NATIONAL BUREAU OF STANDARDS REPORT

10 688

COMPILATION OF ACOUSTIC STANDARDS

prepared by
Applied Acoustics and Illumination Section
Sensory Environment Branch
Building Research Division
Institute for Applied Technology

NBS

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

NATIONAL BUREAU OF STANDARDS

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[1] Headquarters and Laboratories at Gaithersburg, Maryland, unless otherwise noted; mailing address Washington, D.C. 20234.
[2] Located at Boulder, Colorado 80302.
[3] Located at 5285 Port Royal Road, Springfield, Virginia 22151.

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COMPILATION OF ACOUSTIC STANDARDS

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Prepared for
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ABSTRACT

This report contains a compilation of existing acoustics standards. The standards included cover both the physical and subjective aspects of acoustical testing and rating techniques. Standards dealing solely with shock and vibration have not generally been included.

The standards are from the various standards, industrial, and trade organizations or societies concerned with acoustics. The listing includes the name of the organization or society issuing the standard, the complete title, the year of issuance, and a brief summary of the intent and scope of the standard.

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

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

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

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* This Method is being dropped from the Book of Standards.

Compilation of Acoustic Standards

I. Summaries of Standards

A. International Organization for Standardization

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. Preference is given to the International System of Units.

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.

3. ISO Recommendation R140. Field and Laboratory Measurements of Airborne and Impact Sound Transmission (1960).

This ISO Recommendation defines methods of measuring the airborne sound insulation of walls, and the airborne and impact sound insulation of 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.

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 (c/s) and for the conditions stated below:

a) The normal relations existing between sound pressure level and frequency for pure tones of equal loudness.

b) Values for the normal threshold of hearing (normal binaural minimum audible field or MAF).

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 measurements 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.

*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 equivalent absorption area 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.

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.

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

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 recommendation, 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).

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.

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, which it is hoped will help to promote agreement and uniformity in the expression of hearing threshold level measurements throughout the world.

It states the information in a form suitable for direct application to calibration of audiometers, that is, in terms of the response of certain standard types of earphones measured on an artificial ear or coupler of stated type.

*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.

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-field conditions 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.

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.

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

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.

13. ISO Recommendation R507. Procedure for Describing Aircraft Noise Around an Airport (1970).

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

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

1) A method of measurement of the noise produced on the ground by a given aircraft.

2) A method for determining from these data, values of tone-corrected perceived noise level, including the effect of discrete tones when present.

3) A method for determining values of effective perceived noise level which, using the values obtained from (2) above, takes account of duration and regularity of spectrum of a single event.

4) A method for mapping contours around an airport for a given set of aircraft operations.

5) A method for determining a noise exposure index for a succession of events in a specified time interval.

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.

14. ISO Recommendation R512. Sound Signalling Devices on Motor Vehicles, Acoustic Standards and Technical Specifications (1966).

This ISO Recommendation deals with sound signalling devices

-- mounted on motor vehicles
-- functioning with an electrical current
-- 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.

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.

*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 for dwellings when the results of measurements made by the method described in ISO Recommendation R140 are available. Reference values are given with which the measured results should be compared by the method described.

A method is given to derive from this comparison a single index, in terms of which the sound insulation requirements can be defined.

*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.

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

The main purpose of the test code is to give specific instructions so that the results obtained can always be compared.

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.

18. ISO Recommendation R1761. Monitoring Aircraft Noise Around An Airport (1970).

This ISO Recommendation describes a measuring method for monitoring, on the ground, the noise produced by aircraft around an airport.

It specifies the measuring equipment to be used in order to measure noise levels created by aircraft in the operation of an airport. The noise levels measured are approximations to perceived noise level PNL.

In this ISO Recommendation monitoring is understood to be routine measurement of noise levels created by aircraft in the operation of an airport. Monitoring usually involves a large number of measurements per day, from which an immediate indication of the noise level is required.

Monitoring aircraft noise can be carried out either with mobile equipment, often using 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 sound levels measured according to this ISO Recommendation are approximations of perceived noise level in PNdB.

