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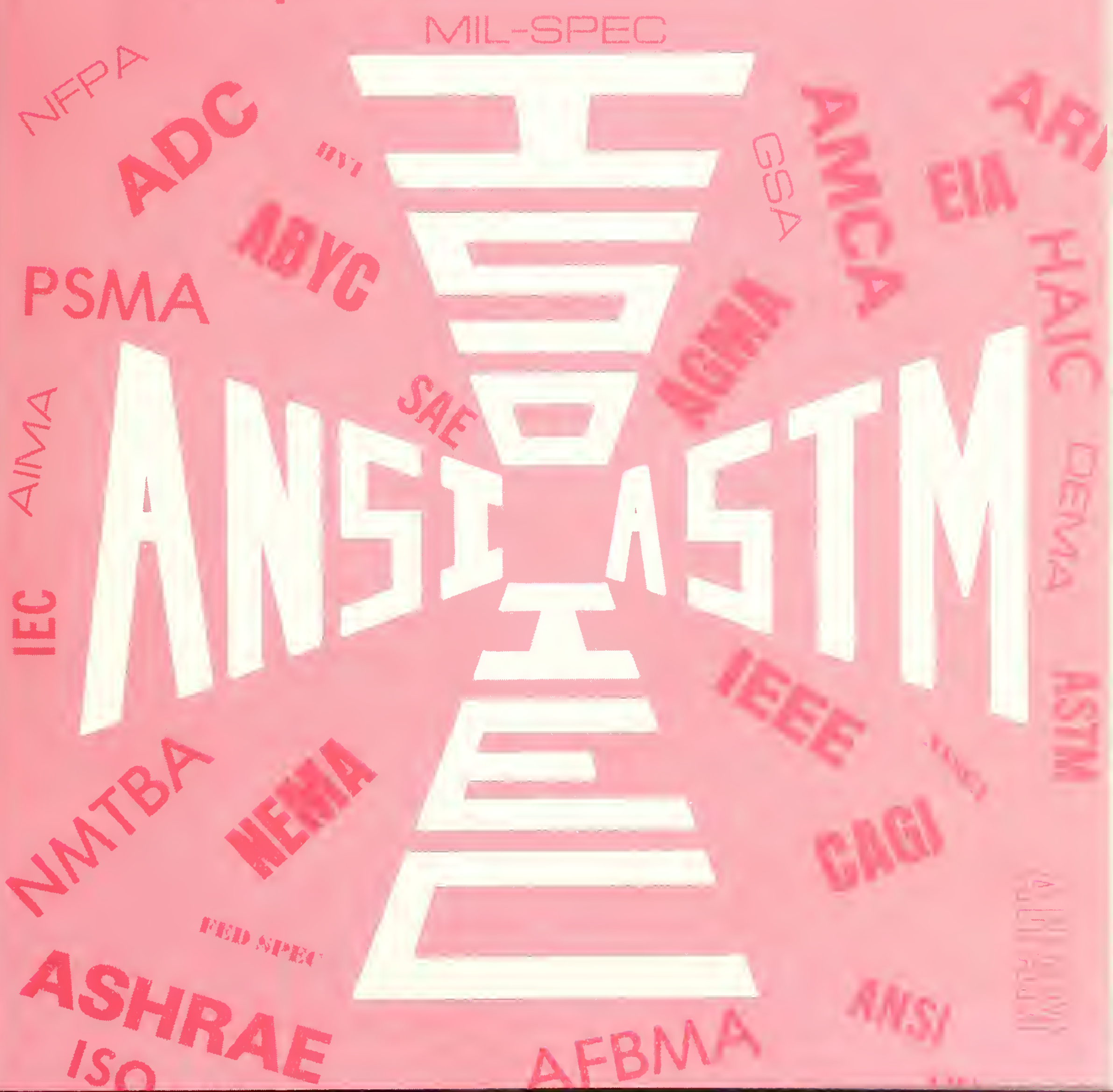
Standards on Noise Measurements, Rating Schemes, and Definitions: A Compilation



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[1] Headquarters and Laboratories at Gaithersburg, Maryland, unless otherwise noted; mailing address Washington, D.C. 20234.
[2] Part of the Center for Radiation Research.
[3] Located at Boulder, Colorado 80302.
[4] Part of the Center for Building Technology.

Standards on Noise Measurements, Rating Schemes, and Definitions: A Compilation

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ABSTRACT

This compilation deals with material assembled from the various standards, industrial and trade organizations, or technical and scientific societies concerned with acoustics. There has been no attempt to review or evaluate the standards, but rather just to list those that are available. The standards cover a broad scope of topics in acoustics--including measurement techniques, rating schemes, definitions, equipment and product specification, subjective measurements and response to noise, and calibration methods. Those standards dealing solely with shock and vibration have not generally been included. The paragraphs describing the standards give a brief summary of intent and/or scope of the standard. In some cases the paragraph is the official description of the standard as issued by the organization or society promulgating the standard, while in others the paragraph merely describes the spirit of the standard. Proposed standards are also listed. The names and addresses of the various organizations or societies and their acoustical standards committees are listed in an Appendix. The compilation includes all information available as of April 1, 1973.

Key words: Acoustics; noise; rating schemes; sound; standards organizations.

Preface

The existence of satisfactory standards and mechanisms for generating them are essential for the appropriate use of a country's technology in its commercial products and industrial processes. Standards deal with techniques for physical measurements, descriptive terminology, methods of test and agreements on dimensions, design, performance and physical characteristics dealing with products that are manufactured and sold. These latter standards are referred to as engineering or industrial standards which usually include more specific types of standards such as product standards, commercial standards and safety standards. The majority of these standards are normally not a matter of law and most are developed in the private sector. Exceptions usually occur in areas of health and safety. The use of such standards is voluntary but their widespread acceptance can often give them considerable commercial importance. The Government does issue mandatory standards as exemplified by those in the areas of pollution control and abatement, fabric flammability, and toy safety. Widely accepted standards can become mandatory when incorporated into contracts, codes and regulations.

There is a lack of central coordination in the standards-writing activities of the USA. This can, and does, result in duplication of efforts, inadequate and inaccurate standards, and a patchwork of mandatory standards written in response to emergencies. This occurs because standards are written by a large number of organizations. The directory of U. S. Standardization Activities (NBS Misc. Publication 288, 1967) lists over 400 organizations that either write or sponsor voluntary standards.

The issues of consumer safety, pollution control, and standards as barriers to international trade have focused attention on the shortcomings of the U. S. standardization system. Most other industrialized nations have a more highly unified system than the USA. Most often they have a single organization through which the private sector meets its standardization requirements and to which the government turns to meet its needs. Direct financial support from the government to these organizations runs from as low as 5% in Germany to as high as 100% in Japan. In the USA, the American National Standards Institute is intended to be the overall coordinating body for those organizations that either write or sponsor standards. However, it has yet to achieve the degree of private or government support and recognition in this role to be fully effective.

The principal international standardization bodies are the International Organization for Standardzation (ISO) and the International Electrotechnical Commission (IEC) in which the U.S. is represented by the American National Standards Institute and the U.S. National Committee for IEC, respectively.

There have been a number of recent legislative actions that give impetus and a sense of urgency to the development of standards and measurement methods that are needed for the effective implementation of a national program on noise pollution abatement and control. While the laws which have been enacted rarely call specifically for new or improved measurement standards, regulations can be enforced most effectively when based upon a fair, equitable, and uniform measurement methodology.

Of the several legislative actions at the Federal level, one of the most sweeping is the Noise Control Act of 1972 (PL 92-574) which gives the U.S. Environmental Protection Agency a wide range of authority for the establishment of noise emission standards for products, regulations on quiet products, coördinating related research and noise control in the federal agencies and other regulatory activities. This Act specifically calls for NBS-EPA cooperation with regard to research and development of improved methods and standards for the measurement and monitoring of noise.

Prior to the enactment of this legislation, EPA prepared, with NBS cooperation, a "Report to the President and Congress on Noise." As backup material for this report NBS prepared a report entitled "Fundamentals of Noise: Measurement, Rating Schemes, and Standards", which was published as EPA Report NTID300.15. This report included a compilation of acoustic standards believed to be relevant to noise abatement and control. Following publication, this compilation was circulated for the express purpose of obtaining comments from qualified individuals in the acoustics field regarding the format and the contents. All the appropriate material received from these individuals has been incorporated into the present compilation, which is more comprehensive than the original.

This compilation deals with material assembled from the various standards, industrial and trade organizations, or technical and scientific societies concerned with acoustics. There has been no attempt to review or evaluate the standards, but rather just to list those that are available. The standards cover a broad scope of topics in acoustics--including measurement techniques, rating schemes, definitions, equipment and product specifications, subjective measurements and response to noise, and calibration methods. Those standards dealing solely with shock and vibration have not generally been included. The paragraphs describing the standards give a brief summary of intent and/or scope of the standard. In some cases the paragraph is the official description of the standard as issued by the organization or society promulgating the standard, while in others the paragraph merely describes the spirit of the standard. Proposed standards are also listed. The names and addresses of the various organizations or societies and their acoustical standards committees are listed in an Appendix. The compilation includes all information available as of April 1, 1973.

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*S3.7 became a standard on January 18, 1973 and replaces Z24.9.

STANDARDS ON NOISE MEASUREMENTS, RATING SCHEMES, AND DEFINITIONS: A COMPILATION

Jack M. Fath

1. International Organization for Standardization (ISO)

1.1. Summary of Standards

The use of the terminology "ISO Recommendation" has been discontinued. Future ISO documents will be titled as ISO International Standards. The currently existing documents (recommendations) will be retitled when they are revised.

1.1.1. ISO RECOMMENDATION R31 PART VII. QUANTITIES AND UNITS OF ACOUSTICS (1965).

This ISO Recommendation is part of a more comprehensive publication dealing with quantities and units in various fields of science and technology. It consists of a table listing the various quantities and units of acoustics, and the respective symbols. Preference is given to the International System of Units.

1.1.2. ISO RECOMMENDATION R131. EXPRESSION OF THE PHYSICAL AND SUBJECTIVE MAGNITUDES OF SOUND OR NOISE (1959).

This ISO Recommendation states that the physical magnitude of sound or noise be expressed by a statement of sound pressure, power or intensity level, and the subjective magnitude as a loudness level in phons or loudness in sones. It also states the interrelationship between phons and sones.

1.1.3. ISO RECOMMENDATION R140. FIELD AND LABORATORY MEASUREMENTS OF AIRBORNE AND IMPACT SOUND TRANSMISSION (1960).

This ISO Recommendation defines methods for measuring the airborne sound insulation of walls and floors, and impact sound on floors, both in the field and in the laboratory.

The way in which the airborne and impact sound fields are generated, the frequency range of measurement and the characteristics of the necessary filters are described. Definitions are also given of the quantity measured in each case, and of the method of normalizing the results to make them comparable.

1.1.4. ISO RECOMMENDATION R226. NORMAL EQUAL-LOUDNESS CONTOURS FOR PURE TONES AND NORMAL THRESHOLD OF HEARING UNDER FREE FIELD LISTENING CONDITIONS (1962).

This ISO Recommendation specifies, for the frequency range 20 to 15000 Hz:

a) The standard relations existing between sound pressure level and frequency for pure tones of equal loudness presented frontally to a listener in a free field.
b) Values for the standard threshold of hearing for pure tones presented frontally in a free field.

1.1.4.1. Proposed Addendum II. Document ISO/TC43/SC2 (63).
1.1.4.2. Proposed Revision. Document ISO/TC43/SC2 (secretariat-7) (62).

1.1.5. ISO RECOMMENDATION R266. PREFERRED FREQUENCIES FOR ACOUSTICAL MEASUREMENTS (1962).

This ISO Recommendation deals with the frequencies used for acoustical measurements. The variety of frequencies being used, prior to 1962, for acoustical measurement made comparison of results inconvenient. Some of the difficulties arose from the use of frequencies spaced at different intervals or of series starting from different reference frequencies. The purpose, therefore, of this ISO Recommendation is to refer all frequency-series to a single reference frequency, and to select other frequencies in such a way as to afford a maximum number of common frequencies in the various series.

For certain acoustical measurements, a constant frequency increment is a suitable spacing. More commonly, however, a constant percentage increment is adopted and the test frequencies then form a geometric series. The present ISO Recommendation deals with the geometric series and is not intended to apply to cases where a constant frequency increment, or other particular spacing, would be more suitable, or where there may be good reasons for the adoption or retention of other frequencies.

1.1.6.* ISO RECOMMENDATION R354. MEASUREMENT OF ABSORPTION COEFFICIENTS IN A REVERBERATION ROOM (1963).

This ISO Recommendation describes how a reverberation room should be used to measure, under specified conditions, the sound absorption coefficients of acoustical materials used as wall or ceiling treatments, or the sound absorption of separate objects, such as furniture, persons or space absorbers. The general principle is that the specimen is introduced into the room and the absorption added is computed from measurements of the reverberation time of the room (or the decay rate of the reverberant sound) before and after the introduction of the specimen.

It specifies certain features of the size and shape of the room, the size and disposition of the test specimen, the methods of measuring the reverberation time (or the decay rate of the reverberant sound) and of computing the results, the frequencies to be used and the manner in which the results should be stated.

1.1.7. ISO RECOMMENDATION R357 (SUPPLEMENTARY TO R131). EXPRESSION OF THE POWER AND INTENSITY LEVELS OF SOUND OR NOISE (1963).

This ISO Recommendation defines the reference sound power and sound intensity and recommends one picowatt as the reference sound power and one picowatt per square meter as the reference intensity.

1.1.8. ISO RECOMMENDATION R362. MEASUREMENT OF NOISE EMITTED BY VEHICLES (1964).

This ISO Recommendation describes methods of determining the noise emitted by motor vehicles, these being intended to meet the requirements of simplicity as far as is consistent with reproducibility of results and realism in the operating conditions of the vehicle.

It is based primarily on a test with vehicles in motion, the ISO reference test. It is generally recognized to be of primary importance that the measurements should relate to normal town driving conditions, thus including transmission noise, etc. Measurements should also relate to vehicle conditions which give the highest noise level consistent with normal driving and which lead to reproducible noise emission. Therefore, an acceleration test at full throttle from a stated running condition is specified.

Recognizing, however, that different practices were in existence before this ecommendation, specifications of two other methods used are also given in the Appendix. These relate to:

a) a test with stationary vehicles (see Appendix A1) and
b) a test with vehicles in motion, under vehicle conditions which (in the case of certain vehicles) are different from those in the ISO reference test (see Appendix A2).

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*The USA Member Body opposed the approval of this recommendation.

When either of these tests is used, the relation between the results and those obtained by the ISO reference test should be established for typical examples of the model concerned.

1.1.9. ISO RECOMMENDATION R389. STANDARD REFERENCE ZERO FOR THE CALIBRATION OF PURE-TONE AUDIOMETERS (1964).

This ISO Recommendation specifies a standard reference zero for the scale of hearing threshold level applicable to pure-tone audiometers.

It states the information in terms of the sound pressure level output of an earphone or an artificial ear or coupler for five different National Standard earphone-coupler combinations. The five sets of reference equivalent threshold sound pressure levels (RETSPL) all refer to the same auditory threshold levels. That is when an earphone actuated by a voltage that sets up the proper RETSPL in the coupler, is placed on the ear, the applied voltage corresponds to the threshold of hearing.

1.1.10. ISO RECOMMENDATION R389, ADDENDUM 1. STANDARD REFERENCE ZERO FOR THE CALIBRATION OF PURE-TONE AUDIOMETERS. ADDITIONAL DATA IN CONJUNCTION WITH THE 9-A COUPLER (1970).

