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National and International Standards Pertaining to Noise and Speech

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ABSTRACT: There has been considerable recent activity in the development of standards relating to bioacoustics, especially in the areas of noise, hearing, and speech. Most of these national and international standards are written within the framework of the Bioacoustic Committee, S3, of the American National Standards Institute. This paper briefly describes how standards for bioacoustics are developed and used. Many of the new standards on noise, hearing, and speech are also described.

KEYWORDS: pathology and biology, standardization, noise

Standards pervade everything we do, but usually we know very little about them. From the light switch on the wall to the design of a nuclear power plant to the determination of the thresholds of hearing, standards are a part of almost every product and most services not only in the United States but throughout the world.

The obvious question is What is a standard? A standard attempts to describe an agreed-upon set of measurements, rules, data, procedures, descriptions, and so on that indicates how something should be built, designed, or operated. The standard's purpose may be to promote safety, uniformity, definitions, practices, or any combination of these. Standards are used in industry, in government, in the sciences, by the consumer—practically everywhere. Standards are not generally legal devices. They do *not* state that someone *must* follow the specification in the standard. They only describe the specifications. Standards may, however, be used in laws, regulations, ordinances, treaties, and other legislative acts. These legal devices often require that certain people or agencies follow the specifications of a standard. Building codes, antinoise ordinances, and military procurement laws are but a few examples of laws that make explicit use of standards.

Standards aid society by providing for: (1) safety, such as the standards for electrical safety of the Underwriters' Laboratories; (2) agreed-upon units of measurement, such as would be provided by the National Bureau of Standards; (3) uniformity in such items as the light switch, thereby guaranteeing that no one manufacturer can monopolize a particular product; (4) information enabling a purchaser to know what is being purchased and to make comparisons; (5) descriptions of procedures for performing a particular task to insure a particular outcome; and (6) terminology.

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Standards cover almost everything that involves commerce, science, and technology in the world. For example, consider four standards in the area of bioacoustics:

(1) American National Standard Specification for Sound Pressure Meters, S1.4(1971);
(2) American National Standard Methods for Measurement of Electro-acoustical Characteristics of Hearing Aids, S3.3-1960(R1976);
(3) American National Standard Method for Measurement of Monosyllabic Word Intelligibility, S3.2-1966(R1972); and
(4) American National Standard Method for Manual Pure-Tone Threshold Audiometry, S3.21-1978.

As these titles suggest, the standards cover a measuring instrument (sound level meter), a consumer product (hearing aid), information (word intelligibility), and a procedure (obtaining thresholds). These are typical of the range of activities covered by standards, especially in the area of bioacoustics.

Each standard mentioned above begins with "American National Standard" in its title, which sounds as if there is some agency that oversees U.S. standards activity. Actually, many organizations are concerned with standards in the United States. The United States is one of the few countries where, in general, standards are not controlled by the government. Most of the standards written and used in this country are the product of voluntary standards organizations. The entire system has produced thousands of standards.

The organization responsible for designating standards as "American National Standards" and the U.S. representative in international standards work is the American National Standards Institute (ANSI). ANSI is a not-for-profit organization that coordinates a large network of societies, organizations, laboratories, companies, and individuals that generate standards through totally voluntary efforts. ANSI provides liaison with various international standards organizations, such as the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC), and accepts standards as "American National Standards" if it can be shown that they represent a consensus of all parties concerned.

ANSI recognizes three ways of achieving consensus on a standard: the Accredited Organization Method, the Canvass Method, and the American National Standards Committee Method. The Accredited Organization Method recognizes the standards of certain groups or societies, such as those developed by committees of the American Society for Testing and Materials (ASTM), as being developed through procedures that assure a substantial consensus by all involved parties. Through the Canvass Method, organizations such as Underwriters' Laboratories write standards and then submit them to ANSI, who canvasses anyone else interested in the particular area. Finally, ANSI has American National Standards (ANS) committees, wherein organizations hold the secretariat of a committee in a particular area and ANSI oversees the procedures through which standards are developed. This last method is the way in which standards in the area of bioacoustics are developed, and the Acoustical Society of America (ASA) holds the secretariat—providing the working control—for ANS Committee S3 on Bioacoustics.

