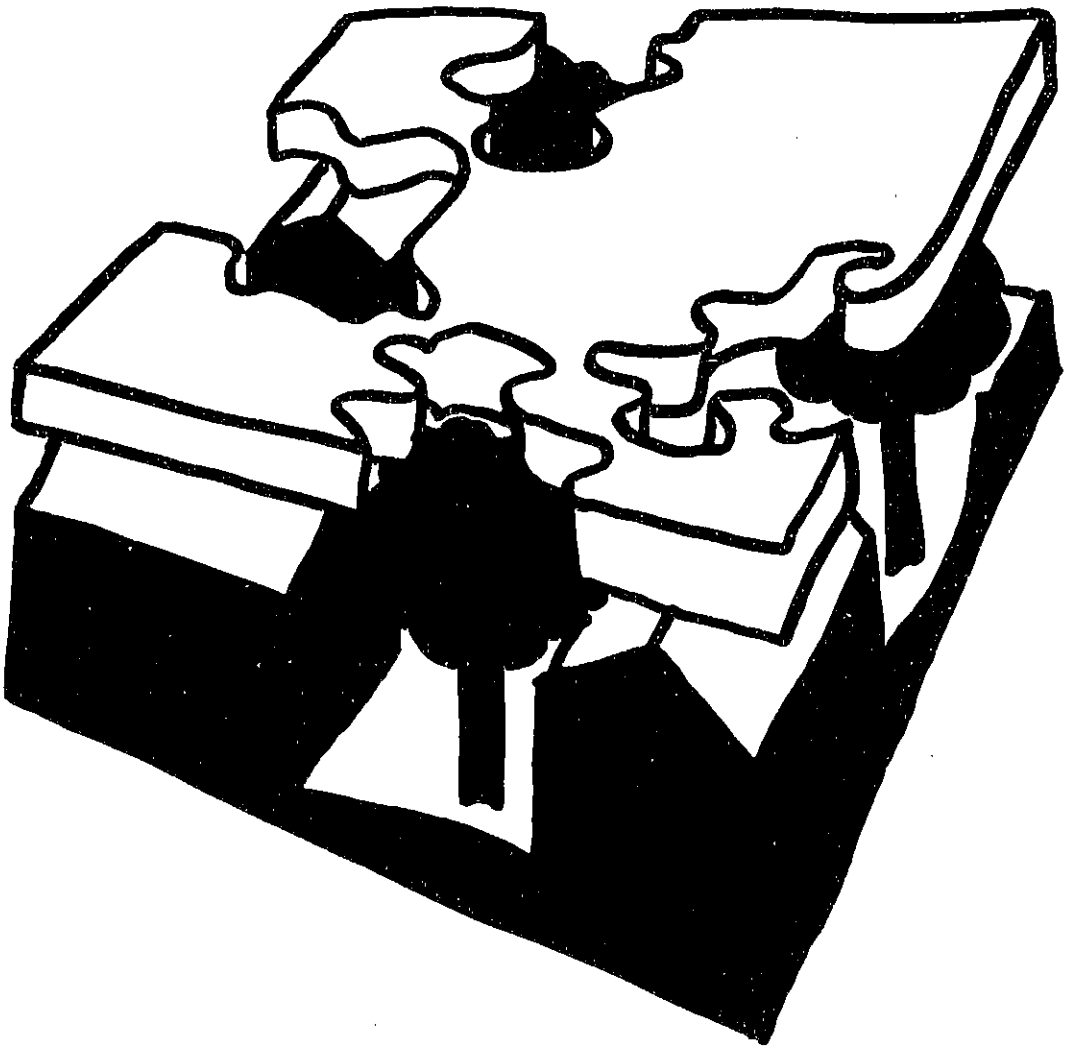
Final Environmental Impact Statement

Noise

U.S. Department of Labor
Occupational Safety and
Health Administration
January 1981



U.S. Department of Labor

Assistant Secretary for
Occupational Safety and Health
Washington, D.C. 20210

MEMORANDUM FOR DISTRIBUTION

FROM: EULA BINGHAM, Assistant Secretary
Occupational Safety and Health Administration

SUBJECT: Final Environmental Impact Statement on a Hearing Conservation Amendment to the Standard for Occupational Exposure to Noise

Enclosed is a copy of the Final Environmental Impact Statement (FEIS) on a Hearing Conservation Amendment to the Standard for Occupational Exposure to Noise. The amendment includes a regulatory framework as well as procedures for hearing conservation programs. This document assesses the potential impacts that these hearing conservation requirements may have on the workplace environment and on the human environment external to the workplace.

Enclosure

FINAL ENVIRONMENTAL IMPACT STATEMENT ON A HEARING CONSERVATION AMENDMENT TO THE STANDARD FOR OCCUPATIONAL EXPOSURE TO NOISE

U.S. Department of Labor
Occupational Safety and Health Administration
Directorate of Technical Support
Office of Regulatory Analysis
Washington, D.C. 20210

(a) Type of Action: Administrative.

(b) Title of Action: A Hearing Conservation Amendment to the Standard for Occupational Exposure to Noise.

(c) Further Information: Further information on this Final Environmental Impact Statement (FEIS) may be obtained from Harold L. Mungin, Office of Regulatory Analysis, Room N3651, Occupational Safety and Health Administration, 200 Constitution Avenue, N.W., Washington, D.C. 20210. Telephone: (202)523-7505.

(d) Abstract: This amendment to the occupational noise standard imposes requirements for hearing conservation programs. It will beneficially impact the workplace environment by reducing hearing loss and other adverse health effects associated with noise exposure. The environment outside the workplace should not be significantly affected as a result of promulgation of the amendment. Minimal increases in capital costs and an increase in operating costs for some industries may occur. OSHA considered other reasonable alternatives in the development of the amendment: (1) revision of the permissible exposure limits for noise, (2) initiation of hearing conservation programs at higher or lower levels, (3) revision of the monitoring, testing, and training provisions, and (4) "no regulatory action." OSHA may conduct future proceedings concerning these and other alternatives.

(e) Comments: The proposal requested comments on the environmental effects, as well as all other issues, from the public, and in addition, letters requesting comments on environmental effects were sent to a number of Federal and State agencies and various organizations. Substantive letters of comment on the Draft Environmental Impact Statement (DEIS) are attached as Appendix B of this FEIS. To the extent that comments were addressed primarily to the substance of the proposal rather than to the environmental consequences of the proposal or the final amendment OSHA has determined these comments are more appropriately dealth with in the Preamble to the Hearing Conservation Amendment.

FINAL ENVIRONMENTAL IMPACT STATEMENT ON A HEARING CONSERVATION AMENDMENT TO THE STANDARD FOR OCCUPATIONAL EXPOSURE TO NOISE

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

LIST OF ILLUSTRATIONS

Figures

Tables

Tables (Continued)

PREFACE

The following document is the Final Environmental Impact Statement (FEIS) on a Hearing Conservation Amendment to the OSHA Standard for Occupational Exposure to Noise. It was prepared by the Office of Regualatory Analysis, Occupational Safety and Health Administration (OSHA), in accordance with requirements of the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321, et seq.), the Guidelines of the Council on Environmental Quality (40 CFR part 1500), and the Department of Labor's own regulations governing the preparation of environmental impact statements (29 CFR Part 11).

The purpose of the FEIS is to present an analysis of the environmental effects that may be expected to occur as a result of employer implementation of an OSHA regulation for the control of worker exposure to noise. In addition, this document updates and presents data and information developed or received since the publication of the Draft Environmental Impact Statement (DEIS) published on June 10, 1975.

Many persons have contributed suggestions and comments that have been included in this Final Environmental Impact Statement (FEIS). The document has been reviewed by the U.S. Department of Labor, Occupational Safety and Health Administration, Directorate of Health Standards Programs and Directorate of Technical Support, Office of Regulatory Analysis. The following individuals have participated in the development of this document:

Harold L. Mungin, MBA/MPH
Environmentalist
Office of Regulatory Analysis
Directorate of Technical Support
OSHA
Department of Labor
Washington, D.C. 20210

Larry Braslow, A.B.D.
Economist
Office of Regulatory Analysis
Directorate of Technical Support
OSHA
U.S. Department of Labor
Washington, D.C. 20210

Anne Crown Cyr, M.A.
Writer/Editor, Environmentalist
Office of Regulatory Analysis
Directorate of Technical Support
OSHA
U.S. Department of Labor
Washington, D.C. 20210

Christine Lomax
Contractor Assistant
Office of Regulatory Analysis
Directorate of Technical Support
OSHA
U.S. Department of Labor
Washington, D.C. 20210

Alice Suter, Ph.D.
Health Scientist
Directorate of Health Standards Programs
OSHA
U.S. Department of Labor
Washington, D.C. 20210

Mary Ellen Weber, Ph.D.
Director
Office of Regulatory Analysis
Directorate of Technical Support
OSHA
U.S. Department of Labor
Washington, D.C. 20210

Karl Kronebusch, M.Sc.
Economist
Office of Regulatory Analysis
Directorate of Technical Support
OSHA
U.S. Department of Labor
Washington, D.C. 20210

Susan Sherman, J.D.
Assistant Counsel for Standards
Office of Solicitor
OSHA
U.S. Department of Labor
Washington, D.C. 20210

Barbara Willis
Secretary
Office of Regualtory Analysis
Directorate of Technical Support
OSHA
U.S. Department of Labor
Washington, D.C. 20210

I. EXECUTIVE SUMMARY

This document is the Final Environmental Impact Statement (FEIS) on a Hearing Conservation Amendment to the Standard for Occupational Exposure to Noise. The FEIS was prepared by the Occupational Safety and Health Administration (OSHA), Directorate of Technical Support, Office of Regulatory Analysis, in accordance with requirements of the National Environmental Policy Act (NEPA) of 1969 (P.L. 91-190, 42 U.S.C. 4321 et seq.), Guidelines of the Council in Environmental Quality (40 CFR Part 1500) and Department of Labor (DOL) regulations (29 CFR Part 11).

The purpose of the FEIS is to present an analysis of the environmental effects that may be expected to occur as a result of implementation of the hearing conservation requirements.

In addition, this document updates and presents data and information developed or received since the publication of the Draft Environmental Impact Statement (DEIS) in June, 1975. The following paragraphs outline the contents of the FEIS.

Background

Noise is generally considered to be unwanted sound or sound without value, since it may interfere with the perception of wanted sound and can be harmful to health and comfort.

Until recently, noise has been accepted as an annoying but necessary price of technological advances and increasing urbanization. While industrial noise was a major health hazard even before the Industrial Revolution, noise from industry and other environmental sources has sharply increased during the last few decades. Urban areas, in particular, have become

increasingly noisy due to the growing numbers of large airports, rapid transit systems, and major highways. Even rural areas are subject to hazardous noise levels. Agricultural machinery such as tractors and crop dryers produce noise levels well above the limit currently considered safe for general industry.[1] Leisure time activities, ranging from trap shooting to attending loud concerts, often aggravate the adverse health effects produced by other noise sources.

In the last few years, increasing concern for the health consequences of rising noise levels has led to a reappraisal of this environmental and occupational problem. The information that has emerged indicates that noise from all sources must be reduced to protect against hearing loss. However, it is also evident that the changes required and the technological problems to be overcome are not amenable to quick solutions. In addition, an overall effort to reduce noise must reverse the tendencies of a society that has permitted rising noise levels for decades.

The noise exposure associated with the work environment is a particularly urgent problem. Worksite noise has been identified as a major occupational health hazard that threatens millions of workers with some degree of hearing loss. According to Dr. Alexander Cohen, a Noise Expert for the National Institute of Occupational Safety and Health (NIOSH), the total number of workers in this country who experience noise conditions that are potentially hazardous to hearing is in excess of 6 million and may possibly be as high as 16 million.[2] OSHA estimates that there are over 5 million workers exposed to noise of at least 85 dB in the manufacturing and utilities sec -s of the U.S. One researcher estimates that approximately 50 percent of the machinery used in heavy industry produces noise levels high enough to cause potential

hearing loss to exposed workers.[3] Occupational noise is, however, no longer a problem solely associated with heavy industry. While advanced technology has accelerated production speeds and streamlined processes in many industries, relatively little attention has been devoted to reducing the attendant increases in noise levels.

Health Effects Associated with Exposure to Noise

The abilities to hear things as loud as they are, as well as to hear sounds with clarity, are distinct attributes of normal hearing. The extent to which normal hearing is impaired by noise is a function of many variables in addition to exposure level and duration. Some factors include the frequency spectrum, the distance from the individual to the sound source, the extent to which the sound is meaningful or important, and individual physiological and psychological tolerance for noise. Some people suffer adverse effects more quickly and more severely than others.

The effects of noise on hearing may cause temporary or permanent nerve deafness or hearing loss. This occurs when the cilia, the tiny nerve cells that act as sensors within the inner ear, become damaged. If the sound is not too loud or too prolonged, the fatigued cells may recover after a period of rest. This temporary decrease in hearing ability is called a temporary threshold shift (TTS).

Generally, it takes a prolonged exposure to noise to damage the sensory cells of the inner ear permanently. Unless hearing is audiometrically tested regularly there is no way to detect the beginning of hearing loss. However, it is widely agreed that noise causing a temporary hearing loss will ultimately lead to permanent hearing loss or a noise induced permanent threshold shift (NIPTS). As stated earlier, somewhere between 6 and 16 million

American workers are exposed to noise levels severe enough to cause permanent hearing damage. The condition is irreversible and hearing aids offer little or no assistance.

Although the prevailing opinion is that man adapts to excessive noise over the long term, researchers are investigating the possibility that exposure to high levels of noise over prolonged periods may trigger adverse physiological and psychological reactions. Studies have focused on such extra-auditory effects of noise exposure as gastrointestinal, cardiovascular, and neurological changes; psychological problems such as irritability, fatigue, and social conflict; disruptions of job performance; and communication difficulties. Research has also been initiated on the distracting effect of sounds and the dangers of noise interference with warning shouts or signals. It is not exactly known to what extent these factors contribute to the occurrence of industrial accidents and job dissatisfaction.

Although several studies have suggested that excessive noise exposures may affect general health adversely, actual dose-response relationships are at present lacking. However, it is clear that the worst victims of noise are those who must spend every working hour exposed to it. These workers have a greater chance of developing noise-related illnesses, and the noise they endure makes their jobs more difficult and hazardous.

The Hearing Conservation Amendment

OSHA intends to regulate employee exposure to noise by issuing hearing conservation requirements as an amendment to the current standard 29 CFR 1910.95). Specifically, when employees are subjected to noise exposure levels equivalent to or exceeding an 8-hour time-weighted average (TWA) of 85 decibels (dB) without regard to the use of personal hearing protective equipment, a

continuing effective hearing conservation program as described in the current amendment shall be administered. The amendment contains requirements for measuring employee noise exposure. Where employee noise exposures equal or exceed an 8-hour TWA of 85 dB, then the employer must provide audiometric examinations, employee education and training, hearing protectors, and in certain circumstances, referral to an otolaryngologist or audiologist. The amendment will apply to all general industry employers, who have one or more employees, but will not affect construction or agricultural operations.

Alternatives

Major alternatives considered along with the hearing conservation amendment were to (1) revise the permissible exposure level for noise, (2) initiate a hearing conservation program at 85 dB as suggested in the proposal, (3) initiate a hearing conservation program at either higher or lower exposure levels, (4) revise the monitoring, testing, and training provisions, and (5) a "no regulatory action" alternative.

Projected Environmental Impacts

The amended standard would have its greatest impacts on the workplace environment and the health of workers. Health benefits derived from promulgation of the amendment are expected to result in a reduction in both the incidence and the degree of hearing loss among employees. In addition, existing hearing impairments are likely to be identified by the audiometric examination and treated accordingly. New research is going on to understand more about the effects of occupational noise exposure. However, it is readily apparent that hearing loss is only the most obvious in a long line of noise-related illnesses. Conceivably, therefore, a secondary impact may be a

reduced prevalence of the extra-auditory effects of noise--physiological and psychological disturbances which adversely affect employee general health, performance, employment opportunities, social patterns, and industry production. Thus, a vital aspect of preserving the nation's human resources may be to protect the workers from excessive noise exposure.

Irretrievable commitments of this amendment are the time and money spent in acquiring and retaining the appropriate available medical personnel to perform audiometric examinations and tests, the medical material (medication, cotton swabs, etc.) and the equipment (construction of treatment and examination facilities, maintenance and operating supplies, etc.) that will be used. In addition, one must consider the person-hours lost both during and after examinations, the energy or power and fuels consumed while maintaining and operating a treatment and examination facility, and the purchase of equipment such as noise dosimeters, sound level meters, earplugs, and other personal protection equipment needed to be in compliance with the hearing conservation requirements.

A concomitant adverse impact of the amendment is expected to be a minimal increase in capital costs and an increase in operating expenses in certain industries. However, the annual costs ($254 million) for implementing the amendment would not be substantial in terms of the national economy or the general industry's overall market structure. Moreover, no significant impacts are expected on the environment external to the workplace as a result of the promulgation of the amendment.

Relationship with other Federal Actions

The Noise Control Act of 1972, (42 USC 4901 et seq.), gives the Environmental Protection Agency (EPA) the responsibility for coordinating all Federal noise regulations.

Noise regulations are primarily concerned with two distinct problems. First is the regulation of noise sources, such as airplanes, traffic and other noise problems which affect the general public health and welfare. Agencies concerned with these problems are EPA, the Department of Housing and Urban Development, the Department of Transportation, and the National Aeronautics and Space Administration. Second is the regulation of noise as it concerns individual work-related exposure. Agencies concerned with these noise problems are OSHA, NIOSH, the Department of Defense, and Department of Interior. A brief discussion of each Agency's regulatory activities concerning exposure to noise may be found in Chapter VII of this FEIS.

Comments

Letters of comment received in direct response to the DEIS have been reviewed. To the extent that comments were addressed primarily to the substance of the proposal rather than to the environmental consequences of the proposal or the final amendment, OSHA has determined these comments are more appropriately dealt with in the Preamble to the Hearing Conservation Amendment. In addition, all comments, data, evidence, and testimony concerning environmental issues received into the public record of this rulemaking proceeding have been reviewed prior to the development of this FEIS.

REFERENCES

[1] H.L. Barrows, Deputy Assistant Administrator, Letter Commenting on the Draft Environmental Impact Statement, Agriculture Research Service, U.S. Department of Agriculture, Washington, D.C., July 6, 1975.

[2] "Noise Effects on Health, Productivity and Well Being," Transactions of the New York Academy of Science, II, 30 (1968).

[3] J.R. Anticaglia, "Introduction: Noise in Our Overpolluted Environment," ed. B. L. Welch and A. S. Welch: Physiological Effects of Noise, pp. 1-3.

II. BACKGROUND AND HISTORY OF THE HEARING CONSERVATION AMENDMENT

Noise has been recognized for several years as an occupational hazard. Only in the past 20 years have efforts been made to regulate occupational exposure to noise. The first Federal efforts to regulate occupational exposure to noise were introduced in 1955 for members of the armed forces.

In 1969, a regulation (41 CFR 50-204.10) was promulgated under the Walsh-Healey Public Contract Act (WHPCA) which established a threshold limit value of 90 dB (originally 85 dB) for an 8-hour time-weighted average (TWA) exposure to noise. This regulation applied only to firms with supply contracts with the Federal government in excess of $10,000 annually.

Similar noise exposure limits were placed in the regulations under the McNamara-O'Hara Service Contract Act (34 FR 7946-7954) which included work performed on Federal government service contracts of $2,500 or more annually. The Coal Mine Health and Safety Act of 1969 (36 FR 12739) contains the same noise exposure limits, which are applicable to surface and underground mining operations.

The Williams-Steiger Occupational Safety and Health Act of 1970 established the Occupational Safety and Health Administration (OSHA) and granted wide authority in setting and enforcing standards designed to ensure safe and healthful working conditions for the Nation's workers. The WHPCA became an OSHA standard by law.

Initially, OSHA adopted the existing noise regulation from the WHPCA which limited worker exposure to a 90 dB TWA for an 8-hour day.

The National Institute for Occupational Safety and Health (NIOSH) developed a criteria document for noise which was submitted to OSHA in August 1972. This criteria document included an extensive review of pertinent studies relating to occupational noise exposure. In recommending a standard, NIOSH focused primarily on criteria that would protect against hearing loss, since it concluded that existing data on other disturbances associated with noise exposure were either insufficient or inconclusive. NIOSH emphasized that adherence to noise limits for hearing conservation would also lessen the possibility of other noise-related problems.

NIOSH recognized the need for reducing workplace noise to 85 dB, but concluded that the Department of Labor should determine, on the basis of feasibility data, when the current TWA level of 90 dB should be reduced to this more stringent limit. The Institute recommended, however, that the 85 dB level apply to all newly designed occupational environments. NIOSH also recommended that workers should at no time be exposed to continuous noise at levels above 115 dB. If noise levels exceeded the specified limits, administrative or engineering controls were to be utilized.

Regarding medical surveillance, the NIOSH criteria document suggested an audiometric testing program for those employees exposed to a daily noise dose that equals or exceeds the specified levels and for those who wear personal protective equipment. Employees whose audiograms indicated a threshold shift of 10 dB at 500, 1000, 2000, or 3000 Hz; or 15 dB at 4000 or 6000 Hz would, according to the NIOSH recommendations, have to receive appropriate medical evaluations and be provided with personal protective equipment as required.

The NIOSH document recommended the use of personal protective equipment only as an interim measure until engineering and administrative controls could be implemented to reduce noise to the specified limits. Training and inspection procedures to assure that protectors are worn properly were also included in the document.

Other provisions included the labeling of hazardous areas, apprising employees of the noise hazard, and identifying specifications for audiometric testing and requirements for monitoring and recordkeeping.

To assist in setting a standard for noise exposure, the Secretary of Labor appointed an OSHA Standards Advisory Committee on Noise to further evaluate the issues involved. Committee members representing labor, management, and the scientific community began their review of the issues on the noise standard on February 23, 1973. After several meetings, they submitted their recommendations to the Department of Labor on December 20, 1973. The Committee concluded that the TWA limit of 90 dB for 8 hours should be maintained as the permissible exposure level, and that no worker should be exposed for any period of time to steady state sound pressure levels exceeding 115 dB. It was also recommended that impulsive or impact sounds should not exceed a 140 dB peak sound pressure level. The Committee further recommended that personal protective equipment be required to limit employee exposure to noise during the installation of engineering or administrative controls and in situations where it is demonstrated that engineering controls are not feasible.

The Advisory Committee also recommended that medical surveillance in the form of an audiometric testing program be provided annually for those employees exposed to daily noise doses equalling or exceeding 85 dB for an 8-hour day, and for those employees relying on personal protective equipment.

In case of the occurrence of a significant threshold shift, the affected employee was to be provided with personal protective equipment and an appropriate medical evaluation. A significant threshold shift was defined as any shift of 20 dB or more at any one test frequency (500, 1000, 2000, 3000, 4000, and 6000 Hz). On the other hand, a significant shift for those employees whose baseline audiogram already showed a shift greater than 25 dB was defined as: 10 dB or more at 500, 1000, or 2000 Hz; 15 dB or more at 3000 Hz; and 20 dB or more at 4000 or 6000 Hz.

In October 1974, OSHA published its proposed noise standard in the Federal Register (39 FR 3773) which essentially maintained the current 90 dB 8-hour TWA and required a hearing conservation program based on periodic audiometric testing for workers exposed to levels at or above an 85 dB 8-hour TWA. The proposal requested submission of written comments from all interested parties on a variety of scientific, technical, environmental, and procedural issues addressed by, or implied in, the proposal. OSHA also transmitted the proposal to industry trade associations and unions inviting their participation.

The proposed noise standard attracted interest from many organizations and associations, including Federal, State, and local government agencies. In order to accommodate these opinions and views, hearings were held June 23 through July 30, 1975 and September 21 through October 8, 1976, at which time over 270 persons presented technical data and testimony supporting their positions. After completion of the public hearings, time was permitted for the submission of post hearing comments, evidence, and briefs.

On June 10, 1975, OSHA made its Draft Environmental Impact Statement (DEIS) available to the Council on Environmental Quality (CEQ) and the public.

The Federal Register notice of the DEIS requested submissions of written comments from all interested persons with respect to the potential for any significant, adverse impacts on the environment that might occur as a result of the proposed standard. Also, the DEIS was transmitted to over 250 environmental interest groups and associations inviting their participation.

Realizing that the agency was still unprepared to issue a complete standard due to the lack of quantitative data on several physiological and economic issues and not wanting to postpone providing workers with needed protection, OSHA decided to issue hearing conservation requirements as an amendment to the current standard. The record was reopened on April 18, 1980, for public comment on the hearing conservation issue.

After extending the closing date 20 days, the record was closed on July 3, 1980. OSHA carefully reviewed the material received and, when merited, utilized it in the development of the hearing conservation amendment to the noise standard.

The entire record includes over 300 exhibits and approximately 2,500 transcript pages and errata. Copies of materials in the record may be obtained from the OSHA Docket Office, Room S6212, U.S. Department of Labor, 200 Constitution Avenue, N.W., Washington, D.C. 20210. The hearing conservation amendment was based on full consideration of the entire record of these proceedings, including material discussed or relied on in the proposal, and on all written comments, exhibits, and environmental issues.

III. HEALTH EFFECTS ASSOCIATED WITH EXPOSURE TO NOISE

Introduction

Comments on the Draft Environmental Impact Statement (DEIS) suggested that this chapter be more explicit and more detailed in discussing the health effects associated with exposure to noise. (See Appendix B - Anderson, ANPA/RA, Barrows, Cromwell, Davis, B., Davis, L., Doremas, Grant, Gaimes, Muir, Myers, Pennington, Prokop, Taylor, and Watts.) Although this section does not repeat all of the information submitted, sincere efforts have been made to respond appropriately to all comments and suggestions made. Moreover, all data, information, views, and testimony on the health effects associated with exposure to noise received into the record for the noise rulemaking proceeding have been reviewed and considered in the development of this chapter.

Noise and Hearing

Noise is generally considered to be unpleasant or unwanted sounds; whereas sound is generally considered to be useful in communications or associated with pleasant things such as music. The terms noise and sound are often used interchangeably.

A person's normal environment contains sounds or noises from many different sources. In the non-occupational environment, there are many conditions during which people are exposed to noise, including the crying of children, entertainment activities, hobbies, transportation, and home maintenance. In the occupational environment, noise is the by-product of any number of industrial processes and may in fact be a mixture of different types of sound. Some noise is continuous, such as the low hum of a fan, and some fluctuates like the sound of a vehicle in different gears. Many noises occur intermittently

such as drilling or sawing, and others are impulsive, such as the blows generated by drop-forge hammers.

"The basic function of the hearing mechanism is to gather, conduct and perceive sounds from the environment. Sound waves, propagated through an elastic medium, liberate energy in a characteristic pattern which varies in frequency and intensity."[1]

The human voice and other ordinary environmental sounds are composed of fundamental tones modified by harmonic overtones. Our hearing sensitivity is greatest in childhood, but as we get older, our perception of high tones worsens, a condition known as "presbycusis." The frequency range of the human ear extends from as low as 16 Hz to as high as 30,000 Hz. From a practical standpoint, however, few adults can perceive sounds above 11,000 Hz.[2] It should be noted that sound with frequencies below 16 Hz is called infrasound, and sound with more than 20,000 Hz is called ultrasound. There is some evidence that these sounds, which cannot be heard, can be hazardous to workers' health under certain conditions.[3] This Final Environmental Impact Statement (FEIS) deals only with noise that can be heard.

The ear responds to alterations in the pressure level of sound. The amplitude of these sound pressure alterations determines the intensity of the sound. So great is the range of intensities to which the ear responds that a logarithmic unit, the decibel (dB), is commonly used to express the pressure level of sound. The subjective correlates of frequency and intensity of sound are pitch and loudness.[4]

To measure an individual's hearing threshold, a specialist such as an audiologist, or otolaryngologist) determines the person's hearing thres-hold for specific frequencies with an audiometer, an instrument which produces pure tones at specific frequencies (e.g., 500, 1000, 2000, 3000, 4000, and 6000 Hz). This is done by measuring the lowest level of the pure tones that can be heard at each frequency using standardized audiometric procedures.

Hearing levels for certain pure tone frequencies are compared to a reference value to determine if hearing loss has occurred. This value, "audiometric zero," has been standardized by such organizations as the International Standards Organization (ISO R-389-1964) and the American National Standards Institute (ANSI S3.6-1969).

The record of a given individual's hearing acuity is called an audiogram. Audiograms are very important because they can provide an accurate record of the status of an individual's hearing. An audiogram may show a shift in hearing level, but upon retesting after a number of hours away from the noise, the audiogram may reveal normal hearing. In this case, the temporary threshold shift (TTS) acts as a warning flag, and steps may be taken to protect the individual before the loss becomes permanent. Audiograms are also a tool for evaluating the overall effectiveness of hearing conservation programs. If a sizable percentage of workers show permanent threshold shifts then improvement plans are warranted.

Noise - Auditory and Extra-Auditory Effects

The extent to which individuals are impacted by noise is a function of many variables in addition to level and duration. Some factors include the frequency spectrum, the distance from the individual to the sound source, the extent to which the sound is meaningful or important, and individual physiological and psychological tolerance for noise. Some people suffer adverse effects more quickly and more severely than others.

Since the ear does not have an overload switch or a circuit breaker, it has no option but to receive all the sound that strikes the eardrum. In industry, excessive noise constitutes a major health hazard. Excessive noise exposure may cause both auditory and extra-auditory effects.

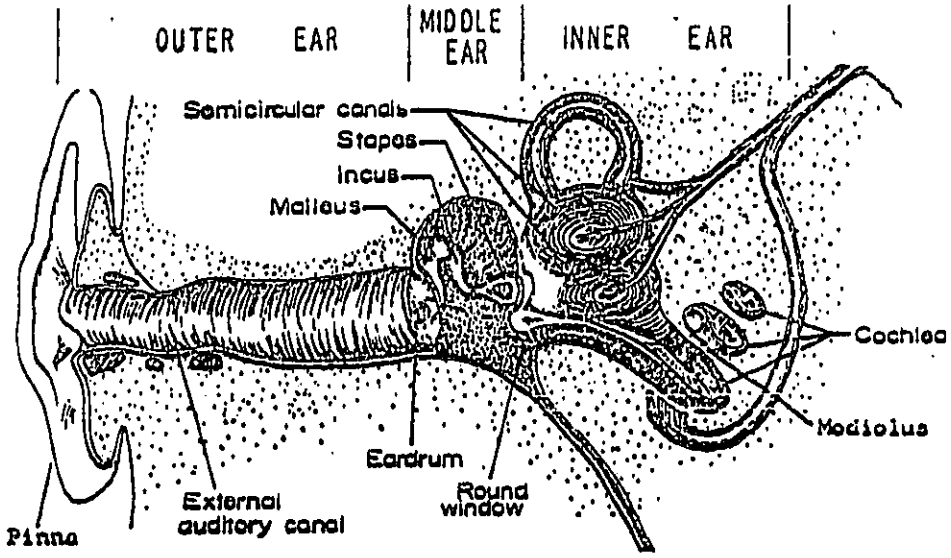
There is a wealth of information on the relationship between noise exposure and auditory effects. This relationship is well established and it can

be further explained in terms of noise levels and frequencies, age, sex, years of exposure, and other important variables.

The extra-auditory effects of noise involve complex physiological and psychosocial reactions, which are much more difficult to document. For example, we are familiar with the reflex-like startle response of an individual to a loud, unexpected sound. Less commonly noted are the cardiovascular, neurologic, endocrinologic and biochemical changes secondary to the intense noise exposure. Subjective complaints of nausea, malaise, and headache have been reported in workers exposed to ultrasonic noise levels. Vasoconstriction, hyperreflexia, fluctuations in hormonal secretions, disturbances in equilibrium and visual functions have been demonstrated in laboratory and field studies. For the most part these changes are transient in nature, and it remains to be clarified whether such noise exposure has long lasting ill effects on the organism.[5] However, the data highly suggestive of adverse effects, and therefore provide additional incentives for caution.

Auditory Effects

The Auditory Mechanism. The human ear is especially adapted to respond to the pressure changes underlying airborne sounds or noise (Figure III-1). Anatomically, the ear is divided into the outer, middle, and inner ear. The principal functions of the outer and middle ear are to collect and transmit sound pressure to the inner ear where the delicate hair cell receptors for hearing are located. The hair cells are arranged in several rows along the entire length of the basilar membrane, one of two partitions that spiral around the bony axis of the cochlea. These hair cells together with their supporting cells comprise the Organ of Corti, the auditory sense o· ın in which hydraulic pressure variations within the fluid-filled cochlea are transformed into neural impulses transmitted to the brain.



Source: U. S. Department of Health, Education, and Welfare, Criteria for a Recommended Standard....Occupational Exposure to Noise, HSM 73-11001, second printing, Health Services and Mental Health Administration, National Institute for Occupational Safety and Health (Washington, D.C.: Government Printing Office , 1972), Figure 3.

FIGURE III-1

CROSS-SECTION OF OUTER, MIDDLE, AND INNER EAR STRUCTURES

When sound pressure waves strike the ear, the outer ear gathers sound in the environment and funnels it into the ear. The middle ear then carries these sound waves to the fluid-filled inner ear, and the three small bones (or ossicles) in the middle ear amplify the sound waves. The inner ear changes the sound vibrations from mechanical to neural energy by means of cochlea. Here minute sensory cells (hair cells) respond to the mechanical vibrations, change them into electrical energy, and transmit the message to the brain.

The ability to hear things as loud as they are, as well as to hear sounds with clarity, are distinct attributes of normal hearing. If there is damage to the outer or middle ear there is a problem with perceiving the volume of sound. If there is damage to the inner ear and/or the nerve fibers that carry the message to the brain, there is a different type of problem. In this case, perception of intelligibility as well as volume is impaired. Even if sounds are amplified, they still seem muffled. This damage is irreparable and cannot be medically treated. Some people with noise-induced hearing loss can benefit from the use of a hearing aid, but the aid can never provide normal hearing.

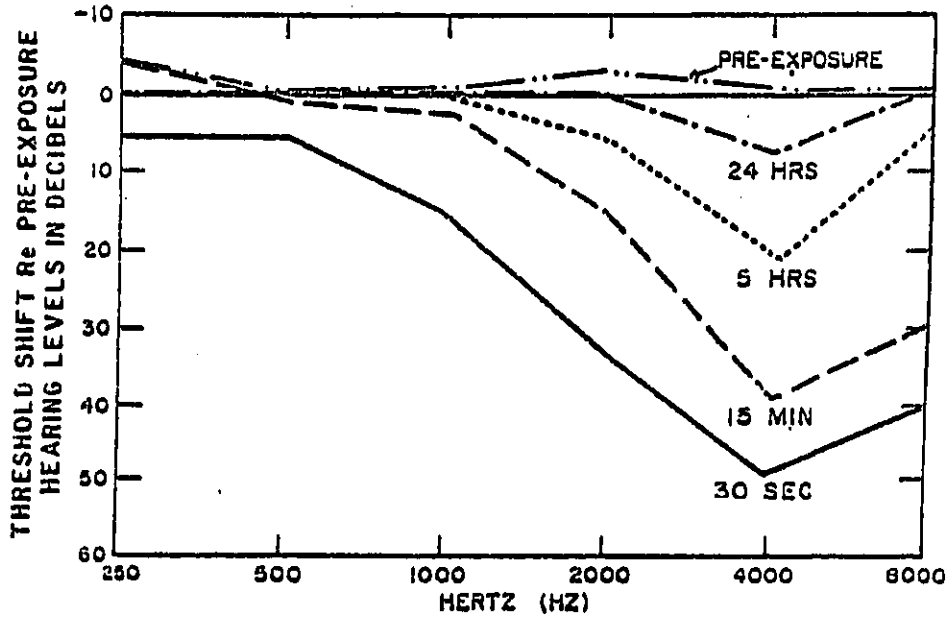
Hearing Loss. Hearing loss falls into two basic categories: conductive and sensorineural. Conductive hearing loss, which is not typically associated with noise exposure, is characterized by a limitation of the amount of sound energy traveling through the external and middle ear to the inner ear. This type of hearing loss can be caused by ear infections, perforated eardrums, defects in the middle ear, or blockages of the ear canal. While the outer and middle ear structures are rarely damaged by exposure to intense noise, explosive sounds or blasts can rupture the eardrum and possibly dislodge the tiny bones of the middle ear.

The other type of hearing loss, sensori-neural, is caused in the inner ear by damage of the hair cells which produce the neural impulses to the brain. Since excessive noise exposure injures the hair cells of the inner ear, noise-induced hearing loss is normally of this type. No treatment has yet been discovered to correct or alleviate this impairment.

Noise-Induced Hearing Loss (Permanent or Temporary). Loss of hearing may at first be only temporary. Temporary hearing loss, usually called TTS, can be produced by brief exposures to high level sound, after which hearing gradually recovers with a sufficient period of quiet time. TTS is greatest immediately after exposure to noise and progressively diminishes with increasing time in a quiet environment, a phenonemon which reflects the ear's recovery from apparent noise overstimulation. Figure III-2 illustrates the effects of exposure to high noise levels and the gradual recovery of hearing with time.

After prolonged noise exposure, the ear may not fully recover its hearing capacity, and hearing loss then becomes permanent. As a general rule, noise capable of causing significant TTS with brief exposures is probably capable of causing significant permanent losses in hearing under conditions of prolonged or recurrent exposure. Daily exposure for several hours per day for months or years to noise that produces TTS poses a risk of permanent hearing loss. The ear is not likely to recover full hearing capacity with recurrent exposures of this type. Since individual sensitivities to noise vary widely, the point at which TTS becomes permanent cannot be predicted.

The most significant permanent hearing loss, induced by steady state noise occurs first in the high frequency range, most prominently at 4000 Hz. Since high frequency sounds above the 6000 Hz range are relatively insignificant



Source: U. S. Department of Health, Education, and Welfare, Public Health Service, Cincinnati, Ohio.

FIGURE III-2

HEARING LEVELS MEASURED AT VARIOUS TIMES AFTER A TWO-HOU EXPOSURE TO A BROAD-BAND NOISE AT 103 dB AS COMPARED WITH PREEXPOSURE DETERMINATIONS

with respect to speech reception, decreased sensititivy to these sounds may not be recognized as much by the hearing-impaired individual. With increasing years of exposure, however, the losses multiply and broaden to include other lower frequencies.

Usually the noise-induced hearing loss appears in the higher frequencies, those above 2000 Hz, making it difficult for a person to hear certain sounds. Since most of the intelligibility of speech lies in the consonants rather than in the vowels, and the sound energy of consonants is higher in frequency and lower in volume than the vowels, people with noise-induced hearing loss characteristically have difficulty understanding speech.

Occupational Noise-Induced Hearing Loss. The relationship between occupational noise exposure and hearing loss cannot be reviewed or studied properly without briefly addressing the effects of continuous (or steady state) noise and impulse noise of hearing loss. Comments addressed to the Draft Environmental Impact Statement (DEIS) (Davis, Muir, and Myers - see Appendix B) agree that any action to regulate exposure to noise must consider both hazards.

Continuous noise. There is rarely a case where a worker is exposed to a constant noise level for 8 hours. Generally, the exposure level fluctuates in time. The higher the noise level, the more harmful the effects for a given exposure duration. It is necessary, therefore, to define safe limits for short duration exposures. Termed an "exchange rate," "time/intensity trade-off value" or "doubling rate," the noise level is allowed to be higher as the duration is decreased or interrupted. This relationship is best expressed in the following example. The current standard calls for an 8-hour TWA of 90 dB. If a worker is exposed to 95 dB, the time period of exposure

should not exceed 4 hours, or if the exposure is 100 dB, the duration should not exceed 2 hours. This relationship is a 5-dB exchange rate. This concept is based on the observation that noise interrupted on a regular or irregular basis is less hazardous to hearing than the same total duration applied continuously.

Another theory is that the auditory damage is a function solely of the total acoustic energy impinging on the ear. This is the equal energy theory and would require that the exposure time be reduced by a factor of two for each 3 dB increase in the noise level. This approach is called the 3-dB exchange rate, or the equal energy rule.

The 5-dB doubling rate specified by the present OSHA noise standard remains unchanged at this time, pending the results of further research and studies on economic and technological feasibility. The 5-dB rate for occupational exposures is based on the assumption that even short-duration industrial noise exposures are interrupted and that the interruptions are staggered uniformly throughout the exposure period. According to one noise expert, inconspicuous interruptions in what might appear to be a continous exposure--lunch, coffee breaks, washroom visits, and occasional stoppage of machinery--have an ameliorative effect.[6]

Impulse noise. The fact that impulse noise can be extremely damaging to hearing is widely supported in studies submitted to the record (Ex. 29, pp. 211-216, pp. 219-228, pp. 229-234; Ex. 30, Appendix G; Ex. 37 or Ex. 26-12 B; Ex. 279, 11-3 and 11-5). Although these studies suggest that there is no uniformly accepted definition of impulse noise, there are certain accepted parameters that are common to it. Impulse noise is characterized by a rapid rise time, high peak value of short duration, and a rapid decay. These sounds

may be divided into two general categories: A-duration impulses are of very short duration (usually measured in microseconds), and non-reverberant in that they usually occur outside or in a sound-deadening environment. An example would be gunfire outdoors or in a sound-treated firing range. B-duration impulses are of longer duration (usually measured in milliseconds) and are reverberant mainly because they occur inside where the sound is augmented by reflective surfaces. B-duration impulses are more typical of industrial conditions where the sounds of metal striking on metal, or short, high-level bursts of compressed air, are quite common. B-duration impulses are considerably more damaging to hearing than A-duration impulses of the same level because of the increased duration (Ex. 30, App. G, p. G-4).

There were a number of comments (see Appendix B - Davis, Muir, Myers) and exhibits in the record concerning impulse noise. Some were reports of studies, others were reviews of research on impulse noise, and others were discussions and recommendations for the standard.

In contrast to the studies of continuous noise discussed above, dose-response relationships for impulse noise were not so easily defined. In part, this may be due to the fact that the different studies of impulse noise varied considerably in such parameters as the model (human or animal), the effect (TTS or NIPTS) and the stimulus (level, rise time, A-duration, B-duration, etc.). Also, there appears to be more individual variability associated with response to impulse noise than there is with response to continuous noise (Ex. 29, p. 227).

Many of the investigators and witnesses concluded that the best way to describe the effects of impulse noise was an approach called the "equal energy" method or rule (Ex. 54, pp. 16, 17; Ex. 279, 11-3, pp. 444, 449;

Ex. 29, pp. 213-214; Ex. 321-21E, pp. 1-9; Ex. 80, App. B, p.3, Ex. 81A, p. 3). According to this approach, equal amounts of sound energy produce equal effects on hearing, even though they are distributed differently in time. This would imply a 3-dB doubling rate.

In summary, it is clear from examining the studies, reviews, and comments discussed above that the early criteria were developed using assumptions that are not generally applicable to industrial conditions. The studies on which they were based used A-duration (gunfire) impulses, even though they extrapolated to cover B-duration impulses, (Ex. 29, pp. 212-213; Ex. 16, p. 6; Ex. 30, App. G, p. G-6). In addition, the early studies of gunfire noise did not include moderate or high levels of continuous noise in the background, which is typical of the industrial situation (Ex. 294, p.1; Ex. 26-12B, p. 117). Since the early criteria were meant to apply to the military situation, they assumed only 10 to 20 exposures per year (Ex. 29, p. 214), whereas workers in industry often are exposed to impulsive noise on a daily basis.

When impulsive noise was combined with continuous noise, the studies and reports submitted to the hearing record showed fairly clearly that the hazard increased (Ex. 26-12B, p. 119; Ex. 29, pp. 221, 227). The study by Hamernik, et. al. (Ex. 26-12B, p. 119) showed an effect that was not just additive but synergistic. Field studies where impulses were superimposed on background noise indicated that hearing loss was exacerbated. Ceypek, et. al.(Ex. 29, p. 22) found considerably more damage than would be expected from continuous noise. Dr. Martin (Ex. 279, pp. 449, 432-444), through the results of his own investigation and by evaluating the data from studies by Guberan, et. al., Ceypek et. al., and Atherly, found that the best way to predict hearing loss

was to extend the equal energy rule from continuous through impulsive noise. The draft ANSI standard submitted by Col. Johnson (EX. 321-21 E, p. 1) supports this method for use in the U.S.

Therefore, OSHA has determined that impulse noise should be combined with continuous noise for purposes of calculating employee noise exposure. Since industrial impulses are almost always superimposed on a background of moderate-to-high levels of continuous noise (Ex. 6, p. 12338; Ex. 26-12B, p. 117; Ex. 29, p. 229, Ex. 29, p. 227; Ex. 30, p. G-8), and since both may be harmful, it is only reasonable to consider their effects together, rather than separately. There is ample justification for this approach in the studies and comments submitted to the hearing record (Ex. 26-12B, pp. 117, 121; Ex. 279, 11-3, p. 449; Ex. 29, p. 213; Ex. 80, App. B, p. 3; Ex. 81A, p. 3; Ex. 54, p. 16). However, since there are still some uncertainties as to the ameliorative effects of certain temporal patterns, (Ex. 26-12A, pp. 6-7, 10; HT VII, p. 1051; Ex. 26-12B, p. 120) and since there usually are some quiet periods (or less noisy periods) during the workday (Ex. 64-5, p. 2; Ex. 64-6, p.6; Ex. 6, p. 12338, Ex. 114, p. 7), OSHA has chosen to retain the 5-dB exchange rate for purposes of the hearing conservation amendment. Until such time as another method -- such as the equal energy rule (the 3-dB exchange rate) a combination of the 3-dB and 5-dB exchange rate (as suggested by Dr. Ward, HT VII, pp. 1042-1043), or an even more stringent rule is borne out by laboratory and field research -- OSHA will continue to require the integration of sound according to the 5-dB exchange rate.

Studies on Occupational Noise Exposure and Hearing Loss. OSHA reviewed the methods used by various researchers who have attempted to predict the relationship between occupational noise exposure and hearing loss, namely

Passchier-Vermeer, Burns and Robinson, Baughn, Johnson, and a NIOSH study by Lempert and Henderson, among others.

