CYNTHIA BURKE
Room 2709-D
ANR-445

ONAC
II-96-01
II-A-283

PLAN FOR THE DEVELOPMENT OF VOLUNTARY STANDARDS ON ENVIRONMENTAL SOUND IN RESPONSE TO FEDERAL AGENCIES' NEEDS

DECEMBER 1978

Only Copy
Please
Do Not Remove

PRELIMINARY

PLAN FOR THE DEVELOPMENT OF VOLUNTARY STANDARDS ON ENVIRONMENTAL SOUND IN RESPONSE TO FEDERAL AGENCIES' NEEDS

DECEMBER 1978

PREPARED FOR

U.S. ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D. C. 20460

by

ACOUSTICAL SOCIETY OF AMERICA

FROM

WORKSHOP ON DEVELOPMENT OF STANDARDS FOR ENVIRONMENTAL SOUND
STANDARDS PLANNING PANEL ON NOISE ABATEMENT AND CONTROL
AMERICAN NATIONAL STANDARDS INSTITUTE

PRELIMINARY

Contents

LIST OF TABLES

Section 1
INTRODUCTION

1.1 Background

Recent efforts by the Federal Government, and several state and local governments to control environmental noise in an effort to reduce noise exposure of the population brought out the need for uniform, standardized sound measurement methods, human response evaluation and analysis of noise control effectiveness. Although the voluntary standards system coordinated by the American National Standards Institute (ANSI) has been and is presently providing through its various committees concerned with sound, a broad spectrum of standards on physical acoustics, bioacoustics, noise emission by various sources and its control, it became obvious that the various legislative and regulatory needs required additional, sometimes slightly different standards from those available. Frequently, regulatory agencies are committed to mandatory time schedules and require standards reflecting the present state of knowledge that are not available and cannot be produced as voluntary consensus standards without adequate lead time. Since these regulatory efforts are rapidly increasing, it can clearly be foreseen that the need for additional and/or updated standards also will increase.

To anticipate these needs and to provide for a coordinated program of standards development of the voluntary system to satisfy government requirements, the ANSI Executive Standards Council established in 1976 the ANSI Standards Planning Panel on Noise Abatement and Control. This panel, composed of representatives from the various societies with an interest in noise standards and from regulatory agencies, issued a report ("Assessment and Recommendation: Report of ANSI Standards Planning Panel on Noise Abatement and Control")[1] carrying out the Planning Panel's mission to: (1) identify standards needs and their priorities and scheduling requirements, (2) determine if there are standards projects covering the scope of the needs (3) identify standards developing organization most capable of carrying out the mission, (4) endeavor to have the project initiated in a standards developing organization. One of the critical action items recommended in the Planning Panel's report is the convening of a conference workshop on "Development of Standards for Environmental Sound" to prepare (1) "a detailed, integrated development plan for voluntary standards, including priorities and research requirements, for measurement and evaluation of sound in communities, rooms and industry, and for basic standards necessary to support measurement and evaluation of source sound emission and its control and (2) guidelines for the use of writing groups in the federated voluntary standards system, which are endeavoring to develop standards for the measurement of source sound emission, with particular emphasis on relating the intent of the measurement standard with the ease of use, accuracy and appropriateness for its purpose."

[1] Available from the American National Standards Institute, 1430 Broadway, New York, NY 10018, and from the Acoustical Society of America, 335 East 45th Street, New York, NY 10017.

In response to this recommendation such a workshop was organized and managed by the Acoustical Society of America under the auspices of the ANSI Standards Planning Panel on Noise Abatement and Control and was sponsored by the U. S. Environmental Protection Agency in cooperation with the National Bureau of Standards. It was held Dec. 7-9, 1977 at Deerfield Beach, Florida, with the administrative support of Florida Atlantic University. Participants came from many voluntary standards organizations including the Acoustical Society of America, ANSI, The American Society for Testing and Materials, and the Society of Automotive Engineers and several federal agencies including, in addition to EPA and NBS, the Department of Labor, Transportation, Health, Education and Welfare, Housing and Urban Development, the U. S. Air Force, U. S. Navy, and the General Services Administration. Additional participants came from state governments, industry, universities and acoustical consulting organizations (for List of Participants see Appendix A1). The participants contributed to the workshop as individuals, not as representatives of their organizations.

The results of the workshop are presented in two separate documents according to the two goals listed above: the report on "Guidelines for the Preparation of Procedures for Measurement of Source Sound Emission" and the present report "Plan for the Development of Voluntary Standards on Environmental Sound in Response to Federal Agencies' Needs."

1.2 Operation of the Workshop

Sixty-eight people attended the workshop. Thirty-two were assigned to the "guidelines" and thirty-three to the "planning" division according to expertise and organizational background. The three others represented project management, ANSI staff, and the editor of this report. Care was taken to have balanced representation on all groups. Most participants had received assignments ahead of time and after opening presentations and agreement on purpose and goals detailed discussion and collection of material took place in small working groups.

The results of the working groups' analyses and recommendations were presented to all workshop participants to benefit from broad discussion and all possible inputs. The final accumulation and editing of the reports took place after the workshop and all participants were given another chance for review and comments. An attempt was made to incorporate all opinions and suggestions. When conflicting opinions existed they were resolved by the working group chairpersons, the division chairpersons or the editor. Although an attempt was made to achieve a consensus document, final responsibility for the plan represented rests with the five persons who chaired the planning division and with the editor.

1.3 Introduction to the Plan

In its structure, the report follows the organization of the planning division effort. Section 2 covers the results of the working group efforts:

Section 2.1 covers physical acoustics and instrumentation. After analysis of the standards requirements for the various noise sources identified (2.1.1), the recommendations with respect to standards actions and research requirements are presented (2.1.2).

Section 2.2 covers human response. Requirements are broken down in terms of hearing hazards, annoyance and speech interference (2.2.1) and recommendations presented the same way as for physical acoustics (2.2.2).

Section 2.3 deals with noise control elements, analyzing needs and applicable standards in 2.3.1 and recommending standards actions according to judged priority in 2.3.2.

Section 3 presents the overall plan and priorities in the form of summary tables and illustrates in 3.2 how the plan is responsive to the regulatory and other needs of selected agencies (EPA, DOL, the National Institute of Occupational Safety and Health, HUD, DOT). Although these tables are in no way exhaustive, they were considered important to illustrate the large number of standards frequently required from each of the three subareas to satisfy one single regulatory objective.

Section 3.3 contains the recommendations emanating from the workshop.

The review of standards requirements was conducted by means of uniform worksheets, developed for this purpose which summarize, for each technical subarea, or potential standardization area identified, the findings of the group. A sample worksheet appears at the end of this section.

The detailed worksheets used by the groups are attached as Appendices A3, A4, and A5. The report is not to be looked at as a rigid plan fixed by consensus agreement to be executed on a preset schedule by the organizations involved or addressed, but rather as a working document to facilitate communication and collaboration between regulatory agencies, standards development coordinating bodies such as ANSI's Acoustical Standards Management Board, and the standards committees producing the actual standards. The plan should also help ANSI, other voluntary standards setting organizations, and Government agencies who participate in international standards actions to coordinate and harmonize international standards developments with existing U. S. standards and plans for the future. The plan is expected to change with the input from each of these bodies using it as a working document and it is hoped that the plan can be updated as the regulatory needs, the standards output and the research requirements change with time.

Technical sub-area	Assigned to:	Organization to do work

Statement of regulatory needs

Existing national and international standards

Work in progress—national and international

Future work - national

CONTINUED ON REVERSE SIDE

Future work—international

Title of proposed new standard

Time required to produce the document

Research required

Special problems

Priority—rate on a scale of 1 to 10

6

Section 2
PLANNING REPORT

2.1 Physical Acoustics

There are a wide variety of standards needs in the general areas of noise emission of moving and stationary noise sources, measurement of sound pressure level, instrumentation, community noise, and sound propagation. The following subsections analyze these needs in the area of physical acoustics, and recommend standards actions. A table which outlines a development plan for physical acoustics standards including research requirements necessary for future standards development is presented.

The Planning Panel Worksheets in Appendix A3 detail the needs, activities and future actions for individual standards within the broad categories defined above.

2.1.1 Analysis of Standards Requirements

The key issues in the general areas of interest in physical acoustics are listed below and the importance of various areas is indicated. For more details, the reader should review the detailed planning panel worksheets in Appendix A3.

The general conclusions and plan for each area within the scope of the planning division on physical acoustics are given below.

2.1.1.1 Noise Emission of Moving Noise Sources

It was recognized that although a large number of standards for particular moving equipment exists, there is no series of basic documents similar to those being developed for stationary noise sources which can be used for moving sources. It was concluded that it would be desirable to set up a working group to consider such topics as test measurement criteria, correction of test data to reference conditions, definition of appropriate descriptors and test result reporting, including correction of data for other conditions (e.g., distance corrections).

2.1.1.2 Noise Emission of Stationary Noise Sources

The noise emission of stationary sources can be described in terms of sound power level. Measurement of sound pressure level is covered in section 2.1.1.3.

Regulatory uses for specification of noise emission in terms of sound power level are: (1) to estimate the sound pressure level on a measurement surface at some distance from a source, (2) to be used as part of a regulation design criteria or (3) for noise labeling purposes. The sound power level output of a

noise source is a fundamental property of the source and one can relate this power level to sound pressure level at varying distances from the source. In practice it is difficult to determine sound power level except in a well defined acoustical environment. It is then necessary to relate the sound power level to the sound pressure level at varying distances and directions from the source when situated in a typical room or environment. If a basic set of measurement procedures for sound power level are developed, including simple survey types whose precision and accuracy are clearly related to the more exact laboratory types, it should be feasible to regulate or specify the noise emission of stationary sources using the sound power level as the basic descriptor.

Work on a series of "frame" documents is proceeding as rapidly as possible. The ISO standards in this area are moving more rapidly than the national standards; it is planned to complete the national work as soon as is feasible.

Another area of interest is the rating of machinery noise and the determination of noise emission using a reference sound source. ANSI standards already exist for rating machinery noise and related international standards are being processed. Research is required to determine how best to utilize reference sound sources, except in the case of measurements in reverberation rooms where reference sound sources have been used for approximately 20 years.

2.1.1.3 Measurement of Sound Pressure Level

There is an obvious need for techniques for measurement of sound pressure level by all federal agencies concerned with noise. The basic ANSI standard in this area is S1.13. This document gives guidance for positioning of microphones around sources and guidelines for ambient noise measurements. However, the sections dealing with fluctuating and time varying noise need to be improved. There is a need for a specific standard for other measurements of sound pressure, particularly at the operator's position of a machine and in rooms. A definite need exists for standardized techniques for sound surveys in industry and in communities.

A better knowledge of the directional properties of sound fields in industrial situations would be extremely useful in future standards specifying calibration of dosimeters and other devices used to monitor noise exposure. Directional microphones are available and thus this topic appears to be a research item.

2.1.1.4 Instrumentation

Since several documents on instrumentation are needed, as shown below, the ANSI S1 committee should increase its activity in the area of instrumentation.

There is a clear regulatory need by OSHA and NIOSH/MESA for a standard on dosimeters, and work on a proposed standard in this area will be expedited.

A standard on field calibrators for sound level meters would be of value for all federal agencies concerned with accurate measurement of noise. Although the details to be included in such a standard still have to be delineated, it appears that work in this area should be started immediately.

A review of current standards on filters (octave and one-third octave) used in noise analysis led to the conclusion that our current analog standards are generally satisfactory. However, some effort should be made to identify those problems that may arise when digital filtering is used. There is also a need for a new class of filters having greater attenuation in the frequency regions outside the filter's nominal passband.

On the subject of other digital analyzers there is a need for a general standard covering the testing and characteristics of instruments that process acoustical data using digital means. These include digital spectrum analyzers and community noise analyzers. The community noise analyzer is of particular interest. It was concluded that organization of an informal meeting of users and producers of community noise analyzers would identify many of the problems that exist with measurements made using these instruments.

It would be very desirable to have a standard on an integrating sound level meter. Several draft documents have already been produced in the United States and there is work beginning on the international level. Specification of the characteristics of these instruments should be expedited.

International specifications for sound level meters are undergoing a thorough revision at this time, and there will be a need to revise the current ANSI standard (ANSI S1.4-1971, R1976). Issuance of a new national standard on sound level meters will have a significant impact on all regulatory agencies and other agencies making or specifying noise measurements. The physical characteristics of the sound level meters specified in the new standard must be carefully considered.

2.1.1.5 Community Noise

Making measurements in both time and space for purposes of determining compliance with regulations for land-use planning represents a problem in standardization. Particular problem areas to be faced in developing standards are the classification of noise surveys and determining the accuracy of measurements considering both spatial and temporal variability. An existing S1 Working Group in this area is beginning its work and will attempt to use the results of recent EPA-sponsored studies on community noise.

2.1.1.6 Sound Propagation

The need for standards in four key areas of sound propagation are:

1. There is no existing standard method for evaluation of barriers. This applies particularly to barriers used outdoors to shield communities from the effects of highway noise. While there was no general agreement as to whether this work should be performed by ASTM or ANSI, the need was clearly identified. This is discussed in greater detail in Section 2.3 under Noise Control Elements.

2. A need was also identified for guidelines for the description of sound propagation in urban environments. This includes standard methods for estimating the levels in city streets and other built-up urban areas.

3. In the area of influence of atmospheric turbulence and ground effects on sound propagation, an S1 committee has nearly completed work on a document describing absorption of sound in the atmosphere. However, a new document that would describe the effects on sound propagation of both wind and temperature is needed. The effects of finite acoustic impedance of the ground also must be included.

4. Regarding the attenuation of bands of noise, a standard similar to that described above except dealing with all frequency dependent mechanisms of sound attenuation is required. This standard would take into account the spectrum of the noise, the height of the source above the ground and the effects of the finite acoustic impedance of ground surfaces.

2.1.1.7 Standards Requirements

Table 2-1 shows recommended standards actions and research for major areas in physical acoustics as detailed below.

2.1.2 Recommendations

The following recommendations are made with respect to future voluntary standardization in the area of physical acoustics:

2.1.2.1 Standards Actions

Noise Emission of Moving Sources: The chairman of the ANSI S1 committee should appoint an ad hoc group of specialists in measurement of moving noise sources to meet with the standards management of the Society of Automotive Engineers and the ANSI Acoustical Standards Management Board to discuss the assignment of this project to a standards writing group. Currently, there is no working group on moving sources closely attached to S1, except for S1-72 (S3) on motor vehicle noise and S1-73 (S3) on aircraft noise. Both these committees are the ANSI counterparts of SAE committees.

Noise Emission of Stationary Sources: Working Group S1-50 should move as rapidly as possible to complete work it began several years ago on the series of documents on noise emission of stationary sources. The first priority is to complete the draft division of ANSI standard S1.21 Sound Power Levels of Small Sources in Reverberation Rooms into two parts, S1.31 (broad band sources) and S1.32 (discrete frequencies and narrow band sources). The second priority is to resolve the negative votes on draft S1.33 (source in special rooms). As soon as the ISO issues standards 3744 and 3746, work should be completed on corresponding national documents. It is expected that the international work will be completed during 1978. Research should be encouraged in development of applications of the reference sound source method to the determination of noise emission in other than reverberant environments.

Sound Pressure Level Measurement: A document on sound pressure level measurement at the operator's position should be prepared by S1 as soon as a corresponding international document is available. S1 should encourage the completion of the work on an ad hoc group on fluctuating noise. This information should be disseminated as soon as possible, perhaps in the form of a draft standard for trial and review.

The ANSI Acoustical Standards Management Board should contact the American Industrial Hygiene Association regarding development of a standard for sound pressure level measurements in industry.

S1 should encourage the development of techniques for directional sound pressure measurements in industrial situations.

Instrumentation: The draft dosimeter document should be finalized as soon as possible.

A chairman for the S1 working group on calibrators for sound level meters should be named and this committee instructed to write a standard on field calibration as soon as possible.

A meeting of individuals involved with the design and use of digital filters should be held within the next six months to identify problems with the measurement of the characteristics of digital filters according to current ANSI specifications.

A group of manufacturers and users of community noise analyzers should be assembled for the purpose of discussing difficulties with the use of these instruments such as problems that arise in interpreting the data obtained in using these instruments.

A draft standard on integrating sound level meters should be prepared as soon as feasible.

When the consolidated revision of IEC 123, 179 and 179a on sound level meters and precision sound level meters is available, it should be proposed as an S1 standard. Broad input from government regulatory agencies and other agencies should be solicited relative to the effects of the new standard on current measurement practice within the United States of America.

Community Noise: The new ANSI Working Group, S1-62 (S3), should be encouraged to complete a draft as soon as possible.

Sound Propagation: The Acoustical Standards Management Board of ANSI should assign preparation of a standard on noise reduction by barriers to either ASTM or S1.

The current S1 working group on atmospheric absorption, S1-57, should be redirected to begin work on standards describing the effects of atmospheric turbulence and ground effects on sound propagation and also to consider the attenuation of bands of noise. A new chairman and new personnel for this working group will probably be needed.

An ad hoc group should be set up to make a more detailed proposal on a standard for sound propagation in an urban environment. This group should report to the chairman of S1 and be the precursor of a new working group in this area.

2.1.2.2 Research Requirements:

Moving Noise Sources: Research is required to determine criteria to be used for the flatness of the test site and the extent of the required cleared area for a given degree of accuracy. Research is also required to specify the tolerable degree of surface roughness and the optimum placement of the test microphones.

Stationary Noise Sources: Considering the current stage of development of stationary noise source test procedures, it would be desirable to make a number of tests on a wide variety of noise sources in order to verify the test procedures which are specified in the document. This research would also serve as the basis for the revision of existing standards. Research is also needed in the development of a method of using the reference sound source for noise measurements in free field environments. Basic work also needs to be done to determine sound pressure level when the sound power level of a source is given.

Measurement of Sound Pressure Level: Current ANSI procedures for measurement of burst noise (ANSI S1.13) are not satisfactory because they merely specify an instrumentation system and oscilloscope for viewing the waveform. This situation will be partially remedied by publication of a new standard on impulsive noise currently in the letter ballot process. Research is also required to determine the directional nature of sound fields in industry. The research should be directed towards determining under what conditions measurements made using a personal noise dosimeter may be invalid.

Community Noise: In order to complete a community noise standard, research is needed in error analysis, studies of sampling procedures for typical patterns of community noise and studies of the spatial variability of noise fields.

Sound Propagation: With respect to barrier design, field studies are needed to validate currently used design procedures. Considerable research is needed in the development of propagation models for urban areas including atmospheric and ground attenuation effects. Research is also needed on the effects of scattering of sound through atmospheric turbulence, the nature of the turbulent fluctuations in wind velocity and temperature near ground surfaces, the propagation of sound at shallow grazing angles and on the effects of vibration of vegetation, shrubs, and trees.

Research is also needed regarding techniques to be used for specifying attenuation of bands of noise. The attenuation of discrete frequency tones is reasonably well understood and is the subject of an ANSI standard which should be published in the near future.

Table 2-1
RECOMMENDED STANDARDS ACTIONS AND RESEARCH
IN MAJOR AREAS OF PHYSICAL ACOUSTICS

STANDARDS ACTION	RESEARCH TOPICS
Noise Emission of Moving Sources	
Formation of a working group in S1	Criteria for flatness of test site; Tolerable degree of surface roughness; Optimum placement of test microphones.
Noise Emission of Stationary Sources	
Completion of a series of standards, S1.30-S1.36 (19XX), for a variety of sources in various environments.	Development of applications of the reference sound source method; Verification of test procedures on a wide variety of sources; Determination of sound pressure level when sound power level is given.
Sound Pressure Level Measurement	
For industrial purposes: Development of standards for measurement of SPL at the operator's position; Sound pressure level in an industrial setting; Completion of work on fluctuating noise.	Technique for directional sound pressure measurements in industry; Determination of conditions that invalidate measurements made with a personal noise dosimeter.
Instrumentation	
Completion of dosimeter standard; Development of standards on field calibration of sound level meters and integrating sound level meters; Meetings to analyze problems of measurement of characteristics of digital filters and use of community noise analyzers.	
Community Noise	
Completion of draft standard	Error analysis and sampling procedures; Spatial variability of noise fields.

Table 2-1 (Continued)

Sound Propagation	
Development of standards on ground effects on propagation of bands of noise; Investigation of sound propagation in an urban environment.	Progation models for urban areas including atmospheric and ground attenuation effects; Effects of atmospheric turbulence, wind velocity and temperature near ground surfaces; Propagation at shallow grazing angles and effects of vegetation; Attenuation of bands of noise.

2.2 Human Response

Federal agencies with missions concerned with the adverse effects of noise must of necessity consider the effects of noise on the health and welfare of our nation's citizens. The bases of any noise-related standardization program must be rooted in human response to noise.

The effects of noise on human behavior can be categorized into three areas: 1) hearing and damage to hearing; 2) annoyance and 3) interference with speech and communication. The properties of noise are a function of frequency, amplitude and time. As described in the previous section, Physical Acoustics, one can analyze noise for its spectral content, measure its sound pressure or intensity level, and monitor its variation with time. All these measurements specify noise physically. However, how do these physical properties affect human response?

Research that has already been done in this field has shown that the particular descriptor, or combination of the noise parameters, that is significant depends upon which human factor is being considered. A particular descriptor may be appropriate in measuring the effect of noise on damage to hearing and a different descriptor may be appropriate in estimating human annoyance. Standards in the area of human response are used to define descriptors. It is these descriptors that form the basis of standards relating to noise control, and help determine the type of physical measurement to be made.

2.2.1 Analysis of Standards Requirements

2.2.1.1 Hearing Hazard

One of the primary standards requirements in this area is the development of tables specifying noise exposures that will just produce a given amount of noise induced permanent hearing loss at specified frequencies in given percentages of the population. This standard would consider not only steady-state noises of given durations (including exposure times greater than eight hours per day) but also the hazards from time varying and intermittent noises. The noise descriptor would have to be defined for this particular tabulation but in all likelihood would involve some weighting scheme such as A-weighting. The acoustic properties of impulse/impact noise and its effect on people are sufficiently different from steady-state noise that a separate standard should be developed to outline the hazards of this particular type of sound. For the immediate future a standard should be developed which would relate hearing loss to the peak sound pressure level and effective duration of the impulses as well as the number of impulses. This standard should also provide a means for evaluating the effect of various impulse combinations as well as the combination of impulse and steady-state noise.

As an aid in writing standards relating hearing hazard to noise exposure another type of standard is necessary. This standard would require the development of tables expressing the deterioration of auditory sensitivity associated with the aging process as well as the wear and tear on the auditory system due to

the experience of noises in everyday living. This standard might require four separate tables indicating changes in auditory sensitivity as a function of age: 1) individuals whose hearing has been affected by the aging process (pure presbyacusis); 2) individuals affected by aging plus the average amount of otologic disease; 3) those affected by age plus the noises experienced outside of the occupational environment in everyday life; and 4) those affected by all of these factors; aging, environmental noises as well as otologic disease.

New criteria for hearing impairment and/or handicap should be standardized. Such a standard would be beneficial to federal and state regulatory agencies in determining the risk associated with a given exposure to noise, establishing permissible noise exposure limits and finally assisting in determination of compensable occupational hearing losses.

Federal agencies concerned with the hazards of noise exposure to hearing have an inherent interest in hearing conservation programs. These programs involve the testing of hearing and protection of hearing from the adverse effects of noise environment. The reliability and validity of the hearing test results depends upon equipment calibration, hearing test procedure, and test conditions such as background noise. With respect to calibration, the present ANSI standard specifications for audiometers need to be expanded to include self-recording audiometers because of their wide use in large scale hearing programs in industry and the military services. In the future, specifications for computerized data handling systems and for computer microprocessor systems for measuring hearing sensitivity will be needed because of their increasing use in large scale hearing programs. Circumaural earphones have become popular in industrial hearing testing programs. Use of this type of earphone dictates standardization of a coupler suitable for calibrating the earphone response.

The importance of audiometer calibration has been recognized in hearing conservation programs developed thus far. As a result of the increased involvement in hearing conservation by federal agencies as well as private industry there has been a flurry of development of systems which are commercially available for calibration of hearing test equipment both in the field and in the laboratory. If the calibration is to have any value, the equipment used for such a calibration must be precise. This is true both for the complete calibration as well as the daily check. Thus far no standard exists in this area and therefore the standardization process should be initiated.

The need for a standard test methodology for conducting measurements of pure tone hearing sensitivity has been recognized by the voluntary standards program. Standardization activities in this area are in progress with a published standard anticipated in the near future.

