Standardization Activity of the AES – the History Before 1982

Langdon, Queen, McKnight, and Campbell

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John G. (Jay) McKnight, Chair
AES Historical Committee
2005 Nov 14

Standardization Activity of the AES*

Standards committee members present their reports to Society's 70th Convention: (from left) Richard H. Campbell, chairman, technical council; Geoffrey M. Langdon, chairman, S4 committee and AES standards committee; John G. (Jay) McKnight, governor, and prime mover in AES participation in standards activity; and Daniel Queen, secretary of S4 and long-time contributor to national and international standards work.

THE S4 COMMITTEE ON AUDIO ENGINEERING AND ITS RELATION TO OTHER NATIONAL AND INTERNATIONAL STANDARDS ACTIVITY

Geoffrey M. Langdon
Sennheiser Electronic Corp., New York, NY

0 INTRODUCTION

The S4 committee, originally the American National Standards Committee on Sound Recording, was retitled rescoped, and reorganized in 1980. Its present title is broader: the American National Standards Committee on Audio Engineering. The Audio Engineering Society (AES) is the administrative secretariat; the Electronic Industries Association is co-secretariat. Before discussing the relationship of the S4 committee to other standards activity, I think a brief outline of the "world of standards" would be helpful.

When we discuss "standards," we are referring to a system generally known as the voluntary standards system. It is important to keep in mind the fact that voluntary standards differ from regulatory or statutory standards such as those issued by the Federal Communications Commission, Federal Trade Commission, and the like—the latter have the weight of the law behind them. Although not a government agency, Underwriters' Laboratories, also has the weight of law behind its standards in many cities and states, as their standards are often incorporated into state and municipal safety codes. Voluntary standards also differ from those issued by organizations such as the National Bureau of Standards, a U.S. Government facility which retains a primary set of reference weights and measures and defines the proper methods for their use. Voluntary standards, in general, are documents produced by committees composed not of bureaucrats or legislators, but of individuals working on a voluntary basis—except for some administrative people, they are not directly paid for their contributions to the document. Conforming to these standards is also *strictly voluntary*, unless they are incorporated into statutory regulations. The process used to arrive at a "standard" is one of consensus: a true standard either documents widespread current practice or represents the closest practical approach to complete agreement on new practices by all affected parties.

1 NEED FOR STANDARDS

Standards are becoming more important with every passing day. Everyone is aware of the general implications of standards and standardization. For example, if a person in the U.S. goes to a department store to buy a table lamp, there is no need for concern over whether or not it will plug into a household outlet, just as there is no need to measure the base diameter of a light bulb before purchasing one. These items are manufactured in accordance with voluntary standards. In the audio industry, standards are widespread in their effect, covering everything from interfacing of electronic equipment to the interchangeability of mechanical (disk) recordings or magnetic tape recordings—in short, the audio industry, as we know it today, *could not survive* without many voluntary standards.

The existence of a voluntary standard in no way restricts innovation on the part of designers or manufacturers. A new product, process or format may conflict with an existing standard, but if consumers (domestic and/or professional) widely accept the new invention, the standard will eventually be changed. This is required if the standard is to reflect widespread current practice as mentioned previously.

The standards which we use in the audio industry are developed on a number of different levels. The most important level is the international one; national stan-

* Presented at the 70th Convention of the Audio Engineering Society, New York, 1981 October 30–November 2; revised 1982 February.

dards are next, and association standards third. Association standards can be divided into two major categories: industry associations (usually groups of manufacturers), and professional societies, such as the AES.

2 INTERNATIONAL STANDARDS ACTIVITY

Today, there is increasing emphasis on international standardization. Participation in international standardization activities is a relatively new concern for the audio community in the U.S. In the past decade, the U.S. was not very active in this area, but as the audio industry becomes more of a "world family," our industry—in all countries—is becoming more internationally oriented.

The continued growth in world trade in general over the same decade and the conclusion of negotiations on an international standards code under the auspices of the General Agreement on Tariffs and Trade (GATT) in 1979 have emphasized the importance of international standardization to the international exchange of goods and services. The GATT Standards Code, recently signed and accepted by the United States and twenty-nine other countries, is an international attempt to eliminate or at least mitigate technical barriers to trade that are caused by differences in national laws, regulations and standards. The code includes a number of requirements that the signatory governments or parties have agreed to respect. The first is that where national technical regulations and standards are required and relevant international standards exist, the governments that signed the agreement ". . . shall use them as a basis for their technical regulations." In other words, if a signatory government is going to adopt a *mandatory* standard for a particular product, it is encouraged to use a relevant international standard. However, the code lists extensive exceptions to this requirement.

In the United States, the code itself has not become law, but Congress has enacted the Trade Agreements Act of 1979 to implement multilateral trade agreements which include the GATT Standards Code. Although the GATT code applies specifically to mandatory standards, its philosophy extends to voluntary standards as well, and this is endorsed by the Audio Engineering Society and the S4 committee.

3 INTERNATIONAL ORGANIZATIONS

In the area of international standards the two most important organizations for the audio field are the International Electrotechnical Commission (IEC), and the International Organization for Standardization (ISO). The IEC is primarily involved with electrical, electronic and audio standards, while ISO deals with standards for acoustics, noise and vibration, and mechanical matters such as thread dimensions, etc.

Two other international standards organizations, which are less well known in the United States, are The International Radio Consultative Committee (CCIR), formerly known as CCIF, and the International Telegraph and Telephone Consultative Committee (CCITT), both of which operate under the auspices of the International Telecommunication Union (ITU). CCIR and CCIF standards deal with the topics of broadcasting, sound recording, and various related measurements (for example, the CCIR Recommendation 468 noise-weighting curve, and the CCIF difference-frequency distortion measurement method). The CCITT, which deals with telecommunications, will become more familiar to the audio community with the advance of digital technology and digital signal transmission. Voluntary standards activity in the U.S. rarely involves these two organizations since representation in them is through the federal government.

4 NATIONAL STANDARDS ORGANIZATIONS

Almost every developed nation in the world has a national standards organization. The United States is somewhat unusual in that its national standards organization, the American National Standards Institute (ANSI), is neither a branch of, nor supported by the federal government, as is the case in many other countries. The primary function of ANSI is to coordinate the development of voluntary national standards and to approve standards as American National Standards when ANSI has verified evidence that the development of the standards meets due-process and consensus requirements. One method for developing the evidence of consensus, which is required for approval of American National Standards, is the American National Standards Committee (ANSC) method. Under this method, ANSI delegates the responsibility for the administration of a given American National Standards Committee to an appropriate secretariat. ANSI also audits the activities of the committee to certify that it is following the procedures provided by ANSI for developing standards which reflect a true consensus. ANSI does not operate or sponsor these committees. American National Standards are not developed by ANSI, but rather are approved by ANSI.

Another function of ANSI is to represent the interests of the U.S. standards community in the activities of the IEC and ISO. ANSI is the U.S. member of ISO. An integrated part of ANSI, the United States National Committee (USNC) of the IEC, is the U.S. member of the IEC. Technical input for this activity is provided by U.S. Technical Advisory Groups (TAGs) each comprising a Technical Advisor (TA) and several technical experts.

Another national standards organization familiar to the audio profession is "DIN," the German Institute for Standardization. This organization's work is more prominent in Europe than in the United States.

5 ASSOCIATION STANDARDS ACTIVITY

Association standards are the level below international and national standards. As mentioned earlier, there are two groups involved: industry associations and pro-

fessional societies. Industry associations include the Electronic Industries Association (EIA)—which includes the former Institute of High Fidelity (IHF), the International Tape Association (ITA), the National Association of Broadcasters (NAB), and the Record Industry Association of America (RIAA). These are the primary industry organizations in the audio field in the U.S. They are organizations of manufacturers (or, of broadcasters, as in the case of the NAB) with commercial interests.

Professional societies include organizations such as the Audio Engineering Society (AES), the Acoustical Society of America (ASA), the Institute of Electrical and Electronics Engineers (IEEE), and the Society of Motion Picture and Television Engineers (SMPTE).

Association standards are basically "in-house" standards. In other words, the AES or the SMPTE, for example, may produce a "standard" under its own banner for its membership or any others who may wish to use it. However, if the AES produces a standard on a specific topic, the EIA has one on the same topic, and the SMPTE, for example, has still another, the result is three (most likely different) standards on the same topic, or, by definition, *no standard at all.* This illustrates, and introduces us to one of the main objectives of the American National Standards Committee S4 on Audio Engineering: to bring groups together in related areas and with overlapping interests to work on topics of mutual interest, hopefully avoiding a number of people pulling in different directions, wasting energy and, quite possibly, producing conflicting documents.

