



Standard Guide for Forensic Audio Laboratory Setup and Maintenance¹

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1. Scope

1.1 This guide sets forth recommendations for the creation of a forensic audio laboratory space as well as the configuration, verification, and maintenance of the equipment contained within the lab.

1.2 In designing and configuring an audio laboratory, it is important to consider the acoustical environment/room of the laboratory, as well as climate control. Other than having a viable location for the laboratory, computer hardware and software applications are the most important components of a laboratory.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*²

E1732 Terminology Relating to Forensic Science

2.2 *ISO/IEC Standard:*³

ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories

¹ This guide is under the jurisdiction of ASTM Committee E30 on Forensic Sciences and is the direct responsibility of Subcommittee E30.12 on Digital and Multimedia Evidence.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <http://www.iso.org>.

2.3 *AES Standard:*⁴

AES Recommended Practice for Audio Preservation and Restoration – Storage and Handling – Storage of Polyester-Base Magnetic Tape, AES Standard 22-1997, Reaffirmed 2008

2.4 *SWGDE Standard:*⁵

SWGDE Recommendations for Validation Testing

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms that may assist in interpreting this standard, refer to Terminology **E1732**.

4. Significance and Use

4.1 The design and configuration of an audio laboratory, as well as the maintenance of equipment, are factors that must be considered to ensure an optimal environment to produce the best results. This guide is intended to provide general guidance for laboratory setup and maintenance.

4.2 This document is not meant to be an all-inclusive guide on how to set up a laboratory; nor does it contain information pertaining to specific commercial products as it relates to computer hardware, forensic, and non-forensic software applications.

4.3 When dealing with equipment and technology outside your area of expertise, consult with an appropriate specialist.

5. Audio Laboratory Considerations

5.1 *Environment*—The physical environment, independent of equipment, in and around a forensic audio laboratory can have a profound effect on the quality of work produced. Audio laboratory design is a complex task and comprehensive references should be consulted, including Refs (1-4).⁶

5.1.1 *Acoustics*—The acoustic environment of a forensic audio laboratory is the collection of ambient sounds and influences (for example, materials, resonances, echo), which

⁴ Available from Audio Engineering Society, Inc. (AES), International Headquarters, 551 Fifth Ave., Suite 1225, New York, NY 10176, <http://www.aes.org>.

⁵ Available from the Scientific Working Group on Digital Evidence (SWGDE), <https://www.swgde.org>.

⁶ The boldface numbers in parentheses refer to a list of references at the end of this standard.

can affect the quality of a forensic audio analysis. Eliminate or minimize sound distractions in the audio laboratory to prevent confusion as to what sounds are present on a recording (5).

5.1.1.1 Acoustical impediments:

- (1) Background conversation, TV, radio, and music;
- (2) Computer and equipment cooling fans;
- (3) Air conditioning units and airflow; and
- (4) Vibration.

5.1.1.2 Steps can be taken to mitigate external noise in the laboratory, such as

- (1) Using acoustic foam or other materials to absorb reverberation and echo,
- (2) Designing the laboratory with acoustic traps,
- (3) Rerouting unnecessary HVAC ducts,
- (4) Using acoustic baffling within the HVAC ducts that are present,
- (5) Using heavy wooden doors that seal tightly all around when closed, and
- (6) Using high-quality headphones during examinations to reduce extraneous sounds and maximize the audibility of the signal being examined.

5.1.2 *Temperature and Humidity*—Ensure the temperature and humidity of the laboratory is within the manufacturer's specifications of the equipment. Equipment itself generates heat and requires adequate ventilation to prevent heat buildup that could affect the signal (AES Recommended Practice for Audio Preservation and Restoration, (6)).

5.1.3 *Electromagnetic Interference*—Interference from a variety of electromagnetic sources can affect signal quality (7-10).

5.1.3.1 Alternating current (AC) sources, such as power lines, motors, lamp dimmers, fluorescent lights, and uninterruptible power supplies can create magnetic pickup loops that can induce noise into improperly routed signal cables. Separate transformers and power lines from signal lines. If power and signal lines must cross, have them cross at 90° to one another.

5.1.3.2 Improper grounding can create ground loops. Many factors contribute to this phenomenon. Properly ground equipment and racks to minimize ground loops.

5.1.3.3 Items that generate magnetic fields strong enough to affect the integrity of any magnetic media nearby, such as loudspeakers, should be kept as far away as possible from evidentiary recordings or removed from the laboratory.

5.1.3.4 Cell phones, pagers, radios, and other radio frequency (RF) transmitting devices may interfere with cables or equipment and should be turned off or removed from the laboratory.

5.1.3.5 Cathode ray tube (CRT) video monitors can induce audible noise in nearby or connected audio equipment. Do not place playback/recording devices next to CRT monitors (11).

5.2 *System Configuration*—The quality and arrangement of equipment, cables, connectors, interfaces, and software directly affects the audio signal (2, 5, 7, 12).

5.2.1 *Computer and Network Systems*—Process evidence on a system isolated from people not authorized to access the evidence. It is also important to ensure that computers and network systems are secure. It is recommended to have a

separate computer for searching the Internet for unique codecs, proprietary players, etc.

5.2.2 *Audio Equipment*—Choose playback, processing, and recording equipment suitable for the task at hand, using professional and broadcast grade equipment where possible.

5.2.3 *Signal Path*—The signal path is the complete route of the audio data from the source through all of the connectors, interfaces, cables, and software to the destination. Design signal paths with the least amount of degradation. Use cables and connectors of sufficient quality and minimal length to minimize signal loss and reduce the opportunity for interference. For analog audio runs, maximize the use of balanced lines over unbalanced lines (10, 13). Avoid stacking adapters to interconnect equipment. It is preferable to use a cable designed for the particular interfaces involved. Be aware of the impedance and level of analog interfaces (7). Loudspeakers are not recommended for conducting forensic audio analyses, but if otherwise used during an examination, ensure that they are capable of reproducing the full frequency spectrum of the audio signal.

5.2.4 *Transmission Format*—Choose the signal format that transmits the audio data with the least amount of degradation, loss, or attenuation. This decision depends upon what formats are available on the equipment being used. Minimize the number of digital to analog and analog to digital conversions (14, 15).

5.3 *System Verification*—Once the equipment and interconnections are configured, updated, or changed, run test signals through the various components to verify that everything is operating as expected.

5.3.1 *Calibration*—Calibration is the process of establishing the relationship between measurements and known standard values (see Terminology E1732). If a piece of equipment is the basis for measurements in which the numerical results themselves have decisive relevance to examinations, then it is critical that it be calibrated. Equipment producing these measurements, such as signal generators and spectrum analyzers, should be calibrated to a traceable standard (see ISO/IEC 17025). Calibration should occur according to the manufacturer's specifications, after any significant maintenance or repair, or if it fails a control test.

5.3.2 *New or Temporary Equipment*—Certain audio exhibits will require equipment that is not a regular part of the laboratory. This new or temporary equipment can include:

- (1) Submitted devices,
- (2) Equipment or codecs acquired to support the format of submitted media,
- (3) Older or archived equipment, and
- (4) Newly acquired equipment.

5.3.2.1 Optimizing the playback of audio exhibits may require interfacing this equipment to the system. Refer to any available user manuals to ensure proper use of unfamiliar equipment. Take reasonable precautions when installing unknown or untested software onto the system, such as backup and virus scanning. Due to the possible instability within, or incompatibility between third-party codecs or utilities, it is recommended that the use of these programs be limited to a stand-alone computer or virtual machine.