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AES standard for acoustics - Measuring loudspeaker maximum linear sound levels using noise

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AES standard for acoustics – Measuring loudspeaker maximum linear sound levels using noise

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Abstract

This standard details a procedure for measuring maximum linear sound levels of a loudspeaker system or driver using a test signal called M-Noise. In order to measure maximum linear sound levels meaningfully and repeatably, a signal is required whose RMS and peak levels as functions of frequency have been shown to be representative of program material. Various existing standards define noise-based test signals which, like M-Noise, have incorporated the knowledge that typical program material has a diminishing RMS level with increasing frequency, but M-Noise uniquely also features a relatively constant peak level as a function of frequency, so that the crest factor (peak level – RMS level) increases with frequency, which an analysis on a large variety of music and other content has revealed is an important additional characteristic of typical program material. The specified procedure determines a loudspeaker's maximum linear sound levels by incrementally increasing the Playback Level of M-Noise until a stop condition is met: either an unacceptable change in the transfer function's magnitude or an unacceptable change in the coherence of the transfer function.

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Contents

0 Introduction 4
0.1 General 4
0.2 Patents 5
0.3 Documentation conventions 5
1 Scope 5
2 Normative references 6
3 Terms, definitions, and abbreviations 6
4 Setup 8
5 Procedure 11
6 Reporting 14
Annex A (informative): Notes on measurement technique 15
A.1 Determining Coherence Regime 15
A.2 Dynamic Range for Measurement Microphones and Pre-amps 16
A.3 Amplifier Headroom 17
A.4 M-Noise Properties 18
A.5 Obtaining Accurate Sound Levels 18
Annex B (normative): Additional measurement steps 20
B.1 Analyzers Without Gain Tracking 20
B.2 Recommendation for identifying Two Octaves of Compression 20
B.3 Real-Time Transfer-Function Analyzer 20
B.4 Considerations Regarding Analyzer Settings 20
Annex C (Informative) M-Noise™ Test Signal End User License Agreement (EULA) 22
Annex D – Bibliography 24

Foreword

This foreword is not part of the AES-X250 *AES standard for acoustics – Measuring loudspeaker maximum linear sound levels using noise*.

This document was developed in project AES-X250, in the SC-04-03-A task group on measurement of maximum linear sound levels using noise, under the leadership of Merlijn van Veen and Roger Schwenke.

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2021-11-02

Note on normative language

In AES standards documents, sentences containing the word “shall” are requirements for compliance with the document. Sentences containing the verb “should” are strong suggestions (recommendations). Sentences giving permission use the verb “may”. Sentences expressing a possibility use the verb “can”.

AES standard for acoustics – Measuring loudspeaker maximum linear sound levels using noise

0 Introduction

0.1 General

This standard specifies a method for measuring the maximum linear sound levels of a loudspeaker system or driver. It uses a mathematically derived test signal called M-Noise that effectively emulates the dynamic characteristics of music. It measures loudspeaker maximum linear sound levels in a repeatable manner which closely represents the values determined in practice with typical program material.

In order to measure maximum linear sound levels meaningfully and repeatably, a signal is required whose RMS and peak levels as functions of frequency have been shown to represent program material. Previous standards have incorporated the idea that typical content has a diminishing RMS level with increasing frequency. In research leading to this standard, a large variety of music has been analyzed, and it has additionally been found that peak levels do not reduce, but rather are relatively constant with frequency. The M-Noise test signal features a relatively constant peak level as a function of frequency, but a diminishing RMS level with increasing frequency.

The maximum sound levels of a loudspeaker are determined by incrementally increasing the Playback Level of M-Noise until a stop condition is met: either an unacceptable change in the transfer function's magnitude, or an unacceptable change in the coherence of the transfer function.

To help clarify the relationship between the terms peak level and RMS level it is useful to consider a period of silence interrupted by a drum strike followed by more silence. The peak sound level of this signal can be measured. Now imagine the same drum being hit with exactly the same strength over and over again at an increasing rate. The peak sound level of this signal is the same as the single drum hit. However, the RMS sound level increases as the rate of the drum hits increases.