Figure 1 shows the structure of the entire standards system as it pertains to the area of bioacoustics. This figure includes both national and international groups working on standards directly related to bioacoustics. In the United States, almost the entire system is nongovernmental and voluntary. In bioacoustics almost 100% of the existing standards have been enacted by the ANSI/IEC/ISO structure.

How does an idea or a felt need become a standard? Figure 2 outlines the major steps for an American National Standard in the area of bioacoustics. As can be seen, the process involves various stages of voting to determine that a consensus of scientific, industrial, manufacturing, consumer, and general interest inputs are received and considered. The heart of the system rests at the secretariat (for bioacoustics, ASA) and the S (in this case, S3) com-

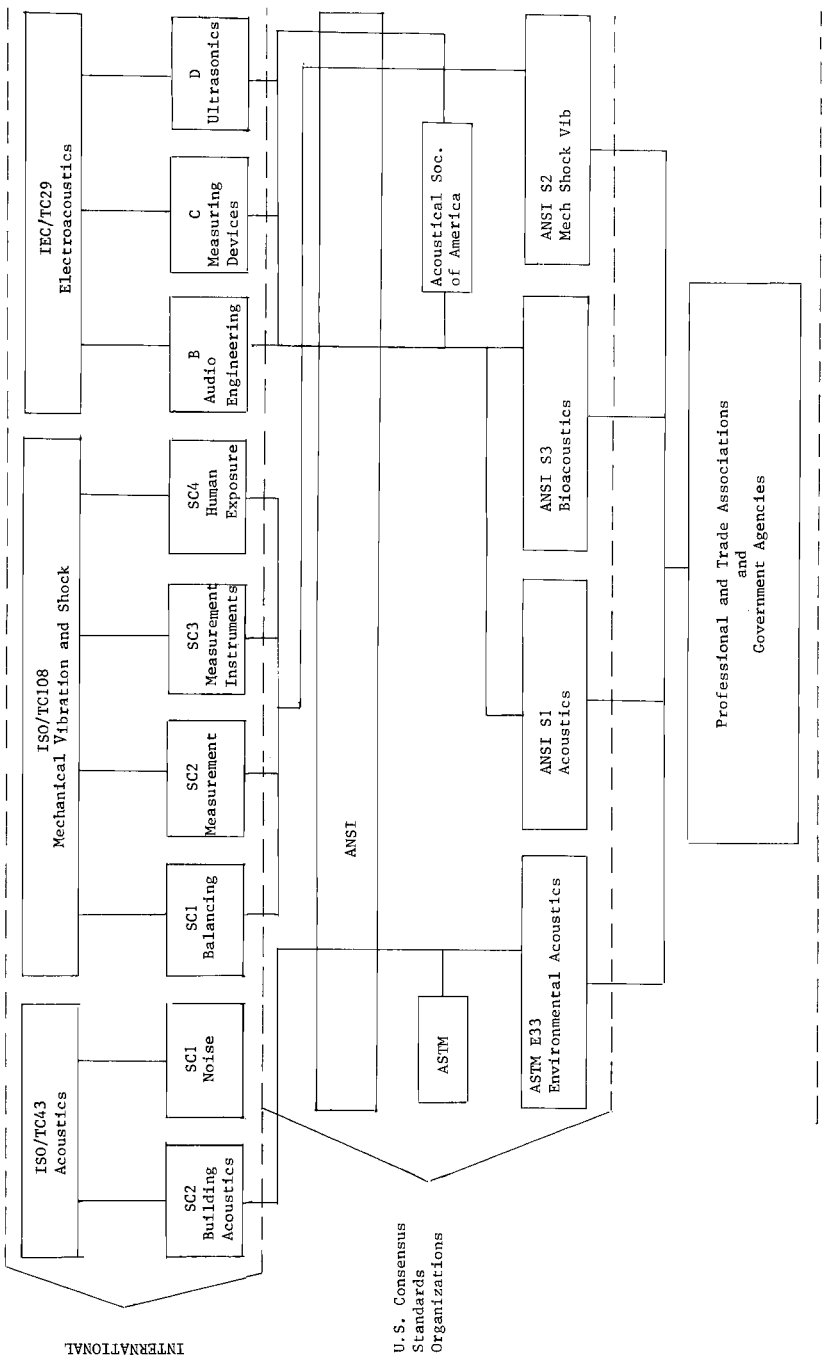

FIG. 1—*The structure of national and international standards organizations involved with bioacoustics.*

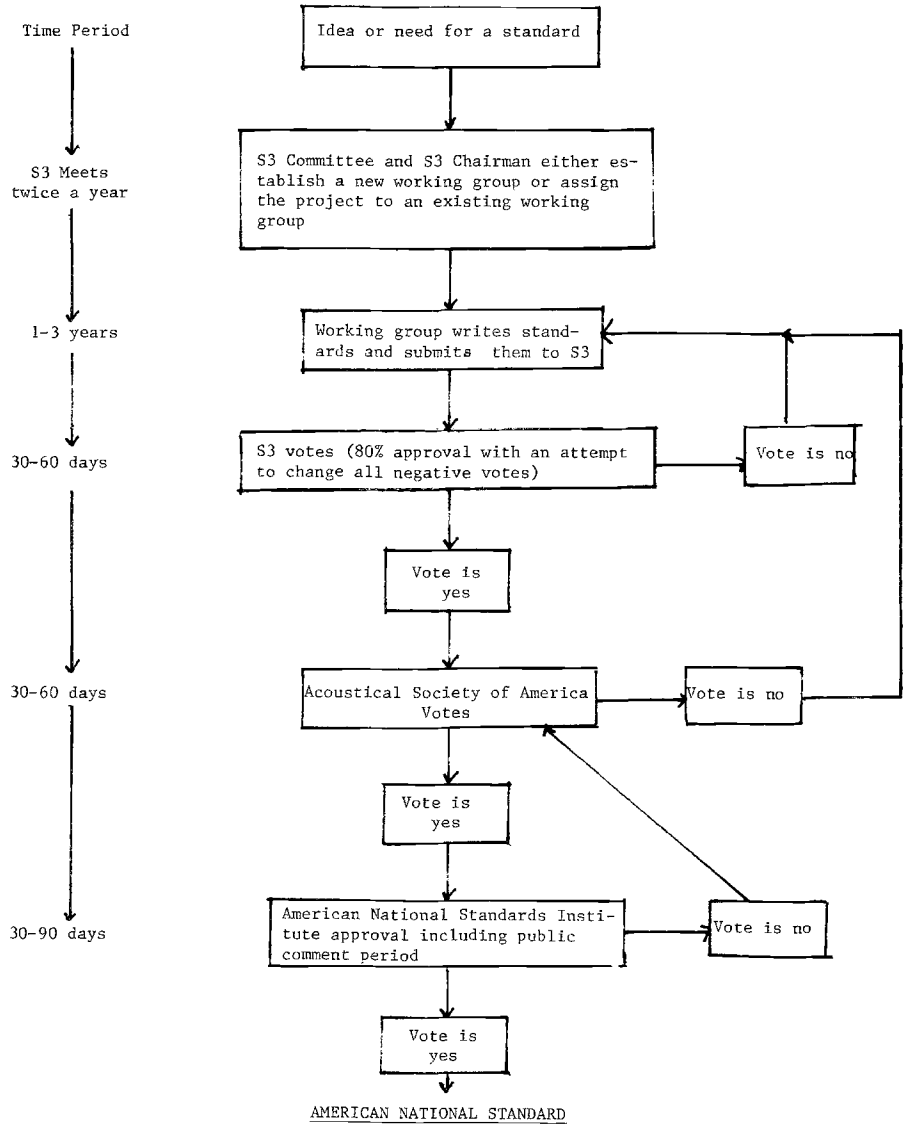

FIG. 2—*A flow diagram including an approximate time table for the development of a standard in the Bioacoustic Committee (S3) of the American National Standards Institute.*

mittee levels. The S committee organizes and provides for the management of the working groups that actually develop a standard. In addition, the S committee through its voting members makes sure that the standard meets a level of scientific or technical excellence that renders it applicable for use by or in society. Thus, there are two parts of a standard committee (S committee): the working group and the voting membership. Table 1 shows the working group and membership (by organization) for Committee S3 on Bioacoustics.