6 THE S4 COMMITTEE AND SUBCOMMITTEE S4-1

The S4 committee operates under the primary supervision of the Acoustical Standards Management Board (ASMB) of ANSI, and under the secondary supervision of the Electrical and Electronics Standards Management Board (EESMB). It is sponsored by the AES, which is also administrative secretariat of the committee, with the EIA as co-secretariat. S4-1, Sound Recording, is a standing subcommittee of S4. Its scope is that of the original S4—Sound Recording Committee, and its administrative secretariat and sponsor is the EIA.

The membership of S4 (as with all ANS committees) is composed of organizations, both industry and professional. In addition, government agencies, consumer organizations and a few individuals of significant professional standing are members of the committee. A most important segment of the membership consists of liaison members, representing the interests of other ANSI, IEC and ISO committees with similar or overlapping areas of activity. As a subcommittee, S4-1 may be composed of individuals rather than being restricted to organizations as is S4. In either case, a reasonable balance must be maintained within each membership, ensuring fair representation of all interests: producer, consumer (domestic and industrial), general interest and government.

The structure, titles and scope of S4 and S4-1 were intentionally configured to be parallel to two vitally important IEC committees: SC-29B, the subcommittee on Audio Engineering of Technical Committee TC-29, Electroacoustics; and SC-60A, the subcommittee on Sound Recording of Technical Committee TC-60, Recording. One purpose behind establishing this parallelism was to produce a structure for an interface between national and organizational activities in these areas and those activities on the international level. In addition, the membership of S4 and S4-1 will, in the near future, overlap as much as possible with the U.S. Technical Advisory Group (TAG) membership for SC-29B and SC-60A, respectively. This will further enhance the coordination between national and international standards efforts of the United States.

Through the diverse membership of S4, the AES hopes that industry-organization, professional-society, and national and international standards committees will coordinate their standards writing efforts to avoid production of duplicate and conflicting documents.

It is the author's opinion that, even though various organizations and interests may have somewhat different requirements for details (such as reference levels) in a standard on a given generic topic, they can very often be combined in a single document which recognizes the different applications and requirements of those organizations. To some extent, this has already been accomplished in ANSI S1.4-1971 (R 1976) and IEC 179, which recognize three levels or types of sound-level meter accuracy for different applications. This has the significant advantage that all variations are contained in a single document or group of closely related documents, and that everyone is therefore aware of all the permutations on the topic. Different requirements or slightly different test methods do not necessarily require completely different standards.

If the various organizations involved with audio and audio-related standards work in the United States will make use of S4 as a forum and vehicle for intercommunication and cooperation, a more cohesive and functional group of documents can be produced. This will result in a collection of American National Standards which can serve as a complete United States standards resource and which will be in concert with relevant IEC and ISO documents wherever possible. Further, U.S. input to IEC and ISO working groups can be more cohesive and more effective, hopefully further narrowing the gap between national and international standards. Toward that end, the following basic procedure is suggested for organizations that want to assist S4 in achieving its goals.

1) Notify S4 of formation of a working/writing group on a specific topic. Include scope and purpose of group and of proposed documents, and person(s) to contact for further information. (S4 will circulate this information to its member organizations so that they may participate if they so wish.)

2) Incorporate scope, purpose and relevant standards information in draft and final versions of documents. Also include list of working/writing group members

and their affiliation.

3) Check for all existing international, national and association standards which are relevant. (S4 will assist with this.)

4) Try to adopt relevant IEC and ISO standards as completely as possible. When deviation is necessary, it should be so noted and explained.

5) Submit final draft to S4 for approval/comment before publishing. (This enables the organization standard and American National Standard, when approved by ANSI, to read *exactly* the same.)

6) The document can then be published as a *single document* serving both as an organizational standard and as an American National Standard.

The ultimate objective of S4 is for the audio engineering community in the United States to have a truly functional, cohesive and timely collection of standards which will aid, rather than confuse the industry.

STATUS OF CURRENT STANDARDS IN AUDIO AND ACOUSTICS

Daniel Queen
Daniel Queen Associates, Chicago, IL

Existing standards in the audio field fall into several categories. The most commonly recognized category is the configuration standard which provides dimensional and operating limits for a device or a process. Such standards have provided us with interchangeable analog tape recordings, for example. Another category is the "method for measurement" which is sometimes combined with a configuration standard and provides repeatable and reproduceable tests for a device or a process. Other categories include standard definitions, procedures, and performance levels. Such standards usually arise out of a need in the industry and are put into writing by several organizations not always in concert with one another.

0 INTRODUCTION

There are hundreds of published standards on audio and acoustics now available from dozens of sources. The majority in the United States are published by various industry associations. Fewer are available as American National Standards and still fewer as international standards. Besides American National Standards, standards are also available in English from other national standards committees, including those of Canada, Australia, and Britain. Standards are sometimes available, in English, from Japan, Germany, the Netherlands, the Soviet Union, Italy, and other industrialized countries. Many of these standards are briefly described in the Appendix. These standards fall into several principal categories: Performance Limits, Configuration Standards, Methods for Measurement, Procedures, and Definitions.

1 INTERNATIONAL STANDARDS

In the audio field, most international standards are issued under the coordination of the International Electro-Technical Commission, a not-for-profit, nongovernmental body based in Geneva and associated with the International Standards Organization. During the past decade this organization has tried to bring the more important audio standards together in single multivolume sets. Thus, sound system measurement standards have been grouped in Publication 268, which includes volumes on amplifiers, microphones, loudspeakers, automatic gain controls, connectors, etc. While mainly covering measurements, the set includes some configuration standardization. Audio performance standards have been grouped in Publication 581, which is now in the process of issue. Definitions are in Publication 50 which includes all electrotechnical definitions. Volume 50(8) covers electroacoustics and 50(806) covers recording and reproduction.

Magnetic recording standardization is treated both in the form of methods for measurement and configuration in IEC Publication 94. Disk recording is covered in Publication 98. IEC 574 contains additional standards on audio-visual equipment.

2 NATIONAL STANDARDS

National Standards organizations exist in most nations represented in the AES membership. For illustration, the U.S. activity will be examined. Similar problems exist in other nations, although standards activity support from both public and private sources is somewhat lower in the United States than in other countries.

In the United States, standards makers have only recently acknowledged the presence of the international activity. As a result, a large number of existing American standards do not correspond to their international counterparts and are less organized and accessible. American National Standards on audio have been written by several organizations, notably, the Electronic Industries Association, the Institute for Electrical and Electronics Engineers and the Acoustical Society of America. In some cases, all of these organizations have issued their own standards covering the same subject, each covering it differently. Which of the standards has become an American National Standard has been as much a question of jurisdictional maneuvering as of technical relevance. For example, all three organizations have had methods available for measurement of loudspeakers. Draft methods of measurement have been written by working groups in the Acoustical Society of America. Included are measurements of frequency response, directivity and distortion. However, none has ever been accepted as an American National Standard, possibly because of jurisdictional conflicts. They were to replace the IEEE Measurement Standard written in 1961 and withdrawn in 1978.

The Electronic Industries Association document was written in 1949. It provides similar measurements, but in addition, provides standard methods for reporting loudspeaker characteristics. The most commonly used characteristic based on this standard, is the "EIA sensitivity" which provides a measurement of the pressure

produced axially by a loudspeaker with the given input. In the 1970s, with the greater recognition of the need to coordinate American standards with international standards, the IEEE rewrote its old loudspeaker standard, basing itself on the International Electrotechnical Commission document 268-5. The Standard is largely a paraphrase of the IEC document with the addition of some methods drawn from IEC 268-4 on microphones and from the Australian Loudspeaker Standard which was being drafted at the same time.

The only American National Standards for microphones are for precision laboratory microphones—configuration standards—and a short document on phasing. There is an EIA standard written in 1949 which does cover microphones. It provides measurements of axial pressure, frequency response, and directivity.

Amplifiers are covered by various older standards, most of them drafted on the basis of power matching—so concepts of insertion gain, and power gain, are important to them. This is in contrast to the IEC 268-3 Standard which does provide measurements more in keeping with current practice.

There are several standards for headphones, most of which involve those used for audiometric purposes. One standard deals with headphones used for audio-visual applications. However, no American National Standard or IEC publication exists for measurement of high-fidelity headphones.