A new standard has just been published which establishes the maximum permissible noise level for testing hearing of pure tones down to the present reference threshold hearing level. This standard now awaits evaluation under in-use field conditions.

Several areas which merit consideration for standardization in the area of hearing protectors include: 1) physical method for measuring effectiveness of insert-type hearing protectors, 2) physical measurement of ear plug effectiveness for quality control purposes, 3) measurements of the effectiveness of nonlinear hearing protectors, 4) standard procedure for monitoring hearing protector performance in the field, 5) standard specifying the comprehensive performance of hearing protectors including noise reduction, discrimination, warning signals, wearablility, etc. The standardization program for hearing protectors requires extensive literature research as well as laboratory and field research if suitable documents are to be written.

2.2.1.2 Annoyance

A national standard exists which permits the calculation of the loudness of noise from the acoustical properties of a broad-band, diffuse and steady state sound. This standard, ANSI S3.4-1969 (R1972), does not consider the contribution to annoyance or aversiveness of other acoustical factors such as sound duration and tonal components, and should be revised to include these relevant variables. (There is an SAE standard that does this, as well as FAR Part 36 and ICAO Annex 16.) Descriptors and criteria suitable for relating subjective response to time-varying acoustical environments for both single events and cumulative exposure are necessary. Once these descriptors and criteria are established, equipment performance requirements and procedures for measuring time-varying sound levels should be refined, specified and standardized. To begin with, a separate standard should be written to assess the effects on human annoyance of impulse and impact noises such as sonic booms and quarry blasting and artillery fire. Eventually, however, perhaps a single standard could encompass the annoyance of all types of noise including steady-state, fluctuating, intermittent, cyclic, and impulsive noise with consideration given to spectral features. This all-inclusive standard would certainly be a long term goal.

An airborne noise may also contribute to the overall annoying or aversive effects on human response by subjecting the whole body to vibration as well as auditory effects. At least four different standards were identified in this area: 1) safety limits for whole body vibration exposure; 2) effects of vibration on task performance; 3) effects of vibration on comfort and annoyance and development of criteria for acceptability; 4) human response to combined noise and vibration environments.

Increased concern by the public with the steady growth of environmental noise in residential areas has resulted in activity by federal, state and local governments designed to promote an acoustic environment in the home which will assure the preservation of a desirable quality of life. This is particularly important with the increased use of multi-family dwellings. Standards are needed which will assure protection against intrusion from adjacent units or from the outdoors and the preservation of acoustical privacy in our homes. Criteria for adequacy of the acoustical environment in rooms used for purposes other than residential should be specified (classrooms, auditoria, theaters, etc.). Standardization activities should proceed in developing criteria for steady-state room noise, and time-varying room noise. Underlying both of these standards would be a method for measuring and quantifying room noise.

One adverse aspect of noise is its ability to interfere with sleep. Undoubtedly this property contributes to overall annoyance with the noise environment as well as the potential for decreasing productiveness by increasing fatigue through lack of sleep of the exposed population. At present there are no national or international standards in this area. This area of standardization deserves attention but would require considerable time to develop and must therefore be considered a long term standardization project.

A common method for establishing the aversive or annoying values of sound is a survey of community attitudes. There must be guidelines established for defining and measuring human behavior and attitudinal responses to environmental noise. These guidelines would include uniform definitions for relevant response and significant acoustical variables. They would also include a description of basic methodology for measuring and assessing the variables in order to minimize the response biases and to facilitate comparison of data among different studies of the impact of noise on human response. The development of such guidelines could be accomplished in a relatively short time.

2.2.1.3 Speech Interference

There are two standards which now exist which quantify the effectiveness of noise in interfering with speech communication. These include the articulation index, ANSI S3.5 - 1969, and the speech interference level, ANSI S3.14 - 1977. Calculations in these standards depend upon the measurement of speech level and those properties of the ambient noise that affect the masking of the speech. Standardization in these measurement areas is now in progress.

Those federal agencies responsible for seeking to provide an acceptable acoustical environment for living would probably find a standard which specifies the interference effects of noise on communicating "every-day" speech more relevant than one that relies on test techniques such as lists of monosyllables. Such standards which exist in the area of speech interference usually assume a steady-state noise environment. Since a more realistic environment is often characterized by time-varying noise, there is a need to assess the effects of temporal noise variation on speech interference.

The assessment of speech interference thus far has been based upon young adults with normal hearing. Other segments of the population represent special problems from the aspect of the interference effect of noise on speech communication. These segments include the aged and the hearing impaired. Either new standards must be developed to cover these people or corrections must be evolved which can be applied to existing scales of speech interference by noise.

The present methods for assessing impairment in speech communication for people with otological difficulties are inadequate because they provide only a gross assessment of speech communication ability. New speech testing materials should be standardized to refine those methods now in clinical use. Standards should provide information on sentence and monosyllabic discrimination measured

with various levels and spectra of background noise for various amounts of hearing loss at specified audiometric frequencies. Separate curves or corrections should be provided for those people with hearing loss who wear hearing aids.

2.2.1.4 Summary of Standards Requirements

A summary of the proposed standards program in the area of human response is in Table 2-2. This is a rather comprehensive program but not exhaustive. Although the Workshop attempted to identify gaps in the needed standards in the area of human response, there are undoubtedly areas which need standardization which were not considered. Nevertheless, implementation of the standards program as outlined in this table would go a long way toward meeting the needs of governmental regulatory agencies. The standards requirements with respect to human response to vibration - health hazards, performance impairment and annoyance - were analyzed only briefly, primarily with respect to the frequently occurring simultaneous exposure to noise and vibration. ISO activity in this area appears to proceed at a satisfactory rate considering research data available.

2.2.2 Recommendations

2.2.2.1 Standards Actions

Standards actions in the voluntary sector regarding human response to noise should be directed to the American National Standards Committee, S-3, Bioacoustics, sponsored by the Acoustical Society of America. To meet the standards needs in some instances would require revision and/or expansion of the scopes of existing working groups charged with the responsibility of standards development. In other instances new work must be initiated and new working groups must be formed. Table 2-2 summarizes these needs.

Hearing Hazard and Conservation

For the standard relating noise exposure to hearing loss, members of working group S3-58 should be encouraged to complete their work with steady-state noise and should be directed to expand their scope to include the effects of time-varying noises. Work is now in progress in the development of hearing hazard from impulse/impact noises under the auspices of S3-62. This working group should be encouraged to proceed rapidly so that this standard can be available as soon as possible. In the future, standards concerned with hearing hazard of noises should be combined so that a single standard would serve to describe the relationship of all sound to noise-induced hearing loss.

The presbyacusis curves which standardize the effect of aging on hearing loss are needed by S3-58 to complete their task. The members of this working group should be consulted to see if they can include this development within their present activities or whether a new working group will be required. Their advice should direct the action of the chairman of S-3.

The expansion of the current standard audiometric specification is in progress by working group S3-35. A proposed revision is imminent. S3-35 should be directed to consider specifications for computerized audiometers and computerized audiometric data storage devices. S3-35 should also be directed to develop standard specifications for audiometer calibration systems. This may require appointment of subcommittees within this working group but the strategy for meeting these new responsibilities should be the prerogative of the working group chairperson. Working group S3-37 has considered the problem of a coupler for circumaural earphone calibration in the past but were unable to arrive at a consensus resolution. They have been requested to address this question once more and have been made aware of the need for standardizing this type of coupler.

Several actions are needed in the area of hearing protectors. The responsibilities of Working Group S3-52 should be expanded to develop standards for: 1) physically measuring the effectiveness of insert hearing protectors; 2) measuring the effectiveness of protectors for impulsive noises; and 3) measuring the effectiveness of nonlinear protectors. These problems may be addressed by S3-52 as a group or these responsibilities may better be handled by subcommittees appointed for these particular standards. New working groups should be appointed by S3 to develop methods for: 1) assessing protector function from the standpoint of manufacturer quality control; 2) monitoring field performance of hearing protectors; and 3) evaluating comprehensively, performance of hearing protectors i. e. durability and comfort as well as sound reduction.

Annoyance

Working Group S3-51 has been concerned mainly with auditory magnitude of sound. This working group has concentrated on the loudness of sounds in the past. The charge to the working group should be expanded to look at the overall problem of annoyance. Not only should they be concerned with loudness of steady-state noise as a component of annoyance but also other spectral and temporal properties of sound which contribute significantly to annoyance. This would include concern for tonal elements in the noise, impulsive noise, and noise intermittency and fluctuation. The long term goal should be to develop a single standard which would aid prediction of acoustic annoyance of all types of sound.

A particular environment important for those concerned with acoustic annoyance is that of noise found in rooms. Criteria must be developed for acceptability of room noise environments for the various activities for which a room is intended. This includes time varying noises generated in the room or building itself as well as noise generated outside the room and transmitted across the room boundaries. To accompany the criteria there must be a standard method for measuring room noise. These specific tasks have been assigned to working group S3-57 and are in process of development.

One component of annoyance is of sufficient importance to warrant a separate standard method for estimating the effects of noise and that component is sleep interference. The data available now are scanty. A new working group should be appointed to undertake development of a standard in this area. The standard may require several years to complete but there is a need to evaluate existing data for its predictive utility. The new working group should perform this evaluation and should publicize research needs.

Working group S3-39 has the task of developing a standard which relates human response to vibration. The scope of this group should be expanded to include standardizing a method for assessing the annoying and the hazard value of combined vibration and acoustical stimulation. However, in spite of the need for uniform guidance in this area, the data base has to be considerably enlarged before a standard on annoyance and comfort in combined environments can be written. Environments of primary interest are the private home and the interior of transportation vehicles.

Estimating the annoyance value of noise in the "everyday" living environment requires sampling attitudes of the exposed people in the field. Comparability of the results of attitude surveys would be enhanced if there were standard approaches for conducting the surveys. A new working group should be appointed to address this problem. Pending the standardization of these procedures, the working group should develop guidelines for immediate use.

Speech Interference

Standards action in this area of human response mainly should expand the responsibilities of existing working groups S3-36 and S3-49. Speech interference of noise has been the primary concern of S3-49, and they have produced a standard for estimating the permissable distances between talkers communicating with various spectra and levels of steady-state background noise (S3.14-1977). However, time-varying noises and room reverberation are not adequately taken into account. As a corollary to their work on measuring speech interference properties of noise, S3-49 should consider criteria for an adequate acoustic environment for various types of speech materials including "everyday" speech. The concern of S3-36 has been the measurement of speech intelligibility in general. This working group should also be concerned with standard methods for estimating the speech intelligibility of various types of speech materials, particularly as they interact with the hearing impaired.

The hearing impaired represent a special population and have been shown to be more vulnerable to noise interference with speech intelligibility. A new S-3 working group should be appointed to develop a standard method for estimating the influence of hearing impairment on speech interference.

Noise interference with speech can be considered a special case of masking. Another masking effect of noise which should receive attention from the standards organization is masking of various warning signals. This should be the responsibility of a new working group.

2.2.2.2 Research Requirements

The standardization program proposed above for human response to noise is an ambitious one. Specific research needs for development and evaluation of particular standards are detailed in the worksheets in Appendix A4. In a few instances proposed new standards would involve integrating information and data which already exists in the literature and then formulating the appropriate standard. In other instances the information necessary to develop the proposed standard is not available at all. Systematic and extensive laboratory and field investigations would be required and would require a considerable financial outlay over several years. Interested federal agencies would have to balance the value of the needed

Table 2-2
STANDARDS NEEDS IN MAJOR AREAS OF HUMAN RESPONSE

Hearing Hazard and Conservation
Completion of standards on relating hearing loss to steady state noise including effects of time-varying noise; Standard on effects of impulse/impact noise. Compilation of presbyacusis curves. For audiometry: standards for computerized audiometers, audiometer calibration systems; a coupler for circumaural earphones. For hearing protectors; a physical method for measuring effectiveness of insert protectors; procedure to measure effectiveness due to impulse noise; effectiveness of nonlinear protectors; develop methods for quality control, monitoring field performance and evaluate comprehensive performance.
Annoyance
Loudness as a component of annoyance; contribution of spectral and temporal properties of sound to annoyance. Development of criteria for acceptability of room noise environments. Standard on interference of sleep due to noise. Completion of standard on human response to vibration. Expansion to include combined effects of vibration and noise particularly in the home and inside vehicles. Standard procedures for attitude surveys.
Speech Interference
Standard to take into account effect of room reverberation and time-varying noises; Standard method for estimating the influence of hearing impairment on speech interference. Study of masking of warning signals by noise.

standards with the cost for obtaining the information and base their program of research support and funding on that evaluation.

One particular type of research is frequently neglected. Standards are proposed, developed and published and then the research stops. Attention and interest turns to newer projects. The usefulness of standards which are developed and put into use without further evaluation of their effectiveness may be questioned. This is a weakness in both voluntary and regulatory standards programs. Evaluative and comparative studies are valuable and necessary. This type of research deserves support.

Regardless of the aspect of human response considered - hearing hazard, annoyance, speech interference - there is an evident lack of information about the effects of time-varying noise. Investigation of time-varying noise and human response represents a major research need and merits support. Development of comprehensive standards in the human-response sector awaits information from laboratory and field research of the temporal variable.

2.3 Noise Control Elements

This section deals with the regulatory, advisory and supporting agency needs for voluntary standards on the measurement and evaluation of the acoustical properties of noise control elements. Noise control elements are materials and systems used to control noise at its source, along the path between source and receiver, or at the receiver.

Voluntary standardization organizations interested in noise control elements include:

American National Standards Committee S1 on Physical Acoustics
American National Standards Committee S2 on Mechanical Shock and Vibration
American National Standards Committee S3 on Bioacoustics
American Society for Testing and Materials Committee E-33 on Environmental Acoustics

Many other professional and trade organizations also prepare standards on the measurement and evaluation of the acoustical properties of noise control elements.

2.3.1 Analysis of Standards Requirements

2.3.1.1 Agencies Needing Noise Control Elements

Four governmental regulatory, advisory, and support activities need standards on the measurement and evaluation of noise control elements. Regulatory activities are those activities which lead to government regulations. Advisory activities are activities which provide advice for Federal, state and local government agencies. Support activities are activities which provide services for Federal, state or local governments.

The four specific activities identified were:

1. Product labeling by the Environmental Protection Agency.
2. Building code specifications recommended by the Environmental Protection Agency and the Department of Housing and Urban Development,
3. Hearing conservation and industrial noise control programs under the jurisdiction of the Occupational Safety and Health Administration and the National Institute for Occupational Safety and Health.

4. Open office and building construction by the Public Building Service of the General Services Administration.

Other government activities may regulate, recommend, or use noise control elements but specific standardization needs were not identified. These other activities include activities by the military services, the Federal Aviation Administration, and the Federal Highway Administration.

2.3.1.1.1 Product Labeling by EPA. Section 8 of the Noise Control Act of 1972 (see Reference 1, Section 2.3.1.4) directs the Administrator of EPA to designate any product or class of product "...which is sold wholly or in part on the basis of its effectiveness in reducing noise," and "...by regulation (to) require that notice be given to the prospective user of ... (the product's) effectiveness in reducing noise," on a suitable label. EPA has issued a Notice of Proposed Rule-making (Reference 2) which proposes general provisions for noise labeling standards. The members of the Workshop tried to identify what products are candidates for labeling by EPA and to determine what kinds of standards are needed for the labeling process.

2.3.1.1.2 Building Code Specifications. Both HUD and EPA provide technical assistance to state and local agencies developing performance specifications for noise control in building codes. These specifications usually require that interior walls, floor-ceiling structures, and exterior building shells provide a stated minimum noise isolation. Occasionally the performance of outdoor noise control barriers is specified for buildings in noisy areas. Implementation and enforcement of building codes with noise control specifications requires standard test methods to (1) provide information about the noise isolation of building elements for the designer, (2) verify that a completed building provides the specified noise isolation, (3) identify unsatisfactory building elements in buildings that do not provide the specified noise isolation.

2.3.1.1.3 Hearing Conservation and Industrial Noise Control. Under the Occupational Safety and Health Act of 1970 (Reference 3), OSHA promulgates and enforces industrial noise regulations, and NIOSH provides research and advice on hearing loss due to industrial noise. In order to satisfy various OSHA regulations the performance of hearing protectors, audiometric booths, personnel enclosures, machinery enclosures, and various materials used for noise control must be known. Therefore, standard test methods are needed to evaluate and verify the performance of these noise control elements.

2.3.1.1.4 Open Office and Building Construction. GSA-PBS is responsible for providing office space for the Federal government. Because of cost, efficiency and convenience, GSA-PBS is committed to use open offices (frequently called land-scaped offices) wherever possible. GSA-PBS needs standards to evaluate open office components and to verify that completed open offices satisfy the acoustical require-ments established for them.

2.3.1.2 Kinds of Standards Needed for Noise Control Elements

Establishing standards for the performance of noise control elements is not

a simple matter. Such standards must take into account: (1) measurement and rating methods appropriate to the many types and uses of noise control elements; (2) techniques to assure that production materials perform as rated; and (3) methods for evaluating newly installed acoustical performance and its degradation due to aging and other factors.

The following five kinds of performance standards and standard classifications are needed to evaluate noise control elements:

1. Primary test methods (also called precision, laboratory, or basic test methods),
2. Regulation test methods (also called performance verification test methods),
3. In-use compliance test methods (also called screening or survey test methods),
4. Diagnostic test methods (also called engineering or field test methods),
5. Effectiveness ratings.

2.3.1.2.1 Primary Standard Test Methods. Primary standard test methods are precision test methods which provide the engineer, designer, and manufacturer with the most reliable information possible about the acoustical performance of a noise control element. A primary test method usually provides information about the element which does not depend on the environment where the test is performed and frequently requires special test facilities and instruments.

Competent engineers can use primary test results for noise control design.

Manufacturers can use primary test results to help them decide what performance to show on product labels. A manufacturer may decide to derate the performance shown on his label if feedback from in-use compliance tests indicates that the results of primary tests are not realistic in practice.

Manufacturers can use primary test results during product development to determine whether products meet design goals.

2.3.1.2.2 Standard Regulation Test Methods. Standard regulation test methods are used by manufacturers to verify on a routine basis that production line products perform as claimed on their labels. A regulation test method is required by the EPA labeling program for "performance verification testing" at a manufacturer's plant (see Reference 2 Section 2.3.1.4). This kind of test may also be used by a manufacturer for quality control.

Regulation test methods may be considerably simpler than primary test methods. Since they are to be performed at a manufacturer's plant during production, they cannot require special facilities and instrumentation and cannot take long to perform. Because they are simplified tests, they may not provide information which is as reliable as that provided by primary tests.

2.3.1.2.3 Standard In-Use Compliance Test Methods. Standard in-use compliance test methods provide means to assess the performance of newly installed assemblies of products (such as walls, floor-ceilings, or audiometric booths) and to determine changes in the performance of these assemblies after long use. Usually an in-use compliance test is a simple test which does not require much time or instrumentation. Its purpose is to identify assemblies which do not perform satisfactorily. It neither isolates the causes for unsatisfactory performance nor provides adequate engineering data to determine how to rectify the problems with the unsatisfactory assemblies.

2.3.1.2.4 Standard Diagnostic Test Methods. Standard diagnostic test methods provide information to determine which components of products are at fault when assemblies fail in-use compliance tests.

2.3.1.2.5 Standard Effectiveness Ratings. A standard effectiveness rating for a noise control element is a single number (or other classification) derived from test data that signifies the subjective benefit of the noise control element to the user. The effectiveness rating is to be used on the label of a product which is designated for labeling by the EPA. It must reflect, as well as possible, the benefit which a user of the product would perceive.

2.3.1.2.6 Examples. Examples of existing documents which are appropriate for the kinds of standards described above are indicated for several products and product classes in Table 2-3. Draft standards, standards development projects and needed standards are also indicated in Table 2-3. Other related standards are described in the next section.

2.3.1.3 Standards Relevant to Noise Control Elements

ANSI S2.8-1972, Guide for Describing the Characteristics of Resilient Mountings.

ANSI S2.9-1976, Nomenclature for Specifying Damping Properties of Materials (ASA 6-1976).

ANSI S3.19-1974, Methods for the Measurement of Real-Ear Protection of Hearing Protectors and Physical Attenuation of Earmuffs (ASA 1-1975).

ANSI/ASTM C 384-77, Standard Test Method for Impedance and Absorption of Acoustical Materials by the Impedance Tube Method.

ANSI/ASTM C 423-77, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

ANSI/ASTM E 336-77, Standard Test Method for Measurement of Airborne Sound Insulation in Buildings.

ANSI/ASTM E 596-77, Standard Test Method for Laboratory Measurement of the Noise Reduction of Sound-Isolating Enclosures.

Table 2-3
EXISTING (E), PROPOSED (P), AND NEEDED STANDARDS
TO EVALUATE NOISE CONTROL ELEMENTS

Kind of Standard	Product or Class of Product	
	Interior Partitions (Sound Transmission Loss)	Sound Absorptive Materials
Primary Test Method	ASTM E 90 (E) ISO 140 (E)	ANSI/ASTM C 423 (E) ISO R 354 (E)
Regulation Test Method		ANSI/ASTM C 384 (E)
In-use Compliance Test Method	ASTM E 597 (E)	Needed
Diagnostic Test Method	ASTM E 336 (E)	Not Applicable
Effectiveness Rating	ASTM E 413 (E) (STC) ASTM E 597 (E) (A-weighted level difference)	ANSI/ASTM C 423 (E) (NRC)
	Personnel Enclosures and Audiometric Booths	Floor-Ceilings (Impact Sound Transmission)
Primary Test Method	ANSI/ASTM E 596 (E)	ASTM E 492 (E) ISO 140 (E) ASTM live walker method (P) ASTM modified tapping machine (P)
Regulation Test Method	Not Practical	Not Production Line Items
In-use Compliance Test Method	Needed (Task Group E33.03L has agreed to begin work)	ASTM E 492 (E)
Diagnostic Test Method	Work in Progress Task Group E33.03L	Not Feasible at Present
Effectiveness Rating	ANSI/ASTM E596 (E) (NIC)	ASTM E 492 (E) (IIC) HUD Guidelines (TNR)

ASTM E 90-75, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

ASTM E 413-73, Standard Classification for Determination of Sound Transmission Class.

ASTM E 492-77, Standard Method of Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine.

ASTM E 597-77T, Tentative Recommended Practice for Determining a Single-Number Rating of Airborne Sound Isolation in Multiunit Building Specifications.

ASTM Proposed Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using a Live Walker.

ASTM Proposed Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using a Modified Tapping Machine.

ISO R 140-1960 Field and Laboratory Measurements of Airborne and Impact Sound Transmission.

ISO R354-1963 Measurement of Absorption Coefficients in a Reverberation Room.

2.3.1.4 References

1. Noise Control Act of 1972, PL92-574 as amended by PL94-301.

2. Environmental Protection Agency Proposal, June 22, 1977, General Provisions for Noise Labeling Standards (42 FR 31722).

3. Occupational Safety and Health Act of 1970, PL91-596.

2.3.2 Recommendations

2.3.2.1 Recommended High Priority Standards Development Projects

Six high priority standards development projects for noise control elements are recommended below. One or more of the following criteria were used in determining that these six projects should be designated as high priority projects:

1. A standard or standards must be available within three years in order to satisfy regulatory needs,

2. The project requires a considerable amount of research immediately,

3. No standard or standards exist but existing technology indicates that a standard or standards are needed as soon as possible.

4. A regulatory, advisory, or supporting agency requested immediate action.

It is recommended that the appropriate voluntary standardization organizations expedite or begin work on the following projects immediately:

1. A standard test method to measure the noise isolation provided by prefabricated outdoor barriers. See Section 2.1.1.6.

2. A standard test method to verify the installed performance of audiometric booths and personnel enclosures.

3. A standard test method to measure the reflections from sound absorptive materials at discrete angles.

4. An improved standard test method to measure the impact sound transmission of floor-ceiling structures.

5. A standard method to measure the noise reduction of building shells.

6. A regulation test method (as defined above) to measure the noise reduction of hearing protectors. (See Section 2.2, Human Response, for details.)

2.3.2.1.1 Prefabricated Outdoor Barriers. Prefabricated barriers are now being manufactured that have acoustical properties not considered by available methods of calculating barrier noise reduction when used outdoors. The available design methods are useful only when designing massive masonary or earth berm structures for which sound transmission through the barrier is not significant.

Prefabricated barriers are candidates for noise labeling by EPA. This potential action requires that a test method be developed that considers the problem of the massiveness and cost of installing these barriers.

