

Decibel scales and definitions of levels

ESDU 21003

Supersedes ESDU 66018

Issued May 2021



Endorsed by The Royal Aeronautical Society

This is a preview. [Click here to purchase the full publication.](#)

ESDU Data Items

Data Items provide validated information in engineering design and analysis for use by, or under the supervision of, professionally qualified engineers. The data are founded on an evaluation of all the relevant information, both published and unpublished, and are invariably supported by original work of ESDU staff engineers or consultants. The whole process is subject to independent review for which crucial support is provided by industrial companies, government research laboratories, universities and others from around the world through the participation of some of their leading experts on ESDU Technical Committees. This process ensures that the results of much valuable work (theoretical, experimental and operational), which may not be widely available or in a readily usable form, can be communicated concisely and accurately to the engineering community.

We are constantly striving to develop new work and review data already issued. Any comments arising out of your use of our data, or any suggestions for new topics or information that might lead to improvements, will help us to provide a better service.

The preparation of this Data Item

The work on this particular Data Item supersedes ESDU 66018 and was monitored and guided by the Vibration and Acoustic Fatigue Committee. This Committee first met in 1966 and now has the following membership:

Chairman

Prof. R.D. Adams — University of Bristol

Members

| | | |
|--------------------|---|--|
| Dr N.S. Ferguson | — | University of Southampton |
| Mr E. Green | — | Rolls-Royce plc, Derby |
| Dr P. Green* | — | BAE Systems, Preston, Lancashire |
| Dr A. Grillenbeck* | — | IABG Space Test Center, Germany |
| Mr A.R. Harris* | — | Northrop Grumman, USA |
| Dr D.M.A. Millar* | — | Bombardier Aerospace Short Brothers plc, Belfast |
| Mr C.D. Munger* | — | The Boeing Company, USA |
| Dr S. Patsias | — | Rolls-Royce plc, Derby |
| Mr E. Smyth | — | Bombardier Aerospace Short Brothers plc, Belfast |
| Prof. R.G. White | — | University of Southampton (Member Emeritus) |
| Dr Ir. J.J. Wijker | — | University of Twente, Netherlands. |

* Corresponding Member

The construction and subsequent development of the Data Item were undertaken by

| | | |
|-----------------------|---|--------------------|
| Dr J. Anderson | — | Principal Engineer |
| Dr M. Bratos-Anderson | — | Consultant. |

The person with overall responsibility for the work in this subject area is Mr M. Doherty, Head of Aircraft Noise and Structural Dynamics Group.

DECIBEL SCALES AND DEFINITIONS OF LEVELS

CONTENTS

| | Page |
|---|--------|
| 1. NOTATION | 1 |
| 2. INTRODUCTION | 2 |
| 3. SOUND PRESSURE AND SOUND PRESSURE LEVEL | 2 |
| 4. SOUND INTENSITY AND SOUND PRESSURE LEVEL | 3 |
| 5. SOUND POWER AND SOUND POWER LEVEL | 4 |
| 6. REFERENCES | 4 |
| FIGURES 1 and 2 | 5 to 6 |

DECIBEL SCALES AND DEFINITIONS OF LEVELS

1. NOTATION

| | | |
|---------------|---|-------------------|
| h | altitude | m |
| c_0 | velocity of sound in undisturbed air | m/s |
| I | sound intensity | W/m ² |
| I_n | sound intensity normal to surface S | W/m ² |
| I_{ref} | reference value of sound intensity | W/m ² |
| IL | intensity level | dB |
| L | sound pressure level | dB |
| L_w | Sound power level | dB |
| P | absolute pressure | Pa |
| p | sound pressure | Pa |
| p_0 | sound pressure amplitude | Pa |
| p_{rms} | r.m.s. sound pressure | Pa |
| p_{ref} | reference sound pressure (2×10^{-5}) | Pa |
| S | surface area | m ² |
| T | absolute temperature of the air | K |
| t | time | s |
| u | particle velocity | m/s |
| W | sound power | W |
| W_{ref} | reference sound power | W |
| ρ_0 | density in undisturbed medium | kg/m ³ |
| τ | time interval | s |
| \rightarrow | indicates vector | |
| $—$ | indicates time average | |

Issued May 2021