In the recording field, a substantial number of standards were developed by the former S4 committee which is now the S4-1 subcommittee. Some of the more fundamental standards were developed by the IEEE and adopted as S4 American National Standards. Others were developed by the Electronic Industries Association and cover, mainly, components used in recording, as well as configuration standards for disks and tape. The EIA has also contributed several American National Standards in the electrical group (C83). These include standards for loudspeaker driver configurations, standard magnets, methods for measuring flux, and for measuring characteristics of driver components. Other American National Standards developed by the EIA cover connectors, many of which are used in audio. Unfortunately, the most common audio connectors are not clearly defined in American National Standards. This omission is partially due to the controversy which has existed on the usage of some of the more common connectors. Another body of standards generated by the EIA provides configuration and measurement methods for amplifier components. Some are American National Standards. These include standards for capacitors, resistors, transformers, and active devices, among others. In the professional recording field, no American National Standards are in existence. The standards generally used have been generated by the National Association of Broadcasters.

3 THE S4 COMMITTEE

An examination of the list of standards shown in the Appendix suggests that one task of the newly formed S4 committee will be to draw from this existing literature to fill the gaps that exist in the American National Standards catalog—that is, to subject existing industry standards to the consensus process to see if they can be accepted by the representatives of producers, consumers, and general interest groups who must vote on American National Standards. In addition, some existing American National Standards, as they come up for review, will be reviewed in the light of current International Standards.

The functioning of the Audio Engineering Society in the standardization process is not a rubber stamp process. There are many areas not yet having standards, some due to new technology, some due to refined methods of measurement. Thus, for example, there is a working group on measurement of absolute polarity now functioning in the Audio Engineering Society. Our technical committee on digital recording is well known. Our technical committee on sound-reinforcement system component specification standards has documents ready for public review. Such groups have the task of gathering together standard methods, codifying industry practice and utilizing the scientific literature to produce the type of standard useful to the particular needs of the professional audio community.

4 NATIONAL/INTERNATIONAL INTERACTION

When no similar international work exists, such a working group examines the work of national committees in other nations. By this process, a standard developed nationally can be brought before the international organizations and adopted internationally. In many cases, such a process results in an international standard which differs in some way from the national standard. During the five-year review, such differences are taken into account and revisions made if acceptable to the national consensus. An example occurred in the related field of audio-visual equipment. When Philips developed its original industry standard for the "compact cassette," it included a provision for synchronization of visual material for educational audio-visual purposes. Because of the great interest in education spawned by the various federal education acts of the late 1960s in the United States, this application of the cassette was strongly developed here. A standard was adopted in 1974 for the use of the cassette in the synchronized mode. The standard was brought before the IEC, which shortly afterward adopted it with modifications to suit practice as it had been developing internationally. The differences between the standards were resolved at the time of the five-year review of the American National Standard. Thus, the conflict with the International standard existed for only two years, a relatively short time in the standardization process.

5 THE NEED FOR STANDARDS

Of all the possible areas of standardization activity of interest to the Audio Engineering Society, the one

that perhaps has created the most discussion and controversy has been the usage of audio connectors. In the late 1940s, the generally accepted microphone connector both nationally and internationally, was the so-called "UA" connector. However, it was not long before the "XL" type connector came on the scene, quickly replacing the "UA" connector. Unfortunately, no effort was made at that time to standardize the usage of the "XL" connector, with the exception that, because of its mechanical configuration, the number one pin was always used as the shield connection. However, the absolute polarity of the number 2 and 3 pins became a matter left to industry practice. The problem resulted because each major company in the audio industry at the time had its own approach. Thus today most, but not all, users of "XL" connectors for microphones use number 2 as the high terminal and number 3 as the low terminal. On the other hand, many users of "XL" connectors for line level use the opposite polarity. In an effort to resolve this problem, the International Electrotechnical Commission was able to achieve a compromise in which the number 2 connection is suggested to be used as the high terminal. Many other connectors are vying for use in professional audio applications. Hopefully, an Audio Engineering Society Technical Committee will be able to continually review this usage, providing recommendations to be used by manufacturers to maintain consistency in the phasing and polarity for interchange of equipment.

The need for such vigilance is borne out by the fact that industry practice does not always produce a standard approach. Besides the problems that developed with the "XL" connector, one of the strangest confusions of usage occurred with what we once called the GR plug and what is now more generally referred to as the "double banana-plug," used in setting up test equipment, etc. General Radio originally developed the plug, generously providing it with a rib on one side to indicate the high terminal. General Radio also provided cable assemblies with the rib so connected. For some reason, as competition with General Radio developed for this plug, the competition designated the rib as the low or "ground" terminal. How many hours of data have you thrown away due to a misconnected GR plug?

6 STANDARDS IN RELATION TO NEW TECHNOLOGY

This is not to say that a standards committee must immediately develop configurations standards for every new development. A careful balance must be maintained so that the development of configuration, methods of test, or performance standards do not result in the stifling of creative development. As new technology comes into existence (for example, digital recording) many valid configurations and methods will be suggested. It will take a period of test and experience to determine which of these is widely accepted. In the past, such a process generally proceeded in an orderly manner; thus the evolution of the long-playing record was able to accommodate a slight variation on its configuration—the 45 r/min 7-inch disk. The economic consequences to both producer and consumer, in this case, were minimal. Compatible hardware was quickly and inexpensively developed.

Similarly, when the stereo record came about, the process proceeded fairly painlessly, although in this case, the time span between the initial development and the final configuration was longer. In the course of it many recordings were made and issued, which, while playable, suffered seriously in quality when used on noncompatible equipment.

The next 10 years saw a substantial diversity of technological development and an expansion of development in our field around the world. So with the coming of the quadraphonic record, systems came into the market having no compatibility and requiring expensive playback equipment which could not easily be adapted from one format to the other. The standardization process did not work well in this case, perhaps contributing to the demise of the development.

7 CONCLUSION

Today, we face critical choices in the development of digital recording. We can look at the history during the past decade of video recording and see an almost biennial introduction of new formats causing formats recently introduced to be obsolete. Even the Beta and VHS formats, which are noncompatible but widely proliferated in the American market, are being challenged today.

It can be argued that in the face of very rapidly developing technology, standardization cannot take place without stifling development. However, development may also be crippled economically if users find it impossible to accommodate a multiplicity of nonstandard formats and simply reject all formats as they did with quadraphonic records. The problem is international in nature, which places the Audio Engineering Society technical committees and writing groups in a particularly critical position, since they too are international in scope and membership.

We are now dealing with standardization activity which can no longer be considered only convenience but rather the necessary technical design of a system of communication among the various engineering institutions throughout the world. The success of such activity has always depended on the commitment of voluntary standards writers, and most critically, on the support of manufacturers and institutions in the field.

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[10] Annual IEEE Index of Publications, New York, NY (issued annually).

APPENDIX

Configuration Standards

The following list of standards has been compiled and arranged by category. A brief description is included, where necessary, after the title.

ANSI PH7.4-1975—Issued, Abbrev. Title: "Audio-Visual and Educational Use of Coplanar Magnetic Cartridge Type CP II (Compact Cassette)." Coding for synchronization of single frame visual material.

ANSI C18.1-1979—Issued, Abbrev. Title: "Specifications for Dry Cells and Batteries." Sizes, voltages, and electrolyte types.

ANSI C83.12 EIA RS-297B-1956—Issued, Abbrev. Title: "Cable Connectors for Audio Facilities for Radio Broadcasting." Sizes and performance minimums.

ANSI C83.51 EIA RS-299-A-1968—Issued, Abbrev. Title: "Loudspeakers, Dynamic, Magnetic Structures and Impedance." Preferred dimensions and impedances.

ANSI C83.45 EIA RS-355-1968—Issued, Abbrev. Title: "Dimensions for Unrecorded Magnetic Sound Recording Tape."

ANSI S4.8 EIA RS-399A-1975—Issued, Abbrev. Title: "Dimensional Standard Coplanar Magnetic Tape Cartridge Type CP II (Compact Cassette)."

ANSI S4.16 EIA RS-332A-1967—Issued, Abbrev. Title: "Dimensional Standards—Endless Loop Magnetic Tape Cartridges, Types I, II, III."

ANSI S4.15 EIA RS-433-1976—Issued, Abbrev. Title: "Magnetic Tape Records: Compact Cassette with Four Track Mono-Stereo Compatible Records." Dimensions and tracks.