Passchier-Vermeer correlated the data of many different reports, thus providing a rather broad data base.[7] One weakness of this study is that the original study only provided 25th, 50th, 75th percentile hearing levels and neglected to address the more variant hearing levels found in the extremes of the population. However, in 1971 Passchier-Vermeer published additional data which included both the 10th and the 90th percentiles. Passchier-Vermeer's data also are quite valuable because they are presented for exposure levels of 75 dB, 80 dB, 85 dB, and 90 dB, and include hearing levels at frequencies from 500 Hz to 8000 Hz. Unfortunately, OSHA has little information on population screening techniques used, or audiometric test conditions in the studies that Passchier-Vermeer analyzed.

Burns and Robinson's method provides one mathematical relationship (the hyperbolic tangent) which is adjusted for the audiometric frequencies considered and the percentile levels used.[8] This method's strength is that it allows calculation of the predicted noise induced permanent threshold shift (NIPTS) for a wide variety of conditions. However, it is difficult to visualize how the hyperbolic tangent can be a true approximation to NIPTS for all frequencies and conditions. Nevertheless, Robinson's methodology is well-conceived and provides a useful method for estimating NIPTS empirically.

Baughn's data provide superior insight into how NIPTS develops at various percentile points, as well as at the median.[9] His study contains the largest sample size consisting of 6,835 screened workers ranging age from 18 to 68 years in an industrial plant. Also, Baughn's data provide the basis for the hearing loss predictions used by the ISO. Their weakness is that some

TTS may have been measured, since on occasion only 20 minutes of recovery time from noise exposure were allowed prior to audiometric testing. This limited recovery period would tend to make the measured NIPTS too high. The study was also critized because exposures as high as 78 dB were received by the control group so that they may also have had some hearing loss. This would tend to decrease the noise-induced component after the control group's hearing levels had been subtracted.

The NIOSH study described the hearing status of workers exposed to various industrial noise conditions and established a cause and effect relationship between noise exposure and hearing loss. Since the data were limited to exposures of 85, 90, and 95 dB, there were no hearing loss estimates for the exposures between 80 dB and 100 dB.

In an attempt to overcome some of the technical problems and minor discrepancies in determining a relationship between noise exposure from occupational sources and hearing loss, the Environmental Protection Agency (EPA), on the advice of Johnson,[10] averaged the data of Baughn, Burns and Robinson, and Passchier-Vermeer. The results of the data were used by EPA to strengthen their position on noise-induced hearing loss for the purpose of establishing criteria[11] and identifying safe levels of noise exposure.[12]

Recently, Johnson [13] provided a variety of calculations based on the combined data of Burns and Robinson (referred to only as "Robinson" by Johnson), and Passchier-Vermeer. OSHA has used these latter calculations to estimate the benefits of the hearing conservation amendment. According to Johnson, the studies of Passchier-Vermeer and Robinson were chosen mainly because of their completeness in depicting the effects of noise for various exposure times, levels, frequencies, and population percentiles. While they

are not without some technical criticisms, they are on the whole reasonable attempts to describe the effects of noise. For these reasons OSHA has chosen two data bases for computing the benefits of the amendment.

Although individually none of these studies are perfect, there is consensus among most professionals that the consistency of results, and the methods and controls used are reasons for relying on them as a data base.

In addition, OSHA has reviewed studies performed by other noted researchers such as Martin, Gibson, and Lockington and Berger, Royster and Thomas, and the authors of the Inter-Industry Noise Study (IINS) and found that these studies essentially supported the results of the larger studies described above.

The study performed by Martin, Gibson, and Lockington, related the degree of employee hearing loss to noise levels of 85 and 90 dB in industrial plants. The population consisted of 228 Canadian industrial workers ranging from 18 to 65 years of age who were screened to exclude non-occupational hearing loss. The study concluded that the risk of hearing loss increases significantly between 85 and 90 dB, leaving a portion of the population (up to 22 percent) unprotected by a noise exposure standard of 90 dB. [14]

A study of a North Carolina industrial population that had been exposed from 10 to 12 years to daily average noise levels of 89 dB was performed by Berger, Royster, and Thomas. They found that these exposures caused hearing losses at 4000 Hz which were compatible with the results of the studies cited earlier.[15]

The IINS authors measured noise and hearing levels of 348 industrial subjects. Noise exposures were between 82 and 92 dB for durations ranging from 3 years to greater than 30 years. The authors concluded that differences in hearing levels between the control and experimental populations were not

statistically significant at the frequencies 500, 1000, and 2000 Hz. Differences at 3000, 4000, and 6000 Hz were statistically significant for male subjects, but not for females.[16]

The IINS research report attracted some attention, including some adverse comments by EPA and the National Institute for Occupational Safety and Health (NIOSH). EPA stated that there were major technical problems in the design, administration and analysis, which included:

> 1) disproportionate samples and unequal noise exposure ranges,
> 2) overlaps in noise exposures, and
> 3) poorly matched comparisons between control and experimental subjects... Furthermore, the lack of adequate documentation on subjects' long-term noise exposures negates the appropriateness of any of the comparisons between groups. Such methodological problems raise serious questions concerning the technical appropriateness and usefulness of a number of the conclusions which were presented in the report.[17]

NIOSH also criticized the study by stating that:

> the results shown include only mean or average hearing level comparisons of noise exposed to control workers. While mean noise-induced hearing loss may or may not appear to be relatively significant, much more highly significant effects may be discerned when the full distribution of hearing loss components is presented. Indeed, the effects of noise exposure from 82 to 92 dB on workers had been found in previous studies to be significant for only a minority of the population as retirement age is approached....[18]

Having reviewed and reanalyzed the raw data, and using evaluation techniques developed for the 1972 criteria document, NIOSH reaffirmed that --- "exposure to 85 dBA should allow no more than an increase of 10 to 15 percentage points in the incidence of hearing impairment" relative to a non-noise exposed population.

After reviewing the studies and critiques, OSHA has determined that the findings of the IINS do not jeoardize those of the four major studies cited earlier.

In summary, a number of factors that complicate evaluations of hearing loss due to industrial noise have prevented investigators from defining a clear relationship between occupational noise levels and hearing loss. First, even under normal conditions, hearing sensitivity decreases with age. These losses, or presbycusis, are similar to those caused by excessive noise, since both conditions are marked by differentially greater losses at the higher frequencies. Consequently, it is often difficult to determine the amount of employee's hearing loss due to occupational noise exposure and the amount due to age. Hearing data for different age and sex groups with negligible noise exposure are often used to determine the aging component that must be considered in evaluating audiograms collected on noise-exposed employees.

Other causes of hearing loss besides noise and age include the use of certain drugs, illness and disease processes, and blows on the head. Special audiometric procedures are sometimes necessary to diagnose a given case of hearing loss in order to determine the likelihood that it may have been caused by excessive noise conditions rather than other factors, and the results are often inconclusive.

Even when there is a clear audiometric evidence of noise-induced hearing loss, questions may be raised as to whether such damage was produced entirely by workplace noise. It is apparent that off-the-job noise conditions in an increasingly urban society, particularly in a person's commuting and recreational activities, can themselves pose a risk of hearing impairment or can at least seriously impede the ability of the ear to recover from auditory fatigue

associated with on-the-job exposures. As a result, a degree of uncertainty is inherent in profiles of hearing loss compiled by studies based on audiometric testing results. In order to balance out these effects, most research studies of noise-induced hearing loss have statistically analyzed the hearing of noise-exposed occupational groups relative to that of similar worker groups not exposed to high level noise.

Extra-Auditory Effects of Noise

Noise, both in the environment and in the workplace, has been recognized as a major health hazard--one that can impair not only a persons' hearing but also his physical and mental well-being.

> Laboratory studies have shown that noise reduces efficiency on some tasks, can upset the sense of balance, and can cause blood vessels to constrict; raising blood pressure and reducing the volume of blood flow. It causes the eyes to dilate. Even when we are sleeping, noise can cause changes in electro-encephalograms and blood circulation without waking us. Noise can also cause fatigue, nervousness, irritability, hypertension and add to the overall stress of living.[19]

Speech Interference. The most demonstrable effect of noise on man is that it interferes with verbal communication. A noise that is not intense enough to cause hearing damage may still disrupt speech communication as well as the hearing of other desired sounds. Obviously, such disruption or "masking" will affect performance on those jobs that depend upon reliable speech communication.[20] Also, it can mean that the cry that would have stopped an on-the-job accident, or even death, might go unheard.

> In describing speech interference, the noise concerned can be defined either in terms of its specific spectrum and level or in terms of any number of summarizing schemes. In addition to the average A-weighted sound level, the two most generally used alternative methods of characterizing noises in respect to their speech-masking abilities are the articulation index (AI) and the speech interference level (SIL). The AI takes into account the fact that certain frequencies are more effective in masking than other frequencies. The SIL is more simplified, indicating only the average general masking capability of the noise.[21]

Since most speech is spoken at a reasonably constant level, it is possible to express many of the empirical facts about average speech communication in a single chart showing noise level, vocal effect, and distance as shown in Table III-1.[22]

It should be noted that various factors enter into the degree of speech interference. The characteristics of people (speech, age, hearing) affect communications. Children have less precise speech than adults. Older listeners are more susceptible to interference from background noise. Situational factors (athletic event, theater) influence the degree of speech interference. In some contexts, the predictability of the message will affect speech interference. Nonverbal communication and lipreading have the same effect. Spatial varibles also may facilitate or impede speech communication in noise. Finally, it must be remembered that the exact characteristics of the noise are also important for predicting speech communication.[23]

Performance. As previously mentioned, when a task involves auditory signals, whether speech or nonspeech, noise at any intensity may be sufficient to mask or interfere with the performance of the task. When mental or motor tasks do not involve auditory signals, the effects of noise on their performance have been difficult to assess.[24] In many instances, studies performed to show effects of noise on working efficiency or productivity have

TABLE III-1

MAXIMUM SPEECH INTERFERENCE LEVELS
FOR RELIABLE COMMUNICATION AT VARIOUS DISTANCES
AND VOCAL EFFORTS

Distance feet	Vocal Effort			
	Normal	Raised	Loud	Shout
0.5	76	82	98	94
1	70	76	82	88
2	64	70	76	82
4	58	64	70	76
8	52	58	64	70
16	46	52	58	64
32	40	46	52	68

Source: J.H. Botsford, "Noise Measurement and Acceptability Criteria," in The Industrial Environment--its Evaluation and Control, U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health (Washington, D.C.: Government Printing Office, 1973).

been inconclusive or unreliable. Research efforts have pointed out that there has not always been adequate control of all the numerous physical or psychological variables that may significantly influence performance.

Research efforts have shown that continuous noise levels above 90 dB appear to have potentially detrimental effects on human performance, especially on what have been described as noise-sensitive tasks such as vigilance tasks, information gathering, and analytical processes. Effects of noise on more routine tasks appear to be much less important, although cumulative degrading effects have been demonstrated by researchers. Noise levels of less than 90 dB may be disruptive, especially if they have predominantly high frequency components, are intermittent, unexpected, or uncontrollable. The amount of disruption is highly dependent on "...the type of task; the state of the human organism; and the state of morale and motivation."[25]

Finally, the effects of noise on performance does not usually influence the overall rate of work, but high levels of noise may increase the variability of the work rate. There may be "noise pauses or "gaps" in response, sometimes followed by compensating increases in work rate. Noise is more likely to reduce the accuracy of work than to reduce the total quantity of work. Complex or demanding tasks are more likely to be adversely effected than are simple tasks.[26]

It should be noted that the effects of noise on the performance of tasks has been studied in the laboratory and in the actual work situation, with somewhat more emphasis placed on laboratory research. Thus, there are particular needs for long-term studies in real-life situations.

Annoyance. Perhaps the most widespread reaction to noise is that it is annoying. "Annoyance by noise is a highly subjective phenomenon which

is very difficult to relate to the sound that causes it. Noises become more annoying as they get louder than the background noise on which they are superimposed. Noises that are unsteady or contain tones are most annoying as are those that convey unpleasant meaning."[27]

Whether annoyance types of noise conditions constitute a hazard to health is not known. However, it has been stated that individuals have developed hypertension, ulcers, undue anxiety, and nervous disorders as a result of exposure to annoying types of conditions. Since there was no health survey performed, the possibility that other physiological or psychological type disorders stemming from such noise conditions cannot be ruled out. However, these and other effects have not been convincingly verified.[28]

In any event, it is apparent that the annoying effects of noise are complicated by many acoustical and non-acoustical considerations. Models and measures for predicting noise annoyance are available, but require additional study.

Employee Absenteeism. Absenteeism appears to be higher among workers in noisy industries, whether from psychological aversion to noise or from the physiological consequences of noise stress or annoyance. A NIOSH-sponsored study performed by the Raytheon Service Company found significant differences in absenteeism between groups of workers exposed to noise levels above 95 dB and below 85 dB. Absenteeism in the high noise group was significantly decreased after the institution of a hearing conservation program.[29] Additional studies by Schmidt, et. al.,[30] and Gulian[31] also found significant differences in absenteeism as well as in accident records and employee turnover rates.

Biological Stress. A major concern about extra-auditory health effects from noise arises from the fact that noise under certain circumstances has the ability to act as a nonspecific biological stressor. The concept of biological stress, first introduced by Selye,[32] has been described as the nonspecific response of the body to any demand made upon it. This stress reaction produces a widespread change in bodily activity which causes an increase in blood pressure, intracranial pressure, perspiration, heart rate and respiration. Also, there may be a sharp constriction of the muscles over the whole body. These changes are likely to be mediated by increased adrenal secretion of the catecholamine hormones--epinephrine and nonepinephrine.[33]

In an attempt to explain the mechanisms by which these stress-related physiological changes can affect human health, two conceivable damage pathways were identified: abnormalities in blood pressure regulation that lead to hypertension; and increased blood platelet adhesiveness which accelerates development of atherosclerotic plaques in the walls of the arteries.

Hypertension. According to Welch,[34] intense industrial sound impairs the regulation of blood pressure, the most distinct manifestation of which is an increased prevalence of hypertension. Also, hypotension, or reduced blood level pressure, can result from noise stress. Both hyper- and hypo-tension are fundamental disorders of the circulatory system. They are characterized by exaggerated and inappropriate cardiac and vasomotor response to changes in body position or physical and psychological stimuli. This increase in vascular lability (or changeability) under noise stress affects the circulatory adjustments that must normally be made during the course of a working day. For those who already have impaired circulation, excessive vascular lability

can lead to congestive heart failure, cardiac ischemia, or cardiovascular stroke. It has been established that hypertension, even at moderate elevations, is associated with increased risk of coronary and cerebrovascular disease.

Increase in the Adhesiveness of Blood Platelets. According to Hattis, et. al.,[35] an increase in the adhesiveness of blood platelets has clear potential for negative side effects, due to an increased tendency for the formation of thrombi, small aggregates of platelets and other blood components involved in the clotting process. The thrombi contribute to the buildup of atherosclerotic plaques which gradually narrow the innner walls of the arteries and reduce the oxygen supply to vital tissues. A heart attack can occur when there is complete blockage of an artery to the heart muscle or when the demand for oxygen is greater than that which can be supplied through the narrowed coronary arteries. These effects can be cumulative, because the same thrombi that contributed to a gradual narrowing of the arteries can complete the sequence by forming an occlusion leading to tissue death in the heart.

Cardiovascular Effects. In an epidemiological study of German iron and steel workers, Jansen[36] concluded that noise interferes with involuntary bodily functions, and as such could be a serious health risk. He found that 62 percent of the workers exposed to noise levels above 90 dB had "peripheral circulatory symptoms" compared to 48 percent of those exposed to lower levels. Physiological and psychological examinations were included to determine the extent to which the difference could be caused by non-occupational factors.

In an analysis of over 40 studies from European and Soviet block nations of the effects of noise exposure on the cardiovascular system, Welch[37] found evidence of noise-induced structural changes in the heart, increased

cardiac morbidity, cerbrovascular and peripheral vascular disorders, and hypertension. Although many of these studies had methodological problems, Welch believed that approximately half of them presented data in a statistically verifiable manner. Viewed as a whole, these studies represent a consistent body of data containing significant evidence that noise levels greater than 90-95 dB may increase the risk of cardiovascular disease in exposed workers. He concludes that:

> In a practical sense, the available evidence now demands that prolonged exposure to high intensity sound be viewed in a much broader sense than heretofore as a serious threat to the general human health. The evidence for associating long-term sound exposure with cardiovascular disease, in particular, is comparable to that for associating it with loss of hearing.[38]

In another analysis concerning the recent development in research on the extra-auditory effects of noise, Peterson also found the largest body of evidence centered around the relationship between prolonged exposure to intense noise and cardiovascular performance. The most common occurrence is one of impaired regulation of blood pressure, which may be manifested either as hypotension or hypertension. Other signs and symptoms that are said to occur more frequently in noise exposed workers are abnormalities in cardiac pacing, reduced stroke volume, various electrocardiogram (EKG) abnormalities, and narrowing of retinal arteries. As a result of life-like exposure scenarios averaging 85 dB for 9 months, Peterson, using rhesus monkeys in his own laboratory study of the effects of protracted noise exposure found significant alterations in blood pressure that were sustained even after cessation of the stimulus.[39]

In an attempt to quantify the risk of the cardiovascular system associated with exposure to noise levels averaging 95 dB, Ising and coworkers in a study of German brewery workers, used each individual as his own control by comparing various cardiovascular indicators with and without the use of hearing protectors to attenuate noise exposure.[40] Ising concluded that on days when people worked without hearing protection there was a significant elevation in systolic blood pressure, changes in arterial wall elasticity, and increased levels of catecholamine hormones excreted in the urine.

Despite the quantity of data, precise dose-response relationships are not available for the cardiovascular effects of noise.

Neurological Effects. In his analysis, Welch [41] discusses neurological changes assumed with long-term exposure to occupational noise. Welch found that the sense of balance can be altered, that reaction time is impaired, and that there is decreased tactile sensitivity in the hands and feet. Cohen and Anticaglia[42] suggest that noise-induced neurological changes may occur as a result of overstimulation of the brain's reticular formation, leading to a state of reflex hyperactivity and abnormal electroencephalogram (EEG) response. The authors noticed that laboratory subjects complained about feelings of disorientation after exposure to high levels of noise. Studies cited by Gulian[43] support this observation with factory workers as well. Apart from possibly increasing the chance of an accident in some situations, there are no clear indications that the effects will cause permanent damage.

Other Extra-Auditory Effects. In addition to the effects mentioned above, researchers have found evidence of respiratory, allergenic, musculo-skeletal, and glandular disorders. In a study of medical records, the Raytheon Service Company investigators found that over a period of 5 years the number

of diagnosed disorders in every category was significantly higher for workers exposed to high noise levels than it was for those exposed to low noise levels.[43] Noise can interfere with sleep and may cause fatigue, irritability, insomnia, and pupillary dilation. Although several hypotheses exist, there is no concrete evidence that these reactions can lead to harmful long-term consequences as a result of workplace noise.

Conclusion

This chapter presented a brief analytical review of the health effects associated with exposure to noise. New research is going on to understand more about these effects, but it is apparent that loss of hearing is only the most obvious in a long line of noise-related illnesses. There is growing concern that other serious physical difficulties may be caused or aggravated by excessive noise exposure. Researchers have reported a relationship between exposure to excessive noise over a period of time and the incidence of heart disease, cardiovascular dysfunction, gastrointestinal disorders, and allergies as well as endocrine and metabolic effects. Noise also causes psychological effects. Studies show that noise may cause nervousness, fear, speech interference and psychosomatic illness, as well as disruption of rest, relaxation, and sleep. All of these effects can seriously interfere with employee performance and employer cost, resulting in absenteeism, high turn over, accidents, deaths, and decreased productivity.[44]

REFERENCES

[1] T. Anticaglia, "Physiology of Hearing," The Industrial Environment--its Evaluation and Control, U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health (Washington, D.C.: Government Printing Office, 1973), p. 318.

[2] Ibid., p. 309.

[3] Exhibit 26-3 - Environmental Protection Agency, Public Health and Welfare Criteria for Noise, Office of Noise Abatement and Control, 550/9-73-002, U.S. Government Printing Office, Washington, D.C., July 27, 1973, pp. 10-1 through 10-7.

[4] T. Anticaglia, p. 309.

[5] Exhibit 96 - Anticaglia, J. R. and Cohen, A., "Extra-Auditory Effects of Noise as a Health Hazard," American Industrial Hygiene Association Journal, 31 (May-June, 1970): 277.

[6] J.H. Botsford, "Simple Method for Identifying Acceptable Noise Exposures," Journal of the Acoustical Society of America, 42 (November 1967).

[7] W. Passchier-Vermeer, Hearing Loss Due to Exposure to Steady State Broadband Noise, Report No. 35, (The Netherlands: Institute for Public Health Engineering, 1968).

[8] D.W. Robinson, The Relationship Between Hearing Loss and Noise Exposure, National Physical Laboratory Aero Report Ae 32 (England, 1968).

[9] W.L. Baughn, "Relationship Between Daily Noise Exposure and Hearing Loss Base on the Evaluation of 6,835 Industrial noise Exposure Cases," Joint EPA/USAF Study, June 1973.

[10] Exhibit 17 - Daniel L. Johnson, "Prediction of NIPTS Due to Continuous Noise Exposure," Aerospace Medical Research Laboratory Report, 73-91 AMRL-TR (EPA Report #EPA - 550/9-73-001-8) July 1972, p. 2.

[11] Exhibit 26-3 - EPA, Public Health and Welfare Criteria for Noise, pp. 10-1 through 10-7.

[12] Exhibit 30 - U.S. Environmental Protection Agency, "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety," March 1974, p. C-5.

[13] Exhibit 310 - Col. D. Johnson, "Derivation of Presbycasis and Noise Induced Permanent Threshold Shift (NIPTS) to be Used for the Basis of a Standard on the Effects of Noise on Hearing", Publication No. AMRL-TR-78-128 (Wright-Patterson Air Force Base, Ohio: Aerospace Medical Research Laboratory, U.S. Department of the Air Force, September 1978).

[14]Exhibit 36 - R. H. Martin, et.al., "Occupational Hearing Loss Between 85 and 90 dBA," Journal of Occupational Medicine, 17 (January 1975).

[15]Exhibit 266A - E.H. Berger, L.H. Royster, and W.G. Thomas, "The Effects of Noise Exposure on One Industrial Population" (New York: The Rockfeller Foundation, October 1976).

[16]Exhibit 304 - R. Yerg, Sataloff, A. Glorig, and H. Menduke, "The Effects upon Hearing of Steady State Noise Between 82 and 92 dBA," Journal of Occupational Medicine, 20 (May 1978): 351-358.

[17]Exhibit 321-16 C. I. Elkins -, EPA.

[18]Exhibit 321-36, - W. H. Parr, Ph.D, National Institute for Occupational Safety and Health, Department of Health Education and Welfare Human Services. p. 4.

[19]J. H. Botsford, "Noise Measurement and Acceptability Criteria," in The Industrial Environment - its Evaluation and Control, U.S. Department of Health, Education and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health (Washington, D.C.: Government Printing Office, 1973).

[20]A. D. Hosey, and C. H. Powell,eds., Industrial Noise A Guide to Its Evaluation and Control, PHS Publication No. 1572. U. S. Department of Health, Education, and Welfare, Public Health Service, Bureau of Disease Prevention and Environmental Control, National Center for Urban and Industrial Health Occupational Health Program (Washington, D.C.: Government Printing Office, 1967), p. N-4-9.

[21]Exhibit 26-3, EPA, Public Health and Welfare, pp. 6-10.

[22]J. H. Botsford, p. 330.

[23]Exhibit 26-3, pp 5-7, 8, 9, 10, and 11.

[24]J. C. Webster, "Effects of Noise on Speech Intelligibility," in Noise as a Public Health Hazard, ASHA Report No. 4, (Washington, D.C.: American Speech and Hearing Association, 1969).

[25]Exhibit 26-3, pp. 8-6 and 8-7.

[26]Ibid., p. 8.

[27]J.H. Botsford, p 330.

[28]A.D. Hosey and C.H. Powell, p. N-4-110.

[29]Exhibit 26-11 - Raytheon Service Company, "Effects of a Company Hearing Conservation Program on Extra-Auditory Problems in Workers," Final Report on Contract CDC-99-74-28 for the U. S. Department of Health, Education, and Welfare Public Health Service, Center for Disease Control, National (Burlington, Mass. Raytheon, May 1975), p. 3-172.

[30]Exhibit 321-22F.

[31]Exhibit 97 - E. Gulian, "Noise as an Occupational Hazard: Effects on Performance Level and Health--A Survey of Findings in the European Literature," University of Bucharest. Submitted by Dan MacLeod, United Auto Workers.

[32]Exhibit 26-9 - D. C. Broadbent, "Effects of Noise on Behavior," ed. C.M. Harris: Handbook of Noise Control, (New York: McGraw-Hill, 1957), p. 10-8.

[33]Exhibit 138A - N. A. Ashford, et al., "Some Considerations in Choosing an Occupational Noise Exposure Regulation", submitted by Ashford, MIT.

[34]Exhibit 321-16E - Bruce L. Welch, Extra-Auditory Health Effects of Industrial Noise: Survey of Foreign Literature. Prepared for the Aerospace Medical Research. Laboratory, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio (Woodbridge, Conn: Welch Associates, 1979), pp. 1-11.

[35]Exhibit 138A, N. A. Ashford, pp. 2-40.

[36]Exhibit 98 - Von Gerd Jansen, "Adverse Effects on Noise in Iron and Steel Workers, Stahl v. Eisen," Vol. 81, February 1961, pp. 217-220.

[37]Exhibit 321-16E, Bruce L. Welch, p. 37.

[38]Ibid.

[39]Exhibit 321-16D - Ernest A. Peterson, "Some Issues and Investigations Concerning Extra Auditory Effects of Noise," paper presented at the Symposium on Non-Auditory Effects of Noise, the American Psychological Association, New York, September 1979, p. 1.

[40]H. Ising, T. Gunther, C. Havestadt, Ch. Krause, B. Marhert, H.V. Melchert, K. W. Tietze, "Final Report on the Research Project Study on the Quantification of Risk for the Heart and Circulatory System Associated with Noise Workers" under contract with the Federal Institute for Occupational Protection and Accident Research, Project No. 223. 212-497.2, n.d.

[41]Exhibit 321-16E, Bruce L. Welch, p. 31.

[42]Exhibit 96 - J. R. Anticaglia, and A. Cohen, "Extra-Auditory Effects of Noise," pp. 277-278.

[43]Exhibit 97, Guilan, pp. 38-39.

[44]Exhibit 26-11, Raytheon.

[45]U. S. Department of Labor, Occupational Safety and Health Administration, "Noise - The Environmental Problem, A Guide to OSHA Standards," (Washington, D.C.: Government Printing Office, 1972).

IV. DESCRIPTION OF THE HEARING CONSERVATION AMENDMENT

This chapter describes the hearing conservation amendment to the current noise standard, (29 CFR 1910.95). The preamble to the final regulation will discuss changes to the proposal resulting from the comments and testimony presented at the hearings and from reevaluations by OSHA based on the record. The full text of the proposal may be found in Appendix A of this Final Environmental Impact Statement (FEIS).

Application

This amendment will be applicable to all employers engaged in business in general industry who have one or more employees. It will not effect construction or agricultural operations.

The Amendment - Hearing Conservation Requirements

OSHA intends to regulate employee exposure to noise by issuing hearing conservation requirements as an amendment to the current standard. The amendment clarifies and strengthens the existing requirements for "a continuing effective hearing conservation program" while engineering controls are being implemented, and in cases where engineering controls are infeasible.

When to Implement The Program

A continuing, effective hearing conservation program shall be administered when employee noise exposure equals or exceeds an 8-hour time-weighted average (TWA) of 85 decibels (dB), without regard to the use of personal hearing protections.

Permissible Exposure Limit (PEL)

The current standard on occupational noise exposure limits an employee's exposure to 90 dB, as an 8-hour TWA. OSHA has deferred a final decision on

the PEL until further empirical data and information are available on the health risks, feasibility, and necessity of a lower requirement. OSHA believes that the present level, when coupled with a stringent hearing conservation program beginning at 85 dB, will reduce the risk of material impairment substantially during the period of further consideration.

Another consideration in determining the PEL is the appropriate exchange rate. This rate is the amount by which the exposure level may be increased when exposure time is decreased. For example, the 5 dB doubling rate incorporated in the present standard and continued in the amendment would allow an exposure of 85 dB for 16 hours; 90 dB for 8 hours; and 95 dB for 4 hours.

Controls

The current standard states that feasible engineering and administrative controls shall be used to reduce noise exposure to within permissible levels. If such controls are not feasible or cannot reduce the sound levels to within permissible limits, then personal protective equipment shall be used to achieve compliance with the standard. The amendment leaves these requirements unchanged for the present time.

Monitoring and Measurement Requirements

Although the current standard requires exposures to be controlled to within specified limits, it does not explicitly require monitoring of the individual employee's noise exposure. This amendment makes monitoring and measuring requirements explicit. It requires the employer to determine if any employee is exposed to an 8-hour TWA of 85 dB or above. If any employees are so exposed, the employer must identify such employees and measure their

exposure. Noise exposure monitoring must be performed at least every 2 years and within 60 days of any change in process that causes employee exposure to be above the 85 dB TWA, or that is significant enough to make their ear protectors inadequate. (To enable small businesses to comply more easily with the standard not only do certain provisions have a phased-in implementation period but the exposure monitoring requirements have been relaxed from annual to biennial in most cases.)

In cases where the members of an employee group are engaged in a similar kind of work and have approximately the same noise exposure, the employer has the option of monitoring only one member (who is believed to have the greatest exposure) of the group. This employee's exposure must be attributed to the other members of the group.

Within 21 calendar days after the exposure monitoring, the employer shall notify in writing each affected employee of the measurements of that employee's noise exposure or the representative noise exposure. The employer shall provide an affected employee or the employee's representative an opportunity to observe (without interfering with the monitoring) any measurements of employee noise exposure conducted pursuant to the standard. Notification should be given in advance if possible. The amendment also describes the minimum acceptable accuracy for monitoring instruments.

Audiometric Testing Program

Due to the wide variation in susceptibility to hearing loss from noise, it is not possible to determine a sound level exposure which will prevent all hearing loss in all members of an exposed population. The amendment requires a hearing conservation program that includes audiometric testing which will prevent, or at least minimize, permanent noise-induced hearing loss by identifying those workers especially susceptible to noise. Audiometric testing will be

done annually for all employees with 8-hour TWA noise exposures of 85 dB or higher with the exception of workers who are employed for a period of 120 consecutive days or less.

The testing program must provide each employee with a baseline audiogram against which the employee's subsequent hearing acuity can be measured. If comparison of the annual or recheck audiogram to the baseline audiogram indicates a significant permanent threshold shift, employees not using hearing protectors shall be fitted with hearing protectors, trained in their use and care, and required to use them. Employees already using hearing protectors shall be refitted and retrained in their use, and required to use them. If the employer determines that a permanent significant threshold shift is work-related, this fact must be entered on the OSHA Form 200.

Baseline and recheck audiograms shall be preceded by a period of at least 14-hours free from workplace noise. The employer shall notify the employee of the need to avoid high levels of noise exposure during this period. Hearing protectors may not be used to comply with the requirement for 14-hours free from workplace noise.

Audiometric tests shall be administered by an audiologist, otolaryngologist, other licensed physician, or certified audiometric technician. The equipment used shall meet the specifications of, and be maintained and used in accordance with, the American National Standard Institute's Specification for Audiometers ANSI S3.6-1969.

Hearing Protectors

Employers must provide hearing protectors to employees exposed to a TWA between 85 and 90 dB, but their use is optional except when employees incur a significant threshold shift in hearing. Employees exposed to noise levels

above 90 dB must wear ear protectors. The employer is responsible for purchasing a variety of hearing protectors, giving employees a choice of protectors, for the initial fitting, and for training in the use and care of these devices.

When an employee wears personal protective equipment because of a significant threshold shift, the personal protective equipment must attenuate employee exposure to or below an 8-hour TWA sound level of 85 dB. The employer must evaluate hearing protector attenuation.

OSHA does not believe that hearing protectors constitute a satisfactory final solution to the noise problem. Employees do not like to wear hearing protectors that can be uncomfortable and that do not always provide the attenuation desired. However, effective use of hearing protectors can reduce the level of noise reaching the eardrum. When coupled with noise monitoring, audiometric testing, and worker training and education, the incidence of hearing loss among new employees will decline and existing impairments are likely to stabilize.

Training Programs

Employers shall provide employees whose exposures equal or exceed a TWA of 85 dB with an annual training program that covers the purposes and major components of the hearing conservation program. Employers also have the responsibility of making pertinent material and information available to employees. They must further assure that each employee is informed of the content of the noise standard and the hearing conservation amendment, of the effects of noise, of the use and care of hearing protectors, and of the purpose of audiometric testing.

Warning Signs

The hearing conservation amendment requires that clearly worded signs be posted at entrances to or on the periphery of all well-defined work areas in which employees receive noise exposures exceeding an 8-hour TWA sound level of 85 dB.

Recordkeeping

The maintenance of records indicating the results of the required measuring monitoring, calibrating of instruments, and audiometric testing is required. Employers are required to retain employee noise monitoring and audiograms for the duration of employment plus 5 years, and noise monitoring records for 2 years; retention of other records is required for 5 years.

In addition, the proposal implements the requirements of section 8(c)(30) of the Act (84 Stat. 1599, 29 U.S.C. 657), which concerns, among other things, employee access to monitoring records.

Effective Date

These requirements become effective 90 days after the amendment is promulgated. However, compliance requirements for audiometric test rooms and for dosimeters become effective in 2 years, initial baseline audiograms in 1 year, and initial monitoring 180 days after the effective date.

V. PROJECTED ENVIRONMENTAL IMPACTS OF THE HEARING CONSERVATION AMENDMENT

Introduction

Some comments to the Draft Environmental Impact Statement (DEIS) indicated that the data cited in the DEIS tended to underestimate the probable environmental impacts of the proposed noise standard. (See Appendix B - Anderson, ANPA/RA, Barrows, Cromwell, Davis, B., Davis, L., Doremas, Grant Grimes, Muir, Myers, Pennington, Watts.) The amendment to the current noise standard establishes hearing conservation requirements. These requirements are designed to increase employee protection in addition to that provided by the current standard while OSHA continues to study the implications of noise exposure. Therefore, this chapter will discuss what is considered to be the most significant projected environmental impacts as a result of the promulgation of the hearing conservation amendment and will respond, as appropriate, to those comments and suggestions relevant to this amendment. (See Appendix B for a detailed description of these comments.)

OSHA regulatory actions have their most significant impacts on that aspect of the environment which is under the Agency's direct jurisdiction, i.e., the workplace and on the health and safety of employees in the workplace. In the past, these impacts have been beneficial to the workplace environment, because they have reduced employee exposure to identified and potential health hazards. The amendment to the current noise standard would result in continuing improvements to this workplace environment.

An OSHA standard for control of occupational exposure to noise also has the potential for both direct and indirect impacts on the general human environment external to the workplace. Impacts to the external environment

that have resulted from previous regulatory activities have varied depending on a number of factors, including engineering controls, suitable substitutes, and permissible exposure levels (PEL's). In the case of the hearing conservation amendment, effects on the general human environment include potential benefits to public health and various economic impacts. In addition, the potential for effects on existing environmental conditions (air pollution, water quality, geology, etc.) and any irreversible and irretrievable commitment of resources (medical manpower, material, equipment, etc.) which would be involved as a result of employer implementation of the amendment, are also considered in this chapter. With the exception of the potential effects on worker health, however, none of the projected environmental impacts of the amendment are expected to be significant.

The Internal (Workplace) Environment

The major impact of the amendment will be an improvement in the quality of life for U.S. workers through a sizable reduction in the incidence of occupational hearing loss, which can damage the social relationships of impaired workers by hindering their ability to communicate with other workers, their families, and their friends. Moreover, families and friends will no longer need to endure the difficulties and hardships experienced by those who associate with impaired workers. In addition, possible declines in the number of workplace accidents and in the incidence of cardiovascular disease following the implementation of the amendment will also improve the quality of worker lives. These improvements in the quality of life provide the major justification for this amendment.

The amendment will also create financial benefits for employers, stemming from reductions in worker absenteeism and medical costs, which will partially offset the costs of the amendment. Employers will profit by the decline in workers' absences, while workers will benefit from the reduction in personal medical costs. Consumers and taxpayers as a whole will gain from a reduction in the societal subsidy to medical costs. These financial benefits furnish additional support for the amendment.

The amendment will also lead to a more equitable distribution of the costs and benefits of industrial production. Currently, one undesirable side effect of industrial production is the loss of hearing ability among a substantial number of workers. Although workers bear this cost of industrial production, the benefits of this production are shared by firms, stockholders, and consumers. One traditional principle of distributional equity is that those who benefit from an activity should share in its costs. In order to prevent occupational hearing loss, implementation of the hearing conservation amendment will impose compliance costs on firms. Depending on the particular economic circumstances of these firms, these costs may be passed on to consumers or borne by stockholders. In both cases, most workers will no longer bear the cost of occupational hearing loss, while those who share the benefits of industrial production will share the costs of preventing that loss.

Moreover, the benefits of the reduced incidence of occupational hearing loss will be experienced to a greater extent by poorer and lesser educated workers who often have little choice except to work in the noisiest and least healthful jobs. Evidence derived from a U.S. Public Health Service Survey and presented by the Center for Policy Alternatives,[1] shows that for every age group, those of lower educational attainment have a higher risk of hearing

impairment than those with higher levels of education. Thus, the reduced incidence of occupational hearing impairment will more proportionately benefit those with fewer material resources.

Hearing Impairment Prevented. The methodology used in determining the estimated benefits is derived from a study by the Center for Policy Alternatives (CPA) as well as from other evidence contained in the record. In order to use information recently made available, OSHA has decided to revise and update the calculation of the benefits of the hearing conservation amendment. OSHA's calculations use the noise exposure distribution developed by Bolt, Beranek, and Newman in 1975 since it is the best available evidence on occupational noise exposures (see Table V-1). The analysis is based upon the dose-response data provided by Johnson.[2] Sound frequencies averaged over 1000, 2000, and 3000 Hz, were used to define hearing impairment.

The benefits of hearing conservation programs are described here by presenting (1) the number of persons prevented from incurring hearing impairment at any one point in time up to 70 years after the hearing conservation programs are implemented, and (2) the number of person-years of impairment prevented over the 70-year period. The 70-year period is used because persons in the current work force will only gain a limited benefit from this hearing conservation amendment since many have already suffered noise-induced hearing loss.

Although the benefits of preventing occupational hearing impairment are not fully realized until equilibrium is reached, benefits will accrue during the period prior to equilibrium. As the work force approaches the

Table V-1

NOISE EXPOSURE DISTRIBUTION

Exposure Level (db)	Percent
less than 80	46.88
80-85	18.74
85-90	15.06
90-95	10.98
95-100	5.47
100+	2.87
Total	100.00

Source: Bolt, Barenek, and Newman, Inc., Economic Impact Analysis of Proposed Noise Control Regulations. Prepared for the U.S. Department of Labor Occupational Safety and Health Administration, under Contract No. DOL-3-0-F-6-0019 (Cambridge, MA: BBN, 1076), p. 2-11.

equilibrium level of hearing impairment, the number of workers prevented from having a hearing impairment and the number of years they are free of impairment will increase. In order to describe this, the number of impairments prevented 10, 20, 30, and 40 years following implementation were calculated. These benefits are called the interim benefits of the hearing conservation programs. Once the interim benefits were computed, it was a simple matter to develop estimates of the accumulated number of person-years of impairment prevented over the 70-year period following implementation of the hearing conservation amendment. The BBN estimates of exposures and numbers of impairments to be avoided were criticized in comments on the DEIS. Therefore, OSHA has reestimated benefits from the standard. (A complete discussion of OSHA's methodology in calculating the number of hearing impairments prevented by hearing conservation programs is presented in the benefits section of the Regulatory Analysis and in the Preamble.)

The benefits of the amendment will primarily accrue to future populations of workers, slowly reducing the number of impairments in future populations until equilibriut is reached in 70 years. In each of these years, the pool of hearing impairments (based on a 25 dB fence) in the population at any one time that would have existed if there were no hearing conservation programs remains constant at 1,060,000. Ten years after itplementation of the final amendment there will be 848,000 persons across the 25 dB fence; in 20 years, 583,000; in 30 years, 364,000; in 40 years, 261,000; and at equilibrium in 70 years, 162,000 (Table V-2). Hearing conservation programs are expected to reduce the pool of material impairments of hearing (25 dB fence) by 212,000 for the 10th year after implementation; 477,000 for the 20th year; 696,000 for the 30th year; 799,000 for the 40th year; and 898,000 for the 70th and subsequent years (equilibrium) (Table V-3). The reduction of 898,000 impairments at any one time after the establishment of equilibrium represents 84.7 percent of the pool of occupational impairments that would have occurred without the hearing conservation amendment.

TABLE V-2

NUMBER OF HEARING IMPAIRMENTS*
70 YEARS AFTER IMPLEMENTATION (EQUILIBRIUM LEVEL)
(Millions)

Regulatory Alternative	15 dB fence		25 dB fence		40 dB fence	
	Total Number	Occupational Cause**	Total Number	Occupational Cause**	Total Number	Occupational Cause**
No Hearing Conservation Program	5.598	1.624	2.876	1.060	.934	.473
90 dB Regulatory Alternative	4.649	.675	2.167	.351	.597	.136
85 dB Regulatory Alternative	4.285	.321	1.978	.162	.520	.059
80 dB Regulatory Alaternative	4.099	.125	1.879	.063	.484	.023

Source: OSHA, Office of Regulatory Analysis.

*Number of persons with hearing threshold levels $\geq$ 15, 25, and 40 dB average at 1000, 2000, 3000 Hz.

**Occupational Cause = Total number minus number that would normally occur due to presbycusis. For 15 dB, presbycusis equals 3.974 million; for 25 dB, 1.816 million; for 40 dB, .461 million.

TABLE V-3

HEARING IMPAIRMENTS PREVENTED BY THE HEARING CONSERVATION AMENDMENT

	Years After Implementation				
	10	20	30	40	Equilibrium
Number of Impairments Prevented					
15 dB Fence	-	-	-	-	1,303,000
25 dB Fence	212,000	477,000	696,000	799,000	898,000
40 dB Fence	-	-	-	-	412,000
Accumulated Person-years of Impairment Prevented					
25 dB Fence	1,060,000	4,505,000	10,370,000	17,848,000	43,300,000

Source: OSHA, Office of Regulatory Analysis.

OSHA calculated the number of individuals with hearing impairments at any one time after the establishment of equilibrium for the two other fences--15 dB and 40 dB. These calculations reveal that without a hearing conservation program, 1,624,000 people will be cross a 15 dB fence, and 473,000 will be across the 40 dB fence due to occupational noise exposure. The final amendment will reduce these pools of impairment to 321,000 across the 15 dB fence, and 59,000 across the 40 dB fence (Table V-2). Thus the final hearing conservation programs will reduce the pool of persons across the fences by 1,303,000 for the 15 dB fence, and 412,000 for the 40 dB fence (Table V-3), reductions of 80.2 percent and 87.1 percent, respectively.

Finally, the number of person-years of impairment prevented can be calculated. In the 70 years following implementation of the final amendment, the total accumulated person-years of prevented material impairment is 43.3 million. The pattern of this accumulation is presented in Table V-3.

Full compliance with this amendment will have substantial benefits. Partial compliance will also provide benefits, although not to the same extent. As illustrated in Table V-4 if all workers exposed to levels $\geq$ 85 dB wear hearing protectors, if they receive 15 dB attenuation, and if they wear hearing protection every day they are exposed to noise, then the total pool of occupational hearing impairment 70 years from today will be reduced by 898,000 persons. But if only 50 percent of workers exposed above 85 dB receive 10 dB attenuation and the remaining 50 percent do not wear ear protection then the reduction in the number of impairments declines by about 58 percent to 381,000. The effectiveness of this protection is therefore very dependent on the attenuation that hearing protectors provide and their daily use over a working lifetime.

TABLE V-4

SENSITIVITY ANALYSIS FOR ASSUMPTIONS ON HEARING PROTECTOR USE AND ATTENUATION

Assumption	Number of Occupational Impairments Prevented*
100% of workers required**wear hearing protectors and receive 15 dB attenuation	898,000
100% of workers required**wear hearing protectors and receive 10 dB attenuation	759,000
50% of workers required**wear hearing protectors and receive 10 dB attenuation	381,000
No hearing protector use	0

Source: OSHA, Office of Regulatory Analysis.

*Hearing threshold levels $\geq$ 25 dB average of 1000, 2000, and 3000 Hz. Data are for equilibrium.

**All workers exposed to levels > 90 dB after feasible engineering and administrative controls have been implemented and all workers exposed $\geq$ 85 dB who have shown a permanent significant threshold shift.

Two conclusions follow from these data: First that without a hearing conservation program, a large number of workers will suffer hearing impairment or reduced hearing ability. OSHA has determined that workers who are exposed to noise levels $\geq$ 85 dB face a significant risk of material impairment. Second, a hearing conservation program for all workers exposed to $\geq$ 85 dB of noise will substantially reduce that risk.

Improved Workplace Safety. An additional benefit of the hearing conservation amendment is improved workplace safety. The presence of untreated workplace noise can increase the number of accidents because noise can mask warning signals or shouts, and noise exposure might lead to inattentiveness and fatigue, both of which may precipitate accidents.