The noise reduction of a source when one of these barriers is used is affected by the following:

1. Acoustical characteristics of the noise source,

2. Distance of source to the barrier.

3. Distance of receiver to the barrier,

4. Height of the source and receiver,

5. Atmospheric conditions,

6. Barrier height and length,

7. Integrity of barrier in preventing noise from passing through it (Barrier material and construction).

8. Terrain of the ground surfaces on each side of the barrier.

A test method should be developed that will measure the noise reduction under standardized conditions for items 1 through 4 above.

An inherent problem is the large size and massiveness of exterior barriers that may preclude removal once they are installed. It was suggested that the noise reduction of a barrier in place be compared to a direct line of sight measurement without the barrier in place. The direct line of sight data is basically noise reduction versus distance and might possibly be developed into a table with corrections for ground cover, i.e. grass, dirt, concrete, and atmospheric conditions. Task Group E-33.03H has been established to undertake this task.

2.3.2.1.2 In-Use Compliance Test for Audiometric Booths and Personnel Enclosures. There is an immediate need for a method of test of the performance of noise isolating enclosures in the field. Presently, the ASTM document E596-77 entitled Laboratory Measurement of the Noise Reduction of Noise Isolating Enclosures has been adopted for laboratory tests. Task Group 33.03L has undertaken this task.

2.3.2.1.3 Reflection at Discrete Angles. The percent of incident sound reflected by a sound absorptive material is a function of the angle of incidence. Performance data at discrete angles of incidence is required for design of open-plan offices and similar acoustical systems in order to determine the effectiveness of the noise-control system. At present, there is no suitable laboratory or field test method although a number of methods have been described in the literature. These methods apply only to limited frequency ranges or require expensive special instrumentation.

A task group of Subcommittee E-33.01 has been assigned the problem and will continue to evaluate promising test methods as they appear. There is an immediate need for these test methods and the task group is encouraged to proceed as rapidly as technology will permit. A research program is required to validate the test methods before they can be considered for adoption as standards.

2.3.2.1.4 Impact Sound Transmission. There is an immediate need for revision and improvement of the present method for measuring impact sound transmission. An improved test method is needed for use in building code specifications and compliance testing. There are two methods presently in use (ISO-140 and ANSI/ASTM E-492-73T) and two ASTM proposed alternative methods, one using a modified ISO tapping machine and one using a live walker.

Research is required to validate the proposed ASTM modified tapping machine with a reference to current-style shoes in North America (particularly heels on women's shoes) and to develop a procedure for field measurement under noisy background conditions.

Research on impact sound transmission is needed because there is an increasing belief that the current ASTM standard does not correctly rank-order floor-ceiling systems.

2.3.2.1.5 Building Shells

There is an urgent need to provide a suitable auditory environment in urban dwellings as urban noise continues to rise. A standard method of characterizing and measuring the noise isolation performance of exterior building components and the entire assembled building shell is required. This standard will enable architects and builders to design and specify buildings as well as to test their performance against such specifications.

A recently approved section of ISO 140 provides two procedures; one using existing traffic noise and the other using one or more loudspeakers as the sound source for measuring the attenuation of building facades.

Laboratory measurement methods, e.g. ASTM E 90, exist but are not suited ideally for determining the acoustical performance of components used in the exterior shell of the buildings. There is a need to modify existing methods accordingly.

Problems perceived in ISO 140 include determining ways to use airborne sources and/or elevating fixed sources in order to test roofs and upper levels of tall buildings.

It is recommended that the ongoing work of the task groups within ASTM E33.03 Subcommittee on Sound Transmission be continued at an accelerated pace.

2.3.2.2 Recommended Intermediate and Long Range Standards Development Projects

Four intermediate and long range standards development projects for noise control elements are recommended below. One or more of the following criteria were used in determining that these four projects should be designated for intermediate or long range standards development:

1. A standard procedure is likely to result from work on a high priority project on a related, but different subject.

2. The state of the art is not sufficiently advanced for immediate action.

3. The product was mentioned as a possible candidate for future regulatory action.

It was recommended that the appropriate voluntary standardization organizations speed up or begin work on the following projects as time and resources become available:

1. A standard test method to measure surface noise generated by foot fall and furniture dragged across floor coverings.

2. A standard test method to measure the insertion loss of machinery enclosures.

3. A standard test method to measure the properties of nonlinear vibration isolators.

4. Standard test methods to measure the properties of damping materials.

2.3.2.2.1 Surface Noise Generation. Products and classes of products which are designated for labeling by the EPA must be evaluated for all noise reducing properties claimed for them. Since some floor coverings are claimed to reduce surface noise (noise generated by foot fall and furniture dragged across floor), it may be necessary to develop a standard test method to measure surface noise generation. Such a test is believed not to be necessary in the near future.

2.3.2.2.2 Machinery Enclosures. Manufactured enclosures for noisy machinery are becoming available. At present there is no standard test method to measure the effectiveness of these enclosures. An appropriate test method may result from work being done to measure the effectiveness of audiometric booths and personnel enclosures.

2.3.2.2.3 Vibration Isolators. The properties of vibration isolators are customarily specified. ANSI Standard S2.8 recommends what should be included in a specification for vibration isolators but does not tell how these properties should be measured. Since nonlinear isolators (isolators for which the isolation provided is not independant of amplitude) have become available, it may be necessary to develop a standard method of test to measure the properties of these isolators.

2.3.2.2.4 Damping Materials. ANSI Standard S2.9 defines measured properties to describe the performance of damping materials but neither describes test methods nor offers guidance as to the effectiveness of damping materials. Several non-standardized methods exist to measure the properties of damping materials. It is recommended that work continue toward selecting an appropriate method or methods of measurement. It is also recommended that work be done to relate measured properties to effectiveness in noise control. Task Group E-30.03M is currently preparing a draft standard test method to measure damping properties.

2.3.2.3 Existing Standards Adequate for Needs

Three areas were identified where regulatory, advisory, or supporting agencies expressed needs which are already satisfied adequately by existing standards. They are:

1. Field screening and diagnostic tests for partitions: satisfied by ASTM E 597-77 and ANSI/ASTM E 336-77.

2. Laboratory tests for sound absorption: satisfied by ANSI/ASTM C 423-77.

3. Laboratory test for sound transmission loss: satisfied by ASTM E 90-76.

Section 3
PLAN FOR PREPARATION OF NOISE STANDARDS

3.1 Discussion of Plan

A plan for the voluntary standards system for the measurement and evaluation of sound is embodied in Table 3-1. It is the result of the interaction between Workshop participants both from the federal agencies concerned with noise and the federated voluntary standards system. Highlights of the program were discussed in Section 2 with details in the project worksheets in Appendices A3, A4 and A5.

The plan identifies the recommended projects and indicates the standards organization responsible for undertaking each one. If a standard already exists, it is identified, and the need for further work, such as revision, evaluation or expansion is included under the column headed Status. Whether a project is already in process (perhaps with a draft standard complete) or yet to be initiated, is also included under Status. Needed research is identified, whether laboratory or field type or organization of existing adequate data. An estimate of the time required to complete each project, once initiated, is also given.

3.1.1 Priorities

In the reports of three planning groups in Section 2, the priorities of the recommended projects were discussed, and the priority numbers assigned on the project documentation sheets, Appendices A3, A4, and A5, pinpointed these more precisely. In assigning these priorities, however, the question arose whether it was realistic to assign a high priority to projects based on agency needs alone, when the resources or volunteer personnel are not available to accomplish the job.

Thus, in order to place the priorities assigned by each of the planning groups on an equal footing, to carry out the mandate of the Workshop, and in addition, to take cognizance of the availability of resources to accomplish the job, the following priority plan was delineated:

1. The priorities assigned are strictly the priorities with respect to need to satisfy National regulatory or similar requirements.

2. High priority indicates that:

   (a) it is needed soon and is an important building block in the overall regulatory system;
   (b) it is needed by several regulatory agencies, or;
   (c) it is otherwise important in the overall system of standards.

3. Low priority indicates:

(a) longer range agency requirements;
(b) standards or issues of minor or isolated importance.

4. The priority listing is done without reference to the availability of resources and/or volunteer personnel to accomplish the job.

5. In some cases, projects lacking in manpower and, or funds have been identified. Thus:

(a) efforts judged to be difficult to accomplish with the technical volunteer manpower presently available and committed to standards efforts are marked with an asterisk (*).
(b) efforts considered to be extremely difficult to accomplish because they require additional research or otherwise funding support beyond what might be anticipated are marked by two asterisks (**).

The Recommended Plan for Preparation of Noise Standards, (Table 3-1) follows this priority plan.

Table 3-1
RECOMMENDED PLAN FOR PREPARATION OF NOISE STANDARDS

AREA	STANDARD	RESPONSIBLE ORGANIZATION	STATUS	RESEARCH NEED.	PRIORITY	TIME TO COMPLETION (Once initia
Noise Emission-Moving Sources	Guidelines for the preparation of test codes on moving sources	SAE/S1	To be initiated	Data Organization, field	Long Term	5-7 years
Noise Emission-Stationary Sources (Determination of sound power level)	Guidelines S1.30-197X	S1-50	In process	None	Immediate	1 year
	Small sources in reverberation room S1.21-1972	S1	Exists, needs revision, see S1.31 and S1.32	None	Immediate	See next two below
	Broad band sources in reverberation room S1.31	S1-50	In process	None	Immediate	2 years
	Discrete frequency and narrow band sources in reverberation room S1.32	S1-50	In process	None	Immediate	Less than 1 year
	Free field, over a reflecting plane S1.34	S1-50	In process After completion will need simplification	None for this draft Data organization field	Immediate Near future	Less than 1 year 3-4 years

	Anechoic and semi-anechoic rooms S1.35	S1-50	In process	None	Immediate	Less than 1 year
	Survey method S1.36	S1-50	In process	None	Immediate	1-2 years
	S1.31-S1.36	S1-50	When completed will need evaluation	Data organization, field, laboratory	Very important long term	2-4 years
Noise Emission (Reference sound source method)	Machinery and equipment - engineering and survey method S1.37	S1-50	To be initiated	Laboratory, field	Near future	3 years
Noise Emission Rating	Machinery and equipment S1.23-1976	S1-64	Exists	None	Complete	---
	Inclusion of discrete frequencies and impulsive noise	S1	Needs S3 input	Field, laboratory	Long term*	5-7 years
	Determination of sound pressure level from sound power level	S1	To be initiated	Field, laboratory	Long term	2-3 years
Sound Pressure Level Measurement	S1.13-1971	S1-64	Exists, needs revision	Data organization	Near future	2-4 years
	Operator's position	S1-64	To be initiated	None	Near future	2-3 years
	Industrial noise, surveys, noise exposure predictions	AIHA (?) S1(?)	To be initiated	Data organization	Near future	3-5 years
	Directional properties for calibration of dosimeters on dummy torso	AIHA (?) S1(?)	To be initiated	Laboratory, field	Near future*	3-9 years

Table 3-1 (Continued)
RECOMMENDED PLAN FOR PREPARATION OF NOISE STANDARDS

AREA	STANDARD	RESPONSIBLE ORGANIZATION	STATUS	RESEARCH NEED	PRIORITY	TIME TO COMPLETION (Once initia
Instrumentation	Dosimeter S1.25	S1-45	In Process	None	Immediate	Less than 1 year
	Field calibrator for sound level meter	S1-68	To be initiated	None	Immediate	2 years
	Filters and real time analyzers S1.11-1966	S1-66	Exists, needs revision	Laboratory, field	Near future	3-4 years
	Digital instruments (community noise analyzers)	S1-65	To be initiated	Laboratory, field	Near future	3-4 years
	Integrating sound level meters	S1-45	To be initiated	Laboratory	Immediate	2-3 years
	Sound level meters S1.4-1971	S1-45	Exists, needs revision	Data organi-zation	Immediate	2 years
Community Noise	Measurement and evaluation	S1-62 (S3)	In process	Laboratory, field, data organization	Near future	2-3 years
Sound Propagation	Barriers	S1.ASTM	(See entry under noise control elements)			
	Urban environment	To be decided	To be initiated	Data organi-zation, field laboratory	Near future*	2-3 years
	Turbulence, ground effects, etc. SAE-AIR 923	S1-57 SAE-21 SAE Vehicle Sound Level Committee	To be initiated	Data organi-zation, field laboratory	Long term**	7-10 years

	Attenuation of bands of noise SAE ARP 866A (partial)	SAE S1-57	Exists, needs expansion	Data organization, laboratory	Near future**	2-3 years
	S1.26	S1-57	In process	None	Near future	1-2 years
earing Hazard id Conservation	Noise and hearing loss - steady-state and time fluctuating	S3-58	In process	Laboratory, field, data organization	Immediate	2+ years
	Hearing loss from impulse/impact noise	S3-62	In process	Data organization, laboratory, field	Immediate	1-2 years
	Presbyacusis	S3-58	To be initiated	Data Organization	Immediate	1-2 years
	Hearing impairment/ handicap	S3 - New working group	To be initiated	Data laboratory, field	Near future	2-3 years
	Audiometer specifications (S3.6-1969) (R1973)	S3-35	Exists-revision	Data organization	Immediate	1 year
	Audiometers with microprocessors and computerized data storage	S3-35	To be initiated	Data organization, laboratory field	Near future	2-3 years
	Couplers for circumaural earphones	S3-37 (S1)	Under development	Data organization laboratory	Near future	2-3 years

Table 3-1 (Continued)
RECOMMENDED PLAN FOR PREPARATION OF NOISE STANDARDS

AREA	STANDARD	RESPONSIBLE ORGANIZATION	STATUS	RESEARCH NEED	PRIORITY	TIME TO COMPLETION (Once initiated
Hearing Hazard and Conservation (Continued)	Audiometer calibration systems	Subcommittee S3-35	To be initiated	Laboratory, data organization	Near future	2-3 years
	Permissable ambient noise for hearing testing (S3.1-1977)	S3-56	Exists-evaluate	Field	Immediate	
	Method for manual pure tone audiometry	Subcommittee S3-35	In process		Immediate	Less than 1 year
	Physical method for measuring ear insert effectiveness	Subcommittee S3-52	To be initiated	Data organization laboratory	Near future	2-3 years
	Measurement of hearing protector effectiveness for impulse noise	S3-52	To be initiated	Data organization laboratory, field	Near future	2-3 years
	Physical measurement of protector effectiveness for quality control	S3 (S1) new working group	To be initiated	Laboratory, field	Near future	2-3 years
	Measurement of effectiveness of non-linear hearing protectors	Subcommittee S3-52	To be initiated	Laboratory	Long-term	3+ years

	Method for monitoring hearing protector in field	New working group S3	To be initiated	Data organization, laboratory, field	Near future	2-3 years
	Comprehensive performance of hearing protectors	New working group S3	To be initiated	Data organization laboratory, field	Near future	2-3 years
Annoyance	Loudness-component of annoyance (S3.4-1968)	S3-51	Exist-expansion	Data organization, lab. field	Near future	2-3 years
	Annoyance - steady state noise	S3-51	To be initiated	Data organization, field laboratory	Immediate	3-5 years
	Annoyance - time varying noise	Subcommittee S3-51	To be initiated	Data organization, laboratory, field	Immediate	3-5 years
	Annoyance - impulse noise	Subcommittee S3-51	To be initiated	Laboratory, field	Near future	3-5 years
Speech Interference	Speech interference steady-state and time varying noise (S3.14-1977)	S3-49	Exists-revision and expansion	Data organization, laboratory	Near future	2-3 years
	Adequate environment for everyday speech	S3-49	To be initiated	Data organization	Near future	2-3 years
	Speech interference noise levels for hearing impaired	New working group	To be initiated	Data organization, field, laboratory	Near future	3-4 years

Table 3-1 (Concluded)
RECOMMENDED PLAN FOR PREPARATION OF NOISE STANDARDS

AREA	STANDARD	RESPONSIBLE ORGANIZATION	STATUS	RESEARCH NEED	PRIORITY	TIME TO COMPLETION (Once init
Speech Interference (Cont.)	Speech intelligibility tests for hearing impaired	S3-36	To be initiated	Data organization, field laboratory	Near future	3-5 years
	Intelligibility tests for communications equipment evaluation	S3-36	To be initiated	Data organization, field	Near future	3-4 years
	Masking effects of noise on warning signals	S-3 New working group	To be initiated	Data organization, field	Near future	3-5 years
Other Human Effects	Human response to vibration	S3-39 (S2)	To be initiated	Laboratory, field	Near future	4-6 years
	Criteria for steady-state room noise	S3-57 (S1)	In process	Data organization, field laboratory	Immediate	3-5 years
	Criteria for time varying noise	S3-57 (S1)	In process	Data organization, field, laboratory	Near future	3-5 years
	Method for measuring room noise	S3-57 (S1)	In process	Data organization	Near future	3-5 years
	Sleep interference	S3 New working group	To be initiated	Data organization, field laboratory	Long term	10+ years
	Guidelines for attitude surveys	S3 New working group	To be initiated	Data organization	Immediate	1-2 years

Noise Control Elements	Prefabricated outdoor barriers	S1 and E-33	To be initiated	Field research to verify a test method	Immediate possibly**	3 years
	Installed performance of audiometric booths and personnel enclosures	E-33	To be initiated	None	Immediate	1 year
	Reflections at discrete angles	E-33	In process	Laboratory and field	Immediate	5 years
	Impact sound transmission, ASTM E 492, two ASTM proposals	E-33	Exists-needs revision-proposals need evaluation	Laboratory and field urgently needed	Immediate**	3 years
	Building shell noise isolation ISO 140 Part V	E-33	In process	Field	Immediate	2 years
	Surface noise	E-33	To be initiated	Field	Long term	unknown
	Machinery enclosures	E-33	To be initiated	Laboratory and field	Near future	2 years
	Vibration isolators S2.8	E-33 or S2	To be initiated	Laboratory	Long term	unknown
	Damping materials S2.9	E-33 or S2	In process	Laboratory	Near future	5 years

3.2 Discussion of Response to Agency Needs

At the Workshop, designing a program for voluntary standards in noise responsive to national needs was seen from two points of view. To begin with, the technical areas of acoustics (physical acoustics, human response and noise control elements) were examined to see what could be done to satisfy the composite needs of the federal agencies in each of these areas. The results of these examinations were reported in Sections 2 and 3.1 and Table 3-1.

Then the needs of each agency as mandated by Congress were reviewed in turn to see how the planning in the technical areas of the voluntary standards system had responded. The general needs evolving from statutory requirements for eight federal agencies were examined first. Two examples are given in Sections 3.2.1 and 3.2.2. Then specific standards requirements resulting from these general needs were outlined, and together with the response of the standards organization are summarized in Tables 3-2 through 3-6. The following code was used to simplify the table:

a. No problems
b. Will take time
c. Research needed

It is apparent from examining the plan and its response to agency needs that there are more projects of high priority than resources available in the voluntary standards system to fund the research required. It would be advisable for these agencies to support these high priority projects (as some are doing) as much as possible from their research and development or contract funding. Also, the time frame of an agency's mandate from Congress may be too short for them to make use of the voluntary standards system. In such a case, of course, they should proceed independently. This Workshop, however, should reduce the number of such cases.

3.2.1 Needs for The Environmental Protection Agency

EPA's needs for standards can be categorized into the following broad topics, based on the Agency's mandate from Congress:

1. Emission from specific noise sources to evaluate their impact on the environment
2. Criteria for evaluating the effect of noise on health and welfare
3. Standards for labeling products sold on the basis of reduction in perceived noise and also those products that emit noise capable of affecting the public health or welfare (household and consumer products)
4. Standards for the measurement of community noise both outdoors and indoors. The purpose is both to monitor and identify unwanted sound and to assist local governments in land use planning and writing model building codes.

To meet these needs many standards are needed, often the same standard to satisfy several different needs.

3.2.2 Needs for Federal Aviation Administration

The FAA has responsibility for noise produced by aviation sources. This is concerned with:

1. Measurement of radiated sound power from (rapidly) moving sources
2. Human annoyance due to specific steady state and impulse noise
3. Sound descriptors or physical parameters to be measured that are related to human response
4. Propagation models
5. Land use planning

Table 3-2
RESPONSE TO AGENCY NEEDS IN NOISE
THE ENVIRONMENTAL PROTECTION AGENCY

IDENTIFIED NEED	STANDARD AVAILABLE	STANDARD IN PROCESS	WORKING GROUP	RESEARCH
Noise emission				
Measurement of a given noise source: to meet design specification, for performance verification, quality assurance in use, degradation	No	S1.30 Guidelines S1.31 through S1.36 for stationary source SAE/S1 Guideline for moving sources	S1-50	c
Test facilities, mobile sources	No	c	SAE/S1	
Hearing Loss				
Continuous noise	No	b	S3-58	Intermittent noise background and time-intensity trade-off
Intermittent	No	b	S3-58	
Impulse	No	c	S3-62	Work going on in Syracuse and Poland
Infrasound and ultrasound	No	c	S3-54	
Interactive effects-Noise and other hazards	No	b	S3-39 (S2) noise and vibration	c

ssessment of earing handicap	No	b	S3-New WG	Research results in literature should be examined.
urves for resbyacusis	No	b	S3-58	(more may be needed)
earing protectors: nsert ar muffs on-linear	S3.19-1974	c b c	S3-52	Objective method for insert type c
udiometric easurement	S3.6-1969 S3.1-1977	Under revision	S3-35 S3-56 S3-37	
peech interference	S3.14-1977 See ISO, and S3.2-1960 (R 1976) for word lists	b needs revision and expansion	S3-49 S3-36	Calculations using existing data
ime varying noise	No	b		
easurement of speech evel	ISO proposed standard	b	S3-59	No
rediction of speech/ oise ratio specification	No	c		
peech communication r hearing impaired	No	b		Literature review, possible additions needs
bjective, behavioral d physiological effects				
noyance, measurement aversiveness	Loudness S3.4-1968 (R 1972)	b	S3-51 S3-62	Effects of duration of pure tones, vibration and impulse (including single events)

Table 3-2 (Cont.)
RESPONSE TO AGENCY NEEDS IN NOISE
THE ENVIRONMENTAL PROTECTION AGENCY

IDENTIFIED NEED	STANDARD AVAILABLE	STANDARD IN PROCESS	WORKING GROUP	RESEARCH
Impulse, annoyance measurement	No	b	S3-51 S1.67	Procedures must be agreed upon
Community	Aircraft noise S6.4-1973 community	c for different noise sources,a	S3-50	
Criteria for land use planning	No		S3-55(S1)	
Criteria for room noise	No	c	S3-57 (S1)	Cognitive components
Effect of noise on performance	No	c	S-3	Effects on learning in work place
Interference with sleep		c	S-3	Behavioral awakening, change in sl stage, laboratory and field, after effects of interruptions
Non-auditory physiological effects	No	c		Identify and quantify effects
Instrumentation		See Table 3-1	S1,SAE/S1	
Community Noise				
Field Testing of mobile and stationary sources	No	b	SAE/S1-Mobile sources S1-stationary sources	Research under contract
Descriptors for stationary sources	No	c	S3-58, S3-62, S3/S1 S3-57 partial help	Assessment of accuracy of identifying specific sources for regulation

ɔling, for ɔrcement, site luation and eline studies	Regulation available	b		Additional technical sampling schemes
		b	S1-62	Research under contract
		b	S1-62	Research under contract
lding codes for lation	ISO 140 Part V	b,c	E-33-for building shells	
ıct sound transmission	ASTM E 492		E-33-for impact sound	Laboratory and field
ılation	ASTM E 413, 597		E-33-interior partitions	Laboratory and field
urement procedures for: tionary sources lse noise sources	No	b		Research under contract
averaged noise urements			S1-65 digital instruments in community noise analysis S1-45 integrating sound level meter	
strial process equip-	No	c		Model legislation for communities to be available in 3 years
iction to assess ct on community	No	c		
ding noise, mechanical ɔment outdoors				
ediction models		b		Research under contract
ɔpagation models		c		All different kinds
l test procedures				
reening		b		Research under contract
llure test		b		Research under contract

Table 3-2 (Concluded)
RESPONSE TO AGENCY NEEDS IN NOISE
THE ENVIRONMENTAL PROTECTION AGENCY

DENTIFIED EED	STANDARD AVAILABLE	STANDARD IN PROCESS	WORKING GROUP	RESEARCH
ibration			S3-39-human response to vibration	Human effects
ransportation		c		Descriptors, measurement and interpretation of threshold data
lasting		c		
echanical equipment in ilding		c		
idustrial equipment		c		
asurement methodology		c		
andards for labeling				
easurement methodology r compliance.)) Household and Consumer ise sources				
Guidelines for test codes for moving sources		b,c	SAE/S1	c Data organization
Determination of sound power level of stationary sources		S1.30 through S1.36, b	S1-50	Field c
Determination of sound pressure level from sound power level				Field, laboratory, long term

