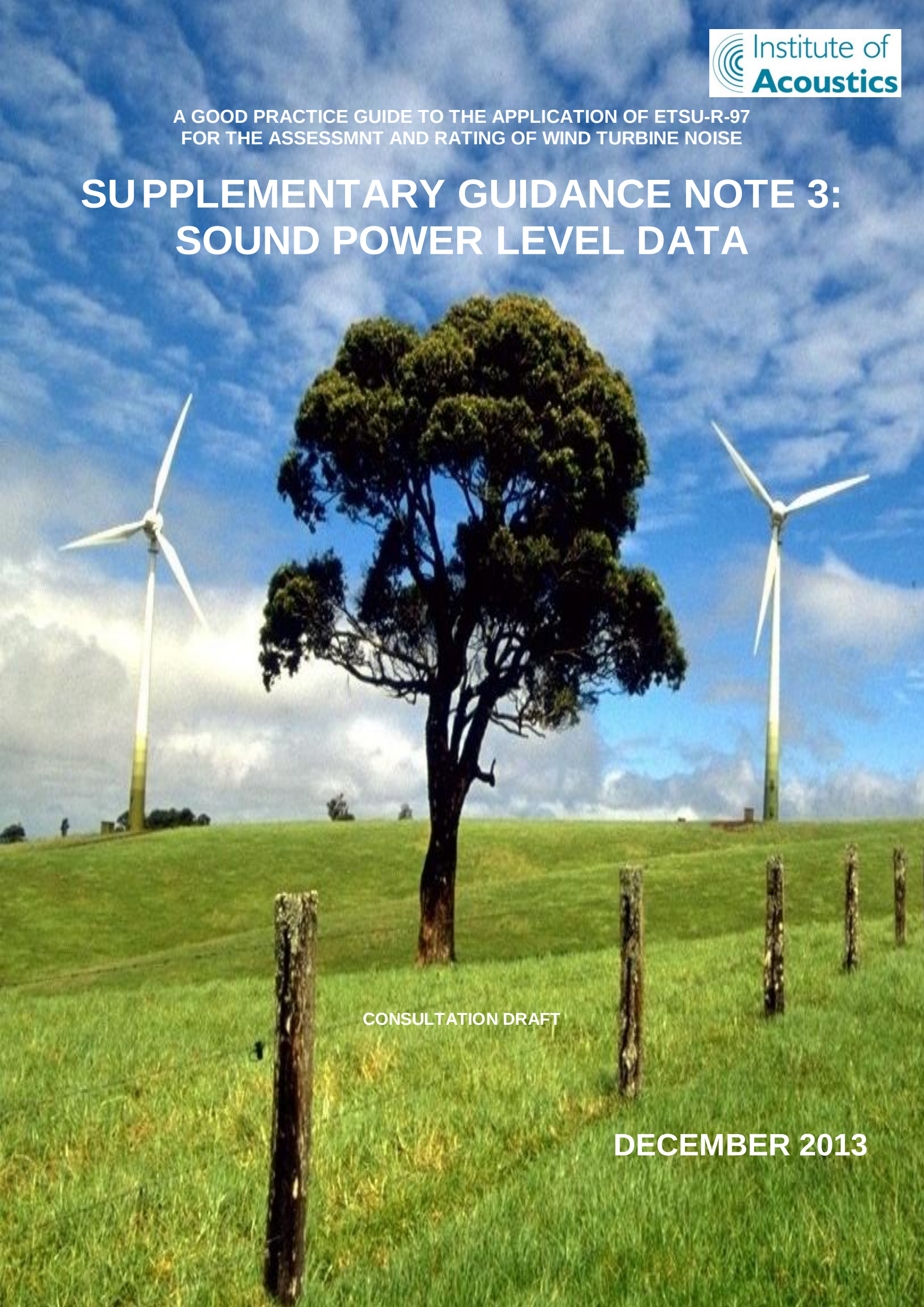
Institute of Acoustics

A GOOD PRACTICE GUIDE TO THE APPLICATION OF ETSU-R-97
FOR THE ASSESSMNT AND RATING OF WIND TURBINE NOISE

# SUPPLEMENTARY GUIDANCE NOTE 3: SOUND POWER LEVEL DATA



CONSULTATION DRAFT

DECEMBER 2013

## PREFACE

This document has been produced by a working group on behalf of the Institute of Acoustics consisting of the following members:

| | |
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The working group was also assisted in the drafting of this note by Jeremy Bass from Renewable Energy Systems Ltd.