A similar but more complicated system operates at the international level for standards related to bioacoustics. There are two major international groups involved with bioacoustic standards used worldwide: IEC and ISO. As Fig. 1 shows, ANSI is the United States' liaison

TABLE 1—*Structure of Committee S3 on Bioacoustics.*

Chairman: W. A. Yost
Vice-Chairman: J. Goldstein

Individual Members

Acoustical Society of America
American Academy of Ophthalmology
Air Conditioning and Refrigeration Conference
American Conference of Governmental Industrial Hygienists
Association of Home Appliance Manufacturers
American Industrial Hygiene Association
American Institute of Ultrasound in Medicine
American Insurance Association
Environmental Protection Agency
Food and Drug Administration
Hearing Industries Association
Home Ventilating Institute
Industrial Medical Association
Industrial Safety Equipment Association
Institute of Electrical and Electronics Engineers
Motor Vehicle Manufacturers Association of the United States
National Bureau of Standards
National Electrical Manufacturers Association
National Hearing Aid Society
Society of Automotive Engineers
Telephone Group
Ultrasonic Industry Association
U.S. Army Medical Corps
U.S. Army Human Engineering Laboratory
U.S. Army Electronics Command
U.S. Department of the Air Force
U.S. Department of Housing and Urban Development
U.S. Bureau of Mines
U.S. Department of Transportation
U.S. Navy Bureau of Medicine and Surgery
U.S. Naval Sea Systems Command
American Iron and Steel Institute
Alliance of American Insurers
American Otological Society
American Society of Heating, Refrigeration, and Air-Conditioning Engineers
American Society of Physicists in Medicine
American Society of Mechanical Engineers
American Speech and Hearing Association
Audio Engineering Society
Canadian Standards Association
Electric Light and Power Group
Electronic Industries Association
U.S. Public Health Service
Occupational Safety and Health Administration

S3 Working Groups

S3-35	Audiometers
S3-36	Speech Intelligibility
S3-43	Method for Calibration of Bone Conduction
S3-48	Hearing Aids
S3-49	Determination of Interference of Noise with Speech Intelligibility
S3-51	Auditory Magnitudes
S3-52	Hearing Protectors
S3-54	Biological Effects of Ultrasound
S3-56	Criteria for Background Noise for Audiometer Testing
S3-58	Hearing Conservation Criteria
S3-59	Measurement of Speech Levels
S3-60	Measurement of Acoustic Immitance of the Ear
S3-61	Sound Pressure Distribution Around the Head and Torso
S3-62	Impulsive Noise with Respect to Hearing Hazard
S3-63	Acoustic Warning Devices
S3-64	Community Noise Annoyance
S3-65	Evaluation of Hearing Conservation Programs
S3-67	Mannequin
S3-68	Psychophysical Procedures

S3/S1 Working Groups

S3-37(S1)	Coupler Calibration of Earphones
S3-55(S1)	Land Use Planning with Respect to Noise
S3-57(S1)	Criteria for Room Noise
S3-66(S1)	Measurement of Workplace Addressed to Effective Hearing Conservation Programs

S3/S2 Working Group

S3-39(S2)	Vibration Levels

to each of these international organizations. This means that the member organizations and S committees of ANSI relate directly to the international activities.

