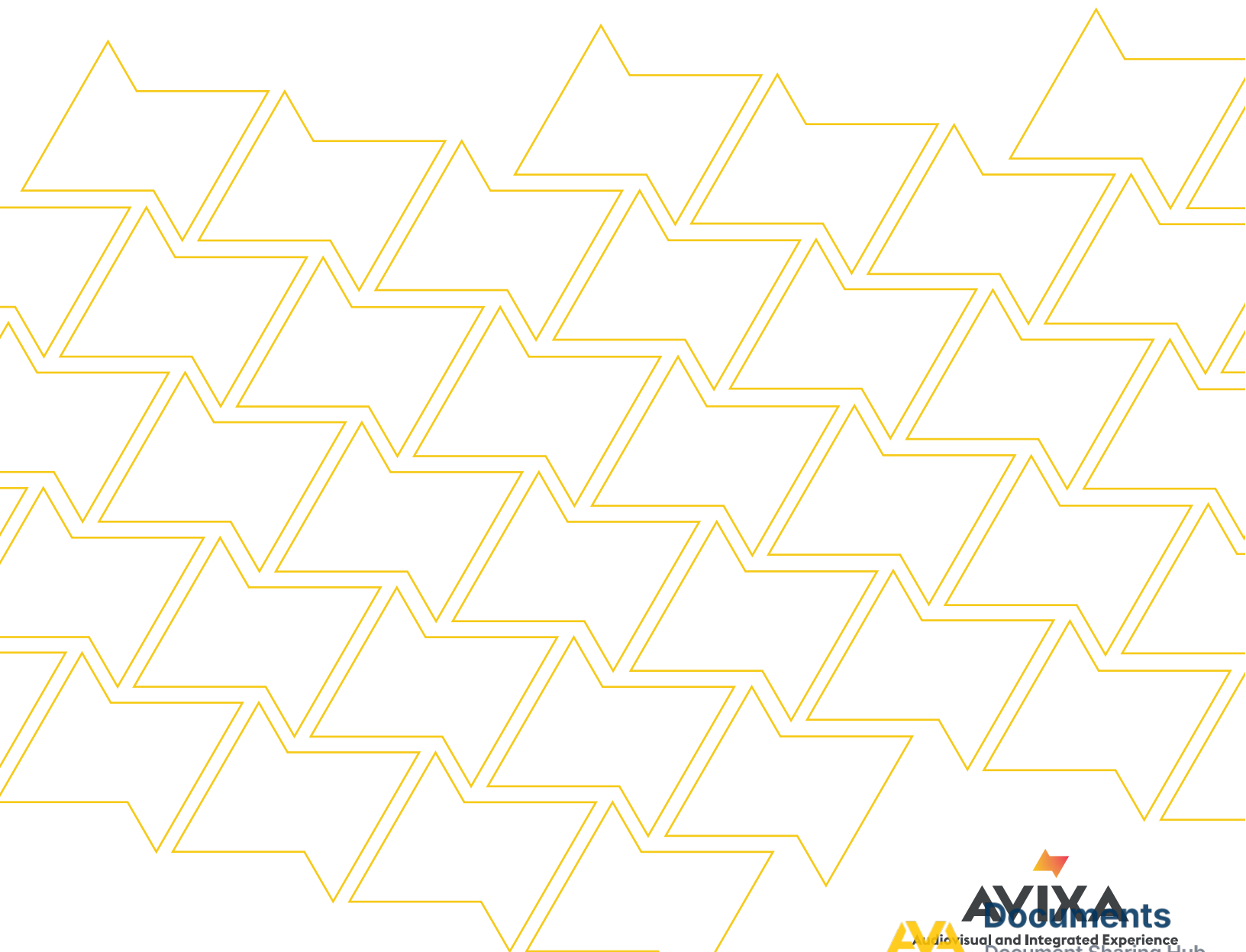


**AVIXA A102.01:2017 (Formerly ANSI/INFOCOMM A102.01:2017)**  
Supersedes ANSI/INFOCOMM 1M-2009

# Audio Coverage Uniformity in Listener Areas



# AVIXA A102.01:2017 (Formerly ANSI/INFOCOMM A102.01:2017)

## Audio Coverage Uniformity in Listener Areas

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### Abstract

This Standard provides a procedure to measure and classify the uniformity of early arriving sound from a sound system across a listener area.