This Addendum to ISO Recommendation R389-1964 gives the corresponding reference equivalent threshold sound pressure levels for eleven audiometric earphones referred to a single type of coupler, namely, the National Bureau of Standards, Washington, D.C., USA, Type 9-A Coupler. Of these eleven earphones, five are those currently used as reference standards in a number of standardizing laboratories, and the remaining six are other types which have been used on commercial equipment and in audiometric laboratories.

1.1.11. ISO RECOMMENDATION R454. RELATION BETWEEN SOUND PRESSURE LEVELS OF NARROW BANDS OF NOISE IN A DIFFUSE FIELD AND IN A FRONTALLY-INCIDENT FREE FIELD FOR EQUAL LOUDNESS (1965).

This ISO Recommendation specifies, for the frequency range 50 to 10,000 Hz (c/s), the difference (in decibels) between sound pressure levels for equal loudness of narrow bands of noise in diffuse and frontally-incident-free sound fields, respectively, under the following conditions.

a) The sound pressure level is measured in the absence of the listener.
b) The listening is binaural.
c) The listeners are otologically normal persons in the age group from 18 to 25 years.
   Note. An "otologically normal subject" is understood to be a person in a normal state of health who is free from all signs or symptons of ear disease and from wax in the ear canal.
d) The sound is a narrow band of noise of less than critical bandwidth.

1.1.12. ISO RECOMMENDATION R495. GENERAL REQUIREMENTS FOR THE PREPARATION OF TEST CODES FOR MEASURING THE NOISE EMITTED BY MACHINES (1966).

This ISO Recommendation is concerned with the procedures to be followed in the objective measurement of the noise emitted by machines. These procedures are not necessarily applicable to noise of an impulsive character.

The aim is to indicate the general principles by which specific test codes for noise measurements may be formulated. These general rules give different methods for measuring noise.

The specific codes for the various types of machines will have to select the most suitable method having regard to the size of the machine and its application. The codes themselves should contain all the necessary particulars to enable a result to be obtained with the required accuracy. (This Recommendation will be superceded).

1.1.13. ISO RECOMMENDATION R507. PROCEDURE FOR DESCRIBING AIRCRAFT NOISE AROUND AN AIRPORT (1970).

This ISO Recommendation provides a means for describing the noise on the ground around an airport produced by one or a number of aircraft, of the same type of different types, operating under any known set of conditions.

It specifies the five steps to be followed for this purpose:

a) A method of measurement of the noise.
b) A method of calulating from these data tone-corrected perceived noise levels, taking into account pronounced irregularities in the spectrum such as when pure tones are present.
c) A method of integrating the tone-corrected perceived noise level, thus taking duration into account, to arrive at an effective perceived noise level.
d) A method for mapping noise contours around an airport.
e) Methods of integrating the perceived noise levels due to a number of takeoff and landing operations in a specified period of time to obtain the total aircraft (perceived) noise exposure level, and to obtain the equivalent continuous perceived noise level for that same period.

It is outside the scope

a) to apply this ISO Recommendation directly to helicopters or vertical take-off flight vehicles;
b) to describe a method for computing from engine data the noise field produced on the ground by a future aircraft. (currently being revised)

1.1.14. ISO RECOMMENDATION R512. SOUND SIGNALLING DEVICES ON MOTOR VEHICLES, ACOUSTIC STANDARDS AND TECHNICAL SPECIFICATIONS (1966).

This ISO Recommendation deals with sound signalling devices

a) mounted on motor vehicles
b) functioning with an electrical current
c) designed for use outside built-up areas.

The aim of this ISO Recommendation is to specify their acoustic properties, such as spectral distribution of acoustic power and sound pressure level, and also their test conditions.

1.1.15. ISO RECOMMENDATION R532. METHOD FOR CALCULATING LOUDNESS LEVEL (1966).

This ISO Recommendation specifies two methods for calculating the loudness or loudness level of a complex sound, which differ not only in the method of analysis of the sound, but also in the principles of computation. The first, Method A, utilizes physical measurements obtained from spectrum analysis in terms of octave bands. The second, Method B, utilizes spectrum analysis in terms of one-third octave bands.

1.1.16.* ISO RECOMMENDATION R717. RATING OF SOUND INSULATION FOR DWELLINGS (1968).

This ISO Recommendation describes a method of evaluating the airborne sound insulation and impact sound level in dwellings when the results of measurements made by the method described in ISO Recommendation R140 are available. Reference values at different frequencies are given against which measured values can be compared to arrive at a single airborne sound insulation index and impact-sound index respectively.

1.1.17.* ISO RECOMMENDATION R1680. TEST CODE FOR THE MEASUREMENT OF THE AIRBORNE NOISE EMITTED BY ROTATING ELECTRICAL MACHINERY (1970).

This ISO Recommendation has been drafted in accordance with ISO Recommendation R495, and gives the detailed instructions for conducting and reporting tests on rotating electrical machines, to determine the airborne noise characteristics under steady-state conditions.

The test code is divided into two parts:

Part I: Methods for usual tests based on sound level (A) measurements
Part II: Methods for special tests based on frequency band analysis measurements.

This test code for the measurement of noise applies to rotating electrical machines such as motors and generators of all sizes without limitation of output or voltage, when fitted with their normal auxiliaries. (This Recommendation will be superceded).

1.1.18. ISO RECOMMENDATION R1761. MONITORING AIRCRAFT NOISE AROUND AN AIRPORT (1970).

This ISO Recommendation describes methods for monitoring, on the ground, the noise produced by aircraft around an airport, and equipment to be used.

Monitoring is understood to be routine measurement of noise created by aircraft in the operation of an airport. Monitoring usually involves a large number of measurements per day, from each of which an immediate indication of the noise may be required.

Monitoring aircraft noise can be carried out either with mobile equipment, often with only a sound level meter, or with permanently installed equipment incorporating one or more microphones with amplifiers located at different positions in the field with a data transmission system linking the microphones to a central recording installation. This ISO Recommendation describes primarily the latter method, but specifications given in this ISO Recommendation should also be followed when using mobile equipment to the extent to which the specifications are relevant.

The noise levels to be reported according to this Recommendation are approximations to perceived noise level (PNL). (currently being revised)

1.1.19.* ISO RECOMMENDATION R1996. ACOUSTICS, ASSESSMENT OF NOISE WITH RESPECT TO COMMUNITY RESPONSE (1971).

The reduction, or limitation, of noise which causes annoyance is of increasing general importance. This ISO Recommendation suggests methods for measuring and rating noises in residential, industrial and traffic areas with respect to their interference with rest, working efficiency, social activities and tranquillity.

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*The USA Member Body opposed the approval of this recommendation.

Besides noise there may be other factors in connection with sound production and radiation, for example mechanical vibrations, which also give rise to annoyance in particular situations and which make the assessment more complex. No general method exists at present to take account of these factors, but the application of numbers and corrections, other than those described, may be desirable in some cases. This ISO Recommendation is intended to serve as a guide to estimating public reaction to noise in a community, and thus to help competent authorities to set limits on community noise.

The Recommendation calls for measurement of A-weighted sound level in decibels. The equivalent steady sound level is obtained by appropriate measurement of the fluctuating noise in a community, or by duration corrections added to measured maximum sound levels. Further corrections are added to the equivalent steady sound level for impulsive or tonal character, to determine the rating sound level. A criterion noise level is described that is further adjusted for time of day and type of district; in special cases the prevailing ambient noise in the community, in the absence of allegedly offending noise, may be used as the adjusted criterion noise level. The actual assessment of noise with respect to community response is obtained from the amount in decibels by which the rating sound level exceeds the adjusted criterion noise level.

When corrective measures are required, a frequency analysis of the offending noise may be necessary. The resulting noise spectrum may be compared with noise-rating (NR) curves given in the Appendix, in order to identify the frequency bands in which the offending noise is predominant.

1.1.20. ISO RECOMMENDATION R1999. ACOUSTICS, ASSESSMENT OF OCCUPATIONAL NOISE EXPOSURE FOR HEARING CONSERVATION PURPOSES (1971).

This ISO Recommendation provides a method for estimating risks of hearing impairment due to exposure to noise. It is intended to facilitate the setting of limits for tolerable exposure to noise during work, and the institution of programs for conservation of hearing.

With regard to the faculty to understand conversational speech, a person is considered to have a hearing impairment if the arithmetic average of his permanent threshold shifts, for the frequencies of 500, 1000, and 2000 Hz, is 25 dB or more. The risk that a person exposed to a given noise (for a period of time) will experience an impairment of hearing is defined as the difference between the percentage of people in a group exposed to such noise whose hearing is impaired minus the percentage of people whose hearing is impaired in a non-noise-exposed (but otherwise equivalent) group. (The risk so defined includes no consideration of the amount of hearing impairment related to exposure to noise, beyond the permanent threshold shift of 25 dB at 500, 1000 and 2000 Hz.).

The equivalent continuous noise level to which a person is exposed during a 40-hour work week is to be calculated from the A-weighted sound level and duration of each noise. From a table in the Recommendation, a partial noise exposure index can be assigned to each noise. The sum of these indices is the composite noise exposure index. Corresponding to this composite noise exposure index, in a second table, the equivalent continuous sound level can be found. A third table shows relations between the equivalent continuous sound level and the risk of impairment of hearing (for conversational speech) that will occur solely as result of exposure to the noise during normal working periods up to 45 years. This is risk in addition to that of normal aging.

When noise control means are adopted to reduce the noise to which a person is exposed, it may be necessary to analyze the noise in octave or 1/3 octave bands. An example is given in the Appendix for calculating from an octave band spectrum the A-weighted sound level to which a person wearing ear protectors is exposed.

The Recommendation does not apply to impulsive noises consisting of noises of a duration each less than one second, or single, short, high-level transients such as from gunfire.

1.1.21. ISO RECOMMENDATION R2151. MEASUREMENT OF AIRBORNE NOISE EMITTED BY COMPRESSOR/ PRIMEMOVER UNITS INTENDED FOR OUTDOOR USE (1972).

This ISO Recommendation is designed to assist in the measurement of airborne noise emitted by outdoor compressors. The information is then used to:

a) Predict the disturbance in the neighborhood of a particular machine.
b) Assess the risk of hearing damage for people working in the immediate vicinity of the machine.
c) Compare the acoustic properties of different makes of machines.

This Recommendation specifies a method of determining, for the above listed purposes, the air-borne sound emitted by compressor/primemover units intended for outdoor use and gives instructions for conducting the tests and reporting the results.

1.1.22. ISO RECOMMENDATION R2204. GUIDE TO THE MEASUREMENT OF ACOUSTICAL NOISE AND EVALUATION OF ITS EFFECT ON MAN.

This ISO Recommendation is a guide to the general procedures for the measurement of noise and evaluation of its effects on man. It is intended as an introduction to the more specialized instructions contained in acoustical test codes and interpretation procedures published by national and international standardizing bodies.

1.2. Draft Proposals for New Standards

1.2.1. ISO DRAFT INTERNATIONAL STANDARD 2249. ACOUSTICS-DESCRIPTION AND MEASUREMENT OF PHYSICAL PROPERTIES OF SONIC BOOMS.

1.2.2. ISO DRAFT INTERNATIONAL STANDARD 2880. DETERMINATION OF SOUND POWER EMITTED BY STATIONARY NOISE SOURCES IN REVERBERATION ROOMS. PART I: BROAD BAND NOISE SOURCES.

1.2.3. ISO DRAFT INTERNATIONAL STANDARD 2922. MEASUREMENT OF NOISE EMITTED BY SHIPS ON INLAND WATERWAYS.

1.2.4. ISO DRAFT INTERNATIONAL STANDARD 2923. MEASUREMENT OF NOISE ON BOARD VESSELS.

1.2.5. ISO DRAFT INTERNATIONAL STANDARD 2946. DETERMINATION OF SOUND POWER EMITTED BY STATIONARY NOISE SOURCES IN REVERBERATION ROOMS. PART II: DISCRETE-FREQUENCY AND NARROW-BAND NOISE SOURCES.

1.2.6. DRAFT PROPOSAL FOR LABORATORY TESTS ON NOISE EMISSIONS BY APPLIANCES AND EQUIPMENT IN WATER SUPPLY INSTALLATIONS.

Document: ISO/TC 43/SC2 (Secretariat 23) 60.

1.2.7. DRAFT PROPOSAL FOR SOUND MEASUREMENT PROCEDURE FOR AIR MOVING DEVICES CONNECTED TO EITHER A DISCHARGE DUCT OR AN INLET DUCT.

Documents: ISO/TC 43/SC1 (Secretariat 107) 134
ISO/TC 43/SC1 170

1.2.8. DRAFT PROPOSAL FOR A GUIDE TO THE EVALUATION OR ASSESSMENT OF NOISE.

Document: ISO/TC 43/SC 1 (Secretariat 120) 152.

1.2.9. DRAFT PROPOSAL FOR DETERMINATION OF SOUND POWER EMITTED BY STATIONARY NOISE SOURCES. PART IV: ENGINEERING METHODS APPROPRIATE FOR FREE-FIELD CONDITIONS OVER A REFLECTING PLANE.

Document: ISO/TC 43/SC 1 (Hague 3) 157.

1.2.10. DRAFT PROPOSAL FOR MEASUREMENT OF NOISE INSIDE RAILBOUND VEHICLES.

Document: ISO/TC 43/SC 1 (Haag 4) 158.

1.2.11. DRAFT PROPOSAL FOR DETERMINATION OF SOUND POWER EMITTED BY STATIONARY NOISE SOURCES. PART V: SOURCES OPERATING IN LABORATORY ANECHOIC ROOMS.

Document: ISO/TC 43/SC 1 (Hague 6) 160.

1.2.12. DRAFT PROPOSAL FOR THE MEASUREMENT OF AIRBORNE NOISE EMITTED BY PNEUMATIC TOOLS AND MACHINES. ENGINEERING METHODS FOR DETERMINATION OF SOUND POWER LEVELS.

Document: ISO/TC 43/SC 1 (Hague 15) 169.

1.2.13. DRAFT PROPOSAL FOR REVERBERATION ROOM MEASUREMENT OF SOUND FROM HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT.

Document: ISO/TC 43/SC 1 (Hague 18) 172.

1.2.14. DRAFT PROPOSAL FOR DETERMINATION OF SOUND POWER EMITTED BY STATIONARY NOISE SOURCES. PART III: ENGINEERING METHODS APPROPRIATE FOR SPECIAL REVERBERANT ROOMS.

Document: ISO/TC 43/SC 1 (Hague 20) 174.

1.2.15. DRAFT TECHNICAL REPORT ON MEASUREMENT OF NOISE WITH RESPECT TO ITS EFFECT ON THE INTELLIGIBILITY OF SPEECH.

Document: ISO/TC 43/SC 1 (Secretariat 95) 177.

2. International Electrotechnical Commission (IEC)

2.1. Summary of Standards

2.1.1. IEC RECOMMENDATION, PUBLICATION 50(08). INTERNATIONAL ELECTROTECHNICAL VOCABULARY, ELECTRO-ACOUSTICS (1960).

The purpose of this Recommendation is to list definitions that have been drawn up with the object of striking a correct balance between absolute precision and simplicity.

2.1.2. IEC RECOMMENDATION, PUBLICATION 118. RECOMMENDED METHODS FOR MEASUREMENTS OF THE ELECTRO-ACOUSTICAL CHARACTERISTICS OF HEARING AIDS (1959).