ANSI S4.13 EIA RS-432-1976—Issued, Abbrev. Title: "Magnetic Tape Records: Endless Loop Cartridges for 8-Track Stereophonic Records at 3.75 in/s (9.53 cm/s)." Dimensions and tracks.

ANSI C83.65 EIA RS-387-1971—Issued, Abbrev. Title: "Magnetic Tape Records. Four Channel Sound."

ANSI S4.14 EIA RS-434-1976—Issued, Abbrev. Title: "Magnetic Tape Records: 4-Track Open Reel Stereophonic Records at 3.75 and 7.5 in/s (9.5 and 19 cm/s)."

ANSI PH22.112-1977—Issued, Abbrev. Title: "Position, Dimensions, and Reproducing Speed of 100-mil Magnetic Sound Record on 16 mm Film."

ANSI PH22.87-1966(R1971)—Issued, Abbrev. Title: "100-mil Magnetic Striping on 16mm Motion-Picture Film, Perforated One Edge." Dimensions.

ANSI S4.2 EIA RS-243-1961—Issued, Abbrev. Title: "Color-Coding of Stereo Pickup Leads."

IEC 94 (1968)—Issued, Abbrev. Title: "Magnetic Tape Recording and Reproducing Systems: Dimensions and Characteristics (Plus Four Amendments through 1978)." Open reel configurations.

IEC 94A(1972)—Issued, Abbrev. Title: "Cassette for Commercial Tape Records and Domestic Use: Dimensions and Characteristics (Plus Two Amendments)." Compact cassette dimensions and recording characteristics.

IEC 94B(1974)—Issued, Abbrev. Title: "8-Track Endless Loop Magnetic Tape Cartridge: Dimensions and Characteristics."

IEC 98(1964)—Issued, Abbrev. Title: "Processed Disk Records and Reproducing Equipment (Plus Four Amendments)." Dimensions and recording characteristics.

IEC 574-10(1977)—Issued, Abbrev. Title: "A-V, Video and Television Equipment and Systems: Audio Cassette Systems." Equivalent to ANSI PH7.4-1975.

ANSI C83.117 EIA RS-278-B (1976)—Issued, Abbrev. Title: "Mounting Dimensions for Loudspeakers." Preferred mounting holes and basket rim dimensions with designations.

NAB (1965)—Issued, Abbrev. Title: "Magnetic Tape Recording and Reproducing (Reel-to-Reel)." Open reel configuration and performance.

NAB (1964)—Issued, Abbrev. Title: "Cartridge Tape Recording and Reproducing." Configuration and performance of endless loop cartridge with cue track.

NAB (1964)—Issued, Abbrev. Title: "Disk Recording and Reproduction." Configuration of disks for broadcast.

ANSI C16.5 IEEE 152-1953—Issued, Abbrev. Title: "Volume Measurements of Electrical Speech and Program Waves." Standard vu meter.

ISO 2969-1977—Issued, Abbrev. Title: "Electro-Acoustic Response of Motion-Picture Control Rooms and Indoor Theatres." Minimum performance and measurement techniques for listening rooms.

EIA RS-215(1958)—Issued, Abbrev. Title: "Broadcast Microphone Cables."

ANSI/EIA RS-221A(1979)—Issued, Abbrev. Title: "Polarity of Broadcast Microphones." Marking and testing of microphone phase.

EIA RS-224(1959)—Issued, Abbrev. Title: "Magnetic Recording Tapes." Track locations and playback characteristics

for 6.35 mm tape.

EIA RS-233A(1965)—Issued, Abbrev. Title: "Phasing of Loudspeakers." Loudspeaker polarity and marking.

ANSI S3.17-1975, ASA 4-1975—Issued, Abbrev. Title: "Rating the Sound Power Spectra of Small Stationary Sound Sources." Single number rating for noise emitted by small machines and appliances.

ANSI S1.23-1976, ASA 5-1976—Issued, Abbrev. Title: "Designation of Sound Power Emitted by Machinery and Equipment." Descriptor in bels for sound power emission.

ANSI S2.9-1976, ASA 6-1976—Issued, Abbrev. Title: "Specifying Damping Properties of Materials." Preferred nomenclature (parameters, symbols, definitions).

ANSI S3.14-1977, ASA 21-1977—Issued, Abbrev. Title: "Rating Noise with Respect to Speech Interference." Calculation of single valued index called speech interference level.

ANSI S1.1-1960(R1976)—Issued, Abbrev. Title: "Acoustical Terminology." Dictionary of acoustical terms.

ANSI S1.6-1967(1976)—Issued, Abbrev. Title: "Preferred Frequencies and Band Numbers for Acoustical Measurements." The cyclical series of numbers to use as test frequencies and band centers.

ANSI S1.8-1969(R1974)—Issued, Abbrev. Title: "Preferred Reference Quantities for Acoustical Levels." Quantities to which levels such as sound pressure level and sound power level are referred.

ANSI S3.20-1973(R1978)—Issued, Abbrev. Title: "Psychoacoustical Terminology." Definitions of terms.

ANSI Y10.11-1953(R1959)—Issued, Abbrev. Title: "Letter Symbols for Acoustics." Preferred symbols for equations.

ANSI C86.46 EIA RS-356-1968—Issued, Abbrev. Title: "Record Changers and Manual Phonographs, Definitions and Terminology."

IEC 574-1(1977)—Issued, Abbrev. Title: "Audio-Visual, Video and Television Equipment and Systems. Part 1—General. Part 2—Explanation of General Terms. Part 3—Tape/Visual Sync. Part 8—Symbols and ID." List of Parts of 574 as planned: general conditions: terms.

ASTM C634—Issued, Abbrev. Title: "Definition of Terms Relating to Environmental Acoustics." Terms used in noise control, etc. applicable to appliance noise.

ISO 16-1975—Issued, Abbrev. Title: "Standard Tuning Frequency." Set musical "A" to 440 Hz.

IEEE STD-151—Issued, Abbrev. Title: "Standard Definitions for Terms for Audio and Electroacoustics (1965)." Terms used in audio.

IEC PUBL 50—Issued and Draft, Abbrev. Title: "International Electrotechnical Vocabulary." Chapters for each field.

ANSI S1.27, ASA 26—Issued as draft, Abbrev. Title: "E-Weighting Network for Noise Measurement." Sound level meter weighting network corresponding more closely to perceived loudness than does A-weighting.

ANSI S1.4-1971(R1976)—Issued, Abbrev. Title: "Specification for Sound Level Meters." Requirements, types, grades, features of SLM's including weighting networks.

ANSI S1.11-1966(R1976)—Issued, Abbrev. Title: "Octave, Half Octave, and Third-Octave Filter Sets." Filter shapes—width, skirts, etc.—for three classes of filters.

ANSI S1.12-1967(R1977)—Issued, Abbrev. Title: "Laboratory Standard Microphones." Acoustical measurement microphones for free-field, pressure, and random incidence.

ANSI S3.6-1969(R1973)—Issued, Abbrev. Title: "Specifications for Audiometers." Requirements for audiometric instrumentation, including earphones.

ANSI PH22.61-1969—Withdrawn, Abbrev. Title: "9-kHz Sound Focusing Test Film for 35mm Motion Picture Sound Reproducers." Replaced by SMPTE RP 64-1976.

ANSI PH22.113-1966(R1971)—Withdrawn, Abbrev. Title: "16mm 3 kHz Flutter Test Film, Magnetic Type." Replaced by SMPTE RP.

ANSI PH22.43-1970—Withdrawn, Abbrev. Title: "16mm 3 kHz Flutter Test Film, Photographic Type." Replaced by SMPTE RP 70-1977.

IEC 94-2(1975)—Issued, Abbrev. Title: "Part 2. Calibration Tapes."

ANSI S3.29-1979—Issued, Abbrev. Title: "Occluded Ear Simulator." Describes dimensions and characteristics of Zwislocki type coupler.

Standard Methods for Measurement

ANSI S3.19-1974, ASA 1-1975—Issued, "Measurement of Real Ear Protection of Hearing Protectors and Physical Attenuation of Earmuffs." Psychophysical procedures and physical requirements for determining effectiveness of hearing protector.

ASA STD-3-1975—Issued, "Test-Site Measurement of Maximum Noise Emitted by Engine Powered Equipment." Measurement of vehicle noise.

ANSI 3.1-1977, ASA 9-1977—Issued, "Permissible Ambient Noise During Audiometric Testing." Maximum noise in room during hearing tests.