*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.

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.

The method described in this ISO Recommendation is considered suitable for predicting approximately the public reaction likely to be caused by noise, and may help authorities to set limits for noise levels.

This ISO Recommendation is intended as a guide to the measurement of acceptability of noise in communities. It specifies a method for the measurement of noise, the application of corrections to the measured levels (according to duration, spectrum character and peak factor), and a comparison of the corrected levels with a noise criterion which takes account of various environmental factors.

The method given for rating noises with respect to community response forms a basis on which limits for noises in various situations may be set by the competent authorities.

The method of rating involves the measurement of the A-weighted sound level in decibels (commonly called dB(A)).

Where corrective measures are required, a frequency analysis may be necessary. The resulting data may be compared with noise rating curves, for instance the NR-curves, in order to identify the intrusive frequency bands. This more elaborate procedure is described in an Appendix.

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

20. ISO Recommendation R1999. Acoustics, Assessment of Occupational Noise Exposure for Hearing Conservation Purposes (1971).

Hearing impairment can be expressed, for many purposes, in terms of threshold shift at various frequencies. In most cases, however, the previous audiometric history is not available, so that prescriptions in terms of hearing level are necessary. Thus, for the retention of the faculty to understand conversational speech, a limit may be set to the permitted hearing level at frequencies of importance for the intelligibility of speech.

In this ISO Recommendation the recommendations and data are based primarily on the impairment criterion that hearing is considered impaired if the arithmetic average of the permanent threshold shifts for the three frequencies 500, 1000 and 2000 Hz is 25 dB or more.

The manner in which noise exposure is related to hearing impairment, for the purpose of this ISO Recommendation, is through the concept of "risk", defined below, this being an expression of the probability that exposed persons will acquire a specified degree of hearing impairment.

The levels and durations of the noises concerned are measured and an additive index is assigned to each. The sum of these indices is converted to a continuous noise level considered to be equally hazardous to hearing. A table is given to show the percentage of workers for which impairment of hearing according to the above impairment criterion will occur solely as a result of exposure to this noise during normal working time in periods of up to 45 years, the effects of age also being taken into account. Therefore, this ISO Recommendation provides a basis for the fixing of tolerable limits for noise exposure under working conditions by appropriate bodies.

It should be emphasized that if noise control methods are necessary in order to keep the exposure below fixed limits, more complicated measurements than those described in the main body of this ISO Recommendation may be necessary. An example of this is given in the Appendix.

This ISO Recommendation gives a practical relation between occupational noise exposure, expressed in terms of A-weighted sound level in dB (commonly called dB(A)) and duration within a normal working week (assumed to be 40 hours), and the percentage of the workers that may be expected to exhibit an increased threshold of hearing amounting to 25 dB or more averaged over the three frequencies 500, 1000 and 2000 Hz solely as a result of the noise exposure.

It is not applicable to impulsive noises consisting of noise of a duration less than 1 second or single high-level transients of a very short duration, for example, from gunfire.

B. International Electrotechnical Commission

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. 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 using electronic amplification and 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.

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.

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 (c/s), of air-conduction hearing aids using earphones coupled to the ear by means of ear inserts, e.g., ear moulds of 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.

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.

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 does not purport to deal with all features of screening audiometers, but specifies certain minimum requirements for a pure-tone audiometer for screening purposes.

It is not implied that medical diagnosis can be based on screening procedures, but within its limitations a screening audiometer can be used to measure the hearing threshold levels of individuals.

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.

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.

*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.

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.

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

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 delay 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.

12. 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.

13. IEC Recommendation, Publication 268-3. Sound System Equipment. Part 3: Sound System Amplifiers (1969).

This 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.

14. 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 additonal information to Clause 16, Output Characteristics, of Publication 268-3 dealing with sound system amplifiers.

15. 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.

16. IEC Recommendation, 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 Hz to 8000 Hz.

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.

17. 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 Hz 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.

