

DEFINITIONS OF TERMS FOR ACOUSTIC FATIGUE ANALYSIS

1. INTRODUCTION

This Data Item defines terms employed in subsequent Data Items on acoustic fatigue. The terms are listed alphabetically under each of four headings.

- 2.1 General Terms
- 2.2 Acoustic Loading
- 2.3 Structural Response
- 2.4 Fatigue

The majority of definitions are derived or quoted from relevant British Standards.

Terms and notation relating to conventional aircraft fatigue analysis are presented in Item No. 70016 (Reference 6).

2. DEFINITIONS AND NOTATION

2.1 General Terms

Acoustic fatigue

Fatigue due to repeated loading produced by sound waves.

Acoustic fatigue test

A test in which a specimen is subjected to acoustic loading in a test channel, reverberant chamber, or in the open.

Discrete frequency acoustic test

A test in which the specimen is subject to sound waves of only one frequency.

Mixed-spectrum acoustic test

A test in which the specimen is subjected simultaneously to sound waves covering a broad band of frequency with superimposed discrete frequency sound waves.

Random frequency acoustic test

A test in which the specimen is subjected simultaneously to sound waves covering a broad band of frequency.

Amplitude

The amplitude of a simple sinusoidal quantity is the mean-to-peak value.

Bandwidth

The interval between two frequencies. Bandwidths may be expressed in octaves, or multiples thereof, or as a frequency difference in hertz.

NOTE. Preferred frequency bandwidths for constant percentage increments (*e.g.* one-third octave bands) are adopted to provide a common basis for comparison (see Reference 5). Occasionally constant frequency bandwidths may be used.

Frequency, f

The frequency of a periodic quantity is the rate of repetition of the cycles. The unit is the hertz.

Level

The level of a quantity related to power is the ratio, expressed in decibels, of the magnitude of the quantity to a specified reference magnitude.

Node

A point, line, or surface at which the amplitude of the sound pressure, particle velocity, or some other characteristic of the wave field is zero. If the nature of the node is not apparent, an appropriate modifier should be used; for example, pressure node, velocity node, displacement node.

Octave

The interval between two frequencies, the higher of which is twice the lower.

Root mean square value (r.m.s. value)

The r.m.s. value of a varying quantity is the square root of the mean value of the squares of the instantaneous values of the quantity.

Spectral density

The mean square value of the quantity in a band one hertz wide, centred at a specified frequency.

2.2 Acoustic Loading**Band pressure level**

The r.m.s. sound pressure level of the sound energy within a specified frequency band.

Bel

A scale unit used in the comparison of the magnitude of like quantities that are proportional to power. The number of bels, expressing the relative magnitude of two quantities, is the logarithm to the base 10 of the ratio of the quantities. For example, two sound intensities I_1 and I_2 are said to be separated by n bels where,

$$n = \log_{10} \left(\frac{I_1}{I_2} \right).$$

Broad-band loading

Loading having a spectral content distributed over a broad frequency band. The bandwidth is usually one octave or greater.

Decibel

One tenth of a bel. $10 \log_{10} \left(\frac{I_1}{I_2} \right)$ defines the previously specified separation in decibel units.

Free field

A sound field in a medium of such extent that the effects of the boundaries are negligible throughout the region of interest.

Narrow-band loading

Loading having a spectral content within only a narrow frequency band. The bandwidth is usually equal to or less than one-third octave.

Near field

The region in the vicinity of a noise source, radiating sound in free-field conditions, wherein the sound pressure and particle velocity are not in phase. In this region the acoustic intensity is not simply related to the sound pressure squared.

Pressure spectrum level

The pressure spectrum level of a sound at a specified frequency is the r.m.s. sound pressure level of the sound energy per unit bandwidth centred at this specified frequency. The reference pressure must be explicitly stated. The unit is the decibel.

Shock cell noise

A phenomenon that may occur in the efflux of a jet engine with certain nozzle configurations and super-critical pressure ratios. It can give rise to high sound intensities contained within relatively small bandwidths and has highly directional properties.

Smooth spectrum

A continuous spectrum having a low rate of change of level with frequency.

Sound intensity, I

In a specified direction. The mean rate of flow of sound energy per unit area normal to that direction.

Sound intensity level, IL

The acoustic energy per unit surface area received or emitted is expressed as a sound intensity level by the relation

$$IL = 10 \log_{10} \left(\frac{I}{I_{ref}} \right) \quad \text{dB.}$$

NOTE. $I_{ref} = 10^{-12}$ watts/m² throughout these Data Items. Other reference intensities are sometimes used elsewhere.

Sound power level, PWL

The acoustic power output of a noise source is expressed as a sound power level by the relation.

$$PWL = 10 \log_{10} \left(\frac{W}{W_{ref}} \right) \quad \text{dB.}$$

NOTE. $W_{ref} = 10^{-12}$ watts throughout these Data Items. Other reference powers are sometimes used elsewhere.

Sound pressure, p

The alternating component of the pressure at a point in a sound field.

NOTE. It is usual, as in these Items, to consider sound pressure in terms of its r.m.s. value. (Alternatively the term "sound pressure" may be qualified by the terms "instantaneous", "peak", "maximum", etc.)