ANSI S1.2-1962(R1976)—Issued, Abbrev. Title: "Physical Measurement of Sound." Largely superseded by S1.13 and S1.21.

ANSI S1.10-1966(R1976)—Issued, Abbrev. Title: "Calibration of Microphones." Procedures for calibration of laboratory precision microphones meeting the requirements of S1.12.

ANSI S1.13-1971(R1976)—Issued, Abbrev. Title: "Measurement of Sound Pressure Levels." Guide to use of precision microphones and SLM's for measuring sound pressure both in laboratory and field.

ANSI S1.21-1972—Withdrawn, Abbrev. Title: "Determination of the Sound Power Levels of Small Sources in Reverberation Rooms." Procedures for measurement and for qualification or instruments and measuring rooms. Replaced by S1.30 Series.

ANSI S3.2(R1976)—Issued, Abbrev. Title: "Measurement of Monosyllabic Word Intelligibility." Procedures and lists of words for testing intelligibility using human subjects.

ANSI S3.4-1980—Issued, Abbrev. Title: "Computation of Loudness of Noise." Procedures for computing perceived loudness of noise from multiple frequency measurements (expressed in sones or phons).

ANSI S3.5-1969(R1978)—Issued, Abbrev. Title: "Calculation of the Articulation Index." Procedures for computing articulation index, a measure of intelligibility, from multiple band measurements of signal and noise.

ANSI S3.7-1973—Issued, Abbrev. Title: "Coupler Calibration of Earphones." A compilation of various methods and couplers for earphones. No one method is favored.

ANSI PH7.2-1974(R1981)—Issued, Abbrev. Title: "Audio Amplifier Single Frequency Output for Institutional Audio-Visual Equipment Used Primarily for Speech." Method for measuring output power including provision for dynamic headroom.

ANSI S1.5-1961, IEEE 219-1961—Withdrawn, Abbrev. Title: "Loudspeaker Measurements." Largely obsolete standard, but contains valuable tutorial material. IEEE has issued revision based on IEC 268.

ANSI C16.29, IEEE STD 150-1956—Withdrawn, Abbrev. Title: "Gain Amplification Loss Attenuation and Amplitude-Frequency Response." Largely superseded by IEC 268-3.

ANSI/ASTM C423-77—Issued, Abbrev. Title: "Sound Absorption of Acoustical Materials in Reverberation Rooms." Test of materials in which sample covers partial surface of reverberation room.

ANSI S6.3-1973, SAE RP-J986A-1973—Issued, Abbrev. Title: "Sound Level for Passenger Cars and Light Trucks." Passby noise measured on specially prepared site.

ANSI S4.6, IEEE STD 347-1972—Issued, Abbrev. Title: "Measuring Recorded Flux of Magnetic Sound Records at Medium Wavelengths." Short-circuit flux measurement requires calibrated head.

ANSI S4.1, IEEE STD 192-1958—Issued, Abbrev. Title: "Calibration of Mechanically Recorded Lateral Frequency Records."

ANSI C83.69, EIA RS 386-1971—Issued, Abbrev. Title: "Measurement of Phonograph Rumble."

ANSI S4.12, EIA RS-238B-1975—Issued, Abbrev. Title: "Stylus Tips Used for Disk Phonograph Reproducing."

ANSI S4.3, IEEE STD 193-1971—Issued, Abbrev. Title: "Weighted Peak Flutter of Sound Recording and Reproducing Equipment." Compatible with IEC.

IEC 268—Issued, Abbrev. Title: "Sound System Equipment Pts 1-14: General, Amplifiers, Mics, Speakers, Passive Elements, AEC, Reverb-Delay, etc." Encyclopedia of test methods and configurations.

IEC 98A(1972)—Issued, Abbrev. Title: "Measuring the characteristics of disk record playing units."

IEC 386(1972)—Issued, Abbrev. Title: "Measurement of Speed Fluctuations in Sound Recording and Reproducing Equipment." Equivalent to ANSI S4.3.

ASTM C384-77—Issued, Abbrev. Title: "Impedance and Absorption of Acoustical Materials by The Impedance Tube Method." Method usable in incoming quality control for measuring materials, e.g., fiberglass.

ANSI/ASTM E596-78—Issued, Abbrev. Title: "Noise Reduction of Sound Isolating Enclosures." Precision method for measuring small enclosures used for acoustical testing.

ANSI/ASTM C423-81—Issued, Abbrev. Title: "Sound Absorption and Sound Absorptions Coefficients by the Reverberation Room Method." Primary method for rating acoustical absorption materials—contains method for measuring reverberation time.

ISO 3382-1975—Issued, Abbrev. Title: "Measurement of Reverberation Time in Auditoria."

ANSI S1.30-1979, ASA-10—Issued, Abbrev. Title: "Guidelines for Use of Sound Power Standards to Prepare Test Codes." Introduction to Series.

ISO 3741-1975—Issued (ANSI S1.31-1980), Abbrev. Title: "Determination Sound Power of Noise Sources—Precision Methods for Broad-Band Sources in Reverberation Rooms." Use of reverberation rooms for measuring sources having no discrete tones—useful for noise measurement of speaker response.

ISO 3742-1975—Issued (ANSI S1.32-1980), Abbrev. Title: "Determination Sound Power of Noise Sources—Precision Methods for Discrete Frequency and Narrow Band Sources in Reverberation Rooms." Requires costly equipment and measuring room.

ISO 3743-1976—Issued (ANSI S1.33-) Abbrev. Title: "Determination Sound Power Levels of Noise Sources—Engineering Methods for Special Reverberation Test Rooms." Simplified methods requiring fewer measurements than precision methods.

ISO 3744-1981—Issued (ANSI S1.34-1980), Abbrev. Title: "Determination Sound Power Levels of Noise Sources—Engr. Methods for Free-Field Over a Reflecting Plane." Pressure measurements in large room or outdoors.

ISO 3745-1977—Issued (ANSI S1.35-1979) Abbrev. Title: "Determination Sound Power Levels of Noise Sources—Precision Methods for Anechoic and Semi-Anechoic Rooms." Uses multiple pressure measurements in laboratory free-field to integrate to power levels.

ISO 3746-1978—Issued (ANSI S1.36-1979), Abbrev. Title: "Determination Sound Power Levels of Noise Sources—Survey Method." Calculates power from several pressure measurements made near-field in situ.

ANSI S1.39- ASA-12 DRAFT—Abbrev. Title: "Guidelines for Preparation of Procedures for Measurement of Sound Source Emission." Trial use to 31-December-1981.

IEEE SID-258—Issued, Abbrev. Title: "Test Procedure for Close-Talking Pressure Type Microphones (1965)." Measurement of near vs. far field for noise cancellation etc.

ASHRAE 36-72—Issued, Abbrev. Title: "Testing for Sound Rating . . ." Contains useful reverberation room construction data and techniques for power measurement.

EIA SE105 (1949)—Issued, Abbrev. Title: "Microphones for Sound Equipment." Basis for many ratings now in use, but not always directly applicable. Superseded by IEC 268-4.

IEEE STD-219-1975—Issued, Abbrev. Title: "Recommended Practice for Loudspeaker Measurement." Based on IEC 268-5

and 268-4 with enhancements from Australian standards.

EIA RS-157—Review, Abbrev. Title: "Measurement of Loudspeaker Magnetic Air Gap Energy." Search coil flux density method.

ANSI PH7.10—Committee, Abbrev. Title: "Acoustical Output of Audio-Visual Equipment." Sound power levels of loudspeaker output and mechanical noise by simplified testing methods.

ANSI PH7.305-1980—Issued, Abbrev. Title: "Test Method for Headphones for Audio-Visual Equipment Used Primarily for Speech." Sensitivity and impedance.

ANSI PH7.3-1977—Issued, Abbrev. Title: "Measuring Effective Output Power Bandwidth for Institutional Audiovisual Equipment Used Primarily for Speech." Technician methods include headroom test.

ANSI/EIA RS426(1980)—Issued, Abbrev. Title: "Loudspeakers, Power Rating, Full Range." Noise signal for testing damage related power handling of single drivers—differs from IEC and IEEE.

IEC 94-3(1979)—Issued, Abbrev. Title: "Part 3: Methods of Measuring the Characteristics of Recording and Reproducing Equipment for Sound on Magnetic Tape (Plus One Amendment)."