Figure 3 is a flow diagram of how an international standard is typically formed. The member nations play the primary role of voting consensus for the standard. This, in turn, means that each organization or S committee of ANSI becomes involved in formulating the United States' one vote at the international level. Table 2 shows the membership of one of the ISO committees responsible for writing or certifying international standards. The TC of ISO is

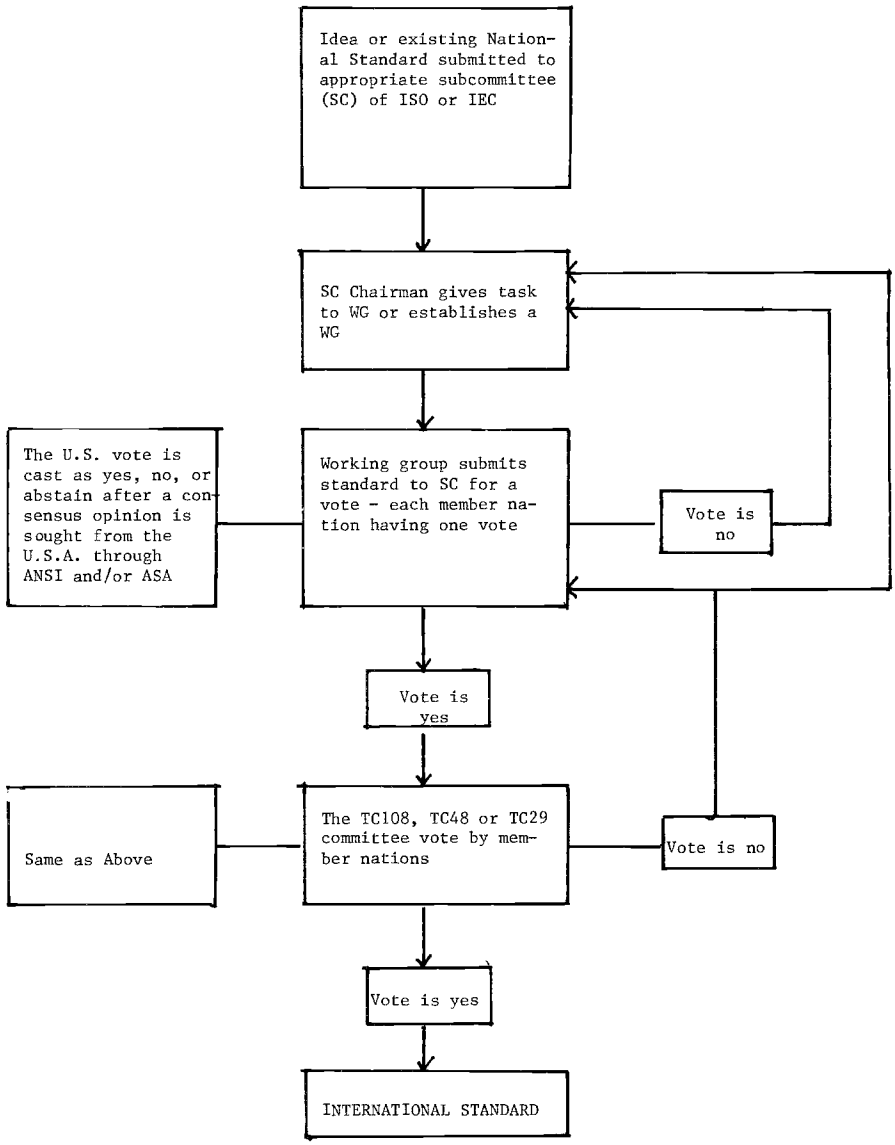

FIG. 3—*A flow diagram for the development of an international standard. This is a general flow diagram since each international committee operates with different rules.*

the equivalent of the S committee of ANSI, and the member nations are analogous to the voting members of the S committee. There are working groups at both the TC and S committee level.