Noise reducing devices				
Barriers		b,c	S1 & E-33	c
Audiometric booths & personnel enclosures		a	E-33	none
istrial Applications				
Vibration isolators	S2.8	b	E-33 or S2	c
Damping materials exhaust systems	S2.9	b	E-33 or S2	

:

No problem
Will take time
Research needed

Table 3-3
RESPONSE TO AGENCY NEEDS IN NOISE
THE DEPARTMENT OF LABOR

NTIFIED D	STANDARD AVAILABLE	STANDARD IN PROCESS	WORKING GROUP	RESEARCH
ring Conservation iometer specification	S3.6-1969	Draft - updated version includes automatic audiometers & limited or OSHA-type a	S3-35	
cifications for puterized audiometers data storage systems		b	S3	c
plers for circumaural phones		b	S3-37 (S1)	c
missable ambient noise hearing testing	S3.1-1977		S3-56	should be evaluated
cifications for audio-ar calibrations		b	S3-35	c
hod for manual pure e audiometry		Draft, a	S3-35	
talled performance of iometric booths and sonal enclosures		To be initiated a	E-33	
teria				
teria for impulsive noise osure		b	S3-62	c

riteria for steady state ogether with impulsive oise exposure, presbyacusis orrections		b	S3-62	c
riteria for determining he effectiveness of hearing onservation programs				
on-auditory health riteria of noise				c
mpliance and exposure				
und pressure level asurement	S1.13-1971	Update part on unsteady noise	S1-64	c
erator's position		To be initiated b	S1-64	
dustrial noise, surveys posure predictions		b	To be decided	c
rectional properties for libration of dosimeters dummy torso		To be initiated b	AIHA (?)	c
simeter	S1.25	a	S1-45	
eld calibrator for sound vel meter		To be initiated	S1-68	
und level meters	S1.4-1971	Needs revision b	S1-45	Data organization
asurement procedure for ulsive noise exposure steady state with ulsive noise exposure				

Table 3-3 (Concluded)
RESPONSE TO AGENCY NEEDS IN NOISE
THE DEPARTMENT OF LABOR

IDENTIFIED NEED	STANDARD AVAILABLE	STANDARD IN PROCESS	WORKING GROUP	RESEARCH
Measurement of sources (non-EPA) for labeling	S1.23-1976	Should be updated to include discrete frequencies and impulsive noise	S1-64	
Machinery enclosures		To be initiated b	E-33	c
Hearing protectors	S3.19-1974		S3-52	
Method for monitoring hearing protector performance in field		To be initiated b	S3	c
Measurement of hearing protector effectiveness for impulse noise			S3-52	
Method for labeling hearing protectors				
Miscellaneous				
Criteria for the effects of infrasonics and ultrasonics				
Standard noise warning sign				

Code: a. No problem
b. Will take time
c. Research Needed

Table 3-4
RESPONSE TO AGENCY NEEDS IN NOISE
THE DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
THE GOVERNMENT SERVICES ADMINISTRATION

)ENTIFIED NEEDS FOR .ANNING AND DESIGN	STANDARD AVAILABLE	STANDARD IN PROCESS	WORKING GROUP	RESEARCH
:iteria for room noise		b	S3-51 (S1)	c, laboratory, field
ıting noise with respect speach interference eady state and time vary- g	S3.14-1977 needs revision, expansion	b	S3-49	c, laboratory, data organization
iteria for annoyance due noise	S3.5 (1972) needs expansion	b	S3-51	c
rcraft noise - effective rceived noise level (only context of NEF)	S6.4-1973 SAE ARP 1071			
ındard for land use plan- ıg with respect to noise, :luding impulsive noise :tillery).		Not impulsive noise	S3-55 (S1)	
ulsive noise - human ponse			S3-62	c
surement of sound sure level	S1.13-1971	a	S1-64	c, data organization
egrating sound level er. (L_{dn})		a	S1-45	c

Table 3-4 (Concluded)
RESPONSE TO AGENCY NEEDS IN NOISE
THE DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
THE GOVERNMENT SERVICES ADMINISTRATION

IDENTIFIED NEEDS FOR PLANNING AND DESIGN	STANDARD AVAILABLE	STANDARD IN PROCESS	WORKING GROUP	RESEARCH
Field calibrator for sound level meter		To be initiated a,b	S1-68	
Noise output of household appliances, hearing and airconditioning systems	ARI, SAE ASHRAE, ASTM			
Community noise measurement			S1-62 (S3)	
Moving traffic noise and airplane noise		Guidelines to be initiated, b	SAE/S1	c
Materials and structure for noise control			E-33	
Sound absorption	ASTM C 384-58 (1972) ASTM C 423-66 (1972)			
Sound propagation through urban areas		b,c	ASTM/S1	c
Barriers		b,c	ASTM/S1	c
Sound absorption of installed materials			Task group E-33.C1-W	
Sound transmission loss of walls, partitions, doors, ceiling, windows	ASTM E 90-75			
Insertion loss of silencers, duct lining materials	ASTM E 477-73	Updating present standard	Task group E-33.08G	c

›oratory and field ..easure- ıt of impact sound	ASTM E 492-73T	b	Task group E-33.03-C	c
ınsmission loss character- :ics of ceiling materials l products	AMA 1-11-1967	Updating present standard	ASTM E.33.03 Task Group A	
:ld measurement of trans- sion loss or noise uction	ASTM E 336-71	Old standard revised, a	E-33	
ld measurement, single ber rating of airborne sound lation in multi-family dwellings		Draft complete, a	E-33	
ld measurement of building ll noise isolation	ISO 140 Part V	Converting ISO to ASTM standard, a	E-33	c
lections at discrete angles ›ustical absorption materials)		b	E-33	c

a:

a. No problem
b. Will take time
c. Research needed

Table 3-5
RESPONSE TO AGENCY NEEDS IN NOISE
THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
THE MINING ENFORCEMENT SAFETY ADMINISTRATION

DENTIFIED EED	STANDARD AVAILABLE	STANDARD IN PROCESS	WORKING GROUP	RESEARCH
efinition of Hearing andicap including: riteria for beginning andicap and the relationship etween pure tone hearing loss id hearing handicap	Noise exposure and risk of hearing handicap ISO R1999 S31-013 (France) IS:7194 (India)	a	S3-New WG	
:andard curves)r presbyacusis, socio- :usis, nosioacusis	None		S3-58	Audiometric study of population; coordination with Public Health Service
:termination of :rsonal hearing protector)r attenuation character- ;tics in the field, .cluding standard method determination and ting of hearing pro- ctors as worn.	ANSI S3.19-1974 MSZ15498/1 MSZ15498/2 (Hungary) BS-5108 (United Kingdom)	a,b	S3-New WG	A standard method can be developed from available information, however, rating of all protectors will take ti
termination of the effect hearing protectors on scrimination in noise, :luding: standard :hods of determination, :ech discrimination, :alization, frequency :crimination, intensity :crimination, discrimination common warning signals, ex of attenuation- crimination		b	S3	Determination of frequency, intensity and warning signal discrimination in noise; index of combined effect

nstrumentation (audio-eters): specifications or automatic audiometers sed in industry including method for determining thres-old	ANSI S3.6-1969 (R 1973) IEC 177 (1965)	a, Drafts	S3-35 and subcommittee of S3-35	
tandard specifications for osimeters NIOSH/MESA have ecently proposed an mendment to Title 30 of the ode of Federal Regulations to ermit the use of personal oise dosimeters to assess oal miner exposure to noise. romulgation of a noise osimeter standard by ANSI ould enhance acceptance f this regulation.	Standard is being proposed by S1-45	S1.25-197X a	S1-45	
ecifications for sound ressure level measure-nts (industrial noise) perform plant noise rveys for the purposes of termining operator posure and general vels within an dustrial plant, mine and rface operations of mines.		a	S1	Research has been completed
strumentation (Calibrators): lerance (mechanical d electroacoustic) ould be specified, well as frequency d type of calibration eck for audiometer, sound vel meter, dosimeter, and tegrating sound level ter calibrators. Also mits of calibrator drift er time.	ANSI S1.4-1971 ANSI S1.10-1966 (R1976) ANSI S3.6-1969 (R1973)	a,b	S1/S3 Subcommittee S3-35 - audiometer calibration systems	S1-68 - field calibrators for sound level meter

Table 3-5 (Concluded)
RESPONSE TO AGENCY NEEDS IN NOISE
THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
THE MINING ENFORCEMENT SAFETY ADMINISTRATION

NTIFIED)	STANDARD AVAILABLE	STANDARD IN PROCESS	WORKING GROUP	RESEARCH
:rumentation (Integrating id Level Meters): :ifications for integrating .d level meters with particular asis on specifications for urement of varying sound.	ANSI S1.4-1971	b, Work in process for noise dosimeters	S1-45 (Sub group)	
eria for, and determination risk of noise exposure to ing: continuous noise sure	ISO R 1999	a	S3-58, S3-62	
varying noise sure including rmittent and impact/impulse		b		Epidemiologic research on intermittent noise exposure, sponsored by NIOSH, should be completed by 1978-79. NIOSH sponsored epidemiologic research on impact noise schedul for completion in 1979. Parametric study of effect of impact noise on hearing in animal subjects, on-going.

iteria for, and determination , the effects of noise on n-auditory responses ysiologic other than litory task performance	ANSI S3.4-1968 (R1972) ISO R2204	b	S3	Some work has been completed in both areas.
eld Method for determination sound transmission loss for ms and enclosures used for liometric testing in industry	ANSI S3.1-1960 (R1971) E90-70 ASTM E336-71 ASTM E413-70 ASTM ISO R140 (1960) ASTM E-596-77 (Lab method)	a	ASTM E-33.03L	
teria for damage risk for osure to noise and other sical and chemical agents luding vibration and borne contaminants	None	b,c	S3-39	Research has been completed in each area; however dose effect relationship must be determined.

e:
No problem
Will take time
Research needed

Table 3-6
RESPONSE TO AGENCY NEEDS IN NOISE
THE FEDERAL AVIATION ADMINISTRATION
THE DEPARTMENT OF TRANSPORTATION

ENTIFIED ED	STANDARD AVAILABLE	STANDARD IN PROCESS	WORKING GROUP	RESEARCH
:rophone calibration,)oratory	S1.10-1971			
:ld calibrator for sound :el meter		To be initiated b	S1-68	
:a aquisition system 'formance--recording system	IEC	a	SAE A-21	
nd level meters	S1.4-1971 Needs revision	a	S1-45	
-third octave band ters	S1.11-1966 IEC R225-1966 Needs revision	b	S1-66	c, laboratory, field
l-time data analysis tems		b,c	S1-65	Meeting of manufacture and users at May 1978 meeting of ASA
ilsive signal analysis ipment			ISO TC 43/SC1/ WG2 ICAO CAN WGB	
utation of EPNL	S6.4-1977 ISO 3891 Needs revision	b	FAA/ICAO	
riptor for human response mpulsive sound		b	S3-62 (hearing loss) S3-51 (annoyance) S3-49 (speech interference) ISO TC 43/SC1/WG2 ICAO CAN WG B	c

:ption of sound in the :phere	SAE ARP 866A needs revision	S1.26 (draft) b	FAA/NASA S1-57, SAE A21 SAE Vehicle Sound Level Committee	c
l propagation near :urface of the earth	SAE AIR 923	c	S1-57 SAE A-21	c
:iptors for cumulative : exposure	S3.23 ISO 3891		FAA/EPA S3-58	c
:dure for extrapolation of l level as a function of :nce		b,c	SAE A-21	c
l propagation through : areas			EPA/DOT	c, field studies
:uation of barriers for : control		To be initiated b	S1 and E-33 (FHWA/EPA)	c, field research to verify a test method
;rating sound level meters		a	S1-45	
tal and temporal sampling :dures for community noise :rement and monitoring		b	S1-62 (S3)	c
:dures for design of :l surveys (including :nology).		b	S3	Data organization

:
:o problem
Will take time
Research needed

3.3 Recommendations

At the final plenary session of the Workshop the following recommendations were affirmed:

1. A continuing dialogue is needed between regulatory agencies and voluntary standardization organizations in order to identify changing regulatory needs. In order to promote this dialogue it was recommended that:

   (1) Regulatory agencies designate representatives to participate in the activities of voluntary standardization organizations within any constraints imposed by agency policy.

   (2) Voluntary standardization organizations designate representatives or sub-groups to receive communications from regulatory agencies and to transmit communications to regulatory agencies on a timely basis.

2. There is a need for the voluntary standards system to respond to national needs both in time and in substance. In order to speed up the voluntary standardization process, more information documents should be written for trial and study. Also the purpose of each standard should be clearly written so that it can easily be seen whether or not it meets a national need. (Details of the purpose of a standard can be found in, "Guidelines for the Preparation of Procedures for the Measurement of Sound Source Emission," the companion report resulting from this workshop).

3. There should be a continuation of the planning process, as exemplified by the workshop in Deerfield Beach, and this report, on a yearly or biannual basis.

4. In order to generate quality noise standards, consideration by all agencies concerned with noise should be given to the following:

   (1) Support should be given to the voluntary standards system which is an invaluable technical resource to those federal agencies concerned with noise. The results of the Workshop could not have been possible without the many hours of effort contributed without renumeration by the personnel of the standards system. Since this system is a public interest organization, it would be quite fitting and proper for these federal agencies to support the standards activities of the member organizations supporting standards such as travel to meetings, and standards overhead, from public interest funding.

   (2) Support should be given for the research needs identified as necessary for better or future standards.

Appendix A1

PARTICIPANTS IN WORKSHOP

ON

DEVELOPMENT OF STANDARDS FOR ENVIRONMENTAL SOUND

December 7-9, 1977

Organized and managed by the Acoustical Society of America under the auspices of the ANSI Standards Planning Panel on Noise Abatement and Control.

Co-Chairpersons:	Henning E. von Gierke Kenneth M. Eldred
Project Manager:	Avril Brenig
Editor:	Pearl G. Weissler
ANSI Staff:	Alvin Lai

PLANNING DIVISION

Co-Chairpersons:	Henning E. von Gierke David T. Goldman
Working Group Chairpersons:	Richard M. Guernsey George C. Maling, Jr. William Melnick

Members:

Dwight E. Bishop	Charles T. Molloy
Michael W. Blanck	Harold R. Mull
Donald S. Blomquist	Charles W. Nixon
Paul N. Borsky	Bertram Scharf
Casey Cavanaugh	Thomas B. Schieb
Kenneth Feith	Theodore J. Schultz
William J. Galloway	Gerald A. Studebaker
Parker W. Hirtle	Alice H. Suter
Robert N. Hosier	Lou C. Sutherland
Daniel L. Johnson	Richard N. Tedrick
Arnold G. Konheim	W. Dixon Ward
Warren R. Kundert	John C. Webster
David Lee	George E. Winzer
Alan H. Marsh	Simone L. Yaniv

GUIDELINES DIVISION

Co-Chairpersons:

Kenneth M. Eldred
Henry E. Thomas

Working Group Chairpersons:

Peter K. Baade
Robert S. Gales
Ralph K. Hillquist

Members:

Ronald L. Bannister
Warren F. Blazier Jr.
Clifford R. Braydon
Paul R. Donavan
Scott Edwards
Larry J. Friksson
Jeffrey Goldstein
J. Barrie Graham
Larry Gray
Robert D. Hallwas, Jr.
Rod Jenkins
Anita B. Lawrence
William A. Leasure, Jr.
Richard H. Lincoln
Ralph Lombard
Jerome S. Lucas
Peter A. Mansbach
Nicholas A. Miller
Fred Mintz
Roy Muth
Karl M. Pearsons
Irwin Pollack
Gerald H. Ritterbusch
William Roper
Jack Schreiner
Allan M. Teplitzky
Juergen Tonndorf

ADDRESSES OF PARTICIPANTS IN PLANNING REPORT

Bishop, Dwight E.
Bolt Beranek and Newman, Inc.
21120 Vanowen St.
Canoga Park, CA 91303

Blomquist, Donald S.
Acoustical Engineering Division
National Bureau of Standards
Washington, D.C. 20234

Blanck, Michael W.
Industrial Park
Cortland, New York 13045

Borsky, Dr. Paul N.
Columbia University
School of Public Health
367 Franklin Avenue
Franklin Square, New York 11010

Brenig, Avril
Standards Manager/ASA Standards Secretariat
335 East 45 Street
New York, New York 10017

Caccaveri, Casey
U.S. EPA
Mail Code AW 471
Technical Assistance Programs
Washington, D.C. 20460

Eldred, Kenneth M.
Bolt Beranek and Newman, Inc.
50 Moulton Street
Cambridge, Mass. 02138

Feith, Kenneth E.
U.S. EPA
Mail Code AW 471
Noise Standards & Regulations Div.
Washington, D.C. 20460

Galloway, Dr. William
Bolt Beranek and Newman, Inc.
21120 Vanowen Street
Canoga Park, CA 91305

Goldman, Dr. David T.
Associate Director for Long-Range Planning
U.S. Department of Commerce
National Bureau of Standards
Washington, D. C. 20234

Guernsey, Richard M.
Cedar Knolls Acoustical Lab
9 Saddle Road
Cedar Knolls, New Jersey 07927

Hirtle, Parker W.
Bolt Beranek and Newman, Inc.
50 Moulton Street
Cambridge, Mass. 02138

Hosier, Robert N.
Acoustical Engineering Division
National Bureau of Standards
Washington, D. C. 20234

Johnson, Daniel L.
Bioacoustics Branch
Aerospace Medical Research Lab
Wright-Patterson AFB, Ohio 45433

Konheim, Arnold G.
U. S. EPA
Mail Code AW-471
Technical Assistance Program
Washington, D.C. 20460

Kundert, Warren R.
General Radio Company
Route 117
Boston, Mass. 01740

Lai, Alvin
ANSI
1430 Broadway
New York, New York 10018

Lee, David
Office of Standards Development
U. S. Department of Labor
RM N3660
Washington, D. C. 20210

Malina, George C.
IBM Corporation
Acoustics Lab
C18-704
P. O. Box 390
Poughkeepsie, New York 12603

Marsh, Alan H.
DyTec Engineering Inc.
Research & Consulting
5092 Tasman Drive
Huntington Beach, CA 92649

Melnick, Dr. William
Ohio State University
Department of Otolaryngology
4024 University Hospitals Clinic
456 Clinic Drive
Columbus, Ohio 43210

Molloy, Charles T.
U. S. EPA
Mail Code AW-471
Noise Standards & Regulations Div.
Washington, D.C. 20460

Mull, Harold R.
Harold R. Mull, Bell & Assoc. Inc.
181 Main Street
Norwalk, CT 06851

Nixon, Charles W.
Bioacoustics Branch
Aerospace Medical Research Lab.
Wright-Patterson AFB, Ohio 45433

Scharf, Dr. Bertram
Northeastern University
Department of Psychology
360 Huntington Avenue
Boston, Mass. 02115

Schieb, Thomas B.
Criteria Development Branch
Division of Criteria Documentation
& Standards Development
NIOSH
Parklawn Bldg. Mail Stop 3 - 28
5600 Fischers Lane
Rockville, Md. 20857

Schultz, Dr. Theodore J.
Bolt Beranek & Newman, Inc.
50 Moulton St.
Cambridge, Ma. 02138

Studebaker, Dr. Gerald
Ph.D. Program in Speech and Hearing
Graduate Center
33 West 42 Street
New York, New York 10036

Suter, Alice
Office of Physical Agents Standards
Room No. N3718
Occupational Safety and Health Adm.
Washington, D. C. 20210

Sutherland, Louis C.
Wyle Labs
128 Maryland Street
El Segundo, CA 90245

Tedrick, Richard N.
Federal Aviation Administration
AFO-210
800 Independance Avenue S. W.
Washington, D. C. 20590

von Gierke, Henning E.
AMRL/BB, U. S. Air Force
Wright Patterson AFB, Ohio 45433

Ward, W. Dixon
Hearing Research Lab
University of Minnesota
2630 University Avenue S. E.
Minneapolis, MN 55414

Weissler, Pearl G.
Acoustical Consultant
5510 Uppingham Street
Chevy Chase, Maryland 20015

Yaniv, Dr. Simone L.
National Bureau of Standards
Bldg. 225 A313
Washington, D. C. 20234

Webster, John
Audiology Department
National Technical Institute for
the Deaf
Rochester Institute of Technology
Rochester, New York 14623

Winzer, George
U. S. Department of HUD
451 Seventh Street, S. W.
Washington, D. C. 20410

Appendix A2
ABBREVIATIONS, ACRONYMS AND DESIGNATIONS

AIHA	American Industrial Hygiene Association
AFR	Air Force Regulation
AMA	American Materials Association
ASA	Acoustical Society of America
ANSI	American National Standards Institute
ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASTM	American Society for Testing and Materials
BBN	Bolt Beranek and Newman Inc.
CAN	Committee on Aircraft Noise
CHABA	Committee on Hearing, Bio-Acoustics, and Biomechanics National Academy of Sciences-- National Research Council
CID	Central Institute for the Deaf
CSTB	Centre Scientifique et Techniques de Bâtiment
dB	Decibel
DOD	Department of Defense
DOL	Department of Labor
DOT	Department of Transportation
EPA	Environmental Protection Agency
E-33	ASTM Committee on Environmental Acoustics
EPNL	Effective Perceived Noise Level
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FRA	Federal Railroad Administration
FHWA	Federal Highway Administration
GSA-PBS	Public Building Serfice of the General Services Administration
h	Hour
HTL	Hearing Threshold Level
HUD	Department of Housing and Urban Development
HMSO	Her Majesty's Stationery Office (England)
ICAO	International Civil Aviation Organization
IEC	International Electrotechnical Commission
IIC	Impact Insulation Class
INR	Impact Noise Rating
ISO	International Organization for Standardization
L_{dn}	Day-night average sound level--the 24 hour A-weighted equivalent sound level, with a 10 decibel penalty applied to nighttime levels
L_{eq}	Equivalent A-weighted sound level over a given time
MRL	Marine Research Laboratory
MESA	Mining Enforcement Safety Administration
NEF	Noise Exposure Forecast

NIC	Noise Isolation Class
NIOSH	National Institute of Occupational Safety and Health
NPEL	Noise and Power Emission Level
NRC	Noise Reduction Coefficient
OSHA	Occupational Safety and Health Administration
Pa	Pascal
PNR	Product Noise Rating
RSS	Reference Sound Source
S1	ANSI Committee on Physical Acoustics sponsored by the Acoustical Society of America
S2	ANSI Committee on Shock and Vibration sponsored by the ASA
S3	ANSI Committee on Bio-Acoustics sponsored by the ASA
SAE	Society of Automotive Engineers
SAE-AIR	SAE Aerospace Information Report
SAE-ARP	SAE Aerospace Recommended Practice
SRN	Sound Rating Number
STC	Sound Transmission Class
TC	Technical Committee
WG	Working Group

Appendix A3
PROJECT DOCUMENTATION, PHYSICAL ACOUSTICS

The following pages contain the updated versions of the Planning Panel Worksheets for Physical Acoustics. A sample worksheet can be found in Section 1.3. Under "priority" projects are rated on a scale of 1 to 10, and 1 is highest priority. For identification purposes, the worksheets have been given the code PA (Physical Acoustics) followed by sequential numbering.

Planning Panel Worksheet PA-1

Technical Sub-area:	Assigned to:	Organization to do work:
Noise Emission (Moving Sources)	S1	To be determined

Statement of regulatory and other needs:

Most moving machines are associated with transportation or construction and include land, air and water vehicles. Nationally, regulatory authority exists within EPA, DOT, FHWA and FAA to develop noise level regulations for most or all of these moving machines. Current practice sets these regulations on a type-by-type basis. Standardization of the approach (methodology) used for testing and reporting would be beneficial to both the regulators and the industries involved.

Existing national and international standards:

There are a large number of standards and recommended practices developed primarily by SAE, that detail the procedures to be used in noise measurements of specific moving sources. In addition, ASA covers general methods for test site measurement of maximum noise emitted by engine-powered equipment. However, there are currently no recognized moving source "frame" documents similar to ISO 3740-3746 for stationary sources.

Work in progress - national and international:

Work on standards for the measurement of noise produced by moving sources has been performed primarily by SAE. However, there is no national work in progress to define a series of "frame" documents for moving sources. Internationally, a very general outline, "Principles for the Measurement of Noise from Moving Sources," has been drafted and is currently being considered by ISO/TC43/SC1.