Standard Procedures

ANSI S1.26-1978, ASA 23-1978—Issued, Abbrev. Title: "Calculation of the Absorption of Sound by the Atmosphere." Provides tables and formulae for calculation of propagation absorption which is particularly dependent on temperature and humidity.

ANSI S3.21-1978, ASA 19-1978—Issued, Abbrev. Title: "Manual Pure-Tone Threshold Audiometry." Procedure for measuring hearing using pure tone method with operator-patient interaction.

IEC 543(1976)—Report, Abbrev. Title: "Informative Guide for Subjective Listening Tests." Procedures, conditions, statistical methods, etc. for listening tests on audio equipment.

IEEE STD-297 (1969)—Issued, Abbrev. Title: "Recommended Practice for Speech Quality Measurements." Methods for jury preference testing.

EIA RS-160(1951)—Issued, Abbrev. Title: "Sound Systems." Formulae for electrical calculation for sound systems—acoustical calculations largely obsolete.

Standards for Quality Level Requirements or Recommendations

ANSI S2.19-1975, ASA 2-1975—Issued, "Balance Quality of Rotating Rigid Bodies." Permissible Unbalances re: speed, balance quality grades.

ANSI C33.43, UL 464-1976—Issued, Abbrev. Title: "Safety Standard for Audible Signaling Devices." Includes free-field method for evaluating output: diffuse field method under consideration.

IEC 581—Issued, Abbrev. Title: "High Fidelity Audio Equipment and Systems: Minimum Performance Requirements." Part 1: General; Part 3: Record Players; Part 4: Tape Recorders; Part 6: Amplifiers.

ITA ATA-A-101—Issued, Abbrev. Title: "Audio Cassette Specifications—Up to 90 Minutes Total Playing Time." 1978. Minimum quality requirements. Based on IEC, ANSI, and EIA—but check compatibility: commercial test materials required.

ITA-A-102 ITA-A-102—Issued, Abbrev. Title: "Audio Cassette and Associated Hardware." 1978 Cassette-Player "Interface" Minimum Quality Requirements. Based on IEC but check compatibility and errors.

ITA ATA-A-103—Issued, Abbrev. Title: "Audio-Eight Track Cartridge." 1978 min. mechanical and rec/repro quality requirement.

ITA ATA-A-104—Issued, Abbrev. Title: "Duplication Guidelines for 8-Track Cartridges and 4-Track Cartridges." Minimum quality requirements for pancake duplication of commercial tape records for CPII cassette and 8-T cartridge.

Standards for Writing Specifications

ANSI S3.22-1976, ASA 7-1976—Issued, Abbrev. Title: "Specification of Hearing Aid Characteristics." Electroacoustical characteristics and tolerances useful for specifying selecting fitting hearing aids.

ANSI S2.4-1976, ASA 8-1976—Issued, Abbrev. Title: "Specifying the Characteristics of Auxiliary Analog Equipment for Shock and Vibration Measurements." Uniform terminology and format for specification.

AES (1981)—Draft, Abbrev. Title: "Recommended Practice for Acoustical Component Specification Used in Sound Reinforcement." Describes units and characteristics of speakers and horn drivers.

EIA RS-174 (1956,R1975)—Issued, Abbrev. Title: "Audio Transformers for Electronic Equipment." General guide to transformer specification.

EIA RS183(1957;R1975)—Issued, Abbrev. Title: "Output Transformers for Radio Receivers."

A HISTORY OF AUDIO STANDARDS WRITING IN THE USA

John G. McKnight
Magnetic Reference Laboratory, Mountain View, CA

1 SCOPE OF THIS HISTORY

Audio engineering standards have been developed in many countries—the USA, Germany, England, France, and Japan first come to mind. Several international standards-writing groups also come to mind: ISO, IEC, and CCIR. In this report, however, I will only attempt to cover work done in the USA.

The term "audio standards" includes a large number of generally-accepted practices which are not formally documented, and a much smaller number of practices which have been formally documented and adopted as standards. This report will discuss only those which have been formally adopted; determining the informally-recognized practices would require much more his-

torical research.

My own work on standards committees began in about 1961, and this report is based on documents in my library that I collected from 1957 to the present. But audio engineering standards writing began in the 1920s, and much of our present practice dates back to standards written in the 1930s and 1940s. The *Journal* would welcome a definitive review of earlier work by any of our readers who have first-hand knowledge of it.

Standards written by the engineering societies (SMPTE, previously SMPE; the IEEE, previously IRE; and the AES) contain the background information necessary to determine the history of the standard—lists of the committee members, background information, literature references, dates of approvals, publications, and revisions, etc. Unfortunately, the standards written by the industry associations (EIA, previously RETMA, previously RMA; NAB, previously NARTB, previously NAB; and RIAA) contain little background information—no list of the writing committees, sometimes no date of approvals, publications, and revisions, etc. Therefore, I have not been able to give much information on the history of these standards. If anyone knows the history, we would welcome a review of these industry-association standards.

This report is *not* a review or listing of currently available audio engineering standards—the emphasis is on historical work. Current catalogs of standards are available from the standardizing organizations [1]; magnetic tape recording standards as of 1970 have been previously summarized [2].

2 STANDARDS APPROVED BEFORE 1935

Audio engineering in the USA has its roots in the telephone, and in systems developed by the Bell Telephone Laboratories and its offspring Electrical Research Products (ERPI). The other early developer of professional audio equipment is the Radio Corporation of America (RCA). These organizations developed many of the basic devices and systems that we know in sound reinforcement and radio broadcasting, and in sound recording and reproduction as used in motion pictures, in broadcasting and in phonograph records. Many of the standards, as well as many of the informally recognized standard practices, arose from the designs embodied in the pioneering products of these early developers and manufacturers of audio systems.

The first audio engineering standards that I have found are those of the Society of Motion Picture Engineers (SMPE). Ms. Peggy Sullivan of the SMPTE engineering department kindly provided me with the following summary of the early SMPE work in audio standards: In 1928 March an SMPE committee started work to standardize the dimensions for film used in the photographic reproduction of sound. Drawings showing practices of the Fox Case Film Corporation, RCA, and Bell Telephone Laboratories were published in the the 1928 September *SMPE Journal* for consideration. The 1929 February *SMPE Journal* reported that the Standards and Nomenclature Committee had appointed a subcommittee on Sound Film Practice with Donald MacKenzie as Chairman, and that this subcommittee had considered proposals for the location and width of the sound track on combined sound and picture positives. By 1929 May specific proposals for trial were made for standards for taking and projection speed for 35-mm sound pictures (24 pictures per second), picture-to-sound distance (14.5 inches), and the location and width of the sound track; and Recommended Practices for leaders and for projector apertures for sound on film. These were approved by the SMPE in 1929 October, published in the 1930 May Journal, and approved by the American Standards Association in 1930 September. The 1933 October SMPE issue carried papers on "National Standardization in America" [3], and "A Historical Summary of Standardization in the Society of Motion Picture Engineers" [4]—a "Historical Summary" 49 years ago.

3 STANDARDS APPROVED BETWEEN 1936 AND 1945

The continuing work in the motion-picture field was carried on by both the SMPE and the Research Council of the Academy of Motion Picture Arts and Sciences. Around 1937 the Research Council published "Working Standards" for the dimensions and locations of optically-recorded tracks on motion-picture film [5]. The Research Council also produced a "Standard Nomenclature for Release Print Sound Tracks" and a "Standard Fader Setting Instruction Leader," both in 1937 [5]. In 1938 October the Research Council published a "Revised Standard Electrical Characteristics for Two-Way Reproducing Systems in Theaters" in their *Technical Bulletin*, which has been summarized elsewhere [6]. Some of these standards were later processed through the SMPE as American Standards. John Hilliard published reports on the work of the various sound standardization committees in the *SMPE Journal* in 1938 [7] and 1939 [8].

The next area of audio engineering standardization was the "standard volume indicator." The work was done by an industry committee (Bell Telephone Laboratories, CBS, and NBC) in 1938. The results of the research, and the specific recommendations for the standard volume indicator were published in the *Proceedings of the IRE* in 1940 [9], and the resulting standard was formalized in 1942 by the American Standards Association (ASA) as C16.5 (later designated 53 IRE 3.S2, and IEEE Std 152). At that time audio standards were handled by the C16 "Radio" committee under the Electrical and Electronics Board of the ASA.