The purpose of these recommendations is to describe practicable and reproducible methods of determining certain physical performance characteristics of air-conduction hearing aids that use electronic amplification and are acoustically coupled to the eardrum by means of ear inserts, e.g., ear moulds or similar devices.

The acoustic test procedure is based on the free field technique, in which the hearing aid is placed in a plane progressive wave, with the earphone coupled to a standardized coupler.

Unless otherwise specified all measurements are carried out without using an ear insert (ear mould) which is normally to be regarded as incorporated in the coupler or the artificial ear employed.

The results obtained by the methods specified express the performance under the conditions of the test, but will not necessarily agree exactly with the performance of the hearing aid under practical conditions of use.

For this reason, the difference between practical and test conditions must be borne in mind in interpreting the test results.

2.1.3. IEC RECOMMENDATION, PUBLICATION 123. RECOMMENDATIONS FOR SOUND LEVEL METERS (1961).

The object of the present Recommendation is to specify the characteristics of equipment to measure certain weighted sound pressure levels. The weighting applied to each sinusoidal component of the sound pressure is given as a function of frequency by three standard reference curves, called, A, B, and C.

In practice, measurements may have to be made under very different conditions, ranging from the free field of a single source to a completely diffuse field.

In order to simplify the procedure for the calibration and checking of the apparatus, these recommendations are written primarily in terms of the free field response.

2.1.4. IEC RECOMMENDATION, PUBLICATION 126. IEC REFERENCE COUPLER FOR THE MEASUREMENT OF HEARING AIDS USING EARPHONES COUPLED TO THE EAR BY MEANS OF EAR INSERTS (1961).

The purpose of this publication is to recommend a coupler for loading the earphone with a specified acoustic impedance when determining the physical performance characteristics, in the frequency range 200 to 5000 Hz, of air-conduction hearing aids using earphones coupled to the ear by means of ear inserts, e.g., ear moulds for similar devices. The coupler described is a development of an earlier 2 cm^3 coupler.

The use of this coupler does not allow the actual performance of a hearing aid on a person to be obtained; however, the I.E.C. recommends its use as a simple and ready means for the exchange of specifications and of physical data on hearing aids.

2.1.4.1. Draft Amendment under consideration. (Amendment to Low Frequency Tolerances) Document No. IEC/TC29/SC29C (Central Office) 12.

2.1.5. IEC RECOMMENDATION, PUBLICATION 177. PURE TONE AUDIOMETERS FOR GENERAL DIAGNOSTIC PURPOSES (1965).

The audiometer covered by this Recommendation is a device using pure tones designed for general diagnostic use and for determining the hearing threshold levels of individuals by:

a) monaural air-conduction earphone listening, and by
b) bone conduction.

The Recommendation does not purport to deal with all the features of audiometers, but specifies certain minimum requirements for a pure tone audiometer for general diagnostic use.

The purpose of this Recommendation is to ensure that tests of the threshold of hearing of a given individual on different audiometers, complying with the Recommendation, will give substantially the same results under comparable conditions and that the results obtained will present a good comparison between the threshold of hearing of the individual and the standard reference threshold of hearing.

This Recommendation applies primarily to audiometers giving discrete frequencies, but also applies to audiometers giving continuous frequency variation, as far as the provisions are relevant.

2.1.6. IEC RECOMMENDATION, PUBLICATION 178. PURE TONE SCREENING AUDIOMETERS (1965).

The audiometer covered by this Recommendation is a device designed for screening purposes by monaural air-conduction earphone listening using pure tones.

The Recommendation is almost identical to Publication 177 in its specifications for air-conduction. Notable differences are (a) the range of frequencies and the range of sound pressure levels are smaller, and (b) the tolerances for the accuracies of the sound pressure levels are larger.

2.1.7. IEC RECOMMENDATION, PUBLICATION 179. PRECISION SOUND LEVEL METERS (1965).

This Recommendation applies to sound level meters for high precision apparatus for laboratory use, or for accurate measurements in which stable, high fidelity and high quality apparatus are required.

This apparatus will be called: precision sound level meter.

This Recommendation does not apply to apparatus for measuring discontinuous sounds or sounds of very short duration.

2.1.7.1. Draft Amendment under consideration. (Amendment to Low Frequency Tolerances) Document No. IEC/TC29/SC29C (Central Office) 12.

2.1.7.2. Draft Supplement under consideration. (Additional Requirements for the Measurement of Impulsive Sounds) Document No. IEC/TC29/SC29C (Central Office) 16.

2.1.8. IEC RECOMMENDATION, PUBLICATION 200. METHODS OF MEASUREMENT FOR LOUDSPEAKERS (1966).

This Recommendation applies only to single direct-radiator electrodynamic loudspeakers of the moving-coil type. If the terminals representing the moving coil are available, it is recommended that they be used, as this gives information about the unit in its most basic form. However, where other elements such as a transformer or a special network form part of the unit, or are prescribed in the manufacturer's specification to be used with the unit, it may be so tested provided that this is clearly stated when presenting the results. Provision is made for different acoustic loads by prescribing three types of mounting.

The object of this Recommendation is to specify, on the simplest possible basis, practical and uniform methods of measuring certain characteristics of loudspeakers, so that discussions between suppliers, users and testing authorities may be based on clearly expressed and reproducible results. The interpretation of the results and an assessment of actual performance are matters of the individual users' experience. This is because uniformity of measuring conditions demands a radical simplification of the acoustical environment, which is an important factor for determining loudspeaker performance; moreover, it should be remembered that the ultimate appeal is to human judgment. For these reasons, the objective measurements recommended need to be supplemented by subjective listening tests under the appropriate conditions if a final assessment is to be made.

2.1.9.* IEC RECOMMENDATION, PUBLICATION 225. OCTAVE, HALF-OCTAVE AND THIRD-OCTAVE BAND FILTERS INTENDED FOR THE ANALYSIS OF SOUNDS AND VIBRATIONS (1966).

This Recommendation applies to band filters commonly known as octave, half-octave and third-octave band filters of the passive or active type, the latter including amplifier elements, e.g., tubes, valves and/or transistors.

It specifies the most important characteristics of these filters together with the corresponding tolerances.

The object of the Recommendation is to specify the characteristics of band-pass filters to be used in sound and vibration analysis for which octave and third-octave band-pass filters are preferred.

2.1.10. IEC RECOMMENDATION, PUBLICATION 268-1. SOUND SYSTEM EQUIPMENT PART 1: GENERAL (1968).

This Recommendation applies to sound systems of any kind, and to the parts of which they are composed or which are used as auxiliaries to such systems.

The Recommendation is confined to a description of the different characteristics and the relevant methods of measurement; it does not attempt to specify performance.

The purpose of this Recommendation is to facilitate the determination of the quality of audio-apparatus, the comparison of these types of apparatus and the determination of their proper practical applications, by listing the characteristics which are useful for their specification.

2.1.11. IEC RECOMMENDATION, PUBLICATION 268-1A. FIRST SUPPLEMENT TO PUBLICATION 268-1. SOUND SYSTEM EQUIPMENT. PART 1: GENERAL (1970).

This Recommendation deals with devices intended to give reverberation, time delayed or frequency shift to electroacoustical signals. It covers devices of this kind as generally used for this purpose in sound recording, broadcasting and public address systems.

2.1.12. IEC RECOMMENDATION, PUBLICATION 268-1B. SECOND SUPPLEMENT TO PUBLICATION 268-1. SOUND SYSTEM EQUIPMENT. PART I: GENERAL (1972).

This Recommendation is a second supplement to Publication 268-1, and has been prepared on the basis of material which has since been published in later parts of Publication 268. The purpose of this supplement is to avoid unnecessary repetition of common materials in future parts.

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*The United States National Committee cast a negative vote on this Publication.

2.1.13. IEC RECOMMENDATION, PUBLICATION 268-2. SOUND SYSTEM EQUIPMENT. PART 2: EXPLANATION OF GENERAL TERMS (1971).

The purpose of this Recommendation is to discuss and define the general terms applicable to sound system equipment.

2.1.14. IEC RECOMMENDATION, PUBLICATION 268-3. SOUND SYSTEM EQUIPMENT. PART 3: SOUND SYSTEM AMPLIFIERS (1969).

The Recommendation applies to amplifiers which form the heart of a sound system, i.e., a system for the amplification and distribution of sound via input elements such as microphones and pick-ups and via output elements which are, in general, loudspeakers.

The amplifiers considered are valve amplifiers as well as transistor devices.

The purpose of this Publication is to give recommendations relative to the characteristics to be specified and the relevant measuring methods.

In general, the methods of measurement recommended are those which are seen to be the most directly related to the definitions. This does not exclude the use of other methods which will give equivalent results.

Rated conditions and normal working conditions as specified have been adopted as conditions for specifications and measurements.

2.1.15. IEC RECOMMENDATION, PUBLICATION 268-3A. FIRST SUPPLEMENT TO PUBLICATION 268-3. SOUND SYSTEM EQUIPMENT. PART 3: SOUND SYSTEM AMPLIFIERS (1970).

The purpose of this Recommendation is to include additional information to Clause 16, Output Characteristics, of Publication 268-3 dealing with sound sytem amplifiers.

2.1.16. IEC RECOMMENDATION, PUBLICATION 268-4. SOUND SYSTEM EQUIPMENT. PART 4: MICROPHONES (1972).

This Recommendation applies to sound system microphones in both professional and domestic applications. It gives recommendations relative to the characteristics to be specified and the methods of measurement for sound system microphones, such as wide band microphones, microphones used normally for speech, and close talking microphones. In general the methods of measurement recommended are those which are seen to be the most directly related to the characteristics. This does not exclude the use of other methods which will give equivalent results.

2.1.17. IEC RECOMMENDATION, PUBLICATION 268-5. SOUND SYSTEM EQUIPMENT. PART 5: LOUDSPEAKERS (1972).

This Recommendation applies to sound system loudspeakers in both professional and domestic applications, treated as entirely passive elements. It gives recommendations relative to the characteristics to be specified and the relevant measuring methods for sound system loudspeakers. The methods of measurement recommended are those which are seen to be the most directly related to the characteristics. This does not exclude other methods which will give equivalent results.

2.1.18. IEC RECOMMENDATION, PUBLICATION 268-6. SOUND SYSTEM EQUIPMENT. PART 6: AUXILIARY PASSIVE ELEMENTS (1971).

This Recommendation applies to auxiliary passive elements which shall be understood to include such elements as attenuators, transformers, filters and equalizers, applied as separate units to be combined with other separate sound system units to constitute a complete sound system. It gives recommendations relative to the characteristics to be specified and the relevant measuring methods for auxiliary passive elements for sound system equipment. The methods of measurements recommended are those which are seen to be most directly related to the definitions. This does not exclude the use of other methods which will give equivalent results.

2.1.19. IEC RECOMMENDATION, PUBLICATION 268-14. SOUND SYSTEM EQUIPMENT. PART 14: MECHANICAL DESIGN FEATURES (1971).

This Recommendation applies to dimensional characteristics of single moving-coil (dynamic) loudspeakers of the direct radiator type.

The object of this Recommendation is to secure as great a measure of interchangeability as seems practicable, and to discourage unnecessary divergences.

2.1.20. IEC REPORT, PUBLICATION 303. IEC PROVISIONAL REFERENCE COUPLER FOR THE CALIBRATION OF EARPHONES USED IN AUDIOMETRY (1970).

This report describes an interim reference coupler for loading an earphone with a specified acoustic impedance, when calibrating audiometers, in the frequency range of 125 to 8000 Hz one configuration of this coupler is identical with the National Bureau of Standards 9-A coupler.

The sound pressure developed by an earphone is not, in general, the same in the coupler as in a person's ear. However, the IEC recommends its use as a simple and ready means for the exchange of specifications on audiometers and for the calibration of earphones used in audiometry.

2.1.21. IEC RECOMMENDATION, PUBLICATION 318. AN IEC ARTIFICIAL EAR, OF THE WIDE BAND TYPE, FOR THE CALIBRATION OF EARPHONES USED IN AUDIOMETRY (1970).

This Recommendation relates to the specification of an artificial ear which covers the frequency band 20 to 10000 Hz and is intended for calibrating supra-aural earphones applied to the ear without acoustical leakage. This device is not intended for the calibration of circumaural earphones.

The audiometric artificial ear is a device to permit calibration of earphones used in audiometry and comprises a microphone to measure the sound pressure and an acoustical network so constructed that the acoustical characteristics of the whole approximate to the acoustical characteristics of the mean external human ear.

2.1.22. IEC RECOMMENDATION, PUBLICATION 327. PRECISION METHOD FOR THE PRESSURE CALIBRATION OF ONE-INCH STANDARD CONDENSER MICROPHONES BY THE RECIPROCITY TECHNIQUE (1970).

This Recommendation describes the calibration of one-inch condenser microphones used as laboratory standards. It is restricted to reciprocity pressure calibration by the coupler method.

2.1.23. IEC RECOMMENDATION, PUBLICATION 402. SIMPLIFIED METHODS FOR PRESSURE CALIBRATION OF ONE-INCH CONDENSER MICROPHONES BY THE RECIPROCITY TECHNIQUE (1972).

This Recommendation describes a simplified technique for calibration of condenser microphone cartridges, commonly known as one-inch microphones, based upon reciprocity pressure calibration by the coupler method.

The object of this Recommendation is to specify a method of absolute pressure calibration of one-inch condenser microphones used in laboratories for conventional measuring purposes, without requiring the highest obtainable accuracy. The frequency range of the calibration is restricted to 50 Hz-10 kHz.

The calibration method described is based on the reciprocity technique using air in a closed cavity as the coupling medium between the microphones. The calibration procedure is simplified -- at the expense of the total accuracy of the calibration -- in order that the calibration can be carried out without using the most advanced instrumentation and techniques. The error introduced by using this simplified method is estimated to be less than 0.3 dB.

Procedures giving a higher accuracy of calibration are described in IEC Publication 327: Precision Method for Pressure Calibration of One-inch Standard Condenser Microphones by the Reciprocity Technique.

2.2. Draft Proposals for New Standards

2.2.1. PRECISION METHOD FOR FREE-FIELD CALIBRATION OF ONE-INCH STANDARD CONDENSER MICROPHONES BY THE RECIPROCITY TECHNIQUE.

Document No. IEC/TC 29/SC 29C (Secretariat) 7.

3. American National Standards Institute (ANSI)

3.1. Summary of Standards

The majority of the standards listed in this section were sponsored by the Acoustical Society of America. The few exceptions are individually noted.

3.1.1. ANSI S1.1-1960 (R1971). AMERICAN NATIONAL STANDARD ACOUSTICAL TERMINOLOGY.

The purpose of this Standard is to establish standard acoustical terminology.

3.1.2. ANSI S1.2-1962 (R1971). AMERICAN NATIONAL STANDARD METHOD FOR THE PHYSICAL MEASUREMENT OF SOUND (PARTIALLY REVISED BY S1.13-1971 AND BY S1.21-1972).

This Standard applies primarily to airborne sound produced by apparatus which normally operates in air. These sounds must be nonimpulsive and of sufficient duration to be with the dynamic measuring capabilities of the instruments used. It applies primarily to apparatus which radiates sound as a by-product of its primary function. However, the general principles apply also to other sources of sound.

If the microphone used to perform the sound-pressure-level measurements is immersed in a moving air stream of appreciable velocity, or exposed to high temperatures or other adverse local environmental conditions, special precautions must be taken, a discussion of which is beyond the scope of this Standard.