C. American National Standards Institute

The American National Standards Institute, ANSI, was formed in October 1969. Prior to this date the official name of the organization was United States of America Standards Institute, USASI. USASI evolved from the American Standards Association, ASA, in August 1966. The standards presented in this document are listed under the organizational designation in effect at the time of their inception.

1. ASA S1.1-1960. American Standard Acoustical Terminology.

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

2. ASA S1.2-1962. American Standard Method for the Physical Measurement of Sound.

   The purpose of this Standard is to establish methods for measuring and reporting the sound pressure levels and sound powers generated by a source of sound. A standard sound-level meter and standard octave-band filter set are considered minimum equipment. This standard is intended to serve as a basis for test codes and standards for specific types of sound sources. It applied primarily to airborne sound produced by apparatus which normally operates in air. These sounds must be non-impulsive and of sufficient duration to be within the dynamic measuring capabilities of the instruments used.

3. ANSI S1.4-1971. American National Standard Specifications for Sound Level Meters.

   The purpose of this Standard for Sound Level Meters and their calibration is to ensure maximum practical accuracy in any particular sound level meter, and to reduce to the lowest practical minimum any difference in corresponding readings among various makes and models of meters that meet the standard. 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 sounds 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.

4. ASA S1.5-1963. American 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. 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.

5. USAS S1.6-1967. USA Standard Preferred Frequencies and Band Numbers for Acoustical Measurements.

The variety of frequencies that were used prior to 1967 for acoustical measurements made comparison of results inconvenient. Some of the difficulties arose from use of different intervals or different starting frequencies for a series. The object of this Standard, therefore, 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 frequencies common to the various series. The resulting simplification thus reduces to a minimum the number of frequencies at which acoustical data need to be tabulated. 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.

6. ANSI S1.8-1969. American National Standard Preferred Reference Quantities for Acoustical Levels.

This Standard is concerned with the reference quantities and the 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. 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.

7. ASA S1.10-1966. American Standard Method for the Calibration of Microphones.

In this Standard, methods are described for performing absolute and comparison calibrations of laboratory standard microphones specified in USASI S1.12-1967. 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 USASI S1.12-1967.

8. ASA S1.11-1966. American 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 broadband electrical signal. For acoustical measurements an electro-acoustic transducer and amplifier are employed to convert the acoustical signal to be analyzed into the required electrical signal.

9. USAS S1.12-1967. USA 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 USA 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.

10. ANSI S1.13-1971. American National Standard Methods for the Measurement of Sound Pressure Levels.

The purpose of this Standard is to establish uniform guidelines for measuring and reporting sound levels and 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.

11. ASA S3.1-1960. American 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 USASI S3.6-1969.

12. ASA S3.2-1960. American 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.

13. ASA S3.3-1960. American 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 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.

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.

14. USAS S3.4-1968. USA 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:

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

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

3. 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.

15. 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 perception tests administered to a given group of talkers and listeners. This measure is called the Articulation Index, or 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.

16. 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.

The purpose of this Specification is to insure that tests of the hearing of a given individual ear on different audiometers of a given class complying with this specification shall give substantially the same results under comparable conditions, and that the results obtained shall represent a true comparison between the hearing threshold level of the individual ear and the standard reference threshold level.

17. USAS S3.8-1967. USA 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 USA Standard Methods for Measurement of the Electroacoustical Characteristics of Hearing Aids, S3.3-1960.

18. ANSI S5.1-1971. American National Standards Test Code for the Measurement of Sound From Pneumatic Equipment.

This Standard applies to compressors and pneumatic equipment and specifies procedures and operating conditions acceptable and expedient for use by non-specialists as well as by acoustic engineers.

19. ASA Y10.11-1953. American Standard Letter Symbols for Acoustics.

This Standard comprises letter symbols for use in acoustics.

20. ASA Z24.9-1949. American Standard Method for the Coupler Calibration of Earphones.

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 5,000 H_z.

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.

