wind turbine being measured, $L_{WA}$ is determined at bin centre wind speeds at hub height.

Note 1 to entry: Apparent sound power level is expressed in dB re. 1 pW.

3.2 apparent sound power level with reference to wind speed at 10 m height

$L_{WA,10m}$

A-weighted sound power level re. 1 pW of a point source at the rotor centre with the same emission in the downwind direction as the wind turbine being measured, $L_{WA,10m}$ are determined at bin centre wind speeds at 10 m height within the measured wind speed range.

Note 1 to entry: Apparent sound power level with reference to wind speed at 10 m height is expressed in dB re. 1 pW.

3.3 audibility criterion

$L_a$

Frequency dependent criterion curve determined from listening tests, and reflecting the subjective response of a "typical" listener to tones of different frequencies.

Note 1 to entry: Audibility criterion is expressed in dB re. 20 $\mu$Pa.

3.4 sound pressure levels

3.4.1 A-weighted sound pressure levels

$L_A$

Sound pressure levels measured with the A frequency weighting networks specified in IEC 61672.

Note 1 to entry: A-weighted sound pressure levels are expressed in dB re. 20 $\mu$Pa.

3.4.2 C-weighted sound pressure levels

$L_C$

Sound pressure levels measured with the C frequency weighting networks specified in IEC 61672.

Note 1 to entry: C-weighted sound pressure levels are expressed in dB re. 20 $\mu$Pa.