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Edition 3.0 2018-06

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

AMENDMENT 1
AMENDEMENT 1

Wind turbines –
Part 11: Acoustic noise measurement techniques

Éoliennes –
Partie 11: Techniques de mesure du bruit acoustique

IEC 61400-11:2012-11/AMD1:2018-06(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

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FOREWORD

This amendment has been prepared IEC technical committee 88: Wind energy generation systems.

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

CDV	Report on voting
88/615/CDV	88/644A/RVC

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

The committee has decided that the contents of this amendment and the base publication will remain unchanged until the stability date indicated on the IEC website 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- withdrawn,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.

The contents of the corrigendum of October 2019 have been included in this copy.

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 to the Amendment

This amendment to IEC 61400-11:2012 addresses the situation where a measurement consists of measurements series on different days or with substantially different conditions. Furthermore, clarifications have been introduced on tonality analysis and reporting. Editorial changes have been made.

6 Instrumentation

6.1.2 Equipment for the determination of the equivalent continuous A-weighted sound pressure level

*Add "*relevant to this document*" after "*requirements*".*

6.1.3 Equipment for the determination of A-weighted 1/3-octave band spectra

*Add, in the second sentence, "*relevant to this document*" after "*requirements*".*

7 Acoustic measurements and measurement procedures

7.1 Acoustic measurement positions

Add, at the end of the second paragraph after 2 %, the following new text:

The measurement distance shall be as close as possible to R_0. The allowed tolerance should only be used where it is essential to obtain valid data and, where this is done, clear evidence shall be reported to justify the decision made.

7.2.2 Acoustic measurement requirements

Add "(see 7.2.8)*" at the end of 6th bullet of the first paragraph.*

Add the following new subclause after 7.2.7:

7.2.8 Combining measurement series

When there are data available from different measurement series with differing environmental conditions, then the data can only be combined using expert judgement. This may involve pooling all the available data and analysing collectively, or it may involve analysing the periods separately and combining the results. In the latter case, when there are overlapping results then the method of weighted means, defined in Annex H, shall be used to combine these into a single result.

The tonal analysis should always be based on pooling all the available data.

Where this is done, clear evidence shall be provided to justify the decisions made. This may, for example, be accomplished by showing a scatter plot of the raw data colour coded for the measurement series.

8 Non-acoustic measurements

8.2.1.1 Determination of wind speed through power curve

*Add, in third sentence of the first paragraph, "*closed*" before the term "*intervals*" to read "*closed intervals*".*

Add, at the end of the first paragraph, the following new text:

Within the allowed range of the power curve, piece-wise linear interpolation shall be used to define a continuous function between interval supporting points.

8.2.2 Wind speed measurements during background noise measurements

*Replace, in the second paragraph, "*κz*" by "*κ_Z*".*

9 Data reduction procedures

9.2.4 Calculation of noise levels at bin centres including uncertainty

Replace Equation (20) by the following new equation:

$$L_{V,i}(t) = (1-t)\cdot \overline{L}_{i,k} + t\cdot \overline{L}_{i,k+1} \qquad (20)$$

Replace Equation (22) by the following new equation:

$$u_{L_V,i}(t) = \sqrt{u_{L,i}^2(t) - \frac{\mathrm{cov}_{LV,i}^2(t)}{u_V^2(t)}} \tag{22}$$