This supplementary guidance note has been produced to supplement the IOA document 'A GOOD PRACTICE GUIDE TO THE APPLICATION OF ETSU-R-97 FOR THE ASSESSMENT AND RATING OF WIND TURBINE NOISE' which is available on the IOA website at the following link: : http://www.ioa.org.uk/pdf/ioa-gpg-on-wtna-issue-01-05-2013.pdf (checked 14.10.13).

Prior to publication of this note, a peer review was undertaken by a separate group.

Any comments on this document should be sent to ETSUCONSULT@IOA.ORG.UK. The IOA will keep the document under review, and consider updating when significant changes to current good practice have occurred.

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### Supplementary Guidance Notes

| Number | Title | Information |
|---|---|---|
| 1 | **Data Collection** | Equipment specifications; measurement surveys: Practical considerations and set-up guidance and examples. |
| 2 | **Data Processing & Derivation of ETSU-R-97 background curves** | Data filtering, processing and regression analysis for different types of noise environments. |
| 3 | **Sound Power Level Data** | Manufacturer's data and warranties analysis. |
| 4 | **Wind Shear** | Wind speed references and long-term data analysis. |
| 5 | **Post Completion measurements** | Examples, considerations and strategies. |
| 6 | **Offshore Wind** | Noise propagation over large bodies of water. |

## CONTENTS

# 1 Context

## 1.1 Background

1.1.1 The Institute of Acoustics (IOA) published 'A GOOD PRACTICE GUIDE TO THE APPLICATION OF ETSU-R-97 FOR THE ASSESSMENT AND RATING OF WIND TURBINE NOISE' (GPG) in May 2013 to provide technical assistance for the undertaking of wind turbine noise assessments using the ETSU-R-97 document. In order to keep the GPG to a reasonable length, but not to lose clarifications and case studies, it was decided to produce a number of supplementary guidance notes which would support the GPG.

1.1.2 This guidance note will be of relevance to:

i. Acoustics consultants;
ii. Local Planning Authority (LPA) Environmental Health and Planning departments;
iii. Developers;
iv. The Planning Inspectorate or equivalent regulating authority;
v. The general public.

## 1.2 Scope of the Document

1.2.1 A series of six Supplementary Guidance Notes have been produced. This Supplementary Guidance Note 3 supports Section 4.2 and 4.3 of the GPG. It provides additional information on the variety of source data for the sound power levels of turbines, and offers guidance on how to interpret the data for use in accordance with the method in the GPG.

1.2.2 The main aim of this SGN is to ensure the adequacy of the input data for prediction of turbine noise immission. Turbine Sound Power Level data can be acquired from a number of different sources, and it is a requirement of the noise assessment report to demonstrate that whatever the data source, that an appropriate allowance has been made for the potential uncertainty in the data. Uncertainty can arise from measurement uncertainties, production tolerances and design differences, and must be clearly stated.

1.2.3 It is important to distinguish between a site-specific warranty given to a customer purchasing a turbine, and a more general 'warranty' document which can be a generic specification document.

## 1.3 Statutory Context

1.3.1 This Supplementary Guidance Note has been approved by the IOA Council for use by IOA Members and others involved in the assessment and rating of wind turbine noise using ETSU-R-97. It covers technical matters of an acoustic nature which the IOA-NWG believes represent current good practice.

## 2 Sound Power Data Examples

### 2.1 Example 1

2.1.1 The example represented in Figure 1 shows sound power data specified by the manufacturer. It is not fully clear if or how the specified data (green curve) is warranted, as this is likely to be agreed to specific terms in each commercial situation. Nonetheless, the specification states that an additional 1 dB should be added for all calculations (red curve). The tested sound power data is shown to be clearly below the specified data. The specified test uncertainty is of σ =0.8 dB, therefore the expanded uncertainty is 1.64 σ = 1.32 dB and is shown in Figure 1. This shows that the indication to use the specification data +1dB would be suitable with the prediction parameters specified in section 4 of the GPG (including G=0.5).