In a study performed by the Raytheon Service Company,[3] (as mentioned in the Health Effects chapter) researchers examined the records of a boiler fabrication plant for the 2-year period before the initiation of a hearing conservation program and the 2-year period after program initiation. The results of this study showed a statistically significant reduction in the number of accidents among workers exposed to noise levels greater than 95 dB after the initiation of the hearing conservation program. The median frequency of accidents was reduced from 3.8 to 2.3 accidents per year, or by 39.5 percent.[4]

A second study performed by Schmidt, Royster, and Pearson[5] (see Health Effects chapter) examined a cotton yard plant where a hearing conservation program requiring the use of hearing protectors was instituted in 1972. Using a statistical technique by which a worker serves as his/her own control, the researchers compared the mean number of injuries in the 4-year period prior to the hearing conservation program to the 4-year period following institution of

period following institution of the hearing conservation program for two groups of employees exposed to noise levels from 92 to 96 dB. For one group, the reduction in the mean injury rate was from 0.4 to 0.2 injuries per year, or by about 50 percent; for the other group the reduction was from 0.5 to 0.3 injuries per year, or by about 40 percent.[6]

The Raytheon study and the Schmidt, Royster and Pearson study together reveal that the initiation of a hearing conservation program is likely to reduce the number of accidents by 40-50 percent among those exposed to high levels of noise. Information compiled from the Bureau of Labor Statistics shows that there are about 2,474,000 reported occupational injuries in the 19 industries from which Bolt, Beranek and Newman (BBN)[7] supplied exposure data. Of these injuries about 1,052,900 are lost workday cases.[8] If these accidents are distributed evenly among all workers in these industries without regard to noise exposure, then approximately 851,000 total cases and 362,000 lost workday cases occur each year for those exposed above 85 dB [2,474,000 injuries X 34.4 percent (workers exposed >85 dB) = 851,056; 1,052,900 lost workday cases x 34.4 percent = 362,198.] Similarly, there are 477,000 total cases and 203,000 lost workday cases among those exposed above 90 dB [2,474,000 injuries x 19.3 percent = 477,482; 1,052,900 lost workday cases x 19.3 percent = 203,210]. The hearing conservation amendment reduce this toll of accidents.

Extra-Auditory Benefits. As explained in Chapter III, there is a wealth of information concerning the extra-auditory effects of noise--such as including increased cardiovascular disease--but clear dose-response relationships do not yet exist. For that reason, OSHA has not attempted precise quantification of these benefits. However, one example does reveal the magnitude of the occurrence of cardiac disease. The current rate for deaths due to

heart disease for those between 45 and 54 years old is 536.7 per 100,000.[9] If this rate applies to the 4,984,000 workers aged 45-64 in the 19 industries studied, then approximately 27,000 will die of heart disease annually. By reducing noise exposure, the hearing conservation amendment may help to prevent some of these premature deaths.

Reduced Absenteeism and Increased Performance. A reduction of workplace noise levels will enhance the health and welfare of employees by preserving hearing acuity and by creating a more desirable environment in which to work. It has been observed that an inability of an employee to hear and understand speech adversely affects social patterns, employment opportunities, attendance, performance, and compensation. It can also adversely affect production and costs. Thus, a vital aspect of preserving the nation's human resources is to protect the employee from hearing impairment.

The reduction in noise exposures due to hearing protector use should reduce the number of noise-induced diseases and could also improve worker attitudes towards their jobs, thus improving attendance records, and job performance. In either case, employers would benefit from increased output and reduced costs.

As mentioned above, the Raytheon Service Company study [10] also found that the median number of absences of the group exposed at levels 95 dB and above after initiation of a hearing conservation program fell by 12.4 days per year, or about 63 percent of the preconservation program absences.[11]

As explained in the discussion on health effects, continuous noise levels above 90 dB appear to have potentially detrimental effects on human performance, especially on what have been described as noise-sensitive tasks

such as vigilance tasks, information gathering, and analytical processes.[12] Such tasks require the subject to keep a constant watch over a number of dials or indicators so as to report changes that may occur on any dial or indicator at any time. Noise-related losses in vigilance performance are important because of their implications for automated jobs which involve the monitoring of control panels with many indicators displaying information about an ongoing machine process. This finding also has practical importance for jobs requiring the inspection of items passing on a conveyor belt. In such situations, a single item must be viewed within a short period of time before passing on to the next.[13] Thus, by reducing the level of noise in the workplace, improvements in the efficiency or accuracy of human performance may be anticipated.

However, it should be noted that noise does not usually influence the overall rate of work, but high levels of noise may increase the variability of the work rate. There may be "noise pauses" or gaps in response, sometimes followed by compensating increases in work rate. Noise is more likely to reduce the accuracy of work than to reduce the total quantity of work. Complex or demanding tasks are more likely to be adversely affected than are simple tasks. Since laboratory studies represent idealized situations there is a great need for field studies under real-life conditions.[14]

Reduced Workers' Compensation Payments. A reduction in workers' compensation payments can also be anticipated as a result of the final amendment. Two studies can be used to estimate the anticipated reduction in workers' compensation payments for occupational hearing loss. In one study, CPA made an estimate of the total potential workers' compensation payments that a noise regulation might save. They calculated, using a rate of 7 percent, that the present value of the stream of potential savings for an 85 dB regulation

over the next 40 years would be $530 million.[15] Another study further estimated that the additional workers' compensation liability saved by reducing noise exposures from 90 dB to 85 dB would be $16.097 million.[16] However, these estimates are speculative since hearing impairment is often not compensated. According to the Environmental Protection Agency (EPA), over 70 percent of manufacturing employees in the U.S. live in states that pay few or no hearing impairment claims. EPA estimates that in 1977, 6,095 claims totaling approximately $13 million were paid for occupational hearing loss.[17] This figure could change considerably in the future since the number of claims filed has been increasing dramatically, and states are gradually changing their criteria for judging hearing impairment.

However, it should be noted that an estimate of reduced workers' compensation payments cannot be directly added to the other benefits described in this chapter. Workers' compensation payments are transfer payments from employers to impaired workers. As such, they are not a social cost and their reduction is not a social benefit. The true social cost is the incidence of occupational hearing impairment and the various other extra-auditory effects of noise; the true social benefit is the reduction in the number of hearing impairments and extra-auditory effects.

Reduced Medical Costs. A reduction in medical expenses (including third party medical payments) incurred as a result of occupational noise exposure is anticipated from promulgation of the final amendment. Although in most cases, noise-induced hearing loss is untreatable and irreversible medical resources (i.e., clinical visits, medications, therapeutic aides, etc.) are still required in examining these cases.

Ideally, the magnitude of this loss could be quantified. However, comments to the DEIS and to the noise record do not include either estimates of this loss or information from which estimates could be calculated. Because of this lack of information, OSHA has not attempted to quantify these savings, even though the reduced medical costs for the pool of 898,000 hearing impairments prevented is likely to be substantial.

Compliance Cost. Many industry groups strongly recommended to OSHA that hearing conservation programs are a cost-effective and affordable means of reducing noise induced hearing impairment among workers. BBN, in its 1976 report for OSHA, estimated that the hearing conservation provisions of the proposed standard would cost the manufacturing and utilities sectors of the U.S. economy a total of $289.3 million per year in 1975 prices.[18] Although the BBN estimates of these provisions were not widely criticized, certain differences between the proposed standard and the final amendment, as well as the availability of more timely cost data, have convinced OSHA to update these estimates of the expected compliance costs. The current estimated costs, which are based on a thorough review and analysis of the entire record, are presented in Tables V-5 and V-6 and discussed in detail in the Regulatory Analysis.

Overall, the calculations show that the annual cost of compliance with all of the provisions of this regulation would amount to about $53 for each of the more than five million workers protected by the program. The total annual cost, as measured in current dollars, is about $270 million a year. After adjustment for some of the compliance activities already taking place, the total annual costs were estimated to be approximately $254 million in current dollars and could fall well below this amount.

TABLE V-5

ESTIMATED NEW ANNUAL COMPLIANCE COSTS OF THE HEARING CONSERVATION AMENDMENT BY PROVISION

Provision	Estimated Cost
Monitoring	$ 73,731,000
Audiometric Testing	87,199,000
Ear Protectors	45,534,000
Training	40,029,000
Warning Signs	1,795,000
Recordkeeping	6,033,000
Total	$254,321,000

Source: OSHA, Office of Regulatory Analysis.

TABLE V-6

ESTIMATED NEW ANNUAL COMPLIANCE COST OF HEARING CONSERVATION AMENDMENT BY SIC

SIC	Industry	Estimated Cost
20	Food	$17,319,440
21	Tobacco	224,058
22	Textiles	17,756,670
23	Apparel	6,134,562
24	Lumber & Wood	30,864,350
25	Furniture & Fixtures	6,117,161
26	Paper	9,076,951
27	Printing & Publishing	22,284,030
28	Chemicals	10,944,270
29	Petroleum & Coal	4,454,069
30	Rubber & Plastics	6,721,314
31	Leather	909,841
32	Stone, Clay & Glass	7,348,522
33	Primary Metals	23,072,240
34	Fabricated Metals	23,505,250
35	Machinery, Except Electrical	25,519,890
36	Electrical Machinery	6,843,939
37	Transportation Equipment	12,914,530
49	Utilities	22,310,000
Total		$254,321,000

Source: OSHA, Office of Regulatory Analysis.

The External Environment

No significant impacts are expected to occur on the environment external to the workplace as a result of the promulgation of the final amendment. However, a reduction of noise levels in areas contiguous to the workplace could result, depending upon industry's response to the amendment.

Industry could respond to the amended standard by substantially reducing noise levels in workplaces. Controls such as machine containment, personnel enclosures, and isolation of noisy processes may be used to produce substantial reductions in noise exposure, but this approach to compliance may prove to be prohibitively costly in some industries, and could increase consumption of energy, power, or fuels.

Hopefully, industry's increasing awareness of the need to eliminate the noise problem will influense decisions relating to the procurement of new equipment and the design of plant facilities. There is no question that businesses could achieve substantial reductions in noise levels by the careful construction of new plants or by the modernization of existing plant facilities. In most cases, however, machinery manufacturers would be in the best position to reduce the level of noise produced in industry by means of improved equipment design. It is hoped that industry will incorporate noise level considerations in engineering specifications for purchasing new equipment. As OSHA develops an adequate record regarding the feasibility of these solutions, the issues will be specifically addressed in a rulemaking proceeding.

Obviously, the amendment is not a panacea, but a suggested approach which could result indirectly in a reduction of noise levels contiguous to the workplace. This would benefit residents and others located in proximity to noisy jobsites, a frequent situation in a society that is becoming increasingly

urbanized. Since construction operations are covered by a separate set of standards, noise produced by this industry, a major contributor to environmental noise levels, has not been considered in this statement. In addition, noise from traffic and in-flight aircraft, two other major sources of community noise pollution, will not be affected by the amendment because jurisdiction in these areas is not within the scope of Department of Labor activities. There are no other significant impacts expected on the environment external to the workplace.

Other Environmental Concerns

An environmental inventory was performed to identify and consider other factors which may cause a significant impact on the environment (internal and external) as a result of the promulgation of the hearing conservation amendment. The results of the inventory showed that there are no significant impacts to be expected on air quality, water quality, climate, terrestrial ecology, aquatic biology, geology, and historic and archeological sites.

Irreversible and Irretrievable Commitment of Resources

The irretrievable commitment of resources that would be involved as a result of the promulgation of the hearing conservation amendment are the time and money spent in acquiring and retaining the appropriate available medical personnel to perform audiometric tests and examinations. Other resources include the medical material (medication, cotton swabs, etc.) and equipment (construction of treatment and examination facilities, maintenance and operating supplies, etc.) that will be used, the man-hours lost be ' during and (if necessary) after examinations, the energy or power, and fue s consumed while maintaining and operating a treatment and examination facility, and the

noise dosimeters, sound level meters, earplugs, and other personal protective equipment to be in compliance with the hearing conservation requirements.

Conclusion

This chapter discussed the major impacts that may be imposed as a result of the promulgation of the hearing conservation Amendment. A more complete examination of this data may be found in OSHA's Regulatory Analysis and the Preamble to the Hearing Conservation Amendment.

The amendment would have its greatest impacts on the workplace environment and the health of its workers. Health benefits derived from promulgation of the amendment are expected to result in a reduction in both the incidence and degree of hearing loss among employees. In addition, existing hearing impairments are likely to be identified and treated.

A secondary impact may be a reduction in the prevalence of physiological and psychological disturbances which adversely affect social patterns, employment opportunities, employee performance and industry production. Thus, a vital aspect of preserving the nation's human resources is to protect the workers from hearing impairment.

An adverse impact is expected to be a minimal increase in capital costs and an increase in operating expenses in certain industries. However, the annual costs ($254 million) for implementing the hearing conservation requirements would not be substantial in terms of the national economy or the general industry's overall market structure. Large price impacts are not expected and the financial positions of firms will not be adversely affected. No other significant impacts are expected on the environment external to the workplace.

REFERENCES

[1]Exhibit 138A - N. A. Ashford, D. Hattis, and G. Hearton, "Some Considerations in Choosing An Occupational Noise Exposure - Regulation," Performed for the Environmental Protection Agency under Contract No. P5-01-2041T, (Cambridge, Mass: Center for Policy Alternatives, MIT, 1976), pp. 3-2 through 3-3.

[2]Exhibit 310 - Col. D. Johnson, "Derivation of Presbycusis and Noise Induced Permanent Threshold Shift (NIPTS) to be Used for the Basis of a Standard on the Effects of Noise on Hearing," Publication No. AMRL-TR-78-128 (Wright-Patterson Air Force Base, Ohio: Aerospace Medical Research Laboratory, U.S. Department of the Air Force, September 1978).

[3]Exhibit 26-11 - Raytheon Service Company, "Effects of a Company Hearing Conservation Program on Extra-Auditory Problems in Workers," Final Report. Prepared for the U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health under Contract No. CDC-99-74-28 (Burlington, Mass: Raytheon, May 1975).

[4]Ibid., pp. 3-5 to 3-6.

[5]Exhibit 321-22F, Schmidt, et. al.

[6]Ibid., p. 22.

[7]Exhibit 192 - Bolt, Beranek, and Newman, Inc., "Economic Impact Analysis of Proposed Noise Control Regulations," Publication No. OSHA 3246. Prepared for the U.S. Department of Labor, Occupational Safety and Health Administration under Contract No. DOL-J-9-F-6-0019 (Cambridge, Mass: BBN, 1976).

[8]Bureau of Labor Statistics, Occupational Injuries and Illnesses in 1978, Summary, Report 586, March 1980, Table 3.

[9]Bureau of the Census, Statistical Abstract of the United States, 1979, Table 111, p.77.

[10]Exhibit 26-11 - Raytheon Service Company, pp. 3-177.

[11]Ibid.

[12]Environmental Protection Agency, Public Health and Welfare Criteria For Noise, (Washington, D.C.: Government Printing Office, July 1973) p. 8-6.

[13]A. D. Hosey and C. H. Powell, eds., Industrial Noise A Guide to [illegible]s Evaluation and Control, PHS Publication No. 1572. U.S. Department [illegible] Health, Education, and Welfare, Public Health Service, Bureau of Disease Prevention and Environmental Control, National Center for Urban and Industrial Health Occupational Health Program (Washington, D.C.: Government Printing Office, 1967), p. N-4-11.

[14]Environmental Protection Agency, Public Health and Welfare Criteria, p. 8-6.

[15]Exhibit 232 - Nicholas A. Ashford, Statement of Center for Policy Alternatives at the Massachusetts Institute of Technology. (As revised with substitute pages by order of Administrative Law Judge Jean F. Greene, 8 October 1976, T.R.) p. 5-25.

[16]Exhibit 192 - Bolt, Beranek, and Newman, Inc.

[17]Exhibit 321-16C - Richard E. Ginnold, Occupational Hearing Loss - Workers Compensation Under State & Federal Programs, EPA 550/9-79-101. Prepared for U.S. Environmental Protection Agency (Madison: University of Wisconsin, 1979), p. viii.

[18]Exhibit 192 - Bolt, Beranek, and Newman, Inc. p. 3-9.

VI. ALTERNATIVES TO THE HEARING CONSERVATION AMENDMENT

Introduction

Alternatives to nearly every provision of the proposed standard were either identified or considered by OSHA, prior to publication of the proposal, or suggested by those submitting comments to the Draft Environmental Impact Statement (DEIS) or participating in the public hearing, following publication of the proposal. (See Appendix B - Anderson, ANPA/RA, Cromwell, Davis, B., Davis, L., Grimes, Marienthal, Muir, Myers, Prokop, and Taylor.) This chapter discusses all reasonable alternatives which the agency considered for promulgation and their comparative environmental impacts. The alternative of no action is also discussed. Other alternatives were eliminated from further study in this rulemaking because OSHA believes they would be ineffective or because data do not exist to assess their effect.

The reasonable alternatives disscussed below include the

(1) Revision of the permissible exposure level for noise.

(2) Initiation of a hearing conservation program at 85 dB as suggested in the proposal.

(3) Initiation of a hearing conservation program at either higher or lower exposure levels.

(4) Revision of the monitoring, testing, and training provisions.

(5) No regulatory action.

These provisions are considered to be reasonable because OSHA believes they could reduce adverse health effects from noise exposure. Their environmental impacts may be significant because of the number of employees and work operations covered by the standard, the improvement of health of employees, and the quality of the workplace environment, their reliance on engineering controls, and the economic costs of implementing the standard, and human

resources (i.e., professional, medical, and technical personnel needed to conduct the activities required by the standard). Further, the alternatives may have indirect effects on the environment external to the workplace especially in terms of the affected employee's acceptance and participation in social activities and the health and welfare of non-occupationally exposed persons residing in areas surrounding the noise-producing facilities.

In the future OSHA intends to develop data for further rulemaking concerning noise exposure which will require renewed evaluation such as personal protective equipment as a permanent solution for noisy conditions; industry-specific noise standards; use of administrative controls; and a required 85 dB limit in new facilities and other environments, where feasible.

Revised Permissible Exposure Level

A number of witnesses stated that OSHA should lower the permissible exposure level (PEL) from the current 90 dB level. However, many others asserted that the noise record is not adequate to address all of the problems that would be created by requiring additional engineering controls to achieve substantially lower exposures to occupational noise. OSHA concurs with the statements that these feasibility issues are critical and that many questions remain unanswered regarding the effectiveness of engineering controls in specific industrial settings. Therefore, although the Agency is committed to continue efforts to resolve these feasibility issues, the final determination of a new comprehensive standard must await the collection and analysis of substantial new data.

Notwithstanding the lack of adequate data on the feasbility of engineering controls, the noise record does contain evidence that current noise levels are damaging the hearing ability of a sizable fraction of the worker

population. Thus, OSHA is convinced that until the engineering feasibility record can be augmented, the only regulatory approach capable of reducing the extent and the severity of occupationally induced hearing impairment is a requirement for effective hearing conservation programs.

85 dB Hearing Conservation Amendment

A hearing conservation amendment covering workers exposed to at least 85 dB was the option ultimately selected by the Agency.

In the absence of hearing conservation programs, OSHA's analysis indicates that over one million people would suffer material impairment of hearing caused by occupational noise. As stated in Chapter V, hearing conservation programs were estimated to prevent 212,000 individuals from suffering hearing impairment in the 10th year; 477,000 in the 20th year; 696,000 in the 30th year; 799,000 in the 40th year; and 898,000 in the equilibrium year and in each year thereafter. Moreover, by the equilibrium year 412,000 people would be prevented from crossing the 40 dB fence, which indicates a more severe impairment. Because some evidence indicates that up to 20 percent of the workers currently exposed to noise levels above 90 dB are already provided hearing protectors, about 120,000 impairments may be prevented due to the current use of these protectors. Therefore, the additional protection resulting from the 85 dB hearing conservation amendment is expected to reduce material impairments of hearing by 778,000 by the equilibrium year.

A number of comments to the record assert that OSHA must demonstrate that benefits compare favorably to compliance costs before promulgating a standard (Ex. 261A, p. 39, provides a succinct statement of the basis for this view). However, OSHA believes that the major benefit of this regulation

is expressed in terms of hearing impairment which affect personal relationships even more than they impede market interactions. Thus, it is impossible to monetize one of the major costs of hearing loss.

Moreover, there is no preconceived rule that will unequivocally justify or reject a decision to allocate an increased portion of society's resources to the reduction of future cases of hearing impairment. However, the pain, discomfort, and social disability accompanying lost hearing at any stage of life are clearly substantial relative to these costs when viewed over a time horizon long enough to allow the manifestation of the program's results. OSHA, therefore, is convinced that the amendment's contribution to an improved quality of life for hundreds of thousands of workers, their families, and friends more than balances the estimated cost of the amendment. Moreover, this conclusion is strengthened to the extent that extra-auditory health effects increase the measured benefits, and that fewer accidents and reduced absenteeism and medical payments decrease the cost burden, as suggested by the evidence cited in Chapter V.

Alternative Initiation Levels

Numerous comments to the record addressed the appropriate worker noise exposure level at which to initiate hearing conservation programs. Although many witnesses agreed that 85 dB was a proper level, others asserted that 90 dB would be sufficient, and at least one participant stated that 75 dB should be the long-range goal.[1] The scientific evidence presented to justify these alternatives primarily relates to the risk of hearing loss at various levels of noise exposure. As explained in Chapter IV, OSHA believes that the results of this research are best represented by Johnson's synthesis of the Passchier-Vermeer, and Burns and Robinson studies[2] which show that significant levels of risk appear at noise exposures well below 90 dB.

Johnson's data indicate that for the more sensitive 10th percentile of workers exposed over a working lifetime, the amount of noise-induced permanent threshold shift (NIPTS) for the frequencies 1000, 2000, and 3000 Hz is 11.1 dB for workers exposed to 90 dB, 4.7 dB for workers exposed to 85 dB, and only 1.8 dB for workers exposed to 80 dB (see Table VI-1). Moreover, a risk matrix based on these data, and reproduced in Table VI-2 implies that the probability of crossing a 25 dB fence solely due to a 40-year exposure to occupational noise of 90-95 dB is 25 percent for males and 28 percent for females. For noise exposures between 85 and 90 dB this probability remains a relatively high 11 percent and 14 percent for males and females, respectively. However, for exposures of 80-85 dB, the probability of crossing this fence because of work-related noise falls to 5 percent for males and 6 percent for females.

To illustrate further how the 85 dB amendment compares to various alternatives, OSHA estimated the number of individuals who would suffer hearing impairment following a reduction in the amendment's coverage to 90 dB or an expansion in scope to 80 dB. The procedures for these calculations were described in the previous Chapter.

Table VI-3 presents the number of persons at the equilibrium time period who would have hearing threshold levels (across a fence) >15 dB, 25 dB, and 40 dB for the alternative regulations. Thus, without the use of ear protectors, 1,624,000 individuals would be across a 15 dB fence; 1,060,000 would be across a 25 dB fence; and 473,000 would be across a 40 dB fence. This is 9.2 percent, 6.0 percent, and 2.7 percent, respectively, of the population studied. Instituting hearing conservation programs at 90 dB reduces these impairments by only 58-71 percent, whereas the 85 dB amendment decreases the number of impairments by 80-90 percent, and the 80 dB alternative decreases them by 92-95 percent.

TABLE VI-1

NOISE-INDUCED PERMANENT THRESHOLD SHIFT (NIPTS)*
(dB)

Exposure Level (dB)	Exposure Duration (Percentile of Population)											
	10 years			20 years			30 years			40 years		
	(.9	.5	.1)	(.9	.5	.1)	(.9	.5	.1)	(.9	.5	.1)
75	0	0	0	0	0	0	0	0	0	0	0	0
80	.1	.8	1.8	.7	1.0	1.8	1.7	1.1	1.8	2.6	1.3	1.8
85	.7	1.9	4.7	1.5	2.4	4.7	2.6	2.9	4.7	3.7	3.2	4.7
90	1.6	4.1	9.3	2.9	5.3	10.2	4.3	6.4	11.1	6.0	7.3	11.1
95	3.3	8.1	15.6	5.4	10.4	17.9	8.5	12.7	19.5	10.9	14.4	20.4
100	7.1	13.6	23.3	10.6	17.4	26.6	14.4	20.8	29.2	17.9	23.5	30.8

Source: Daniel L. Johnson, Derivation of Presbycusis and Noise-Induced Permanent Threshold Shift, Exhibit 310, Table 5, p. 29.

*The NIPTS values presented here are the decibel shifts in hearing ability for the 90th, 50th, and 10th percentiles of populations exposed for 10, 20, 30, and 40 years. These NIPTS values are the average of the shifts at the frequencies 1000, 2000, and 3000 Hz. Following Johnson's suggestion, the data published in his report for 80, 85, and 90 dB levels were adjusted to ensure that the NIPTS for a particular exposure duration at a particular exposure level would be equal to or greater than the NIPTS for shorter exposure durations (See Johnson, Exhibit 310, p. 10).

TABLE VI-2

RISK MATRIX - 25 dB FENCE*
(Percent)

Exposure Level (dB)	Age Group 18-24	25-34	35-44	45-54	55-64	65+
			MALE			
<80	0.0	0.3	7.8	17	31	31
80-85	0.0	1.3	12	22	36	36
85-90	0.0	3.8	18	29	42	42
90-95	0.0	10	28	41	56	56
95-100	0.0	22	41	59	76	76
100+	0.0	30	48	71	86	86
			FEMALE			
<80	0.0	0.3	0.3	3.8	13	13
80-85	0.0	0.6	1.3	7.6	19	19
85-90	0.0	1.6	4.6	14	27	27
90-95	0.0	5.8	14	27	41	41
95-100	0.0	16	29	47	65	65
100+	0.0	23	39	59	80	80

Source: Daniel L. Johnson, Derivation of Presbycusis and Noise-Induced Permanent Threshold Shift, (Exhibit 310).

*Hearing threshold levels >25 dB average at 1000, 2000, and 3000 Hz.
Each cell of this matrix gives the percentage across the 15 dB fence for each age and exposure level combination. Johnson's report presents information for exposure levels of 80, 85, 90, 95, and 100 dB. Linear interpolation is used to calculate the percentages for the midpoints of the exposure ranges: 82.5, 87.5, 92.5 dB. The matrix is generated using the computer program listed in the Appendix to the Johnson report.

Table VI-3

PERSONS WITH OCCUPATIONAL HEARING IMPAIRMENT AT EQUILIBRIUM
(1000, 2000, 3000 Hz)

	15 dB Fence		25 dB Fence		40 dB Fence	
Regulatory Alternatives	Number	Percent*	Number	Percent*	Number	Percent*
No Hearing Conservation Program	1,624,000	9.2	1,060,000	6.0	473,000	2.7
90 dB	675,000	3.8	351,000	2.0	136,000	0.8
85 dB	321,000	1.8	162,000	0.9	59,000	0.3
80 dB	125,000	0.7	63,000	0.4	23,000	0.1

Source: OSHA, Office of Regulatory Analysis.

*Number of impairments as a percentage of the number of persons in the population studied (17,638,000).

Table VI-4 displays estimates of the annual costs and the number of hearing impairments expected to be avoided by the 90, 85, and 80 dB regulatory alternatives. Using the same methodology that was used to develop the cost estimates for the 85 dB amendment, annual costs for the 90 and 80 dB alternatives were calculated as $179.3 and $373.8 million, respectively. The table shows the number of hearing impairments that would be prevented at equilibrium and at 4 interim years for the 25 dB fence, and at equilibrium for the 15 and 40 dB fences. Figure VI-1 illustates the time path of these benefits as calculated for the 25 dB fence.

The additional costs and the additional impairments that would be prevented by implementing the successively more inclusive alternatives are presented in Table VI-5. Since the baseline for this analysis is no hearing conservation program, the numbers in the 90 dB row are unchanged from Table VI-4. The 85 and 80 dB entries in Table VI-5 were calculated by taking the difference between the 85 and 90 dB rows, and the 80 and 85 dB rows, respectively, from Table VI-4. Table VI-5 indicates, for example, that the 85 dB amendment would cost $90.6 million a year more than the 90 dB alternative, but would prevent 38,000 more hearing impairments by the 10th year after promulgation of the amendment.

The data indicate the differential effects likely to follow the promulgation of the alternative regulations. For example, Table VI-4 showed that a regulation limited to workers exposed to 90 dB or above would prevent a substantial number of hearing impairments. By the equilibrium year, this alternative would achieve 79 percent of the impairments prevented by the 85 dB amendment. Although this percentage is significant, Table VI-5 indicates that after 10 years, one would expect to find 38,000 additional individuals over a

TABLE VI-4

ANNUAL COMPLIANCE COSTS AND IMPAIRMENTS PREVENTED BY REGULATORY ALTERNATIVE

Regulatory Alternative	Annual Costs ($ Millions)	Impairments Prevented						
		25 dB Fence					15 dB Fence	40 dB Fence
		10th year	20th year	30th year	40th year	Equilibrium	Equilibrium	
90 dB	179.3	174,000	377,000	553,000	632,000	709,000	946,000	337,000
85 dB	269.9	212,000	477,000	696,000	799,000	898,000	1,303,000	412,000
80 dB	373.8	235,000	548,000	795,000	897,000	997,000	1,499,000	450,000

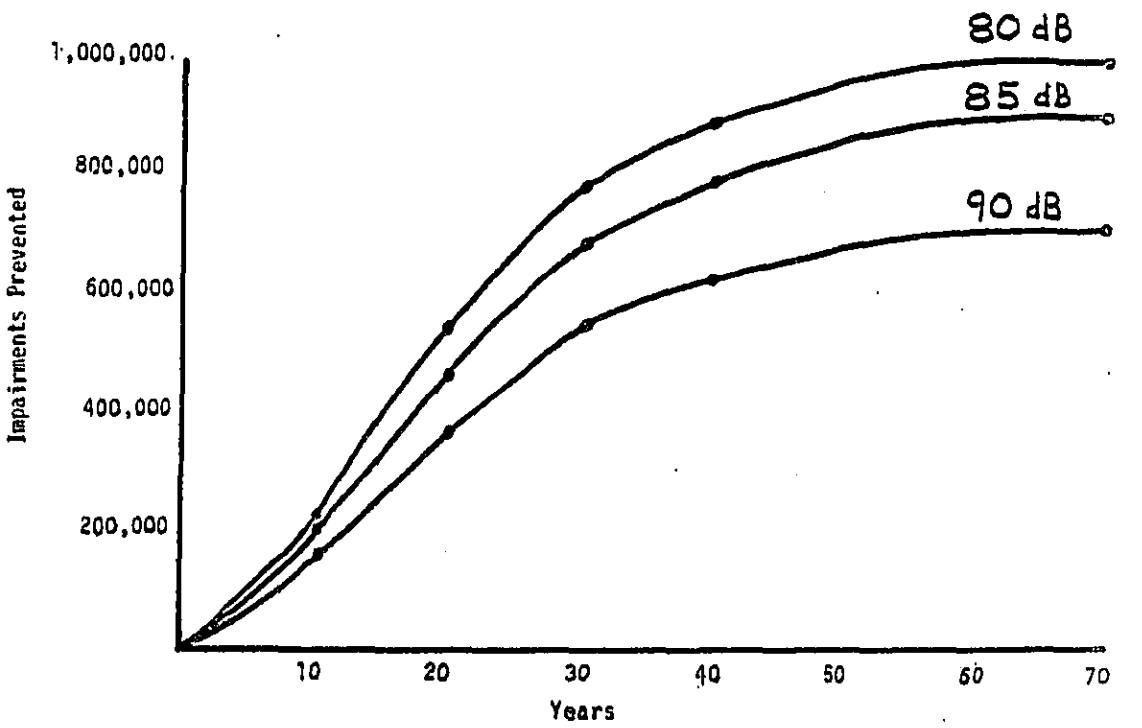
Source: OSHA, Office of Regulatory Analysis.

TABLE VI-5

ADDITIONAL ANNUAL COMPLAINCE COSTS AND ADDITIONAL IMPAIRMENTS PREVENTED FOR SUCCESSIVELY MORE INCLUSIVE REGULATORY ALTERNATIVES

Regulatory Alternative	Additional Annual Costs ($ Millions)	Additional Impairments Prevented						
		25 dB Fence					15 dB Fence	40 dB Fence
		10th year	20th year	30th year	40th year	Equilibrium	Equilibrium	
90 dB	179.3	174,000	377,000	553,000	632,000	709,000	946,000	337,000
85 dB	90.6	38,000	100,000	143,000	167,000	189,000	354,000	75,000
80 dB	103.9	23,000	71,000	99,000	98,000	99,000	196,000	30,000

Source: Derived from Table 18 by the Final Regulatory Analysis of the Hearing Conservation Amendment.



Source: OSHA, Office of Regulatory Analysis

FIGURE VI-1

MATERIAL IMPAIRMENTS OF HEARING PREVENTED
BY HEARING CONSERVATION PROGRAMS

25 dB fence with the 90 dB alternative than with the 85 dB final amendment. These additional impairments rise to 100,000 after 20 years and 143,000 after 30 years. At an equilibrium year, there would be an additional 189,000 people materially impaired, 75,000 of whom would suffer the more serious hearing loss measured by the 40 dB fence. Furthermore, Table VI-5 indicates that to prevent these additional impairments by extending coverage to workers exposed to 85 dB would cost $90.6 million a year more than the 90 dB alternative. This amounts to an average cost of only about $41 for each of the 2.2 million workers exposed to noise between 85 and 90 dB.

An alternative presentation of these data consists of calculating the number of person-years of impairment prevented. Tables VI-6 and VI-7 show the cumulative and additional cumulative person-years of impairment prevented for durations of 10, 20, 30, 40, and 70 years following the implementation of the alternative regulations and not accounting for current ear protector use. For instance, Table VI-6 notes that during the first 20 years after initiation, the 90 dB alternative would prevent 3,625,000 person-years of impairment and the 85 dB amendment would prevent 4,505,000 such years. Table VI-7 displays the increments, showing that the 85 dB amendment would prevent 880,000 more person-years of impairment than the 90 dB alternative over the 20 year period. Over the next 70 years, almost 9 million additional person-years of impairment would be avoided by implementing the 85 dB amendment as opposed to the 90 dB alternative.

The data also signify some risk of hearing impairment to workers exposed at noise levels below 85 dB. Table VI-5 shows that a more extensive hearing conservation program covering workers exposed to as low as 80 dB would prevent almost 100,000 additional impairments at equilibrium. However, the

TABLE VI-6

CUMULATIVE PERSON-YEARS OF MATERIAL IMPAIRMENT PREVENTED
(25 dB Fence) (millions)

Regulatory Alternative	Years 10	20	30	40	70
90 dB	.87	3.625	8.275	14.20	34.315
85 dB	1.06	4.505	10.37	17.845	43.30
80 dB	1.175	5.09	11.805	20.265	48.675

Source: OSHA, Office of Regulatory Analysis.

TABLE VI-7

ADDITIONAL CUMULATIVE PERSON-YEARS OF MATERIAL IMPAIRMENT PREVENTED
(25 dB Fence) (millions)

Regulatory Alternative	Years 10	20	30	40	70
90 dB	.87	3.625	8.275	14.20	34.315
85 dB	.19	.880	2.095	3.645	8.985
80 dB	.115	.585	1.435	2.420	5.375

Source: OSHA, Office of Regulatory Analysis.

total cost of the 80 dB alternative should include not only the extra $103.9 million of compliance cost that employers would bear, but also the inconvenience and discomfort experienced by those workers required to wear ear protectors despite the relatively small risk of their incurring hearing impairment from occupational noise. Moreover, certain legal and technical considerations have precluded OSHA from making a final judgment on this issue. Therefore, this regulatory action does not lower the initiation level to 80 dB. However, OSHA remains concerned about the risks from these lower noise levels and will continue to study the implications of these exposures while concurrently urging employers to include these workers in hearing conservation programs.

Revised (Alternative) Monitoring, Training, and Audiometric Testing Provisions

OSHA has carefully reviewed the scientific data, evidence, suggestions, recommendations, and other pertinent information and has found that it was not possible to make quantifiable estimates of the benefits attributable to the individual provisions (monitoring, training and audiometric testing) of the final amendment because each requirement was developed as an integral component of a comprehensive program. Many industrial noise experts agree that workers will not use ear protectors often or appropriately unless their cooperation has been gained as a result of educational activities. Thus, monitoring, training, and audiometric testing do not provide benefits in and of themselves, but only as they support and enhance other aspects of the program by heightening the awareness and motivation of employees and employers. In the absence of carefully designed experimental studies, OSHA believes that precise numerical estimates of these individual effects would be highly

speculative. Nevertheless, the final form of each provision was based on expert testimony in the record regarding those hearing conservation practices generally accepted as necessary to safeguard worker hearing levels.

No Regulatory Action

OSHA rejected the "No Hearing Conservation Program" alternative because data presented in Chapter V (Environmental Impacts) show that, in the absence of a hearing conservation program, over one million people would suffer hearing impairment caused by occupational noise. OSHA has calculated that the implementation of hearing conservation programs would prevent 212,000 individuals from suffering hearing impairments in the 10th year, 477,000 in the 20th year, 696,000 impairments in the 30th year, 799,000 in the 40th year, and 898,000 in the equilibrium year and in each year thereafter. Moreover, 412,000 people would be prevented from crossing the 40 dB fence which indicates a more severe impairment. Current hearing protector use may account for about 120,000 of these prevented impairments. Therefore the hearing conservation amendment has been selected and is expected to prevent 778,000 impairments in addition to the 120,000 impairments which would be prevented due to the current use of hearing protectors.. (See Chapter V for a detailed discussion of the impairments prevented.)

Other Alternatives

Use of personal protective equipment as a permanent solution for noisy conditions. This option would provide employees with adequate protection against most occupational noise levels. However, there are problems with personal protective devices--including discomfort, lack of employee acceptance, and the unsuitability of transferring the burden of compliance from the employer to the employee--which make this alternative less desirable than engineering or administrative controls. Moreover, studies have shown that workers often do not receive as much attenuation as laboratory tests of hearing

protectors would imply. Therefore, the effectiveness of this approach would be uncertain. Additional information and studies will be required before a final decision is reached.

Industry-specific noise standards. This alternative calls for establishing noise levels according to the currently available technology and the economic impact in each industry group. This option will be considered as new information is made available to the Agency on the appropriate feasibility concerns for each industry.

Use of administrative controls as a permanent solution for noise control. This alternative would protect workers from overexposure by rotating workers in and out of noisy areas on a short shift basis. It is both a cumbersome and expensive alternative, and its widespread application would be impractical or prohibitively expensive in many cases.

Maintenance of the 90 dB limit, but a required 85 dB limit for newly designed occupational environments and those for which controls are currently technologically feasible to meet the 85 dB limit. This alternative, recommended by the National Institue for Occupational Safety and Health (NIOSH), emphasizes the preference to eventually reduce exposure levels below 90 dB, although problems with the definition of "newly designed work environment" could seriously limit the usefulness of the alternative. To determine in what work environments an 85 dB limit applied, it would be necessary to demonstrate the date of design or production of equipment and facilities. This would prove cumbersome for purposes of inspection and enforcement. However, this alternative will be evaluated as additional information is collected by the Agency.

Conclusion

The data presented above demonstrate that OSHA has thoroughly considered and documented the need for regulatory action, assessed the environmental and economic consequences of the amendment, and evaluated the implications of selecting alternative regulatory programs. It was estimated that in the absence of hearing conservation programs, over one million individuals would suffer material impairment of hearing because of job-related noise. If hearing conservation programs effectively reduce at-ear noise levels by 15 dB, they would prevent about 70 percent of these impairments by the 30th year, and about 85 percent by the 70th year, following implementation. In addition, evidence was presented to indicate that the incidence of extra-auditory health effects, job-related accidents, and worker absentee levels could decline significantly.

The compliance cost of the amendment was estimated at about $53 per exposed worker and constitutes less than 0.2 percent of the profits in the affected industries. This level of cost can be financed easily without causing major problems to the great majority of business firms in each industry sector.

Alternative initiation levels for the hearing conservation program were considered and rejected. Although this limited scope alternative would reduce annual compliance costs by $90.6 million, its selection would permit an estimated 189,000 additional impairments by the equilibrium year. Based on this information, OSHA has concluded that most individuals, as well as society as a whole, will consider the hearing conservation amendment to be a judicious investment in the quality of life for this nation's work force.

[1]Exhibit 5, p. 43802

[2]Exhibit 310-D. Col. D.,Johnson, "Derivation of Presbycusis and Noise Induced Permanent Threshold Shift (NIPTS) to be Used for the Basis of a Standard on the Effects of Noise on Hearing," Publication No., AMRL-TR-YB-128, (Wright-Patterson, AFB, Ohio: Aerospace Medical Research Laboratory, September 1978).

VII. RELATIONSHIP WITH OTHER FEDERAL AGENCIES

The Noise Control Act of 1972, (42 USC 4901 et seq.) gives the Environmental Protection Agency (EPA) the lead for coordinating all Federal noise regulations.

Noise regulations are primarily concerned with two distinctly different problems. First is the regulation of noise sources, such as airplanes, traffic, and other noise problems which affect the general public health and welfare. Agencies concerned with these problems are EPA, the Department of Housing and Urban Development (HUD), the Department of Transportation (DOT), and the National Aeronautics and Space Administration (NASA). Second is the regulation of noise as it concerns individual work related exposure. Agencies concerned with these noise problems are the Occupational Safety and Health Administration (OSHA), the Department of Defense (DOD), and the National Institute for Occupational Safety and Health (NIOSH).

This section includes a brief discussion of the noise regulation activities of each of these agencies.

Environmental Protection Agency

The passage of the Noise Control Act of 1972 created a central focus for activities regarding noise control measures in the Federal Government. First, this law provided EPA with the authority to coordinate Federal noise control programs. Second, it gave EPA the responsibility for promoting Federal research and development related to noise and for providing technical assistance to states in the area of codes and laws. EPA is also authorized to establish noise emission regulations for construction equipment, transportation equipment, motors and engines, and electrical and electronic equipment, as well as regulations on the labeling of noisy products.

Department of Defense

DOD is involved in extensive research programs that concentrate on the areas of occupational noise control and hearing conservation, operational aircraft noise abatement, and construction specifications for noise control. DOD is also studying the effects of noise-induced hearing loss on the efficiency of soldiers' performance, rotary wing aircraft noise reduction, noise control within vehicle interiors, and sonic fatigue.

The Air Force and the Army have set exposure limits for their personnel at 84 and 85 dB, respectively, based on slightly different regression equations.

Department of Transportation

Noise programs in DOT focus on research relating to transportation noises and, more recently, in the certification of aircraft for noise level. DOT's noise research programs include truck engine noise, measurement and simulation modeling of community noise levels related to transportation noises, and research of noise generation in the internal combustion engine.

Studies undertaken by the Federal Aviation Administration (FAA), a component of DOT, emphasize aircraft noise suppression and the adverse effects of sonic boot. FAA is responsible for setting air traffic rules in the interest of noise abatement such as specified noise levels on takeoff and landing for new subsonic aircraft. In addition, FAA establishes national policy on the protection and enhancement of the environment in the development of airports.

Also, according to Benjamin O. Davis, Jr, FAA, Assistant Secretary for Environment, Safety and Consumer Affairs, the Bureau of Motor Carrier Safety (of the Federal Highway Administration) has issued regulations limiting

interior noise levels for interstate motor carriers (Title 49, CFR, Chapter III, Subchapter B, part 393, published at 38 FR 30880 on November 8, 1973). These regulations are based on the OSHA 90 dB/8-hour criterion, and incorporate a simplified test procedure for vehicle inspection. In addition, the United States Coast Guard has issued noise level regulations adopting the OSHA noise standards for persons onboard gas turbine vessels (publicly owned vessels are excluded) and is currently preparing an amendment to extend this coverage to all vessel personnel exposed to noise from operating machinery and related systems (46 CFR 58.10-15). A similar regulation is currently being considered for railroad personnel by the Federal Railroad Administration of DOT, again based on the OSHA regulations. While DOT standards are currently based on the OSHA 90 dB/8-hour criterion, future lowering of this noise level requirement could be reflected in modifications to DOT standards.[1]

National Aeronautics and Space Administration Noise Activities

Another agency that has been involved in extensive aircraft noise research is NASA. Some areas of recent investigation include reduction of aircraft noise at the source, noise propagation, effects on receptors, and approach trajectory modification.

National Institute for Occupational Safety and Health

NIOSH, within the Department of Health and Human Services (HHS), carries out noise studies relative to industrial noise exposure. To support OSHA's efforts to reduce noise-induced hearing loss, NIOSH has undertaken research to define occupational noise limits for hearing conservation; to assess industrial noise effects on overall health, safety and performance capacity; and to consider the differential diagnosis of noise-induced hearing loss cases. NIOSH's criteria document on

noise was among the sources used by OSHA in developing the hearing conservation admendment.

The National Institute of Environmental Health Sciences and the National Institute of Neurological Diseases and Stroke within HHS have been similarly involved in research concerning the auditory, pathological, and mental effects of noyse. Their research has included areas such as the effects of noise on speech discrimination, the annoyance factor associated with high sound levels, and the efficiency of various types of hearing aids.

Department of Housing and Urban Development

HUD is concerned with noise problems related to housing site selection, structural characteristics of buildings, and land use planning. Current activities include the development of comprehensive urban noise survey methodologies and metropolitan aircraft noise abatement policy studies. In addition, noise level limitations have been established in HUD projects located near airports and in other HUD assisted projects.

Department of Commerce

Research and measurement programs directed toward noise abatement in DOC are conducted by the National Bureau of Standards (NBS). One NBS study is investigating new measuring techniques for the subjective factors of loudness, noisiness, and annoyance. NBS is also conducting research on calibration procedures for measuring equipment, audiodosimeters, ear protective devices, as well as on the noise characteristics of passenger car tires, toys, and postal sorting machines.

Department of Interior

According to Stanley D. Doremus, Deputy Assistant Secretary of the Interior, Noise Control Research, Bureau of Mines (BOM), Department of Interior (DOI) studies include identifying and attenuating noise, monitoring of noise, exposure, and requiring certified personal protective equipment.