What is being done in the area of standards dealing with speech and noise? Plenty. With our highly technological society, there is considerable interest at the governmental level for measuring, defining, and controlling noise. This concern has spawned a large industry dealing with noise. Thus, Committee S3 on Bioacoustics is responding to the needs of the governmental agencies and of the industrial-societal marketplace. The area of speech communication is an important aspect of noise and its effect on man, and, thus, standards activities on

TABLE 2—*Example of an ISO technical committee subcommittee.*

ISO/TC 108/SC 4—Human Exposure to Mechanical Vibration and Shock
Secretariat (operating chair of subcommittee)—Germany

Participating Members	**Observing Members**
	Australia
Belgium	Bulgaria
Czechoslovakia	Canada
Denmark	Finland
France	Hungary
Germany	Ireland
Italy	Mexico
Japan	New Zealand
Netherlands	Pakistan
Norway	Romania
Sweden	
Switzerland	**Working Groups**
Union of Soviet Socialist Republics	
United Kingdom	WG1 Terminology
United States	WG2 Whole Body Vibration
Yugoslavia	WG3 Hand Transmitted Vibration
	WG4 Human Impact Testing and Evaluation
	WG5 Biodynamic Modeling

bioacoustics are involved in the standardization of equipment, terms, procedures, and data in areas pertaining to speech and noise. In recent months, Committee S3 has considered working groups on speech production, since efforts to date have been mainly on speech perception. There is rather strong support for standardizing certain sets of data for codifying certain procedures for measuring or calibrating a speech utterance or waveforms, and there are a variety of devices dealing with speech production for which standards might be of assistance to consumers or scientists.

In particular, the existing standards on noise cover instruments like sound pressure level meters and dosimeters; products such as hearing aids; information such as the definition of the thresholds of hearing; and terminology such as standard terms in psychoacoustics. There are documents on speech thresholds in different noise environments, on the measurement of word intelligibility and articulation for different types of utterances in different types of noise backgrounds, and the measurement of and the definition of loudness and other subjective attributes of sounds. There are other standards that have a direct bearing on noise and speech. These deal with vibration, sound, and noise from various classes of machinery, hearing, community noise and community planning, noise from aircraft and other vehicles, architectural conditions and noise, and the audio industry. Probably any area of commerce and science that touches on the area of noise and speech has a list of standards to aid it in providing a useful, safe, and informative product or service.

Similar concerns are also being addressed at the international level. In addition, Committee S3 is trying to insure that the standards believed suitable for use in the United States are not jeopardized by conflicting international standards. Committee S3 is also making sure that standards used in other countries are written to be useful in the United States.

At the national level there are now approximately 20 standards that deal specifically with noise and speech. There are another dozen documents in the process of becoming standards, and Committee S3, with the assistance of ASA and ANSI, has proposed another 15 standards that will shortly enter the writing-voting procedures outlined earlier. As a result of growing cooperation with the Food and Drug Administration (FDA), ANSI is helping the

FDA to develop three to five standards dealing with medical devices. In addition, Committee S3 has initiated about five standards in the areas of noise and speech not covered by either the existing standards or the interactions among ASA, ANSI, FDA, and other agencies.

A complete list of existing standards can be obtained by writing the Standards Secretariat, Acoustical Society of America, 335 East 45th St., New York, N.Y. 10017.

The activity and work in standards is done almost entirely by volunteers who are experts in a particular field. The voluntary aspect of standardization poses some problems for writing standards; whenever experts are brought together to decide how to do something, the possibility for debate looms large. This is especially true in the area of bioacoustics where sometimes our data bases, theories, and procedures are not as exact as might be hoped for.

President Truman was often quoted as saying that everytime he asked a scientist a question the reply was, "Well, on the one hand we can do this, but on the other hand we can't do this." Truman's response was that he wished for a one-armed scientist. Scientists working on standardization have to work toward a compromise that will result in a standard based on consensus. Given the transitory nature of science, standards must be reviewed and updated. Within ANSI all standards are reviewed every five years and either renewed, withdrawn, or revised. The task of forming a consensus among the experts, especially in the many areas of bioacoustics, is one of the interesting challenges for scientists working on standardization. The ANSI/international system is responding to the expressed needs of society for standardization in the areas of bioacoustics.

Finally, in closing, I would like to add that given the totally voluntary nature of the United States' standards activities, standards-writing organizations welcome any assistance or suggestions anyone has in terms of standardization.

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