21. ASA Z24.22-1957. American Standard Method for the Measurement of the Real-Ear Attenuation of Ear Protectors at Threshold.

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.

D. American Society for Testing and Materials

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, excited by a single tone of selectable frequency, in which the standing wave pattern in front of a specimen upon which plane waves impinge at normal incidence 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 from the measured normal incidence data are given in Appendix I.

2. ASTM Designation: C423-66. Standard Method of Test for Sound Absorption of Acoustical Materials in Reverberation Rooms.

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.

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. 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.

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.

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.

*7. ASTM Proposed Method (RM 14-3). Proposed Method of Steady-State Determination of Changes in Sound Absorption of a Room. (1966)

This Method is introduced, for information only, primarily for use in studying the utility of the steady-state technique, as an adjunct to the procedures given in ASTM Recommended Practice E90-70, for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

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* This Method is being dropped from the Book of Standards.

8. 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 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.

E. Society of Automotive Engineers

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.

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.

3. SAE Recommended Practice J336. Sound Level for Truck Cab Interior. (1968)

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 J919.

4. SAE Recommended Practice J366. Exterior Sound Level for Heavy Trucks and Buses. (1969)

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 produced by trucks and buses over 6000 lb. gvw shall not exceed 88 dB on an A-weighted network at 50 ft when measured in accordance with the procedure described.

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.

6. SAE Standard J671. Sound Deadeners and Underbody Coatings. (1958)

The materials classified under this Specification are:

1. Mastic sound deadeners used to reduce the sound emanating from metal panels.

2. Mastic underbody coatings used to give protection and some sound deadening to motor vehicle underbodies, fenders, and other parts.

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.

8. SAE Recommended Practice J919. Measurement of Sound Level at Operator Station. (1966)

This SAE Recommended Practice sets forth the equipment and procedure to be used in measuring sound levels at the operator station.

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.

9. 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.

10. 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.

11. 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.

12. SAE Recommended Practice J994. Criteria for Backup Alarm Devices. (1967)

This SAE Recommended Practice establishes the sound levels for backup alarm devices when used on construction and industrial machinery. It also establishes the equipment and procedure to be used when making such measurements.

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.

13. 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.

14. 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.

15. 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.

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 the approximate measure of the Perceived Noise Level of an aircraft flyover. The 40 Noy 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.

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.

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.

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:

1. Turbojet with standard circular nozzle.

2. Turbojet with nonstandard nozzle.

3. Turbofan or bypass engine with (a) unmixed exhausts or (b) 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.

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.

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.

22. 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.

F. Institute of Electrical and Electronics Engineers

1. IEEE No. 85. Test Procedure for Airborne Noise Measurements on Rotating Electric Machinery. (1965)

This Test Procedure covers instructions for conducting and reporting tests on rotating electric machines of all sizes to determine the airborne noise characteristics under steady-state conditions. The purpose of this Test Procedure is to outline practical techniques and procedures which can be followed for the uniform determination of the noise produced by a single machine in the normal audible frequency range. It is not intended that the Test Procedure cover all possible tests. The Test Procedure shall not be interpreted as requiring the making of any or all of the tests described in any given transaction.

2. 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.

3. 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 procedures, 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.

4. 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.

G. American Society of Heating, Refrigerating and Air-Conditioning Engineers

1. ASHRAE Standard 36-62. Measurement of Sound Power Radiated from Heating, Refrigerating and Air-Conditioning Equipment.

This Standard is intended to provide a means for determining the character and amount of the sound produced by air conditioning, refrigerating and heating equipment. It should provide a basis for comparison among the available equipment and also for estimating the sound pressure level to be expected from the equipment in a given space.

If this Standard is to fulfill its purpose and make possible the proper comparison of ratings reported by different manufacturers, a relatively high degree of absolute accuracy is necessary. Such absolute accuracy is difficult to obtain by means of instruments and techniques available at this time (1962). To minimize this difficulty, this Standard uses a "reference sound source" calibrated directly in sound power output, thus permitting the determination of the sound power output of the equipment by direct comparison with the reference sound source.