### Keywords

ACU; audio coverage uniformity; audio system; early arriving sound; listener area; sound pressure level; sound system; spatial coverage; uniformity

### Disclaimer

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## Foreword

The performance of a sound system can be characterized by several factors including uniformity of coverage, tonal balance and consistency, gain before feedback, and maximum sound pressure level. This Standard focuses on the uniformity of coverage of a sound system's early arriving energy to listener area. An ideal sound system design allows all listeners to hear reproduced content at approximately the same sound pressure level independent of the listener's position in a designated listener area. This performance Standard provides a procedure to measure and a means to classify the uniformity of coverage.

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## 1. SCOPE, PURPOSE, AND APPLICATION

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### 1.1. Scope

- 1.1.1. This Standard defines parameters for characterizing a sound system's coverage of defined listener areas. It provides performance classifications and measurement procedures to assess the uniformity of coverage of a sound system's early arriving sound, with the goal of achieving consistent sound pressure levels throughout defined listener areas.
- 1.1.2. The procedure associated with this Standard is one of many verifications of the deployment and performance of a sound system. This Standard specifically excludes testing or measuring for spectral balance, gain before feedback, maximum sound pressure level, and other parameters required to assess the total performance of a sound system.

### 1.2. Purpose

- 1.2.1. The purpose of this performance Standard is to establish a method by which an audio system's coverage can be assessed and classified. This is accomplished by measuring the uniformity of coverage of the early arriving sound from the loudspeaker system(s) throughout the designated listener area(s).

### 1.3. Application

- 1.3.1. The procedures described in this Standard are to be applied to sound reinforcement and audiovisual (AV) presentation systems. These systems are implemented in a variety of applications, including conference rooms, training rooms, classrooms, auditoria, theatres, houses of worship, and other venues where sound reinforcement is employed. Additionally, the metrics and classifications in this Standard may be used to establish design criteria for new systems.

### 1.4. Exceptions

- 1.4.1. This Standard may be used in conjunction with, but does not supersede, regulatory authority requirements.
- 1.4.2. This Standard is not intended for use in the following applications:
  - 1.4.2.1. Cinema (refer to SMPTE: Society of Motion Picture and Television Engineers)
  - 1.4.2.2. Home theater (refer to CEDIA: Custom Electronic Design & Installation Association)
  - 1.4.2.3. Sound masking/speech privacy

## 2. REFERENCED PUBLICATIONS

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### 2.1. Normative References

- 2.1.1. There are no normative references for this Standard. Although there are no normative references for this Standard, Annex 5.2 is a normative annex and is considered a requirement of the Standard.

### 2.2. Informative References

- 2.2.1. The following publications contain information that supports the design and application of this Standard, but are not required provisions of the Standard. Use the latest edition unless otherwise specified.

Acoustical Society of America (ASA). *ANSI/ASA S1.1-2013, Acoustical Terminology*. Melville, NY: Acoustical Society of America (ASA).

———. *ANSI/ASA S12.2-2008, Criteria for Evaluating Room Noise*. Melville, NY: Acoustical Society of America (ASA).

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Audio Engineering Society, Inc. *AES56-2008 (R2014) AES Standard on Acoustics-Sound Source Modeling – Loudspeaker Polar Radiation Measurements*. New York, New York: Audio Engineering Society, Inc.

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InfoComm International. *ANSI/InfoComm 10:2013 Audiovisual Systems Performance Verification*, Section 9.1. Fairfax: InfoComm International, 2013.

International Organization for Standardization. *ISO 266:1997, Acoustics -- Preferred Frequencies*. Geneva: ISO.

Sinclair, Rex. "The Design of Distributed Sound Systems from Uniformity of Coverage and Other Sound-Field Considerations." *70th AES Convention*, NYC, Oct. 30-Nov. 2, 1981, revised July 27, 1982.

### 3. DEFINITIONS

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As used in this document, “shall” and “must” denote mandatory provisions of the Standard. “Should” denotes a provision that is recommended, but not mandatory.