Future work - national:

Consideration ought to be given to the preparation of four general standards for the measurement of noise from moving sources outdoors.

1. Test measurement criteria, including specification of test site, determination of measurement location(s) with regard to the source location and ground plane; ambient environmental conditions, definition of vehicle location, path of movement and operation; and recording of special conditions.

2. Test data corrections, including spectral corrections, are required to reference conditions for source characteristics (speed, power, etc.) and for noise propagation where source-microphone distances warrant.

3. Definition of appropriate descriptions, (noise exposure units), including references to other existing standards and guidelines for the choice of the physical quantities to be measured.

4. Test result reporting and data adaptation/extrapolation to other conditions, distances, or noise exposure units. An additional general standard might be considered for indoor measurement of moving sources, such as subways.

Future work - international:

The general outline under consideration by ISO (ISO TC 43/S1 (Secretariat-250)340 could be modified or replaced by the four general standards on moving sources to be prepared nationally. It might be also replaced by the "Guidelines" document prepared as a companion to this report as described in Section 1.

Title of proposed new standard:

ANSI S1.xx-198x.

Time required to produce the document:

5 to 7 years.

Research required:

1. Determination of the flatness which must be specified for both the test track and the measurement area. If the degree of flatness is unspecified it is possible the measurements will have unacceptable errors. Conversely, if the flatness requirements are specified too stringently, the cost of the test site could be prohibitive.

2. Establishment of the extent of cleared, hard surface areas which must surround the test microphone(s) in order to guarantee results which are uncontaminated by reflections from obstacles and by the proximity of sound absorptive ground.

3. Quantitative specification of surface roughness as well as the development of means for constructing surfaces of prescribed roughness.

4. Determination of optimum placement of test microphones for moving sources. This includes microphone heights and spacings to achieve prescribed measurement goals for pass-by and source directivity data.

Priority:

5

Planning Panel Worksheet PA-2

Technical Sub-area:	Assigned to:	Organization to do work:
Noise Emission (Guidelines)	S1	S1-50

Statement of regulatory and other needs:

It is obvious that procedures are necessary for the measurement and rating of noise from all kinds of equipment. Not all regulations will be based on sound power level as evidenced by the fact that regulations based on sound pressure level at a distance have already been prepared. Nevertheless, sound power level can be used in at least three ways:

1. To estimate the sound pressure level on a measurement surface at some distance from a source. Guidelines in this area are already given in ANSI S3.17. For regulatory purposes, other distances besides the 1 meter distance given in S3.17 might be used, and in many cases may be adequate to determine if the requirements of a regulation have been met.

2. As part of a regulation. No current sources to be regulated in terms of sound power were, however, identified.

3. For labeling purposes. Sound power based measurements may be very useful. Three candidates that already exist are the ARI sound rating number (SRN), the ANSI S3.17 Product Noise Rating (PNR) and the ANSI S1.23 Noise Power Emission Level (NPEL). At this time, no one of these three is preferred for labeling purposes, and in fact labeling may be in terms of any of these depending on established practice.

Thus there is a need for a basic set of measurement procedures for sound power level including simple survey types whose precision and accuracy are clearly related to the more exact laboratory procedure.

Existing national and international standards:

ISO 3740, Acoustics - Determination of sound power levels of noise sources, Guidelines for the use of basic standards and for the preparation of noise test codes, has been approved by the International Organization for Standardization. This document covers guidelines for the selection of one of a series of international standards on determination of noise emission of sources.

Work in progress - national and international:

The national counterpart of ISO 3740, S1.30-197X, has been voted upon once by S1. The comments on this document are currently being reviewed and it is expected that a second letter ballot will be issued in late 1978.

Future work - national:

(See above)

Future work - international:

The international document has ~~recently~~ been published and no efforts are currently underway to revise the document.

Title of proposed new standard:

Same as international standard

Time required to produce the document:

It is expected that the document will be completed in 1979.

Research required:

It is believed that there is enough information available to prepare a complete set of standards on sound power determination for stationary sources. When these standards have been issued, it will be necessary to make measurements on a wide variety of sources in all of the environments defined by the standards in order to obtain new information on the precision and accuracy of the data and to define special problems that may be encountered.

Priority:

3

Planning Panel Worksheet PA-3

Technical Sub-area:	Assigned to:	Organization to do work:
Noise Emission (Reverberant Room - Precision)	S1	S1-50

Statement of regulatory and other needs:

Same as PA-2

Existing national and international standards:

ISO 3741-1975, Acoustics - Determination of Sound Power Levels of Noise Sources - Precision Methods for Broad-band Sources in Reverberation Rooms. ANSI S1.21, American National Standard method for the determination of the sound power of small sources in a reverberation room.

The national standard covers both broad band and discrete frequency sources. The international document covers only broad-band sources; a second international document, ISO 3742, covers discrete frequency sources.

Work in progress - national and international:

The international documents are complete and are not at this time being revised. The national document is being divided into two parts, ANSI S1.31 and S1.32. It is expected that these national documents will then parallel the international documents.

Future work - national:

See above.

Future work - international:

None planned.

Title of proposed new standard:

ANSI S1.31-197X Acoustics - Determination of Sound Power Levels of Noise Sources - Precision Methods for Broad-band Sources in Reverberation Rooms.

Time required to produce the document:

It is expected that this document will be issued in 1979.

Research required:

Same as PA-2

Priority:

2

Planning Panel Worksheet PA-4

Technical Sub-area:	Assigned to:	Organization to do work:
Noise Emission (Reverberant Precision)	S1	S1-50

Statement of regulatory and other needs:

Same as PA-2

Existing national and international standards:

ISO 3742-1975, Acoustics - Determination of Sound Power Levels of Noise Sources - Precision Methods for Discrete-frequency and Narrow-band Sources in Reverberation Rooms. ANSI S1.21, American National Standard Methods for the Determination of the Sound Power Level of Small Sources in a Reverberation Room. The international document covers only discrete frequency sources; the national document covers both broad-band and discrete frequency sources.

Work in progress - national and international:

The international document is complete and is not being revised. The national is in the process of being divided into two parts. The discrete frequency portion of ANSI S1.21 will become ANSI S1.32.

Future work - national:

See above.

Future work - international:

This document is new and is not yet up for revision.

Title of proposed new standard:

ANSI S1.32-197X, Acoustics - Determination of Sound Power Levels of Noise Sources - Precision Methods for Discrete-frequency and Narrow-band Sources in Reverberation Rooms.

Time required to produce the document:

It is expected that a document will be issued in 1979.

Research required:

Same as PA-2

Priority:

2

Planning Panel Worksheet PA-5

Technical Sub-area:	Assigned to:	Organization to do work:
Noise Emission (Special Test Room)	S1	S1-50

Statement of regulatory and other needs:

Same as PA-2

Existing national and international standards:

ISO 3743, Acoustics - Determination of Sound Power Levels of Noise Sources - Engineering Methods for Special Reverberant Test Rooms. This document covers the design of a special low-cost test room that can be used to determine the sound power level of small sources.

Work in progress - national and international:

This document has ~~recently been approved~~ as an international standard. The counterpart document has been voted upon by S1 as ANSI S1.33. A position is being developed on the reasons for the negative votes and S1-50 is trying to resolve the comments.

Future work - national:

See above.

Future work - international:

This is a new international standard. No new work is planned.

Title of proposed new standard:

S1.33-197X, Acoustics - Determination of Sound Power Levels of Noise Sources - Engineering Methods for Special Reverberant Test Room.

Research required:

This standard has been developed internationally, but has not been widely used in the United States. Research is required to evaluate the proposed techniques and to ensure that the methods proposed in the standard lead to data having an acceptable accuracy.

See also PA-2

Priority:

1

Planning Panel Worksheet PA-6

Technical Sub-area:	Assigned to:	Organization to do work:
Noise Emission (Free Field Engineering Method)	S1	S1-50

Statement of regulatory and other needs:

Same as PA-2

Existing national and international standards:

ISO/DIS 3744, Determination of Sound Power Levels of Noise Sources - Engineering Methods for Free-field Conditions Over a Reflecting Plane (Draft). This document details a wide variety of techniques that can be used to determine the noise emission of sources outdoors or indoors. It specifies certain conditions which must be met in order to make measurements having a suitable accuracy. These conditions include environmental corrections that must be applied when reflections are present within the room.

Work in progress - national and international:

The counterpart document, ANSI S1.34 has been voted upon by S1. S1-50 is in the process of resolving the negative votes. It is expected that a second letter ballot will be issued after the international document has been published.

Future work - national:

It is widely recognized that ISO 3744 is a very complicated document. It is likely that ISO will begin work on the development of a new standard that will simplify the engineering determination of sound power level. Nationally, it is planned to follow this work very carefully.

Future work - international:

It is believed that the ISO will start on a new document which may simplify the current procedures of ISO 3744.

Title of proposed new standard:

ANSI S1.34, Acoustics - Determination of Sound Power Levels of Noise Sources - Engineering Methods for Free-field Conditions Over a Reflecting Plane.

Time required to produce the document:

It is expected that the national counterpart document will be voted on again in 1979.

Research required:

There is a long term (3-4 years) need to develop new and simplified methods for engineering determination of the sound power emitted by sources in a free field. The current procedures in ISO 3744 are complex. Perhaps the most immediate simplification would be to define environments in which measurements would be made using an environmental correction of 0 dB.

See also PA-2

Priority:

4

Planning Panel Worksheet PA-7

Technical Sub-area:	Assigned to:	Organization to do work:
Noise Emission (Free Field Precision Methods)	S1	S1-50

Statement of regulatory and other needs:

Same as PA-2

Existing national and international standards:

ISO 3745, Acoustics - Determination of Sound Power Levels of Noise Sources - Precision Methods for Anechoic and Semi-anechoic Rooms. This is a document that allows for precise determination of sound power in a laboratory environment.

Work in progress - national and international:

There is no work in progress internationally on this document; it is a recent ISO standard. Nationally, the counterpart document, ANSI S1.35-197X has been voted upon once and the negative votes are in the process of being resolved.

Future work - national:

See above.

Future work - international:

This is a new document; it is not expected that any new international work will be done in the immediate future.

Title of proposed new standard:

ANSI S1.35, Acoustics - Determination of Sound Power Levels of Noise Sources - Precision Methods for Anechoic and Semi-anechoic Rooms.

Time required to produce the document:

It is expected that the document will be published in 1979.

Research required:

Same as PA-2

Priority:

3

Planning Panel Worksheet PA-8

Technical Sub-area:	Assigned to:	Organization to do work:
Noise Emission (Survey Method)	S1	S1-50

Statement of regulatory and other needs:

Same as PA-2

Existing national and international standards:

ISO/DIS 3746, Acoustics - Determination of Sound Power Levels of Noise Sources - Survey Method (Draft).

Work in progress - national and international:

The international document is in the final stages of completion. A United States counterpart document, ANSI S1.36-197X, has had one letter ballot and the negative votes are being reviewed.

Future work - national:

This is perhaps the most important sound power document under consideration because it defines very simple procedures that can be used for estimating the sound power emitted by a source. It is hoped that future national work will lead to a determination of the correlation among the various available methods for measurement of sound power.

Future work - international:

Not known.

Title of proposed new standard:

ANSI S1.36, Acoustics - Determination of Sound Power Levels of Noise Sources - Survey Method.

Time required to produce the document:

It is expected that a new document will be voted upon in 1979.

Research required:

None to produce the document. However, validation of the method will require a large number of measurements.

See also PA-2

Priority:

4

Planning Panel Worksheet PA-9

Technical Sub-area:	Assigned to:	Organization to do work:
Noise Emission (Reference Sound Source Method)	S1	S1-50

Statement of regulatory and other needs:

Same as PA-2

Existing national and international standards:

None

Work in progress - national and international:

No work is in progress on the national level. On the international level, work has just started on the development of noise emission techniques through the use of a reference sound source (a source of known sound power output). The RSS has been used for many years in reverberant rooms to provide a calibrated source for sound power determinations and has been extremely successful. However, there are no techniques accepted at this time for the use of such a source in a free-field environment. It is in this area that the reference sound source may provide the greatest simplification in measuring noise emission of sources.

Future work - national:

A plan is needed to define a national program in this area. While the document eventually produced will probably follow the international documents, a research program is needed to support the international program.

Future work - international:

Work on an international standard is just beginning and will be continued in the future.

Title of proposed new standard:

ANSI S1.37, Acoustics - Noise Emitted by Machinery and Equipment - Engineering and Survey Methods Using a Reference Sound Source.

Time required to produce the document:

Approximately 3 years.

Research required:

There is very little information available on this subject except for RSS

methods in reverberant rooms. The first step is to encourage publication of existing data on this subject and then to apply the results to measurements on a wide variety of machines.

Priority:

7

Planning Panel Worksheet PA-10

Technical Sub-area:	Assigned to:	Organization to do work:
Noise Emission (Rating of Machinery)	S1	S1-64

Statement of regulatory and other needs:

Same as PA-2

Existing national and international standards:

ANSI S1.23-1976, Methods for the Designation of Sound Power Emitted by Machinery and Equipment.

Work in progress - national and international:

An international document, DP 4871, Noise classification and labeling of equipment and machinery, is the subject of a letter ballot.

Future work - national:

It is expected that the international document will be reasonably similar to the national document. If necessary, the national document will be revised.

Future work - international:

The international document being proposed is an absolute comparison method as is the existing national document. It is expected that future international work will attempt to develop a relative classification scheme.

Title of proposed new standard:

None

Research required:

Basic work needs to be done to measure the sound pressure level for many products that have been rated in terms of sound power level and to develop methods for the determination of sound pressure level when the sound power is known. In a sense, this is the inverse problem of determination of sound power from sound pressure data. The major difference is that the environment used to determine the sound power originally is more carefully defined. More measurements in "typical" rooms are needed to define the sound field due to a source.

Special problems:

A key issue in the noise classification of machinery and equipment is the method that should be used to identify discrete frequencies produced by the equipment and the presence or absence of impulsive noise. These are key issues that must be identified by the groups concerned with human response.

Priority:

Not applicable - national standard exists.

Planning Panel Worksheet PA-11

Technical sub-area:	Assigned to:	Organization to do work:
Measurement of Sound Pressure Level	S1	S1-64

Statement of regulatory and other needs:

Techniques for the measurement of sound pressure level are needed in almost all situations except those for which the appropriate description is the sound power level of the source. Regulatory situations in which sound pressure levels are needed include:

1. Sound-pressure-at-a-distance measurements for characterizing a source.

2. Ambient noise measurements in rooms and in communities for comparison with criteria.

3. Measurements to be used as inputs to a model to determine community impact, especially measurements on moving sources.

Existing national and international standards:

ANSI S1.13-1971, Methods for the Measurement of Sound Pressure Level. ISO 2204-1973, Acoustics - Guide to the Measurement of Airborne Acoustical Noise and Evaluation of its Effects on Man.

Work in progress - national and international:

The international document is being revised. The national document needs revision in several important areas. An ad hoc group is in the process of attempting to define methods for statistical treatment of fluctuating noise and measurement of noise from moving sources.

Future work - national:

ANSI S1.13-1971 is a key S1 document and needs to be revised. More details need to be included on outdoor measurements including recommended distances from the source. The section on fluctuating noise also needs considerable revision to take into account current methods of noise analysis including statistical distributions, L_{dn}, L_{eq} and other descriptors of time-varying noises.

Future work - international:

ISO R2204 to be revised.

Title of proposed new standard:

Same as existing standard.

Time required to produce the document:

Two years.

Research required:

The procedures given in ANSI S1.13 for measurement of burst noise are not very satisfactory; they need to be revised.

Priority:

3

Planning Panel Worksheet PA-12

Technical sub-area:	Assigned to:	Organization to do work:
Sound Pressure Measurement (Operator's Position)	S1	S1-64

Statement of regulatory and other needs:

It is believed that measurement of the sound pressure level of a source at one or more operating positions will be useful:

1. To define the hazard (from a noise viewpoint) to an operator:

2. As a descriptor for regulatory purposes when sound pressure at a distance or sound power are selected as descriptors of source noise level.

Existing national and international standards:

None

Work in progress - national and international:

A first draft proposal ISO/DP 6081, Acoustics - Noise Emitted by Machinery and Equipment - Guidelines for the Preparation of Test Codes Requiring Noise Measurements at the Operator's Position. This document provides guidelines for preparing test codes that involve sound pressure level measurements at the operator's position. It is not only an expansion of those parts of ANSI S1.13 that deal with operator position measurements but is also a detailed document that may be used to define operator position sound pressure levels. Thus, a minimum description of the noise emitted by a machine would include the sound power level and the sound pressure level at specified points where operators are likely to be exposed. This document is in the initial states of preparation internationally; no work is in progress nationally.

Future work - national:

One of two approaches should be selected for the national document; either the appropriate sections of ANSI S1.13 could be revised or this document could be issued as an American National Standard.

Future work - international:

Nothing beyond current program.

Title of proposed new standard:

Same as international document.

Time required to produce the document:

18 months

Priority:

2

Planning Panel Worksheet PA-13

Technical sub-area:	Assigned to:	Organization to do work:
Sound Pressure Level Measurements (Industrial Noise)	To be decided	To be decided

Statement of regulatory and other needs:

There are two major regulatory needs:

1. To perform plant noise surveys for the purposes of determining operator exposure and general levels within an industrial plant, mines, and surface operations forces.

2. To determine the effects of source noise control on sound pressure level in an industrial situation for the purposes of preparing cost/benefit analyses, and for assistance to industry for determination of compliance with regulations.

Existing national and international standards

None

Work in progress - national and international

None

Future work - national:

There is obviously a need to define methods of measurement of industrial noise. This includes such areas as how to make a noise survey (points at which noise levels should be measured and how to describe these points, how long observations should be made at each point, how to describe the industrial environment, how to describe the operating conditions of the equipment under test, etc.) In spite of obvious regulatory needs, there is no general document which describes how a noise survey should be taken, how to predict daily worker noise exposure based on short-time measurements or time and motion studies and other problems associated with noise in industry. This is an open problem at the moment which should be addressed by a standards-setting body.

Future work - International:

None known.

Title of Proposed Standard:

To be decided.

Priority:

4

Planning Panel Worksheet PA-14

Technical sub-area:	Assigned to:	Organization to do work:
Sound Pressure Measurements (Directional Properties)	To be decided	To be decided

Statement of regulatory and other needs:

A knowledge of the directional properties of sound fields would probably be useful if one were to specify the calibration of a noise dosimeter on a dummy torso.

Existing national and international standards:

None, perhaps not applicable

Work in progress - national and international:

No systematic work known

Future work - national:

There is a need to define the directional characteristics of sound fields in industry. In order to determine, for example, where a noise dosimeter should be worn and what the differences in recorded noise exposure will be if the unit is worn, for example, on the helmet or placed in a pocket. It is obvious that the directional characteristics of sound fields in industry cannot be standardized but it would be very useful to consider how standardized measurements could be made of these properties.

Future work - international:

None

Title of Proposed Standard:

To be decided

Time required to produce the document:

Four years.

Research required:

Research is required to determine the nature of sound fields in industry. The research should be directed toward determining under what conditions measurements made using a personal noise dosimeter may be invalid.

Priority:

5

Planning Panel Worksheet PA-15

Technical sub-area:	Assigned to:	Organization to do work:
Instrumentation (Personal Dosimeter)	S1	S1-45

Statement of regulatory and other needs:

There is no question that an ANSI standard for a personal noise dosimeter is badly needed. Many dosimeters are currently being used both by regulatory agencies and by industry. An amendment is being added to Title 30, Code of Federal Regulations to permit use of dosimeters in coal mines. The mining industry has objected to the amendment on the basis that a national standard does not exist. The clear immediate need is for a dosimeter that has a 5 dB exchange rate and indicates a percentage or fraction of a criterion level given by a Federal Regulation.

Existing national and international standards:

None

Work in progress - national and international:

A proposed national document, ANSI S1.25-197X has been submitted to the ANSI Board of Standards Review for public comment before being issued as an American National Standard.

An international IEC document has been circulated to IEC National Committees for comment, has been revised and is about to be circulated again for comment. This document, in contrast to the ANSI document, describes a dosimeter that has a 3 dB exchange rate and is calibrated to indicate Pa^2h.

Future work - national:

Two key issues have been identified during voting and commentary on the national document. These are: (1) In the method of calibrating the dosimeter, should it be calibrated with a wearer present or not. (2) Rather than calibration to read a fraction of a "regulated" total exposure, the dosimeters could be calibrated to read in units of Pa^2 h.

Future work - international:

To complete work on international document.

Title of proposed new standard:

ANSI S1.25-197X Personal Noise Dosimeters.

Time required to produce the document:

It is hoped that a document will be issued in 1978.

Special problems:

See future work - national.

Priority:

1

Planning Panel Worksheet PA-16

Technical sub-area:	Assigned to:	Organization to do work:
Instrumentation Field Calibration of Sound Level Meters and Sound Analyzers	S1	S1-68

Statement of regulatory and other needs:

Many field calibrators are in use to calibrate sound level meters and other sound measuring instruments that meet ANSI S1.4 and IEC Standards. Yet these calibrators are not standardized. Increased Federal regulation means that for legal purposes, it is best to have validated data. Calibrators, like sound level meters, should produce comparable results, independent of their make and model.

Parameters of a sound level meter other than sensitivity at a single level and frequency may be of interest, particularly where data must pass the test of court action or when greatest accuracy must be assured because of cost considerations.

Existing national and international standards:

None

Work in progress - national and international:

A questionnaire is being circulated from TC29/SC29C to the National Committees of IEC.

Future work - national:

The mechanical characteristics of couplers relative to the microphone being calibrated need to be defined. Also preferred frequencies and levels and permissible variations with time must be defined. Other parameters of a sound level meter or sound analyzer should also be considered for field calibration, for example, indicator response.

A draft document on coupler calibrators has been developed and has been circulated to a number of acoustical specialists for comments.

Future work - international:

Possibility of an IEC standard resulting from the questionnaire.

Title of proposed new standard:

ANSI S1.XX-197X, American National Specification for Acoustic Couplers of the Calibrator Type.

Priority:

1

Planning Panel Worksheet PA-17

Technical sub-area:	Assigned to:	Organization to do work:
Instrumentation (filters and real time analyzers)	S1	S1-66

Statement of regulatory and other needs:

The Federal Aviation Administration requires one-third octave analysis for administration of FAR-36.

The Environmental Protection Agency requires octave analysis for regulation of some products. The Department of Labor requires octave analysis of background noise for location of audiometric test rooms.

Existing national and international standards:

ANSI S1.11-1966, Specifications for Octave, Half-Octave and Third-Octave Band Filter Sets.

IEC 225-1966, Octave, Half-Octave and Third-Octave Band Filters Intended for the Analysis of Sounds and Vibrations.

Future work - national:

Digital filters are coming into use. These filters have characteristics which are not adequately controlled by the existing standards. Some areas that need addressing are dynamic range, linearity, resolution, processing time, filter shape, etc.

Additionally, a standard for a new class of filters with greater slopes may be needed for aircraft noise application.

New work in this area should address the octave or one-third octave analyzer as a whole and not just the filter. A standard could be formulated to cover both complete analyzers and filter sets.

Title of proposed new standard:

Revision of existing standard.

Special problems:

The revised standard must consider converting data from Fast Fourier Transforms (FFT) into octave, one-half & one-third octave bands if this is an acceptable method of processing.

Priority:

3

Planning Panel Worksheet PA-18

Technical sub-area:	Assigned to:	Organization to do work:
Instrumentation (Digital Instrument Specifications)	S1	S1-65

Statement of regulatory and other needs:

Many digital instruments are in use in regulatory and data gathering noise measurements, yet our standards do not take cognizance of their special characteristics.

Existing national and international standards:

None

Work in progress - national and international:

An international working group (WG16) has been set up under ISO/TC43/SC1. This committee has not yet begun its work. A national committee (S1-65) was set up but is currently not active and must be reorganized.

Future work - national:

There is a need for standards covering the testing and characteristics of instruments that process acoustical data using digital means. This includes digital spectrum analyzers, integrating sound level meters that operate digitally, community noise analyzers and other instruments that use digital means for calculating acoustical quantities. A U.S. representative to the international working group must be appointed and should participate actively in the work of the international group.

A need for a better understanding of the characteristics of community noise analyzers has been identified.

Future work - international:

The work of WG16 will be initiated.

Title of proposed new standard:

ANSI S1.XX, 19XX Characteristics and Test Methods for Digital Acoustical Instrumentation

Research required:

Community noise analyzers are one class of digital instruments for which standards do not exist, therefore,a panel discussion was held at the INTER-NOISE 78 meeting in May 1978 to discuss the basis for standardization of the characteristics of these instruments. The result of this panel discussion will be reported separately.