To illustrate, in a (BOM) study of the identification and abatement of noise sources in mine machines, suitable control measures applied to the chain conveyor of a coal loader reduced the noise generated by the machine in an underground coal mine from 108 dB to 95 dB.[2]

In the continuing effort to provide adequate monitoring of noise in the mine environment, an evaluation of commercial, personal audiodosimeters was completed. Based on this work, the Mining Enforcement and Safety Administration (MESA) has formulated rules for the use of dosimeters underground and specifications for their procurement for MESA personnel. The dynamic range of the Bureau-developed audiodosimeters was extended to provide the coverage down to 85 dB that would be required by new noise standards now being considered. The time-resolved audiodosimeters were revised to provide increased memory and equipped with readouts that now make it possible to process data directly in the field.[3]

In addition, a stereo version of the BOM discriminating earmuff was developed that gives the miner the directional information necessary to assess roof noises. Extensive evaluation of earmuffs showed that the discriminating earmuffs provide excellent protection above 90 dB while permitting normal hearing below that level. As an offshoot of these investigations, an audio-visual course was prepared to instruct coal miners in the need for and proper use of personal hearing protection.[4]

REFERENCES

[1]Benjamin O. Davis, Jr., Assistant Secretary for Environment, Safety, and Consumer Affairs, Letter Commenting on the Draft Environmental Impact Statement, Office of Secretary of Transportation, U.S. Department of Transportation, Washington, D.C., August 11, 1975.

[2]Stanley D. Doremus, Deputy Assistant Secretary of the Interior, Letter Commenting on the Draft Environmental Impact Statement, Office of the Secretary, U.S. Department of the Interior, Washington, D.C., August 18, 1975.

[3]Ibid.

[4]Ibid.

VIII. COMMENTS

Comments on the Draft Environmental Impact Statement (DEIS) on the proposed standard for occupational exposure to noise were solicited by notice in the Federal Register published June 16, 1975 (40 FR 25525). OSHA received 29 written submissions in direct response to the DEIS as published in June 1975. The majority (27) of these comments addressed the feasibility of the proposed standard to protect public health and welfare adequately and to provide the necessary protection to insure that no employee will suffer material impairment of health or functional capacity. Sixteen (16) letters directly addressed the contents of the DEIS with some concern as to whether the statement provided an adequate detailed and comprehensive analysis of the noise issues. (See Appendix B - Anderson, ANPA/RA, Barrows, Crowell, Davis, B., Davis, L., Doremas, Grant, Grimes, Marienthal, Muir, Myers, Pennington, Prokop, Taylor, and Watts.) The remaining 13 letters either had no specific comments or stated general approval or disapproval of the proposed standard or certain aspects of the proposed standard. As a result, the scope of the Final Environmental Impact Statement (FEIS) has been expanded from the DEIS to include a consideration of submissions received by OSHA. However, it should be noted that this FEIS focuses attention on those environmental issues pertinent to the hearing conservation amendment to the current noise standard. To the extent that comments were addressed primarily to the substance of the proposal rather than to the environmental consequences of the proposal or the final amendments, OSHA has determined these comments are more approporiately dealt with in the Preamble to the Hearing Conservation Amendment. Thus, the FEIS' responses to the comments received will be given in light of this amendment. Written comments were received from the various Federal agencies and private industries identified in the following pages.

Federal Agencies (11)

H.L. Barrows
Deputy Assistant Administrator
U.S. Department of Agriculture
Agricultural Research Service
Washington, DC 20250

Paul Cromwell
Acting Director
Office of Environmental Affairs
U.S. Department of Health,
Education and Welfare
Washington, DC 20210

Charles Custard, Director
Office of Environmental Affairs
U.S. Department of Health
Education and Welfare
Washington, DC 20210

Benjamin O. Davis
Assistant Secretary for
Environment, Safety and
Consumer Affairs
U.S. Department of Transporation
Office of the Secretary
Washington, DC 20590

Stanley Doremas
Deputy Assistant Secretary
of Interior
U.S. Department of Interior
Washington, DC 20240

Lindsey Grant, Director
Office of Environmental Affairs
U.S. Department of State
Washington, DC 20520

George Marienthal
Deputy Assistant Secretary
of Defense
Environmental Quality
U.S. Department of Defense
Washington, DC 20301

David O. Meeker, Jr., FAIA, AIP
Assistant Secretary for Community
Planning and Development
U.S. Department of Housing and
Urban Development
Washington, DC 20410

Sheldon Meyers, Director
Office of Federal Activities
U.S. Environmental Protection
Agency
Washington, DC 20460

Warren R. Muir, Ph.D
Senior Staff Member for
Environmental Health
Council on Environmental Quality
722 Jackson Place, N.W.
Washington, DC 20006

W. H. Pennington
Assessment and Coordination Officer
Division of Biomedica and
Environmental Research
U.S. Energy Research and Development
Administration
Washington, DC 20545

Private Industry (18)

David M. Anderson
Manager, Environmental
Quality Control
Bethlehem Steel Corporation
Bethlehem, PA 18016

Letitia Davis
Coordinator
Urban Environment Conference, Inc.
1714 Massachusetts Avenue, N.W.
Washington, DC 20036

Arthur B. Dayton, Jr.
Engineering Manager
Risdon Manufacturing Company
Naugatuck, CT 06770

Danal A. Gray, Jr.
President
The Naugatuck Valley Industrial
Council, Inc.
30 Holmes Avenue
Waterbury, CT 06710

Francis P. Grimes
Staff Representative
Safety and Health Department
United Steel Workers of America
Five Gateway Center
Pittsburgh, PA 15222

Vincent J. Hanlon
Vice President and General Manager
Risdon Manufacturing Company
2100 S. Main Street
Waterbury, CT 06706

Everett E. Harris
Manager, Production Operations
Linen supply Association of America
Post Office Box 402427
975 Arthur Godfrey Road
Miami Beach, FL 33140

F. Donald Hart
President
American Gas Association
1515 Wilson Boulevard
Arlington, VA 22209

G. O. Keutgen
Executive Director
Ford Motor Company
The American Road
Dearborn, MI 48121

Rufus W. Miller, M.D.
Chairman, AOMA Committee on
Noise and Hearing Conservation
6060 W. Bristol Road
Flint, MI 48554

William R. Petricone
Vice President
Torin Corporation
Kennedy Drive
Torrington, CT 06790

William H. Prokop
Director of Engineering
Services
National Renderers Association,
Inc.
3150 Des Plaines, IL 60018

William D. Rinehart
Vice President
American Newspaper Publishers
Association/Research Institute
1350 Sullivan Trail
Post Office Box 598
Easton, PA 18042

E. M. Stoddard
Trustee
Southern Idaho Forestry Association
Box 1991
Boise, ID 83701

S. G. Sweet
Vice President
The Eastern Company
112 Bridge Street
Naugatuck, CT 06770

Darold W. Taylor
Director of Engineering
National Clay Pipe Institute
1130 17th Street, N.W.
Washington, DC 20036

Carl Toothaker
Vice President, Manufacturing
Uniroyal Consumer Products
Division of Uniroyal, Inc.
Naugatuck Footwear Plant
58 Maple Street
Naugatuck, CT 06790

Glenn E. Watts
President
Communications Workers of America
1925 K Street, N.W.
Washington, DC 20006

The comments received from the above are attached as Appendix B of this FEIS. In addition to these written comments, all data, information, views, and testimony on environmental impacts received into the record for the noise rulemaking proceeding have been reviewed and considered in the development of this FEIS.

IX. APPENDIX A

FEDERAL REGISTER NOTICE - PROPOSED REQUIREMENTS AND PROCEDURES FOR OCCUPATIONAL EXPOSURE TO NOISE

(39 FR 37773 - 37778)

proposed rules

DEPARTMENT OF LABOR

Occupational Safety and Health Administration

[29 CFR Part 1910]

[Docket No. OSH-11]

OCCUPATIONAL NOISE EXPOSURE

Proposed Requirements and Procedures

I. *Background.* On August 14, 1973, the National Institute for Occupational Safety and Health (NIOSH), Department of Health, Education, and Welfare, provided to the Department of Labor a criteria package, "Occupational Exposure to Noise" (HSM 73-11001), in accordance with section 20(a)(3) of the Occupational Safety and Health Act of 1970 (84 Stat. 1610, 29 U.S.C. 669). Thereupon, the Assistant Secretary of Labor for Occupational Safety and Health appointed a Standards Advisory Committee on Noise under section 7(b) of the Act (84 Stat. 1597, 29 U.S.C. 656). The purpose of this Committee was to obtain and evaluate additional recommendations from labor, management, government, and independent experts. The Committee in its deliberations considered 138 written comments directed to it by interested parties, as well as numerous oral presentations. It transmitted recommendations for a revised standard to the Occupational Safety and Health Administration (OSHA) on December 20, 1973.

OSHA has evaluated the information and recommendations contained in the NIOSH criteria package and the Advisory Committee's report. The OSHA proposal set forth below incorporates these recommendations with several additions and modifications.

II. *Exposure limits.* The current standard on occupational noise exposure limits an employee's exposure to 90 dBA, as an eight hour time weighted average. NIOSH indicated a need for reducing this eight hour exposure level to 85 dBA, but was unable to recommend a specific time period after which the 85 dBA noise level should become effective for all industry due to the unavailability of sufficient data relating to technological feasibility of this level. Therefore, NIOSH reluctantly concurs with the generally acceptable 90 dBA occupational exposure level for an eight hour day. The Advisory Committee's final report recommended retaining the 90 dBA permissible limit for an eight hour day.

The Environmental Protection Agency (EPA), basing its recommendations on a review of hearing impairment risk, has recommended that OSHA reduce the limit at least to 85 dBA. EPA, which reviewed the draft standard proposal under the authority of section 4(c)(2) of the Noise Control Act of 1972, further recommended that additional studies be undertaken to explore reducing the permissible level still further at some future date.

With regard to the risk of hearing loss, OSHA recognizes that comparatively more workers will be at lower risk at 85 dBA than at 90 dBA. However, we also recognize the technical feasibility problems and the economic impact associated with an 85 dBA requirement as reflected in the Bolt Baranek and Newman study and in the draft Environmental Impact Statement. Therefore, OSHA proposes to keep the level at 90 dBA until further empirical data and information on the health risk, feasibility, and economic impact indicate the practicality and necessity of an 85 dBA requirement. We feel that the present level, when coupled with a stringent hearing conservation program beginning at 85

dBA, will reduce the risk to an acceptable level during the period of further consideration.

OSHA is aware of several studies currently under way that may provide additional information for this determination. In addition, the audiometric testing program required by this proposal should provide even more information on this issue. OSHA also requests any available information that can help clarify the question of permissible level.

Another consideration in determining the permissible exposure level is the appropriate doubling rate. This rate is the amount by which exposure intensity may be increased when exposure time is decreased. For example, the 5 dB doubling rate incorporated in the present standard and continued in the proposal would allow an exposure of 85 dBA for 16 hours; 90 dBA for 8 hours; and 95 dBA for 4 hours.

EPA recommended a doubling rate of 3 dB. While the 3 dB doubling rate is hypothetically correct for uninterrupted noise exposure, noise exposure in industry is normally interrupted since there are several breaks in the day's work. OSHA agrees with the Advisory Committee that the doubling rate should be adjusted to take into account the various breaks which occur in a workday. Therefore, OSHA believes that a doubling rate of 5 dB is more appropriate than 3 dB.

The present OSHA standard recommends that impact or impulse sounds not exceed a peak sound pressure level of 140 dB. The Advisory Committee suggested that this limit be made mandatory. OSHA has made an addition to the Advisory Committee's recommendation with respect to impulse noise exposure, because the actual exposure is a summation of the peak sound levels of the impulses and the number of impulses. OSHA proposes to limit exposure to impulses at 140 dB to 100 per day and to permit a tenfold increase in the number of impulses for each 10 dB decrease in the peak pressure of the impulse. For example, the number of impulses allowed at 130 dB would be 1,000 per day and the number of impulses allowed at 120 dB would be 10,000 per day. This proposal is in accordance with the criterion proposed by McRobert and Ward (H. McRobert and W. D. Ward, "Damage Risk Criteria: The Trading Relation Between Intensity and the Number of Non-Reverberant Impulses," "J. Acoustic. Soc. Am." 53: 1297–1300 (1973)).

III. *Controls.* The current standard states that feasible engineering and administrative controls shall be used to reduce noise exposure to within permissible levels. If such controls are not feasible or cannot reduce the sound levels to within permissible limits, then personal protective equipment shall be used to achieve compliance with the standard. This proposal continues the requirement that engineering and administrative controls be applied first to reduce noise to within permissible levels. The proposal also makes it clear that if engineering and administrative controls are not sufficient to reduce noise exposure to within permissible levels, such controls must nevertheless be used to reduce exposure to the greatest extent feasible and must be supplemented by personal protective equipment to achieve compliance. The proposal requires that all engineering and administrative controls be implemented, except where they are infeasible.

It is the opinion of OSHA that general use of hearing protection devices as a primary means of controlling noise exposure is not good industrial hygiene practice. It is not a satisfactory method of reducing noise exposure due to administrative difficulties commonly associated with the use of hearing protective devices. Thus, while hearing protective devices might technically afford the same protection as engineering controls, experience has shown that the protection afforded is diminished by the difficulty of management in requiring their use, workers' resistance to using them, and improper use and improper maintenance of such equipment. Accordingly, except in certain limited circumstances this proposal relies primarily on engineering and administrative controls to reduce employee noise exposure. OSHA has, however, received numerous recommendations to permit the use of hearing protective devices in lieu of expensive engineering controls to reduce the workplace noise level. Some claim that hearing protective devices are as effective as engineering controls in reducing noise exposure and may even have the added benefit of reducing worker exposure far below 85 dBA. Therefore, it has been suggested that the employer be given the choice of which method is utilized to achieve compliance with the standard. In view of the controversy surrounding the desirability of using protective devices to reduce employee noise exposure, OSHA will welcome and consider any submissions concerning the effective use of these devices.

IV. *Hearing conservation program.* Due to the wide variation in susceptibility to hearing loss from noise, it is not possible to determine a sound level exposure which will prevent all hearing loss in all members of an exposed population. The proposed requirement for a hearing conservation program that includes audiometric testing will prevent, or at least minimize, permanent noise induced hearing loss by identifying those workers especially susceptible to noise. Audiometric testing will be initiated for all employees with eight hour noise exposures of 85 dBA or higher. The audiometric testing program will also be required for those employees who wear personal protective equipment to reduce their noise exposures. Testing is necessary for these employees to assure that their hearing protectors are being used effectively.

OSHA believes that the audiometric testing program will detect any changes in hearing level in these workers so that the employer can adopt corrective action and inform employees before the changes become significant. In order for the results of such a testing program to be valid and meaningful, the audiometric environment and technique must be well standardized and stable over a sufficient number of years to represent a significant fraction of the employee's working life. It is also essential that these factors be reasonably identical from one employment to another. For these reasons, mandatory requirements are proposed for audiometric test rooms and the calibration of audiometers in the Appendix of this proposal.

V. *Monitoring.* Although the current standard requires exposures to be controlled within specified limits, it does not explicitly require monitoring of the sound level of the employee's surroundings nor measurement of the individual employee's resulting exposure. This proposal makes monitoring and measuring requirements explicit. It requires the employer to determine if any employee is exposed to an eight hour time weighted average of 85 dBA or above. If any employees are so exposed, the employer must identify such employees and measure their exposure. The proposal also prescribes the minimum acceptable accuracy for monitoring instruments.

VI. *Records.* The proposal requires the maintenance of records of the results of required measuring, monitoring and the calibration of the instruments used therein. Employers are required to retain employee audiograms for the duration of employment plus five years; retention of other records is required for five years. The proposed period of retention of these records reflects OSHA's evaluation of their future usefulness to employers, employees and the government.

In addition, the proposal implements the requirements of section 8(c)(3) of the Act (84 Stat. 1590, 29 U.S.C. 657), which concerns, among other things, employee access to monitoring records. Accordingly, the proposal contains provisions concerning the employee right to observe monitoring and provisions assuring employees and former employees access to records of noise exposure. In addition, the proposal would require that prompt written notification be given to any employee who has been exposed to noise in excess of the permissible limits. This notification must be accompanied by a statement of the corrective action being taken.

Accordingly, pursuant to section 6(b) and 8(c)(3) of the Williams-Steiger Occupational Safety and Health Act of 1970 (84 Stat. 1593, 1599; 29 U.S.C. 655, 657), Secretary of Labor's Order No. 12–71 (36 FR 8754), and 29 CFR Part 1911, it is hereby proposed to revise § 1910.95 of Title 29 of the Code of Federal Regulations as set forth below.

Written data, views, and arguments concerning the proposal may be mailed to Docket Officer, Docket OSH–11, Occupational Safety and Health Administration, Room 2[illegible] 1726 M Street, NW, Washington, [illegible] 20210, on or before December 9, 19[illegible] The data, views, and arguments will [illegible] available for public inspection and copying at the above address.

Pursuant to 29 CFR 1911.11 (b) and (c), interested persons may, in addition to filing written matter as provided above, file objections to the proposal and

request an informal hearing with respect thereto in accordance with the following conditions:

(1) The objections must include the name and address of the objector;

(2) The objections must be postmarked on or before December 9, 1974.

(3) The objections must specify with particularity the provision of the proposed rule to which objection is taken, and must state the grounds therefor;

(4) Each objection must be separately stated and numbered; and

(5) The objections must be accompanied by a summary of the evidence proposed to be adduced at the requested hearing.

As proposed, § 1910.95 would read as follows:

§ 1910.95 Occupational noise exposure.

(a) *Application and purpose.* This section applies to occupational noise exposures in employments covered in this part. The purpose of this standard is to establish requirements and procedures that will minimize the risk of permanent hearing impairment from exposure to hazardous levels of noise in workplaces.

(b) *Definitions.* "Administrative controls" means any procedure which limits daily noise exposure by control of the work schedule. Hearing protectors do not constitute administrative controls.

"Assistant Secretary" the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or his designee.

"Audiogram" a graph or table of hearing level as a function of frequency that is obtained from an audiometric examination.

"Baseline audiogram" the first audiogram taken during employment with the current employer.

"Certified audiometric technician" an individual who meets the training requirements specified by the Intersociety Committee on Audiometric Technician Training (American Industrial Hygiene Association Journal, 27:303–304 (May–June 1966)) or who is certified by the Council of Accreditation in Occupational Hearing Conservation.

"Daily noise dose" (D) the cumulative noise exposure of an employee during a working day.

"dBA" (decibels—A-weighted)—a unit of measurement of sound level corrected to the A—weighted scale, as defined in ANSI S1.4–1971, using a reference level of 20 micropascals (2×10^{-4} Newtons per square meter).

"Director" the Director, National Institute for Occupational Safety and Health, U.S. Department of Health, Education, and Welfare, or his designee.

"Engineering control" any design procedure that reduces the sound level.

"Hearing level" the amount, in decibels, by which the threshold of audibility for an ear differs from the standard audiometric reference level.

"Peak sound pressure level" the peak instantaneous pressure expressed in decibels, using a reference level of 20 micropascals.

"Workplace sound level" the sound level measured at the employee's point of exposure.

"Impulse or impact noise"—a sound with a rise time of not more than 35 milliseconds to peak intensity and a duration of not more than 500 milliseconds to the time when the level is 20 dB below the peak. If the impulses recur at intervals of less than one-half second, they shall be considered as continuous sound.

"Significant threshold shift" an average shift of more than 10 dB at frequencies of 2000, 3000, and 4000 Hz relative to the baseline audiogram in either ear.

(c) *Permissible exposure limits.*—(1) *Steady state noise—single level.* (i) The permissible exposure to continuous noise shall not exceed an eight hour time-weighted average of 90 dBA with a doubling rate of 5 dBA. For discrete permissible time and exposure limits, refer to Table G–16a, which is computed from the formula in paragraph (c) (1) (ii) of this section.

TABLE G–16a

Sound level (dBA)	Time permitted (hours-minutes)	Sound level (dBA)	Time permitted (hours-minutes)
85	16-0	101	1-44
86	13-56	102	1-31
87	12-8	103	1-19
88	10-34	104	1-9
89	9-11	105	1-0
90	8-0	106	0-52
91	6-58	107	0-46
92	6-4	108	0-40
93	5-17	109	0-34
94	4-30	110	0-30
95	4-0	111	0-26
96	3-29	112	0-23
97	3-2	113	0-20
98	2-50	114	0-17
99	2-15	115	0-15
100	2-0		

(ii) Where Table G–16a does not reflect actual exposure times and levels, the permissible exposure to continuous noise at a single level shall not exceed a time amount "T" (in hours) computed by the formula:

$$T=\frac{16}{4^{[.2(L-85)]}}$$

where "L" is the workplace sound level measured in dBA on the slow scale of a standard sound level meter. The relationship between time and sound level is depicted in Figure G–9.

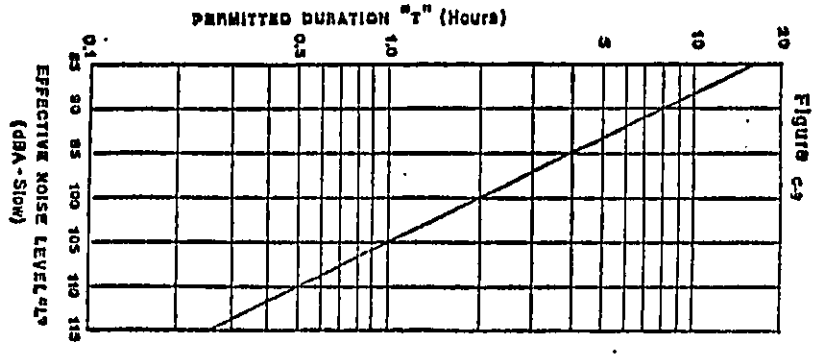


Figure G-9

(2) *Steady state noise—two or more levels.* Exposures to continuous noise at two or more levels may not exceed a daily noise dose "D" of unity (1) where "D" is computed by the formula:

$$D=\frac{C_1}{T_1}+\frac{C_2}{T_2}+\cdots+\frac{C_n}{T_n}$$

where C is the actual duration of exposure (in hours) at a given steady-state noise level; and T is the noise exposure limit (in hours) for the level present during the time C, computed by the formula in paragraph (c) (1) (ii) of this section.

(3) *Maximum steady state noise level.* Exposures to continuous noise shall not exceed 115 dBA, regardless of any value computed in paragraphs (c) (1) or (c) (2) of this section.

(4) *Impulse or impact noise.* (i) Exposures to impulse or impact noise shall not exceed a peak sound pressure level of 140 dB.

(ii) Exposures to impulses of 140 dB shall not exceed 100 such impulses per day. For each decrease of 10 dB in the peak sound pressure level of the impulse, the number of impulses to which employees are exposed may be increased by a factor of 10.

(d) *Monitoring*—(1) *Duty.* Each employer shall determine if any employee is exposed to a daily noise level dose of 0.5 or above, and shall determine if any employee is exposed to impulse or impact noise in excess of the exposure permitted by paragraph (c)(4) of this section. Such determinations shall be made:

(i) At least annually, and

(ii) Within 30 days of any change or modification of equipment or process, or other workplace or work practice modifications affecting the noise level.

(2) *Procedure.* If determinations made pursuant to paragraph (d)(1) of this section reveal any employee exposure to a daily noise dose of 0.5 or above, or exposure to impulse or impact noise in excess of that permitted by paragraph (c)(4) of this section, the employer shall:

(i) Identify all employees who may be so exposed;

(ii) Measure the exposure of the employees so identified; and

(iii) Make all noise level measurements with the microphone of the sound measuring instrument at a position which most closely approximates the noise levels at the head position of the employee during normal operations.

(3) *Equipment.* (i) Measurements of steady state noise exposures shall be made with a sound level meter conforming as a minimum to the requirements of ANSI S1.4–1971, Type 2, and set to an A-weighted slow response or with an audiodosimeter of equivalent accuracy and precision. The unit of measurement shall be decibels re 20 micropascals A-weighted.

(ii) Measurements of impulse or impact noise exposures shall be made with a sound level meter conforming as a minimum to the requirements of the ANSI S1.4–1971, Type 1 or Type 2, with a peak hold capability or accessory. For peak hold measurements, the rise time of the strumentation) shall be not more than 50 microseconds. The decay rate for the peak hold feature shall be less than 0.05 decibels per second. The unit of measurement shall be decibels peak sound pressure level re 20 micropascals.

(4) *Calibration of equipment.* An acoustical calibrator accurate to within plus or minus one decibel shall be used to verify the before and after calibration of the sound measuring instrument on each day noise measurements are taken.

(5) *Observation of monitoring*—(i) *Duty.* The employer shall give employees or their representatives an opportunity to observe any monitoring of the noise levels in the workplace which is conducted pursuant to this section.

(ii) *Notification of employee right.* Written notice of the opportunity to observe the monitoring required by this section shall be prominently posted in a place regularly visited by affected employees and where notices to employees are usually posted. The employer shall take steps to insure that this notice is not altered, defaced, or covered by other material.

(A) The notice shall be posted at least three working days before monitoring is scheduled to occur.

(B) The notice shall list the time and place where monitoring will take place.

(C) The employer may require the employee or the employee representative to give advance written notification of intent to observe such monitoring.

(iii) *Exercise of opportunity to observe monitoring.* (A) When observation of the monitoring of the workplace for noise levels requires entry into an area where the use of personal protective devices is required, the employer shall provide and the observer shall use such equipment and comply with all other applicable safety procedures.

(B) Observers shall be given an explanation of the procedure to be followed in measuring the workplace noise level.

(C) Observers shall be permitted, without interference with persons performing the monitoring, to:

(*1*) Visually observe all steps related to the collecting and evaluating of the noise level data that are being performed at the time;

(2) Record the results obtained; and

(3) Have a demonstration of the calibration function tests of the monitoring equipment when the calibrations are performed at the worksite before monitoring; where the calibrations are not performed at the worksite, the techniques shall be explained.

(e) *Methods of compliance.* (1) Whenever employees are exposed to workplace sound levels exceeding those permitted by paragraph (c) of this section, engineering and administrative controls shall be utilized to reduce employee noise exposure to within permissible limits, except to the extent that such controls are not feasible. If such controls fail to reduce sound levels to within the permissible limits of paragraph (c) of this section, they shall be used to reduce the sound levels to the lowest level feasible and shall be supplemented by personal protective equipment in accordance with paragraph (*f*) of this section to further reduce the noise exposure to within permissible limits. Where the engineering and administrative controls which have been implemented do not reduce the sound levels to within the permissible limits of paragraph (c) of this section, the employer shall continue to develop and implement engineering and administrative controls as they become feasible.

(2) A program shall be established and implemented to reduce exposures to within the permissible exposure limit, or to the greatest extent feasible, solely by means of engineering controls. Written plans for such a program shall be developed and furnished upon request to authorized representatives of the Assistant Secretary and the Director.

(3) Exception. Hearing protectors may be provided to, and used by an employee to limit noise exposures in lieu of feasible engineering and administrative controls if the employee's exposure occurs on no more than one day per week.

(f) *Hearing protectors.* (1) Hearing protectors shall be provided to, and used by: (i) Employees receiving a daily noise dose between 0.5 and 1.0 (a daily noise dose of 0.5 is equivalent to an eight hour time weighted exposure of 85 dBA) if their audiograms show any significant threshold shift;

(ii) Employees who receive noise exposures in excess of the limits prescribed in paragraph (c) of this section: (A) During the period required for the implementation of feasible engineering and administrative controls; (B) in instances where engineering and administrative controls are feasible only to a limited extent; or (C) in instances where engineering and administrative controls have been shown to be infeasible.

(2) Hearing protectors shall reduce employee noise exposure to within the limits prescribed in paragraph (c) of this section.

(3) Procedures shall be established and implemented to assure proper issuance, maintenance, and training in the use of hearing protectors.

(g) *Hearing conservation*—(1) *General.* (i) A hearing conservation program shall be established and maintained for employees who:

(A) Receive a daily noise dose equal to or exceeding 0.5; or

(B) Are required to wear hearing protectors pursuant to paragraph (*f*) of this section.

(ii) The hearing conservation program shall include at least an annual audiometric test for affected employees at no cost to such employees.

(iii) If no previous baseline audiogram exists, a baseline audiogram shall be taken within 90 days for each employee (A) who receives a daily noise dose of 0.5 or above; or (B) who is required to wear hearing protectors pursuant to paragraph (*f*) of this section.

(iv) Each employee's annual audiogram shall be examined to determine if any significant threshold shift in either ear has occurred relative to the baseline audiogram.

(v)(A) If a significant threshold shift is present, the employee shall be retested within one month.

(B) If the shift persists: (*1*) Employees not having hearing protectors shall be provided with them in accordance with paragraph (*f*) of this section;

(2) Employees already having hearing protectors shall be retrained and reinstructed in the use of hearing protectors.

(3) The employee shall be notified of the shift in hearing level.

(2) *Audiometric testing.* (i) Audiometric tests shall be administered by a certified audiometric technician or an individual with equivalent training and experience.

(ii) Audiometric tests shall be preceded by a period of at least fourteen hours during which there is no exposure to workplace sound levels in excess of 80 dBA. This requirement may be met by wearing hearing protectors which reduce the employee noise exposure level to below 80.

(iii) Audiometric tests shall be pure tone, air conduction, hearing threshold examinations, with test frequencies including as a minimum, 500, 1000, 2000, 3000, 4000 and 6000 Hz and shall be taken separately for each ear.

(iv) The functional operation of the audiometer shall be checked prior to

each period of use to ensure that it is in proper operating order.

(v) Equipment, calibration and facilities shall meet the specifications set forth in the Appendix.

(h) *Information and warnings.*—(1) *Signs.* Clearly worded signs shall be posted at entrances to, or on the periphery of, areas where employees may be exposed to noise levels in excess of the limits prescribed in paragraph (c) of this section. These signs shall describe the hazards involved and required protective actions.

(2) *Notification.* Each employee exposed to noise levels which exceed the limits prescribed in paragraph (c) of this section shall be notified in writing of such excessive exposure within 5 days of the time the employer discovers such exposure. Such notification shall inform the affected employee of the corrective action being taken.

(i) *Records.* — (1) *Noise exposure measurements.* (i) The employer shall keep an accurate record of all noise exposure measurements made pursuant to paragraph (d) of this section.

(ii) The record shall include the following information: (A) name of employee, social security number and daily noise dose;

(B) location, date, and time of measurement and levels obtained;

(C) Name of person making measurement;

(D) Type, model and date of calibration of measuring equipment.

(iii) These records shall be maintained for a period of at least five years.

(2) *Audiometric tests.* (i) The employer shall keep an accurate record of all employee audiograms taken pursuant to paragraph (g) of this section.

(ii) The record shall include the following information: (A) Name of employee and social security number;

(B) Job location of employee;

(C) Date of the audiogram;

(D) The examiner's name and certification;

(E) Model, make and serial number of the audiometer; and

(F) Date of the last calibration of the audiometric test equipment.

(iii) These records shall be maintained for the duration of the affected employee's employment plus 5 years.

(3) *Calibration of audiometers.* (i) The employer shall keep an accurate record of all audiometer calibrations required to be made pursuant to paragraph (g) of this section and the Appendix.

(ii) The record shall include the following information:

(A) Type of calibration;

(B) Date performed; and

(C) All measurements obtained.

(iii) These records shall be maintained for a period of 5 years.

(4) *Access to records.* (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary and the Director.

(ii) Records of noise exposure measurements required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(iii) Employee audiometric data required to be maintained by this section shall be made available upon written request to the employee or former employee.

(j) *References.* (1) ANSI S1.4–1971, American National Standard Specification for Sound Level Meters, S1.4–1971, American National Standards Institute, 1430 Broadway, New York, New York 10018.

(2) ANSI S3.6–1969—American National Standard Specifications for Audiometers, S3.6–1969—American National Standards Institute, 1430 Broadway, New York, New York 10018.

(3) ANSI S1.11–1971—American National Standard Specification for Octave, Half-Octave, and Third Octave Band Filter Sets S1.11–1966 (Reaffirmed 1971), American National Standards Institute, 1430 Broadway, New York, New York 10018.

(4) ANSI Z24.22–1957 (R 1971)—American National Standard Method for the Measurement of the Real-Ear Attenuation of Ear Protectors at Threshold, Z24.22–1957, American National Standards Institute, 1430 Broadway, New York, New York 10018.

(5) American Industrial Hygiene Association Journal, 27:303-304 (May-June 1966), American Industrial Hygiene Association, 66 S. Miller Road, Akron, Ohio 44313.

(6) Council for Accreditation in Occupational Hearing Conservation, 1610 Chestnut Avenue, Haddon Heights, New Jersey 08035.

(7) ISO R389–1964—International Organization for Standardization Recommendation R389–1964, Standard Reference Zero for the Calibration of Pure Tone Audiometers, including Addendum 1–1970, Available from the American National Standards Institute, 1430 Broadway, New York, New York 10018.

APPENDIX

AUDIOMETRIC EQUIPMENT AND FACILITIES

(1) *Audiometric test rooms.* Rooms used for audiometric testing shall not have sound pressure levels exceeding those in Table G–10b when measured by equipment conforming to the requirements of ANSI S1.4–1971, Type 1 or Type 2, and ANSI S1.11–1971.

TABLE G–10b—MAXIMUM ALLOWABLE SOUND PRESSURE LEVELS FOR AUDIOMETER ROOMS

Octave band center frequency (Hz)	500	1000	2000	4000	8000
Sound pressure level (dB)	40	40	47	53	62

(2) *Audiometric measuring instruments.* (i) Instruments used for measurements required in paragraph (g) of this section shall be of the discrete frequency type which meet the requirements for limited range pure tone audiometers prescribed in ANSI S3.6–1969.

(ii) In the event that pulsed tone audiometers are used, they shall have a tone on-time of at least 200 milliseconds.

(iii) Self-recording audiometers shall comply with the following requirements: (A) The chart upon which the audiogram is traced shall have lines at positions corresponding to all multiples of 10 dB hearing level within the intensity range spanned by the audiometer. The lines shall be equally spaced and shall be separated by at least ¼ inch. Additional gradations are optional. The audiogram per tracings shall not exceed 2 dB in width.

(B) It shall be possible to set the stylus manually at the 10 dB graduation lines for calibration purposes.

(C) The slewing rate for the audiometer attenuator shall not be more than 6 dB/sec except that an initial slewing rate greater than 6 dB/sec is permitted at the beginning of each new test frequency, but only until the second subject response.

(D) The audiometer shall remain at each required test frequency for 30 seconds (±3 seconds). The audiogram shall be clearly marked at each change of frequency and the actual frequency change of the audiometer shall not deviate from the frequency boundaries marked on the audiogram by more than ±3 seconds.

(E) For audiograms taken with a self-recording audiometer, it must be possible at each test frequency to place a horizontal line segment parallel to the time axis on the audiogram, such that the audiometric tracing crosses the line segment at least six times at that test frequency. At each test frequency the threshold shall be the average of the midpoints of the tracing excursions.

(3) *Audiometer calibrations.* (i) A biological calibration shall be made at least once each month and shall consist of testing a person having a known stable audiometric curve that does not exceed 25 dB hearing level at any frequency between 500 and 6,000 Hz and comparing the test results with the subject's known baseline audiogram, and

(ii) If the results of a biological calibration indicate hearing-level differences greater than 5 dB at any frequency, if the signal is distorted, or there are attenuator or tone switch transients, then the audiometer shall be subjected to a periodic calibration.

(iii) A periodic calibration shall be performed at least annually. The accuracy of the calibrating equipment shall be sufficient to assure that the audiometer is within the tolerances permitted by ANSI S3.6–1969. The following measurements shall be performed: (A) With the audiometer set at 70 dB hearing threshold level, measure the sound pressure levels of test tones using a National Bureau of Standards Type 9A coupler, for both earphones and at all test frequencies.

(B) At 1000 Hz, for both earphones, measure the earphone decibel levels of the audiometer for 10 dB graduations in the range 70 to 10 dB hearing threshold level. This measurement may be made acoustically with a National Bureau of Standards Type 9A coupler or electrically at the earphone terminals.

(C) Measure the test tone frequencies between 500 and 6000 Hz with the audiometer set at 80 dB hearing threshold level, for one earphone.

(D) A careful listening test, more extensive than that required for biological calibration shall be made in order to ensure that the audiometer displays no evidence of distortion, unwanted sound, or other technical problems.

(E) The functional operation of the audiometer shall be checked to ensure that it is in proper operating order.

(iv) An exhaustive calibration shall be performed at least every five years. This shall include testing at all settings for both earphones. The test results shall demonstrate that the audiometer meets specific requirements stated in the applicable sections of ANSI S3.6–1969 as listed below: (A) [Sections 4.1.2 and 4.1.4.2] Accuracy of decibel level settings of all test tones,

(B) [Section 4.1.2] Accuracy of test tone frequencies,

(C) [Section 4.1.3] Harmonic distortion of test tones,

(D) [Section 4.5] Tone-envelope characteristics, i.e., rise and decay times, overshoot, "Off" level,

(E) [Section 4.4.2] Sound from second earphone,

(F) [Section 4.4.1] Sound from test earphone, and

(G) [Section 4.4.3] Other unwanted sound.

(Secs. 6, 8, Pub. L. 91-596, 84 Stat. 1593, 1600 (29 U.S.C. 655, 657), Secretary of Labor's Order No. 12-71 (36 FR 8754)).

Signed at Washington, D.C., this 18th day of October 1974.

JOHN STENDER,
Assistant Secretary of Labor.

[FR Doc.74-24705 Filed 10-23-74;8:45 am]

X. APPENDIX B

COMMENTS RECEIVED IN RESPONSE TO THE DEIS

Bethlehem Steel Corporation

BETHLEHEM, PA. 18016

D. M. ANDERSON, Ph. D.
Manager of
Environmental Quality Control
M. A. CONAHAN
Assistant Manager of
Environmental Quality Control

July 31, 1975

Mr. David R. Ball
Room N3669
New Department of Labor Building
200 Constitution Avenue, N.W.
Washington, DC 20210

Re: Draft Environmental Impact Statement,
Proposed Legislation, Noise

Dear Mr. Bell:

We are taking advantage of our opportunity to submit comments and recommendations on subject Statement before the closing date of August 8, 1975. It is requested that serious consideration be given to the comments and recommendations given below for specific aspects of the Environmental Impact Statement:

Exposure Levels

In subject document, comparisons are made to a 90 dBA for 8-hour exposure rule; however, the proposed regulation is based on an 85 dBA for a 16-hour exposure. The proposed standard, as it is written, would cause an increase of 40% in the number of employees at Bethlehem Steel Corporation affected by the present OSHA 90 dBA for 8-hour exposure standard. This being the case, it would seem that the impact of employees protected by the proposed standard is not properly considered or stated. It is recommended that the true impact be stated or the proposed standard be rewritten to allow 90 dBA for an 8-hour exposure.

Also, the impact/impulse exposure limits are not in accordance with the article by McRoberts and Ward as stated. It is revealed in that article that considerable more exposure than the proposed limit could be allowed in many cases. This point should be clarified in the impact statement.

Controls

It has been well established through written comments and by testimony at the hearings on the proposed noise regulations that ear protectors are effective in adequately controlling excessive noise exposures. It has also been shown that the cost of ear protection is a mere fraction of that

required for engineering controls. A comparison of costs for ear protection versus engineering controls should be made in the Statement. Also, some of the drawbacks of engineering controls, like loss of production, increased maintenance costs, reducing of machine life due to heat should be discussed. The health impact of using ear protection for controlling excessive noise exposures versus using engineering controls should be discussed in detail.

Hearing Conservation Program

It was brought out in the hearings on the proposed regulation that it is not necessary to provide annual audiometric tests on employees after they have had two or three audiograms. The health impact of annual audiometric testing versus testing every three years after the first two audiograms should be discussed.

Monitoring and Records

Many people presenting testimony at the hearings on the proposed regulation criticized the extreme requirements of the monitoring and records sections. The health impact of reducing these requirements should be discussed.

In general, it is felt that the environmental impact which would be caused by the proposed regulation would be greater and much broader than what is reported in the subject Statement. It is recommended that the vast amount of information presented at the hearings on all aspects of the proposed noise exposure regulation be used to develop the impact. Also, it is recommended that an economic impact statement be prepared and published for the proposed regulation.

We thank you for the opportunity to comment on the Draft Environmental Impact Statement.

Sincerely yours,

David M. Anderson

David M. Anderson
Manager
Environmental Quality Control

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
WASHINGTON, D.C. 20250

July 7, 1975

Mr. David R. Bell
U.S. Department of Labor
New Department of Labor Building
200 Constitution Avenue, N. W.
Washington, D.C. 20210

Dear Mr. Bell:

We have reviewed the Draft Environmental Impact Statement on the Proposed Regulation on Noise.

According to a statement in the middle of page 3, the proposal will not be applicable to agriculture, therefore, we assume that noise from machines such as tractors and corn pickers does not come under the proposal. If our assumption is correct, why is the statement regarding agricultural machinery included in the summary paragraph?

For the past three or four years, the Nebraska Tractor Test Data, "Agricultural Engineers Yearbook," includes sound levels for most of the tractors tested. These data show that most of the tractors with cabs that were tested had sound level readings below the 90 dB(A) standard. Most of the tractors without cabs had sound levels above the 90 dB(A). This high noise level is and should be of some concern. However, field operations seldom, if ever, are performed in continuous 8-hour time units (2 to 4-hour time units are more common). Most field operations, such as harvesting, are performed in a time frame of less than one month and the actual operating time during that month is frequently less than ten days. The effect that intermittent exposures to noise levels like those created by the use of farm machinery has not been fully determined.

I suggest changing the statement on page 1, 1st paragraph, to the following:

> "Agricultural machinery such as tractors and crop dryers produce noise levels above the limit currently considered safe for general industry."

Sincerely,

H. L. Barrows
Deputy Assistant Administrator

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20201

AUG 13 1975

Mr. David R. Bell
Occupational Safety and Health
Administration
U.S. Department of Labor
New Dept. of Labor Building, Room N3669
200 Constitution Avenue, N.W.
Washington, D.C. 20210

Dear Mr. Bell:

We have reviewed the draft Environmental Impact Statement concerning the Proposal to Regulate Occupational Exposure to Excessive Noise. Based on the review, we offer the following comments:

In August 1972, NIOSH transmitted to the Department of Labor, through the Secretary of DHEW, criteria for a recommended standard for occupational exposure to noise. The document notes on page II-3 that "Currently NIOSH reluctantly concurs with the generally acceptable 90 dBA occupational exposure level for an 8-hour day. The need for reducing this 8-hour exposure level to 85 dBA, as supported by the material in this document, is also recognized. It is recommended that the 85 dBA, 8-hour exposure level be applicable to all newly designed occupational exposure environments after 6 months from the effective date of this standard. However, due to the unavailability of sufficient data relating to the technological feasibility of meeting the 85 dBA level, NIOSH is unable to recommend a specific time period after which the 85 dBA, 8-hour occupational exposure level might become effective for all occupational noise environments."

On a strictly hearing loss basis however, the data is clear cut. Most of those exposed to over 90 dBA, 85 dBA, and a significant portion of those exposed to over 80 dBA, will

suffer some loss of ability to hear. The areas of contention can be divided into two major and a number of minor issues. The most important major issue is over how much impairment can be suffered before "handicapping" can be said to occur. Some years ago, the American Academy of Otology and Otolaryngology arbitrarily set an impairment of 25 dB (based on the average of losses at 500 Hz, 1 Khz and 2 Khz) as the point at which handicap in every day communication begins. Because losses at 500 Hz are generally very small compared to 2 KHz, 3 Khz or 4 KHz, and 25 dBA represents a significant portion of one's hearing, this definition of "hearing loss" or "hearing risk" has been increasingly criticized.

It should be noted that there is no other occupational health risk to which workers are subjected which definitely brings about the significant impairment of a bodily function. The fact that the impairments will occur is not disputed. Baughn's data for loss at 4 KHz indicates that 52% of the 14 million or so industrial production workers will lose more than 25 dB at 90 dBA exposure, 30% will lose more than 25 dB at 85 dBA, and 6% will experience this loss at 80 dBA. ISO, EPA and NIOSH figures for hearing handicap are indicated below:

	90 dBA	85 dBA	80 dBA
ISO	21%	22.3%	25%
EPA	10%	12%	15%
NIOSH	0%	5%	3%

(more than 25 dB loss at an average of 500 Hz, 1 KHz, and 2 KHz)

Thus there is hardly any dispute that roughly twice as many workers risk suffering hearing losses at 90 dBA than at 85 dBA, even considering the generous amount of impairment allowed before these levels are attained. Therefore, from a health effects standpoint OSHA's conclusion, that a 90 dBA standard is "substantially" protective, cannot be justified.

NIOSH's concern was expressed by Dr. Finklea, Director, National Institute for Occupational Safety and Health, Center for Disease Control, DHEW. In his testimony at a recent public hearing, he stated: "We are now concerned that the proposed standards may allow excessive exposures for periods of less than eight hours. We now believe that a 5 dBA step function is appropriate for an 85 dBA standard but may not provide adequate protection for a 90 dBA standard."

The EPA has recommended an 85 dBA eight-hour limit along with a 3 dBA per doubling of time trading ratio, a standard most of the industrial nations of the world have adopted in some form or another. The omission of this fact from OSHA's E.I.S. is a serious one as the level and trading ratio constitute the second important issue. We note the regulated levels and trading ratio in other countries to be as follows: East and West Germany, Sweden, Austria, Finland, USSR: 85 and 3; United Kingdom, Switzerland, France: 90 and 3: Czechoslovakia and Poland: 85 and 5. Thus OSHA's recommendation of 90 and 5 for the U.S. would be least protective of the major industrial nations.

The requirement for audiometric testing when exposures reach 85 dBA is a positive step. Such testing can be expeditiously and economically accomplished by technology now available.

There is a statement on page three under "Probable Impact" attributed to Burns and Robinson that reduction of current noise levels to 90 dBA would prevent handicapping hearing impairments for approximately 463,000 workers. It is difficult to see how such a conclusion could be drawn from the stated reference, which certainly makes no explicit statement to that effect. This and similar type references in support of important conclusions, such as the reference to anonymous experts, together with omission of data unfavorable to the proposed regulation lessen the credibility of the E.I.S.

We recommend that the final Environmental Impact Statement address systematically the issues raised by Public Health Service reviewers; and that an adequate explanation be provided as to why the United States cannot insist upon standards at least as rigorous as those of other industrial nations.