"Electrical transcriptions and recordings for radio broadcasting" (mechanical disk recordings) were standardized by the Recording and Reproducing Committee of the National Association of Broadcasters (NAB) in 1941. The NAB standards were published in the *Proceedings of the IRE* in 1942 [10]; they covered disks with outer diameters of 10, 12, and 16 inches, at speeds of

33⅓ r/min or 78.26 r/min, with a laterally or vertically modulated groove, and a standardized recording frequency characteristic. The NAB Standards were never adopted as USA national standards.

An "American Recommended Practice for Loudspeaker Testing," ASC C16.4 (later designated 42 IRE S6), was adopted in 1942. I have not found further information on this standard.

4 STANDARDS APPROVED BETWEEN 1946 AND 1955

In 1946 the SMPE sponsored, and the ASA approved, standards Z22.51, "Intermodulation Tests on Variable-Density 16-mm Sound Motion Picture Prints," and Z22.52, "Cross-Modulation Tests, 16-mm Variable-Area Photographic Sound." Ironically, the usual harmonic distortion method has never been officially standardized in the USA.

The *SMPE Journal* of 1948 November reports on a meeting of the "American Standards Association Committee for Sound Recording" in 1947. I have not yet found the origin or fate of this committee. E. W. Kellogg of RCA, representing the SMPE, assumed chairmanship of a committee on the measurement of performance characteristics and distortion in sound recording and reproducing systems. Their detailed progress report [11] discusses measurement of flutter, frequency-response characteristic of a system or its elements, frequency characteristic of a record, wave-shape distortion, and noises and signal-to-noise ratio.

Although I cannot find further mention of this committee, an IRE Sound Recording and Reproducing Committee appeared in 1950, with many of the same members, and it appears that the work of writing measurement standards was transferred bodily from ASA to IRE. This committee produced the standards outlined by the ASA/SMPE committee in its 1948 report: flutter, noise, and frequency response. The first of the IRE "Standards on Audio Techniques" was 51 IRE 6. S1 (1951) (later designated IEEE Std 151), "Definitions of Terms"; then followed 53 IRE 19. S1 (1953) (later designated IEEE Std 193, and ANSI Z57.1), "Standards on Sound Recording and Reproducing: Methods of Determining Flutter Content"; and 53 IRE 19. S1 (1953) (later designated as IEEE Std 191) "Methods of Measuring Noise." Then in 1954 54 IRE 3. S1 "Definitions of Terms"; and in 1956 56 IRE 3. S1 (later designated IEEE Std 150, and ANSI C16.29) "Methods of Measurement of Gain, Amplification, Attenuation, Loss, and Amplitude-Frequency Response." This committee worked during the early 1960s to revise "Measurement of Noise," during the late 1960s to revise "Measurement of Gain . . .," and during the 1960s and 1970s to revise the Standard Volume Indicator ("vu meter") standard, but was unable to reach agreement on any of these revisions. Consequently, all of these revisions still need to be completed.

Practices for audio transmission were described in several published papers, and standardized in the Radio, Electronics, and Television Manufacturers' Association (RETMA) Standards TR-105A (1948), "Audio Facilities for Radio Broadcasting," and SE-101A (1949), "Amplifiers for Sound Equipment."

The RETMA adopted a group of audio standards in 1949, on microphones, amplifiers, and loudspeakers for sound equipment. There was also a "Standard Frequency Test Record," REC-128 (1949), and "Phonograph Pickups," REC-125A (1949).

In 1953 the NARTB published the first USA magnetic tape recording standard. However, it was never adopted as a USA national standard.

In 1954 the AES published its only standard to date, TSA-1-1954, "Standard Playback Characteristic for Lateral Disk Recording." The same characteristic was adopted that year by the RIAA as their "Standard Recording and Reproducing Characteristic"; the document carries neither an identifying number nor date, but was later identified as "Bulletin No. E1," with appropriate revision dates. The status of audio engineering standards as of 1956 was published in the *IRE Transactions on Audio* [12]; it lists 32 standards.

5 STANDARDS APPROVED BETWEEN 1956 AND 1965

In 1958 the IRE adopted 58 IRE 19. S1 (later designated IEEE Std 192, and ANSI S4.1-1960), "Methods of Calibration of Mechanically-Recorded Lateral Frequency Records."

In 1964 the NAB revised their "Disk Recording and Reproducing" standard, and in 1965, they revised their magnetic tape recording standards, introducing a standard for tape cartridges for radio broadcasting.

During this period the EIA approved many new audio standards, which can be found in their current standards list. They also revised many of their older audio standards, but it is not possible to trace the history of their development from the standards documents themselves since they contain no background information.

The RIAA issued several disk and tape recording standards, which also contain no background information. Many are even undated and, therefore, difficult to place historically.

6 STANDARDS APPROVED AFTER 1966

Measurement standards include a revision of the flutter measurement standard (IEEE Std 193-1971, also ANSI S4.3-1972), and a Magnetic Tape Flux measurement standard (IEEE Std 347-1972, also ANSI S4.6).

Standards on tape records on 6.3-mm tape on open reels, and on cassette tapes, were adopted by the EIA, and approved by ANSI.

7 WHEN AND WHY ARE STANDARDS WRITTEN?

When a new technology is first introduced, it is often "self-standardizing" because only one manufacturer

makes the product, and that manufacturer must, for commercial necessity, make the parts of the new product "fit together."

If this product remains the sole one in the field, it may set a de facto standard: its use may become so widespread that any other manufacturer who wants to enter the field must make its product interchangeable (which is to say "standard"), or no one will buy it. (One example is the Cannon "XL" audio connector.)

As long as there is only one manufacturer, a formal standard probably won't be written because it is not really needed. In the USA there is also a possible problem of antitrust action because standardizing a one-manufacturer product might be considered anticompetitive. But when others enter the field, a formal standard becomes useful so that there is agreement on the *essential* features required for functional interchangeability.

There are times when a new technology seems to offer a large and profitable market. In this case, it is likely that several companies will have simultaneous research and development projects. The likelihood of their arriving at a "standard" product is very small: what engineer or product manager does not believe that *his* design is the best possible design?

In other countries, several companies may pool their research efforts, in which case a "standard" product may evolve. In the USA, even if companies want to do it, it is not possible because, according to the antitrust law, cooperative research is considered anticompetitive. (Some would argue that, at the present time, this law acts mainly to prevent U.S. manufacturers from competing with manufacturers in other countries, but that is a story for another time.)

For all these reasons, then, it is likely that several noncompatible products will be introduced into the market at about the same time. This happened for instance in the case of tape cartridges for automobile players, where three noncompatible products were introduced at about the same time. In such a case, a standard may be written which covers each of the systems, and it must be left to the market to decide which system is (or systems are) the commercial "winner."

8 WHY DO SOME STANDARDS PROJECTS DIE?

In reviewing the history of audio standards, I find that although many have been written and approved, many more have died aborning. Sometimes the desire and willingness exists to standardize, but the technological basis isn't there to do it. Other situations involve competing factions that just can't get together on one standard, but they are unwilling to establish two or more standards.

In the case of measurement standards, there may be competing philosophies and the committee members are evenly divided. If both sides are adamant in their positions, no standard can be written. Occasionally a committee will simply "bite off more than it can chew," and it runs out of time and ambition before it can complete the project. My experience has been, however, that the communication established in *trying* to write a standard is very useful to the participants in the committee even in those cases when their work does not result in an approved standard.

In reviewing the various standards (those published and those abandoned), I see that some are more polished than others. In my opinion, many of the abandoned drafts would have been better than *no* standard at all. The lesson, I think, is that when a standards committee arrives at a draft which has majority agreement, but some significant disagreement, they should be sure to press for approval under the "trial status" rules. This allows the committee's work to be seen publicly, and reviewed. It should reduce the number of cases "died aborning."

9 SOME CONCLUSIONS

Audio standards have been written since almost the beginning of audio engineering itself—the late 1920s—and many of our present practices are based on these standards.

This preliminary report will give you some feel for the history of audio engineering standards. The *Journal* would be pleased to publish reviews of the writing of audio engineering standards written by participants in that work, and by the various sponsoring organizations we have mentioned.

10 REFERENCES

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[9] H. A. Chinn, D. K. Gannett, and R. M. Morris, "A New Standard Volume Indicator and Reference Level," *Proc. IRE*, vol. 28, pp. 1–17 (1940 Jan.).

[10] L. C. Smeby, "Recording and Reproducing Standards," *Proc. IRE*, vol. 20, pp. 355, 356 (1942 Aug.).

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Measurement of Distortion in Sound Recording," *J. SMPE*, vol. 51, pp. 449–467 (1948 Nov.).