2. ASHRAE Standard 36A-63. Method of Determining Sound Power Levels of Room Air Conditioners and Other Ductless, Through-The-Wall Equipment.

This Standard, while complete in itself, follows the provisions of Standard 36-62, wherever possible.

The purpose of this Standard is to establish a method of determining the sound power levels of room air conditioners and other ductless wall or ceiling-mounted heating, ventilating, and air-conditioning equipment which radiate sound directly to both the conditioned space and the outdoors. The sound power radiated to the conditioned space and that radiated to the outdoors are to be determined separately and by one-third octave band increments.

The method given in this Standard measures only airborne sound radiated from the equipment itself. It is recognized that additional low frequency sound may be radiated from the structure in which the equipment is mounted as a result of vibration transmitted from the equipment. The magnitude of this additional sound will depend upon the characteristics of the particular structure involved and this is a function of the equipment application.

Finally, it should be noted that this Standard does not cover the measurement of transient sounds which may occur, for example, during the starting or stopping of equipment nor the measurement of the directivity patterns of the sound radiated from the equipment on test. For special situations where these characteristics may be significant, other sound measurement methods must be employed.

3. ASHRAE Standard 36B-63. Method of Testing for Rating the Acoustic Performance of Air Control and Terminal Devices and Similar Equipment.

This Standard, while complete in itself, follows the provisions of the generic ASHRAE Standard 36-62 prepared by that committee wherever possible. Modifications have been made, however, to make this Standard specifically applicable to air control and terminal devices used in air-conditioning, heating and ventilating systems.

The purpose of this Standard is to present, in a single document, all those techniques, facilities and procedures required for the determination of sound power generation and attenuation of one particular group of air conditioning, heating and ventilating system components: Air Control and Terminal devices, which are generally duct-connected to a central air moving system.

H. Air-Conditioning and Refrigeration Institute

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.

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. This annoyance level (ANL) may be experimentally checked in a precise manner by applying the calculations specified in Appendix A to one-third octave band sound pressure levels measured at the point of question. It may be approximately checked (normally within ± 4 dB) by a measurement of dBA. 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.

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.

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.

I. Air Moving and Conditioning Association

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: (1) Present values that are useful in field applications. (2) Give uniformly reproducible results in all qualified laboratories. (3) 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 rooms with minimal restrictions on size and construction. The test set-ups are designed to represent general usage of the AMDs tested.

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 the 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. When a detailed method of publishing sound ratings for these units has been adopted an addendum to this Standard will be issued.

3. AMCA Bulletin 302. Application of Sone Loudness Ratings for Non-Ducted 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.

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.

J. Air Diffusion Council

1. ADC Standard AD-63. Measurement of Room-to-Room Sound Transmission Through Plenum Air Systems.

The purpose of the measurements covered by this Standard is to determine the sound transmission along a complex path, the incident side or area of which is an opening (which may be fitted with a grille or similar device), the transmitting side or area of which is an identical opening, and the intervening element of which is a ceiling plenum whose characteristics are described. Such paths are commonly used for unducted air handling systems in buildings.

2. ADC Test Code 1062R2. Equipment Test Code (1966).

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.

K. Home Ventilating Institute

1. HVI Test Procedure. Air Flow Test Procedure (1968).

The general purpose of the HVI Report is:

a. To provide a procedure for the taking of measurements of the sound output of home ventilating equipment.

b. To establish a method for the interpretation and/or presentation of the data obtained from the measurements of (a).

L. Association of Home Appliance Manufacturers

1. AHAM Standard SR-1. 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 Standard 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.

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

1. NSSEA Test Procedure. Testing Procedures for Measuring Sound Transmission Loss through Movable and Folding Walls (1966).

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.

N. California Redwood Association

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.

O. Factory Mutual Systems

1. FMS Loss Prevention Data. 1-11, Insulating and Acoustical Materials (1952).

This data sheet lists those insulating and acoustical materials most commonly used as interior wall and ceiling finish.