Sincerely,

Paul Cromwell
Acting Director
Office of Environmental Affairs

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20201

AUG 29 1975

Mr. David R. Bell
Occupational Safety and Health
Administration
U. S. Department of Labor
New Dept. of Labor Building - Room N3669
200 Constitution Ave., N. W.
Washington, D.C. 20210

Dear Mr. Bell:

On August 13, 1975, we commented on the draft Environmental Impact Statement concerning the Proposal to Regulate Occupational Exposure to Excessive Noise. Inadvertently the figures contained in the chart shown on page 2 were transposed. The chart should read:

	90 dBA	85 dBA	80 dBA
ISO	21%	10%	0%
EPA	22.3%	12%	5%
NIOSH	29%	15%	3%

(More than 25 dB loss at an average of 500 Hz, 1 KHz, and 2 KHz)

We hope the inversion did not caused any inconvenience in the interpretation of our comments.

Sincerely,

Charles Custard
Director
Office of Environmental Affairs

OFFICE OF THE SECRETARY OF TRANSPORTATION
WASHINGTON, D.C. 20590

ASSISTANT SECRETARY

AUG 11 1975

Mr. David R. Bell
U.S. Department of Labor
Room N3669, New Department
of Labor Building
200 Constitution Avenue, N.W.
Washington, D.C. 20210

Dear Mr. Bell:

As requested in your letter of June 10, the Department of Transportation has reviewed the draft environmental impact statement (EIS), "Proposed Noise Regulation," prepared by the Occupational Safety and Health Administration, Department of Labor.

We have no comments to offer regarding technical discussions presented in the document. The material that is quoted appears factual and accurate. However, in view of the major significance of the action proposed to be taken, the complexity of the issues involved, and the wide differences of opinion concerning the numbers of workers who would be spared hearing impairment if an 85dBA noise limit were imposed instead of the 90dBA standard, we believe that the statement should address in considerably greater detail and depth the nature of the industries in terms of unit size and numbers of each size, the present level and distribution of audiometric testing by industry (and unit size), and the potential capability of all classes of employers to provide audiometric testing in conformity with the regulation.

The statement would also benefit from expansion of the very cursory attention to discussion of the six alternatives covered on pages 52-53. For example, the Description of Action on pages 2-3, in justifying the 90dBA standard, states: "Further, the proposal will require a standardized program of audiometric testing when noise levels are equivalent to 85dBA or higher over an eight hour period. The objective of this program will be to detect shifts in hearing before significant or permanent impairment occurs." Yet on page 53, in the four-line discussion of audiometric testing done alone, the statement is made: "Further, employees would risk some degree of

hearing loss prior to detection by testing procedures." (emphasis added)

Expanded discussion would also be useful to further rationalize the selection of Robinson's data on workers at risk of permanent hearing impairment under present conditions, a 90dBA standard and an 85dBA standard, in lieu of accepting BBN estimates based on Baugn's study. According to the BBN estimate, 838,000 more workers would be protected from hearing impairment by an 85dBA standard than by a 90dBA standard. Basing estimates on the Robinson study, this difference would amount to only 73,000 workers. The reason given for using estimates based on Robinson's work is that his tests filtered out temporary threshold shifts. As "full" recovery from auditory fatigue usually requires at least fourteen hours, it would appear that most of those impaired during a working day at a 90dBA level exposure would retain some degree of hearing impairment for the remainder of their hours awake, and could only look forward to repetition of the cycle the next day. If this supposition has merit, discussion of its implications would be desirable.

Section VI of the draft EIS describes the relationship of OSHA hearing regulations to other Federal actions. Under the general heading for the Department of Transportation (DOT), it should be noted that the Bureau of Motor Carrier Safety (of the Federal Highway Administration) has issued regulations limiting vehicle interior noise levels for interstate motor carriers (Title 49, CFR, Chapter III, Subchapter B, part 393, published at 38 FR 30880 on November 8, 1973). These regulations are based on the OSHA 90dBA/8-hour criterion, and incorporate a simplified test procedure for vehicle inspection. In addition, the United States Coast Guard has issued noise level regulations adopting the OSHA noise standards for persons on board gas turbine vessels (publicly-owned vessels are excluded) and is currently preparing an amendment to extend this coverage to all vessel personnel exposed to noise from operating machinery and related systems (46 CFR 58.10-15). A similar regulation is currently being considered for railroad personnel by the Federal Railroad Administration of the Department, again based on the OSHA regulations.

While DOT standards are currently based on the OSHA 90dBA/8-hour criterion, future lowering of this noise level criterion could be reflected in modifications to the DOT standards.

We appreciate the opportunity to review this document.

Sincerely,

Herbert H. Kaiser Jr.

for Benjamin O. Davis, Jr.
Assistant Secretary for
Environment, Safety, and
Consumer Affairs

URBAN ENVIRONMENT CONFERENCE, INC.

1714 Massachusetts Avenue, N.W. • Washington, D.C. 20036 • 202 462-0660

August 21, 1975

Mr. David R. Bell
Occupational Safety and Health
Administration
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, D.C. 20210

Dear Mr. Bell,

On August 8, 1975, I called your office and received an extension of the deadline for submission of comments on the Occupational Noise EIS. My comments are attached. I appreciate the consideration.

Sincerely,

Letitia Davis

Letitia Davis

LD/ggt

URBAN ENVIRONMENT CONFERENCE, INC.

1714 Massachusetts Avenue, N.W. • Washington, D.C. 20036 • 202 462-0660

August 22, 1975

Mr. David R. Bell
Occupational Safety and Health
Administration
U.S. Department of Labor
New Dept. of Labor Bldg.
Room N 3669
200 Constitution Avenue, N.W.
Washington, D.C. 20210

Dear Mr. Bell:

We have reviewed the draft environmental impact statement on OSHA's proposed regulation for occupational noise. Based on this review, we offer the following general comments. More detailed comments on specific sections of the draft are attached.

The document, as written, cannot be accepted as an adequate EIS. An EIS is designed to serve as a decision-making tool in which the environmental impacts of one action are identified and systematically compared with impacts of other actions which might reasonably be taken to accomplish the same objective. The EIS in question serves primarily as a biased justification of the proposed action rather than an objective analysis of the environmental impacts of the various reasonable alternatives. There is an obvious commission of available data which would prove unfavorable to the proposed regulation. The data which is cited tends to underestimate the probable impacts. Several alternatives which can be considered reasonable are not discussed. Those alternatives which are addressed are dismissed with little or no analysis of their environmental consequences and without due justification. There are technical inconsistencies within the document, and many of the technical points made are subject to dispute among members of the scientific community. Where such dispute exists, it should be explicitly acknowledged in the statement.

There is one question that demands asking from a procedural perspective. "On what basis did the Department of Labor decide to prepare the EIS?" According to the National Environmental Policy Act, an EIS is required for any major federal action having a significant impact on the quality of the environment. The best vehicle for determining whether an action will have a significant environmental impact is to compare the proposed action with the "no action" alternative. Consideration of "no action" is also required in the "CEQ Guidelines for Environmental Statements". In the case in question, the impact of OSHA's proposed standard should be compared with the state of the environmental under the existing noise regulation. We question how the proposed regulation is going to significantly change the quality of the environment. It is recommended that OSHA briefly and clearly describe the existing conditions and how these are to be altered by the proposed action. If the statement was prepared in light of the fact that one was never developed for the initial regulation, this should be so stated.

Specific comments on the various sections of the draft are attached. It is strongly hoped that DOL will respond to these remarks in the development of the final environmental statement.

Sincerely,

Letitia Davis

Letitia Davis
Coordinator

LD/ggt

COMMENTS ON SPECIFIC SECTIONS OF THE EIS

Summary

1. The current research studies referred to on page 3 should be referenced.

2. On page 3 it is stated that the major impact of the proposed standard is to lessen the incidence of handicapping hearing loss related to workplace noise exposure. What is meant by "handicapping hearing loss?" The literature makes a distinction between hearing impairment, hearing handicap and hearing disability. It is suggested that OSHA likewise make a distinction between these terms and use them accordingly.

3. It is stated that the reduction of noise to 90 dBA will prevent hearing impairment which will be handicapping for approximately 463,000 workers. It is misleading to quote this one estimate alone. The 73,000 figure quoted for the 85 dBA standard is equally misleading. Members of the scientific community have provided significantly divergent estimates of the numbers of workers likely to be protected under the two possible standards. EPA, estimates for example, that under an 85 dBA standard, 1,204,820 workers would be protected from exceeding a 25 dBA hearing loss.

4. The fact that OSHA "hopes" that industry will incorporate noise level considerations in engineering specifications for new equipment (Page 4) is irrelevant to this summary discussion of environmental impact.

5. The discussion of workers not protected by the proposed standard fails to provide any quantitative estimates. Why is it that estimates are given for the number of people protected by the standard but not the number of people likely to incur hearing loss? Such estimates are available. According to NIOSH, 29% of the workers exposed to 90 dBA over a working lifetime are likely to exhibit hearing impairment.

6. The range of alternative considered is inadequate. It is recommended that OSHA expand this list to include:

   a) and 85 dBA standard to be effective after 3 years
   b) a similar standard to be effective after 5 years
   c) and 85 dBA standard combined with a 5 dBA time intensity trade-off.

Description of Proposed Action

1. OSHA uses NOISH's "reluctant concurrence" with the 90 dBA standard in justifying the proposed regulation. An objective refence to the NIOSH position would stress that on a hearing loss basis, NIOSH believes that the data is clear cut and the 85 dBA time exposure limit is more appropriate. It would also include the NIOSH recommendation that the 85 dBA level be applicable to all newly designed occupational environments. These points are mentioned later in the draft, but the failure to mention them in the preamble is analogous to quoting out of context in order to support your argument.

2. OSHA's argument that sufficient data on the technological feasibility of the 85 dBA standard contradicts the information provided by OSHA's own contractors. Bolt, Beranek and Newman have estimated that it is technologically feasible for 92% of the industries to comply with both the 90 dBA and the 85 dBA standards. Their study concluded, "The primary current limitation to the reduction of noise at the workplace is the level of costs which the industry finds acceptable."

3. The studies cites on page 11 should be referenced.

4. OSHA justifies the use of the 5 dBA time intensity trade-off ration on the basis that noise exposure in industry is usually interrupted. Periodic interruptions in continuous noise ameliorate the effect of the noise on hearing capacity only if the sound levels during those breaks are sufficiently low to allow for recovery from temporary theshold shift.

   A standard based on the occurance of interruptions in continuous noise levels must specify the levels of noise to allowed during such breaks. OSHA has failed to address this issue in both the standard and the RIS.

5. The discussion of the impulse noise standard (p. 12) raises two questions:

   a) Has OSHA addressed the question of double-dose, given that impulse noise will arise concurrently with the continuous noise in the workplace?

   b) The impulse noise standard apparently relies heavily on the data provided in a document entitled, "Damage Risk Criteria: The Trading Relation Between Intensity and the Number of Non-reverberant Impulses." (p. 12) It is generally agreed, however, that most industry noise is reverberant in character. Can OSHA reconcile this discrepancy between the data on which the standard was based and the real life conditions t' standard was designed to address.

6. In the preamble, OSHA has identified the controversy surrounding the use of hearing protection and has called for suggestions from the public. OSHA has failed, however, to acknowledge the dispute over the 85 DBA versus the 90 DBA standards and the question of technological feasibility. This omission is but one example of the failure to include readily available information unfavorable to the proposed regulation.

Background and History

1. The history of noise regulation provided in the document fails to include the fact that the Walsh Healy Standard originally established an 85 dBA, eight-hour exposure level.

2. On page 18 it is stated, "NIOSH also recommended that workers should at no time be exposed to 115 dBA." This statement is unclear. Did NIOSH consider impulse noise in this recommendation?

3. On page 19 the NIOSH definition of significant threshold shift is cited. The Advisory Committee's definition of significant shift referred to on the following page differs from that provided by NIOSH. This difference should be explicitly acknowledged and explained in the draft.

4. (p. 25) As suggested in a previous comment, a distinction should be made between hearing handicap and hearing impairment. A major question concerning occupational noise is what is to be considered the acceptable level of hearing loss. The failure to distinguish between impairment and handicap in the draft muddles the issue.

5. The draft refers to "frequencies in the speech range as well as around 4,000 Hz." (page 28) This statement is misleading as it assumes that frequencies in the range of 4,000 Hz are not important to the understanding of spoken language. Recent research, has indicated that preception at the higher frequencies is important for understanding speech as a considerable portion of the sound energy of consonants lies in the high frequency range. (See EPA's "Request for Review and Report, F.R., December 18, 1974, Volume 39, #224).

The Impact of Noise in the Workplace Environment

1. OSHA makes the assumption that interruption in continuous noise exposures are staggered uniformly throughout the exposure period. This assumption fails to coincide with not only the literature but also commonsense. On what data is this assumption based?

2. The draft states that in predicting hearing loss from impulses noise, the number of impulses as well as the intervals between impulses and simultaneous exposure to continuous noise must be considered. Yet the proposed standard fails to take into account the intervals between impulses and the question of double dose. How does OSHA account for the failure to consider these issues in its proposed standard?

3. In justifying the use of the 25 dBA fence, OSHA refers to the acceptance of this formula by the European community. Why has OSHA failed to cite the fact that most industrial nations recommend an 85 dBA standard and 3 dBA time intensity trade-off ration in one form or another? Again, OSHA has selected facts which support its position and has omitted information which would prove unfavorable.

4. According to Table 3 of the BBN report (Appendix B, p. 13), 70% of the production workforce are exposed to 85 dBA or more. Given

BBN's estimated workforce of 14, 382,000 approximately 10,000,000 workers would fall into this "above 85 dBA" category. On page 45 of the draft, it is stated that 8,524,000 production workers are exposed to over 85 dBA. How does OSHA account for this discrepancy?

5. Numerous estimates of the number of workers who would incure hearing loss under the 90 dBA and the 85 dBA standards were presented at the recent public hearing. EPA, for example, has estimated that compliance with a 90 dBA standard would produce approximately 1,125,250 hearing handicapped workers. They further estimated that compliance with the 85 dBA standard would result in 667,770 hearing handicapped workers. This figure is eleven times greater than that cited by OSHA. When there is such a wide dispute over facts among members of the scientific community, and when the dispute cannot be reconciled, the range of estimates should be displayed in the statement. OSHA has consistently selected to cite figures which minimize the probable impact of the proposed action.

6. The discussion of the comparative costs of the 85 dBA and the 90 dBA standards is entirely inadequate. The reliability of these costs estimates is highly open to question. The basis on which these cost estimates were made should be discussed briefly and, given the controversy over costs, other estimates should be cited.

Alternatives

According to the National Environmental Policy Act, the Federal agency proposing the action must consider reasonable alternatives which would accomplish the stated objective. When an alternative is considered reasonable, the environmental impacts of this action should be identified and compared with those of the action the agency is proposing to take. The purpose is to provide a framework for the comparative analysis of the environmental impacts of the various alternatives. The present draft fails to provide adequate discussion of the alternatives and their environmental impacts. It eliminates alternatives arbitrarily and omits additional alternatives which might reasonably be taken.

1. The task of elimination alternatives should be approached systematically. The draft, however, discards alternatives arbitrarily without due justification. Audiometric testing, for example, is eliminated because it does not address the problem of eliminating workplace hazards. Personal protective equipment also does not deal with the elimination of hazards, but no mention is made of this fact.

2. The argument that the "newly designed work environment" is difficult to define is totally unacceptable. If problems with definition were taken to preclude the development of federal regulations, how many regulations would be in effect? The very task of the agency is to work with the experts and with the public to develop mutually acceptable definitions which can serve as a basis for action.

3. The alternatives cited on page 1 of these comments should be considered in depth.

RISDON

July 15, 1975

Mr. David R. Bell
Room N-3669
New Department of Labor Building
200 Constitution Avenue N. W.
Washington, D. C, 20210

Gentleman:

We at Risdon firmly believe that personal hearing protection devices in conjunction with a good hearing conservation program are more than satisfactory to accomplish the goals of OSHA; and such a program is far less expensive than engineering programs.

Personally the writer testified on May 3, 1975 to the House Subcommittee on Manpower, Compensation, Health and Safety meeting in Waterbury, Connecticut. Attached is a copy of that testimony.

It has been stated that management cannot administer adequately personal hearing protective devices; and it is with this statement that I would take issue. In the final analysis, good management, together with a good safety committee, can enforce the use of such devices just as easily as it can police the dozens of other regulations which apply in any large factory.

In the last year, we at Risdon have moved to written policies covering many aspects of management, including discipline and safety. Attached are current policies on DISCIPLINE, HEARING PROTECTION, and SAFETY GLASSES. Also attached is a list of other safety policies. Obviously, handing out free coffee is much easier than enforcing policies. But we submit that there is no reason why any competent management cannot easily enforce such policies, if they want to.

The alternatives to the use of hearing protective devices, in most of our departments, are simply devastating. Even if funds were available, it is probable that the results would be at best marginal to unsatisfactory. With hearing protective devices, the wearer is protected very satisfactorily to levels much lower than shielding, etc. could ever produce.

RISDON

One more thought: Any OSHA inspector can immediately pick up employees not wearing hearing protective devices in a required area; but that same inspector may not as easily be able to check the noise level produced by any given machine, as the noise levels in the metal drawing business varies with the job that happens to be in the machine.

Engineering controls, in the writers opinion, are as far out in our business as the extermination of all insects in the world as compared to the use of screens in our windows.

Most sincerely,

RISDON MFG. COMPANY

Arthur B. Dayton, Jr.

Arthur B. Dayton, Jr.
Engineering Manager

/gv

RISDON

May 3, 1975

Testimony to House Subcommittee on Manpower, Compensation, Health and Safety

I represent a firm which has over one hundred transfer presses engaged in making deep drawn parts on a contract basis.

May I illustrate just what "sound shielding" will and will not do:

Sound is produced in our factory wherever and whenever energy is expended. Please note these typical readings in our factory:

Background Level	With plant active, during working hours, but with all productive machines turned off:	85 Decibels
Operational Level	With plant active, and with average number of machines running:	98 Decibels

The largest contributor to the above increase is from the actual cutting of the metal.

Please remember two things from this testimony:

1. "Sound Shielding" of a productive machine can at best reduce the sounds from within the shielded area. In our factory it can only approach the 85 Decibel level. but Hearing Protective Devices Can and Will Protect to Levels of 75 and Below.

2. "Sound Shielding" of a productive machine cannot protect people from background noises, but Hearing Protective Devices Can. Attached is a small list of the background noises in our factory.

I Conclude that Hearing Protective Devices Can do the job right now.

Elimination of sound thru "Sound Shielding" and other engineering solutions will in effect require the complete rebuilding of all our machinery and most of our factories, and even then will do an Inferior job.

Yours truly,

RISDON MANUFACTURING COMPANY

Arthur B. Dayton, Jr.
Engineering Manager

/gv

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

PEP ER-75/658

AUG 18 1975

Dear Mr. Stender:

Thank you for your letter of June 10, 1975, requesting the Department's comments on the draft environmental impact statement for the Proposed Regulation of Noise.

Our comments are submitted according to the format of the statement or by subject.

SUMMARY (SECTION I)

Much progress has been made in hearing conservation since the inception of the Occupational Safety and Health Act of 1970. However, it appears that there is insufficient data at this time to justify the lowering of the present 90 dbA requirement to the proposed 85 dbA. We feel that it is impracticable at this time because of technology, cost and enforcement. We concur with the position taken by the Occupational Safety and health Administration, in that the limit of 90 dbA for eight hours should be maintained as the permissible workplace noise level, and support the recommendation of the OSHA Standards Advisory Committee submitted to the Assistant Secretary of Labor, on December 20, 1973, and contained on pages 19 and 20 of the subject draft.

RELATIONSHIP TO OTHER FEDERAL ACTIONS (SECTION VI)

No mention is made of the pertinent activities of the Department of the Interior. Some mention should be made of research activities being carried on by the Bureau of Mines and the enforcement activities of the Mining Enforcement and Safety Administration (please refer to enclosure).

ADDITIONS TO THE STATEMENT

The final statement should discuss the following points, not treated in the draft statement, in order to comply with the National Environmental Policy Act and the CEQ Guidelines.

(1) Any probable adverse environmental effects which cannot be avoided.

(2) The relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity.

(3) Any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

We hope these comments will be helpful to you in the preparation of the final statement.

Sincerely yours,

Stanley K. Sorkness

Deputy Assistant Secretary of the Interior

Honorable John H. Stender
Assistant Secretary of Labor
U. S. Department of Labor
Washington, D. C. 20210

Enclosure

DEPARTMENT OF STATE

Washington, D.C. 20520

BUREAU OF OCEANS AND INTERNATIONAL
ENVIRONMENTAL AND SCIENTIFIC AFFAIRS

August 1, 1975

Mr. John H. Stender
Assistant Secretary of Labor
U.S. Department of Labor
Occupational Safety and
Health Administration
Washington, D.C. 20210

Dear Mr. Stender:

This will acknowledge receipt of the draft environmental impact statement for the proposed regulation of noise. The State Department has reviewed the draft statement and has the following comments.

As the draft points out, an adverse impact from implementing even the 90 dBA standard would be felt in certain industries. In considering various alternatives, however, the draft does not take into account the fact that such increased prices, displacement of productive investment, etc. will presumably have impacts on this country's foreign trade. This would appear to be an additional "cost" which, regardless of how hard it may be to quantify, should be factored into the assessment and comparison of the possible alternatives. (On the other side of the coin, there may be trade benefits also--e.g., increased labor productivity, new exportable equipment.)

Additionally, the question of trade impacts is important in view of the US adherence to the OECD's "Guiding Principles Concerning the International Economic Aspects of Environmental Policies." One of the themes of these principles is that import levies, export rebates, "or measures having equivalent effect" should not be used to compensate for differences in countries' environmental policies. The corollary is that, to minimize the potential effects on international trade, member states will seek common international environmental standards wherever appropria

Since differing standards on noise levels among industrialized states might have impacts on international trade, it would be our suggestion that, in connection with the environmental analysis, some thought should be given to the subject of other countries' noise standards and any existing international standards, as well as research in other countries into noise reduction technology. If it has not already been done, consideration might well be given to exploring through organizations such as the OECD the possibility/likelihood of achieving international agreement on industrial noise standards.

Sincerely,

L GRANT

Lindsey Grant
Director
Office of Environmental Affairs

THE NAUGATUCK VALLEY INDUSTRIAL COUNCIL, INC.
30 Holmes Avenue
Waterbury, Connecticut 06710

July 15, 1975

Mr. David R. Bell
New Department of Labor Bldg. Room N-3669
200 Constitution Avenue NW
Washington, D.C. 20210

Dear Mr. Bell:

The Naugatuck Valley Industrial Council Inc., a 28 year old, 146 member association, whose membership is exclusively engaged in manufacturing in the Naugatuck Valley, Litchfield County, Shelton and Cheshire areas of the State of Connecticut, expresses grave concern over certain aspects of the proposed OSHA noise regulations.

Generally, we agree with the OSHA proposal that the present 90db standard be retained and that audiometric testing be required for workers exposed to noise levels in excess of 85db. However, metal fabrication and deep drawing had their origins in the Valley, and are still concentrated here today. The normal operation of these industries creates noise well in excess of the minimum permissible limits, and the proposed requirement that engineering and administrative controls must first be used in an attempt to lower noise levels to 90db before personal hearing protective devices may be used is, in our opinion, illogical, impractical and economically wasteful.

The Council, represented by five panelists, personally appeared and testified before the subcommittee on manpower, compensation, Health and Safety at a hearing held in Waterbury on Saturday, May 3.

We took the position, and we still maintain that administrative controls, as they would apply to the operations of our members, are so disruptive as to be unworthy of comment, and that engineering controls, if they first had to be applied before personal hearing protective devices are permitted, are economically unfeasible for the reasons that they would require tremendous non-productive capital expense for (1) encasement of machines (2) expansion of floor space, particularly in older buildings (3) loss of production time during encasement (4) creation of new safety problems by reason of the enclosure.

If it is then found that the engineering controls do not achieve the required result, then the use of personal hearing protective devices is mandatory.

We contend, and a field investigation will bear us out, that personal hearing protective devices will economically and satisfactorily protect the worker immediately to sound levels lower than those presented by OSHA and will have the added advantage of protection from background noise which engineering controls will not do.

THE NAUGATUCK VALLEY INDUSTRIAL COUNCIL, INC.
30 Holmes Avenue
Waterbury, Connecticut 06710

The Council's membership is proud of its workforce and has long been concerned with the safety, health and welfare of its workers. In fact last September the Council sponsored a course for training of personnel as audiometric technicians to update hearing conservation programs in our factories.

Contrary to testimony presented at OSHA hearings in Washington recently, we have found that after a brief education program on hearing conservation, there is very little reluctance on the part of our workers to wear personal hearing protective devices and that enforcement is no more difficult to achieve than enforcing other OSHA prescribed personal protective devices such as hard hats, safety shoes, safety glasses etc.

Our members are engaged in business in a geographical area of high unemployment. The unemployment figure for the State is well in excess of the national average and our area figure exceeds the state figure by a wide margin. To add any enforced unnecessary expense to our cost of production at a time when we are trying to remain competitive with our sister states who do not have our high production costs can only mean further economic disruption from plant closings and resultant job loss.

It is axiomatic that hearing, like the other senses, is subject to deterioration due to the aging process. We do not have any control over this natural phenomenon, nor do we have any control over employee noise exposure away from the job which may, and in many instances does exceed the OSHA prescribed limits.

We can by use of personal hearing protective devices in conjunction with a sound hearing conservation program protect our employees immediately to well below the OSHA prescribed noise levels at a cost which will not jeopardize employment and we urgently request that careful and thoughtful consideration be given to the matter.

Yours very truly,

Donald A. Gray

Donald A. Gray,Jr.
President

DAG/mak

cc: Congressman Sarasin

Phone (412) 562-2400

United Steelworkers of America

AFL-CIO-CLC

FIVE GATEWAY CENTER, PITTSBURGH, PA. 15222

August 6, 1975

David R. Bell
New Department of Labor Building
200 Constitution Avenue, N.W. - Room N3669
Washington, D.C. 20210

Dear Mr. Bell:

The United Steelworkers of America would like to submit the following comments on the Occupational Safety & Health Administration Environmental Impact Statement.

There seems to be a very serious error on Page 48, Table 2. Hearing Impairment after forty years exposure, according to Robinson method. The error seems to be in the number of workers exposed at various noise levels. These figures are no way near all other estimates that I have read or heard at the recent noise hearing. Even if you compare it with the BBN (Bolt, Beranek, and Newman) study that was used in writing this statement, there is a great difference in the two estimates. (Page 13 BBN study)

The Table 2 on Page 48 shows there are 5,753,000 employees exposed between 80 and 85 dBA. The BBN states this would be 30% of the production workers currently exposed. Table 2 then shows the number drops to 2,157,000 between 85-90 dBA, when BBN shows the percent increase to 40% of the production workers. This 10% increase should make Table 2 read 6,328,000 exposed at 85-90 dBA, not 2,157,000 as it presently shows. This is a 300% error. The other levels show a similar error. This 300% error would make almost 1,779,000 workers with hearing impair under present conditions, instead of the 593,000 as it states on Pages 48 and 49.

There are many other areas where we disagree with the Environmental Impact statement, but most of these were made part of the record at recent noise hearings, and we will comment on these in our post hearing comments.

Yours truly,

Francis P. Grimes

FRANCIS P. GRIMES
Staff Representative
Safety & Health Dept.

FPG:tls

RISDON

WATERBURY DIVISIONS

July 3, 1975

Mr. David R. Bell
Room N-3669
New Department of Labor Building
200 Constitution Avenue, N.W.
Washington, D. C. 20210

Dear Mr. Bell:

I am writing to urge you to consider the possible impact of proposed noise regulations on employment and a general ability of many small businesses to remain viable.

On the basis of current cost and engineering possibilities, I see no practical way to solve the problem in my plant or in other similar operations if it is decided that personal hearing protective devices together with a good hearing conservation program are not a satisfactory answer.

We have made a sincere effort internally, used outside consultants, contacted equipment manufacturers, reviewed possibilities of rotating personnel etc. None of these offer a reasonable solution for several of my major departments even to arrive at a 95 dBa level.

We have an exceptional safety record, have a real concern for the welfare of our employees, and have budgeted for 1975 OSHA improvements alone, an amount equal to more than 30% of my average pretax profit over the last four years. We are trying but have not found a solution. If personal hearing protective devices are not acceptable, I don't know the answer.

Sincerely yours,

Vincent J. Hanlon
Vice President and General Manager

VJH:fdm

SAMUEL B. SHAPIRO
Executive Director
JOHN J. CONTNEY
General Manager

LINEN SUPPLY ASSOCIATION OF AMERICA

P. O. Box 402427
975 Arthur Godfrey Road
Miami Beach, Florida 33140
phone: 532-6371 / area code 305

July 8, 1975

Mr. David R. Bell
Room N 3669
New Department of Labor Building
200 Constitution Avenue N. W.
Washington, D. C. 20210

Dear Mr. Bell:

The Linen Supply Association of America offers the following comments in response to OSHA's "Draft Environmental Impact Statement" released on June 10, 1975.

As background, the Linen Supply Association of America (LSAA) represents over 1,000 establishments renting hygienically cleaned textile items to millions of customers in the health care industry and related services--as well as in many other segments of commerce, industry and the professions.

The industry employs about 70,000 persons and spends about $40,000,000 on buildings, machinery and equipment annually. The industry processes about eleven billion textile pieces annually.

As a result of studies made to determine the noise levels existing in typical linen supply plants -- at work stations as well as in non-work station areas -- we have found that:

67% of the recorded noise levels were at 85 dBA or lower.

13% fell within the 86-90 dBA range at a constant level.

10% fell within the 86-90 dBA range during momentary peak levels.

1% were over 90 dBA at a constant level. (These existed in either non-work station areas or part-time work stations.)

9% were measured at over 90 dBA during momentary peak levels.

An additional survey of a number of our members indicates that our industry has no record of hearing impairment or injury. This agrees with OSHA's contention that an individual can work in an industrial environment for eight hours at a 90 dBA level without undue risk of injury to his hearing.

The Linen Supply Association supports the 90 dBA exposure limit and urges that this be maintained. We believe it is unnecessary to reduce the limit to 85 dBA because of the absence of documented cases of hearing impairment or injury. To set an 85 dBA limit would impose an unnecessary and expensive hardship on members of the linen supply industry.

Our industry, as all service industries, is known to be especially vulnerable to cost increases -- which, of course, must be eventually, reflected in the prices our members charge for their services. Each time these prices are increased the industry suffers a loss of business as its customers shift their purchases to other alternatives for satisfying their needs.

To a great extent, many customers of linen supply businesses depend upon the successful operation of the linen supplier for the success of their own businesses. This is especially true in the area of health care and related services.

LSAA supports the alternative of using personal protective equipment (Section V, Paragraph 1) as a means of providing employees with adequate protection against occupational noise.

LSAA also supports the concept of industry - specific or occupation - specific noise standards - with enforcement measures geared to target industries or target occupations. The precedent for using this approach has already been established through the administration of OSHA's Target Industry Program (TIP) wherein efforts are concentrated in the industries with the highest reported injury-frequency rates.

We trust that our members will not be faced with the cost of unnecessary, difficult and expensive installations and procedures in order to meet a noise limitation set at lower than necessary level.

Yours very truly,

Everett E. Harris
Manager - Production Operations

EEH:Pat Merrill

American Gas Association

1515 Wilson Boulevard, Arlington, Va. 22209
Telephone (703) 524 2000

F. Donald Hart
President

August 6, 1975

Mr. David Bell
Occupational Safety & Health Administration
Room N3669, New Labor Bldg.
200 Constitution Ave., N.W.
Washington, D.C. 20210

Dear Mr. Bell:

The American Gas Association is the national trade association for the natural gas distribution and transmission industry. Its member companies distribute the majority of natural gas sold in the United States.

The Association fully supports all efforts to achieve proper safety goals and has had the safety of its employees and the general public as one of its basic tenets since its inception.

The A.G.A. Coordinating Group for Occupational Safety and Health, on behalf of our member companies, submits the attached comments with respect to the Draft Environmental Impact Statement, Proposed Regulation Noise.

On behalf of our member companies and the Coordinating Group, I want to thank you for the opportunity to review this study and your consideration of the attached material. It is anticipated that a number of our member companies will submit their individual comments.

Sincerely,

F. D. Hart

FDH/fs
Enclosure

August 7, 1975

COMMENTS ON DRAFT ENVIRONMENTAL IMPACT STATEMENT-NOISE

Submitted by

A.G.A. Coordinating Group for
Occupational Safety and Health

The following is a series of modifications recommended for the subject referenced standard to increase the effectiveness of the proposed standard and make it more workable for all concerned.

Although EPA has requested that the Secretary of Labor review the proposed Occupational Noise Exposure Regulation, we recommend the present proposal of 90 dBA be adopted. The 90 dBA level is adequate and should not be lowered to 85 dBA. We do not feel there is adequate medical information for lowering at the present time. Also the study prepared for the Department of Labor by Bolt, Beranek and Newman, Inc. of Cambridge, Massachusetts, asserted it would cost U.S. industry about $13 Billion to comply fully with the 90 decible rule but over $30 Billion to meet the 85 decible standard, so it would not appear to be economically feasible to lower the exposure level at this time.

F.R. Vol. 39, Page 37775, 1910.95 (c) (e)

We recommend the formula

$$D = \frac{C_1}{T_1} + \frac{C_2}{T_2}$$

be strictly based on 90 dBA. The lowering of the limits as listed in Table G-16a appears to be a compromise between the 90 dBA and 85 dBA advocates. Certainly for single level steady-state noise, the exposure limits retains the same 90 dBA equivalent status for an eight-hour exposure as previously promulgated by OSHA. Using the proposed standard beginning at 85 dBA, obviously, places the employee exposure at a point much more difficult to comply with.

F.R. Vol. 39, Page 37776, 1910.95 (g) (ii)

We further recommend that audiometric testing be changed to two years instead of the proposed one year. Experts generally agree

that when personnel are subjected to sound pressures and time duration described in this proposed legislation, a significant hearing threshold shift cannot be determined in the short span of one year. Since testing every two years provides adequate information for hearing conservation purposes, we see no reasons for annual audiograms.

F.R. Vol. 39, Page 37776, 1910.95 (d) (i)

Once plant surveys have been completed we feel it is unnecessary to monitor equipment and the workplace unless modification of equipment or other workplace or work practice modifications take place that may affect the noise level.

F.R. Vol. 39, Page 37776, 1910.95 (5) (ii) (A) (B) (C) (iii) (B) (C) (1) (2) (3)

We recommend that Section (5), Observation of Monitoring, down to Section (e), Methods of Compliance, be removed from the standard. This is the section relating to observation by the employees of sound level monitoring. Not only would this require considerable amount of time but would make no contribution to the overall hearing protection program.

F.R. Vol. 39, Page 37776, 1910.95 (e)

In the past, personal protection in the form of hard hats, safety glasses and safety shoes have assured the employees of a safe and healthy work environment. Therefore, we feel there is no reason to believe that this type of an approach to personal protection is suddenly invalid when it comes to the use of hearing protectors to prevent a hearing loss. To attempt to reduce noise levels below the 90 dBA level where it is not feasible, would compound the cost without benefit. It seems irrational to expect the employer to pass large expenditures on to the consumer that would not necessarily reduce noise exposure to permissible levels, because hearing protectors would still be required to remain within these limits.

We, therefore, recommend that personal protection be considered as an alternative to both engineering and administrative controls.

Section III is a progressive report of the evolution of the standards.

Section IV is a compilation of studies indicating the effects of noise on the hearing acuity of different individuals. Gas industry studies have not been undertaken to provide information to support this section so we will not comment.

In section V, we support the use of hearing protectors in lieu of engineering and administrative controls where it is not feasible to reduce the noise exposure.

G. O. Keutgen
Executive Director
Manufacturing Staff

Ford Motor Company
The American Road
Dearborn, Michigan 48121

August 7, 1975

Mr. David R. Bell
Room N-3669
New Department of Labor Building
200 Constitution Avenue, N.W.
Washington, D.C. 20210

Subject: Draft Environmental Impact Statement on Proposed Noise Regulation

Dear Mr. Bell:

We appreciate having the opportunity provided by Mr. Steader's letter of June 10, 1975 to review and comment on the draft Environmental Impact Statement on the proposed revisions to the OSHA noise regulation.

Our comments on the proposed revisions were submitted to OSHA in a written statement dated March 20, 1975 and in an oral statement on July 28, 1975. Copies of these statements are enclosed.

We respectfully request that the comments in our statements be reflected in the final Environmental Impact Statement, particularly the following major points:

1. Permissible noise levels presently provided in Table G-16 of the present OSHA regulation should be retained unless and until it is demonstrated that there is need for engineering controls below present levels.

2. Personal hearing protection is an effective means of hearing conservation when used in conjunction with an audiometric testing program. We support preplacement and annual audiometric examinations. Since ear protectors provide the safeguarding required, they should be permitted as acceptable noise control devices unless practical and cost effective engineering controls can be implemented.

3. There are certain procedural requirements in the proposed standard which we believe should be modified or deleted. Some of these requirements do not contribute to assuring a safe and healthful workplace while others add an unnecessary and costly administrative burden.

4. It is essential that the term "feasible" used in the regulation be defined explicitly to include economic considerations. Because the proposed regulation would require implementation of engineering controls based on technological considerations only and to the virtual exclusion of personal hearing protection, large capital expenditures would be required and significant increased operating costs would be incurred. Ford expenditures to meet the proposed standard are estimated at about $400 million and could increase to about $1 billion. Annual operating costs would increase at least $280 million per year. Any unreasonable expenditure and cost associated with noise control would worsen an already serious economic and sales problem in our industry. Unless the practical approach that we have recommended is taken, we believe that unproductive and inflationary costs will be incurred needlessly to the detriment of employes, the Company, the industry, and the economy.

Very truly yours,

G. O. Kautgen

G. O. Kautgen

Enclosures

ASSISTANT SECRETARY OF DEFENSE
WASHINGTON, D. C. 20301

HEALTH AND
ENVIRONMENT

22 AUG 1975

Mr. David Bell
Room N3669, New Department of
Labor Building
200 Constitution Avenue, N. W.
Washington, D. C. 20210

Dear Mr. Bell:

This is provided in response to your request of June 10 for our review and comment on DOL's proposal to regulate occupational exposure to excessive noise. We apologize for our late reply. Technical comments on the preliminary draft OSHA rules were furnished April 18, 1974. These comments are still valid and are included as an attachment.

The proposed standard will have a significant economic impact on the Department to comply with the requirements to provide mandatory engineering controls to reduce noise to the standard level. We believe these controls would be of limited value since they would be required even in those cases where use of engineering controls alone would not reduce employees' exposure to permissible limits of the standard.

With regard to the alternatives, we would suggest combining the more desirable elements of the alternatives presented into a separate alternative for consideration. The alternative section is also void of any discussion of the minority recommendation of the Standards Committee on Noise, dated December 20, 1973, which includes a fixed standard and a varying environmental noise control strategy based upon feasibility, use of personal protective devices and other elements of a comprehensive hearing conservation program.

Our detailed comments are contained in the attachment. We appreciate the opportunity to comment on this important environmental impact statement.

Sincerely,

George Marienthal

George Marienthal
Deputy Assistant Secretary of Defense
(Environmental Quality)

Enclosures

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
WASHINGTON, D.C. 20410

AUG 12 1975

OFFICE OF THE ASSISTANT SECRETARY
FOR COMMUNITY PLANNING AND DEVELOPMENT

IN REPLY REFER TO:
CSP

Mr. David R. Bell
Department of Labor
200 Constitution Avenue, N.W.
Washington, D. C. 20210

Dear Mr. Bell:

This is in response to Assistant Secretary John H. Stender's letter of June 10, 1975, enclosing the Draft Environmental Impact Statement on the proposed Noise Regulation for the Occupational Safety and Health Administration.

The Department of Housing and Urban Development's (HUD's) major concern is similar to that already expressed by the Environmental Protection Agency that the proposed noise level of 90 dBA for an 8-hour working period is too high and may be hazardous to employees' health. Our own HUD noise policy and standards deem any area that exceeds 75 dBA for 8 hours out of a 24-hour period as unacceptable for a suitable living environment.

We hope that your Department will reconsider the noise levels being proposed in the draft regulations.

Sincerely,

Joseph S Carr, Acting

David O. Meeker, Jr. FAIA, AIP
Assistant Secretary

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

AUG 22 1975

OFFICE OF THE
ADMINISTRATOR

Mr. David R. Bell
New Department of Labor Building
Room N3669
200 Constitution Avenue, N.W.
Washington, D.C. 20210

Dear Mr. Bell:

The U.S. Environmental Protection Agency (EPA) has reviewed the draft environmental impact statement (EIS), which the Occupational Safety and Health Administration (OSHA) submitted in connection with its proposed rulemaking on noise exposure.

EPA has repeatedly expressed its environmental reservations concerning OSHA's proposed noise regulations. We do not believe that they protect the public health and welfare to the extent necessary and feasible, nor do we believe that they adequately ensure to the extent feasible that no employee will suffer material impairment of health or functional capacity. Specifically, EPA contends that the proposed regulations are deficient in the following respects:

(1) The proposed eight-hour time-weighted average noise exposure level of 90 dBA is unnecessarily high;

(2) The proposed allowable increase of 5 dB in exposure levels with every 50% decrease in exposure time (time-intensity trade-off) is excessive; and

(3) The proposed standard for impulse noise: (a) would allow too many impulses at too high a level and (b) ignores the combined effect of impulse noise and background noise.

In our opinion, this draft EIS underestimates the adverse impacts of these regulations and does not discuss either the relevant issues or the feasible alternatives sufficiently. Accordingly, EPA has classified this draft EIS as Category ER-2 (Environmental reservations concerning the proposed action and insufficient information in the EIS).

Data and information, which were not available to OSHA when this draft EIS was prepared, have subsequently been submitted in connection with the public hearings OSHA sponsored last month. They should be reflected in the final EIS. Enclosed are detailed comments explaining our concerns; also included are suggestions designed to assist OSHA in preparing the final EIS on these regulations.

Sincerely yours,

Sheldon Meyers
Director
Office of Federal Activities

Enclosures

U.S. Environmental Protection Agency Comments on
Occupational Safety and Health Administration's Draft
Environmental Impact Statement,
"Proposed Regulation: Noise"

Summary. EPA's comments address both the proposed noise regulations and the draft EIS filed in support of them. We have environmental reservations concerning the proposed regulations, and we believe that the draft EIS did not contain sufficient information. These comments are organized in the following manner:

A. Problems with the Proposed Regulations

1. Noise Exposure Level
2. Time-Intensity Tradeoff
3. Impulse Noise
4. Audiometric Testing
5. Schedule of Improvements

B. Problems with the Draft EIS

1. Definitions
2. Estimates of Hearing Loss
3. Implications of Hearing Loss
4. Other Effects of Noise on the Employees
5. Technical Feasibility, Costs of Compliance, and Enforcement
6. Alternatives to the Proposal

A. Problems with the Proposed Regulations

1. Noise Exposure Level. EPA believes that the proposed eight-hour, time-weighted average noise exposure level of 90 dBA is unnecessarily high. We do not believe that the draft EIS makes a convincing case either for the safety of this level or for the infeasibility of setting a lower and safer level. EPA has repeatedly urged OSHA to set lower and safer levels. (See, for example, EPA's "Request for Review and Report on the Occupational Noise Exposure Regulation, which was published in the Federal Register on December 13, 974,

and which was Appendix C to the EIS.) In subsequent sections of these comments we point to significant related inadequacies of the draft EIS.

2. Time-Intensity Tradeoff. EPA believes that the proposed allowable increase of 5 dB in exposure levels with every 50% decrease in exposure time is excessive. EPA has recommended that the allowable increase be only 3 dB. (For our earlier comments on this point, see Appendix C in the draft EIS.)

The EIS mentions that the 3 dB rule is "hypothetically correct for uninterrupted noise exposure." However, EPA recommends this rule because there are both field and laboratory data to support it. The EIS gives no data in support of the 5 dB rule. (Although OSHA's Standards Advisory Committee on Noise approved table G-16 in the proposed regulation, it was brought out in the public hearings that this Advisory Committee did not explicitly discuss time-intensity trading rules.[15])

Although most experts would agree that truly intermittent noise is somewhat less damaging than continuous noise, this fact is dependent on the existence of quiet periods that are sufficiently long and sufficiently quiet to permit recovery from Temporary Threshold Shift (TTS). The "CHABA" (Committee on Hearing, Bioacoustics, and Biomechanics) curves, which have been modified by Botsford and in turn by OSHA, are predicated on evenly spaced noise burst and quiet periods. The EIS states that the 5 dB rule is "based on the assumption that even short-duration industrial noise exposures are interrupted and that the interruptions are staggered uniformly throughout the exposure period" (p. 41). This statement is supported neither by the technical literature nor by known characteristics of industrial environments.

As was brought out so often during the public hearings, any rule for increasing exposure level while decreasing duration should be based on epidemiological evidence rather than on theory. The evidence of Burns and Robinson shows that the 3 dB rule is valid for continuous and time-varying noise, and the EIS acknowledges that most industrial noise is continuous in nature (p. 21). If there are situations where the noise bursts are evenly spaced, and the noise levels during quiet periods are sufficiently low to permit recovery from TTS, these situations are exceptional. Considering the

mandate of the Occupational Safety and Health Act, it seems more appropriate for OSHA to set a conservative regulation based on the common occurrence rather than a more lenient regulation based on the rare occurrence.

3. Impulse Noise. EPA believes that the proposed standard for impulse noise would allow too many pulses at too high a level. This proposed standard also ignores the combined effect of impulse noise and background noise. We believe this standard would, therefore, allow considerable amounts of hearing loss, especially since a full dose of continuous noise at 90 dBA would be allowed concurrently with a full dose of impulse noise. This double dose effect has been shown to be more damaging than either dose alone.[16,17]

The EIS states that such factors as intervals between impulses and preceding or simultaneous exposure to continuous noise are important for predicting hearing loss. But these factors are not addressed in either the proposed standard or the draft EIS. The definition of "impulse or impact noise" in the proposed regulations states: "If the impulses recur at intervals of less than one-half second, they shall be considered as continuous sound." However, a period between impulses of only one-half second in duration is not long enough to permit recovery from Temporary Threshold Shift (TTS).