Special problems:

In general, it is desirable that the same result be obtained whether processing is done by analog or digital means. Considering the differences in the analog and digital circuitry, it may not be possible to satisfy this requirement.

Priority:

3

Planning Panel Worksheet PA-19

Technical sub-area:	Assigned to:	Organization to do work:
Instrumentation (Integrating Sound Level Meters)	S1	S1-45

Statement of regulatory and other needs:

It appears that EPA regulations for noisy products generally require the measurement of the space and time average sound level in the vicinity of the product. Community noise criteria tend to be based on L_{eq} (time average sound level). Also, L_{dn} (L_{eq} over a 24 hour period with a night time penalty) may be adopted by HUD for planning and design. Measurements can be made with conventional sound level meters but the process is tedious, time consuming and subject to error. A standard instrument that integrates a function of sound pressure level over seconds, minutes and possibly hours is clearly needed.

Existing national and international standards:

None

Work in progress - national and international:

S1-45 has a subgroup considering work on the standard for integrating sound level meters.

IEC/TC29/SC29C/WG11 is also working on an international standard for an integrating sound level meter. A partial draft has been prepared and sent to the members for consideration.

Title of proposed new standard:

ANSI S1.XX-197X, Characteristics of Integrating Sound Level Meters.

Priority:

1

Planning Panel Worksheet PA-20

Technical sub-area:	Assigned to:	Organization to do work:
Instrumentation (Sound Level Meters)	S1	S1-45

Statement of regulatory and other needs:

The current ANSI S1.4-1971 Specification for Sound Level Meters has a number of shortcomings and is in need of review. Particularly, S1.4 does not sufficiently control the detector-indicator characteristics, and does not make allowances for wide range indicators, recording or digital displays. Better tests of the mean square and transient characteristic of the detector are desired. Instruments are becoming available with recording indicators and digital indicators that are not adequately covered by the current standard. Furthermore, a need exists for instruments and specifications to measure impulsive sounds. The effect of wind screens on performance also needs to be considered.

Existing national and international standards:

ANSI S1.4-1971, Specification for Sound Level Meters. IEC Publication 123 and 179 on sound level meters. IEC Publication 179A on impulse sound level meters.

Work in progress - national and international:

Internationally, (IEC/TC29/SC29C/WG8) is preparing a consolidated revision of the IEC publications.

A draft of the consolidated revision has been circulated for vote and a new IEC standard is expected to be issued before year end 1978. ANSI S1-45 is engaged in a revision of ANSI S1.4-1971 following the consolidated revision.

Future work - national:

See above.

Title of proposed new standard:

S1.4-197X, Specification for Sound Level Meters.

Special problems:

A key question is the inclusion of an impulse meter characteristic in an American national specification. At this time, there is no impulse sound level meter characteristic specified in the United States but that characteristic is being used overseas.

Planning Panel Worksheet PA-21

Technical sub-area:	Assigned to:	Organization to do work:
Community Noise	S1	S1-62 (S3)

Statement of regulatory and other needs:

EPA is assisting communities to undertake noise assessments as part of the development of community noise control programs under Section 14 of the 1972 Noise Control Act. A standard measurement methodology would:

(a) allow communities to compare their noise measurements with those from other communities; i.e., facilitate the exchange and comparison of community noise data.

(b) allow comparisons with identified levels or standards of community noise that might be issued by state and federal agencies;

(c) facilitate assessment of the national noise environment;

(d) allow communities to evaluate the effectiveness of noise control progress with time;

(e) reduce survey costs by utilization of uniform procedures and criteria in performance requirements;

(f) facilitate community planning of noise measurement programs.

EPA also foresees the need for standards in defining methodology and instrumentation for noise measurements employed in community enforcement of local noise ordinances. The feasibility of developing such standards as an integral part of the proposed S1-62 "Community Noise" standard will be investigated.

The need for and the extent of community and/or source measurement for environmental impact assessments has not yet been defined. Standardized procedures for selecting and performing such measurements might be helpful. Such standardization should probably follow (not precede) the development of needed impact assessment standards.

Existing national and international standards:

National: None directly covering area. Other relevant standards: ANSI S1.4- 1971 "Specification for Sound Level Meters" and ANSI S1.13-1971 "Methods for Measurement of Sound Pressure Levels."

S1/S3 Working Groups whose contributions may be relevant to this topic: S1-45 "Sound Level Meters and Their Calibration"; S1-57 "Attenuation of Sound in Air"; S1-64 "Noise Measurement Systems"; S1-67 "Analysis and Presentation of Blast Noise Data or Similar Impulse Type Noises"; S3-55 "Land Use Planning with Respect to Noise"; and the Ad hoc Group on Statistical Considerations in Noise Measurements.

International: None Approved. ISO R1966-1971 "Assessment of noise with respect to Community Response" has not been approved as an international standard, and is being revised.

Work in progress - national and international:

Working Group S1-62(S3) "Measurement and Evaluation of Community Noise" has been set up to develop a draft standard in this area. The first working group meeting was held during Workshop in Environmental Sound, Deerfield Beach, Florida, December 1977. Recent EPA sponsored studies in community survey planning, and in developing recommended code practices for enforcement of local noise ordinances, provide a technical resource that will be utilized in developing an initial draft standard. These studies exist in draft form and will be available in final form for public distribution within several months.

Future work - national:

Over the next few months, Working Group S1-62(S3) will define a statement of purpose and scope for a draft "Community Noise" standard, and plans to develop a rough first draft of key technical sections of a standard. These key sections include: classification of surveys, definitions of what is to be measured, and list of data to be reported. Foreign community noise standards will be reviewed, and lists of recent technical studies will be circulated among members.

The Working Group met for the first time at the Workshop on Environmental Sound to discuss plans for preparation of a standard.

Future work - international:

Not known. Plans for revision of ISO R 1996 are uncertain at this time.

Title of proposed new standard:

Measurement of Community Noise

Time required to produce the document:

2 to 3 years.

Research required:

1. Undertake error analyses:

   (a) continuous vs intermittent sampling;

   (b) distributed sampling vs bunched sampling;

   (c) day-to-day, weekly and seasonal variability considerations.

2. Undertake spatial variability analyses:

   (a) define expected spatial variability for differing measurement areas;

   (b) define expected vertical variability for differing measurement areas.

3. Relate equipment measurement accuracy requirements to expected variability in noise environment and to measurement purposes.

Special problems:

There will be need to maintain liaison with the ANSI Working Group concerned with developing standards for room measurements for acceptability evaluations, and to review proposed ANSI standards for outdoor-indoor sound reduction measurements (i.e., adaptation of a part of ISO DIS 140). There will also be the need to keep in touch with the ANSI group developing standards for statistical analyzers used in community noise measurements.

Priority:

1

Planning Panel Worksheet PA-22

Technical sub-area:	Assigned to:	Organization to do work:
Noise Reduction by Barriers	S1 (See Worksheet NCE-1)	S1-XX

Statement of regulatory and other needs:

A standard is needed to describe uniform procedures for specifying acoustical design features of barriers and for assessing the noise reduction to be expected after installation. The term barrier is used here to mean any type of permanent or temporary structure used to reduce community noise levels. The noise source can be some form of transportation or a stationary piece of equipment or machinery.

State and federal agencies need such a standard. Portable (temporary) barriers are candidates for EPA labeling action. Barriers are installed with FHWA funds along many highways. Barriers may be required to meet HUD criteria for dwelling noise levels. Airport Development Aid Program (ADAP) funds may be used by airports to install barriers to reduce ground runup, takeoff, or thrust-reversal noise. In many communities, barriers may be the only feasible method to reduce property-line noise levels caused by railroad operations. The standard is needed by government agencies in reviewing environmental impact statements. Barriers are used around stationary noise sources such as power transformers and air conditioning system components. Portable barriers are often used to control construction-site noise. Federal, state, county, and municipal agencies need the standard for use in approving proposed projects.

Existing national and international standards:

No standards exist. Barrier design procedures are available in published reports and manuals prepared for the Federal Highway Administration (FHWA). Additional barrier design procedures and acoustical performance data are also available from publications of the DOT Transportation Systems Center and publications of agencies in England, France, and Japan.

Work in progress - national and international:

FHWA is sponsoring research to refine barrier design procedures.

Future work - national:

Organize a writing group to collect information and draft a standard. The effort by S1 should be coordinated with similar efforts by the ASTM E33 committee.

Title of proposed new standard:

Noise Reduction by Barriers.

Time required to produce the document:

3 to 4 years after formation of writing group

Research required:

Additional field studies of the actual noise reduction achieved by various barriers are needed to validate design procedures; to confirm appropriateness of specific barrier designs for reducing noise produced by various forms of transportation and to define barrier performance under a variety of weather conditions and types of ground cover and terrain.

Priority:

Planning Panel Worksheet PA-23

Technical Sub-area:	Assigned to:	Organization to do work:
Sound Propagation in an Urban Environment	S1	S1-57

Statement of regulatory and other needs:

Predictions of urban noise levels generated by highway traffic and railroad and aircraft operations are required as part of national and local assessments of the impact on public health and welfare. Urban noise from construction sites and stationary noise sources must also be estimated. EPA, DOT, DOD and state and local agencies need a standard procedure to account for propagation effects in urban areas. An interim standard, based on best-available information, is urgently needed as soon as possible to define an interim procedure that provides consistent and comparable results.

Existing national and international standards:

No standards exist.

At least one country (England) has published a method for predicting urban noise environments due to highway traffic. The prediction method is contained in documents prepared for the U.K. Department of the Environment and is available from Her Majesty's Stationery Office, London, England, as "New housing and road traffic noise, a design guide for architects" and Calculation of road traffic noise."

Work in progress - national and international:

Some research studies of sound propagation along city streets and around buildings and highways have been performed - some by actual in-situ measurements, some by acoustic modeling techniques.

Theoretical and model scale studies are being conducted in the U.S.
Model scale studies are also being conducted in France and at the National Physical Laboratory in England on noise propagation in builtup urban areas. Definitive engineering prediction rules have not been published yet as a result of this research.

Future work - national:

Theoretical, field, and scale-model studies should be continued to generate the data needed to eventually develop a standard calculation procedure to replace the interim standard.

Future work - international:

Specific details of international research on sound propagation in urban areas are

unknown although model scale studies are expected to continue in France at Centre Scientifique et Technique de Batiment in Grenoble where a major facility has been developed for such work.

Title of proposed new standard:

Method for Specifying Sound Propagation Losses in an Urban Environment.

Time required to produce the document:

For production of an interim standard, 2 to 3 years after formation of the writing group. For the more-definitive standard, 8 to 12 years will be required after the data are available.

Research required:

Generalized sound propagation models need to be developed, tested and validated.

Particularly desirable would be exploratory research to quantify the range of propagation losses, independent of atmospheric effects, in the full spectrum of building densities and configurations that exist in urban areas. The spectrum should range from open terrain, for which ground attenuation studies or potential standards may be available, to continuously built-up city canyons. The research should also identify the range of propagation losses in such areas for surface mounted or elevated stationary sources and for aircraft. Following such problem-bounding research, detailed studies should be carried out to develop practical design prediction models for standardization. These models should also include atmospheric and ground attenuation effects.

Priority:

3

Planning Panel Worksheet PA-24

Technical sub-area:	Assigned to:	Organization to do work:
Influence of Atmospheric Turbulence and Ground Effects on Sound Propagation	S1	S1-57

Statement of regulatory and other needs:

The technical basis for many regulatory actions to reduce noise from a variety of sources is a determination of the number of people exposed at different criterion levels. Atmospheric absorption for pure tones is now the subject of an ANSI standard. However, there is a clear regulatory need for development of procedures for calculating the losses in excess of atmospheric absorption, that occur during propagation through a real (turbulent) atmosphere near the earth's surface at various angles of elevation between the ground plane and the source. Because no such standards exist, a wide variety of procedures, for the most part uncodified, are used to fulfill regulatory requirements of EPA, FAA, FHWA, FRA, and other government agencies. A national standard based on experimentally validated procedures would fill this void and provide uniformity among the numerous studies requiring application of this type of propagation loss.

Work in this area should be coordinated with the standards activity for specifying attenuation for bands of noise.

Existing national and international standards:

An SAE report, AIR 923, available since 1966, defines procedures for calculating losses in excess of atmospheric absorption along propagation paths close to the ground for an elevated noise source such as an aircraft. Many experimental studies have been published providing data on horizontal, or near horizontal, sound propagation, but no U.S. standards have been developed. Some European countries have estimated standard procedures for determining highway noise impact. These procedures imply the existence of a standard for horizontal sound propagation. An SAE report, AIR 1327, published in 1977, defines a model for ground reflection effects for noise produced by stationary sources such as a jet engine on a test stand.

Work in progress - national and international:

FAA, FHWA, NASA and DOD are conducting research studies related to atmospheric and ground effects on sound propagation. A subcommittee of the SAE A-21 committee is preparing an Aerospace Information Report to supplement AIR 1327 with practical methods for determining free field sound pressure levels around jet-engine test stands.

Information on sound propagation over vegetated terrain is becoming increasingly available from the literature.

Future work - national:

Future standards efforts in this area should be coordinated with the SAE A-21 Committee on Aircraft Noise Measurements and the SAE Vehicle Sound Level Committee.

Specification of procedures to account for sound refraction effects by wind and temperature gradients (that is for those which can be considered to be non-fluctuating on a short time scale) probably could be accomplished before specification of the acoustical effects of atmospheric turbulence or ground impedance.

Title of proposed new standard:

Method for Determining Effects of Atmospheric Turbulence, Temperature and Wind Gradients, and Ground Surfaces on Sound Propagation.

Time required to produce the document:

7 to 10 years after formation of writing group.

Research required:

The apparent attenuation resulting from scattering effects after propagation through atmospheric turbulence and the wake behind a moving noise source is not well understood.

The effects of turbulent fluctuations in the velocity and temperature of the air near the ground surface on the phase of direct and reflected sound waves are not well understood.

The effect of the finite acoustic impedance of the ground on sound propagation at shallow grazing angles is beginning to yield to a series of analytical studies. Uncertainty persists as to suitable analytical models for surface waves or even the need to consider surface waves. Models are also lacking for the acoustical impedance of ground surfaces, for the type of wave motion in the ground (i.e., compressional only or compressional plus shear), and for the various layers which constitute real soils. Extensive experimental validation and development of practical engineering methods for application of the analytical models must occur to support a standard.

Special problems:

Support will be required for analytical and experimental studies.

The size of predicted noise-exposure contours from stationary or moving noise sources could well be significantly altered by the procedures of the new standard compared to results obtained using existing models or various empirical methods.

Special techniques may be required for moving noise sources.

Priority:

3

Planning Panel Worksheet PA-25

Technical sub-area:	Assigned to:	Organization to do work:
Attenuation for Outdoor Propagation of Bands of Noise	S1	S1-57

Statement of regulatory and other needs:

A standard method for specifying atmospheric absorption losses for bands of noise is needed for predictions of far-field noise levels, adjustment of measured noise levels for differences in absorption losses between test and reference meteorological conditions, environmental impact assessments, type certification of the noise output of moving and stationary noise sources, and urban modeling. A general procedure based on validated data and applicable to a wide range of temperature and humidity is needed for these regulatory needs.

A unifying standard specifying a calculation procedure for all frequency-dependent attenuation mechanisms is needed for outdoor propagation of broadband sound. Attenuation mechanisms include atmospheric absorption, finite-impedance ground effects, and atmospheric turbulence.

Existing national and international standards:

An SAE recommended practice, ARP 866A, published in 1975 and included in FAR Part 36, ISO IS 3891, and ICAO Annex 16, exists for prediction of air-to-ground losses of constant-percentage bands of aircraft noise. A new U.S. national standard, ANSI S1.26-1978, is available for general application to predictions of atmospheric absorption of pure tones, but with only general guidelines for procedures to handle bands of noise.

Work in progress - national and international:

FAA has sponsored a study to extend the method developed by ANSI Working Group S1-57 for determining atmospheric absorption losses of pure tones. The S1-57 pure-tone method is contained in ANSI S1.26-1978. The extension considers the problem of adjusting measured 1/3-octave-band aircraft flyover noise levels from test to reference conditions. The results of further work in this area should appear in the literature in the near future.

FAA and NASA are conducting research studies related to atmospheric effects on sound propagation. The results of these research studies will provide data to validate the calculation procedures of bands of noise.

Future work - national:

Future standards efforts in this area should be coordinated with the SAE A-21 Committee on Aircraft Noise Measurements and the SAE Vehicle Sound Level Committee.

Work sponsored by FAA should be extended to be applicable to the problem of accounting for atmospheric absorption losses in projecting predictions, or measurements, of source noise to distant locations in the community. The converse problem of accounting for atmospheric absorption losses when projecting measured community noise levels back along the propagation path to obtain estimates of source noise levels should also be included.

Future work - international:

Coordination with ISO is required to consider needs of ICAO and potential revisions of ISO 1S3891 and ICAO Annex 16.

Title of proposed new standard:

Method for determining attenuation of noise analyzed by constant-percentage-bandwidth filters.

Time required to produce the document:

3 to 5 years after formation of writing group

Research required:

The FAA-sponsored method, or similar methods, needs to be further developed and then validated by comparison with results from outdoor sound propagation experiments, especially for propagation through horizontally stratified atmospheres.

A model for a standard vertical profile of humidity needs to be developed in conjunction with the choice of reference atmospheric conditions at a height near ground level.

Simplified methods not requiring a large-scale digital computer should be developed and validated.

Special problems:

The impact of using the new procedure instead of SAE ARP 866A on national and international standards for certification of aircraft noise should be considered.

The size of calculated noise-exposure contours around airports, highways, railroads, and stationary noise sources (e.g. power plants) may be different using the new procedure instead of the empirical SAE ARP 866A procedure to account for losses of noise analyzed by constant-percentage-bandwidth filters.

The new standard should also specify atmospheric absorption losses for bands of noise in reverberant rooms.

Priority:

3

Appendix A4
PROJECT DOCUMENTATION, HUMAN RESPONSE

The following pages contain the updated versions of the Planning Panel Worksheets for Human Response. A sample worksheet can be found in Section 1.3. Under "Priority" projects are rated on a scale of 1 to 10 and 1 is highest priority. For identification purposes, the worksheets have been given the code HR (Human Response) followed by sequential numbering.

Planning Panel Worksheet HR-1

Technical sub-area:	Assigned to:	Organization to do work:
Noise and Hearing Loss	ANSI-S3	S3-58

Statement of regulatory and other needs:

A statement of the relation between habitual noise exposure and the resulting change in auditory sensitivity is needed by all agencies concerned with hearing conservation, particularly by the Departments of Defense, Labor, and Transportation. The need is therefore to develop tables specifying occupational noise exposures E, that will just produce a noise-induced hearing loss, L, at frequency F, in S% of the population habitually exposed.

F may be any frequency or some particular combination of frequencies.

L may range from "measurable" (ranging from perhaps 15 dB in the individual case down to 5 dB, or even lower, a group mean) up to "significant" or "handicapping"; again, either a single frequency or a combination of frequencies may be involved.

S can be any number between (but not including) 0 and 100. Values of S of 50, 10, 5 and 1 are recommended.

Noise exposure, E, may be weighted either equally with respect to frequency or according to some other scheme such as A-weighting.

Exposure is to be specified in terms of some combination of duration, D and sound pressure levels at specific octave bands, OB, again with equal or unequal weighting. The primary tables shall concern continuous exposure to steady noise; fluctuating SPLs at specific octave bands (OB), again with equal or unequal weighting. The primary tables shall concern continuous exposure to steady noise; fluctuating and intermittent exposures will be dealt with by development of either separate tables or a set of correction factors to be applied to the primary tables.

Separate tables should be developed that express the losses expected (1) when the noise exposures concerned are presumed to be the only cause of damage to hearing sensitivity, and (2) when they are presumed to be accompanied by typical changes attributable to the aging process (Presbyacusis), disease (Nosoacusis) and non-occupational noise exposure (Sociacusis).

Existing national and international standards:

USA: OSHA-90 dB A-weighted for 8 hours to 115 dB A-weighted for 15 minutes (5 dB per doubling time relation);89 dB A-weighted low fence and 116 dB A-weighted high fence.

AFR: 161-35: 84 dB A-weighted for 8 hours + 4 dB per doubling time relation.

ARMY:85 dB A-weighted any time

ISO R1999 - 90 dB A-weighted for 8 hours with total-energy principle
Data of Passchier-Vermeer's synthesis from "Steady-State and Fluctuating Noise: It's Effects on the Hearing of People," in Occupational Hearing Loss, edited by D. W. Robinson, Academic Press, New York 1971.

Work in progress - national and international:

ISO under process of revision (risk tables); OSHA: Low fence drop to 84 dB A-weighted (i.e. 85 dB x 16 hr); Considerable work in all countries in measurement of hearing levels (notably in Austria, which tries to measure all workers); Interindustry study has just verified Passchier-Vermeer prediction for 82-92 dB A-weighted 8-hour exposures. The same has been verified for industrial workers in England (Robinson and co-workers). S3-58 Armed Forces Collaboration (DOD).

Future work - national:

Continue measuring workers with doses less than unity (interindustry). Repeat PHA study of average hearing, but at least dividing respondents into those exposed to industrial noise so loud that they had to raise voice to talk and those not exposed and where possible, obtaining history of exposure to auditory hazards.

Animal exposures studying trade-off between level and duration. Study of correction factors for unusual spectra (when dB A-weighted is not adequate).

Future work - international:

Audiometric studies should be encouraged in all situations in which workers are exposed to levels in excess of 80 dB A-weighted but are not required to wear hearing protectors.

Title of proposed new standard:

Effects on Hearing of Continuous or Fluctuating Noise. Or: The Relation Between Exposure to Continuous Noise and Hearing Loss.

Time required to produce the document:

2 years for reasonable first draft

Research required:

Animal studies (with development of correction factors for species differences using various spectra and durations).

Development of probability tables (probability of development of X dB of loss given a certain exposure) can be considered.

Correlation of hearing losses with reasonably specifiable exposures to intermittent and time-varying noise (even though such exposures may all be in the past) can continue to contribute needed information.

Special problems:

Some think pure-tone studies should be done; however, present evidence indicates that such corrections are necessary, if at all, only at frequencies below 1000 HZ. In view of other simplifications (e.g., use of dB A-weighted), this factor appears negligible in impact.

Priority:

1

Planning Panel Worksheet HR-2

Technical sub-area:	Assigned to:	Organization to do work:
Hearing loss from Impulse/Impact	ANSI - S3	S3-62

Statement of regualtory and other needs:

The department of Labor has requested development as soon as possible of a standard that would relate impulse noise to noise induced hearing loss by considering only the peak sound pressure level and the number of impulses. The standard should provide a means for evaluating the effect of combinations of impulse and steady-state noises. In the long term, the standard may be modified to use a better descriptor than peak sound pressure level. The EPA has also expressed a need for a useful criteria for quantifying the hazardous effects of impulsive noise. Finally, the DOD expressed a need for the standard to provide some guidance as to assessing the protection afforded from impulse noise by hearing protection.

Existing national and international standards:

The DOD are using the CHABA working group 57 report as the basis of several standards. OSHA has proposed a 140 dB peak limit and foreign countries are using a variety of approaches. The most convenient standard to use is an equal energy concept for impact noise currently in use in Britain.

Work in progress - national and international:

ANSI-S3 working group 62 is currently working on an appropriate standard.

Title of proposed new standard:

Estimated Changes in Hearing Due to Exposure From Impulse/Impact Noise

Time required to produce the document:

1 year

Research required:

Although a standard can be prepared now, for a reasonable assessment of industrial impulse/impact noise, several programs should be started. The most important program is a survey of the type and levels of impulse/impact noise found in industry. A second program needed is a survey of the hearing levels associated with the exposure to impulse noise. A final program required is the evaluation of the best methods to quantify impulse/impact noise based on the results of the previous two programs.

In the long term, use of animal studies to determine possible synergystic effects of continuous and impulse noise, effect of number of impulses, frequency weighting, etc. are required.

Special problems:

A lack of data relating permanent changes in human hearing to various types and levels

of impulse noise is a substantial problem. Risk of hearing loss must be made from temporary threshold shift data and animal experimentation.

A second problem is that there are no approved standards on any of the various possible descriptors of impulse noise.