3.1.3. ANSI S1.4-1971. AMERICAN NATIONAL SPECIFICATION FOR SOUND LEVEL METERS.

The sound level meter is intended to be equally sensitive to sounds arriving at various angles, and to provide an accurate measurement of sound level with certain weightings for sound within stated ranges and with an indicating instrument that has standardized characteristics. The basic calibration of the sound level meter is given in terms of a random-incidence acoustic field of known properties.

It is recognized that various degrees of precision and accuracy are required in the practical measurement of sounds of various kinds for different purposes. Hence, this Standard provides the minimum requirements for three basic types of sound level meters: Types 1, 2, and 3, with performance requirements that become progressively less stringent, preceeding from Type 1 to Type 3. Further, it is recognized that sound level meters may be desired for special purposes that do not require the complexity of any of the three basic types. Therefore, provision is made for a special purpose sound level meter, Type S. The Type S meter can be qualified to the performance of any of the basic types (1, 2, 3) but is not required to have all three weighting networks.

3.1.4. ANSI S1.5-1963 (R1971). AMERICAN NATIONAL STANDARD RECOMMENDED PRACTICES FOR LOUDSPEAKER MEASUREMENTS.

These recommended practices define terms associated with loudspeakers and their testing, recommend various methods of testing, and indicate preferred methods of presenting information regarding their characteristics. Specific information is presented in Secs. 2-7. Discussions of a more qualitative nature are given in Secs. 8 and 9.

In these practices, the tests recommended involve physical, steady-state measurements only. Work has been and is now being done on transient measurements of loudspeaker performance, but experience with these methods is still not sufficiently widespread to warrant their inclusion.

While the physical data which can be obtained as detailed in Secs. 4-9, inclusive, are a helpful guide in designing and in selecting a loudspeaker for a certain purpose, they are not a complete guarantee that the subjective performance will be satisfactory. Wherever it is possible, the quality of reproduction should be checked by means of listening tests such as those described in the literature.

3.1.5. ANSI S1.6-1967 (R1971). AMERICAN NATIONAL STANDARD PREFERRED FREQUENCIES AND BAND NUMBERS FOR ACOUSTICAL MEASUREMENTS.

For certain acoustical measurements a constant-frequency increment is a suitable spacing. More commonly, however, a constant-percentage increment is adopted and the test frequencies then form a geometric series. This Standard deals with the geometric series. The present Standard is not concerned with frequencies for music.

3.1.6. ANSI S1.8-1969. AMERICAN NATIONAL STANDARD PREFERRED REFERENCE QUANTITIES FOR ACOUSTICAL LEVELS.

This Standard is concerned with the reference quantities for, and definitions of, some levels for acoustics, electroacoustics, and mechanical vibrations. It applies to oscillatory quantities.

The use of levels is not made mandatory by this Standard. It simply provides standard reference quantities for use when, and if, levels are employed for reasons beyond the scope of the Standard.

Reference quantities are stated in units of the International System (Systéme International S1), and also in centimeter-gram-second (cgs) and British units. The reference quantities are, however, applicable regardless of the system of units employed.

Certain symbols and abbreviations not already standardized were needed, and have been employed here simply for illustrative purposes. The present Standard is intended to encourage uniformity of practice by specifying a definition for a level likely to be employed in acoustics. The purpose of this Standard is to provide a preferred reference quantity of convenient magnitude for a given kind of acoustical level.

3.1.7. ANSI S1.10-1966 (R1971). AMERICAN NATIONAL STANDARD METHODS FOR THE CALIBRATION OF MICROPHONES.

In this Standard, methods are described for performing absolute and comparison calibrations of laboratory standard microphones specified in American Standard Specification for Laboratory Standard Pressure Microphones, Z24.8-1949. Absolute calibration is based upon the reciprocity principle. Techniques for performing pressure (coupler), free-field, and random-field calibrations are described, including experimental procedures. The free-field and random-field calibration techniques may also be used for calibrating microphones not described in American Standard Z24.8-1949.

3.1.8. ANSI S1.11-1966 (R1971). AMERICAN NATIONAL STANDARD SPECIFICATION FOR OCTAVE, HALF-OCTAVE, AND THIRD-OCTAVE BAND FILTER SETS.

The purpose of this Standard for filter sets is to specify particular bandwidths and characteristics which may be used to ensure that all analyses of noise will be consistent within known tolerances when made with similar filter sets meeting these specifications.

The Standard for filter sets is suited to the requirements for analyzing, as a function of frequency, a broad-band electrical signal. For acoustical measurements an electroacoustic transducer and amplifier are employed to convert the acoustic signal to be analyzed into the required electrical signal.

3.1.9. ANSI S1.12-1967 (R1972). AMERICAN NATIONAL STANDARD SPECIFICATIONS FOR LABORATORY STANDARD MICROPHONES.

This Standard describes types of laboratory microphones that are suitable for calibration by an absolute method such as the reciprocity technique described in U.S. Standard Method for the Calibration of Microphones, S1.10-1966. These microphones are intended for use as acoustical measurement standards either in a free-field or in conjunction with a variety of devices such as artificial voices and couplers for calibrating earphones or microphones.

Note: The reciprocity method of calibration is an absolute method; that is, it involves only basic physical measurements. The microphones calibrated by this method, therefore, become reference-standard or working-standard instruments.

Specifications for an ideal laboratory standard microphone are given in Sec. 3 and characteristics of practical laboratory standard microphones are described in Sec. 4.

3.1.10. ANSI S1.13-1971. AMERICAN NATIONAL STANDARD METHODS FOR THE MEASUREMENT OF SOUND PRESSURE LEVELS. (Partial revision of S1.2-1962).

General recommendations are given to assist in the development of noise measurement techniques that are satisfactory for use under various environmental conditions.

The measurement of sound produced by sources which radiate directly into the air is given first priority. The airborne sound pressures may be partially attributable to sound transmission along structural pathways and reradiation from solid (or fluid) bodies.

Primary consideration is given to the measurement of sound created as a by-product of the principle function of the source. The methods may also be applied to other sources which are intended to generate sound. For example, measurements may be desired of the sound pressure generated by an alarm device operating in the presence of multiple noise sources.

This Standard does not consider sound-pressure-level measurements which are obtained for the purpose of determining the sound power radiated by a source.

The purpose of this Standard is to provide uniform guidelines for measuring and reporting sound-pressure levels observed under different environmental conditions. This Standard is applicable to the many different types of sound-pressure-level measurements commonly encountered in practice. This Standard is intended to assist in the preparation of test codes for (1) determining compliance with a specification, ordinance, or acoustical criterion, and (2) obtaining information to assess the effects of noise on people or equipment.

3.1.11. ANSI S1.21-1972. AMERICAN NATIONAL STANDARD METHODS FOR THE DETERMINATION OF SOUND POWER LEVELS OF SMALL SOURCES IN REVERBERATION ROOMS. (Revision of Section 3.5 of S1.2-1962.)

This Standard describes a direct method and a comparison method for determining the sound power level produced by a source. This Standard contains test room requirements, source locations and operating conditions, instrumentation, and techniques for obtaining an estimate of the mean-square sound pressure from which the sound power level of the source in octave or one-third-octave bands is calculated. It is intended to provide techniques for acoustical measurements that can be used in test codes for particular types of equipment.

This Standard applies primarily to the measurement of sound that is uniformly distributed in frequency over the frequency range of interest and is relatively steady for at least 30 sec. The spectrum of the sound may, however, also include prominent discrete-frequency components or narrow bands.

When the sound contains significant narrow-band or discrete-frequency sound, determination of the sound power level in a reverberation room requires the use of a greater number of source locations and microphone positions (or a greater path length of a moving microphone). The required numbers of locations and positions depend upon the desired accuracy, the spectrum of the radiated noise, and the properties of the test room. These numbers can usually be reduced if one or more rotating diffusers are operated in the test room during the measurements. Guidelines for the design of suitable rotating diffusers are given in Appendix B. The use of rotating diffusers reduces the effort required to make measurements on sources that emit discrete-frequency components. If the source emits primarily discrete-frequency sound below 200 Hz, this Standard may not be suitable and a free-field measurement should be considered.

3.1.12. ANSI S3.1-1960 (R1971). AMERICAN NATIONAL STANDARD CRITERIA FOR BACKGROUND NOISE IN AUDIOMETER ROOMS.

This Standard specifies the maximum ambient sound-pressure levels in an audiometer room that will produce negligible masking of tones presented at the normal threshold pressures specified in American National Standard Audiometers for General Diagnostic Purposes, Z24.5-1951, and American National Standard Specification for Pure-Tone Audiometers for Screening Purposes, Z24.12-1952.

This Standard pertains to earphone listening and pure-tone audiometry. Cushions and earphones not described in American Standards Z24.5-1951 and Z24.12-1952 are specifically excluded.

3.1.13. ANSI S3.2-1960 (R1971). AMERICAN NATIONAL STANDARD METHOD FOR MEASUREMENT OF MONOSYLLABIC WORD INTELLIGIBILITY.

This Standard describes the procedures to be followed in conducting intelligibility tests which employ monosyllabic word lists.

The purpose of this Standard is (1) to specify the speech material and the methods to be used in these tests, and (2) to note the variables to be controlled during the measurement and to be evaluated in the report.

3.1.14. ANSI S3.3-1960 (R1971). AMERICAN NATIONAL STANDARD METHODS FOR MEASUREMENT OF ELECTROACOUSTICAL CHARACTERISTICS OF HEARING AIDS.

The purpose of this Standard is to describe practicable and reproducible methods of determining certain physical performance characteristics of air-conduction hearing aids that use electronic amplification and acoustic coupling to the ear canal by means of ear inserts, e.g., ear molds or similar devices. This Standard does not apply when automatic gain control is in use. The methods specified here give information on the measurement of:

	Section
Characteristic of the gain control (optional)	5.2
Effect of tone-control positions on frequency response	5.4
Frequency response of the hearing aid	5.5
Saturation sound-pressure level in the coupler	5.6
Full-on acoustic gain	5.7
Effect of power-supply voltage variation on acoustic gain (optional)	5.8
Harmonic distortion	5.9
Battery current	5.10

The acoustical test procedure is based on the free-field technique, in which the hearing aid is placed in a plane progressive wave with the earphone coupled to a standardized coupler.

The results obtained by the methods specified herein express the performance under the conditions of the test, but will not necessarily agree exactly with the performance of the hearing aid under practical conditions of use. For this reason, the difference between practical and test conditions must be borne in mind in interpreting the test results.

3.1.15. ANSI S3.4-1968 (R1972). AMERICAN NATIONAL STANDARD PROCEDURE FOR THE COMPUTATION OF LOUDNESS OF NOISE.

This Standard specifies a procedure for calculating the loudness experienced by a typical listener under the following conditions:

Diffuse Field. The sound is assumed to reach the listener's ears from essentially all directions. This condition is approximated in an ordinary room.

Spectrum. The procedure is designed specifically for noise with broad-band spectra. Errors may arise if it is applied to noises with sharp line spectral components, e.g., fan-blade noise.

Steady State. The procedure is designed for noises that are steady state rather than intermittent. Application to certain types of intermittent sounds, e.g., impact sounds and speech, may lead to discrepancies between measured and calculated loudness levels. The magnitude of the discrepancy will be related to the dynamic characteristics of the sound level meter used to determine the sound-pressure levels.

Note 1: Since the loudness of a sound depends upon the nature of the enclosure in which it is heard, it is important that comparative evaluations of different noise sources should be based on measurements made in essentially similar enclosures.

Note 2: The band levels in the diffuse field should be measured by means of an omnidirectional microphone located in the unobstructed sound field at the position of the listener's head.

3.1.16. ANSI S3.5-1969. AMERICAN NATIONAL STANDARD METHODS FOR THE CALCULATION OF THE ARTICULATION INDEX.

Methods have been developed for computing a physical measure that is highly correlated with the intelligibility of speech as evaluated by speech preception tests administered to a given group of talkers and listeners. This measure is called the Articulation Index, AI. The AI is a weighted fraction representing, for a given speech channel and noise condition, the effective proportion of the normal speech signal that is available to a listener for conveying speech intelligibility. AI is computed from acoustical measurements or estimates of the speech spectrum and of the effective masking spectrum of any noise which may be present along with the speech at the ear of a listener.

The method described in this Standard is designed for and has been principally validated against intelligibility tests involving adult male talkers. The method cannot, therefore, be assumed to apply to situations involving female talkers or children. The purpose of this Standard is to prescribe procedures for computing an AI and to provide functions relating to AI and speech intelligibility scores obtained with male talkers.

3.1.17. ANSI S3.6-1969. AMERICAN NATIONAL STANDARD SPECIFICATIONS FOR AUDIOMETERS.

The audiometers covered by this specification are devices designed for use in determining the hearing threshold level of an individual in comparison with a chosen standard reference threshold level, primarily for the purpose of identification of hearing deficiencies of the individual.

Effective 1 September 1970, this standard replaces three previous American National Standard specifications: Audiometers for General Diagnostic Purposes, Z24.5-1951; Pure-Tone Audometers for Screening Purposes, Z24.12-1952; and Speech Audiometers Z24.13-1953.

Prior to 1965, many laws and administrative rules and regulations relating to the impairment of hearing, to minimum requirements for hearing in military service, to audiometric screening levels in school systems, to admission to schools for the deaf, etc., were written in terms of decibels, usually without explicit statement of any reference level. In addition, unwritten practices under certain other laws have been developed for expressing permanent hearing disability in terms of decibels relative to audiometric zero. It should be clear that the intent in all such situations was to refer to ANSI Z24.5-1951. Furthermore, it should be clear that the intent was always to specify a particular set of physical sound pressure levels that the listener would or would not be able to hear or at which screening tests should be carried out. The adoption of the Table 2 of this Standard must not be interpreted as altering these previously implied physical sound-pressure levels for specific purposes. These sound-pressure levels can be expressed equally well on the scale of Table 2, and it is hoped that each organization will redefine its laws, rules, regulations, or practices in terms of the levels of Table 2. Until this is done, however, all levels measured by the scale of Table 2 must be translated to the ANSI Z24.5-1951 scale before the law, rule, regulation, or practice in question is applied. In this way, the original intent will be preserved in each case.

Similar conversions to ANSI Z24.5-1951 values shall be made before applying the specifications as to hearing loss mentioned in American National Standard Method for the Measurement of Real-Ear Attenuation of Ear Protectors at Threshold, Z24.22-1957, and also the specifications in American National Standards Criteria for Background Noise in Audiometer Rooms, S1.3-1960.

Audiometric measurements may be made either by the use of pure tones or by the use of spoken material. This differentiates two general classes of audiometers: (1) the pure-tone audiometer, and (2) the speech audiometer. Changes of test material and of sound-pressure level, and the recording of results, may be performed automatically. An audiometer may be equipped to serve both as a pure tone audiometer and as a speech audiometer. (currently being revised)

3.1.18. ANSI S3.8-1967 (R1971). AMERICAN NATIONAL STANDARD METHOD OF EXPRESSING HEARING AID PERFORMANCE.

The purpose of this Standard is to provide a uniform method of numerically and graphically expressing certain fundamental performance characteristics of hearing aids in a simple manner, so that those using such data can be assured of their meaning.

All quantities to be specified in this Standard shall be based on measurements made in accordance with U.S. Standard Methods for Measurement of the Electroacoustical Characteristics of Hearing Aids, S3.3-1960.

3.1.19. ANSI S3.13-1972. AMERICAN NATIONAL STANDARD ARTIFICIAL HEAD-BONE FOR THE CALIBRATION OF AUDIOMETER BONE VIBRATORS.