It is suggested that the final EIS contain predicted amounts of hearing loss resulting from the proposed standard for impulse noise, and that the problem of combined effects of impulse noise and continuous noise be discussed. A simpler and more protective method for treating impulse noise is to integrate it into the total allowable dose by a time-intensity trading rule. EPA recommends the 3 dB rule and method for all types of noise exposure. (This is current practice in the United Kingdom.[12,18])

4. Audiometric Testing. The proposed regulations would establish an audiometric testing program, but employers would not be required to notify OSHA of any hearing impairment detected as a result of this program. It would seem that the occurrence of significant threshold shifts in a significant number of employees would indicate a deficiency in either OSHA's standards or OSHA's enforcement of them -- or both. In any event, employers should be required to notify OSHA promptly of such occurrences.

The summary section of the EIS mentions that the objective of the audiometric testing program is to detect shifts in hearing before significant or permanent impairment occurs. Audiometric monitoring is a useful practice, particularly at potentially hazardous exposure levels, but it would not prevent permanent impairment; it would only detect it. The only action that the employer must perform in such cases is to issue personal protective equipment or to reinstruct the employee in its use. This action may or may not prevent further deterioration.

5. Schedule of Improvements: The Preamble to the proposed regulations states that

> OSHA proposes to keep the [eight-hour time-weighted average noise exposure] level at 90 dBA until further empirical data and information on the health risk, feasibility, and economic impact indicate the practicality and necessity of an 85 dBA requirement.

EPA believes that the information and data already available to OSHA indicates that the 85 dBA level is feasible and necessary. But regardless of the specific level established now, progress toward a quieter occupational environment is clearly needed. EPA believes that the regulations should specify a series of lower levels to be attained by certain dates. The working public deserves improved protection, and industry needs such a schedule for efficient, long-range facility planning.

B. Problems with the Draft EIS:

1. Definitions. The draft EIS discussed the incidence of "handicapping hearing loss" associated with workplace noise (pp. 3-6). The hearing loss thus described is an average of 25 dB at 500, 1000, and 2000 Hz. Later in the EIS this amount of hearing loss was termed "impairment", and it was referred to as such throughout the rest of the document. The terms "handicap" and "impairment" are not interchangeable[3,4,5] The American Academy of Ophthalmology and Otolaryngology has developed the following definitions:[6]

Disability: actual or presumed inability to remain employed at full wages.

Impairment: a deviation or a change for the worse in either structure or function, usually outside of the range of normal.

Handicap: the disadvantage imposed by an impairment sufficient to affect one's personal efficiency in the activities of daily living.

According to currently acceptable audiological and medical terminology, hearing impairment is stated in terms of decibels above audiometric zero, and handicap is calculated in percentage points above a certain fence. The most widely used formula assigns 1.5 percentage points of handicap for each dB above a fence of 25 or 26 dB.

In 1970 OSHA published "Bulletin 334", which stated that a 25 dB average hearing loss at 500, 1000, and 2000 Hz was "disabling loss of hearing." Although these losses were considered "disabling" in 1970, they are merely "impairments" now. However, the EIS does state (p. 5) that these losses are "substantial enough to be handicapping." EPA believes that, regardless of terminology, these losses are too great to be permitted by an exposure standard designed to prevent material impairment. The 25 dB average hearing level at 500, 1000 and 2000 Hz allows substantially more than 25 dB loss at the important frequency of 2000 Hz, and unlimited amounts of loss at the frequencies 3000 and 4000 Hz, which are also important in the discrimination of speech sounds. It is indeed handicapping to those who experience it.[4,7,8] Bolt, Beranek and Newman (BBN), whose report is included as Appendix B to the EIS, states that "...few who would experience such a hearing loss would find it 'acceptable'", (Vol. I, p. 3). BBN also states than an 85 dBA exposure standard would produce "additional benefits to millions of other workers in that their hearing levels would be significantly less than the 25 dB fence instead of approaching it..." (Vol. II, p. D-6).

To describe adequately the impact of occupational noise on exposed populations, the predicted amounts of hearing loss resulting from various exposure levels should be given, whether or not they exceed the 25 dB fence. This process was attempted in Table 3 (p. 49) of the EIS. Such calculations

can easily be made for various population contiles despite the EIS's statement to the contrary (p. 50). Since the EIS makes use of the data and analysis of Burns and Robinson, it is suggested that the predicted hearing level can be calculated more quickly from Robinson's tables than by calculating each prediction from the formula. (EPA is sending OSHA a copy of the "Tables for the Estimation of Noise-Induced Hearing Loss"[9] by D. W. Robinson and M. S. Shipton of the British National Physical Laboratory under seperate cover.)

2. Estimates of Hearing Loss. The data and arguments in the draft EIS, tend to underestimate the adverse effects of the proposed regulation. This underestimation is most obvious in Tables 1 and 2 and in the conclusions drawn from them concerning hearing losses likely to occur from various levels of noise exposure.

The section in the EIS entitled "Major Studies of Occupational Noise Exposure" (pp. 44-50) is perhaps the most critical portion of the EIS in that the identified numbers of "impaired" (more appropriately "handicapped") workers have presumably been the major influence on OSHA's regulatory decision. The EIS uses BBN's estimated numbers of workers exposed to various levels of noise for present conditions and for the hypothetical conditions of maximum compliance for the 90 dBA and 85 dBA standards. To predict the resulting hearing losses, the EIS uses Daughn's estimates of the percentages exceeding the 25 dB fence in Table 1 and Burns' and Robinson's estimates of these percentages in Table 2. The predictions based on Burns' and Robinson's data are used to justify the proposed regulation.

However, EPA believes that the EIS's estimates of hearing loss are too low. It seems that a combination of the following three factors produced this result:

- OSHA used the criterion of hearing handicap instead of impairment,
- A clerical error was committed in compiling Tables 1 and 2, and
- The effects of aging were ignored.

The first of these factors was discussed above (in Section B.1. Definitions).

Clerical Error in Tables 1 and 2 of the EIS. According to Tables 3 and 6 of BBN's Volume 1 (Appendix B of the EIS), 30% of production workers are currently exposed to noise levels of 80-84 dBA, 40% to levels of 85-89 dBA, and 15% to levels of 90-94 dBA, etc. The EIS reports these data as 30% are exposed to less than 80 dBA, 40% to levels of 80-85 dBA, and 15% to levels of 85-90 dBA, etc. Thus the columns describing numbers exposed and exposure levels have been shifted approximately 5 dB with respect to each other, and consequently the numbers presently handicapped are understated. For example, Table 1 should state that the 5,753,000 workers are exposed not to levels of 80-85 dBA, but to levels of 85-89 dBA. The number of handicapped workers in this category should not be 8% but approximately 12%. The underestimations caused by this procedure apply not only to the number of hearing handicapped workers under present conditions, but also to workers exposed to the proposed 90 dBA and 85 dBA standards.

Effects of Aging on Hearing Loss. Tables 1 and 2 of the EIS failed to account for the fact that hearing is adversely affected by both presbycusis and pathology as well as by exposure to noise. As yet no satisfactory method has been developed to account for the incidence of pathology, but this fact should be noted in the EIS to remind the reader that the figures given are conservative. It is feasible, however, to determine the effect of aging on hearing and to estimate the combined effect of presbycusis and noise exposure.

It is, of course, useful to examine the effect of different levels of noise exposure in terms of noise-induced threshold shift. EPA has often used this method of assessing the effects of noise on hearing. It is also traditional to examine the percentage of the population that will be "at risk" from noise alone (excluding other factors). NIOSH[10] and ISO[11] have presented data for populations who will exceed a certain fence as a result of various levels of noise exposure. But they also include total percentages of people with "impaired" hearing. Not to include such totals would mislead the reader into thinking that the percentage "at risk" would be the only hearing impairments that would occur in a noise-exposed population.

In order to make predictions about a real life population, the presbycusis values that have originally been subtracted must be added back. There is no such thing as a population of 60-year old people without hearing loss from aging. The

necessity of this procedure is evident in the instructions for the use of Burns' and Robinson's nomogram, which is reprinted as p. 48a of the EIS. Step #7 states, "Add age correction according to Table 10.3." This step should be performed in the final EIS so that the realistic environmental impact can be properly evaluated.

In order to clarify this matter, EPA has prepared a revised Table 2, which corrects for the clerical error and presbycusis effect mentioned above. (This table is attached to these comments.) In order to determine the percentage of the population expected to be handicapped at each range of exposure levels or exposure window (eg. 85-89 dBA), the average value has been calculated from pages 126-129 of the tables of Robinson and Shipton.[9] Since 5% of the population are expected to achieve a certain hearing level at 85 dBA, 6% at 86 dBA, 7% at 87 dBA, and 8% at 88 dBA and 10% at 89 dBA, the percentage selected was 7.2%. The value for expected hearing loss that was selected was an average of 17 dB at 500, 1000, and 2000 Hz, since, according to Burns and Robinson, the median value for presbycusis at age 60 is 7.6 dB at these three frequencies. The resulting hearing level from noise and aging would therefore be 24.6 dB. These values do not include hearing losses from pathology (other than noise-induced loss and presbycusis).

Figures from the suggested revision of Table 2 show that 1,875,590 workers would incur handicapping hearing loss after 40 years of exposure to current noise levels, which is about three times as many as the EIS estimates. Compliance at 90 dBA would produce approximately 1,125,250 hearing handicapped workers as opposed to the EIS estimate of 130,000. Compliance at 85 dBA would result in an estimated 667,770 hearing handicapped workers, as opposed to 57,000. Another important calculation is the number of workers who would be prevented from exceeding the 25 dB average hearing level if an 85 dBA standard were enforced. Approximately 1,207,820 workers would fall into this category, and the difference between compliance at 90 dBA and compliance at 85 dBA would be some 457,480 "protected" workers, as opposed to the 73,000 estimated in the EIS. The statement in the EIS (p. 4) that these workers would be prevented from incurring a handicapping hearing loss by the requirement for"providing personal protection remedies" is misleading since the proposed standard does not require personal protective devices between 85 and 90 dBA.

For the final EIS to present a more complete discussion of the impact of noise in the workplace, Tables 1 and 2 should be reworked according to the method just described. Many experts have testified that 25 dB fence at 500, 1000, and 2000 Hz is unacceptable. EPA recommends, accordingly, that similar calculations be done using an alternative fence. A 25 dB fence at 1000, 2000 and 3000 Hz, has been recommended by NIOSH[10,14] and the Department of Labor's Bureau of Employee Compensation. EPA would prefer a 25 dB fence at 1000, 2000, and 4000 Hz.

The final EIS should examine more thoroughly the amounts of hearing loss produced by noise exposure of various levels. Table 3 of the draft EIS presented data for some frequencies for the 2nd and 10th percentiles. Table 3 would be more complete and more meaningful if hearing loss values for the frequencies 3000 and 4000 Hz were included. However, since presbycusis has been omitted, these values cannot be labeled "Hearing Level" and cannot be considered predictive of a normal population. Moreover, there is no precedent for averaging the three mid-frequencies and calling the amount in dB above the 25 dB fence "impairment." This practice misleads the reader by inappropriately minimizing the effect.

The discussion of Temporary Threshold Shift (TTS) in the final EIS should reveal that contemporary research shows that cell damage may occur even though behavioral audiometry does not indicate a loss of hearing. Thus, the recovery phenomenon that is observed may not really be complete recovery, although the resulting loss of hearing would not become evident until later in life.[19,20,21]

3. Implications of Hearing Loss. The proposed regulation was not designed to prevent hearing loss. Instead, the criterion on which it was based would allow a certain percentage of the population to incur hearing impairments of more than 25 dB at the averaged frequencies 500, 1000, and 2000 Hz, and a larger percentage to incur hearing losses that are somewhat less than this amount. The final EIS should examine the social, psychological, and economic implications of these hearing losses, in terms of the effects on speech communication, job performance, and the enjoyment of life in general. This information is critical to the understanding of the proposed regulations's impact.

4. Other Effects of Noise on the Employee. The draft EIS stated (p. 6) that OSHA decided to limit the scope of the noise standard to hearing loss alone. It noted that research is being conducted to determine the other adverse effects noise has on employees, but it did not describe this research or discuss this problem in any detail.

EPA believes that the final EIS should address such problems as stress related disease, worker absenteeism, performance decrements, and the masking of speech and warning signals from various levels of noise.

Most of these effects (with the exception of masking effects) are fairly difficult to quantify. However, this is not sufficient reason to dismiss them. According to Ashford et al, "To ignore uncertain effects essentially assigns a value of zero to them, if one is thinking in cost-benefit terms. However, if there is any appreciable probability that the effects occur, then society is taking an extra chance of incurring additional harm if the less protective standard is adopted."[24]

A very thorough overview of various physiological effects of noise is presented in Ashford's report, which includes summaries and caveats for each study, and an extensive bibliography. It is highly recommended to OSHA as a resource in preparing the final EIS and in formulating the final rule.

NIOSH has also been engaged in research on this subject[14], and it was discussed in the public hearings which OSHA sponsored in July, 1975.

5. Technical Feasibility, Cost of Compliance, and Enforcement. One of the weakest aspects of this draft EIS was its failure to explore in any depth the technical feasibility of achieving various noise exposure levels and the accompanying economic costs to the affected employers and employees.

The noise exposure standard of 90 dBA, which OSHA is proposing, is the existing standard, which had been in force even before OSHA adopted it in May, 1971. Yet this EIS estimates that it would cost industry $13 billion to comply with this standard. Is this a fair measure of OSHA's past performance in enforcing this standard? Will OSHA's enforcement program become significantly more vigorous in the near future?

The EIS in justifying the 90 dBA level mentioned technical feasibility problems and referred to the report included as Appendix B. However, OSHA's "Review and Report to EPA," which was included as Appendix D to the EIS stated:

> The Department of Labor generally agrees with EPA that the technology now exists for compliance with either an 85 dBA or a 90 dBA limit through engineering controls. While there are some significant exceptions, such as textile weaving, we would accept the Bolt, Beranek and Newman conclusion that by the maximum application of existing technology the sound levels of 92 percent of jobs can be reduced to either 90 dBA or 85 dBA.

EPA is skeptical of the contention expressed in Appendix B to the EIS that it would cost industry $13 billion to achieve 90 dBA and $31 billion to achieve 85 dBA. However, let us grant this contention for the moment and investigate its implications. What is the collective cost to all employees of being exposed to the 90 instead of the 85 dBA level? Is it equal to, less than, or greater than $18 billion (the difference between $13 and $31 billion)? What rationale did OSHA use to determine that $13 billion was an acceptable cost to industry but that $31 billion was not acceptable?

EPA believes that the final EIS should explicitly reveal the assumptions OSHA used in weighing the tradeoffs between capital investment and employee health and in arriving at its preferred alternative. We also suggest that the final EIS more fully discuss the questions of technical feasibility and OSHA's enforcement program. Testimony presented at OSHA's public hearings should be included where appropriate.[22,23]

6. Alternatives to the Proposal. In the Alternatives section of the draft EIS, six approaches to protecting the hearing of workers were summarily dismissed. None were discussed thoroughly. The approach which EPA had previously recommended to OSHA of phasing reductions in maximum noise levels over time was not even mentioned. EPA believes that the final EIS should contain a substantial discussion of the approaches to hearing protection mentioned below:

- Personal protective equipment. EPA has supported OSHA's decision not to allow personal protective equipment as a permanent solution to noise

reduction. But there are many situations where ear plugs and ear muffs are an extremely valuable and necessary form of protection. The final EIS should cover this area thoroughly, especially in view of the many arguments for and against personal ear protective equipment that were raised during OSHA's public hearings.

- Industry-specific standards. The assertion that OSHA would have difficulty enforcing such standards is not sufficient reason for rejecting them without considerably more explanation. What is the trade-off between ease of administration and employee health?

- Requiring lower noise levels for New Plants than are required for Existing Plants. The difficulty of defining a "new plant" is not sufficient justification for rejection of this alternative. While existing machinery is often placed in new plants, there are a variety of ways to reduce noise exposure levels in newly designed work environments.

- Step reductions over time. EPA has suggested that incremental reductions be achieved over time. (See Appendix C to the draft EIS.) We believe it is an alternative worthy of exploring in the final EIS. The reductions need not be considered in 5 dBA steps. For example, OSHA could require reduction to 88 dBA by 1978, 85 dBA by 1981, and 83 dBA by 1985, or some other such sequence of incremental reductions.

- Abatement agreements: Although compliance strategies are not always part of the standard setting procedure, their contribution can be very usefully examined. According to Ashford et al, "...the OSHAct provides various means to work around standards that may be overly strict for certain individuals.... Abatement agreements are a currently evolving technique which have great potential use as a flexible enforcement tool."[24] This paper, also contains other valuable suggestions for regulatory alternatives. It was submitted to the record of the public hearings as exhibit No. 130(a),

and we suggest that OSHA consult it in preparing the final EIS and in formulating the final rule.

These approaches to protecting the hearing of employees are not mutually exclusive "alternatives"; in fact, EPA suggests that OSHA consider adopting a combination of them as its final regulation.

References

1. Environmental Protection Agency, Office of Noise Abatement and Control, "Critical Commentary on the Occupational Safety and Health Administration, Preliminary Draft Environmental Impact Statement and Proposed Standard for Occupational Exposure to Noise", May 30, 1974.

2. Alice H. Suter, "Environmental Noise Levels and Health Impact", paper presented at Noisexpo, Atlanta, Georgia, April 30, 1975, (in publication).

3. Testimony of Alvin F. Meyer, Jr., Deputy Assistant Administrator for Noise Control Programs, U. S. Environmental Protection Agency, at the Public Hearings on the Proposed Exposure Standard for Occupational Noise, U. S. Department of Labor, OSHA, June 26, 1975.

4. Testimony of W. Grady Thomas, on behalf of the U. S. Environmental Protection Agency, at the Public Hearings on the Proposed Exposure Standard for Occupational Noise, U. S. Department of Labor, OSHA, June 27, 1975.

5. Alice H. Suter and Henning E. von Gierke, "Evaluation and Compensation of Occupational Hearing Loss in the United States", presented at the Conference of the World Health Organization, Turin, Italy, June 9, 1975, (in publication).

6. American Academy of Ophthalmology and Otolaryngology, Committee on Conservation of Hearing, "Guide for the Classification and Evaluation of Hearing Handicap," Trans. Amer. Acad. Ophthal. Otolaryng., 69: 740-751, 1965.

7. Testimony of William C. Sperry at the Public Hearings on the Proposed Exposure Standard for Occupational Noise, U. S. Department of Labor, OSHA, presented in written form July 30, 1975.

8. Testimony of Karl D. Kryter, on behalf of the U. S. Environmental Protection Agency, at the Public Hearings on the Proposed Exposure Standard for Occupational Noise, U. S. Department of Labor, OSHA, June 27, 1975.

9. D. W. Robinson and M. S. Shipton, "Tables for the Estimation of Noise-Induced Hearing Loss", National Physical Laboratory (Great Britain), NPL Acoustics Report Ac61, March 1973.

10. U. S. Department of Health, Education and Welfare, National Institute for Occupational Safety and Health, "Criteria for a Recommended Standard....Occupational Exposure to Noise", 1972.

11. International Organization for Standardization, "ISO Recommendation R1999", May 1971.

12. Testimony of William Burns on behalf of the U. S. Environmental Protection Agency at the Public Hearings on the Proposed Exposure Standard for Occupational Noise, U. S. Department of Labor, OSHA, June 30, 1975.

13. D. W. Robinson, "Estimating the Risk of Hearing Loss Due to Exposure to Continuous Noise", in Occupational Hearing Loss, D. W. Robinson, Ed., Academic Press, N. Y. and London, 1971.

14. Testimony of John F. Finklea, M. D., Director, National Institute for Occupational Safety and Health, U. S. Department of Health, Education and Welfare, at the Public Hearings on the Proposed Exposure Standard for Occupational Noise, U. S. Department of Labor, OSHA, June 25, 1975.

15. Response to questionning by Dr. Daniel Boyd at the Public Hearings on the Proposed Exposure Standard for Occupational Noise, U. S. Department of Labor, OSHA, transcript page 33.

16. R. P. Hamernik, D. Henderson, J. J. Crossley and R. J. Salvi, "Interaction of Continuous and Impulse Noise: Audiometric and Histological Effects", J. Acoust. Soc. Am., Vol. 55, No. 1, January 1974.

17. M. Schmidek, B. Margolis and T. L. Henderson, "Effects of the Level of Noise Interruptions on Temporary Threshold Shift", report of U. S. Department of Health, Education and Welfare, National Institute for Occupational Safety and Health, March 1972.

18. Great Britain, Department of Employment, "Code of Practice for Reducing the Exposure of Employed Persons to Noise", London, Her Majesty's Stationary Office, 1972.

19. D. Henderson and R. D. Hamernik, "Uncertainties of Present Hearing Damage Risk Criteria", Proceedings of the Technical Program, Noisexpo, Chicago, IL, June 4-6, 1974.

20. J. M. Mills, R. W. Gengel, C. S. Watson and J. D. Miller, "Temporary Changes in the Auditory System due to Exposure to Noise for One or Two Days", J. Acous. Soc. Am., Vol. 48, 524-530, 1970.

21. D. M. Lipscomb, "What is the Audiogram Really Telling Us? Part I: Audiometrics vs. Cochlear Damage", Maico Audiological Library Series, Vol. 13, Report 5, 1975.

22. Testimony of Lyle F. Yerges of behalf of the Occupational Safety and Health Administration at the Public Hearings on the Proposed Exposure Standard for Occupational Noise, U. S. Department of Labor, OSHA, June 23, 1975.

23. Testimony of Howard K. Pelton on behalf of the Occupational Safety and Health Administration at the Public Hearings on the Proposed Exposure Standard for Occupational Noise, U. S. Department of Labor, OSHA, June 23, 1975

24. N. A. Ashford, D. Hattis, G. R. Heaton and J. I. Katz, "Some Considerations in Choosing an Occupational Noise Exposure Regulation", report submitted to the record in conjunction with testimony at the Public Hearings on the Proposed Exposure Standard for Occupational Noise, U. S. Department of Labor, OSHA, July 22, 1975.

Revised Table 2
Hearing Handicap After 40 Years Exposure
According to Robinson Method

Level dBA	% Handicapped	Presently		Compliance at 90 dBA		Compliance at 85 dBA	
		Number Exposed	Number Handicapped	Number Exposed	Number Handicapped	Number Exposed	Number Handicapped
		Numbers are in Thousands					
80-84	3.6	4,315	155.34	4,315	155.34	13,232	476.32
85-89	7.2	5,753	414.22	8,917	642.02	575	41.40
90-94	15	2,157	323.55	575	86.25	288	43.20
95-99	28.2	1,007	283.97	288	81.22	144	40.61
100-104	46	575	264.50	144	66.24	144	66.24
105-109	65.4	288	188.35	144	94.18		
110-114	81.6	144	117.50				
>115	89	144	128.16				
Totals		14,383	1,875.59	14,383	1,125.25	14,383	667.77

August 4, 1975
6060 W. Bristol Road
Flint, Michigan 48554

Mr. David R. Bell
New Department of Labor Building
Room N 3669
200 Constitution Avenue, NW
Washington, D.C. 20210

RE: AOMA Comments on OSHA Proposed Regulation on Noise

Dear Mr. Bell:

As Chairman of the American Occupational Medical Association Committee on Noise & Hearing Conservation, I am writing you the following brief comments on the proposed OSHA regulation on noise. The AOMA is an organization comprised of thousands of health professionals who serve American industry and whose dedication is to the prevention and treatment of conditions related to occupational exposure. It is therefore our stated position that we are dedicated to the prevention of hearing loss for all workers in American industry. Our Committee has reviewed the draft environmental impact statement on the proposed noise regulation in detail and we have the following comments to make:

In the overall it is the feeling of this Committee that the proposed regulation is a good one. To wit we agree with retaining the 90 dBA action limit for mandatory hearing conservation programs, the 85 dBA hearing testing limit and the 5 dBA doubling rate. We recognize that there are occasional susceptible individuals who will suffer hearing loss at exposures of 85 to 90 dBA. When such workers are identified by the 85 and above testing, we should provide hearing protection for these individuals. The objections from various agencies, individuals, etc., to OSHA's position is of particular concern to our organization. If an objective assessment of all the available data and information is made, one must arrive at the following conclusion; namely, that there is insufficient data at the present time to make hard and fast conclusions, particularly from the medical standpoint, for the purpose of promulgating a federal regulation. The antagonists to the 90 dBA rule are using basically three studies, all of which have been proven to have serious flaws, and then extrapolating figures and terms which appear on the surface to be valid, but which from the practical and logical standpoint are invalid. It is therefore our sincere recommendation that the proposed regulation be allowed to stand

as written until new data appears, particularly the currently underway inter-industry study on noise, which should be completed in approximately $1\frac{1}{2}$ to 2 years. We feel that OSHA should not impose regulations which are practically unobtainable and economically impossible for American industry without having all possible scientific data as a base for making such decisions. We feel that the inter-industry study will be the first real sound scientific data base on which to make such conclusions. It is therefore our hope that the government and the scientific community will await this and other similar studies before attempting to promulgate a long range regulation with unobtainable goals.

In the section dealing with engineering and administrative controls, there is language which is ambiguous. To state our position simply, we do not feel that industry should be made to expend large sums of money to lower noise to an unacceptable level, and then have to implement supplemental personal protective equipment programs. Experience has shown that in lower risk probability levels, it becomes more difficult to convince employes to effectively use hearing protection. Reference should also be made in the regulation to an effective, ongoing employe educational program. It should be clearly stated that where engineering and administrative controls cannot, from a practical or economical standpoint, achieve the desired result then personal protective equipment may be used in lieu thereof. We believe that each industry should be able, under the law, to plan and implement their own hearing conservation program, and where they can demonstrate that engineering controls can in no way, or from any viewpoint, reduce the exposure to acceptable levels, then personal hearing protective equipment should be allowed.

Under Section 4, Hearing Conservation Program, we have one further comment to make. There should be in the regulations a statement as to responsibility of overall professional r-veillance of hearing conservation programs. If we do n avail ourselves of the professional expertise and experience o those professionals dedicated to work in industry, the overall surveillance could end up in many cases in the hands of untrained and inexperienced nonprofessionals who would destroy or ultimately circumvent the intent of the regulation. The AOMA feels

very strongly that medical surveillance of any hearing conservation is the only logical direction which should be taken.

As Dr. Glorig aptly stated in the first week of the recent hearings, "we have enough in the regulations to work with right now, so let's get on with the business of protecting worker's hearing." We trust that this association will be informed of any future developments so that we may have the opportunity to make comment.

Sincerely yours,

Rufus W. Miller, M.D.
Chairman
AOMA Committee on Noise & Hearing Cons.

RWM:r

EXECUTIVE OFFICE OF THE PRESIDENT
COUNCIL ON ENVIRONMENTAL QUALITY
722 JACKSON PLACE, N. W.
WASHINGTON, D. C. 20006

January 28, 1976

Mr. David Bell
Department of Labor
Occupational Safety & Health
Administration
Washington, D.C. 20210

Dear David:

The Council on Environmental Quality has reviewed the DOL/OSHA draft Environmental Impact Statement "NOISE", filed with the Council on June 10, 1975. I hope the following comments will be helpful to you in your preparation of a final EIS in your standard development:

(1) The draft EIS addresses only one aspect of hearing loss -- hearing impairment or hearing handicap generally found compensable by Federal and state workmen's compensation boards. It has a fence of 25 dbA at 500, 1000 and 2000 Hz. By the time "hearing handicap" is reached, so much loss has occurred that speech can be heard only in a quiet surrounding, and the higher frequencies are totally lost. "Significant threshold shift" on the other hand is a 10 dbA shift at 2000, 3000 and 4000 Hz.

As it now stands the draft EIS addresses primarily compensable hearing loss. The importance and feasibility of preventing significant threshold shift, i.e., 10 dbA loss at 2000,3000 and 4000 Hz is not assessed.

(2) The assumption made throughout the EIS that the 90 dbA standard is unprecedented distorts the projected economic effects. The old regulation is not exhibited for comparison purposes and economic projections for achieving 90 dbA neglect to factor out expenditures already supposed to have been made for levels supposed to have been reached. Instead of analyzing worker health under the existing standard, projections are made as if 90 dbA was a new standard. These projections should, of course be made, but the hearing experience of workers exposed to the existing levels should not be ignored. Likewise, economic projections should be made which treat the cost of achieving 90 dbA as already having been met.

(3) The draft EIS does not fully discuss premature deafness. It treats all workers though they had reached the age of 60, at which time a substantial percentage of all persons have significant hearing loss. The approach of the EIS seems to be that since a percentage of workers will become deaf at a later date, there is no reason to protect against premature deafness.

(a) On page 45, the BBN study showed that at ages 50 to 54 a 90 dbA standard will protect 840,000 workers from premature deafness and a reduction to 85 dbA would protect an additional 700,000 workers, totalling 1,240,000. At ages 55-59, 700,000 workers would be protected from premature deafness by a 90 dbA standard and an additional 280,000 by an 85 dbA standard totalling 980,000. However, the discussion on pages 45 and 46 neglects to specify the age at which industrially caused deafness occurs versus the age at which natural deafness occurs and thus obscures their relationship.

(b) Baughn's addendum ("Relation Between Daily Noise Exposure and Hearing Loss Based on the Evaluation of 6,835 Industrial Noise Exposure Cases", page 32) contains figures for hearing loss at 4000 Hz at 78, 86 and 92 dbA. These show, for instance, that at 92 dbA 34 percent of 33 year olds with 15 years exposure would have a 40 dbA hearing loss. This kind of information would be more useful if presented and analyzed in the EIS.

(4) It is acknowledged that the proposed standard will allow some workers to incur handicapping hearing loss, but DOL/OSHA's projections as contained in the statement are presented in less than comprehensible manner.

(a) On page 3 of the summary the figure of 463,000 workers is used as the number who will not suffer hearing handicap because of the proposed rules. A second figure of 73,000 workers is submitted as the number protected by the 85 dbA standard. Robinson's data are used but the assumptions used to arrive at the final figures are not given, e.g., was Robinson's aging table used in reaching final figures?

(b) Alternative projections are not fully considered. For instance, Baughn's data is not used because he measured some temporary threshold shift, even though Baughn gives, within his work, a formula for compensating for this effect.

(5) Tables set forth on pages 31-35 of draft EIS are open to misinterpretation unless:

(a) The assumptions underlying various projections are specified;

(b) Figures which are approximate are so indicated;

(c) Comparable figures are developed for that level necessary to prevent significant threshold shift as defined in the proposed rules; and

(d) Basis on which DOL/OSHA accepted or rejected one set of figures over another is clearly stated.

(6) The discussion of the 3 dbA versus 5 dbA doubling rate is inadequate.

(a) It is assumed that the various breaks in a work day justify a 5 dbA doubling rate. It appears that the ameliorative effect of the breaks is assumed by the EIS to go beyond the duration of the breaks themselves, because in determining worker exposure employers may exclude time when the worker is not being exposed. No data is cited to justify this assumption. Botsford's work "Simple Method for Identifying Acceptable Noise Exposures" in which a similar statement is made is cited, but no elaboration is given to show how this paper supports the proposition. Botsford's examples and techniques for determining acceptable exposure appear quite different, are not presented in terms of the present standard, and may or may not be appropriate.

(b) On page 41 of the draft EIS a theory is referred to that would allow a 5 dbA doubling rate. No citation is given. No indication is given whether this is a widely held theory among experts in the field. Given the simple mathematics of the propositions under discussion it is obvious that the 5 dbA doubling rate allows workers to be exposed to much greater sound energy at 100 dbA than at 90 dbA. To have equal exposure, given the equal energy theory, apart from the ameliorative effects of breaks, one hour in two would have to be spent in rest breaks. We think evidence of ameliorative effects of the 5 dbA doubling rate should be very strong before the 3 dbA doubling rate is rejected. In any event, however, the discussion should be more complete.

(7) The alternatives section neglects to assess options such as:

(a) Adoption of an 85 dbA limit with a 5 dbA doubling rate and the 90 dbA limit with a 3 dbA doubling rate.

(b) Adoption of an 85 dbA limit after 3 or 5 years, accompanied by requiring new installations to meet the 85 dbA standard when constructed.

(c) The use of the 3 dbA doubling rate for determining applicability of the monitoring program to worker. This would move the .5 exposure level downward and bring more workers within its scope.

(d) Significant threshold shift as defined in the proposed regulations, should be discussed in terms of the effect it would have on worker health and on industry if it were adopted as a standard in lieu of the one proposed.

Sincerely,

Warren R. Muir, Ph.D.
Senior Staff Member
for Environmental Health

UNITED STATES
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
WASHINGTON, D.C. 20545

AUG 7 1975

Mr. David R. Bell
U.S. Department of Labor
New Department of Labor Building
Room N3669
200 Constitution Avenue, N.W.
Washington, D. C. 20210

Dear Mr. Bell:

DOL/OSHA ENVIRONMENTAL IMPACT STATEMENT, PROPOSED NOISE REGULATION

The subject statement has been reviewed by ERDA staff, and we offer the following observations.

1. The Air Force has adopted a noise standard of 84 dBA and a doubling rate of 4 dBA. These values have been selected after years of study of the audiograms of approximately three million people. Since your values are quite different, you may wish to evaluate their point of view in the final impact statement.

2. During the recent public hearings on the OSHA noise standard, Dr. Rutenberg, an economist, was critical of BB&N because they did not quantify the benefits of the lower 85 dBA standard value. She hinted that the impact most certainly would be far less than $31 billion and, that there might even be a net saving. You may wish to discuss her views in the final impact statement.

3. Considering the number of years of exposure required in many cases, for a noise-induced hearing loss to become significant enough to become compensable under existing Workmen's Compensation Laws, it would appear necessary to retain the audiometric records far longer than the five-year period recommended.

4. The summary gives the impression that the 73,000 people in the 85-90 dBA category will not suffer adverse effects because the audiometric testing program will identify them so that hearing protection can be required. However, the standard would allow these 73,000 people to incur "significant threshold shift(s)," i.e., an average of 10 dBA at 2,000, 3,000 and 4,000 Hz. The e

shifts would then result in use of hearing protection, the enforcement of which is a problem. Since hearing protection is not necessarily the best solution to personal protection, these people could incur further shifts.

5. The summary (page 3, paragraph 3) implies that the "reduction" to 90 dBA is a benefit. Since 90 dBA is the existing standard, enforcement of the existing standard would not result in additional benefit.

We appreciate the opportunity to review this statement.

Sincerely,

H. H. Pennington
Assessments and Coordination Officer
Division of Biomedical and Environmental Research

Kennedy Drive
Torrington, Connecticut 06790
(203) 482-4422

William R. Petricone
Vice President

June 26, 1975

Mr. David R. Bell
Room N-3669
New Department of Labor Bldg.
200 Constitution Avenue, N.W.
Washington, D. C. 20210

Dear Mr. Bell:

In December, 1974 we commented on the proposed noise exposure standards as issued by OSHA in October 1974 and revised in December 1974. Our comments were directed to the Docket Officer at that time.

There are new hearings beginning this week and our understanding of the proposed regulation leads us to believe that the latest proposals contain all the features we opposed earlier.

Therefore, I am enclosing for your fresh consideration a copy of our earlier comments and hereby wish to restate our opposition to these aspects of the regulations.

Very truly yours,

William R. Petricone

Enclosure

nra

NATIONAL RENDERERS ASSOCIATION, Inc.

3150 DES PLAINES AVENUE • DES PLAINES, ILLINOIS 60018

O'Hare Office Center (5 Minutes from Chicago's O'Hare International Airport)

TEL. 827-8151 AREA CODE 312 • CABLE: NARENDAS

EUROPE OFFICE: BRUSSELS, BELGIUM • FAR EAST OFFICE: TOKYO, JAPAN

August 8, 1975

Mr. David R. Bell
Room N-3669
New Department of Labor Building
200 Constitution Avenue, N.W.
Washington, D.C. 20210

Gentlemen:

This is in response to your letter of June 10, 1975 and your request to review the Draft Environmental Impact Statement on NOISE prepared by OSHA.

We have reviewed this draft and particularly have examined the two documents in the Appendix:

1. EPA Request of 12/18/74 for Review and Report from OSHA
2. OSHA Report of 3/18/75 at Request of EPA

We concur with OSHA that the steady state noise limit of 90 dBA for an eight hour time weighted average be retained. Likewise, the doubling rate of 5 dBA should be retained. We have reviewed OSHA's reasoning in arriving at these proposed values and definitely support OSHA's position. Of fundamental importance is the selection of the Robinson data as opposed to the Baughn data which certainly must be considered questionable because of the brief 20 minute time period allowed after exposure.

We are particularly opposed to the EPA statement in their 12/18/74 document that "EPA's criteria support a level of 75 dBA for an ultimate health goal." In the second category of Suggested Alternatives under incremental reductions, the EPA "strongly recommends that either the 5-year or better, the 3-year provision be reinserted (for reduction to 85 dBA) with serious

consideration given to reducing to 80 dBA after another subsequent period". This type of statement clearly shows that the EPA has no interest in considering the technological and economic factors that are involved, particularly where they propose unproven standards or limits. It is another example of their simplistic and frivolous approach toward protecting the nation's environment.

Attached is our previous statement of January 17, 1975 relative to the proposed OSHA noise standards.

An additional comment should be made relative to the application of "feasible" engineering controls. The rendering industry operates certain equipment that is inherently noisy. Attached is a brochure briefly describing our industry and a flow sheet illustrating the basic rendering process. For example, the animal by-product raw material must be reduced in size to small pieces for efficient cooking and pressing. Prebreakers, crushers and hoggers are used for this purpose. We have consulted with suppliers of this equipment in an attempt to design quieter machines. However, there is a practical limit to be reached in noise reduction because of the inherent noise resulting from the crushing of bones and other by-product raw material. We desire that OSHA define the word "feasible" more clearly. Also, where it is "unfeasible" to apply engineering and administrative controls, there should be provision for the allowance of hearing protectors.

Paragraph (e)(3) on Methods of Compliance for proposed 1910.95 provides for an employee's exposure (use of hearing protectors) to not occur more than one day per week. As a result, it would be necessary to have a different employee each of five days assigned to the particular job requiring the use of a hearing protector. If there are only two or three operating personnel in the plant, this clearly would not be feasible.

Our Association appreciates having this opportunity to comment on this OSHA draft statement.

Sincerely yours,

William H. Prokop

WHP:mm
Enclosures

William H. Prokop
Director of Engineering Services

ANPA RESEARCH INSTITUTE

1350 Sullivan Trail, P.O. Box 598
Easton, Pennsylvania 18042
(215) 253-6155

August 6, 1975

Mr. David R. Bell
Room N3669
New Department of Labor Building
200 Constitution Avenue, N.W.
Washington, D.C. 20210

Dear Mr. Bell:

This is in response to the request by John H. Stender for comments relative to the Draft Environmental Impact Statement - Proposed Regulation Noise.

On behalf of the American Newspaper Publishers Association and the National Newspaper Association, we submit the following comments:

1. We take strong exception to the section entitled "Summary," pages 1-7. The summary is not a true summary of the materials presented on pages 9-58. The summary appears to be the thinking of an author rather than a summary of the findings, particularly the third paragraph which conflicts with the actual test findings cited on pages 27-37 of the report;

2. The last paragraph of page 5 is an understatement. If the regulation continues to ignore the use of personal protectors, the regulation will add economic incentive to automate the job completely and eliminate the worker. Other small employers not able to automate will be forced out-of-business and the "localized layoffs" will be massive;

3. We fail to see the purpose of scheduling the comments on this draft prior to August 8, 1975. This date is prior to the completion of the OSHA Noise Hearings at which industrial, scientific and labor specialists are being heard. These OSHA Noise Hearings are the first opportunity for non-government voices to be heard on the proposed regulation. The final Environmental Impact Statement should include information from the public and private segments;

SOUTHERN IDAHO FORESTRY ASSOCIATION

Organized for Promotion of Practical Forestry, Not for Profit

August 5, 1975

BOX 1091
BOISE, IDAHO 83701

U.S. Department of Labor
Occupational Safety and Health Administration
Office of Standards Development
Room N-3669, 200 Constitution Ave., N.W.
Washington, D.C. 20210

Gentlemen:

Regarding the "Draft Environmental Impact Statement for the Proposed Regulation of Noise," this Association wants to go on record as opposing any reduction in the proposed noise standard from the present 90 dBA. It has been estimated that an immediate reduction of noise exposure to a permissible limit of 85 dBA solely by engineering controls could cost industry an estimated $31 billion dollars. In our own industry such an attempt would virtually bankrupt most of the small mills as well as many of the larger better financed concerns.

Our association strongly recommends the use of personal protective equipment as a permanent solution for noisy conditions where it is not feasible to use engineering or administrative action to control the noise to the desired level. There are many mills where it is physically impossible to engineer or administrate out the noise except through personal protective equipment. We know of several mills in our area that will have to close down if engineering or administrative controls are required instead of personal protective devices. We have found no strenuous objection from the employees to wearing personal protective devices and our regular audiometric testing would appear to date that such protective personal devices satisfactorily answer most of the objection to excessive noise.

In some cases we have found that engineering in noise controls has created other safety problems that perhaps are almost as serious to the employees as the noise problem. This is particularly true with older mills that have to be remodeled to meet the noise standards.

Sincerely yours,

SOUTHERN IDAHO FORESTRY ASSN

by E.M. Stoddard

E.M. Stoddard
Trustee

Help Grow Trees
Keep Idaho Green

"He has the right to criticize who has the heart to help"

THE EASTERN COMPANY

June 25, 1975

Mr. David R. Bell
Room N-3669, New Department of Labor Building
200 Constitution Avenue, N. W.
Washington, D. C. 20210

Subject: Occupational Noise Exposure

Dear Mr. Bell:

Back in November of 1974, we submitted comments on the proposed regulations for controlling and monitoring noise in the industrial environment. A copy of that letter is enclosed for your perusal.

Since that time, we have seen various printed discussions "pro" and "con" for maintaining the 90 dBa level and utilizing protective personal ear equipment as a solution for controlling this level. None of this testimony, combined with our own personal endeavors to solve this problem, has given us any reason to change our opinion that personal protective ear equipment is a viable solution and should be acceptable in meeting the safety and health requirements of this act as are safety glasses, hard hats, etc.

We support the 90 dBa level, but are unalterably opposed to the dual standard of audiometric testing at 85 dBa. Ear protection must be acceptable in combating this problem in that the monies required to engineer noise out of an operation are absolutely staggering, with no known guarantee that these expended monies will solve the problem.

Yours very truly,

THE EASTERN COMPANY

S. G. Sweet
Vice President

SGSweet:ap
Enc.

CC: Senator Lowell Weicker
Congressman Ronald Sarasin

112 BRIDGE STREET, NAUGATUCK, CONNECTICUT 06770 • PHONE (203) 729-2255

NATIONAL CLAY PIPE INSTITUTE

Washington Office

Tel. (202) 296-5270

August 12, 1975

Mr. David R. Bell
U. S. Department of Labor
Room N3669
New Department of Labor Building
200 Constitution Avenue, N. W.
Washington, D. C. 20210

Dear Mr. Bell:

This is with reference to Assistant Secretary of Labor, John A. Stender's letter of June 10, 1975, inviting our review and comment on the draft Environmental Impact Statement for the proposed Noise Regulations.

We have reviewed the draft material and have no comments to offer at this time.

Very truly yours,

Darold W. Taylor

Darold W. Taylor
Director of Engineering

DWT:sc

1130 SEVENTEENTH STREET, N.W. • WASHINGTON, D.C. 20036

UNIROYAL CONSUMER PRODUCTS
Division of UNIROYAL, Inc.
Naugatuck Footwear Plant
58 Maple Street
Naugatuck, Connecticut 06770
203-729-0261

July 10, 1975

Mr. David R. Bell
Room N-3669
New Department of Labor
Building 200
Constitution Avenue NW
Washington, D. C. 20210

Dear Sir:

I would like to add my voice to the many who are offering comments with respect to the proposed changes in OSHA noise level standards.

I have personally testified before the Subcommittee hearing for Manpower Compensation, Health and Safety held in Waterbury, Connecticut, on Saturday, May 3.

As a representative of the rubber footwear industry, Uniroyal employs in the order of 5500 people, the greater numbers of these people being engaged in operations which have moderate noise levels which take place in old manufacturing buildings, and are not easily adaptable to the application of engineering controls.

Furthermore, the footwear industry is marginal at best and is plagued by the constant threat of competition from imports whose cost structures do not necessitate compliance with even the current OSHA standards. Any action which would impose the substantial expenditures to comply with regulations tighter than the present standards could be detrimental to the employment prospects of those employees affected.

It is our feeling that the present standards do provide protection for the general manufacturing employee and that any higher standards would be economically unfeasible.

Furthermore, it is our firm belief that the use of personal protective devices in conjunction with good hearing conservation programs are more than satisfactory to accomplish the goals of OSHA. Such a program would be far less expensive than engineering programs, particularly in old and established buildings and processes.

Sincerely,

Carl Toothaker
Vice President, Manufacturing

Communications

GLENN E. WATTS, *President*

CWA

Workers of America

(AFFILIATED WITH AFL-CIO)
1925 K STREET, N.W.
WASHINGTON, D. C. 20006
TELEPHONE: AC 202/331-7711

August 6, 1975

File: 3.3.7

David R. Bell
Room N3669
New Department of Labor Building
200 Constitution Avenue, N.W.
Washington, D.C. 20210

Dear Mr. Bell:

This is in reply to the draft environmental impact statement (EIS) concerning the proposal to regulate occupational exposure to noise.

The draft EIS does not represent a balanced, comprehensive review of the effects of occupational noise regulation on the quality of the human environment. Rather, it reflects a selective use of data to justify the Department of Labor's position on an occupational noise exposure limit. All data which are unsupportive of the Department's position are completely ignored.

Thus, for example, the draft EIS uncritically accepts the BBN estimates for the cost of compliance to a 90 dBA level and an 85 dBA level but rejects the BBN estimates showing an 85 dBA standard would protect 838,000 more employees and would be feasible for 92 percent of the production workforce.