Priority:

1

Planning Panel Worksheet HR-3

Technical sub-area:	Assigned to:	Organization to do work:
Presbyacusis	S3	S3-58

Statement of regulatory and other needs:

Development of tables expressing the deterioration of auditory sensitivity associated with aging, typical otological disease and the noises of everyday living are needed in order to correct audiometric data for these influences in the determination of the relation between occupational noise exposure and hearing loss. Tables are therefore desirable that indicate the change in auditory sensi-tivity, as a function of age, for (1) individuals whose hearing has been affected only by the aging process (pure presbyacusis), (2) individuals affected by aging plus the average amount of otological disease (presbyacusis plus nosoacusis), (3) those affected by aging plus the noises of everyday life (presbyacusis plus nosoacusis plus sociacusis).

Existing national and international standards:

None. Extensive data have been gathered in which attempts to exclude sociacusis and nosoacusis have been made; however, lack of agreement among the results make it clear that even our best estimates of 'pure presbyacusis' are uncertain. Hence, nobody has had confidence to use any data as the basis for a standard.

Work in progress - national and international:

A random sample of the U.S.A. population should be studied audiometrically, with anamnestic data collection given the same attention that industrial hearing surveys now receive--i.e., a detailed history of exposure to all known agents causing hearing loss should be taken. It is said that the Public Health Service is doing this.

Future work - national:

The Public Health Service should continue this work.

Future work - international:

Similar studies should be encouraged in all countries.

Title of proposed new standard:

Correction of Audiometric Data for Living.

Time required to produce the document:

1 year for first guess, 10 years for good data.

Research required:

Compile data existing and develop curves. Use data from most recent PHS study as soon as available.

Special problems:

The "special problem" is that people cannot always remember everything in their lives that might have caused hearing loss. Therefore, the first two tables will probably always be quite uncertain; only the third table can be expected to be accurate.

Priority:

1 (if the data from PHS have indeed met the criteria mentioned in "work in progress")

Planning Panel Worksheet HR-4

Technical sub-area:	Assigned to:	Organization to do work:
Related Standards (Hearing Impairment)	S3	New WG

Statement of regulatory and other needs:

This standard should specify, as a minimum, the following: (1) criteria for establishing beginning hearing impairment, (2) the pure tone hearing level averaged over those frequencies which correspond to beginning hearing impairment, (3) the growth of hearing impairment as a function of pure tone hearing loss and (4) the level of total hearing impairment. Such a standard would be most beneficial to federal and state regulatory agencies in the following areas:

1. Determination of risk associated with noise exposure.
2. Determination of permissible noise exposure limits.
3. Determination of compensable occupational hearing losses.

Existing national and international standards:

ISO Recommendation R 1999 - Assessment of Occupational Noise Exposure for Hearing Conservation Purposes (1971) S31013 Hearing (French) (1969) IS:7194 - Specification for Assessment of Noise-Exposure During Work for Hearing Conservation Purposes. (India) (1973) Sen 590111 Estimation of Risk of Hearing Damage from Noise. Measuring Methods and Acceptable Values (Sweden, 1972).

Title of proposed new standard:

American National Standard Specification for Beginning Hearing Impairment.

Time required to produce the document:

1 year

Special problems:

Past history shows it is very difficult to obtain agreement in this area.

Priority:

1

Planning Panel Worksheet HR-5

Technical sub-area:	Assigned to:	Organization to do work:
Audiometer Calibration	ANSI-S3	S3-35

Statement of regulatory and other needs:

Agencies with hearing conservation programs have need for this standard. Measures of hearing are essential in assessing effects of noise on hearing and effectiveness of hearing conservation. Reliability of testing and validity of results depends on equipment calibration. Specifications for selfrecording audiometers would be useful because of wide use of large scale hearing testing programs in industry and the military.

Existing national and international standards:

ANSI S3.6-1969 (R-1973) American National Standard Specifications for Audiometers IEC Recommendation R177 Recommendation for General Diagnostic Audiometers IEC Recommendation R178 Recommendation for Pure Tone Screening and Audiometers

Work in progress - national and international:

Revision in preparation by S3-35 for letter ballot by S3. Should be available for ballot within 6 months. A document has been prepared and forwarded to TC29C for 6 month vote. The IEC document combines the earlier two documents on diagnostic and screening audiometers. Proposed revision of ANSI S3.6-1969 will be consistent with the IEC proposal. Proposed revision will include specifications for self-recording (Automatic) audiometers frequently used in industry and the military.

Future work - national:

Refine the method for developing specification of the reference threshold sound pressure level for transducers other than those mentioned in the standard. Develop data bearing on the comparison of a threshold transfer procedure with an equal loudness procedure.

Develop a suitable coupler for measuring circumaural earphones. Develop specifications for computer systems for data handling and specifications for computer microprocessor systems for measuring hearing sensitivity.

Future work - international:

Evaluation of the adequacy of the flat plate coupler proposed by Diestel in Germany for use with circumaural earphone-cushion arrays.

Title of proposed new standard:

Same.

Time required to produce the document:

6 months.

Research required:

Development of standard coupler which is acceptable for use with circumaural earphones. Revision and standardization of the method for performing the transfer of reference threshold sound pressure levels for newly manufactured earphone- cushion assemblies. Evaluation of data obtained from computerized equipment for measuring hearing sensitivity. Comparison with results from more traditional testing methods and equipment.

Special problems:

Coupler development and acceptance. This matter is being investigated by WG S3-37 (S1).

Priority:

1

Planning Panel Worksheet HR-6

Technical sub-area:	Assigned to:	Organization to do work:
Couplers for Circumaural Earphones	ANSI-S3	S3-37 (S1)

Statement of regulatory needs:

Use of circumaural phones desirable in hearing conservation programs because of desire for less variability in fit from individual to individual and attenuation of ambient background voise. Any of those agencies involved with hearing conservation would have use for this standard, at least indirectly.

Existing national and international standards:

ANSI S3.7-1973 Method for Coupler Calibration of Earphones.

IEC Recommendation R318 IEC An IEC Artificial Ear of Wide Band Type for Calibration of Earphones Used in Audiometry.

IEC Report 303 Provisional Reference Coupler for Calibration of Earphones Used in Audiometry.

Work in progress - national and international:

Development of revised standard including a new coupler of Zwislocki type.

Diestel (PTB, Germany) developing and proposing a flat plate coupler for calibrating circumaural earphone-cushion assemblies.

Research required:

Continued evaluation of Zwislocki coupler and modification for use with circumaural earphones. Monitor and evaluate adequacy and reliability of flat-plate coupler.

Priority:

4

Planning Panel Worksheet HR-7

Technical sub-area:	Assigned to:	Organization to do work:
Electroacoustic Systems Audiometer Calibration	ANSI-S3	S3-35 or new WG

Statement of regulatory and other needs:

Audiometry is an essential part of hearing conservation programs. Reliability and validity of results depend on calibration of equipment. Systems commercially available for calibration must meet standard specifications for obvious reasons. Agencies with hearing conversation programs include calibration as an integral part of hearing measurement.

Existing national and international standards:

No existing national or international standards. Unaware of any activity in this area.

Future work - national:

Specifications must be developed in this area. These specifications may be based in part on characteristics of equipment now used in calibration system as separate elements. i.e. sound analyzers, filters, frequency counters, earphone couplers, etc.

Title of proposed new standard:

Standard Specifications ~~for Audiometer Calibrating~~ Systems

Time required to produce the document:

2-3 years for development

Priority:

4

Planning Panel Worksheet HR-8

Technical sub-area:	Assigned to:	Organization to do work:
Permissible Ambient Noise for Hearing Testing	ANSI-S3	S3-56

Statement of regulatory and other needs:

ANSI recently published S3.1-1977 "Criteria for Maximum Permissible Ambient Noise During Audiometric Testing" which establishes the maximum permissible noise levels for testing pure tone thresholds down to 0 dB hearing threshold level (HTL) with ears covered with standard earphones and cushions and with ears uncovered. The standard permits higher permissible noise in those instances where hearing testing program goals can be met by testing down to HTL values greater than 0 dB. The purpose of the standard was to establish maximum permissible ambient noise levels for use by all those who engage in or are responsible for hearing testing or hearing testing programs and for those wishing to estimate sound attenuation requirements for a particular environmental setting prior to purchase or construction of sound attenuating enclosures in that space. The standard also points out the effect of ambient noise on the accuracy of hearing test results use of the now misleading values given in the previous standard would lead to reduced accuracy of test results. Those responsible for hearing testing programs that they need to establish a valid means of dealing with the relatively high ambient noise levels found in many hearing testing environments.

The standard (S3.1-1977) should be used by any regulatory agency or organization concerned with rules of procedure or requirements for hearing testing programs such as the Department of Labor, Public Health Service, the military services, the Food and Drug Administration (for hearing aid selection) the Hearing Aid Industries Conference, American Industrial Hygiene Association, Speech and Hearing Clinics, Otologists.

Existing national and international standards:

ANSI S3.1-1977

Work in progress - national and international:

Consideration by S3-56 of the issues listed under "Future Work." ISO/DP Draft 6189 on audiometry includes a section on ambient noise requirements.

Future work - national:

There is no immediate need for a new standard in this area. A possible future revision is to include a procedure based on "A"-weighted sound level measurements which would be applied under certain restricted sets of circumstances. However, experience with this procedure, which is soon to be published in the Journal of the Acoustical Society of America, is required before its incorporation into an actual standard is considered.

A second revision might be to more explicitly describe the circumstances under which higher noise levels or fewer test frequencies might be used.

Future work - international:

Finalization of ISO/DP 6189.

Research required:

Verification of the levels provided in ANSI S3.1-1977 under "in use" conditions.

Discussion and evaluation by specially chosen expert panels of the effect of ambient noise levels higher than those specified for testing to 0 dB HTL in S3.1-1977 on various hearing testing and evaluation procedures and the establishment of maximum permissible noise levels for each application under given conditions of program goals and procedures. Also they should establish alternative goals and alternative procedures which can be met and used when higher noise levels exist or are thought adequate for specific purposes.

Special problems:

The difficulty of communicating with all of the large number of diverse groups affected to insure that they all understand the implications of S3.1-1977 including the provision for higher noise levels in some applications before further regulations, specifications, rules, or laws are effected. A further difficulty concerns how to acquire the necessary input from experts representing each of the various diverse elements (which is required for both technical and political reasons) to establish the maximum permissible ambient noise levels for particular applications. This could best be handled probably by one or more of the interested regulatory agencies such as OSHA and FDA.

Priority:

6

Planning Panel Worksheet HR-9

Technical sub-area:	Assigned to:	Organization to do work:
Method for Manual Pure Tone Audiometry	ANSI-S3	S3-35

Statement of regulatory and other needs:

Variations in measurement method may contribute to variance in measures of hearing sensitivity. Standardizing the method should serve to reduce variance and increase reliability of audiometry in hearing conservation programs. Agencies involved with hearing conservation would have need for this standard.

Existing national and international standards:

None

Work in progress - national and international:

Proposed standard ANSI S3.21 - 19xx sent to ballot 5/31/77; closed 7/12/77. Six negative votes were cast by members of S3. Negative votes are now in the process of being resolved.

ISO Draft Proposal 6189 Pure tone air conduction threshold audiometry for hearing conservation purposes, TC43/WG3, being submitted to ballot of TC43.

Future work - national:

Monitor its utility and reliability once standard is accepted.

Title of proposed new standard:

Method for Manual Pure Tone Threshold Audiometry

Time required to produce the document:

A few months, depending on success in resolving negative votes.

Research required:

Comparison of results using proposed ISO method (bracketing procedure) and ANSI procedure (ascending). Data are to be collated from several laboratories by Spoor of Netherlands.

Special problems:

ISO proposes threshold as the average of 3 ascending and 3 descending trials. ANSI recommends levels at which 2 out of 3 ascending trials produce a positive response. This disagreement should be resolved if possible.

Priority:

1

Planning Panel Worksheet HR-10

Technical sub-area:	Assigned to:	Organization to do work:
Hearing Protection	ANSI S3	New Working Groups & S3-52 (Hearing Protection)

Statement of regulatory and other needs:

1. Physical Method for Measuring Ear Insert Effectiveness.

The purpose of this standard is to establish a set of rules which, if implemented, will provide information to EPA, NIOSH and DOL for regulatory and monitoring application of insert hearing protection from noise exposure with respect to public health and welfare.

2. Measurement of Hearing Protector Effectiveness Against Impulse Noise.

The purpose of this standard is to establish a set of rules which, if implemented will provide information to EPA, NIOSH and DOL for regulatory application of all categories of hearing protective devices against impulsive noise with respect to public health and welfare.

3. Physical Measurement of Earplug Effectiveness for Quality Control and/or Labeling Compliance.

The purpose of this standard, if implemented, is to provide information to EPA for regulatory application of the sustained quality assurance of the labeling of hearing protector performance for purposes of public health and welfare.

4. Measurement of the Effectiveness of NonLinear Hearing Protectors.

The purpose of this standard, if implemented, is to provide information to EPA for regulatory application of nonlinear hearing protectors against noise for purposes of public health and welfare.

5. Procedure for Monitoring Hearing Protector Performance in Field Use.

The purpose of this standard, if implemented, is to provide information and procedures to NIOSH and DOL for regulatory application of hearing protection in hearing conservation programs for purposes of public health and welfare.

6. Standard for Comprehensive Performance of Hearing Protectors: Noise Reduction, Discrimination, Warning Signals, Wearability and the like.

The purpose of this standard, if implemented, is to provide information to NIOSH, EPA and DOL for regulatory and/or monitoring applications of hearing protector effectiveness in noise reduction, discrimination of acoustic cues, wearability, etc., for purposes of public health and welfare.

Existing national and international standards:

ANSI S3.19-1974 (ASA STD 1-1975). This document contains two measurement procedures; (1) real ear protection at hearing threshold measured on human subjects, applicable to all devices (except those excluded by standard) that provide hearing protection; (2) a physical method using a dummy head and measured at higher sound pressure levels for use on earmuffs and helmets. This standard will be critically reviewed in 1979.

Work in progress - national and international:

National: Working Group Z-137, Selection, care and use of hearing protectors (Sponsor is National Safety Council), has a proposal standard that has achieved greater than 80% affirmative votes on the last ballot (1-1/2 to 2 years ago). This proposed document is in the hands of the WG secretary but has not been submitted to ANSI. The need for this document appears to have diminished.

International: ISO/DIS 4869. Proposed ISO standard on the measurement of Real Ear Protection that closely follows the current ANSI S3.19-1974 has just completed a second international balloting. Acceptance of the document is expected.

Proposed standard on a Simplified method for Evaluating Attenuation of Earmuffs for Quality Control. Draft has been completed by ISO TC/43 WG/17 and will be submitted to the Secretariat.

A general physical measurement method (as on S3.19-1974) has been tabled because the WG 17 members require additional information on subjects such as anthropometric data, angle of head configuration, and data for the design of artificial flesh.

Future work - national:

No other new hearing protection standards work is planned for the immediate future. S3.19-1974 will be critically reviewed in 1979 with actual work beginning in 1978.

Future work - international:

Although the need for a general purpose physical measurement procedure is recognized, activity has been diminished for the reasons stated in work in progress above. A time schedule to reactivate this item by WG 17 has not been established.

Time required:

Time schedule is a function of an available technology base in each area relative to research identified below.

Research required:

Some isolated studies are accomplished but a systematic approach to the general questions re hearing protection is not underway. Some research is required for each of the regulatory needs identified earlier, to include insert protector effectiveness,

impulse noise, nonlinear devices, operational performance, and the like. Validation of current S3.19-1974 procedures and application of the data by laboratory and field studies. Effect of hearing protectors on perception and discrimination of acoustical signals to include speech, warning signals, localization and hearing level of the user. Systematic and analytic review of experience and data from use of S3.19-1974 as basis for refinement of the standard. Evaluate use of miniature microphones for semi-physical attenuation measurements to include microphone positioning, directionality, resonance, and the like. Research on methods of monitoring hearing protectors effectiveness in field use situations; all types or devices. Research to demonstrate/validate hearing protector performance in infrasound, very low frequency and ultrasound. Ongoing assessment of the above threshold and non-standard procedures for evaluating hearing protector effectiveness.

Special problems:

Implementation of systematic/sustained research as identified above. Preparation of standards that will embrace the care and use of protectors, to include aggressive indoctrination and education if possible, which is the level at which hearing protection technology breaks down.

Regulatory need:	Priority:
1	5
2	8
3	9
4	5
5	4
6	8

Planning Panel Worksheet HR-11

Technical sub-area:	Assigned to:	Organization to do work:
Loudness, Annoyance	ANSI S3	S3-51

Statement of regulatory and other needs:

Single measure that represents the contribution of auditory and acoustical factors to annoyance. Although loudness summarizes most of the contribution of acoustical factors, other factors such as sound duration and tonal components contribute to annoyance but apparently not to loudness.

Regulatory needs include noise labeling for consumer products and acceptable noise levels in the home, work place, and so forth.

Existing national and international standards:

(Have not included relevant standards on physical measurements)

ANSI S3.4-1968 (R1972) Procedure for Computation of Loudness of Noise ASA Standard 4-1975 (ANSI S3.17) Method for Rating the Sound Power Spectra of Small Noise Sources. S6.4-1973 (SAE ARP 1071) Definitions and Procedures for Computing the Effective Perceived Noise Level for Flyover Aircraft Noise. ISO/R 131-1959 (E) Expression of the Physical and Subjective Magnitudes of Sound or Noise. ISO/R 532-1966 (E) Method for Calculating Loudness Level.

Work in progress - national and international:

National: S3-51 has sent out for balloting a revision of S3.4 Procedures for the Computation of Loudness of Noise. Revision would expand scope. In resolving negative ballots, S3-51 will probably have to change current proposal.

International: Round robin experiments on loudness at short durations (just completed).

Future work - national:

Extension of procedure to sounds with tonal components, temporal fluctuations, and impulsiveness to the extent that loudness and aversiveness are identical with respect to these properties.

To the extent that loudness and aversiveness are different, these properties would be handled in a different standard on sound aversiveness.

Future work - international:

Conflict in computed values for loudness level in ISO R532 should be resolved.

Title of proposed revised standard:

Procedure for Computing Loudness (A Basic Component of Annoyance) of Noise.

Time required to produce the document:

2 months

Research required:

Subjective measurements of how annoyance depends on overall sound duration and fluctuation (including intermittency), and how temporal variables interact with level, spectral features, and background noise.

Subjective measurements of how loudness and aversiveness (annoyance) depend upon tonal components. In current version of proposed revision of S3.4, sounds with tonal components are excluded.

Special problems:

Need to provide for computation on basis of sound power level as is done in ISO R532.

Possible conflict with S6.4 (EPNL for flyover aircraft noise).

Priority:

1

Planning Panel Worksheet HR-12

Technical sub-area:	Assigned to:	Organization to do work:
Annoyance	ANSI S3	S3-51

Statement of regulatory and other needs:

Single number description of sound aversiveness or annoyance based upon acoustical properties. Description would quantify relative aversiveness experienced by the typical listener with provision for typical activities.

Existing national and international standards:

ANSI S3.4, ANSI S3.17, ANSI S6.4, ~~ISO-R1996~~ (Now defunct)

Work in progress - national and international:

NBS has ongoing research program with respect to subjective effects of time-varying noise and noise with tonal components.

EPA is supporting evaluation of various tone-correction procedures.

Future work - national:

This standard, once promulgated, will need frequent revision as data become available that are now lacking.

Future work - international:

Cross-cultural comparisons would help ensure that concordance of national and international standards does not do violence to particular national needs and/or idiosyncracies.

Title of proposed new standard:

Procedure for the Computation of Sound Aversiveness.

Time required to produce the document:

1 year to 5 years depending upon urgency of need.

Research required:

Subjective measurements of how sound aversiveness depends on overall duration, temporal fluctuations, intermittency, etc. and how temporal-variables interact with level, spectral features, and background noise. Similar need for sounds with tonal components. Development of procedures for calculating corrections to S3.4 computation where needed. Research on the interaction between ongoing activity (speech communication, sleep, etc.) and degree of sound aversiveness.

Information on percentage of people who would reach different levels of annoyance as function of descriptor level and ongoing activity.

Special problems:

Need to ensure agreement with ISO standards now being formulated. Possible conflict with S6.4 (EPNL). Current lack of adequate data may necessitate some very gross estimates if standard is to be written immediately.

Priority:

2

Planning Panel Worksheet HR-13

Technical sub-area:	Assigned to:	Organization to do work:
Annoyance from Time Varying Noise	ANSI S3	ANSI S3/S1

Statement of regulatory and other needs:

Descriptor(s) and criteria suitable for relating subjective response (e.g. annoyance) produced by time-varying acoustical environments, for both single events and cumulative exposure. Equipment performance requirements and procedures for measuring time-varying sound levels.

Existing national and international standards:

ANSI S6.4 ISO R 1996 Work in Progress; Draft ANSI S3.4 Auditory Magnitude; Draft ANSI S3.23 Land Use; S1 WG 62 (S3) Integrating Sound Level Meters; ISO TC431/SC1/WG18 Revision of R 1996 - Measurement and Assessment of Community Noise; ISO TC43 SC1/WG2 - Assessment of Impulsive Noise of a Rapetitive Nature (helicopter blade slap).

Future work - international:

Extensions and revisions of above.

Research required:

1. Research required to establish differences, if any, in response to cumulative exposures having equal average (equivalent) sound level, but substantially different statistical characteristics (e.g. cumulative exposure dominated by small number of high level single events compared to large number of moderate level single events).

2. Effects of background level and signal-to-noise ratio problems.

3. Hypotheses that annoyance is affected by rate-of-change of sound level are not validated and need investigation.

4. Uniform procedures for conducting surveys of community response are required to allow direct comparison between different surveys.

5. Experimental base for use of day/night weighting in assessing community response is sketchy and needs strengthening.

Priority:

2

Planning Panel Worksheet HR-14

Technical sub-area:	Assigned to:	Organization to do work:
Annoyingness and Aversiveness of Impulsive Noise	ANSI-S3	S3-62

Statement of regulatory and other needs:

The Bureau of the Mines, the Dept. of the Defense, and the Environmental Protection Agency have expressed a need for a standard to assess the effects of high-energy type impulses such as sonic booms, quarry blasting and artillery fire. The EPA has expressed a need for criteria that assesses the general effects of impulsive noise.

Existing national and international standards:

None

Work in progress - national and international:

An ISO standard is in process for assessing the impulsiveness of heliocopter noise.

Future work - national:

Work will begin in preparing a draft standard with respect to the Annoyingness/ Aversiveness to impulse noise.

Title of proposed new standard:

Not decided

Time required to produce the document:

2 years

Research required:

More research is required to determine the best frequency weighting schemes to assess the effect of high-energy impulses on residential houses.

Priority:

2

Planning Panel Worksheet HR-15

Technical sub-area:	Assigned to:	Organization to do work:
Human Response to Vibration	ANSI S3/S2	S3-39 (S2)

Statement of regulatory and other needs:

Human exposure to whole body vibration can occur from structure born vibration being at the same time the source of airborne noise. It can also occur as a result of noise-induced vibration in structures and buildings as for example--house vibrations caused by low frequency aircraft noise, sonic booms or blast noise. Regulatory decisions and enforcement as well as environmental impact statements on noise require standards on:

a. Safety limits for human whole body exposure.
b. Effects of vibration on performance.
c. Effects of vibration on comfort, annoyance by vibration, and criteria for acceptability.
d. Human response to combined noise and vibration environments.

Agency needs for:

a. NIOSH, OSHA, DOD, DOT, EPA, MESA
b. NIOSH, OSHA, DOT, FAA, DOD, EPA, MESA
c. NIOSH, OSHA, DOT, FAA, DOD, EPA, MESA
d. NIOSH, OSHA, DOT, FAA, DOD, EPA, MESA

Existing national and international standards:

ISO Standard 2631-1974: Guide for the Evaluation of Human Exposure to Whole Vibration (1-80Hz) (Two amendments to this standard are near publication); ISO Draft Standard: Guide for the Evaluation of Vibration in Buildings; ISO 2631 has been adopted by ANSI S3 vote as ANSI Standard and is being processed; SAE Recommended Practice J1013: Method for the Measurement of Whole Body Vibration of the Seated Operator of Agricultural Equipment.

Work in progress - national and international:

The ISO TC108/SC4 is very active working on amendments to and a long term revision of 2631.

Future work - national:

National ANSI activity is restricted to review and comments on the various ISO documents under preparation. It is expected that all of these documents will be processed as ANSI standards with minor modification.

U.S. expertise and general interest in this area is limited and the ISO activity provides the better forum for collecting the limited research data and the experiences with the guides issued.