The purpose of this Standard is to specify the mechanical impedance characteristic of an artificial headbone that would be incorporated into devices used in calibrating audiometer bone vibrators. The Standard also specifies the vibrator tip size and shape, as well as the static force of application for which the standardized mechanical impedance characteristics apply. The characteristics of an interim head-bone device presently used for audiometer bone-vibrator calibration are stated in Appendix A and corresponding interim reference threshold levels are given.

3.1.20. ANSI Y10.11-1953. AMERICAN NATIONAL STANDARD LETTER SYMBOLS FOR ACOUSTICS. (This Standard was sponsored by ASME).

This Standard comprises leter symbols for use in acoustics.

3.1.21. ANSI Y32.18-1972. AMERICAN NATIONAL STANDARD SYMBOLS FOR MECHANICAL AND ACOUSTICAL ELEMENTS AS USED IN SCHEMATIC DIAGRAMS. (This Standard was sponsored by ASME).

This document presents standard symbols and definitions that may be used in constructing schematic diagrams for mechanical and acoustical systems whose performances are describable by finite sets of scalar variables.

3.1.22.*ANSI Z24.9-1949 (R1971). AMERICAN NATIONAL STANDARD METHODS FOR THE COUPLER CALIBRATION OF EARPHONES. (This Standard will be redesignated as an "S" Standard).

The purpose of this Standard is to describe a practical and reproducible method of evaluating the performance characteristics of an earphone by means of physical measurements of the earphone in conjunction with a standard terminating volume known as the "coupler".

The method is adequate for controlling the characteristics over the frequency range most useful for speech, i.e., 300 to 5000 cycles per second. Limitations of this method are discussed in 3.2.1, Type-1 Coupler.

This Standard specifies a number of couplers, each of which is suitable for a certain type of earphone. No one of these couplers is suitable for all of the different types. Test laboratories are expected to select the coupler which is most suitable for each particular instrument, in order that their results may be comparable with those obtained for other instruments of the same general type but of different manufacture.

The selection of the pressure microphone to be used for measuring the sound pressure in the coupler will depend upon the magnitude of the sound pressure, the range of frequency to be covered by the test, and the acoustical impedance of the diaphragm. Suitable pressure microphones are described in the American Standard Specification for Laboratory Standard Pressure Microphones, Z24.8-1949. The basic research leading to the establishment of the couplers in this Standard was done with the Type-L microphone of that Standard. The use of other standard microphones might lead to differences in the measured results and when intercomparison of data is desired these differences should be established for a particular design of earphone.

The method for the calibration of the microphones is described in the American Standard Method for the Pressure Calibration of Laboratory Standard Pressure Microphones, Z24.4-1949. Drawings and test procedures, as well as other pertinent information, have been included as an aid to designers in setting up the tests.

3.1.23. ANSI Z24.22-1957(R1971). AMERICAN NATIONAL STANDARD METHOD FOR THE MEASUREMENT OF THE REAL-EAR ATTENUATION OF EAR PROTECTORS AT THRESHOLD. (This Standard will be redesignated as an "S" Standard).

This Standard specifies the physical requirements, psychophysical procedures, and means of reporting results for measuring the real-ear attenuation at threshold of any wearable device that is designed to protect the auditory system against excessive sound.

Tests described in this Standard are designed to measure only real-ear attenuation at threshold. The quality of an ear protector cannot be decided on the basis of such tests alone; other factors must be taken into account, such as toxicity of the material used, sanitation, comfort in use, and the ability to maintain effective attenuation in use.

Tests described in this Standard for real-ear attenuation at threshold are meant to be applied when the effectiveness of a completely developed ear protector is to be ascertained. There are other quicker and less involved procedures not described in this Standard that may be used by manufacturers and others in the development of new ear protector designs or materials. Such methods include loudness balance techniques and physical tests with an artificial head.

*This Standard was replaced with S3.7 on January 18, 1973.

3.2. Draft Proposals for New Standards

3.2.1.* ANSI S3.7-1972. AMERICAN NATIONAL STANDARD METHOD FOR COUPLER CALIBRATION OF EARPHONES. (A revision of ANSI Z24.9-1949).

3.2.2. ANSI S3.17-1972. AMERICAN NATIONAL STANDARD METHODS FOR RATING THE SOUND POWER SPECTRA OF SMALL STATIONARY NOISE SOURCES.

*S3.7 became a standard on January 18, 1973 and replaces Z24.9.

4. American Society for Testing and Materials (ASTM)

4.1. Summary of Standards

4.1.1. ASTM DESIGNATION: C384-58. STANDARD METHOD OF TEST FOR IMPEDANCE AND ABSORPTION OF ACOUSTICAL MATERIALS BY THE TUBE METHOD.

This Method of Test is limited to the use of apparatus consisting of a tube of uniform cross-section and fixed length, terminated by a specimen of acoustical material, excited by a single tone of selectable frequency, in which the standing wave pattern in front of the specimen upon which plane waves impinge at normal indicence is explored by means of a moving probe tube or microphone. This tube method provides absolute measurement of the normal incidence sound absorption coefficient and the specific normal acoustic impedance of a material. Normal incidence coefficients, as measured by this method, are considerably lower than random incidence values, which more closely represent the performance of the material in a room; and there is no simple, unique relation between the two values. Means of estimating random incidence values from the measured normal incidence data are given in Appendix I. (currently being revised).

4.1.2. ASTM DESIGNATION: C423-66. STANDARD METHOD OF TEST FOR SOUND ABSORPTION OF ACOUSTICAL MATERIALS IN REVERBERATION ROOMS (ANSI S1.7-1970).

This Method covers the measurement of the sound absorption of acoustical materials in a diffuse sound field. When a material is in the form of an extended plane surface, such as an acoustical ceiling or wall treatment, the results shall be given as sound absorption coefficients. When the materials are separate objects, such as theater chairs or unit sound absorbers, the results shall be given in sabins per unit with a description of the number and spacing of the units.

4.1.3. ASTM DESIGNATION: C634-69. STANDARD DEFINITIONS OF TERMS RELATING TO ACOUSTICAL TESTS OF BUILDING CONSTRUCTIONS AND MATERIALS.

This standard lists the terms commonly associated with the acoustical tests of buildings. In some of the entries, those that are measures of physical quantities, the associated symbol dimensions and units are given.

4.1.4. ASTM DESIGNATION: E90-70. STANDARD RECOMMENDED PRACTICE FOR LABORATORY MEASUREMENT OF AIRBORNE SOUND TRANSMISSION LOSS OF BUILDING PARTITIONS.

This Recommended Practice covers the laboratory measurement of airborne sound transmission loss of building partitions such as walls of all kinds, floor-ceiling assemblies, doors, and other space-dividing elements. The sound transmission loss is defined in terms of a diffuse incident sound field, and this is intrinsic to the test procedure. The results are most directly applicable to similar sound fields, but provide a useful general measure of performance of the variety of sound fields to which a partition may typically be exposed.

4.1.5. ASTM DESIGNATION: E336-71. STANDARD RECOMMENDED PRACTICE FOR MEASUREMENT OF AIRBORNE SOUND INSULATION IN BUILDINGS.

This Recommended Practice establishes uniform procedures for the determination of field transmission loss, that is, the airborne sound insulation provided by a partition already installed in a building. It also establishes, in Appendix A1, a standard method for the measurement of the noise reduction between two rooms in a building, that is, the difference in average sound pressure levels in the rooms on opposite sides of the test partition. Where the test structure is a complete enclosure out-of-doors, neither the field transmission loss nor the noise reduction is appropriate; instead, a method is established for determining the insertion loss, also in Appendix A1. This Recommended Practice gives measurement procedures for determining the field transmission loss in nearly all cases that may be encountered in the field; no limitation to room-to-room transmission is intended. Thus, several different test procedures are given, each suited to a specific type of measurement situation; the appropriate measurement procedure must be selected for each field test according to the type of situation which that particular case most closely resembles.

4.1.6. ASTM DESIGNATION: E413-70T. TENATIVE CLASSIFICATION FOR DETERMINATION OF SOUND TRANSMISSION CLASS.

The purpose of this Classification is to provide a single-figure rating that can be used for comparing partitions for general building design purposes. The rating is designed to correlate with subjective impressions of the sound insulation provided against the sounds of speech, radio, television, music and similar sources of noise in offices and dwellings. Excluded from the scope of this classification system are applications involving noise spectra that differ markedly from those described above. Thus excluded, for example, would be the noises produced by most machinery, certain industrial processes, bowling alleys, power transformers, and the like. A particular exclusion would be the exterior walls of buildings, for which noise problems are most likely to involve motor vehicles or aircraft. In all such problems it is best to use the detailed sound transmission loss values, in conjunction with actual spectra of intrusive and ambient noise.

4.1.7. ASTM PROPOSED METHOD (RM-14-4). PROPOSED METHOD OF LABORATORY MEASUREMENT OF IMPACT SOUND TRANSMISSION THROUGH FLOOR CEILING ASSEMBLIES USING THE TAPPING MACHINE (1971).

This method covers a laboratory method of measuring impact sound transmission of floor-ceiling assemblies, wherein it is assumed that the test specimen constitutes the primary sound transmission path into a receiving room located directly below and in which there exists a diffuse sound field. Measurements may be conducted on floor-ceiling assemblies of all kinds, including those with floating-floor or suspended ceiling elements, or both, and floor-ceiling assemblies surfaced with any type of floor-surfacing or floor-covering materials. This method further prescribes: a uniform method of reporting laboratory test data, and a single-figure classification rating, "Impact Insulation Class, IIC" that can be used by architects, builders, and specification and code authorities for acoustical design purposes in building construction. Details regarding its derivation and significance are given in Appendix A1.(currently being balloted for advancement to a tentative standard).

4.2. Draft Proposals for New Standards

4.2.1. STANDARD METHOD OF TESTING DUCT LINER MATERIALS AND PREFABRICATED SILENCERS FOR ACOUSTICAL AND AIRFLOW PERFORMANCE.

4.2.2. TENTATIVE RECOMMENDED PRACTICE FOR APPLICATION PROCEDURES AND DETAILS FOR FIXED PARTITIONS OF LIGHT FRAME TYPES IN REGARD TO SOUND.

5. Society of Automotive Engineers (SAE)

5.1. Summary of Standards

5.1.1. SAE RECOMMENDED PRACTICE J184. QUALIFYING A SOUND DATA ACQUISITION SYSTEM (1970).

Various SAE vehicle noise standards require use of a sound level meter which meets the requirements of International Electrotechnical Commission (IEC) Publication 179, Precision Sound Level Meters, and American National Standard (ANSI) S1.4-1961, Sound Level Meters. The purpose of this Recommended Practice is to provide a procedure for determining if an acoustical data acquisition system has performance equivalent to such a meter.

5.1.2. SAE RECOMMENDED PRACTICE J192. EXTERIOR SOUND LEVEL FOR SNOWMOBILES (1970).

This SAE Recommended Practice establishes the maximum exterior sound level for snowmobiles and describes the test procedure, environment, and instrumentation for determining this sound level.(currently being revised).

5.1.3. SAE STANDARD J336. SOUND LEVEL FOR TRUCK CAB INTERIOR (1971).

This SAE Recommended Practice suggests design criteria for maximum truck cab interior sound levels and describes the equipment and procedure for determining this sound level. This Practice applies to new motor trucks and truck-tractors and does not include construction and industrial machinery as outlined in SAE J919a. (currently being revised).

5.1.4. SAE STANDARD J366a. EXTERIOR SOUND LEVEL FOR HEAVY TRUCKS AND BUSES (1971).

This SAE Recommended Practice establishes the maximum exterior sound level for highway motor trucks, truck-tractors, and buses, and describes the test procedure, environment, and instrumentation for determining the maximum sound level.

The sound level, A-weighted, produced by trucks and buses of gross vehicle weight over 6000 lb. shall not exceed 88 dB at a 50 foot distance when measured in accordance with the procedure described (currently being revised).

5.1.5. SAE STANDARD J377. PERFORMANCE OF VEHICLE TRAFFIC HORNS (1969).

This SAE standard establishes the minimum operational life cycles, corrosion resistance, and sound level output for traffic horns (electric) on new automotive highway vehicles. Test equipment, environment, and procedures are specified.

5.1.6. SAE STANDARD J671. SOUND DEADENERS AND UNDERBODY COATINGS (1958).

The materials classified under this Specification are:

a. Mastic sound deadeners used to reduce the sound emanating from metal panels.
b. Mastic underbody coatings used to give protection and some sound deadening to motor vehicle underbodies, fenders, and other parts.

5.1.7. SAE STANDARD J672a. EXTERIOR LOUDNESS EVALUATION OF HEAVY TRUCKS AND BUSES (1970).

This SAE Standard establishes the design criteria for loudness of highway trucks, buses, and truck-tractors exceeding 6000 lb gvw; it describes the equipment, test environment, and procedure for determining the loudness. In this Method, the sound level is recorded on a tape recorder at a test site as the truck passes by under load. The sound thus recorded is played back through a set of octave bandpass filters. The peak band pressure level readings are converted to sones by established relationships. The sones are then totaled to obtain a single loudness reading for the vehicle.

5.1.8. SAE RECOMMENDED PRACTICE J919a. SOUND LEVEL MEASUREMENTS AT THE OPERATOR STATION FOR AGRICULTURAL AND CONSTRUCTION EQUIPMENT (1971).

This SAE Recommended Practice sets forth the instrumentation and procedure to be used in measuring sound levels at the operator station for agricultural and construction equipment, including mobile outdoor industrial equipment.

5.1.9. SAE STANDARD J952b. SOUND LEVELS FOR ENGINE POWERED EQUIPMENT (1969).

This SAE Standard establishes maximum sound levels for engine powered equipment and describes the test procedure, environment, and instrumentation for determining these sound levels. It does not include machinery designed for operation on highways or within factories and building areas. (currently being revised).

5.1.10. SAE STANDARD J986a. SOUND LEVEL FOR PASSENGER CARS AND LIGHT TRUCKS (1970).

This SAE Standard establishes the maximum sound level for passenger cars and light trucks and describes the test procedure, environment, and instrumentation for determining this sound level. (currently being revised).

5.1.11. SAE RECOMMENDED PRACTICE J994a. CRITERIA FOR BACKUP ALARM DEVICES (1972).

This SAE Recommended Practice establishes criteria for backup alarm devices on construction and mobile outdoor industrial machinery. It also establishes the equipment and procedure to be used when making such measurements as well as sound level intensity, alarm activation and mounting.

The scope of construction and industrial machinery encompasses only mobile equipment, powered by internal combustion engines and generally utilized outside factory and building areas, such as crawler tractors, dozers, loaders, power shovels and cranes, motor graders, paving machines, off-highway trucks, ditchers, trenchers, compactors, scrapers, and wagons. (currently being revised).

5.1.12. SAE AEROSPACE RECOMMENDED PRACTICE ARP 796. MEASUREMENT OF AIRCRAFT EXTERIOR NOISE IN THE FIELD (1965).

The purpose of this Recommended Practice is to define measurement techniques and equipment for acquisition and reduction of basic data on aircraft exterior noise. It is not its purpose to propose use of these techniques or this equipment for research or monitoring-type tests. (currently being revised).

5.1.13. SAE AEROSPACE RECOMMENDED PRACTICE ARP 865A. DEFINITIONS AND PROCEDURES FOR COMPUTING THE PERCEIVED NOISE LEVEL OF AIRCRAFT NOISE (1969).