Observations like this led to the development of the M-Noise ("Music Noise") test signal used in this standard as a more appropriate signal than the commonly used pink noise signal. Even if a filter, such as the ANSI/CTA-426-B filter, is applied to a pink noise signal to shape its magnitude to more closely match the magnitude of typical music content, the resulting crest factor versus frequency will not match that of typical music like M-Noise will. The RMS magnitude spectra for M-Noise and other signals are shown in figure 0. The magnitude is shown as signal power per 1/n octave-based frequency bands. Pink noise would be a horizontal line at 0 dB.

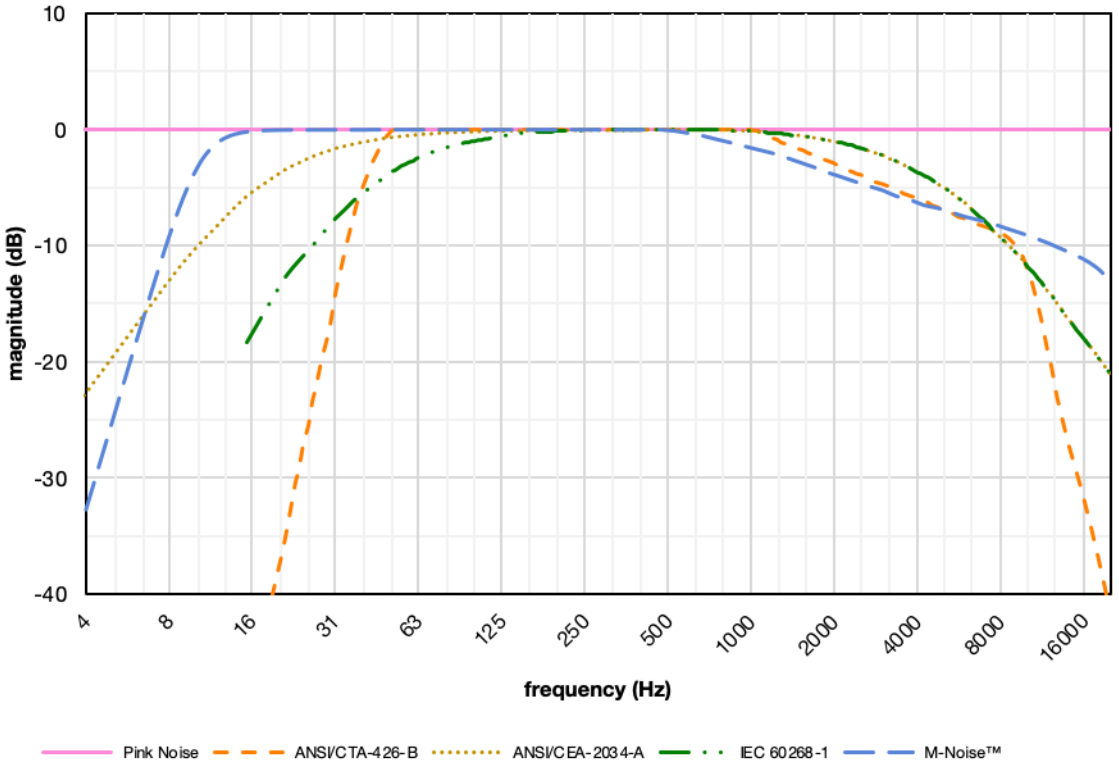

Figure 0 – RMS spectra of various Simulated Programme Content normalized at 500 Hz

0.2 Patents

The AES draws attention to the fact that compliance with this document involves the use of US patent 10,841,717 dated 2020-11-17.

The AES has no position concerning the evidence, validity and scope of this patent right.

The holder of this patent or intellectual property rights has agreed to license them under the End User License Agreement (EULA) in Annex C.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights other than those identified above. The AES shall not be held responsible for identifying any or all such patent rights.

0.3 Documentation conventions

Following ISO convention, decimal points are conventionally shown as commas (,).

1 Scope

This standard specifies a method for measuring the maximum linear sound levels of a loudspeaker driver or system. It uses a mathematically derived test signal that effectively emulates the dynamic characteristics of music as a function of frequency as well as its spectral content.