AES recommended practice for professional audio — Subjective evaluation of loudspeakers

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Abstract

This standard is a set of recommendations for the subjective evaluation of high-performance loudspeaker systems. It is believed that, for certain audio components, including loudspeakers, subjective evaluation is a necessary adjunct to objective measurements. The strong influence of listening conditions, program material, and individual evaluators is recognized. This document seeks, therefore, to assist in avoiding testing errors rather than to attempt to establish a correct procedure.

An AES standard implies a consensus of those substantially concerned with its scope and provisions and is intended as a guide to aid the manufacturer, the consumer, and the general public. The existence of an AES standard does not in any respect preclude anyone, whether or not he or she has approved the document, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standard. This document is subject to periodic review and users are cautioned to obtain the latest edition.

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Foreword

[This foreword is not a part of *AES recommended practice for professional audio — Subjective evaluation of loudspeakers,* AES20-1996.]

The scope of this document identifies its application for "loudspeakers in domestic listening environments and in professional environments of similar acoustics." However, there are several levels of interest in subjective assessments of these loudspeakers, and it is in this diversity that there is a lack of focus. At one extreme are the experimenters who probe the limits of human perception and measurement capability. These researchers constantly push the state of the art in experimental and statistical procedures. Their needs are so variable, however, that it is unlikely that any standard could be adequately embracing. Closer to the mainstream are some consumer-product testing groups who seek a standardized approach to follow and to point to in any challenge of their findings. At the opposite extreme are persons, including some product reviewers, who depend on their perceptual insights to transcend experimental controls, hearing imperfections, and room acoustics.

However, the vast majority of listening tests are motivated by immediate needs and are performed in spite of limited facilities and significant financial and time constraints. Intentions are good, but all too often the results contain biases or errors. Such errors may be serious when they cause a manufacturer to launch a new product, only to have it falter in the marketplace, or when biased opinions reach the public through a product review in a magazine.

In the evaluation of loudspeakers, the science of listening tests has made considerable progress. There are definite signs of order, and certain generalizations about loudspeaker performance seem to be safe, but listening rooms remain a significant factor in what is heard by listeners, and important aspects of sound quality and stereo imaging will, with certainty, relate only to the specific circumstances of the test. In such situations, experimental blinds and statistical analyses cannot substantially improve the utility or meaning of the results.

For these reasons, the working group decided to focus its efforts on the areas where the largest problems exist and the most substantial improvements can be anticipated. Mainly, these relate to the room, the program material, and the basic test procedure. The initial objective, therefore, has been not to develop a rigid standard, in the conventional sense, but to issue a set of procedures and guidelines by which persons conducting listening tests can assess the circumstances of their tests with a view to detecting sources of obvious bias or error.

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1 Scope

The recommendations of this document apply to the subjective evaluation of sound reproduction of loudspeakers in domestic listening environments and in professional environments of similar acoustics. The recommendations apply most directly to user-installed free-standing and in-wall loudspeakers. Specifically excluded are

1) custom-built and equalized professional monitors;
2) loudspeakers used at very short listening distances;
3) loudspeakers for computer workstations.

For broadcast monitoring applications, attention is drawn to ITU and EBU standards documents.

1.1 Object

This document gives recommendations for test procedures, data acquisition and analysis, and interpretations of subjective evaluations of reproduced sound. Consideration is given to tests designed to reveal the presence of differences between devices under test, as well as tests intended to yield subjectively scaled ratings according to any of several possible criteria.

The recommendations include practical measurements and experimental procedures by which the subjective influences of certain physical, psychological, and experimental variables can be identified, isolated, and controlled. The objective is to minimize or control the biases and variations in listeners' judgments that are attributable to factors other than the devices under test.

1.2 Application

This standard applies to the evaluation of high-performance loudspeakers by loudspeaker manufacturers, professional users, product testing organizations, and consumers.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this document. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this document are encouraged to investigate the possibility of applying the most recent editions of the indicated standards.

IEC 268-3, Sound system equipment — Part 3: Amplifiers. *Geneva, Switzerland: International Electrotechnical Commission, 1988.*

IEC 268-5, *Sound system equipment — Part 5: Loudspeakers*. Geneva, Switzerland: International Electrotechnical Commission, 1989.

IEC 651, *Sound level meters*. Geneva, Switzerland: International Electrotechnical Commission, 1979.

IEC 804, *Integrating-averaging sound level meters*. Geneva, Switzerland: International Electrotechnical Commission, 1985.

ISO 1996-1, *Acoustics — Description and measurement of environmental noise — Part 1: Basic quantities and procedures*. Geneva, Switzerland: International Organization for Standardization, 1982.

ISO 2204, *Acoustics — Guide to International Standards on the measurement of airborne acoustical noise and the evaluation of its effects on human beings*. Geneva, Switzerland: International Organization for Standardization, 1979.

ISO 3382, *Acoustics — Measurement of reverberation time in auditoria*. Geneva, Switzerland: International Organization for Standardization, 1975.

ISO 7029, *Acoustics — Threshold of hearing by air conduction as a function of age and sex for otologically normal persons*. Geneva, Switzerland: International Organization for Standardization, 1983.

3 Terminology

3.1 acoustical recording:
Recording made with microphones, of musical instruments that do not rely on electroacoustics for their sound emission.

3.2 anechoic recording
Recording made with microphones in an acoustical environment having negli-gible reflections.

3.3 foreground listening
Listening to program material in a situation where the program material is the center of attention.

3.4 front (of room)
End of the room that the listener faces.

3.5 front (of stage)
End of the stage closest to the listener.

3.6 impaired listener
Listener having a hearing threshold level below that regarded as normal per ISO 7029.

3.7 listening fatigue
Subjective sensation of annoyance and tiring that develops gradually after a long period of continuous listening (see annex C), not to be confused with auditory fatigue, an objective hearing-threshold shift.

3.8 robustness
Stability of performance with normal listener movements and listening locations (see annex C).