Future work - international:

ISO work, to which U.S. research results from DOT, NIOSH, NASA and DOD contribute, will concentrate on:

(a) collecting field experiences with existing standard (DOT and DOD application); application to ride quality in ships and railroads; human response to building vibration.
(b) Revision of time dependency of limit boundaries; treatment of crest factor, intermittency and vibration in more than one direction
(c) extension of frequency range.
(d) Application of guidelines to finer differentiation of environments.

Title of proposed new standard:

Guide for the Evaluation of Human Exposure to Whole Body Vibration (revised).

Time required to produce the document:

4 years

Research required:

1. Effect of simultaneous exposure to vibration on human annoyance reaction to noise.

2. Acceptability of, or aversion to noise-induced building vibration. Correlation of dose response relationship with standardized environmental descriptors.

3. Acceptability of vibration/shocks plus noise impulses in buildings (residential homes as well as occupational environments).

4. Field studies on ride quality.

5. Study of aversiveness to noise-induced vibration as part of community response studies to noise.

6. Laboratory and field work on response to complex, multidirectional vibration environments.

Special problems:

Most government agencies involved do not realize the close connection/interrelation between noise and vibration environments. Some realize the problem but do not interpret their responsibility in the noise area to include vibration environments.

Research capability and expertise regarding vibration effects is much more limited than expertise in the noise area.

Lack of organized government programs and/or support.

Priority:

4

Planning Panel Worksheet HR-16

Technical sub-area:	Assigned to:	Organization to do work:
Residential Noise Problems	S3/51	See below

Statement of regulatory and other needs:

In a recent study by EPA, it was estimated that approximately 75 million people in the U.S. live in residential areas where the Day-Night Average Noise Level is in excess of 60 dB. For those people, the quality of life has been significantly lowered. Moreover, whereas noise exposures sufficient to induce some degree of hearing loss were once confined mainly to factories and occupational situations, the same EPA study indicates that close to one million people presently live in residential areas where noise exposures are a potential threat to hearing. Increased public concern with this steady growth of environmental noise in residential areas has resulted in a multitude of regulatory and administrative actions by federal, state and local government designed to promote a home environment which will protect people from noise that may jeopardize their health and welfare. In fact, the Environmental Protection Agency has vigorously moved to help local government achieve quieter residential environments through programs such as the development of model building codes, in use regulations of products used in and around the home and through the development of labeling actions regarding consumer products which affect the residential environment. Similarly HUD and GSA both are actively involved with the development of buildings. In 1971 the Department of Housing and Urban Development (HUD) issued Circular 1390.2 establishing standards for noise exposure at sites proposed for new construction to be observed in the approval of all HUD projects. Now needed are criteria for acceptability of noise in rooms used for various purposes. With the increase in multifamily dwellings, criteria for noise in rooms from which design goals for building elements (floor, ceiling, facade and walls) can be developed to protect against intrusions from adjacent units or from outdoors and insure privacy.

The increased regulatory and administrative actions by federal, state and local governments has created new needs for standards development in many areas such as:

1. methods for defining acceptability criteria for noise in rooms used for various purposes;

2. methods for characterizing the noise environments encountered in and around buildings;

3. methods for assessing the impact in terms of health and welfare effects of proposed actions designed to improve environmental noises, in residential areas;

4. methods for analyzing and controlling noise propagation within and into building to protect users against intrusion from either adjacent residential units or outdoor noise sources;

5. criteria and methods for insuring adequate privacy;

6. methods for quantifying and characterizing flanking paths in constructed buildings;

7. methods for evaluating compliance with standards embodied in building codes for both airborne and structureborne noise; and

8. methods for assessing building systems performance in terms of user requirements to insure adequate design goals derived from present criteria.

Existing national and international standards:

National: ANSI

ANSI S1.4-1971 American National Specification for Sound Level Meters

ANSI S1.6-1967 (R1971) American National Standard Preferred Frequencies and Band Numbers for Acoustical Measurements

ANSI S1.13-1971 American National Standard Methods for the Measurement of Sound Pressure Levels (Partial revision of S1.2-1962)

ANSI S3.4-1968 (R 1972) American National Standard Procedure for the Computation of Loudness of Noise

ANSI S3.5-1969 American National Standard Methods for the Calculation of the Articulation Index.

ANSI S3.17-1975 Method for Rating the Sound Power Spectra of Small Stationary Noise Sources

ANSI S3.20-1973 Psychoacoustical Terminology

ANSI S6.4-1973 Computing the Effective Perceived Noise Level for Flyover Aircraft Noise, Definitions and Procedures for.

ANSI S3.55 (S1) Proposed Land Use Planning with Respect to Noise

ASHRAE:

ASHRAE 36-72 Methods of Testing for Sound Rating Heating, Refrigerating, and Airconditioning Equipment.

ASHRAE 68-75 Method of Testing Sound Power Radiated into Ducts from Air Moving Devices

ASTM:

ASTM C634-73 Standard Definitions of Terms Related to Acoustical Tests of Building Constructions and Materials

ASTM E90-75 Standard Recommended Practice for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions

ASTM E336-71 Standard Recommended Practice for Measurement of Airborne Sound Insulation in Buildings

ASTM E413-73 Standard Classification for Determination of Sound Transmission Class

AHAM:

AHAM RAC-2SR (1971) Room Air Conditioner Sound Rating.

International: ISO

ISO R31 Part VII-1965 Quantities and Units of Acoustics.

ISO R131-1959 Expression of the Physical and Subjective Magnitudes of Sound or Noise.

ISO R140-1960 Field and Laboratory Measurements of Airborne and Impact Sound Transmission.

ISO 266-1975 Acoustics - Preferred Frequencies for Acoustical Measurements (agrees with ANSI S1.6-1967 (R 1971)).

ISO 532-1975 Acoustics - Method for Calculating Loudness Level.

ISO R717-1968 Rating of Sound Insulation for Dwellings.

ISO R507-1970 Procedure for Describing Aircraft Noise Around an Airport.

ISO R1996-1971 Acoustics - Assessment of Noise with Respect to Community Response.

ISO R2204-1973 Guide to the Measurement of Acoustical Noise and Evaluation of its Effect on Man.

ISO 2923-1975 Acoustics - Measurement of Noise on Board Vessels.

ISO/TR 3352-1974 Acoustics - Assessment of Noise with Respect to its Effect on the Intelligibility of Speech.

Work in progress - national and international:

National:

ANSI S1 WG 62 Measurement and Temporal Sampling of Community Noise.

ANSI S3 WG 55 Development of Descriptor for Land Use Planning.

ANSI S3-57-S1 Criteria for Room Noise.

International:

ISO/DIS 3746 Acoustics Procedure for Describing Aircraft Noise Heard on the Ground.

ISO Acoustics Guide to the Evaluation or Assessment of Noise.

ISO/TC 43/SC 1: Noise recommended Methods for Measuring the Intelligibility of Speech.

ISO/TC 43/SC 1: Noise WG 15 Evaluation of Fluctuating Noise for the Assessment of General Negative Reactions.

Future work - national:

Need to develop a procedure for assessing the effects of time-varying noise on general adverse response to noise. The procedure must account for several temporal factors such as intermittency, range of fluctuations, rate of change of levels with time. To accomplish this task the relationship(s) between steady state and intermittently fluctuating noise must also be understood.

Need to develop a procedure for assessing the effects of tonal components on general annoyance for both moderate and intense noise levels.

Need to develop a procedure for assessing speech interference associated with fluctuating noise.

Need to develop a procedure for accounting for noise generated in buildings through vibration of building structures and plumbing systems.

Need to develop temporal and spatial sampling procedures for characterizing noise in rooms used for various purposes.

Need to develop procedure for rating privacy.

Need to develop uniform and standardized procedures for determining user requirements and acceptability criteria.

Future work - international:

Need for standard method of rating temporal factors of noise in terms of their contribution to general adverse response (i.e. continue work of ISO TC/43 WG 15 efforts and that of ISO TC/43 WG 18).

Title of proposed new standard:

1. Criteria for Steady-State Room Noise (2 years). 2. Criteria for Time Varying Room Noise (3-5 years). 3. Method for Measuring Room Noise (2-3 years).

Time required to produce the document:

See above

Research required:

Need to define time-varying parameters of noise and how they affect human response. (These include intermittent, cycling and rise and decay time, duration, rate of change of levels with time and fluctuation.)

Need to assess SIL method for its adequacy for population with hearing impairment and children with no speech and language. Need to define tonal effects on speech interference and general adverse responses indicating how much above a level a tone must be before it makes a difference in evaluation of a room and what correction(s) should be applied.

Need to define how many microphones and their location to accurately characterize room noise (this may be dependent upon purpose of room). Need to assess adequacy of various predictors (i.e. Is L_{eq} adequate? Is L_{dn} better? Is an L_{eq} plus a correction for rate of change of level better? Is A-weighted level sufficient for room characterization or is there a need to go to more detailed spectral analysis?)

Special problems:

Poor criteria exist at present for describing indoor noise. Criteria for temporal factors are not sufficient. Should attempts be made to space average in a room or go with a maximum level or source level not to exceed X% time?

Priority:

2

Planning Panel Worksheet HR-17

Technical sub-area:	Assigned to:	Organization to do work:
Sleep Interference	ANSI-S3	New WG

Statement of regulatory and other needs:

EPA particularly, as well as HUD and DOT, need more complete criteria for behavioral awakening and change in sleep stage caused by noise. The standard should specify levels and durations that produce effects in various percentages of the exposed population.

Existing national and international standards:

No national standards or international standard.

Work in progress - national and international:

European economic community task group is working in this area.

Future work - national:

None anticipated.

Future work - international:

EEC task force will produce report in about four years.

Title of proposed new standard:

Noise-Induced Sleep Disruption.

Time required to produce the document:

10 years??

Research required:

Effects of noise on behavioral awakening. Effects of noise on change of sleep stage. Effects of noise on sleep in the house (as opposed to laboratory). Consequences of noise-induced sleep disruption (after-effects) in terms of performance decrements and adverse effects on health and well-being.

Special problems:

Research is very costly.

Priority:

long term

Planning Panel Worksheet HR-18

Technical sub-area:	Assigned to:	Organization to do work:
Annoyance and Behavioral Response	ANSI-S3	New WG

Statement of regulatory and other needs:

Establish guidelines for defining and measuring human behavior and attitudinal responses to environmental noise. Uniform definitions would be established for relevant response and intervening variables. Basic methodology would be proposed for measuring and assessing these variables in order to minimize response biases and facilitate comparisons of data among different studies of noise impact on human response and attitudes.

Existing national and international standards:

Organization of Economic Cooperation and Development - OECD guidelines.

Work in progress - national and international:

TC 43 WG 18-150 Community Noise.

European Economic Community (EEC) being organized.

Future work - national:

Establish a working group under S3.

Title of proposed new standard:

Guidelines for Assessment of Human Behavioral and Attitudinal Responses to Environmental Noise.

Time required to produce the document:

1-2 years

Research required:

Laboratory and field studies to establish number and level of noise exposure trade-offs in respect to annoyance and behavioral responses. Also the effects of peak versus average exposures, time of day, ambient levels versus noise source levels, type of activity affected and outside versus inside noise relationships.

Priority:

Near future

Planning Panel Worksheet HR-19

Technical sub-area:	Assigned to:	Organization to do work:
Speech Interference	ANSI-S3	S3-49 and S3-59

Statement of regulatory and other needs:

Regulatory, health and welfare, and compensatory agencies responsible for interpreting the effectiveness of speech communications based on knowledge of existing speech and noise levels. For example, those who can predict effectiveness from existing standard on Articulation Index (S3.5-1969) for Speech Interference Level (ASA 21, 1977; S3.14-1977) need standardized methods of measuring speech level and the aspects of noise levels that affect the masking of speech.

Existing national and international standards:

S3.5-1969 Methods for the Calculation of the Articulation Index
S3.14-1977 (ASA 21-1977) Standard for Rating Noise with Respect to Speech Interference

Work in progress - national and international:

National S3-59 Measuring Speech Level

Time required to produce the document:

3 years

Research required:

Existing standards need continued evaluation.

Priority:

4

Planning Panel Worksheet HR-20

Technical sub-area:	Assigned to:	Organization to do work:
Speech Interference	ANSI-S3	

Statement of regulatory and other needs:

Agencies responsible for guaranteeing adequate speech communication effectiveness based on measures of ambient noise levels only.

Existing national and international standards:

National S3.14-1977 (ASA 21-1977) Standard for Rating Noise with Respect to Speech Interference

Work in progress - national and international:

None

Special problems:

This standard should be revised at some future data to include the effects of room enclosures especially reverberation.

Actually it works pretty well now according to recent validation by H. Levitt, et al.

Planning Panel Worksheet HR-21

Technical sub-area:	Assigned to:	Organization to do work:
Speech Interference	ANSI-S3	

Statement of regulatory and other needs:

Agencies responsible for guaranteeing an adequate acoustic environment for communicating "everyday speech."

Existing national and international standards:

S3.2-1960 (R1971) PB; S3.5-1969 AI; S3.14-1977 SIL

Work in progress - national and international:

none

Future work - national:

none

Title of proposed new standard:

Everyday Speech Intelligibility

Time required to produce the document:

2 years

Research required:

None

Special problems:

Decide between use of CHABA/CID/MRL everyday sentences for BBN speech perception in noise (SPIN) test which accounts for linguistic background of listeners.

Priority:

4

Planning Panel Worksheet HR-22

Technical sub-area:	Assigned to:	Organization to do work:
Speech Interference-- Time Varying Noise	ANSI-S3	

Statement of regulatory and other needs:

Agencies responsible for generalizing speech communication effectiveness evaluation methods developed for steady state noises to environments characterized by time varying noises.

Existing national and international standards:

None

Research required:

Determine use, duration and amount of changes in ambient level that will effect a change in vocal effort of live talkers in the environment and/or a change in the volume control on a radio/tv/recording playback.

Priority:

5

Planning Panel Worksheet HR-23

Technical sub-area:	Assigned to:	Organization to do work:
Speech Interference Levels for Hearing Impaired	ANSI-S3	S3-36

Statement of regulatory and other needs:

Agencies responsible for guaranteeing adequate acoustical environment for everyday speedy communications for the total population including the aged and the hearing impaired.

Title of proposed new standard:

Speech Interference Levels Generalized for Various Degrees of Hearing Impairment.

Time required to produce the document:

4 years

Research required:

Determine interaction of noise levels (especially competing speech), hearing impairment, and use of hearing aids for all types and degrees of hearing loss (for speech).

Special problems:

If interactions include hearing aids, approval of dealer associations might be required.

Priority:

6

Planning Panel Worksheet HR-24

Technical sub-area:	Assigned to:	Organization to do work:
Speech Intelligibility	ANSI-S3	

Statement of regulatory and other needs:

Regulatory groups responsible for communication effectiveness in noisy work spaces (U.S. Dept. of Treasury, U.S. Dept. of Interior, U.S. Dept. of Labor); (2) for adequate living environments when communications are better, desirable or necessary (EPA, HUD): or (3) agencies responsible for compensation claims (private agencies, states, federal - U.S. Department of Labor, Off. of Workmen's Comp. Mil. - VA) based on social or work handicaps due to noise induced hearing impairment and who base their policies on performance specifications need efficient methods for evaluating speech communication effectiveness.

Existing national and international standards:

ANSI S3.2-1960 (R1971) Method for Measurement of Monosyllabic Work Intelligibility

Work in progress - national and international:

ISO version of S3.2-1960 (R1971)

Future work - international:

None

Title of proposed new standard:

Speech Intelligibility Tests Using Closed Set Responses (Modified Rhyme Test)

Time required to produce the document:

Two years

Research required:

None for normal hearing population. Inclusion word foils, testing for words that look alike to speech (lip) readers for hard-of-hearing population.*

* Visemes or homophemes (bike/mike/pike)

Priority:

4

Planning Panel Worksheet HR-25

Technical sub-area:	Assigned to:	Organization to do work:
Speech Communication	ANSI-S3	

Statement of regulatory and other needs:

Surveys estimate up to 20 million Americans have hearing impairments that cause difficulty in understanding speech. These difficulties are compounded by the masking effects of noise. Regulatory agencies, and particularly the EPA, need criteria for speech intelligibility of hearing products. The standard should provide information on sentence and monosyllabic discrimination in various levels and spectra of noise, for various amounts of hearing loss at various audiometric frequencies. Curves should be provided for unaided and aided speech discrimination.

Existing national and international standards:

None

Work in progress - national and international:

None

Future work - national:

None

Future work - international:

None known.

Title of proposed new standard:

Prediction of Speech Discrimination in Noise of Hearing-Impaired Individuals.

Time required to produce the document:

Two - three years.

Research required:

Relatively little additional research is necessary. Sentence discrimination data may be needed for mild-to-moderate impairments in speech-to-noise ratios of about 0 to +20 dB.

Special problems:

May be objections by the hearing-aid industry.

Priority:

3

Appendix A5
PROJECT DOCUMENTATION, NOISE CONTROL ELEMENTS

The following pages contain the updated versions of the Planning Panel Worksheets for Noise Control Elements. A sample worksheet can be found in Section 1.3. Under "Priority" projects are rated on a scale of 1 to 10, and 1 is highest priority. For identification purposes, the worksheets have been given the code NCE (Noise Control Elements) followed by sequential numbering.

Planning Panel Worksheet NCE-1

Technical sub-area:	Assigned to:	Organization to do work:
Noise Reduction by Prefabricated Barriers used Outdoors	E-33.03 and S1 (See Worksheet PA-22)	To be decided

Statement of regulatory and other needs:

1. Candidate for labeling by EPA.

2. Information needed for design purposes.

Existing national and international standards:

None

Work in progress - national and international:

FHWA is believed to have sponsored research in this area.

Time required to produce the document:

Within 3 years.

Research required:

A test method to evaluate the difference in airborne sound propagation, under specified conditions outdoors, with and without the test barrier in the propagation path.

Special problems:

The difficulty of working with a test barrier of sufficient size to be effective (i.e., unlimited by flanking around the ends); it is not easy to install and remove such a structure for testing.

Priority:

1 or 2.

Planning Panel Worksheet NCE-2

Technical Sub-area:	Assigned to:	Organisation to do work:
Field Test to Verify Enclosure Performance	E-33.03L	

Statement of regulatory and other needs:

People who use manufactured audiometric enclosures need a field procedure to verify that an installed enclosure provides the noise reduction specified for it.

Existing national and international standards:

E 596-77 Laboratory Measurement of the Noise Reduction of Noise Isolating Enclosures.

Work in progress - national and international:

E-33.03L will undertake this charge immediately.

Special problems:

Provision of suitably diffuse sound fields *in situ* to allow accurate measurement of Noise Reduction.

Priority:

1

Planning Panel Worksheet NCE-3

Technical sub-area:	Assigned to:	Organization to do work:
Reflections of Discrete Angles	E-33	

Statement of regulatory and other needs:

Need test method and "effectiveness rating" for sound absorption materials used on ceilings and walls in open offices and other types of spaces where control of specific sound reflections is important.

Both laboratory and field test methods are needed.

Existing national and international standards:

None.

Work in progress - national and international:

E-33.01 Task Group is working in this area. Needs encouragement. A number of different test methods have appeared in the literature, but all have limitations, with respect to limited frequency range or requirements for extensive (or exotic) instrumentation, particularly for field tests.

Future work - national:

E-33.01 Task Group will continue to note and evaluate proposed test procedures from the technical literature, for adoption by ASTM.

Future work - international:

Unknown

Research required:

Various ingenious suggestions have appeared in the literature. Research is needed to evaluate and refine the best of these methods and adapt one or more for lab and field testing for ASTM/EPA purposes.

Special problems:

Typical limitations on low-frequency range of tests, and amount of equipment required.

Priority:

1

Planning Panel Worksheet NCE-4

Technical sub-area:	Assigned to:	Organization to do work:
Impact Sound Transmission	E-33.03	

Statement of regulatory and other needs:

1. Building Codes. (both laboratory and field test procedure)

2. Tests for compliance with specifications.

Existing national and international standards:

1. ISO 140

2. ANSI/ASTM E-492-73T Laboratory Measurement of Impact Sound Transmission using ISO Tapping Machine.

3. Two ASTM Proposed Methods of Laboratory Measurement of Impact Sound Transmission using Alternatives to the ISO Tapping Machine (1977).

Work in progress - national and international:

Studies at Chalmers Institute in Sweden and Centre Scientifique et Technique de Batiment (CSTB at Grenoble, France) proposed modified tapping machine.

ASTM Task Group on Alternate Impact Test Methods

International & European national efforts continuing, trying to find suitable replacement for ISO tapping machine and that procedure; rather low priority.

Future work - international:

Further studies of modified tapping machine, but at low priority level, at Chalmers Institute & CSTB.

Title of proposed new standard:

Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using a Modified Tapping Machine

Time required to produce document:

1-2 years.

Research required:

1. Research to validate the physical characteristics of the ASTM proposed modified tapping machine against current-style shoes in North America.

2. Develop test measurement procedure for measuring impact sound transmission in field under noisy background conditions.

Special problems:

1. An impacting device that simulates live footfalls may not generate high enough impact sound levels to be accurately measured in the field with high background noise. (see research above)

2. A standard impacting device can simulate only one kind of impact, whereas in real life there may be several kinds of annoying impacts.

Priority:

1

Planning Panel Worksheet NCE-5

Technical sub-area:	Assigned to:	Organization to do work:
Transmission Loss of Building Facades	E-33.03	

Statement of regulatory and other needs:

Exterior building components (e.g., windows, doors) can be adequately tested by the ASTM E 90 method. The subject standards intended to evaluate the airborne sound attenuation of the building shell as a whole.

Existing national and international standards:

ISO 140 (formerly DIS 7); one of the nine parts of this standard prescribe two alternative procedures (one using traffic noise, the other using a loudspeaker signal as the sound source) for measuring the attenuation of building facades; the latter method permits measurement of a specific angle of incidence.

Work in progress - national and international:

E-33.03 Task Group is working on an ASTM version of the ISO standard

Special problems:

1. Supporting loudspeaker as signal source outside upper floors of high buildings, and/or use of airborne sources.

2. Ambiguity of incident sound at near-grazing incidence, particularly when a facade embodies decorative elements, rather than flat plane surface.

Priority:

1

Planning Panel Worksheet NCF-6

Technical sub-area:	Assigned to:	Organization to do work:
Surface Noise Generation on floors and floor coverings	E-33	

Statement of regulatory and other needs:

1. Possible candidate for labeling by EPA.

2. Methods for evaluating the effectiveness of floor coverings in reducing footfall and scuffling noise in the room where they are installed.

Existing national and international standards:

There is an Austrian method, utilizing a wooden chair sliding along the floor to generate scraping noise which is measured in the same room. The method has not yet been adopted as a standard.

No ISO standard.

No American standard.

Work in progress - national and international:

None. Several years ago an ASTM working group was working on an adoption of the Austrian Method mentioned above, but the effort was abandoned for lack of strong interest.

Priority:

Low

Planning Panel Worksheet NCE-7

Technical sub-area:	Assigned to:	Organization to do work:
Evaluation of Airborne Sound Insulation Machinery Enclsoures	E-33.03L	To be decided

Existing national and international standards:

ASTM E-597-77T is partially applicable

Work in progress - national and international:

E-33.03L expects to consider this problem in the near future.

Priority:

Low

Planning Panel Worksheet NCE-8

Technical sub-area:	Assigned to:	Organization to do work:
Vibration Isolators	E-33.08	To be decided

Statement of regulatory and other needs:

1. Candidate for labeling by EPA
2. Standard specification for spring isolators
2. Method to evaluate & describe non-linear vibration isolators.

Existing national and international standards:

ANS S2.8-1972 Guide for Describing the Characteristics of Resilient Mountings.

Work in progress - national and international:

None

Special problems:

Performance is affected by characteristics of the structure on which the isolators and equipment are mounted.

Priority:

low priority

Planning Panel Worksheet NCE-9

Technical sub-area:	Assigned to:	Organization to do work:
Damping Materials	E-33.03M	Task Group M

Statement of regulatory needs:

1. Candidate for labeling by EPA.
2. Need applications guidance - i.e. How do you interpret data so as to convey subjective evaluation of noise control results.

Existing national and international standards:

1. S2. 9 - Nomenclature for specifying damping properties of materials.

Work in progress - national and international:

1. ASTM Task Group E-33.03M is working in this area.
2. International: unknown.

Time required to produce the document:

less than 3 years.

Research required:

Develop adequate test method

Special problems:

Temperature control; constrained layer damping; sample mounting may affect test results.

Priority:

low