The draft EIS manipulates the data to show that only 73,000 more workers would be protected at 85 dBA. This conclusion differs by an order of magnitude from any other estimate.

Completely unaddressed by the draft EIS are such important questions as the appropriateness as a protection goal of a 25 dB fence at 500, 1000, and 2000 Hz and the fact that workers are

permitted by the proposal to suffer a threshold shift of up to 30 dB at a single frequency before preventive action is taken. This hardly represents an approach designed to assure that no employee will suffer material impairment of health over his or her working life.

For the above reasons, we urge that the draft EIS be revised to accurately reflect the effect of the proposed regulation on the quality of the human environment.

Sincerely,

Glenn E. Watts

Glenn E. Watts
President

XI. APPENDIX C

FEDERAL REGISTER NOTICE - EPA REQUEST FOR REVIEW AND REPORT

OCCUPATIONAL NOISE EXPOSURE REGULATION

(39 FR 43802-43809)

federal register

WEDNESDAY, DECEMBER 18, 1974

WASHINGTON, D.C.

Volume 39 ■ Number 244

PART II

ENVIRONMENTAL PROTECTION AGENCY

■

OCCUPATIONAL NOISE EXPOSURE REGULATION

Request for Review and Report

ENVIRONMENTAL PROTECTION AGENCY

[FRL 303-2]

PROPOSED OSHA OCCUPATIONAL NOISE EXPOSURE REGULATION

Request for Review and Report

I. SUMMARY

On October 24, 1974, the Occupational Safety and Health Administration (OSHA) of the Department of Labor published proposed requirements and procedures respecting occupational noise exposure (39 FR 37773). The Administrator of the Environmental Protection Agency (EPA) believes that the proposed regulation does not protect the public health and welfare to the extent required and feasible. Accordingly, under the authority of section 4(c)(2) of the Noise Control Act of 1972, Pub. L. 92-574 section 4(c)(2), 86 Stat. 1234, 42 USC 4903 (c)(2), the Administrator of EPA hereby requests that the Secretary of Labor review the proposed occupational noise exposure regulation and report to the Administrator of EPA on the advisability of revising such regulation to provide the required protection of the public health and welfare. Such report shall be forwarded to the Administrator of EPA 90 days from the date of this notice, and, as required by section 4(c)(2) of the Noise Control Act, shall be published in the FEDERAL REGISTER, accompanied by a detailed statement of the findings and conclusions of the Secretary of Labor respecting the revision of the regulation.

As presently proposed, the allowable level for an eight-hour workday exposure, 90 dBA, is too high. The Administrator believes that the eight-hour level should be set at 85 dBA, to become effective within three years, with a commitment to reduce to lower levels at a later date when such a reduction is shown to be feasible. Further, the OSHA formula for exposure of other than eight hours in length (the time-intensity tradeoff), allows an increase of 5 dB for each halving of exposure time. The Administrator recommends a 3-dB time-intensity tradeoff as necessary for protection of public health and welfare.

The development of an acceptable occupational noise exposure standard requires the resolution of three major issues: First, the requirements of public health and welfare; next, whether the technology exists to implement the standard necessary to protect health and welfare; and third, whether the costs of implementing such a standard are justified by the need.

EPA believes that there is sufficient information available to address each of these issues. OSHA states, however, that the 90-dBA standard should remain in effect "until further empirical data and information on the health risk, feasibility, and economic impact indicate the practicability and necessity of an 85-dBA requirement" (39 FR 37774). The current standard should not be extended on this basis.

EPA has provided OSHA with sufficient data to support the necessity for reducing the standard to 85 dBA, or lower. EPA has recently published a large amount of information on the effects of noise,[1] culminating in a document entitled *Information on Levels of Environmental Noise Requisite to Protect the Public Health and Welfare with an Adequate Margin of Safety*[2] (March, 1974), [illegible] was required by the Noise Control [illegible]. This document was subjected to an exhaustive review both by the scientific community and by other Federal agencies. The specified levels and the methodology used to identify them have been endorsed by a subcommittee of the Committee on Hearing, Bioacoustics and Biomechanics (CHABA), of the National Academy of Sciences—National Research Council. EPA does not believe the health justification for a lower occupational noise level requires further study. EPA's criteria support a level of 75 dBA for an ultimate health goal;[3] EPA believes that reduction to 85 dBA is an important step toward this goal.

The National Institute of Occupational Safety and Health (NIOSH), under the authority of sections 20(a)(3) and 22(e)(2) of the Occupational Safety and Health Act, Pub. L. 91-596, 42 USC 669(a)(3), 671(e)(2) (1970), developed and provided criteria to OSHA for a recommended standard, Occupational Exposure to Noise.[4] These criteria clearly stated the need for reducing the eight-hour exposure level to 85 dBA and the accompanying data and background material support that conclusion.[5]

In the preamble to the proposed standard, OSHA states that NIOSH "reluctantly concurs" with the 90-dBA level at the present time. The entire text of this NIOSH statement is as follows:

> Currently NIOSH reluctantly concurs with the generally acceptable 90 dBA occupational exposure level for an 8-hour day. The need for reducing this 8-hour exposure level to 85 dBA, as supported by the material contained in this document is also recognized. It is recommended that the 85-dBA, 8-hour exposure level be applicable to all newly designed occupational exposure environments after 6 months from the effective date of this standard. However, due to the unavailability of sufficient data relating to the technological feasibility of meeting the 85-dBA level, NIOSH is unable to recommended a specific time period after which the 85 dBA, 8 hour occupational exposure level might become effective for all occupational noise environments. (*Occupational Exposure to Noise*, p. II-3.)

This inability to comment on technological feasibility is not surprising in view of the fact that NIOSH's responsibility, as articulated in section 20(a)(3) of the Occupational Safety and Health Act, is to evaluate and recommend safe levels of exposure without regard to economics or technological feasibility.

As to technological feasibility, the Department of Labor contracted for an independent study on the feasibility of implementing both 90- and 85-dBA standards, and the results of that study were published on January 1, 1974.[6] The study concluded that compliance with an 85-dBA standard can be achieved using currently existing technology and that the noise control industry is capable of responding adequately to the increase in demand.[7] This study also explored the relative costs to industry of complying with the current 90-dBA level and an 85-dBA level over three- and five-year compliance periods. EPA believes that the resulting cost estimates are inflated and do not reflect the various economic alternatives to the industry-wide, threshold limit approach to the setting of standards.

EPA, charged, under section 4(c)(1) of the Noise Control Act, with the role of coordinating Federal noise control efforts, has worked with OSHA staff members during the development of the proposed regulation. An EPA representative served as non-voting liaison member to OSHA's Standards Advisory Committee on Noise. OSHA's proposed standard and draft Environmental Impact Statement were reviewed extensively by EPA staff,[8] resulting in suggestions for substantial changes and improvements to the standard and EIS.

The most significant recommendations involved reduction to 85 dBA within a 3-year period and adoption of the 3-dB time-intensity tradeoff. EPA also recommended a more conservative standard for impulse noise so that the maximum level would be decreased by 10 dB for each ten fold increase in the number of impulses. Another recommendation was that the definition of significant threshold shift be improved so that shifts of more than 10 dB at any test frequency would be considered significant. All of EPA's suggested improvements, with the exception of the impulse standard, have been rejected without adequate explanation.

EPA has also made several suggestions aimed at ameliorating the cost impact of a more protective standard. These suggestions include the alternatives of industry-by-industry standards, incremental reductions over time, a stringent standard with variance provisions, and lower levels for new plants. There, too, have been rejected without explanation. None of these recommendations are discussed in the preamble to OSHA's proposal. For these reasons, EPA is reporting to the procedures of section 4(c)(2) of the Noise Control Act in asking for a review of the proposed standard. The Act requires that the Department of Labor complete the requested review and report its findings and conclusions to the Administrator.

II. HEALTH AND WELFARE EFFECTS

A. NOISE EXPOSURE LEVEL

OSHA's Proposed Time-Weighted Level: 90 dBA

EPA's Recommendation: Within Three years: 85 dBA

Later Date: 80 dBA

Supporting information. EPA has reviewed OSHA's proposed standards for occupational exposure to noise and in view of the best available data, has determined that the 90-dBA time weighted

level for an 8-hour day does not adequately protect public health and welfare. EPA has identified a level of approximately 20 decibels below OSHA's proposed 90 dBA as the safe level for protection against hearing loss, i.e., a yearly equivalent sound level of 70 dBA averaged over a 24-hour period (Leq(24) 70).[1] The 70 dBA level would be compatible with an 8-hour exposure level of 75 dBA, so long as the exposure level over the remaining 16 hours is sufficiently low to result in a negligible contribution to the 24-hour average, i.e., no greater than an equivalent sound level of 60 dBA. EPA's criterion for the identified level is that it should produce no more than a 5-dB hearing loss at the 4000-Hz frequency over a period of 40 years in virtually the entire population. Although the identified safe level is not a standard, it provides a basis for judgment in the setting of standards. In that sense, it should be considered a long-range public health goal.

The data on which EPA's criteria and recommended levels are based have been drawn from three significant bodies of data, those of Baughn,[2] Passchier-Vermeer,[3] and Robinson.[4] EPA's conclusions are drawn from the averaged data of more than 10,000 subjects from the 12 studies reported by the above researchers. EPA believes these data represent the best available evidence on the effects of noise on hearing. As will be shown below, regardless of the criteria used to predict the effects of noise on the hearing of exposed workers, 8-hour noise levels of 90 dBA represent an unacceptable health hazard.

1. *Noise induced permanent threshold shift (NIPTS).* EPA believes that OSHA's analysis, based upon hearing risk for the averaged frequencies of 500 Hz, 1000 Hz and 2000 Hz, is inadequate, because it fails to account for hearing loss in the critical frequencies above 2000 Hz, which are the soonest and most severely affected by exposure to noise. To account for those factors, EPA has analyzed hearing loss in terms of noise induced permanent threshold shift (NIPTS),[5,6,7] and has examined hearing loss at individual frequencies and various combinations of frequencies,[1] giving special emphasis to the changes in response to higher frequencies. It should be borne in mind that for each 10 dB of hearing loss, sound energy will have to be increased by a factor of 10 in order for a particular sound to be heard.

The most important use of the hearing mechanism in today's society is for hearing and understanding speech. The kind of hearing loss that results from noise exposure impairs this ability to communicate. This impairment is usually a gradual occurrence. Individuals who have begun to suffer such a loss will often notice that ordinary speech is just as loud, but not as distinct as previously. This phenomenon occurs with reduction of high frequency hearing since a considerable portion of the sound energy of consonants lies in the high frequency range. Unfortunately for hearing-impaired individuals, the energy in consonants is smaller in magnitude as well as higher in frequency than it is for vowels, and it is consonants much more than vowels that give intelligibility to English speech.[8,9] As noise-induced hearing loss increases, speech communication becomes progressively more difficult for the hearing-impaired listener.

OSHA's analysis is based upon studies which have shown that in order to understand undistorted speech in quiet conditions (sound-proofed rooms), 500 Hz, 1000 Hz and 2000 Hz are the most important audiometric frequencies.[8,9] However, undistorted speech in quiet surroundings is not characteristic of the typical conditions in which speech must be understood. NIOSH[1] cites modern research as showing that "* * * everyday communication is placed under a wide variety of environmental stresses. Estimates of the amount of time that speech is distorted range from a conservative figure of 50 percent " up to about 100 percent." " It is obvious that everyday communication does not usually take place in sound-proofed booths.

It has been demonstrated that in order to understand speech in less than optimal conditions good hearing in the frequencies above 2000 Hz is very important. As far back as 1947, French and Steinburg [9] showed in a classic study that the frequencies above 1000 Hz are as important as those below 1000 Hz for determining the intelligibility of speech. There have been numerous other significant studies on the understanding of speech under various conditions of noise and distortion which are typical of environmental situations,[8,9] which point to the importance of preserving hearing above 2000 Hz. While these studies do not minimize the importance of good hearing in the mid-frequencies, they emphasize the previously underrated need for perception of frequencies in the range of 3000 Hz and 4000 Hz. Thus, while examining the effects of noise on hearing it is important to assess the effects on perception of the high frequencies as well as the mid-frequency range.

Figures 1 and 2 show the effects of noise on human response to various audiometric frequencies as a function of exposure level. Figure 1 shows the median NIPTS for ten years as a function of exposure level, according to Passchier-Vermeer.[3,7] Figure 2 shows these effects for an exposure of forty years.[7] It can be seen that while damage to hearing at the 4000-Hz frequency occurs mostly during the first 10 years, other critical frequencies, such as 2000 Hz and 3000 Hz continue to be affected as exposure is prolonged. It is also noteworthy that the important 2000 Hz frequency is considerably more affected by an exposure level of 90 dBA than by a level of 85 dBA.

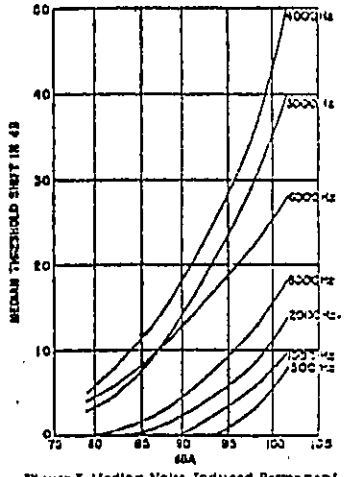


Figure 1. Median Noise-Induced Permanent Threshold Shift in dB as a Function of Exposure Level 8 hours a day for a period of 10 years.[7]

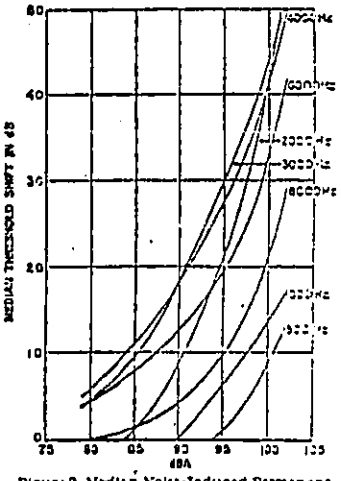


Figure 2. Median Noise-Induced Permanent Threshold Shift in dB as a Function of Noise Exposure Level 8 hours per day for a Period of 40 Years.[7]

Since there appears to be considerable variation in individual susceptibility to NIPTS, it is important to examine the effects of noise on the more affected portion of the population by looking at the higher percentiles. Using data from Passchier-Vermeer [3] and Robinson [4] EPA calculated amounts of NIPTS incurred

See footnotes at end of document.

after numbers of years for various percentiles. Baughn's data were not included in the calculations since discrete NIPTS values for 1000 Hz, 2000 Hz and 3000 Hz were not readily available. Shown in Table I are NIPTS for the [illegible] and 90th percentiles for the frequencies 1000 Hz, 2000 Hz, 3000 Hz and 4000 Hz after 10 and 40 years of exposure as a function of exposure level. Note that at an exposure level of 80 dBA the median NIPTS is less than a decibel for the mid-frequencies, and only reaches 5 dB in the high frequencies after 40 years of exposure. Although more hearing loss is incurred by the 10 percent most susceptible (the 90th percentile), losses due to 80 dBA can still be considered slight. An exposure level of 85 dBA produces nearly twice as much NIPTS as the 80 dBA level and [illegible] the NIPTS for most frequencies [illegible] as between 85 dBA and 90 dBA for both groups. Although the increase of NIPTS at 4000 Hz appears to level off somewhat between 85 dBA and 90 dBA, there is significant increase in NIPTS at 2000 Hz. This value more than doubles between the exposure levels of 85 dBA and 90 dBA.

TABLE I.—*Noise-induced permanent threshold shift (NIPTS) in decibels as a function of noise exposure level for the 50th and 90th percentiles*

(In decibels)

Exposure level	Years	Audiometric frequency			
		1000 Hz	2000 Hz	3000 Hz	4000 Hz
		(a) 50th percentile			
80 dBA	10	0.2	0.5	2.0	4.3
	40	0.36	1.1	4.5	6.8
85 dBA	10	0.4	1.1	4.4	8.0
	40	0.8	2.5	8.7	10.4
90 dBA	10	0.5	2.0	10.7	12.4
	40	1.7	5.2	16.0	17.2
		(b) 90th percentile			
80 dBA	10	0.6	1.8	4.6	10.2
	40	1.3	2.75	7.8	13.4
85 dBA	10	1.1	3.7	8.3	14.7
	40	2.3	6.7	13.1	19.2
90 dBA	10	2.1	7.6	17.4	21.2
	40	4.2	14.5	24.8	26.4

[1] Averaged data of Passchier-Vermeer [8] and Robinson.[9]

It is important to remember that values of NIPTS are not synonomous with hearing threshold levels. As age increases, hearing loss from the natural aging process or "presbycusis" will contribute to the total amount of hearing loss. Since presbycusis and NIPTS are generally considered additive,[6, 10] it is helpful to consider the summed contribution of noise and aging for the average, and for the more affected elements of the population. These figures will more realistically reflect the effect of noise on an exposed population. Table II shows the amounts of NIPTS described in Table I after the presbycusis values have been added.

Here it can be seen that the combined effect of noise and aging will produce considerably more hearing loss than would occur from noise exposure alone. In particular, exposure to a level of 90 dBA, when seen in combination with the aging process, results in substantial losses for average workers while affecting the 90th percentile even more severely.

In order to judge the magnitude of this effect, these exposure levels and the resulting NIPTS can be related to numbers of noise exposed workers. OSHA's contractor, Bolt, Beranek and Newman (BBN), has estimated the percentage of production workers currently exposed to various levels of noise, and the percentage that would be exposed to these levels if maximum compliance with the [illegible] 90-dBA standard or a future 85 dBA standard were achieved, Impact of Noise Control at the Workplace,[4] 1974, pp. 13 & 26. (See Tables III and IV in text.) BBN defines maximum compliance as that which would be achieved with the full use of presently available technology. BBN estimates that unless new technology is developed approximately 8 percent of the workforce would continue to be exposed to noise levels above the required limit, whether that limit is 90 dBA or 85 dBA. According to BBN approximately 14 million workers are currently employed in American production industries. The number of noise exposed workers based on this figure have been entered in Tables III and IV.

See footnotes at end of document.

TABLE II.—*Hearing threshold level in decibels[1] as a function of noise exposure and presbycusis*

[In decibels]

Exposure level	Age	Audiometric frequency 1000 Hz	2000 Hz	3000 Hz	4000 Hz
		(a) 50th percentile			
Nonnoise exposed	30	1.0	0.8	1.8	3.3
	40	6.8	11.3	18.0	24.0
80 dBA	30	1.2	1.3	4.8	7.6
	40	7.9	12.4	22.8	28.8
85 dBA	30	1.8	1.9	7.4	11.3
	40	8.4	12.8	23.7	34.4
90 dBA	30	2.6	3.6	12.8	16.7
	40	10.3	13.8	34.8	41.2
		(b) 90th percentile			
Nonnoise exposed	30	8.8	7.6	13.6	18.1
	40	14.6	18.1	28.8	36.6
80 dBA	30	8.4	8.9	18.2	28.2
	40	15.9	20.9	37.6	40.9
85 dBA	30	8.9	11.3	21.9	20.8
	40	18.9	24.8	43.2	48.0
90 dBA	30	16.9	13.4	31.1	37.8
	40	18.8	32.0	54.8	60.6

[1] Averaged Data of Passchier-Vermeer and Robinson. Presbycusis data previously subtracted by these authors have been added back.

[2] Re audiometric zero (ANSI S 3.6, 1969).

TABLE III.—*Estimates of shift in distribution of worker exposure due to maximum compliance to 90 dBA (according to Bolt, Beranek, and Newman, 1974)*

Exposure level (dBA)	Production workers currently exposed: Percent production workforce	Production workers currently exposed: Approximate number of workers	Those exposed after maximum compliance to 90 dBA: Percent production workforce	Those exposed after maximum compliance to 90 dBA: Approximate number of workers
80 to 84	30	4,200,000	30	4,200,000
85 to 89	40	5,600,000	62	8,680,000
90 to 94	15	2,100,000	4	560,000
95 to 99	7	980,000	2	280,000
100 to 104	4	560,000	1	140,000
105 to 109	2	280,000	1	140,000
110 to 114	2	280,000	0	—
More than 115	1	140,000	0	

TABLE IV.—*Shift in distribution of worker exposure due to maximum compliance to 85 dBA (according to Bolt, Beranek, and Newman, 1974)*

Exposure level (dBA)	Production workers currently exposed: Percent production workforce	Production workers currently exposed: Approximate number of workers	Those exposed after maximum compliance to 85 dBA: Percent production workforce	Those exposed after maximum compliance to 85 dBA: Approximate number of workers
80 to 84	30	4,200,000	93	13,020,000
85 to 89	40	5,600,000	4	560,000
90 to 94	15	2,100,000	2	280,000
95 to 99	7	980,000	1	140,000
100 to 104	4	560,000	1	140,000
105 to 109	2	280,000	0	
110 to 114	2	280,000	0	
More than 115	1	140,000	0	

It can be seen that requiring compliance at either the 90 dBA or the 85 dBA level would be beneficial. However, the difference between compliance at 90 dBA and at 85 dBA as can be seen by comparing Table III and IV is particularly dramatic. Should compliance at 85 dBA be achieved, the numbers of noise exposed workers in the 85–89 dBA group would be reduced from 8,680,000 to only 560,000. Thus, approximately 8,120,000 workers would be prevented from suffering the amount of NIPTS resulting from exposures of 85 dBA to 90 dBA shown in Table I. In addition, the numbers of workers exposed to the more damaging noise levels between 90 dBA and 110 dBA would be reduced from approximately 1,120,000 to 560,000. Although some amounts of hearing loss would still occur as a result of an 85 dBA exposure level, EPA believes that the demonstrated differences between NIPTS resulting from exposure to 85 dBA as opposed to 90 dBA are so significant as to warrant reduction to the 85 dBA level. This significance becomes more profound when one considers that the hearing of 8 million workers is involved.

See footnotes at end of document.

2. *Hearing risk.* Since the effects of occupational noise on hearing are often stated in terms of damage risk or hearing risk figures, it would be useful to examine percentages of the population at risk for various exposure levels. The word "risk" for these purposes is defined as the percentage of noise exposed population with a given amount of hearing impairment after subtractions have been made for the percentage of people who would "normally" incur such losses from other causes in the absence of noise. Criteria published by the International Organization for Standardization (ISO), EPA, and NIOSH, are fairly similar. These criteria shown in Table V, are based on 8-hour exposures, 5 days per week for up to 40 years. They show percentages of people who will have hearing losses that exceed 25 dB at the average audiometric frequencies of 500 Hz, 1000 Hz and 2000 Hz. It can be seen that substantial portions of the exposed population will incur such a hearing impairment at 90 dBA, approximately half as many will incur these impairments at 85 dBA, and the risk is quite small at 80 dBA.

TABLE V.—*Percentage of the population at risk (exceeding 25 dB hearing loss) as a result of various noise exposure levels*

Item	Noise exposure level (dBA)	Risk (percent)
a. Averaged frequencies 500 Hz, 1000 Hz, and 2000 Hz:		
ISO	90	21
	85	10
	80	0
EPA	90	22.5
	85	12
	80	5
NIOSH	90	29
	85	15
	80	3
b. Hearing risk for 4000 Hz:		
BAUGHN	90	52
	85	30
	80	6

These risk figures, however, do not take into account hearing losses above the 2000 Hz frequency. As mentioned earlier, human response to the high frequencies is more vulnerable to the adverse effects of noise, and is important to the understanding of speech in lifelike conditions. In order to compare the risk values for the mid-frequencies with those for a higher frequency, risk figures for 4000 Hz are shown. These figures were taken from Baughn's data, whose risk figures for the averaged mid-frequencies were used in the calculations of EPA's and ISO's risk values. The same 25-dB hearing loss criterion is used. It can be seen that the risk is considerably greater when 4000 Hz is examined, and the differences between exposure levels are even more noticeable. While only 6 percent of the exposed population will exceed the 25 dB loss criterion at 80 dBA, 52 percent of the population will exceed it from exposure to 90 dBA. This is clearly an unacceptable risk.

Although the concept of risk appears to be a fairly straightforward way of examining the effects of noise on hearing, there are a number of reasons why EPA is reluctant to use it as the only measure. First, risk figures say nothing about the shape of the distribution. Individuals could cluster around the area of 25 dB loss or they could be scattered widely up to 50 or 60 dB. Also risk figures say nothing about hearing losses that approach, but do not exceed the criterion in question (in this case 25 dB). In other

words, risk figures may provide information on people whose hearing goes from fair to bad, but not on those whose hearing goes from excellent to fair as a result of noise exposure. In addition, the percentage of risk will vary according to certain parameters such as the age and years of exposure of the exposed population and the presence and degree of otologic screening. For these reasons EPA believes that NIPTS, the actual amount of threshold shift due to noise exposure after correction for presbycusis, is a more appropriate descriptor of the effects of noise on hearing. While these values may appear to be less dramatic, they are less susceptible to bias and in the long run, more meaningful.

3. *Other health factors not considered.* There are certain adverse effects of noise that apparently have not even been discussed in the formulation of the standard. These are the non-auditory physiological effects of noise, and the effects on communication and job performance. While some of these effects are difficult to quantify, they should be taken into consideration as a noise exposure standard is developed, and where appropriate, they should encourage a more conservative approach to the setting of exposure limits. This is especially important in view of the fact that the proposed standard does not afford full protection against hearing loss. The Preamble states that "OSHA recognizes that comparatively more workers will be at lower risk at 85 dBA than at 90 dBA," but there is no consideration of long-range goals.

There is ample evidence that cardiovascular, endocrine and neurological changes do occur as a result of noise exposure.[1 * **] Whether or not these changes are harmful when experienced over a lifetime is still a subject of question for American researchers. Various European and Soviet studies, as well as some American studies, have indicated that high noise levels can produce significant non-auditory physiological effects in humans.[**] With specific reference to industrial noise, NIOSH[1] states that:

> The fact that those who work in high noise levels show greater medical difficulties than those who work under quieter conditions is not conclusive evidence that noise is the crucial causal factor. In each case, it is possible that the differences in the specified health parameters may be explained by other factors such as age, other environmental contaminants, workload and job habits.

However, the fact that such evidence does occur, even though it is not as conclusive as the auditory evidence, is reason to approach the standard-setting process with extra caution.

NIOSH concludes the discussion by saying that the "* * * noise limits designed to provide hearing protection should also reduce the possibility of any extra-auditory health disturbance."[1] Here it should be remembered that NIOSH referred to the 85 rather than the 90 dBA level. Such a statement can be still more safely made with reference to EPA's identified levels of 70–75 dBA.

While the possibility of protection against extra-auditory effects may be true for moderate levels of noise, this protection is less likely to occur with long-term exposures to 90 dBA for 8 hours, 95 dBA for 4 hours, or 100 dBA for 2 hours.

Speech and signal interference creates a similar situation. Varying amounts of communication can occur at levels above [illegible] when talkers move close together and very loud voice or shouting is used. However, speech communication is almost impossible above 100 dBA[1] and the audibility of warning shouts and signals becomes increasingly problematical at such high background levels. These hazards should be acknowledged and kept in mind when setting 8-hour exposure limits, and especially when making decisions about a time-intensity tradeoff. Even with an 8-hour exposure limit of 90 dBA, adoption of a more stringent time-intensity tradeoff than the present 5 dB rule would eliminate exposure to continuous noise at levels above 105 dBA. The chances of masking warning shouts or signals, as well as the probability of auditory damage would be reduced accordingly.

The effects of noise on job performance are more difficult to quantify than the effects on speech and signal interference. Continuous noise levels above 90 dBA appear to have potentially detrimental effects on performance, depending on the type of task and the individual's physiological and motivational state.[1] Intermittent levels of less than 90 dBA can be detrimental depending upon the above-mentioned variables, especially if the noise is unexpected, uncontrollable and has predominantly high frequency components.[1] Although these effects have not been studied extensively in the industrial situation, they should provide added incentive for adopting a conservative approach to the setting of standards designed to protect against other adverse effects.

B. TIME-INTENSITY TRADEOFF

OSHA's Proposal: 5-dB Rule

EPA's Recommendation: 3-dB or "Equal Energy" Rule

The question of the allowable increase in exposure levels with decrease of exposure time (time intensity tradeoff) is an issue that is as important as the 8-hour exposure level for the conservation of hearing. EPA believes that OSHA's allowable increase of 5 dB for every halving of exposure duration does not adequately protect public health and welfare. It is based on an over-simplification of the beneficial effects of intermittency. First, the criteria upon which it is based allow excessive amounts of threshold shift in the exposed population. In addition, the criteria require evenly spaced quiet intervals of specific duration in which to recover from temporary threshold shift (TTS). Such precise temporal distributions are not characteristic of the industrial environment. The typical sound levels during intermittencies in most industrial conditions are not sufficiently low to permit adequate recovery from TTS. It is generally agreed that persistent TTSs will eventually result in comparable permanent threshold shifts.[* *]

It is true that interrupted noise in some instances causes less damage to the hearing mechanism than an equivalent amount of continuous noise.[* *] For this reason, EPA increased by 5 dB the level of environmental noise identified as required to protect against hearing loss.[1] (This correction is distinct from a time-intensity tradeoff.) During the periods of interruption, the ear is able to achieve some amount of recovery from TTS. However, the amount of recovery achieved is highly dependent upon the duration and level of the noise, the amount of time between exposures and the sound level during the quiet period. While long periods of relative quiet are characteristic of most environmental noise, they are not common to industrial noise.

The 5 dB rule is theoretically based on damage-risk criteria developed by Working Group #46 of the Committee on Hearing, Bioacoustics and Biomechanics of the National Academy of Science—National Research Council (CHABA).[*] These criteria, derived from data on TTS, specify tolerable levels and durations of noise for 1-octave and 1/3-octave bands for a range of approximately 85 dB to 135 dB. They allow higher levels of noise as the durations become shorter and recovery periods become longer. Adherence to the CHABA criteria should produce TTS after 2 minutes or NIPTS after 40 years of exposure no greater than the losses displayed in Table VI. EPA believes that these are excessive amounts of allowable threshold shift from noise exposure. Moreover, research has indicated that observed amounts of TTS can be considerably higher than those predicted by the CHABA criteria.[*]

TABLE VI.—[illegible]

Test frequency (hertz)	[illegible]	[illegible]
1000	10	[illegible]
2000	[illegible]	[illegible]
4000	20	[illegible]

The CHABA criteria were later simplified to apply to the industrial situation by consolidating the 1/3- and 1-octave band long- and shortburst intermittent contours into one scheme combining dBA level, total on-time and number of exposure cycles.[*] A time-intensity tradeoff was selected that seemed to characterize a situation with 5 to 7 interruptions per day, namely, a 5 dB tradeoff. The validity of even this simplified method rests on the requirements that the exposure cycles be evenly distributed and the 5 to 7 interruptions are long enough to permit the necessary amount of recovery from TTS. However, as adopted by OSHA, these requirements have disappeared. Thus, an individual can be subjected to a 90 dBA exposure level distributed in any

See footnotes at end of document.

temporal pattern throughout the day, or even continuously, so long as a four-hour dose is not exceeded. The CHABA criteria, even in the simplified form, would permit only 60 minutes of uninterrupted exposure to 85 dBA. A yet more serious misinterpretation occurs by allowing a solid 15 minutes of exposure to 115 dBA. At this level, the CHABA criteria permits only about 30 minutes of uninterrupted exposure.

In addition to the regularity and duration of the interruptions, the noise level of the quiet period contributes to the amount of recovery that can take place. Significantly greater amounts of TTS were found for equivalent exposures of 103 dBA when the sound level during the quiet intervals was 77 dBA than when it was 40 dBA.[4] Significant differences also appeared between quiet intervals of 87 dBA and 57 dBA.[5] This kind of evidence has prompted EPA to identify a level of 80 dBA as a quiet requirement in order to permit complete recovery from 8-hour work-day exposures no higher than 90 dBA.[6] NIOSH has identified a level of 85 dBA as meeting the requirements of a less "effective."[7] Both figures are considerably more conservative than the 91 dBA level implicit in the proposed standard since levels below 77 dBA are not included in the calculation of the daily dose. It has been suggested that sufficiently low sound levels can heighten the effectiveness of interruptions and facilitate recovery that otherwise would not occur.[8] This hypothesis could very well explain the advantages attributed to intermittency in the laboratory and in occupations such as forestry and coal mining where the background noise level is fairly low. Obviously, there is quite a difference between a remote mountain top and a typical production factory.

It is generally agreed that the noise in production industries is fairly continuous or steady-state in nature and that it is not intermittent, i.e., interrupted by periods of subjective silence[9] or by noise levels below 55 dBA[10] to 65 dBA[11] depending on the definition of intermittency. OSHA's draft Environmental Impact Statement[12] maintains that "most industrial operations emit steady-state sounds." For this type of noise there is widespread agreement that the "equal energy" rule holds true, that is that equal amounts of sound energy will cause equal amounts of hearing loss regardless of how the energy is distributed in time. This rule allows a 3 dB increase in exposure level with each halving of exposure duration rather than the 5 dB increase permitted by OSHA. The concept of equal energy is incorporated into the ISO Recommendation R1999 "Assessment of Occupational Noise Exposure for Hearing Conservation Purposes."[13] It is written into most European standards for occupational noise,"[14] and it is used in modified form in the U.S. Army[15] and U.S. Air Force[16] standards. Actually, the Army has adopted a standard that identifies any level above 85 dBA as potentially hazardous, regardless of duration (i.e., a more conservative approach than the 3 dB tradeoff). The Air Force, although it previously used the equal energy rule,[17] has adopted a 4 dB tradeoff,[18] presumably as a compromise between the equal energy rule and the present OSHA method. The equal energy rule is incorporated into the methodology by which EPA has identified safe levels of environmental noise.[19] Accordingly to the EPA/ASHE criteria[20] the equal energy rule "is probably the best available method of predicting the effect of noise on hearing in the case of continuous noise of which the level fluctuates slowly (seconds to hours) during the workday," and its application to these noise conditions is advocated by most contemporary researchers."[21] Experimental support has been given to its application to intermittent noise[22] and there is a growing tendency to apply the rule to impulsive noise as well[23] (see Appendices C and G of EPA's "Noise Levels Document"). The English Code of Practice[24] extends the equal energy rule from completely steady-state noise to short-duration impulses as high as 150 dB. There is no doubt that the equal energy rule is simpler, and it is more practical to use since OSHA's 5 dB time-intensity tradeoff imposes limits of 115 dBA on continuous noise and 140 dB on impulsive noise.

An additional point that may have very serious implications for noise control is the fact that noise exposure can produce structural damage to the ear that is not demonstrated by behavioral audiometry.[25] A scheme such as the CHABA method, which is based on the growth and recovery of TTS, neglects the possibility that anatomical damage may occur even though it is not detected by ordinary methods. Thus, damage risk criteria that appear to be safe as measured by TTS and subsequent recovery may fail to protect individuals from physiological damage that might become apparent after years of exposure.

For the above reasons, a 5-dB time-intensity tradeoff is not appropriate to the industrial environment. Employing it would not protect public health and welfare to the extent required. It would allow excessive amounts of NIPTS, particularly in the more susceptible members of the exposed population (see Table VI), even if the CHABA-recommended intermittency patterns were adhered to. As the rule is currently interpreted, 4 hours of continuous noise at 95 dBA, and likewise 2 hours of continuous noise at 100 dBA and 15 minutes at 115 dBA are allowable, with the resulting amounts of hearing loss potentially much greater than those predicted by the CHABA criteria. These points are among the many reasons to severely restrict exposure to noise levels as high as 110 dBA and 115 dBA, and to apply the more conservative equal energy rule to industrial noise exposures.

III. Feasibility, Technology and Cost

To fill the gap in data which was pointed to in the NIOSH criteria document, the Department of Labor commissioned Bolt, Beranek, and Newman to study the cost and technology of quieting industry to levels of 90 dBA and 85 dBA. That study showed the same technology that is available today to achieve a level of exposure to 90 dBA for 92 percent of the workforce can also be applied to achieve a level of 85 dBA for the same number of workers and that technology can be adequately supplied by the noise control industry. The cost of achieving the 85 dBA level is, of course, greater. However, EPA believes that many of BBN's estimates ($13.5 billion for 90 dBA, $18.1 billion more for 85 dBA) are too high. BBN's report (because of the short time given for it) includes cost data based wholly or in part on extrapolations from individual plants to whole industries, and from smaller industries to very large industries, which, could also produce questionable figures. An example is the use of relative gross annual value of production to compare lumber finishing operations with saw mills, where the control requirements are not directly similar. In addition, it appears that estimates were not based on least cost methodology.[26] The final cost estimates do not take into account the combined use of administrative and engineering controls as allowed by the proposed standard, nor do they include the possibility of using in-house labor to achieve noise reduction.

Also, the estimates of economic impact do not consider as an offsetting savings the beneficial effect of new, quieter machinery on capital and labor productivity. Furthermore, alternatives such as those indicated in Part IV of this document can also favorably alter the cost impact. For these kinds of reasons, EPA suggests that a more thorough study of costs and benefits should be performed.

Even assuming, however, that these figures are correct, EPA believes that, in view of the need to reduce the standard ultimately to 75 dBA in order to protect the population adequately, requiring compliance with an 85 dBA standard within three years is a reasonable first step. The added protection is commensurate with even the BBN estimations of added cost. As shown in Tables III and IV, 8,120,000 more workers are protected at 85 dBA than at 90 dBA.

IV. Suggested Alternatives

EPA recognizes that, in the final analysis, it is OSHA that must perform the balancing of the cost, technology and health and welfare considerations. We believe, however, that for the reasons discussed above, the standards proposed and the justification given by OSHA fall short of protecting the health and welfare of workers to the extent required or to the extent that these values could feasibly be protected. Accordingly, EPA is asking that OSHA address in detail the specific points discussed above. If after doing so, the Secretary determines that an 85-dBA standard (and 3 dB time-intensity tradeoff) applicable to all industries after three years is not justified, the following regulatory alternatives should be considered. Because each of

See footnotes at end of document.

these approaches has been previously suggested to OSHA, and all have been rejected without explanation, the Administrator requests that the detailed response to these [illegible] include a detailed discussion of the Secretary's findings as to whether any one or a combination of these approaches could feasibly be employed to more adequately protect the public health and welfare.

In considering alternatives, EPA would urge OSHA also to abandon its position that the use of hearing protectors and audiometric monitoring are merely supplementary measures. EPA approves of OSHA's inclusion of hearing conservation measures as an integral part of an occupational noise control program. EPA concurs with the approach traditionally held by OSHA that ear protective devices should be used as interim measures until such time as engineering or administrative controls can reduce noise exposure to safe levels. However, since ear protective devices are often improperly used or not used, EPA does not view such devices as a viable alternative to noise reduction at the source or the use of administrative controls. Moreover, there exist with the use of such devices, as with many other personal protective items, possible risks of increased safety hazards.

EPA believes that audiometric monitoring can be a valuable diagnostic tool, but it will not detect "any changes in hearing," and consequently prevent significant threshold shift as OSHA has stated in its preamble. Normal variability among subjects, audiometers and technicians will reduce the probability of detecting hearing losses before they become significant. Moreover, OSHA's definition of significant threshold shift would conceivably allow threshold shifts of up to 25 dB at a single frequency before the worker is apprised of his hearing loss. Even at that point, there are no remedial steps specified except for retraining in the use of ear protection. For these reasons, EPA concurs with OSHA that hearing protection devices and audiometric testing alone cannot be considered as an alternative method of achieving noise reduction.

1. *Industry-by industry standards.* Bolt, Beranek and Newman pointed out in its feasibility study that a small portion of the American production industries is presently unable to comply with a 90-dBA 8-hour exposure standard with existing noise control technology.[9] In addition, some industries will experience the economic impact of compliance much more severely than others. Presumably for these reasons OSHA has chosen to issue extended compliance intervals for certain industries. Such an agreement is currently in effect with the American Can Company and EPA understands that agreements with other large companies are being negotiated. In addition, a multitude of abatement extensions are currently being granted on the local level. By granting different extensions to different industries OSHA has shown that industry-by-industry standards are administratively feasible, and in effect, are being practiced. Setting a more stringent goal for all industries and then allowing different compliance schedules for different industries would be one method of approaching the problem. This method could have the advantage of immediate reductions to noise levels well below 90 dBA wherever such reductions are feasible. Reductions in some cases to levels as low as 75 dBA would preclude even small amounts of threshold shift in most of the exposed population, and would greatly reduce the potential hazard of non-auditory effects.

2. *Incremental reductions.* This alternative is a variation of the plan mentioned above, where all industries would be required to comply with a certain exposure level within, for example, 5 years, and another level in another 5 years and so on until a truly safe level is achieved. It would be less complicated to administer than the industry-by-industry plan, but would not provide such immediate protection for workers employed in industries where abatement to low noise levels is readily achievable. In earlier drafts of OSHA's noise standard (Working Drafts I and II), reduction to 85 dBA in 5 years was specified. That provision has since been deleted. EPA strongly recommends that either the 5-year, or better, the 3-year provision be reinserted with serious consideration given to reducing to 80 dBA after another subsequent period.

3. *Stringent standard with variance provisions.* This alternative involves setting more stringent industry-wide standards, and allowing temporary variances for individual companies that are economically or technologically unable to comply. The agreement with the American Can Company has set clear precedent for the use of variances, even though the word "variance" has not been attributed to the agreement. The concept should be considered not only in terms of the present 90-dBA standard, but with respect to levels of 85 dBA and eventually to 80 dBA. It should, naturally, be viewed in terms of longer compliance periods for the lower levels, and for the companies that would experience the greatest economic and technical difficulties.

4. *Lower levels for new plants.* NIOSH has recommended that new plants be designed to meet an 85-dBA standard. This should be technologically feasible for nearly all industries, and the economic burden would be smaller than it would be for reducing exposures in existing plants. Requiring more stringent standards for new plants would stimulate the development of cost effective noise abatement technology and it would ease the burden of noise abatement requirements in the future.

Dated: December 6, 1974.

Russell Train,
Administrator,
Environmental Protection Agency.

[1] [illegible] (Allyn [illegible], 1969).

[2] U.S. Environmental Protection Agency, Proceedings of the International Congress on Noise as a Public Health Problem, Dubrovnik, Yugoslavia, #550/9-73-008, May, 1973.

[3] U.S. Environmental Protection Agency, Public Health and Welfare Criteria for Noise, #550/9-73-002, July, 1973.

[4] Guignard, J. C. A Basis for Limiting Noise Exposure for Hearing Conservation, U.S. Environmental Protection Agency and U.S. Air Force Aerospace Medical Research Laboratory, AMRL-TR-73-90, EPA-550/9-73-001-A, July, 1973.

[5] Johnson, D. L., Prediction of NIPTS Due to Continuous Noise Exposure, U.S. Environmental Protection Agency and U.S. Air Force Aerospace Medical Research Laboratory, AMRL-TR-73-91, EPA 550/9-73-001-B, July, 1973.

[6] Baughn, W. L., Relation Between Daily Noise Exposure and Hearing Loss Based on the Evaluation of 6,835 Industrial Noise Exposure Cases, U.S. Environmental Protection Agency, and U.S. Air Force Aerospace Medical Research Laboratory, AMRL-TR-73-53, June, 1973.

[7] U.S. Environmental Protection Agency, Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, #550/9-74-004, March, 1974.

[8] U.S. Department of Health, Education and Welfare, Health Services and Mental Health Administration, National Institute for Occupational Safety and Health, Criteria for a Recommended Standard * * * Occupational Exposure to Noise, 1972.

[9] Bolt, Beranek and Newman, Inc., "Impact of Noise Control at the Workplace," Report #2671, submitted to the U.S. Department of Labor, Office of Standards, January, 1974.

[10] U.S. Environmental Protection Agency, Office of Noise Abatement and Control, "Critical Commentary on the Occupational Safety and Health Administration Preliminary Draft Environmental Impact Statement and Proposed Standard for Occupational Exposure to Noise," unpublished document, May 10, 1974.

[11] Passchier-Vermeer, W., Hearing Loss Due to Exposure to Steady-State Broad Band Noise, Report 35, Instituut voor Gezondheidstechniek, Delft, Netherlands, 1968.

[12] Robinson, D. W., The Relationships Between Hearing Loss and Noise Exposure, National Physical Laboratory, Aero Report AC32, Teddington, England, 1968.

[13] Fletcher, H., Speech and Hearing in Communication, Van Nostrand, New York, 1953.

[14] Denes, P. B. and E. N. Pinson, The Speech Chain, Bell Telephone Laboratories, New York, 1963.

[15] [illegible], A. Glorig, [illegible] and A. H. Summerfield, "Predicting Hearing Loss for Speech From Pure Tone Audiograms," Laryngoscope, [illegible] 72, [illegible], January, 1957.

[16] Harris, J. [illegible] J. [illegible] and C. E. Myers, "A Method for Using the Audiogram to Predict [illegible] Hearing Loss," Arch. Otolaryng., Vol. [illegible], [illegible]-770, 1956.

Hood, J. D., "Discussion of Papers," Section III in Occupational Hearing Loss, D. W. Robinson, Ed. Academic Press, N.Y. and London, 1971.

Niemeyer, W., "Speech Discrimination in Noise-Induced Deafness," Intern. Audiol., Vol. 6, 42, 1967.

French, N. R. and J. C. Steinberg, "Factors Governing the Intelligibility of Speech," J. Acoust. Soc. Amer., Vol. 19, 90-119, 1947.

Mullins, C. J. and J. L. Bangs, "Relationships between Speech Discrimination and other Audiometric Data," Acta Otolaryng., Vol. 47, 149, 1957.

Harris, J. D., H. L. Haines, and C. K. Myers, "The Importance of Hearing at 3Kc for Understanding Speeded Speech," Laryng., Vol. 70, No 2, 131, 1960.

Kryter, K. D., C. Williams, and D. M. Green, "Auditory Acuity and Perception of Speech," J. Acoust. Soc. Am., Vol. 34, 1217-1223, 1962.

Ross, M., D. Huntington, H. A. Newby and R. F. Dixon, "Speech Discrimination of Hearing-Impaired Individuals in Noise—Its Relationship to other Audiometric Parameters," USAF Tech. Doc. Rept. No. 62-130, 1962.