This SAE Recommended Practice gives definitions and procedures for computing the perceived noise level of aircraft noise. The perceived noise level is a single number rating of the noise based upon objective acoustic measurements which is related to the relative subjective response to the noise. The perceived noise level, as defined in this document, is based only on the noise spectra measured in octave or one-third octave bands of frequency. As such, it is most accurate in rating broadband sounds of similar time duration which do not contain strong discrete frequency components.

When additional factors such as the duration and the presence of discrete frequency components are to be taken into account, the effective perceived noise level (EPNL) may be a preferred measure.

5.1.14. SAE AEROSPACE RECOMMENDED PRACTICE ARP 866. STANDARD VALUES OF ABSORPTION AS A FUNCTION OF TEMPERATURE AND HUMIDITY FOR USE IN EVALUATING AIRCRAFT FLYOVER NOISE (1964).

This report describes a method by which values can be obtained for the absorption of sound in air over a wide range of temperature and humidity conditions. Although it was developed primarily for use in evaluating aircraft fly-over noise measurements, the information should be applicable to other noise problems as well.

There are a number of factors which influence the propagation of aircraft noise from an aircraft flying overhead to a point on the ground. The purpose here, however, is to consider only the classical and molecular absorption of sound energy by the atmosphere. It is felt that spherical divergence, scattering, refraction, and other effects should be treated separately, (currently being revised).

5.1.15. SAE AEROSPACE RECOMMENDED PRACTICE ARP 1071. DEFINITIONS AND PROCEDURES FOR COMPUTING THE EFFECTIVE PERCEIVED NOISE LEVEL FOR FLYOVER AIRCRAFT NOISE (1972).

The effective perceived noise level, EPNL, specified in units of EPNdB, is a single number measure calculated from objective acoustic measurements in accordance with the procedures defined in this document. It is calculated from a time sequence of tone-adjusted perceived noise levels which are calculated from one-third octave band noise spectra. The tone adjustments are determined from one-third octave band spectra, by a procedure which estimates the extent of discrete frequency (tone) components from irregularities in the shape of the one-third octave band noise spectra.

5.1.16. SAE AEROSPACE RECOMMENDED PRACTICE ARP 1080. FREQUENCY WEIGHTING NETWORK FOR APPROXIMATION OF PERCEIVED NOISE LEVEL FOR AIRCRAFT NOISE (1969).

This Aerospace Recommended Practice specifies a frequency weighting network which may be used for the approximation of Perceived Noise Level.

There has been an increasing desire for the definition of a frequency weighting network which could be incorporated into direct reading and other instruments for an estimate of the Perceived Noise Level of an aircraft flyover. The 40-Noy noisiness contour of ARP 865A, Definitions and Procedures for Computing the Perceived Noise Level of Aircraft Noise, has been selected as the most representative for this purpose.

5.1.17. SAE AEROSPACE INFORMATION REPORT AIR 817. A TECHNIQUE FOR NARROW BAND ANALYSIS OF A TRANSIENT (1967).

This SAE Report describes a technique for analyzing a transient signal of short duration. The standard method of analyzing tape recorded signals of only a few seconds duration is the "loop method". The magnetic tape is cut and spliced to form an endless loop, and the loop is replayed with the aid of a tensioning device. Difficulty arises with transient signals when the length of tape required to make a loop covers a time over which there is a considerable variation. The principle of the system described is that of expanding the timebase of the signal to a point at which there is a length of tape sufficient to make a loop across which the signal is essentially constant. Although the method is one which has been used specifically for the analysis of aircraft flyover noise, it could equally well apply to other transient signals.

5.1.18. SAE AEROSPACE INFORMATION REPORT AIR 852. METHODS OF COMPARING AIRCRAFT TAKEOFF AND APPROACH NOISE (1965).

It is the purpose of this Information Report to describe a method for rating complex aircraft noises or noise flyover cycles which cannot be handled by means of mathematical formulae by comparing them with simpler aircraft noises or noise flyover cycles which can be handled by mathematical formulae.

The report describes the need for an objective means for rating aircraft noise and recommends areas which should be investigated.

5.1.19. SAE AEROSPACE INFORMATION REPORT AIR 876. JET NOISE PREDICTION (1965).

This SAE Report provides calculation procedures for predicting maximum fly-by noise and maximum static ground operation noise from jet aircraft. Three types of engine exhausts are considered:

a. Turbojet with standard circular nozzle.
b. Turbojet with nonstandard nozzle.
c. Turbofan or bypass engine with (1) unmixed exhausts or (2) completely mixed exhausts.

Noise predictions are in terms of octave-band sound pressure levels of maximum air-to-ground fly-by noise or of maximum ground-to-ground side-line noise. These levels may be converted to an over-all sound pressure level or to a subjective rating such as Perceived Noise Level.

5.1.20. SAE AEROSPACE INFORMATION REPORT AIR 902. DETERMINATION OF MINIMUM DISTANCE FROM GROUND OBSERVER TO AIRCRAFT FOR ACOUSTIC TESTS (1966).

This SAE Report describes a photographic technique for determining minimum observer-to-aircraft distance during acoustic "fly-over" tests. Possible sources of error are discussed, and it is shown that with ordinary care results are sufficiently accurate to require no correction.

5.1.21. SAE AEROSPACE INFORMATION REPORT AIR 923. METHOD FOR CALCULATING THE ATTENUATION OF AIRCRAFT GROUND TO GROUND NOISE PROPAGATION DURING TAKEOFF AND LANDING (1966).

The purpose of this SAE Report is to provide a standard method for predicting the propagation of noise over open terrain from (a) an airplane on the ground to other locations on the ground and from (b) an airplane at low altitude, - i.e., where ground effects exist - to locations on the ground at distances which are great compared with the airplane altitude.

This report provides extensive information on what has been called the "shadow effect", i.e., attenuation resulting from temperature and wind gradients near the ground. This effect is called "extra ground attenuation" because it is in addition to the inverse square attenuation and the extra air attenuation, (currently being revised).

5.1.22. SAE AEROSPACE INFORMATION REPORT AIR 1079. AIRCRAFT NOISE RESEARCH NEEDS (1972).

This Information Report is a classification of current aircraft noise research needs. The areas in which research needs exist are characterized broadly as follows: acoustics areas which have general application to a wide variety of aircraft types and operations; specialized topics in acoustics which relate to certain aircraft or aircraft types; and areas which are not related directly to acoustics but which may play a significant role in aircraft noise alleviation.

5.1.23. SAE AEROSPACE INFORMATION REPORT AIR 1081. HOUSE NOISE-REDUCTION MEASUREMENTS FOR USE IN STUDIES OF AIRCRAFT FLYOVER NOISE (1971).

This AIR describes the results of some house noise reduction measurements that were made in five locations in the U.S. in 1966, 1964, 1967, and 1969. The houses used in these tests included a wide range of construction types of single and multiple family dwellings. The house noise reductions also cover a wide range. The average house noise reduction developed in this AIR should be used only when such an average is needed.

The principle objective of this AIR is to use these noise reduction measurements to develop curves showing the noise reduction of aircraft flyover noise when the noise passes from the outside to the inside of houses located in various climates. The noise-reduction data presented herein can be applied to measurements of aircraft noise made outdoors in order to estimate the noise levels indoors.

5.1.24. SAE AEROSPACE INFORMATION REPORT AIR 1115. EVALUATION OF HEADPHONES FOR DEMONSTRATION OF AIRCRAFT NOISE (1969).

The purpose of this SAE Report is to present the results of an engineering evaluation of commercially available headphones from the standpoints of frequency range, flatness of response and tolerances, and dynamic range.

5.1.25. SAE AEROSPACE INFORMATION REPORT AIR 1216. COMPARISONS OF GROUND RUNUP AND FLYOVER NOISE LEVELS (1972).

The principal purpose of this report is to present and discuss, for each aircraft, the differences between flyover sound pressure levels (SPL's) and SPL's projected to comparable flyover conditions from the ground-runup measurements. A second purpose of this report is to present the differences between ground-runup SPL's, measured at comparable distances from the engine, over concrete and over grassy surfaces. Analyses are presented for three different engine power settings for both types of comparisons for both airplanes.

5.2. Draft Proposals for New Standards

5.2.1. PROPOSED SAE STANDARD. MOTORCYCLE SOUND LEVELS.

a. Operational Document XJ331a.
b. Maximum Noise Document XJ47.

5.2.2. PROPOSED SAE RECOMMENDED PRACTICE XJ54. EVALUATION OF OPERATOR'S NOISE EXPOSURE WHILE USING MACHINERY IN AGRICULTURAL OPERATIONS.

5.2.3. PROPOSED SAE RECOMMENDED PRACTICE XJ57. SOUND LEVEL FOR HIGHWAY TRUCK TIRES.

5.2.4. PROPOSED SAE RECOMMENDED PRACTICE XJ87. EXTERIOR SOUND LEVEL FOR POWERED MOBILE CONSTRUCTION EQUIPMENT.

5.2.5. PROPOSED SAE RECOMMENDED PRACTICE XJ88. EXTERIOR SOUND LEVEL MEASUREMENT PROCEDURE FOR POWERED MOBILE CONSTRUCTION EQUIPMENT.

5.2.6. PROPOSED SAE RECOMMENDED PRACTICE. CONSTRUCTION SITE SOUND LEVEL MEASUREMENTS.

5.2.7. PROPOSED SAE RECOMMENDED PRACTICE. SOUND LEVELS FOR ENGINE POWERED AGRICULTURAL EQUIPMENT.

5.2.8. PROPOSED SAE RECOMMENDED PRACTICE. EXTERIOR SOUND LEVEL MEASUREMENT PROCEDURE FOR PLEASURE MOTOR BOATS.

5.2.9. PROPOSED SAE AEROSPACE RECOMMENDED PRACTICE ARP 1157. RECOMMENDED PROCEDURES FOR PRESENTING AND MEASURING AIRCRAFT NOISE IN TESTING OF HUMAN SUBJECTS.

5.2.10. PROPOSED SAE AEROSPACE RECOMMENDED PRACTICE ARP 1158. EFFECTIVE PERCEIVED NOISE LEVEL DETERMINATION BY DIRECT SUBJECTIVE JUDGMENT TEST.

5.2.11. PROPOSED SAE AEROSPACE RECOMMENDED PRACTICE ARP 1264. AIRPLANE FLYOVER NOISE ANALYSIS SYSTEM USED FOR EFFECTIVE PERCEIVED NOISE LEVEL COMPUTATIONS.

5.2.12. PROPOSED SAE AEROSPACE RECOMMENDED PRACTICE. MEASUREMENT OF AIRCRAFT INTERIOR SOUND PRESSURE LEVELS IN FLIGHT.

5.2.13. PROPOSED SAE AEROSPACE INFORMATION REPORT AIR 1114. PROCEDURES FOR DEVELOPING AIRCRAFT NOISE EXPOSURE CONTOURS AROUND AIRPORTS.

5.2.14. PROPOSED SAE AEROSPACE INFORMATION REPORT. THE EVALUATION OF AIRPLANE INTERIOR NOISE.

5.2.15. PROPOSED SAE AEROSPACE INFORMATION REPORT. HELICOPTER AND V/STOL NOISE MEASUREMENT PROBLEMS.

5.2.16. PROPOSED SAE AEROSPACE INFORMATION REPORT. V/STOL FARFIELD NOISE SOURCES - PREDICTION AND RESEARCH.

5.2.17. PROPOSED SAE AEROSPACE INFORMATION REPORT. NOISE TEST DISTANCE.

5.2.18. PROPOSED SAE AEROSPACE INFORMATION REPORT. ACOUSTIC EFFECTS PRODUCED BY A REFLECTING PLANE.

6. Institute of Electrical and Electronic Engineers (IEEE).

6.1. Summary of Standards

6.1.1. IEEE NO. 151. STANDARD DEFINITIONS OF TERMS FOR AUDIO AND ELECTROACOUSTICS (1965).

This Standard lists definitions of terms for which it was felt a need exists for establishment of precise and concise meanings.

The definitions included in this Standard all refer specifically to the use of the terms in audio techniques.

6.1.2. IEEE NO. 258. TEST PROCEDURE FOR CLOSE-TALKING PRESSURE-TYPE MICROPHONES (1965).

This document describes a practical and reproducible method of evaluating the performance characteristics of a close-talking microphone by means of quantitative measurements of the microphone characteristics using a standard artificial voice. Terms associated with microphones and their testing are defined. Test procedure, methods of presentation of data, and a standard artificial voice are specified. The tests described in this document involve physical, steady-state measurements only. The data obtained should be sufficient to enable an evaluation of quality and performance of a given microphone in a speech communication system. However, since it is sometimes desirable to obtain a subjective evaluation of a microphone, a procedure for a qualitative performance test is described in Appendix I.

Several sections of the document specify experimental limits to account for the effect of the test procedures on the accuracy of the data. These limits have been chosen so that results within the range of normal engineering accuracy will be obtained.

6.1.3. IEEE NO. 297. IEEE RECOMMENDED PRACTICE FOR SPEECH QUALITY MEASUREMENTS (1969).

The IEEE Subcommittee on Subjective Measurements, charged with writing an engineering practice for the measurement of speech quality, concluded that a single method should not now be recommended. This Recommended Practice is concerned only with preference measurements for which three methods are tentatively outlined. These are the Isopreference Method, the Relative Preference Method, and the Category-Judgment Method.

6.2. Draft Proposals for New Standards

6.2.1. REVISION OF IEEE NO. 85. (TEST PROCEDURE FOR AIRBORNE NOISE MEASUREMENTS ON ROTATING ELECTRIC MACHINERY, 1965) WHICH IS NO LONGER IN EFFECT.

7. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)

7.1. Summary of Standards

7.1.1. ASHRAE STANDARD 36-72. METHODS OF TESTING FOR SOUND RATING HEATING, REFRIGERATING, AND AIR-CONDITIONING EQUIPMENT (SUPERSEDES ASHRAE STANDARDS 36-62, 36A-63, and 36B-63).

This standard establishes a method of testing heating, refrigerating and air-conditioning equipment to determine the sound power levels in frequency bands. It applies to heating, refrigerating and air-conditioning equipment, or portions of such equipment, that radiate sound directly either to a room or to the outdoors.

This test procedure determines in standardized frequency bands the sound power level output of mechanical equipment by a comparison between: (a) the space/time-averaged sound pressure established by the operation of the equipment in a suitably designed test room; and (b) the space/time-averaged sound pressure established in the same room by a stable reference sound source whose sound power output has been accurately calibrated independently. (This procedure is commonly called the "comparison method".)

7.2. Draft Proposals for New Standards

None at present time.

8. Air-Conditioning and Refrigeration Institute (ARI)

8.1. Summary of Standards

8.1.1. ARI STANDARD 270. STANDARD FOR SOUND RATING OF OUTDOOR UNITARY EQUIPMENT (1967).*

ARI has produced this Standard in order to provide the industry and the public with a procedure for rating and evaluating the sound levels of outdoor unitary equipment. The rating numbers may be used to predict expected sound pressure levels in a specific acoustical environment at a given distance. A recommended procedure for accomplishing this will be described in a related ARI application standard.

In this Standard, the rating of equipment, as obtained at specified Standard Operating Conditions, is in the form of single numbers, designated as ARI Standard Sound Rating Numbers.

For a specific model of outdoor unitary equipment, an ARI Standard Sound Rating Number is developed from basic acoustic measurements made as prescribed in ASHRAE Standards 36-62 or 36A-63, as applicable. These measured one-third octave band power levels are weighted to adjust for psychoacoustic sensitivity to frequency distribution and any discrete tones which may be present and then are converted to an ARI Standard Sound Rating Number.