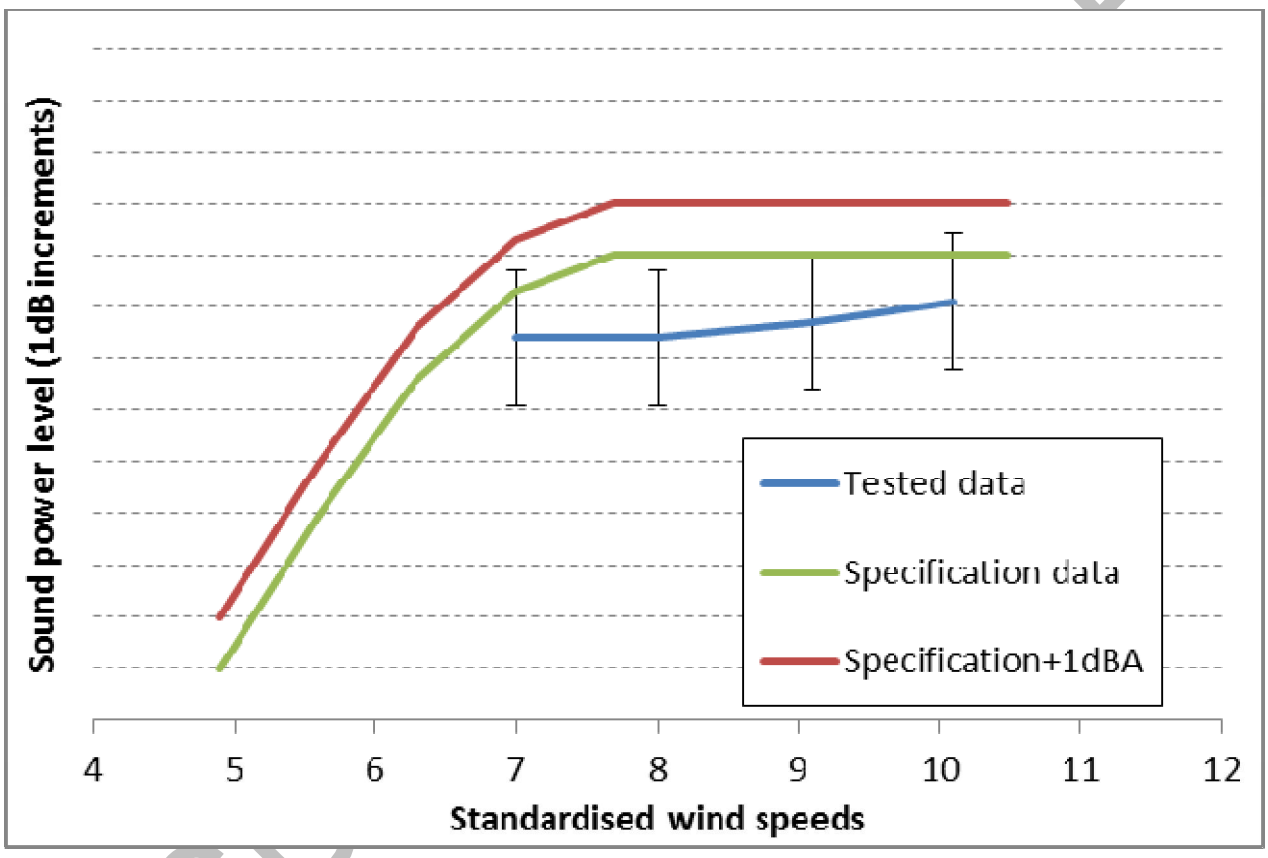


**Figure 1 – example of specification data in relation to tested sound power with expanded uncertainty**

## 2.2 Example 2

2.2.1 The example of Figure 2 shows a different set of manufacturer data (blue curve). The document states that when evaluating any single test result in relation to the specified levels, they will be within the uncertainty values calculated in accordance with IEC 61400-14. This therefore means that the "warranted" values are unlikely to incorporate a margin of uncertainty as it needs to be taken into account as part of the warranty test procedure. This is confirmed by comparing these values to the results of a sound power test supplied by the manufacturer (only a single one available). The tested results are similar to the specified values, although marginally higher at some wind speeds. As the test uncertainty is not specified in the report extract available, a typical expanded uncertainty of 2 dB is indicated on the chart of Figure 2. It can be seen that when adding 2dB to the specified values, this results in more conservative values (green curve), which encompass the test results and the expanded uncertainty. These values (specification + 2dB) should therefore be used in this case when undertaking calculations in accordance with the prediction parameters specified in section 4 of the GPG (including G=0.5).