#### 3.1. Acronyms

For the purposes of this Standard, the following acronyms apply:

- 3.1.1. **ACU:** Audio Coverage Uniformity
- 3.1.2. **ACUML:** Audio Coverage Uniformity Measurement Location
- 3.1.3. **ANL:** Ambient Noise Level
- 3.1.4. **SPL:** Sound Pressure Level

#### 3.2. Definitions

For the purposes of this Standard, the following definitions apply:

- 3.2.1. **Apparent Origin:** The physical point in space from which measurement locations for listening areas of point-source systems are determined
- 3.2.2. **Audio Coverage Uniformity Measurement Locations (ACUML):** The test points within a venue that have been determined to carry out the measurements for the Audio Coverage Uniformity test.
- 3.2.3. **Coverage Envelope:** The absolute value of the difference between the highest and lowest measurement readings in a given octave band.
- 3.2.4. **Early Arriving Energy:** Energy, both direct and reflected, which arrives at a measurement location within 50 milliseconds of the direct sound’s arrival.
- 3.2.5. **Listening Plane:** The distance above the floor to the average audience member’s ears across a listening area.
- 3.2.6. **Listener Area:** A contiguous audience space intended to be covered by a sound reinforcement loudspeaker system.
- 3.2.7. **Loudspeaker Sub-system:** A portion of a larger loudspeaker system, such as front fills or under-balcony loudspeakers, designed to provide coverage to a seating area that is supplemental to the coverage of the primary loudspeakers.
- 3.2.8. **Loudspeaker System:** An implementation of loudspeaker(s) designed to provide coverage to a specific area. The system may be single or multi-channel in nature.

- 3.2.9. **Multi-channel Loudspeaker System:** A loudspeaker system designed so that multiple loudspeaker locations provide coverage to the same listening areas. An example would be a Left/Center/Right system where each feed is discretely provided to each listener.
- 3.2.10. **Octave Band:** A frequency band where the upper frequency limit to the lower frequency limit has a ratio of two to one.<sup>1</sup>
- 3.2.11. **Single-channel Loudspeaker System:** A loudspeaker system designed so that a single source feed is distributed to all designated coverage areas. An example would be a system that contains a central loudspeaker cluster with delayed loudspeakers, such as what might be found in an auditorium or lecture hall.

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<sup>1</sup> ANSI/ASA S1.11-2014: *Electroacoustics – Octave-band and Fractional-octave-band Filters – Part 1: Specifications*. Melville, NY: Acoustical Society of America (ASA).

## 4. REQUIREMENTS

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### 4.1. Sound System Prerequisites

The sound system shall meet these conditions for this Standard to apply.

- 4.1.1. The system shall be in its intended operating state with confirmation of loudspeaker functionality and polarity as well as adjustments for gain structure, spectral balance, system equalization, and time offset corrections having already been performed.
- 4.1.2. In its intended operating state, the system shall be capable of an acoustic output of at least 15 dB above the ambient noise level in each octave band to be tested.
- 4.1.3. The venue shall be in its intended operating configuration. This means that all construction activity has ceased, room finishes are in place, the room is in its typical seating configuration, and extraneous noise from people or equipment is minimized.

### 4.2. Measurement Software and Tools

- 4.2.1. All instrumentation used for measurement of ACU shall be capable of deriving and outputting ISO octave-band measurement results, and shall conform to requirements of Class 1 or Class 2 sound level meter systems.
- 4.2.2. All instruments shall be calibrated as required by the manufacturer's instructions to ensure measurement accuracy.
- 4.2.3. Weighting filters such as A, B, or C shall not be used. All sound pressure levels shall be expressed in unweighted decibels (dB).<sup>2</sup>
- 4.2.4. A transfer function measurement shall be used to capture a 50-millisecond time-windowed frequency response to measure ACU. See Annex 5.1 for further details.

### 4.3. Audio Coverage Uniformity Measurement Procedure

- 4.3.1. A process map is provided in Annex 5.2. The map shows the ACU measurement procedure, necessary documentation, and a decision tree for this Standard. This is a normative annex.
- 4.3.2. This Standard provides measurement procedures for two types of loudspeaker systems: distributed (Section 4.4) and point-source (Section 4.5).
- 4.3.3. For listener areas with varying physical configurations (such as operable partitions), measurements shall be taken and reported separately for each configuration.
- 4.3.4. Systems shall be measured based on their intended usage:

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<sup>2</sup> International Electrotechnical Commission (IEC), *IEC 61672-2:2013 Electroacoustic – Sound Level Meters Pt. 2 Pattern Evaluation Tests*.