8.1.2. ARI STANDARD 275. STANDARD FOR APPLICATION OF SOUND RATED OUTDOOR UNITARY EQUIPMENT (1969).

This standard provides a method of predicting the sound level resulting from the operation of outdoor sections of unitary air-conditioning and heat pump equipment. A simple step-by-step procedure is given which uses a sound rating number for the equipment, and the distance to the point at which equipment noise is to be predicted. The nature of the surroundings and of the installation is also taken into account.

The sound rating number is adjusted for these installation factors to establish a sound level number (SLN) which is used in an alignment chart to predict, for a specific location, a tone-corrected sound level which is intended to be a predictor of annoyance due to the sound. The annoyance level can be calculated precisely in the manner specified in the Appendix, from one-third octave band sound pressure levels measured at the point in question. It may be estimated (normally within ± 4 dB) from measurements of the A-weighted sound level. If desired, the NC level of the sound may also be estimated from the alignment chart. The accuracy of the prediction is dependent upon other application variables; i.e., the directivity of the sound from the unit and, to some degree, the spectrum of the sound from the unit.

Examples are used to clarify the procedure and recommended practices are presented to guide the acoustic considerations of air-conditioning equipment installations.

This Standard shall not be used for determining the sound rating number of outdoor unitary equipment.

8.1.3. ARI STANDARD 443. STANDARD FOR SOUND RATING OF ROOM FAN-COIL AIR-CONDITIONERS (1970).*

ARI has produced this standard to fulfill a growing need for a reliable method of sound rating room fan-coil air-conditioners.

This Method of rating is based upon tests conducted in accordance with ASHRAE Standard 36-62, which gives test results for sound power levels. The acoustic output can best be defined by sound power levels, since these quantities are independent of the many environments in which the equipment may be used. Sound power levels may be used to predict the sound pressure levels that will result in a space of known acoustical characteristics.

It is recognized that room fan-coil air-conditioners and most other air-conditioning equipment produce complex sound spectra which may not be suitably rated from broad band measurements alone. The annoyance of pure tones, for example, is not reflected in octave band measurements. Consequently, this Standard requires measurements by one-third octave bands and applies subjective corrections based on extensive research in order to arrive at meaningful ratings.

8.1.4. ARI STANDARD 446. STANDARDS FOR SOUND RATING OF ROOM AIR-INDUCTION UNITS (1968).*

ARI has produced this Standard to fulfill a growing need for a reliable method of sound rating room air-induction units.

The relationship between this Standard and ASHRAE 36B-63 is analogous to the relationship between ARI 443 and ASHRAE 36-62.

It should also be recognized that the sound power levels of room air-induction units will vary as functions of both the primary air quantity and the damper pressure drop. Therefore, the Standard Rating Conditions of this Standard include a specified damper pressure drop.

*(These Standards reference ASHRAE Standards 36-62, 36A-63 and 36B-63 which have been superceded by ASHRAE Standard 36-72, Methods of Testing for Sound Rating Heating, Refrigerating and Air-Conditioning Equipment.)

8.2. Draft Proposals for New Standards

8.2.1. PROPOSED ARI STANDARD 575. METHOD OF MEASURING MACHINERY SOUND WITHIN EQUIPMENT ROOMS.

This document establishes a uniform method of measuring the sound levels produced by air-conditioning and refrigerating machinery installed in mechanical equipment spaces, and states the requirements for sound level specifications for this type of machinery.

9. Air Moving and Conditioning Association (AMCA)

9.1. Summary of Standards

9.1.1. AMCA STANDARD 300-67. TEST CODE FOR SOUND RATING

This Code establishes a practical method of determining the sound power level of an Air Moving Device (AMD).

The Code will: (a) Present values that are useful in field applications. (b) Give uniformly reproducible results in all qualified laboratories. (c) Be "practical" in the sense that its accuracy will be satisfactory for all general applications while its operation will not add significantly to the cost of the product.

These aims are achieved by applying standard, readily available sound measuring instruments to reverberant or semi-reverberant room with minimal restrictions on size and construction. The test set-ups are designed to represent general usage of the AMDs tested.

9.1.2. AMCA BULLETIN 301. STANDARD METHOD OF PUBLISHING SOUND RATINGS FOR AIR MOVING DEVICES (1965).

This document establishes a standard method of publishing Sound Ratings for Air Moving Devices.

The purpose of this Standard is to eliminate misunderstandings between the manufacturer and the purchaser and to assist the purchaser in selecting and obtaining the proper product for his particular need.

This Standard applies to: (a) Centrifugal Fans. (b) Axial and Propeller Fans. (c) Power Roof and Wall Ventilators. (d) Steam and Hot Water Unit Heaters.

It is intended that this Standard shall also apply to Central Station Heating, Ventilating and Air Conditioning Units.

9.1.3. AMCA BULLETIN 302. APPLICATION OF SONE LOUDNESS RATINGS FOR NONDUCTED AIR MOVING DEVICES (1965).

The AMCA method of rating in sones gives the loudness at a distance of 5 feet from the unit in free space with no nearby reflecting surfaces. Since most practical problems will involve the judgment of loudness within a room, some method is needed to relate the loudness in a given room to the "loudness rating" of the fan.

The charts and formulae given in this bulletin are for the purpose of determining the loudness of fans as installed, and take into consideration the room size and acoustical qualities as well as the number and ratings of the fans. Within the range of 3.5 and 38 sones, these charts are mathematically rigorous, and are sufficiently accurate for engineering applications from 1.5 to 85 sones. For the addition of sounds, it is assumed that the noise spectrums are similar. The room effect chart is for the reverberant field in the room, and applies everywhere except in the space very near to the fan.

9.1.4. AMCA PUBLICATION 303. APPLICATION OF SOUND POWER RATINGS FOR DUCTED AIR MOVING DEVICES (1965).

AMCA Sound Power Level Ratings are indicators of the sound generated by an Air Moving Device when operated at various points within its normal operating range. The ratings are obtained from tests conducted by the method described in AMCA Standard 300. Test Code for Sound Rating AMDs are published in accordance with AMCA Standard 301, Method of Publishing Sound Ratings for AMDs.

Air Moving Devices that are normally used without ducts are rated in sones. Information on the use of sone ratings is given in AMCA Publication 302, Application of Sone Loudness Ratings.

9.1.5. AMCA PUBLICATION 311-67. CERTIFIED SOUND RATINGS PROGRAM FOR AIR MOVING DEVICES.

The purpose of the Certified Sound Ratings Program is to give the buyer, specifier, and user of air moving equipment increased assurance that published sound ratings are reliable. At the same time, the Program establishes standard testing and rating methods and assures the manufacturer that competitive ratings have been checked by an impartial authority.

9.2. Draft Proposals for New Standards

None at present time.

10. Air Diffusion Council (ADC)

10.1. Summary of Standards

10.1.1. ADC TEST CODE 1062R3. EQUIPMENT TEST CODE (1972). (REPLACES 1062R2).

This Test Code is intended to provide a means for testing and rating air distribution and control devices. It should provide a basis for comparison among the available equipment and also for determining the comfort conditions of occupied rooms in air conditioning, heating and ventilating systems.

The purpose of this Test Code is to present in a single document all those techniques and facilities required for the measurement of performance of air distribution or air terminal devices. Methods of Test Measurement have been established to provide uniform test procedures, equipment and instrumentation with regard to air flow, velocity and pressure, temperature and sound generation. The sound measuring instrumentation and tests for determining the sound generated are in accordance with ANSI and ASHRAE Standards.

10.2. Draft Proposals for New Standards

None at present time.

11. Home Ventilating Institute (HVI)

11.1. Summary of Standards

11.1.1. HVI TEST PROCEDURE. SOUND TEST PROCEDURE (1968).

The general purpose of the HVI Report is to provide a laboratory procedure for the taking of measurements of the sound output of home ventilating equipment and to establish a method for the interpretation and/or presentation of the data obtained.

11.2. Draft Proposals for New Standards

None at present time.

12. Association of Home Appliance Manufacturers (AHAM)

12.1. Summary of Standards

12.1.1. AHAM STANDARD NO. RAC-2SR. ROOM AIR CONDITIONER SOUND RATING (1971).

The standard establishes uniform testing conditions. The sound rating of room air conditioners shall be based upon tests made in accordance with ASHRAE Standards 36A-63, Method of Determining Sound Power Levels of Room Air Conditioners and Other Ductless, Through-the-Wall Equipment in test rooms qualified for pure tone response in accordance with Appendix I of this Standard in the one-third octave bands having center frequencies from 100 thru 10,000 Hz, inclusive. Temperature conditions, electrical input, and position of dampers, grilles, and controls shall be maintained continuously for a minimum of one hour before sound measurements are taken to ensure that a stabilized condition has been reached. (Note: ASHRAE Standard 36A-63 has since been superceded by ASHRAE Standard 36-72, Methods of Testing for Sound Rating Heating, Refrigerating, and Air-Conditioning Equipment.

12.2. Draft Proposals for New Standards

12.2.1. AHAM PROPOSED STANDARD FOR APPLICATION OF SOUND-RATED ROOM AIR CONDITIONERS.

13. National School Supply and Equipment Association, Folding Partition Subsection

13.1. Summary of Standards

13.1.1. NSSEA TEST PROCEDURE. TESTING PROCEDURES FOR MEASURING SOUND TRANSMISSION LOSS THROUGH MOVABLE AND FOLDING WALLS (R1972).

The test procedures detailed in this booklet grew out of a long time need, on the part of school officials, architects and others, for a definitive and workable method of comparing the sound transmission loss characteristics of movable walls.

The procedure for the test itself has been standardized by the American Society for Testing and Materials (ASTM E90). But it is necessary, in addition, to standardize the way the test specimen is installed, how its construction is certified, and other details of the conduct of the test.

The test results stated in any NSSEA certificate apply to a movable wall tested in accordance with the procedures outlined and under stated laboratory conditions.

Certification of test results will not be construed as certifying that a movable wall of the same construction will give, under other than laboratory conditions, identical results. For in a field installation, the movable wall is not the only path for noise to pass from one room to the next. Other paths may be ceiling plenums, hollow floors, ventilation ducts, windows and doors, or hollow walls.

13.2. Draft Proposals for New Standards

None at present time.

14. California Redwood Association (CRA)

14.1. Summary of Standards

14.1.1. CRA DATA SHEET 202-6. REDWOOD INSULATION: HEAT, SOUND AND ELECTRICITY (1964).

Insulation is the property of a material which impedes the transmission of energy in the form of heat, sound or electricity. California redwood possesses good insulation characteristics in all three cases. Values on its properties are included in the report.

14.2. Draft Proposals for New Standards

None at present time.

15. Federal Specifications

15.1. Summary of Standards

15.1.1. FEDERAL SPECIFICATION HH-I-545B. INSULATION, THERMAL AND ACOUSTICAL (MINERAL FIBER, DUCT LINING MATERIAL) (1971).

This specification covers mineral fiber insulation for lining the interior surfaces of ducts, plenums, and other airhandling equipment, and to provide sound attenuation in systems that handle air up to 250° F.

15.1.2. FEDERAL SPECIFICATION SS-S-111a AND AMENDMENT-1. SOUND CONTROLLING MATERIALS (TROWEL AND SPRAY APPLICATIONS) (1968).

This specification covers acoustical materials for trowel or spray application.

15.1.3. FEDERAL SPECIFICATION SS-S-118a (3). SOUND CONTROLLING BLOCKS AND BOARDS (ACOUSTICAL TILES AND PANELS, PREFABRICATED) (1972).

This specification covers prefabricated acoustical tiles and panels (blocks and boards) which provide acoustical treatment and interior finish.

15.2. Draft Proposals for New Standards

None at present time.

16. American Boat and Yacht Council (ABYC)

16.1. Summary of Standards

16.1.1. ABYC PROJECT H-17 (PROPOSED). RECOMMENDED PRACTICES AND STANDARDS COVERING INSULATING, SOUNDPROOFING, AND SHEATHING MATERIALS AND FIRE RETARDENT COATINGS (1970).

The purpose is to identify recommended practices for the application of interior materials and finishes for the purpose of thermal insulation and soundproofing as they relate to safety and safe operation.

16.2. Draft Proposals for New Standards

None at present time.

17. Electronic Industries Association (EIA)
(formerly Radio Manufacturers Association, RMA)

17.1. Summary of Standards

17.1.1. RMA STANDARD SE-105. MICROPHONES FOR SOUND EQUIPMENT (1949).

This Standard gives definitions and measurement techniques for a variety of microphones. It discusses microphone response and rating mathods.

17.2. Draft Proposals for New Standards

None at present time.

18. Compressed Air and Gas Institute (CAGI)

18.1. Summary of Standards

18.1.1. CAGI TEST CODE. CAGI-PNEUROP TEST CODE FOR THE MEASUREMENT OF SOUND FROM PNEUMATIC EQUIPMENT (1969) (ANSI S5.1).

The purpose of the Code is to provide standard test procedures for the measurement of airborne sound from pneumatic equipment. This code applies to compressors and pneumatic equipment and specifies procedures and operating conditions acceptable and expedient for use by non-specialists as well as by acoustical engineers.

18.2. Draft Proposals for New Standards

None at present time.

19. American Gear Manufacturers Association (AGMA)

19.1. Summary of Standards

19.1.1. AGMA STANDARD 293.03. SPECIFICATION FOR MEASUREMENT OF SOUND ON HIGH SPEED HELICAL AND HERRINGBONE GEAR UNITS (1968).

This Standard applies to gear units which are within the scope of Standard AGMA 421.06, "Standard Practice for High Speed Helical and Herringbone Gear Units", and as produced by the AGMA High Speed Units Manufacturer's Group. It does not include marine propulsion, aerospace, or automotive gearing.

The specifications and procedures apply to sound measurement, testing methods, and limiting values of direct air-borne sound generated by a gear unit, and the auxiliary equipment required for its operation, whose prime mover is not integral with the unit.

Sound level characteristics of a gear unit are affected by types of foundations and room surroundings. Therefore, it should be understood that shop tests may not fully determine the level of sound in the installed locations.

19.2. Draft Proposals for New Standards

None at present time.

20. National Electrical Manufacturers Association (NEMA)

20.1. Summary of Standards

20.1.1. NEMA STANDARD SM 33-1964. GAS TURBINE SOUND AND ITS REDUCTION.*

This Standards Publication contains information relative to gas turbine inlet and exhaust Sound Pressure Levels and sound reduction to satisfy surrounding neighborhood requirements external to the turbine room in the far field (airborne sound). (Other sources of sound, such as fans for oil coolers, acoustic leakage through buildings housing the equipment, etc., are not covered in this publication.)

20.1.2. NEMA STANDARD MG1-12.49. MOTORS AND GENERATORS. METHODS OF MEASURING MACHINE NOISE (1972).

This Standard describes test methods for measuring the noise levels associated with unloaded motors and generators. The methods are those of the IEEE Publication Number 85.

(Note: IEEE No. 85 is no longer in effect. A draft revision is under consideration).

20.1.3. NEMA STANDARD TR1-1972. TRANSFORMERS, REGULATORS AND REACTORS (SECTION 9-04 AUDIBLE SOUND LEVEL TESTS).

This Standard lists test conditions and measurement procedures for determining the audible sound level associated with transformers under field conditions.

20.2. Draft Proposals for New Standards

None at present time.

*This standard has been discontinued by NEMA due to their departure from the gas turbine field. It is included since it is still being used by individuals active in the gas turbine field.