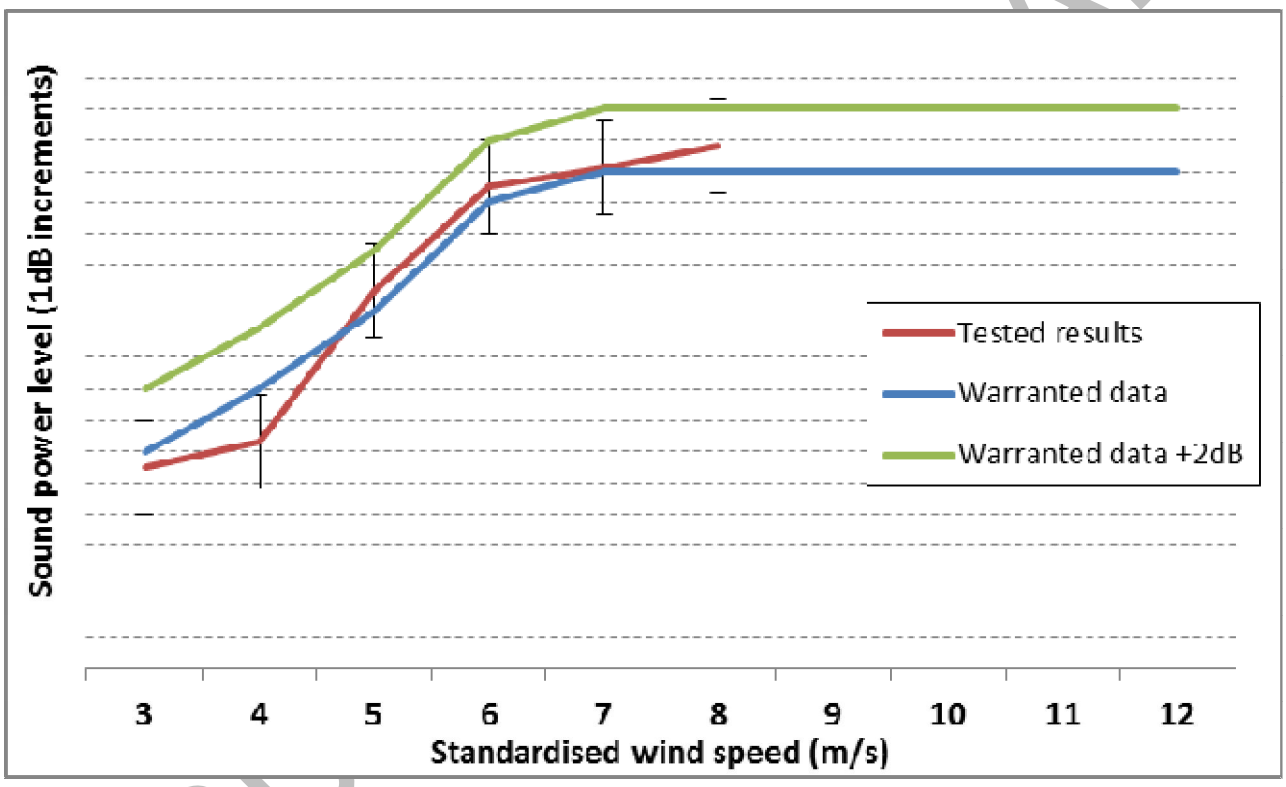


**Figure 2 – example of specification data in relation to tested sound power with expanded uncertainty**
('Warranted data' in Figure 2 above excludes unspecified uncertainty)

## 2.3 Example 3

2.3.1 In this example, no manufacturer warranty or specification is available, however the results of a test report undertaken in accordance with the IEC 61400-11 standard are available: see table below. These test report values can be used but, first, account needs to be taken of uncertainties in the data. In addition to the sound power values ($L_{WA}$), the derived values of the test uncertainty σ are stated: in this example they are relatively high, which may be due to the turbine having been tested in less than ideal conditions (such as with high background levels). In this case, the "expanded" uncertainty (1.645σ) is higher than 2 dB in most cases, it is therefore this value that is added to the sound power levels to obtain the input to the predictions when using a G=0.5 ground factor in accordance with the IOA GPG (4.3.6).

| Example Turbine | | | | | | |
|---|---|---|---|---|---|---|
| **Standardised** Wind Speed: $m.s^{-1}$ | 5 | 6 | 7 | 8 | 9 | 10 |
| Reported $L_{WA}$ | 98.2 | 100.8 | 101.4 | 103.0 | 104.5 | 106.7 |
| Uncertainty σ | 1.2 | 1.3 | 1.7 | 0.9 | 1.0 | 1.7 |
| 1.645.σ | 2.0 | 2.1 | 2.8 | 1.5 | 1.6 | 2.8 |
| $L_{WA}$+ 1.645σ | 100.2 | 102.9 | 104.2 | 104.5 | 106.1 | 109.5 |
| $L_{WA}$+2dB | 100.2 | 102.8 | 103.4 | 105.0 | 106.5 | 108.7 |
| $\Delta L_{WA}$ | 0.0 | 0.1 | 0.8 | -0.5 | -0.4 | 0.8 |
| $L_{WA}$ for Predictions | 100.2 | 102.9 | 104.2 | 104.5 | 106.1 | 109.5 |


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