Harris, J. D., "Pure Tone Hearing Acuity and the Intelligibility of Everyday Speech," J. Acoust. Soc. Am., Vol. 37, 824-830, 1965.

Acton, W. I., "Speech Intelligibility in a Background Noise and Noise Induced Hearing Loss," Ergonomics, Vol. 13, No. 5, 546, 1970.

Lindeman, H. E., "Relation Between Audiological Findings and Complaints by Persons Suffering from Noise-Induced Hearing Loss," J. Am. Indus. Hyg. Assoc., Vol. 32, 447, 1971.

Dickman, D. M., "The Effects of Three Noise Backgrounds on the Sentence Intelligibility Scores of Hearing-Impaired Listeners," unpublished doctoral thesis, University of Maryland, 1974.

Passchier-Vermeer, W., "Steady-State and Fluctuating Noise: Its Effects on the Hearing of People," in Occupational Hearing Loss, D. W. Robinson, Ed. Academic Press, New York and London, 1971.

Hinchcliffe, R., "The Threshold of Hearing as a Function of Age," Acustica, Vol. 9, 303-308, 1959.

International Organization for Standardization, "Assessment of Occupational Noise Exposure for Hearing Conservation Purposes," R1999, 1971.

Robinson, D. W., "Estimating the Risk of Hearing Loss Due to Exposure to Continuous Noise," in Occupational Hearing Loss, D. W. Robinson, Ed., Academic Press, N.Y. and London, 1971.

Anticaglia, J. R., and A. Cohen, "Extra-Auditory Effects of Noise as a Health Hazard," American Industrial Hygiene Assoc. J., Vol. 31, May-June, 277-281, 1970.

Welch, B. L. and A. S. Welch, Ed., Physiological Effects of Noise, Plenum Press, New York and London, 1970.

Jansen, G., "Non-Auditory Effects of Noise, Physiological and Psychological Reaction in Man," in Proceedings of the International Congress on Noise as a Public Health Problem, Dubrovnik, Yugoslavia, U.S. Environmental Protection Agency, #550/9-73-008, 431-439, May, 1973.

Jansen, G., "Adverse Effects of Noise in Iron and Steel Workers," Stahl u. Eisen, Vol. 81, 217-220, 1961.

Shatalov, N. M., A. O. Saitanov, and K. V. Glotova, "On the State of the Cardiovascular System Under Conditions of Exposure to Continuous Noise," Labor Hyg. Occup. Dis., Vol. 6, 10-14, 1962.

Arguelles, A. E., M. A. Martinez, E. Pucciarelli, and M. V. Disisto, "Endocrine and Metabolic Effects of Noise in Normal, Hypertensive and Psychotic Subjects," in Physiological effects of Noise, B. L. Welch and A. S. Welch, Ed., Plenum Press, New York and London, 1970.

Cohen, A., "Industrial Noise and Medical, Absence, and Accident Record Data on Exposed Workers," in Proceedings of the International Congress on Noise as a Public Health Problem, Dubrovnik, Yugoslavia. U.S. Environmental Protection Agency, #550/9-73-008, 441-453, May, 1973.

Cantrell, R. W. and P. W. Hartman, "Biochemical Effects of Intermittent Noise," in Inter-noise '74 Proceedings, J. C. Snowdon, Ed., Institute of Noise Control Engineering, Poughkeepsie, N.Y., 569-572, 1974.

U.S. Environmental Protection Agency "Session 5: Non-auditory Physiological and Pathological Reactions," in Proceedings of the International Congress on Noise as a Public Health Problem, Dubrovnik, Yugoslavia, #550/9-73-008, May 1973.

Glorig, A., W. D. Ward and J. C. Nixon, "Damage Risk Criteria and Noise-Induced Hearing Loss," Arch. Otolaryng., Vol. 74, 413-423, 1961.

Eldredge, D. H. and J. D. Miller, "Acceptable Noise Exposures—Damage Risk Criteria," in Noise as a Public Health Hazard, Proceedings of the Conference, ASHA Reports #4. American Speech and Hearing Association, Washington, D.C. 1969.

Miller, J. D., C. S. Watson, and W. P. Covell, "Deafening Effects of Noise on the Cat," Acta Otolaryng. (Stockholm), Suppl. 176, 1963.

Ward, W. D., A. Glorig and D. L. Sklar, "Temporary Threshold Shift Produced by Intermittent Exposure to Noise," J. Acous. Soc. Am., Vol. 31, p. 791, 1959.

Kryter, K. D., W. D. Ward, J. D. Miller and D. H. Eldredge, "Hazardous Exposure to Intermittent and Steady-State Noise," J. Acous. Soc. Am., Vol. 39, 451-463, 1966.

Schmidek, M., T. L. Henderson and B. Margolis, "Evaluation of Proposed Limits for Intermittent Noise Exposures with Temporary Threshold Shift as a Criterion," J. Am. Ind. Hyg. Assoc., 543, Aug. 1972.

Botsford, J. M., "Simple Method for Identifying Acceptable Noise Exposures," J. Acous. Soc. Am., Vol. 42, 810, 1967.

Schmidek, M., B. Margolis and T. L. Henderson, "Effects of the Level of Noise Interruptions on Temporary Threshold Shift," unpublished report, U.S. Dept. Health, Education and Welfare, National Institute for Occupational Safety & Health, March 1972.

Schmidek, M. and P. Carpenter, "Study of Chain Saw Operators: Nature of Intermittent Noise Exposure and Associated Damage Risk to Hearing," unpublished report, U.S. Dept. Health, Education and Welfare, National Institute for Occupational Safety and Health, 1972.

U.S. Department of Labor, Occupational Safety and Health Administration, "Draft Environmental Impact Statement on Noise," May, 1974.

International Organization for Standardization, R 1999, "Assessment of Occupational Noise Exposure for Hearing Conservation Purposes," May 1971.

United Kingdom Department of Employment, "Code of Practice for Reducing the Exposure of Employed Persons to Noise," London: Her Majesty's Stationery Office, 1972.

France, Norme Expérimentale, "Evaluation de l'Exposition au Bruit au Cours du Travail en Vue de la Protection de l'Ouïe," S31013, Association Française de Normalisation, Paris, April 1969.

Denmark, Direktoratet for Arbejdstil-

Svensk Standard Sen 59 01 11, Utgava #1.

synet, "Støj på Arbejdspladsen," #19, 1972.

Polish Standard for Industrial Noise, PN-70/B-02051, 1970.

Department of the Army, AR 40-5, "Health and Environment," Sec. IV, Hearing Conservation Program, 4-6, Sept. 1974.

Department of the Air Force, Aerospace Medicine, "Hazardous Noise Exposure," AF Regulation 161-35, July 1973.

Department of the Air Force, Medical Service, "Hazardous Noise Exposure," AF Regulation 160-3, Oct. 1956.

Burns, W. and D. W. Robinson, Hearing and Noise in Industry, London, Her Majesty's Stationery Office, 1970.

Eldred, K. M., W. J. Gannon, and H. von Gierke, "Criteria for Short Time Exposure of Personnel to High Intensity Jet Aircraft Noise," Rept. WADC-TN-355, Aerospace Medical Laboratory, Wright-Patterson AFB, Ohio, 1955.

Passchier-Vermeer, W., "Noise-Induced Hearing Loss from Exposure to Intermittent and Varying Noise," in Proceedings of the International Congress on Noise as a Public Health Problem, Dubrovnik, Yugoslavia, U.S. Environmental Protection Agency #550/9-73-008, May 1973.

Eldredge, D. H. and W. P. Covell, "A Laboratory Method for the Study of Acoustic Trauma," Laryngoscope, Vol. 68, 465, 1958.

Sulkowski, W., "Some Epidemiological Data on Noise-Induced Hearing Loss in Poland, Its Prophylaxis and Diagnosis," in Proceedings of the International Congress on Noise as a Public Health Problem, Dubrovnik, Yugoslavia, U.S. Environmental Protection Agency #550/9-73-008, May 1973.

Atherly, G. R. C. and A. M. Martin, "Equivalent-continuous Noise Level as a Measure of Injury from Impact and Impulse Noise," Ann. Occup. Hyg., 14, 11-23, 1971.

Rice, C. G. and A. M. Martin, "Impulse Noise Damage Risk Criteria," J. Sound and Vibration, 359-367, 1973.

Coles, R. R. A., C. G. Rice and A. M. Martin, "Noise-Induced Hearing Loss from Impulse Noise: Present Status," in Proceedings of the International Congress on Noise as a Public Health Problem, Dubrovnik, Yugoslavia, U.S. Environmental Protection Agency #550/9-73-008, May 1973.

Mills, J. H., R. W. Gengel, C. S. Watson and J. D. Miller, "Temporary Changes in the Auditory System due to Exposure to Noise for One or Two Days," J. Acous. Soc. Am., Vol 48, p. 524-530, 1970.

Slavsky, R. and A. R. Ferguson, "Evaluation of the OSHA-Contracted Study by Bolt Beranek and Newman, Inc., The Impact of Noise Control at the Workplace," unpublished report prepared for the Office of Noise Abatement, EPA, by the Public Interest Economics Center, Washington, D.C., May 24, 1974.

[FR Doc.74-29070 Filed 12-17-74;8:45 am]

XII. APPENDIX D

FEDERAL REGISTER NOTICE - REVIEW AND REPORT

REQUESTED BY EPA

OCCUPATIONAL NOISE EXPOSURE REGULATION

(40 FR 12336-12339)

DEPARTMENT OF LABOR

Occupational Safety and Health Administration

OCCUPATIONAL NOISE EXPOSURE

Review and Report Requested by EPA

On October 24, 1974, the Occupational Safety and Health Administration (OSHA), U.S. Department of Labor, published a Notice of Proposed Rulemaking (39 FR 37773) concerning revision of the occupational noise exposure regulations found at 29 CFR 1910.95. Briefly, OSHA proposed to retain the noise exposure limits now in effect, that is, a permissible exposure of 90 dBA as an eight hour time weighted average. The OSHA proposal, among other things, added monitoring and audiometric testing requirements beginning at 85 dBA, defined minimum requirements for hearing conservation programs and proposed new exposures limits to impulse or impact noise. Interested persons were invited to submit written data, views and objections to the proposal and to request a hearing.

On December 18, 1974, the Administrator of EPA, acting under the authority of section 4(c)(2) of the Noise Control Act of 1972 (86 Stat. 1236, 42 U.S.C. 4903), published a notice in the FEDERAL REGISTER requesting that the Secretary of Labor review the proposed occupational noise exposure regulation and report to the Administrator within 90 days on the advisability of revising the regulation (39 FR 43802). In his request, the Administrator suggested a number of revisions to the proposal. This notice constitutes the Secretary of Labor's response to EPA's request, and is published pursuant to the requirements of section 4(c)(2) of the Noise Control Act.

At the outset the Secretary wishes to note that the OSHA document at issue herein is merely a proposal, required by section 6(b) of the Occupational Safety and Health Act (84 Stat. 1593; 29 U.S.C. 655) as a preliminary step in the administrative rulemaking process under the Act. To date OSHA has received over 800 comments from interested persons concerning this proposal. There have also been a number of requests for an informal hearing on the proposal and OSHA will shortly publish a notice in the FEDERAL REGISTER scheduling such a hearing. EPA's objections to the OSHA proposal center, primarily, on the permissible noise exposure level, and the time intensity trade-off or doubling rate. Numerous comments received by OSHA from the public also relate to the issue of the permissible exposure. The propriety of a 5 dB doubling rate has been the subject of a number of comments as well.

Pursuant to the EPA request, OSHA has reviewed the proposed occupational noise exposure regulation and for the reasons set out below does not find sufficient cause to revise the proposal at this time. The points raised by EPA will be issues at the hearing. After the hearing OSHA will consider the proposal on the basis of the full record, including the EPA request, and will make such revisions as are warranted by the evidence.

I. LEVEL NECESSARY TO PROTECT EMPLOYEES

EPA expresses the view that the OSHA proposal "does not protect the public health and welfare to the extent required and feasible." However, the obligation of the Secretary of Labor under section 6(b)(5) of the Occupational Safety and Health Act is to, "set the standard which most adequately ensures, to the extent feasible, on the basis of the best available evidence, that no employee will suffer material impairment of health or functional capacity even if such employee has regular exposure * * * for the period of his working life." Thus, the statutory criterion for an OSHA standard is not couched in the general terms of protection of the "public health and welfare". OSHA believes that its proposal is adequate to achieve the mandate of the Occupational Safety and Health Act.

Since the language of the Act speaks to "material impairment" it is necessary to make some assessment of what constitutes "material impairment." With regard to hearing loss, clearly the most directly measurable deleterious effect of noise exposure, the Administrator bases his argument strictly upon the document, "Information on Levels of Environmental Noise Requisite to Protect the Public Health and Welfare with an Adequate Margin of Safety," published in March 1974. The methodology and the levels set out in this document were endorsed by the individuals recommended by a subcommittee of the Committee on Hearing, Bioacoustics and Biomechanics (CHABA) of the National Academy of Science—National Research Council (1). Within the parameters of that document, the Department of Labor also has no objection to either the methodology or the levels. The basic problem is that, for the purposes of that document and for setting standards for hearing conservation, EPA has chosen levels designed to protect virtually the whole population (the 96th percentile) from a noise induced permanent threshold shift (NIPTS) greater than 5 dB at 4,000 Hz after 40 years of exposure (2). This is a level of NIPTS which cannot be observed either subjectively or by instrumentation in any individual case. EPA admits, at 39 FR 43808, that "normal variability among subjects, audiometers, and technicians will reduce the probability of detecting hearing losses before they become significant." The measured reproducibility of audiometric determinations is such that to state that a real change has occurred with a 95 percent confidence the recorded change must be at least 10 dB at frequencies below 4 kHz, 15 dB at frequencies from 4 to 6 kHz, and at least 20 dB at 8 kHz (11) (12). A 5 dB change might be measured by averaging the hearing levels of large groups. Even such an averaged measurement would be somewhat questionable since the standard audiometric zero is in doubt by 2 or 3 dB (3) (4). The Secretary can not accept a criterion for "material impairment" which can neither be subjectively observed nor instrumentally measured.

The hearing level which has been accepted by the medical profession as marking the beginning of impairment is that level which begins to interfere with the hearing of everyday speech under everyday conditions. The "Guides to the Evaluation of Hearing Impairment" of the American Medical Association (5) states, "the ability to hear sentences and to repeat them correctly in a quiet environment is taken as satisfactory evidence for correct hearing of everyday speech." Because of the practical difficulties with speech audiometry, the usual test is pure tone audiometry according to a formula worked out by the Subcommittee on Noise of the American Academy of Ophthalmology and Otolaryngology (AAOO)

TABLE I

Level	Duration	Percent	Hearing level DB				Impairment	
			500	1,000	2,000	3,000	AAOO	BEC
90	30	2	20	25	30	42	2dB	[illegible]
90	30	10	13	16	22	34	0	0
85	20	2	15	15	23	31	0	1dB
85	30	10	10	12	17	[illegible]	0	0

which was subsequently adopted by the AAOO and the American Medical Association (5) (6). It is also the formula which has been adopted by the International Standards Organization (7). This formula is an average hearing level of 25 dB at 500, 1000, and 2000 Hz re: ANSI 1969. It is correct, as EPA has pointed out, that this formula has been criticized by various authors, but it is still the standard regularly used by the medical profession both here and in Europe in judging the beginning of impairment. The Federal Bureau of Employee Compensation, apparently because of a belief that frequencies higher than 2000 Hz are important to the understanding of speech, has recently modified this formula, for compensation purposes, to an average hearing level of 25 dB at 1000, 2000, and 3000 Hz. Both criteria are used in the following discussion.

Based on these generally accepted definitions of impairment, we can make an estimate of the consequences of life-long habitual exposure at the levels which have been proposed. We have chosen for this estimate to use Robinson's data since it appears that his audiometric work is the most careful which has been done in any large study. Robinson's study has also taken some pains to eliminate such variables as temporary threshold shifts, conductive losses, and other otologic abnormalities from the data. Robinson (3 page 133) provides an equation and nomogram for calculating the hearing levels to be expected in various percentiles of an exposed population. Table I shows the results of this calculation for the second and tenth percentiles of a population exposed for 30 years to 90 dBA and 85 dBA respectively. It is clear from these figures that "comparatively more workers will be at a lower risk at 85 dBA than at 90 dBA." It is also clear that the risk of impairment is minimal under either an 85 dBA or 90 dBA standard, being limited to the most sensitive 2 percent of the population at risk. There is a very high probability that even this minimal risk will be avoided under the proposed standard by the requirement for periodic audiograms for all employees exposed to 85 dBA and mandatory hearing conservation programs for those few individuals who show a modest increase in hearing level. If further investigations, now in progress, show that these conclusions are not correct, they may be reconsidered at that time. Currently, they represent the best data available to us.

The Baughn data (13) were not used in these calculations because they are contaminated by temporary threshold shifts (TTS). Baughn states, "our audiograms are taken throughout the day with only a 20 minute (average) quiet rest period preceding" (p. 27). While a 20-minute period of quiet will allow a fraction of the auditory fatigue caused by several hours of exposure to disappear, full recovery usually requires 8 to 16 hours. Indeed, all current proposals for establishing programs for monitoring the hearing of workers require that the worker be out of the noise at least 14 hours before testing. Naturally, the higher the average noise level, the greater the TTS, so that one would expect higher (but erroneous) hearing levels (HLs) for the "92" group than the "86", and for "86" than for "78." Figure 3 of Baughn's report (p. 12) indicates that the median difference between the HLs of the 78 dBA and 92 dBA groups is never more than 5 decibels. A few hours of exposure to 90 dBA will produce a TTS (measured 20 minutes after exposure) of considerably more than 5 dB. The Passchier-Vermeer report (14) was not used because it is a compilation and recalculation of several studies, the quality of which is difficult to judge.

OSHA's tentative conclusion that 90 dBA provides adequate protection is supported by the recent action of the ILO Panel of Experts on Noise and Vibration in the Working Environment meeting in Turin, Italy, December 2–10, 1974. This panel has recommended 85 dBA as the warning level and 90 dBA as the danger level for hearing purposes. This recommendation parallels the position taken in OSHA's proposal which requires audiometry starting at 85 dBA and sets an exposure limit of 90 dBA. This was also the recommendation of the Advisory Committee on Noise.

Technological Feasibility. The Department of Labor generally agrees with EPA that the technology now exists for compliance with either an 85 dBA or a 90 dBA limit through engineering controls. While there are some significant exceptions, such as textile weaving, we would accept the Bolt, Beranek, and Newman (8) conclusion that by the maximum application of existing technology the sound levels at 92 percent of jobs can be reduced to either 90 dBA or 85 dBA.

EPA asserts that the Bolt, Beranek and Newman cost estimates are inflated. Whether the cost estimates contained in the study are correct is an appropriate issue for the rulemaking proceeding. A number of the written comments received by OSHA relate to the accuracy of the study, and we expect that additional data will be submitted at the hearing. On the basis of the evidence in the record, OSHA will make a determination, to the extent possible, as to the likely costs to industry in complying with various noise limits. We believe that feasibility, including economic feasibility, is a factor which may be taken into consideration in setting a standard. However, we recognize that consideration of economic costs can not detract from the overriding purpose of the Act "to assure so far as possible every working man and woman in the Nation safe and healthful working conditions." As EPA recognizes, in the final analysis it is OSHA which must make the legislative judgment necessary to balance the factors of protection of employees, technology and cost.

Other Health Factors. EPA states that "there are certain adverse effects of noise which have apparently not even been discussed in the formulation of the standard." This statement appears inconsistent with the position taken by EPA in the "Levels Document" (2 page 17) that "At this time, there is insufficient scientific evidence that non-auditory diseases are caused by noise levels lower than those that cause noise induced hearing loss." This question of non-auditory effects of noise was, in fact, discussed and considered by the Advisory Committee. Reference to such non-auditory health effects was eliminated for the same reason set out by EPA in the "Levels Document." In our view, therefore, a standard which protects against hearing loss will also provide adequate protection against non-auditory health effects.

II. Time-Intensity Trade-Off

Under the OSHA proposal, permissible noise exposure may not exceed an 8-hour time weighted average of 90 dBA. Since permissible exposure is defined in terms of a time weighted average, the level of noise may increase if the exposure time is decreased. The 5 dB doubling rate incorporated in the present standard and continued in the proposal would allow an exposure of 85 dBA for 16 hours; 90 dBA for 8 hours; and 95 dBA for 4 hours.

EPA has recommended a doubling rate of 3 dB rather than 5 dB which is proposed by OSHA. The 3 dB doubling rate is hypothetically correct for uninterrupted noise exposure. However, noise exposure in industry is seldom continuous. There are normally a number of instances during the workday when an employee's exposure is interrupted. Evidence discussed below indicates that where breaks in exposure occur, workers show significantly less temporary threshold shift than would otherwise be expected. Therefore, OSHA agrees with the Advisory Committee that the doubling rate should be adjusted to take into account various interruptions which normally occur in a workday. OSHA therefore believes that a doubling rate of 5 dB is more appropriate than 3 dB.

"EPA states . . . that the noise in production industries is fairly continuous or steady-state in nature and that it is not intermittent, i.e., interrupted by periods of subjective silence or by noise levels below 55 dBA to 65 dBA depending on the definition of intermittency (2) Pt

43807). EPA concludes that "for this type of noise there is widespread agreement that the equal energy rule holds true, that is that equal amounts of sound energy will cause equal amounts of hearing loss regardless of how the energy is distributed in time. This rule allows a 3 dB increase in exposure level with each halving of exposure duration, rather than the 5 dB increase permitted by OSHA."

While most industrial operations do tend to produce steady-state noise, frequently with some impulsive components, it does not follow that the exposure of the employees is constant. One of the problems in relating noise exposure to hearing loss is to find subjects who actually have had continuous exposure to constant noise levels. The problem is exemplified by the following quotation from Baughn (13): "The group assigned 86 dBA spend 65% of their work time at 86 plus or minus 3 dBA, 80% at 86 dBA plus or minus 5 dBA and not more than 5% at above 92 and below 78 dBA combined." Baughn gives similar descriptions of the groups which he assigned to 78 dBA and 92 dBA. Burns and Robinson (3 pg 97) found the same problem. As they stated, "The magnitude of the difference ($L_{in}-L_{ss}$) ranged generally from 0 to 10 dB but was as much as 15 in exceptional cases."

EPA has apparently accepted the equal energy hypothesis that equal amounts of acoustical energy produce equal amounts of auditory damage regardless of the distribution in time. At least for temporary threshold shift, and presumably for permanent threshold shift, this hypothesis is not in accord with the evidence from laboratory experiments, which show a difference in temporary threshold shifts depending on the temporal pattern. These experiments were conducted with the periods of noise exposure uniformly spaced in the experimental period, and EPA consequently says that the criteria require evenly spaced quiet intervals in which to recover from temporary threshold shift.

The work of Sataloff, Vasello, and Menduke (10), which measured permanent threshold shifts of miners, showed shifts which would be predicted for levels about 15 dBA lower than the actual levels in which they were working. This lends some credibility to the argument that the pattern of distribution of noise exposure is not of overriding importance, since the quiet periods in these operations are dictated by the nature of the mining operations and can be presumed not to have been evenly spaced. It also indicates that the equal energy hypothesis may not apply to permanent threshold shift with any more accuracy than it does to temporary threshold shift.

In addition, Dr. Terry Henderson of NIOSH told the Advisory Committee, "Based upon presently available evidence, NIOSH could find no technically feasible formula that was clearly superior and more equitable than the presently accepted 5 dB rule" (9).

III. Regulatory Alternatives

EPA requests that, if OSHA disagrees with the basic position of EPA, it should consider several regulatory alternatives. We will address some of these alternatives in detail. At the outset, it should be emphasized that since, for the reasons stated above, we do not believe that an 85 dBA standard and 3 dB trade-off are necessary to afford employees adequate protection, we need not reach the question of whether regulatory strategies which would impose incremental reduction or requirements on a selective basis should be adopted.

1. *Industry-by-industry standards.* EPA has suggested that OSHA develop industry-by-industry standards, and that lower levels be set for those industries which can not achieve such levels. The establishing of varying noise levels for different industries, while a possibility, raises complex policy issues and presents a number of practical difficulties. If OSHA were to adopt this approach, it would be subject to the charge that it is acting inequitably by affording one level of protection for employees in some industries and another, and lesser, level of protection for employees in other industries, even though all employees were subject to the same hazards. In addition, we would confront practical difficulties in determining in a satisfactory manner the appropriate industry groupings; in collecting the data necessary to set industry-by-industry standards; and in enforcing standards with varying permissible limits.

EPA asserts that the national compliance agreement with American Can Company reflects OSHA's recognition of the administrative feasibility of varied compliance intervals on an industry-by-industry basis. This assertion confuses OSHA's section 6 standard-setting function with its section 8 enforcement responsibilities. Thus, in the issuance of a citation for a violation of the noise standard, the Secretary must, under section 9(a) of the Act, "fix a reasonable time for the abatement of the violation." The American Can Company agreement, as well as the Secretary's disposition of Petitions for Modification of Abatement dates represent the exercise of the Secretary's abatement setting authority within the context of enforcement. The agreement is predicated on the noise standard now in effect, which is equally applicable to all industries.

The fact that in specific cases OSHA determines that a particular abatement date is appropriate is in no way a precedent for a determination that separate industry-by-industry standards are justified in the standards-setting context.

2. *Stringent Standard with Variance Provision.* EPA suggests that a more stringent standard be adopted on an industry-wide basis and individual companies that are economically or technologically unable to comply could apply for temporary variances. We believe this alternative misconstrues the purpose of the temporary variance section.

Under section 6(b)(6) of the Act, OSHA may grant temporary variances to an employer if he establishes, among other things, that "he is unable to comply with a standard by its effective date because of the unavailability of professional or technical personnel or of material necessary to come into compliance with the standard or because necessary construction or alteration of facilities cannot be completed by the effective date." Such variances may be granted only after notice to employees and an opportunity for a hearing and may remain in effect for a period of no more than one year, and renewed only twice.

The purpose of this section is to provide a remedy to individual employers, or classes of employers, who because of circumstances peculiar to them are unable to comply with a standard for specific reasons. It was not the purpose of this section to permit temporary variances because of cost factors. More important, under the legislative scheme, OSHA cannot rely on the availability of temporary variances in setting a standard which large numbers of employers are unable to comply with. Clearly, it is not the purpose of the temporary variance section to allow OSHA to avoid its responsibility of determining which standard is generally feasible for industry.

Moreover, adoption of this alternative would impose an unmanageable burden on OSHA in the handling of the variance applications, and an inequitable burden on employers by requiring them to resort to the variance procedures in order to comply with the requirements of the Act.

Conclusion. After a careful review of the proposal, in view of the request from EPA, the Secretary of Labor finds that no changes should be made in the proposal at this stage. EPA's request and the evidence contained therein, will be

considered together with the entire record developed in this proceeding in formulating the final OSHA noise standard.

Signed at Washington, D.C., this 13th day of March 1975.

JOHN STENDER,
Assistant Secretary of Labor.

References

1. Letter from Milton A. Whitcomb to Dr. Alvin F. Meyer, Jr., dated November 20, 1973.
2. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, EPA Document 550/9-74-004 March 1974 page 18.
3. Hearing and Noise in Industry, W. Burns and D. W. Robinson, London: Her Majesty's Stationery Office 1970 page 233 et seq.
4. M. E. Delaney and L. S. Whittle, Acustica 16:227 (1967).
5. Guides for the Evaluation of Hearing Impairment, Trans Am. Acad. Opthal. Otolaryngol. 1961.
6. Guides to the Evaluation of Permanent Impairment—Ear, Nose, Throat, and Related Structures, J. Am. Med. Assn. 177:489-501 (1961).
7. ISO Recommendation 1999, Assessment of Occupational Noise Exposure for Hearing Conservation Purposes, May 1971.
8. Bolt, Beranek, and Newman, Inc., "Impact of Noise Control at the Work Place," Report #2671 (January 1974)
9. Standards Advisory Committee on Noise, Thursday, February 22, 1973, Transcript page 27.
10. Hearing Loss from Exposure to Interrupted Noise, J. L. Sataloff, Vassello, and H. Menduke Arch. Env. Health 18:972 (1969).
11. Reproducibility of Sweep—Frequency Audiometry, W. Passchier-Vermeer and J. Van den Ellk. Am. Ind. Hyg. Assn. J. 35:368-368 (1974).
12. The Reliability of Repeated Auditory Threshold Determination. G. R. C. Atherly and I. Dingwall—Forcyce. Brit. J. Ind. Med. 20:231-235 (1963).
13. Relation between daily noise exposure and Hearing Loss based on the Evaluation of 6,835 Industrial Noise Exposure Cases, Amrl-TR-73-32, June 1973.
14. Hearing Loss Due to Exposure to Steady-State Broadband Noise, W. Passchier-Vermeer IG-TNO Report 35 (1968), Delft, Netherlands.

[FR Doc.75-7107 Filed 3-17-75;8:45 am]

XIII. APPENDIX E

GLOSSARY OF TECHNICAL TERMS

The following explanations of terms are provided to assist the reader in understanding some of the terms used in the proposed standard and in this FEIS.

Acoustics--The science of sound. Relating to, containing, producing arising from, actuated by, or carrying sound.

Acoustic Trauma--Damage to the hearing mechanism caused by a sudden burst, or blast, of intense noise. (The term usually implies a single traumatic event.)

Ambient Noise (Residual Noise; Background Noise)--Noise of a measurable intensity that is normally present in the background in a given environment. The pervasive noise associated with a given environment, being usually a composite of sounds from sources both near and distant.

Audiogram--A chart, graph, or table resulting from an audiometric test showing an individual's hearing threshold levels as a function of frequency.

Audiologist--A professional specializing in the study and habilitation of hearing who is certified by the American Speech Hearing and Language Association or is licensed by a state board of examiners.

Audiometer--An instrument used for measuring the threshold or sensitivity of hearing, which measures hearing acuity for pure tones, speech and base conditions.

Baseline Audiogram--An audiogram obtained on testing after a prescribed period of quiet. The audiogram against which future audiograms are compared.

Cochlea--A spiral wound tube, resembling a snail shell, which forms part of the inner ear and contains the end organ of hearing.

Criterion Sound Level--A-weighted sound level of 90 decibels (TWA).

Decibel--Unit of measurement of sound level.

Frequency--The number of cycles completed by a periodic quantity in a unit time, which is expressed in Hertz (Hz) or in cycles per second (CPS).

Hearing--The ability to perceive sound; the sensation of sound as opposed to vibration.

Hearing Aid--A miniature, portable sound amplifier consisting of a microphone, audio amplifier, earphone, and battery which is used by persons with impaired hearing.

Hearing Conservation (Hearing Conservation Program)--Those measures taken to reduce the risk of noise-induced hearing loss.

Hearing Handicap--The occupational and social difficulty experienced by a person who has a hearing loss.

Hearing Impairment--Reduction in the ability to perceive sound. Hearing loss exceeding a designated criterion (i.e., 25 dB, OSHA averaged from the threshold levels at 1000, 2000, and 3000 Hz).

Hearing Level--A measured threshold of hearing expressed in decibels relative to a specified standard of normal hearing.

Hearing Loss--The symptom of reduced auditory sensitivity.

Hertz--Unit of measurement of frequency, numerically equal to cycles per second.

Impulse Noise (Impulsive Noise)--Noise of short duration (typically, less than 1 second) especially of high intensity, abrupt onset and rapid decay, and often rapidly changing spectral composition. (Impulse noise is

characteristically associated with such sources as explosions, impacts, the discharge of firearms, the passage of supersonic aircraft (sonic boom), and many industrial processes.)

Intermittent Noise--Fluctuating noise whose level falls one or more times to very low or unmeasurable values during an exposure.

Masking--The process by which the threshold of audibility for one sound is raised by the presence of another (masking) sound. The amount by which the threshold of audibility of a sound is raised by the presence of another (masking) sound. The unit customarily used is the decibel.

Material Impairment of Hearing--An average hearing level, with respect to audiometric zero, that exceeds 25 dB for the frequencies 1000, 2000, and 3000 Hz. This hearing level is sometimes called a "fence" in that it provides a demarcation point along the continuum of hearing levels, above which a hearing loss is considered, in the language of the Occupational Safety and Health Act, a "material impairment of health or functional capacity." Most audiologists and acousticians will agree that small amounts of hearing loss can be tolerated, but only up to a certain point. Above that point they cannot function as well as normally hearing individuals. The selection of this point of fence becomes the definition of material impairment of hearing.

Medical Pathology--A disorder or disease. For purposes of this regulation, a condition or disease affecting the ear which should be treated by a licensed physician.

Noise Dosimeter--An instrument that integrates a function of sound pressure over a period of time in such a manner that it directly indicates a noise dose usually as a percentage of the criterion noise dose.

Noise Exposure--A generic term signifying the total acoustic stimulus (both level and duration) applied to the ear over a period of time.

Noise-Induced Hearing Loss (NIHL)--A sensorineural (originating in the cochlea or the fibers of the auditory nerve) hearing loss attributable to the effects of noise.

Noise-Induced Permanent Threshold Shift (NIPTS)--Used to predict the amount of hearing loss, in individuals and in groups due to the noise exposure, after corrections have been made for aging. NIPTS values may be designated for combinations of frequencies or for individual frequencies, including 3000, 4000, and 6000 Hz. These higher frequencies are especially important since they are most vulnerable to noise. NIPTS is usually presented for certain population percentiles of the exposed population such as the median of the 10th percentile.

Otolaryngologist--A physician specializing in diagnosis and treatment of disorders of the ear, nose and throat.

Percentage Risk--Involves predicting the percentage of a population whose hearing levels will exceed a given amount or fence (such as 25 dB) as a result of noise exposure. Exceeding the fence indicates the beginning of material impairment. The fence is usually stated in terms of specific combinations of frequencies, such as the average of 500, 1000, and 2000 Hz or 1000, 2000, and 3000 Hz. This value is estimated by observing the number of people who would "normally" (from aging or other causes) exceed the fence in a non-noise exposed population.

Permanent Threshold Shift (PTS)--The component of threshold shift that shows no progressive reduction in hearing impairment with the passage of time after the apparent cause has been removed.

Presbycusis--The decline in hearing acuity that normally occurs as a person grows older.

Representative Exposure--Measurement of an employee's noise dose or time-weighted average sound level that the employer deems to be representative of other employees in the workplace.

Sensorineural hearing Loss--Hearing loss resulting from a lesion of the cochlear end-organ (organ of Corti) or its nerve supply.

Temporary Threshold Shift (TTS)-- That component of threshold shift which shows a progressive reduction with the passage of time after the apparent cause has been removed.

Threshold of Hearing (Audibility)--The minimum effective sound pressure level of an acoustic signal capable of exciting the sensation of hearing in a specified proportion of trayls in prescribed conditions of listening.

Threshold Shift--An elevation of the threshold of hearing of an ear at a specified frequency.

XIV. APPENDIX F

FEIS MAILING LIST

FEDERAL AGENCIES

H.L. Barrows
Deputy Assistant Administrator
U.S. Department of Agriculture
Agricultural Research Service
Washington, DC 20250

Barry Flamm
Director
Office of the Secretary
Office of Environmental Quality
U.S. Department of Agriculture
Room 412-A, Administration Bldg.
Washington, DC 20250

Warren R. Muir, Ph.D.
Senior Staff Member for
Environmental Health
Council on Environmental Quality
722 Jackson Place, N.W.
Washington, DC 20006

Bruce R. Barrett
Acting Director, Office of
Environmental Affairs
Department of Commerce
Washington, DC 20230

Commanding Officers
Envrironmental Affairs
Headquarters, USAF (PREV)
U.S. Department of Defense
Washington, DC 20330

George Marienthal
Deputy Assistant Secretary
of Defense
(Environmental Quality)
U.S. Department of Defense
Washington, DC 20301

Rebecca Hammer, Acting Director
Office of Federal Activities
Environmental Protection Agency
537 Waterside Mall Bldg.
Washington, DC 20460

William A. Hedeman, Jr. (A-104-5)
Office of Environmental Review
Environmental Protection Agency
401 M Street, S.W.
Washington, DC 20460

W.H. Pennington
Assessment and Coordination Officer
Division of Biomedical and
Environmental Research
U.S. Energy Research and Development
Administration
Washington, DC 20545

Paul Cromwell
Acting Chief Environmental Officer
Department of Health and
Human Services
Room 2718N, 300 Independence Ave.,S.W.
Washington, DC 20201

Charles Custard
Director, Office of Environmental Affairs
Department of Health and
Human Services
Room 537 F, Hubert H. Humphrey Bldg.
200 Independence Avenue, S. W.
Washington, DC 20201

Richard H. Brown
Director, Office of Environmental Quality
Office of the Assistant Secretary
for Community Planning and Development
Department of Housing and Urban
Development
Washington, DC 20410

Bruce Blanchard, Director
Environmental Project Review
Dept. of the Interior Rm. 4256
18th and C Streets, N.W.
Washington, DC 20240

Stanley Doremus
Deputy Assistant Secretary
of Interior
U.S Department of Interior
Washington, DC 20240

Gene Proctor
Occupational Medicine and
Environmental Health
National Aeuronautics and Space
Administration
600 Maryland Avenue, S.W.
Washington, DC 20546

Anthony Robinson, Director
NIOSH
12420 Parklawn Dr., DANNAC Bldg.
Rockville, MD 20852

Lindsey Grant, Director
Office of Environmental Affairs
Department of State
Washington, DC 20520

Assistant Secretary for
Environment, Safety and
Consumer Affairs
U.S Department of Transportation
Office of the Secretary
Washington, DC 20590

Joseph Canny (#9423)
Chief, Environmental Analysis Division
U.S. Department of Transportation
400 - 7th Street, S.W.
Washington, DC 20590

STATE AGENCIES

Alabama Development Office
c/o State Capital
Montgomery, AL 36130

State Clearinghouse
Office of the Governor
State of Alaska
Pouch AD
Juneau, AK 99801

State Clearinghouse
Office of Economic Planning
and Development
State of Arizona
1700 West Washington Street
Room 507
Phoenix, AZ 85007

Department of Local Services
State Planning and Development
Clearinghouse
900 First National Building
Little Rock, AR 72201

Office of the Governor
Office of Planning and Research
1400 10th Street
Sacramento, CA 95814

Division of Planning
Department of Social Affairs
520 State Centennial Bldg.
1313 Sherman Street
Denver, CO 80203

Connecticut State Clearinghouse
Office of Policy and Management
Intergovernmental Relations
Division
80 Washington Street
Hartford, CT 06115

Office of Management, Budget and Planning
Towsend Bldg - Third Floor
P.O. Box 1401
Dover, DE 19901

Division of Budget and Management Systems
District Bldg., Room 423
1350 E. Street, N.W
Washington, DC 20004

Bureau of Intergovernmental Relations
Division of State Planning
Department of Administration
660 Aplalchee Parkway
Tallahassee, FL 32304

Office of Planning and Budget
Room 610
270 Washington Street, S.W
Atlanta, GA 30334

Department of Planning and Economic Development
P.O. Box 2354
Honolulu, HI 96804

State Clearinghouse
Division of Budget, Policy Planning and Coordination
Hall of Mirrors, 2nd Floor West
Boise, ID 83720

State Clearinghouse
Bureau of the Budget
Lincoln Tower Plaza
524 S. Second Street, Room 315
Springfield, IL 62706

Indiana State Clearinghouse
State Planning Services Agency
143 West Market Street
Indianapolis, IN 46204

Office for Planning and Programming
523 East 12th Street
Des Moines, IA 50319

Division of State Planning and Research
Department of Administration
Mills Bldg., Suite 501
109 W. 9th Street
Topeka, KS 66612

State Clearinghouse
Office for Planning and Management
209 Capital Annex
Frankfort, KY 40601

Office of State Clearinghouse
Department of Urban and Community Affairs
5790 Florida Blvd.
Baton Rouge, LA 70806

State Planning Office
State of Maine
184 State Street
Augusta, ME 04333

Department of State Planning
301 West Preston Street
Baltimore, MD 21201

Executive Office of Communities and Development
100 Cambridge Street
Boston, MA 02202

Office of Intergovernmental Relations
Department of Management and Budget
Lewis Cass Bldg., Box 30026
Lansing, MI 48909

State Clearinghouse
Minnesota State Planning
Agency
101 Capital Square Bldg.
St. Paul, MN 55101

Coordinator Federal State
Programs
Office of the Governor
1304 Sillers Bldg.
Jackson, MS 39201

Office of the Administrator
Division of Budget and Planning
P.O. Box 8091
State Capital
Jefferson City, MO 65101

Montana State Clearinghouse
Office of Budget and Program
Planning
Room 221, State Capital
Helena, MT 59601

State Office of Planning and
Programming
State Capital
Box 94601
Linclon, NE 68509

State Planning Coordinator
Capital Complex
Carson City, NV 89701

Coordinator of Federal Funds
Office of the Governor
State House
Concord, NH 03301

Division of State and Regional
Planning
Department of Community Affairs
329 West State Street
P.O. Box 2768
Trenton, NJ 08625

Division of State and Regional
Planning
Department of Community Affairs
329 West State Street
P.O. Box 2768
Trenton, NJ 08625

State Planning Office
Career Bldg.
505 Don Gaspar
Santa Fe, NM 87503

State Clearinghouse
New York State Division of the
Budget
State Capital
Albany, NY 12224

State Clearinghouse
Division of Budget and Management
Department of Administration
116 West Jones Street
Raleigh, NC 27611

State Intergovernmental Clearinghouse
North Dakota State Planning Division
State Capital - 9th Floor
Bismarck, ND 58505

The Ohio State Clearinghouse
Office of Budget and Management
30 East Broad Street, 39th Floor
Columbus, OH 43214

Department of Economics and
Community Affairs
State Grant-in-Aid Clearinghouse
5500 North Western
Oklahoma City, OK 3118

Federal Aid Coordinator
Intergovernmental Relations Division
Executive Department
306 State Library Building
Salem, OR 97310

Pennsylvinia State Clearinghouse
Governor's Budget Office
Intergovernmental Relations Divisions
P.O. Box 1321
Harrisburg, PA 17120

Planning Board
Office of Federal Affairs
P.O. Box 41119 Minillas Station
Santuve, PR 00940

Rhode Island Statewide Planning
Program
Department of Administration
Room 201
265 Melrose Street
Providence, RI 02907

State Clearinghouse
Grants and Contracts Review Unit
Office of the State Auditor
P.O. Box 11333
Columbia, SC 29211

State Planning Bureau
State Capital, 2nd Floor
Pierre, SD 57501

State Planning Office
Grants Review Section
660 Capital Hill Building
Nashville, TN 37219

Governor's Budget and Planning Office
Executive Office Bldg.
411 West 13th Street
Austin, TX 78701

Utah State Planning Coordinator
Office of the Governor
118 State Capital Bldg.
Salt Lake City, UT 84114

The State Clearinghouse
State Planning Office
Pavillion Office Bldg.
Montpelier, VT 05602

Virginia Department of
Intergovernmental Affairs
Ninth Street Office Bldg.
9th Floor, Room 916
Richmond, VA 23219

Office of the Budget Director
P.O. Box 90
St. Thomas, VI 00801

Office of the Governor
Planning and Community Affairs Agency
400 Capital Center Building
Olympia, WA 98504

State Clearinghouse
Governor's Office of Economic and
Community Development
B-548 Bldg. #6
Charleston, WV 25305

State Clearinghouse
Office of State Planning and Energy
Department of Administration
1 West Wilson Street, Room B-130
State Office Bldg.
Madison, WI 53702

State Planning Coordinator
Office of the Governor
2320 Capital Avenue
Cheyenne, WY 82002

PRIVATE INDUSTRIES

David M. Anderson
Manager, Environmental
Quality Control
Bethlehem Steel Corporation
Bethlehem, PA 18016

Letitia Davis
Coordinator
Urban Environment Conference,
Inc.
1714 Mass. Avenue, N.W.
Washington, DC 20036

Arthur B. Dayton, Jr.
Engineering Manager
Risdon Manufacturing Company
Naugatuck, CT 06770

Donald A. Gray, Jr.
President
The Naugatuck Valley Industrial
Council, Inc.
30 Holmes Avenue
Waterbury, CT 06710

Francis P. Grimes
Staff Representative
Safety and Health Department
United Steel Workers of America
Five Gateway Center
Pittsburgh, PA 15222

Vincent J. Hanlon
Vice President and General
Manager
Risdon Manufacturing Company
2100 S. Main Street
Waterbury, CT 06706

Everett E. Harris
Manager, Production Operations
Linen Supply Association of
America
Post Office Box 402427
975 Arthur Godfrey Road
Miami Beach, FL 33140

F. Donald Hart
President
American Gas Association
1515 Wilson Blvd.
Arlington, VA 22209

G.O. Keutgen
Executive Director
Ford Motor Company
The American Road
Dearborn, MI 48121

Rufus W. Miller, M.D.
Chairman, AOMA Committee on
Noise and Hearing Conservation
6060 W. Bristol Road
Flint, MI 48554

William R. Petricone
Vice President
Torin Corporation
Kennedy Drive
Torrington, CT 06790

William H. Prokop
Director of Engineering
Services
National Renderers Association, Inc.
3150 Des Plaines, IL 60018

William D. Rinehart
Vice President
American Newspaper Publishers
Association/Research Institute
1350 Sullivan Trail
Post Office Box 598
Easton, PA 18042

E. M. Stoddard
Trustee
Southern Idaho Forestry Association
Box 1991
Boise, ID 83701

S. G. Sweet
Vice President
The Eastern Company
112 Bridge Street
Naugatuck, CT 06770

Darold W. Taylor
Director of Engineering
National Clay Pipe Institute
1130 17th Street, N.W.
Washington, DC 20036

Carl Toothaker
Vice President, Manufacturing
Uniroyal Consumer Products
Division of Uniroyal, Inc.
Naugatuck Footwear Plant
58 Maple Street
Naugatuck, CT 06790

Glenn E. Watts
President
Communications Workers of America
1925 K Street, N.W.
Washington, DC 20006

U.S. Department of Labor
Ray Marshall, Secretary

Occupational Safety and
Health Administration