[12] "List of Published Standards that May Be Applied to High Fidelity Equipment," *IRE Trans. Audio*, vol. AU-4, pp. 88, 89 (1956 July–Aug.).

ROLE OF THE AES TECHNICAL COUNCIL IN STANDARDS WRITING

Richard H. Campbell

Bang-Campbell Associates, Woods Hole, MA

The undertaking by the Audio Engineering Society in taking over the S4 committee came partially as the result of the increased activity of its technical committees in standards investigation and writing. The technical committee on sound reinforcement has prepared a Draft Recommended Practice and the technical committee on digital recording has issued several reports on the status of digital recording configurations. Other technical committees have been formed during the past year under the aegis of the Audio Engineering Society Technical Council which has been given the responsibility of setting up working groups to identify the need for and to write Recommended Practices.

1 BACKGROUND

The Technical Council (TCL) of the Audio Engineering Society was convened for the first time 1979 November 2. The council was created after several years of discussion among society members concerning standards. The question frequently heard was, Why doesn't or why can't the AES make an organized contribution to the writing of audio standards? Yes, there was an "AES Standards Committee" operating for more than 10 years prior to the 1979 convention, but it functioned mainly as a reporting agency to the membership via the *Journal*. The readers were kept up to date on the activities of TC 29 of the IEC and of audio-related activities of the ASA, EIA, SMPTE and IEEE. Obviously, many members of the AES contributed significantly to standards writing directly through these channels.

When Rex Isom was chairman of the Standards Committee, he wrote an illuminating paper published in the *Journal* in May 1975. The same year, inspired by need, I wrote a detailed document describing what I thought the AES Standards Committee ought to look like. When I passed it around, there was loud silence. After some inquiry, I realized I had overshot the requirement. I was trying to bypass in one step a wringing-out process that always seems to be necessary to build a stable foundation upon which large, effective committees can stand and operate.

During 1977 the idea of technical committees, which form the Technical Council, took shape—possibly inspired by the Acoustical Society Technical Council structure. In 1978 November the AES Board of Governors approved the formation of a Technical Council and technical committees and at the same time approved a document entitled "AES Policy on Standardization." In the *JAES* at the beginning of 1979 "Legal Guidelines for Technical Committees and Engineering Standardization Activities of the Audio Engineering Society" was published. Meanwhile I had agreed to chair the Technical Council at the invitation of J. McKnight and we got it rolling the following fall in New York.

2 OPERATION

The Technical Council operations are based upon the directives contained in the three documents mentioned above. They form the TCL's terms of reference and in order to carry out the wishes of the Board of Governors, the TCL must stay within the terms of reference and deal effectively with all of the tasks assigned to it. Still in the formative stage, it is slowly taking on a definitive shape. Like most good governing bodies, the Board told us what to do, but not how to do it.

I think it is useful to repeat paragraph 1.2 PURPOSE, extracted from the resolution approved by the Board in 1978:

"The Purpose of the Technical Committees is to develop the AES as the focal point for the various specialized technical areas of audio engineering, and within those areas to promote the main objectives of the AES by means of one or more of the following activities:

1) soliciting and promoting technical papers in cooperation with the *Journal* editor;

2) advising the AES Awards Committee of significant technical contributions of individuals to audio engineering;

3) acting as a reservoir of program committee members and organizers of regular and special sessions (including tutorial sessions) at AES conventions, and of AES technical conferences;

4) organizing informal workshops on current scientific and engineering problems, and on advanced topics, for the benefit of AES members;

5) identifying the need for audio engineering standards, and generating standards drafts and proposals: and

6) establishing technical subgroups where appropriate (technical subgroups are large and voluntary, whereas technical committees are small and appointed).

Although the TCL is presently involved in standards work, it is important to note that standards work is only one of six defined areas of activity. We must eventually encompass all of these areas and in fact we have made some progress in workshop sponsorship. However, this report deals mainly with the activities of the TCL in the area of standards, and subsequent remarks will be confined to this subject.

3 COMPOSITION

The TCL is composed of the TCL chairperson, the chairperson of each Technical Committee (TCM), and

the chairperson of the AES Standards Committee (SC) as voting members, while others are invited in an ex-officio capacity, such as the immediate past president, and president-elect, the president of the society, the editor of the *JAES*, the chairman of the Publications Policy Committee, the executive director, the chairperson of the current meeting and the next two meetings. The ex-officio members contribute needed advice and participate in the downward flow of information after the TCL meeting is over.

Each TCM is composed of Working Groups (WG). Each WG is responsible for performing the task assigned downward through the TCM with the approval of the TCL.

4 RELATION TO STANDARDS

The TCL does not write or approve standards. It has been the consensus for many years that there is a crying need for a standard-like document for use within the AES. We have chosen to call these documents Recommended Practice (RP). Prior to approval of an RP by the TCL, the document is called Draft Recommended Practice (DRP). DRPs and RPs can become national or international standards if the AES Standards Committee, as secretariat of S4, wishes to pick them up and submit them in proper format. That is the business of the Standards Committee—reaching beyond the AES providing liaison and secretariat to, from and within S4. The business of the TCL is to operate within the AES, to provide technical services to the membership, to support meeting activities, to recommend awards, to organize workshops, and last, but not least, to write DRPs by virtue of the TCM/WG structure with an eye cast toward S4 as an eventual consumer of the DRP or RP.

Although the TCM/WGs must follow the legal guidelines as set forth by the AES, there is a perceived flexibility in not being saddled with S4 initially. The DRP is not a national consensus standard and must never be invoked as such. If an RP is picked up by S4 and circulated throughout the S4 membership and approved by S4, then it will become an American National Standard. S4 may not be able to accept and approve a DRP, in which case it will not become an American National Standard. This does not preclude its informal use among those members of the AES who believe the document was needed in the first place. Perhaps some years of experience with the DRP will lead to rejection or S4 acceptance. At least the DRP serves as a technical baseline upon which a body of experience is built.

5 RELATION TO MEMBERS

An important accomplishment has been to establish a clear path to publishing DRPs in the *Journal*. The Publication Policy Committee has recommended that a DRP after TCL approval be published in the next available issue of the *Journal*. It will appear in a different type size and format to set it apart from regular material in the journal. A suitable preamble will be included, and comments by the membership at large will be solicited. As AES members you will be charged with the responsibility of commenting, if you have expertise in the particular subject. We hope you will accept this responsibility. Send your comments to the TCL chairperson. We do not want a silent majority turning into a vociferous minority just before the document is cast in cement.

Input to the TCL, on any subject, is encouraged and it is best done in writing to me. All comments received will be aired at the TCL meeting, and a written reply will be returned describing the results.

6 PRESENT WORK

The Technical Council has several operating Technical Commitees, including: Digital Audio, Peak Program Meters, Audio Polarity, Instrumentation, Disk Recording, Architectural Audio, Transducers, and Sound Reinforcement Components.

There is apt to be some realignment as certain titles mentioned above may become working groups—for example, the TCM/PPM may be placed under TCM/Instrumentation and become WG/PPM, but that remains to be seen. There are appointed chairpersons for each TCM listed. If you want to participate in a TCM or a WG, write to me and I shall pass your request on to the appropriate TCM chairperson.

There are two very active TCMs—Digital Audio (DA) and Sound Reinforcement Components (SRC). The TCM/DA has had some well-attended, lively meetings and has published a few reports in the *JAES*. The chairperson, Bart Locanthi, is trying his utmost to get timely information to the membership because he wants to hear from you, if you have something to contribute. Here you see at work the creation of an extremely important standard—and I use that word standard because this TCM's work will become a standard, and quickly, just from the intense commercial pressure to get the job done. In addition, I am pleased to report that we are within an issue or two of publishing a DRP on loudspeaker measurements in the *Journal*. This committee was started by John Eargle in 1975 and was taken over by Cliff Henricksen in 1979. Secretly, I have been very impatient about getting this document published as a DRP but Cliff has worked very thoroughly to ensure its accuracy and to have his Committee members agree that it is the document they wish to put before the membership.

To those who say, What, another loudspeaker measurement standard? (meaning DRP—sorry, a slip of the tongue), I refer to a statement by Cliff:

"This (document) fills the need for expanded information required by professional designers and users which is not currently available in such documents drafted by EIA and IEC."

This document which you, the members of the AES, are urged to comment upon, is a first and exciting step for the Technical Council in its contribution to better audio engineering standards.