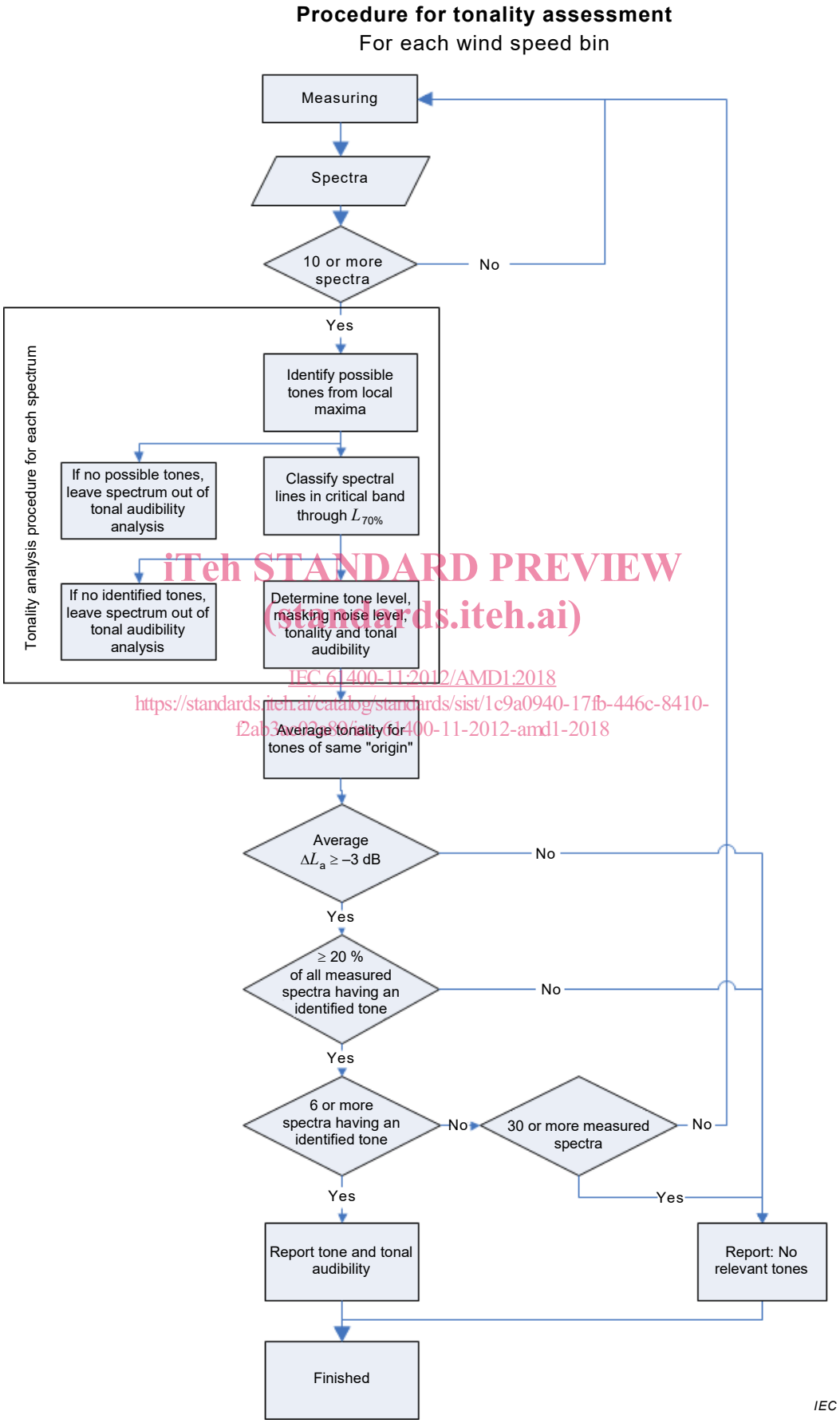
where

$$u_{L,i}^2(t) = (1-t)^2 \cdot u_{\mathrm{com},L,i,k}^2 + t^2 \cdot u_{\mathrm{com},L,i,k+1}^2$$

$$\mathrm{cov}_{LV,i}(t) = (1-t)^2 \cdot \frac{\mathrm{cov}_{LV,i,k}}{N_k} + t^2 \cdot \frac{\mathrm{cov}_{LV,i,k+1}}{N_{k+1}}$$

$$u_V^2(t) = (1-t)^2 \cdot u_{\mathrm{com},V,k}^2 + t^2 \cdot u_{\mathrm{com},V,k+1}^2$$

Replace Figure 7 by the following:



9.5.3 Classification of spectral lines within the critical band

Replace the third bulleted item under b) by the following:

- Where there are several lines classified as “tone”, the line having the greatest level is identified. Lines are then only classified as “tone” if their levels are within 10 dB of the highest level.

9.5.5 Determination of the tone level

Replace, in the first sentence of the first paragraph, 9.5.2 *by* 9.5.3.

Replace in the first paragraph, the sentence reading "This requires dividing the energy sum by 1,5" *by the following:*

This corresponds to subtracting –10·log(1/1,5) or 1,8 dB (1,76 dB) from the tone level.

9.5.8 Determination of audibility

*Add, after "*The $\Delta l_{a,j,k}$ are energy averaged to one $\Delta l_{a,k}$ for each tone of the same origin in each bin", *the following new text:*

For the tones of the same origin, the corresponding frequency to report is the range of frequencies of the tone maxima of the individual spectra from Equation (34).

10 Information to be reported

10.5 Acoustic data

Replace the 9th bulleted item by the following:

- $\Delta L_{a,j,k}$ for each identified tone (as table or plot);

Delete the 10th bulleted item.

Replace the 11th bulleted item by the following:

- $\Delta L_{a,k}$ for each tone of the same origin;

Replace the 12th bulleted item by the following:

- frequency for each tone of the same origin;

Annex F – Small wind turbines

F.5 Tonal audibility

Replace the first sentence by the following:

The general methodology will be followed with the option of determination of tonal audibility as follows.

F.6 Information to be reported

Replace the second paragraph by the following:

For small wind turbines, an immission map based on the determined sound power levels can be reported. The immission map shall cover the wind speed range for which reportable sound power levels are available. On the horizontal axis, the minimal value shall be the tower height of the test turbine and the maximum value shall be chosen such that a representative part of the 35 dB(A) contour line is showing. The sound pressure levels shall be calculated using spherical spreading with a ground reflection correction of 1,5 dB. Sound pressure contours shall be drawn for multiples of 5 dB (e.g. 30 dB(A), 35 dB(A), 40 dB(A) and 45 dB(A)). Note that the immission map does not include penalties for tonality or similar as penalties are subject to local regulations. If penalties from local regulations are included in the immission map, a statement of this shall follow the map.

Add the following new Annex H after Annex G:

Annex H
(normative)

Data treatment for measurement series on different days or with substantially different conditions

When measuring different measurement series over several days with different conditions or with changing measurement position with different conditions and overlapping wind speeds, there is a need for a procedure to reduce the measurement series to one set of data. In this annex, a procedure is laid out.

The results of several measurement series are the apparent sound power spectra at a given wind bin including the uncertainty. The resulting apparent sound power spectrum at the wind speed bin is calculated as the weighted average with the uncertainty as the weight. This is described in Equation (H.1).

$$L_{WA,i} = \frac{\sum L_{WA,i,l} \cdot u_{i,l}^{-2}}{\sum u_{i,l}^{-2}} \tag{H.1}$$

where i is the 1/3 octave and l is the measurement series number.

The corresponding uncertainty is calculated as

$$u_i = \sqrt{b + \frac{1}{\sum u_{i,l}^{-2}}} \tag{H.2}$$

Since the type B uncertainties are eliminated in this calculation, the uncertainty can be less than the uncertainty from instruments and similar. To compensate for this, a fixed number b[1] is introduced in the equation.

_____

[1] The uncertainties from Table C.1 add up to 0,6. This means the number b should be 0,4 or the square root of 0,6 in the formula.