21. National Machine Tool Builders Association (NMTBA)

21.1. Summary of Standards

21.1.1. NMBTA TECHNIQUE. NOISE MEASUREMENT TECHNIQUES (1970).

The purpose of this document is to delineate suggested measuring techniques and procedures for the determination of noise emanating from machine tools. These procedures apply to measurements made in facilities under the control of the machine tool builder. As such it is assumed that the builder will provide a suitable test space so that reasonably accurate noise level data may be obtained and possibly repeated at a later date. Therefore, ambient noise and reverberation correction factors are not included.

21.2. Draft Proposals for New Standards

None at present time.

22. Power Saw Manufacturers Association (PSMA)

22.1. Summary of Standards

22.1.1. PSMA STANDARD N1.1-66. NOISE LEVEL.

This Standard establishes a noise level certification procedure for measuring the noise emitted by power saws for infrequent commercial operation in residential areas.

22.1.2. PSMA STANDARD N2.1-67. NOISE OCTAVE BAND MEASUREMENT.

This Standard establishes a test procedure for measuring noise level at the power saw operator's ear.

22.2. Draft Proposals for New Standards

None at present time.

23. Anti-Friction Bearing Manufacturers Association (AFBMA)

23.1. Summary of Standards

23.1.1. AFBMA STANDARD NO. 13. ROLLING BEARING VIBRATION AND NOISE (1968).

The field of application for standards on bearing vibration and noise is not universal. It encompasses the applications where usefulness of these standards as a basis for bearing selection and specification has been proven by sufficient experimental evidence.

In the current edition of this Standard, only selected methods for the measurement of the (structure-borne) vibration of certain types of ball bearings have been specified. Other vibration measurement methods, as well as methods for the measurement of rolling bearing (air-borne) noise, may be specified in later editions.

23.2. Draft Proposals for New Standards

None at present time.

24. Hearing Aid Industry Conference (HAIC)

24.1. Summary of Standards

24.1.1. HAIC STANDARD 61-1. STANDARD METHOD OF EXPRESSING HEARING-AID PERFORMANCE.

The purpose of this Standard is to provide a uniform method of numerically and graphically expressing certain fundamental performance characteristics of hearing aids in a simple manner, so that those using such data can be assured of its meaning.

24.1.2. HAIC STANDARD 65-1. INTERIM BONE CONDUCTION THRESHOLDS FOR AUDIOMETRY.

The purpose of this Standard is to provide an interim industry calibration for bone conduction, and to provide a uniform interim bone threshold for use in audiometry.

24.2. Draft Proposals for New Standards

None at present time.

25. Military Specifications

25.1. Summary of Standards

25.1.1. MIL-A-8806A, AND AMENDMENT-1. ACOUSTICAL NOISE LEVEL IN AIRCRAFT, GENERAL SPECIFICATION FOR (1966).

This Specification covers the general requirements for the control of acoustical noise in occupied spaces of aircraft, including the acceptable noise levels and the testing requirements for determining conformance to these levels.

25.1.2. MIL-N-83155A, AND AMENDMENT-1. NOISE SUPPRESSOR SYSTEM, AIRCRAFT TURBINE ENGINE GROUND RUN-UP, GENERAL SPECIFICATION FOR (1970).

This Specification covers general design, performance and test of noise suppressor systems used for ground run-up of aircraft turbine engines. The complete requirements for a noise suppressor system applicable to a particular turbine engine shall be stated in the individual equipment specification.

25.1.3. MIL-N-83158A. NOISE SUPPRESSOR SYSTEMS, ENGINE TEST STAND A/F32T-2 and A/F32T-3; FOR TURBOJET AND TURBOFAN ENGINES (1970).

This Specification covers demountable noise suppressor systems for use in performance testing of engines mounted on an A/M37T-6 engine test stand.

25.1.4. MIL-S-3151a, and NOTICE-1. SOUND-LEVEL MEASURING AND ANALYZING EQUIPMENT (1967).

This Specification covers Sound-Level Measuring and Analyzing Equipment consisting of a Sound-Level Meter, an Octave-Band Analyzer and a Magnetic Tape Recorder. When used in conjunction this equipment forms a single type Sound-Level Measuring and Analyzing System.

25.1.5. MIL-S-008806B. SOUND PRESSURE LEVELS IN AIRCRAFT, GENERAL SPECIFICATION FOR (1970)

This limited coordination military specification has been prepared by the Air Force based upon currently available technical information, but it has not been approved for promulgation as a revision of Military Specification MIL-A-8806. It is subject to modification. However, pending its promulgation as a coordinated military specification, it may be used in procurement.

This Specification covers the general requirements for maximum allowable sound pressure levels in aircraft crew and passenger compartments and the testing requirements for determining conformance to these levels.

25.1.6. HEL STANDARD S-1-63C. MATERIAL DESIGN STANDARD FOR NOISE LEVELS OF ARMY MATERIAL COMMAND EQUIPMENT (1972).

This Standard establishes the acoustical noise levels for both steady state and impulsive noise,permitted in and around all equipment designed, developed or procured by AMC, and establishes the testing requirements and measurement techniques for determining conformance to the noise limits stated herin.

25.1.7. DEPARTMENT OF THE ARMY USAEHA-OB TECHNICAL GUIDE (MED). SOUND LEVEL DATA OF MILITARY NOISE SOURCES (1972).

The purpose of this Guide is to provide information concerning exposure to noise sources and the use of personal hearing protective devices. This guide includes:

(a) Representative 140 decibel equal energy noise level contours of small arms and artillery weapons.
(b) Peak sound pressure level measurements of weapons at the firer or crewman positions.
(c) Maximum sound pressure levels of fixed and rotary wing aircraft, combat and non-combat vehicles, powered metalworking and woodworking machinery, all measured at the operator's position.
(d) Data relative to the type, nomenclature, and use of hearing protective devices.
(e) Acoustic measurement procedures and references used in the preparation of the sound level data.

25.2. Draft Proposal for New Standards

25.2.1. MIL-STD-XXX (ARMY) NOISE LIMITS FOR ARMY MATERIAL, DOD PROJECT MISC-A867.

26. National Fluid Power Association (NFPA)

26.1. Summary of Standards

26.1.1. T3.9.70.12. METHOD OF MEASURING SOUND GENERATED BY HYDRAULIC FLUID POWER PUMPS (1970).

This Standard considers only sound directly radiated from hydraulic fluid power pumps in terms of loudness, disregarding installation effects. Its purpose is to establish a uniform basis for measuring, reporting, and accurately comparing the sound levels of such pumps.

26.1.2. T3.9.14. METHOD OF MEASURING SOUND GENERATED BY HYDRAULIC FLUID POWER MOTORS (1971).

This Standard considers only sound directly radiated from hydraulic fluid power rotary motors in terms of loudness, disregarding installation effects. Its purpose is to establish a uniform basis for measuring, reporting, and accurately comparing the sound levels of such motors.

26.2. Draft Proposals for New Standards

None at present time.

27. Acoustical and Insulating Materials Association (AIMA)

27.1. Summary of Standards

27.1.1. AMA-1-II-1967. METHOD OF TEST. CEILING SOUND TRANSMISSION TEST BY TWO-ROOM METHOD.

This is a performance test for a configurational property of ceiling constructions, without explicit reference to the sound absorption coefficients or sound transmission loss of ceiling materials. In particular, performance is rendered independent of the total in-situ absorption contribution of the receiving-room ceiling under test conditions by normalizing results with respect to separate measurements specified herein, thereby focusing attention upon the relative energy transmission of the ceiling configuration without appeal to absorption coefficients. The method of test is designed to reflect field conditions of ceiling erection under laboratory conditions of measurement control, without necessary restriction to standardized classes of ceiling construction beyond convenience for material comparisons.

The method of test is intended primarily for ranking the sound isolation performance of suspended-ceiling configurations in a specific test environment, generalized only with respect to receiving room absorption toward the ultimate objective of relating ceiling rankings quantitatively to partition-test rankings under widely varying field situations.

27.1.2. AIMA BUILDING CODE REPORT. AIMA MODEL NOISE CONTROL ORDINANCE (1971).

The provisions of this section are for the design and construction of interior walls, partitions and floor-ceiling assemblies to provide resistance to airborne and impact noise transmission.

These provisions are applicable to construction assemblies separating a dwelling unit from adjacent dwelling units, public areas, service areas or from other occupancies. The same provisions are applicable to assemblies separating guest units from one another in hotels and motels and to assemblies separating individual tenant areas in commercial structures.

27.1.3. AM SPEC. NO. 11. ACOUSTICAL ABSORBERS (1972).

The purpose of this Standard is to establish a uniform set of practices for the testing of Unit Acoustical Absorbers "Surface-type" which will supplement the requirements, of the American Society for Testing and Materials Designation: C423-66, Standard Method of Test for SOUND ABSORPTION OF ACOUSTICAL MATERIALS IN REVERBERATION ROOMS, or its latest revision.

Unit Acoustical Absorbers "Surface-type" are defined for the purpose of this standard as elements of acoustical material differing from other sound absorbing materials only in distribution during use.

27.2. Draft Proposals for New Standards

None at present time.

28. General Services Administration (GSA), Public Building Service (PBS)

28.1. Summary of Standards

28.1.1. PBS - C.1. TEST METHOD FOR THE DIRECT MEASUREMENT OF SPEECH — PRIVACY PROTENTIAL (SPP) BASED ON SUBJECTIVE JUDGMENTS (1972).

It is the purpose of this test method to define the Speech-Privacy Potential and related quantities and define a method for their direct measurement or determination in a building system prototype or in the field.

28.1.2. PBS - C.2. TEST METHOD FOR THE SUFFICIENT VERIFICATION OF SPEECH — PRIVACY POTENTIAL (SPP) BASED ON OBJECTIVE MEASUREMENTS INCLUDING METHODS FOR THE RATING OF FUNCTIONAL INTERZONE ATTENUATION AND NC—BACKGROUND (1972).

It is the purpose of this test method to define the Noise Isolation Class, the NC-Background and related quantities, with respect to the requirements of speech privacy in the open-plan and closed-room portions of building space, and to define methods for their direct measurement for verification of the Speech-Privacy Potential (SPP).

28.1.3. GUIDE FOR ACOUSTICAL PERFORMANCE SPECIFICATION OF AN INTEGRATED CEILING AND BACKGROUND SYSTEM (1972).

The system selected for coverage by this specification is comprised of five sets of building components and their interfacing. It is the primary intent of this specification to provide for the procurement of these five elements on the basis of acoustical performance criteria. The criteria were developed from the requirement to control air-borne sound transmission for the attainment of speech privacy between functional adjacencies in closed-room or open-plan portions of the typical office space.

28.2. Draft Proposals for New Standards

None at present time.

29. Diesel Engine Manufacturers Association (DEMA)

29.1. Summary of Standards

29.1.1. DEMA TEST CODE FOR THE MEASUREMENT OF SOUND FROM HEAVY-DUTY RECIPROCATING ENGINE (1972).

The purpose of this document is to establish a standard procedure for measuring, recording, and reporting data in acoustic surveys at engine installations. Section 5.0 deals with noise levels inside the building. Section 6.0 deals with noise levels outside the building, particularly on plant boundaries.

This Code applies to heavy-duty internal combustion engines and driven equipment, such as generators, pumps or compressors and specifies procedures and operating conditions acceptable and expedient for use by non-specialists as well as by acoustic engineers.

29.2. Draft Proposals for New Standards

None at present time.

Appendix A

Addresses and Officers

1. International Standards Organization (ISO)
   Central Secretariat-Geneva, Switzerland

1.1. ISO/TC 43 ISO TECHNICAL COMMITTEE ON ACOUSTICS

Secretary: Mrs. Simonsgaard
Postboks 77
DK-2900 Hellerup, Copenhagen
Denmark

1.1.1. ISO/TC 43/SC1 NOISE

Chairman: F. Ingerslev
Technical University
DK-2800 Lyngby, Copenhagen
Denmark

Secretary: Mrs. Simonsgaard

U.S. Technical Advisory Group

ANSI S1 Acoustical Measurements and Terminology
ANSI S3 Bioacoustics

U.S. Technical Advisor

L. Batchelder
983 Memorial Drive
Cambridge, Massachusetts 02138

1.1.2. ISO/TC 43/SC2 BUILDING ACOUSTICS

Chairman: Dr. Ove Brandt
Korsbarsvagen 4 A
Stockholm, Sweden

Secretary: Miss K. Bahlo
Fachnormenausschuss Materialprufung
46 Dortmund
Hakenstrasse 5, Germany

U.S. Technical Advisory Group

ASTM E33, Environmental Acoustics
Subcommittee E33.06, International Standards

U.S. Technical Advisor

Michael J. Kodaras
75-02 51st Avenue
Elmhurst, New York 11373

2. International Electrotechnical Commission (IEC)
Central Secretariat-Geneva, Switzerland

2.1. <u>IEC/TC 29 IEC TECHNICAL COMMITTEE ON ELECTROACOUSTICS</u>

<u>Chairman</u>: L. Batchelder
983 Memorial Drive
Cambridge, Massachusetts 02138

<u>Secretary</u>: W. Koeter
Gloeilampen Sabriehen
P.D./ELA/SPB 6
Eindhoven, 4500
Netherlands

<u>Technical Advisor</u>

H. Knowles
Knowles Electronics, Inc.
3100 North Mannheim Road
Franklin Park, Illinois 60131

2.1.1. <u>IEC/TC 29/SC29B Audio Engineering</u>

<u>Chairman</u>: A. S. Dahlstedt
Akustik Konsult, A.B.
Kragenäsvägen 2
181 62 Lidingö 3
Sweden

<u>Secretary</u>: W. Koeter

<u>U.S. Technical Advisory Group</u>

ANSI S1 Acoustical Measurements and Terminology
ANSI S2 Mechanical Shock and Vibration
ANSI S3 Bioacoustics

<u>U.S. Technical Advisor</u>

Hellmuth Etzold
81 1/2 Central Street
Narragansett, Rhode Island 02822

2.1.2. <u>IEC/TC 29/SC29C MEASURING DEVICES</u>

<u>Chairman</u>: D. W. Robinson
National Physical Laboratory
Teddington, Middlesex
Great Britain

<u>Secretary</u>: P. Lorand
Chef Du Departement Acoustique
Centre De Recherches Du CNET
22301 Lannion
France

U.S. Technical Advisory Group

ANSI S1 Acoustical Measurements and Terminology
ANSI S2 Mechanical Shock and Vibration
ANSI S3 Bioacoustics

U.S. Technical Advisor

W. Koidan
National Bureau of Standards
Sound Building, Room B106
Washington, D.C. 20234

2.1.3. IEC/TC 29/SC29D ULTRASONICS

Chairman: M. Grützmacher
Physikalisch-Technische Bundesanstalt
33 Braunschweig, Bundesalle 100
Germany

Secretary: A. V. Rinsky-Korsakov
Committee for USSR Participation
in International Power Conferences
Gorky Street, 11
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This compilation deals with material assembled from the various standards, industrial and trade organizations, or technical and scientific societies concerned with acoustics. There has been no attempt to review or evaluate the standards, but rather just to list those that are available. The standards cover a broad scope of topics in acoustics--including measurement techniques, rating schemes, definitions, equipment and product specification, subjective measurements and response to noise, and calibration methods. Those standards dealing solely with shock and vibration have not generally been included. The paragraphs describing the standards give a brief summary of intent and/or scope of the standard. In some cases the paragraph is the official description of the standard as issued by the organization or society promulgating the standard, while in others the paragraph merely describes the spirit of the standard. Proposed standards are also listed. The names and addresses of the various organizations or societies and their acoustical standards committees are listed in an Appendix. The compilation includes all information available as of April 1, 1973.

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