P. Federal Specifications

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.

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.

3. Federal Specification SS-S-118a and Interim Amendment-1. Sound Controlling Blocks and Boards (1967).

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

Q. American Boat and Yacht Council

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.

R. Radio Manufacturers Association

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 methods.

S. Compressed Air and Gas Institute

1. CAGI Test Code. CAGI-PNEUROP Test Code for the Measurement of Sound from Pneumatic Equipment (1969).

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 peneumatic equipment and specifies procedures and operating conditions acceptable and expedient for use by non-specialists as well as by acoustic engineers.

T. American Gear Manufacturers Association

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.

U. National Electrical Manufacturers Association

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.)

V. National Machine Tool Builders Association

1. NMBTA Standard. Noise Measurement Techniques (1970).

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.

To obtain an accurate measure of the noise produced by a machine, the ambient noise level should meet the following conditions:

(a) The ambient level of the frequency band being measured should preferably be at least 10 dB lower than the band level generated by the machine.

(b) The ambient level must remain steady for the duration of the test, or if varying, should not exceed a level 10 dB below that of the machine under test.

W. Power Saw Manufacturers Association

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.

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.

X. Anti-Friction Bearing Manufacturers Association

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.

Y. Hearing Aid Industry Conference

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.

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.

Z. Military Specifications

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.

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.

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.

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.

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.

II. Address of Standards Organizations and Societies

*1. American National Standards Institute
1430 Broadway
New York, New York 10018

2. American Society for Testing and Materials
1916 Race Street
Philadelphia, Pennsylvania 19103

3. Society of Automotive Engineers
Two Pennsylvania Plaza
New York, New York 10001

4. Institute of Electrical and Electronic Engineers
345 East 47th Street
New York, New York 10017

5. American Society of Heating, Refrigerating and Air-Conditioning Engineers
United Engineering Center
345 East 47th Street
New York, New York 10017

6. Air-Conditioning and Refrigeration Institute
1815 North Fort Myer Drive
Arlington, Virginia 22209

7. Air Moving and Conditioning Association
30 W. University Drive
Arlington Heights, Illinois 60004

8. Air Diffusion Council
435 North Michigan Avenue
Chicago, Illinois 60611

9. Home Ventilating Institute
1108 Standard Building
Cleveland, Ohio 44113

10. Association of Home Appliance Manufacturers
20 North Wacker Drive
Chicago, Illinois 60606

11. National School Supply and Equipment Association
Folding Partition Subsection
27 East Monroe Street
Chicago, Illinois 60603

* The standards of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) can be obtained from the American National Standards Institute (ANSI).

12. California Redwood Association
617 Montgomery Street
San Francisco 11, California

13. Factory Mutual Engineering Division
184 High Street
Boston, Massachusetts 02110

14. Federal Specifications
Specification Sales (3FRDS)
Building 197, Washington Navy Yard
General Services Administration
Washington, D.C. 20407

15. American Boat and Yacht Council
15 East 26th Street
New York, New York 10010

16. Radio Manufacturers Association
1317 F Street, N. W.
Washington, D.C. 20004

17. Compressed Air and Gas Institute
122 East 42nd Street
New York, New York 10017

18. American Gear Manufacturers Association
1330 Massachusetts Avenue, N.W.
Washington, D.C. 20005

19. National Electrical Manufacturers Association
155 East 44th Street
New York, New York 10017

20. National Machine Tool Builders Association
2139 Wisconsin Avenue
Washington, D.C. 20007

21. Power Saw Manufacturers Association
734 15th Street, N.W.
Washington, D.C. 20005

22. Anti-Friction Bearing Manufacturers Association
60 East 42nd Street
New York, New York 10017

23. Hearing Aid Industry Conference, Inc.
75 East Wacher Drive
Chicago, Illinois 60001

24. Military Specifications

Commanding Officer
Naval Publications and Forms Center
5801 Tabor Avenue
Philadelphia, Pennsylvania 19120