

DEPARTMENT OF LABOR

Occupational Safety and Health Administration

29 CFR 1910

Occupational Noise Exposure; Hearing Conservation Amendment

AGENCY: Occupational Safety and Health Administration (OSHA), Labor.

ACTION: Final rule

SUMMARY: This rule finalizes various aspects of the hearing conservation amendment to the occupational noise exposure standard. In January 1981, OSHA promulgated a hearing conservation amendment (46 FR 4078) requiring hearing conservation programs for all employees whose noise exposures equal or exceed an 8-hour time-weighted average (TWA) of 85 decibels (dB). The amendment was subsequently stayed for reconsideration and clarification. In August 1981, major portions of the amendment went into effect; the administrative stay was continued on other portions of the amendment and additional comments were solicited on these stayed portions (46 FR 42622).

By its action today, OSHA is (1) revoking many of the stayed provisions of the hearing conservation amendment, (2) lifting the administrative stay as to other portions of the amendments, and (3) making certain changes and corrections of a technical nature. The hearing conservation amendment to the OSHA noise standard, which is reprinted in its entirety at the end of this notice, establishes a comprehensive hearing conservation program, including exposure monitoring, audiometric testing, and training for employees with significant workplace noise exposures.

EFFECTIVE DATE: This final rule is effective April 7, 1983. Baseline audiograms must be completed by March 1, 1984. See Supplementary Information for details on effective dates.

FOR FURTHER INFORMATION CONTACT:

James Foster, Director, Office of Information and Consumer Affairs, Occupational Safety and Health Administration, Room N-3637, U.S. Department of Labor, 200 Constitution Avenue, NW., Washington, D.C. 20210, Telephone (202) 523-8148.

Copies of any portion of the record, including the Regulatory Analysis, may be obtained by contacting: Docket Officer, Docket No. OSH-11, Room S-6212, U.S. Department of Labor, 200 Constitution Avenue, NW., Washington, D.C. 20210, Telephone (202) 523-7894.

SUPPLEMENTARY INFORMATION: The recordkeeping requirements in the amendment have been approved by the Office of Management and Budget pursuant to the Paperwork Reduction Act of 1980, Pub. L. 96-511, 44 U.S.C. 3501, *et seq.* The OMB approval number is 1218-0048.

I. Executive Summary

The following summary briefly discusses the required components of the hearing conservation program. For a more detailed discussion and explanation of the amendment, see parts II-VI of this Supplementary Information section.

Monitoring

The hearing conservation amendment requires employers to monitor noise exposure levels in a manner that will accurately identify employees who are exposed at or above an 85-decibel (dB) 8-hour time-weighted average (TWA). The exposure measurement must include all noise within an 80 dB to 130 dB range. The requirement is performance oriented and allows employers to choose the monitoring method that best suits each individual situation.

Under this revised amendment, employees are entitled to observe monitoring procedures and, in addition, they must be notified of the results of exposure monitoring. However, the method used to notify employees is left to the discretion of the employers.

Employers must remonitor workers' exposures whenever changes in exposures are sufficient to require new hearing protectors or cause employees who were previously not included in the program because they were not exposed to an 8-hour TWA of 85 dB, to be included in the program.

Instruments used for monitoring employee exposures must be calibrated to ensure that the measurements are accurate. Since calibration procedures are unique to specific instruments, employers should follow the manufacturer's instructions to determine when and how extensively to calibrate.

Audiometric Testing

Audiometric testing not only monitors employee hearing acuity over time, but also provides an opportunity for employers to educate employees about their hearing and the need to protect it. The audiometric testing program includes baseline audiograms, annual audiograms, training and follow-up procedures. The audiometric testing program should indicate whether hearing loss is being prevented by the employer's hearing conservation program. Audiometric testing must be

made available to all employees who have average exposure levels of 85 dB. A professional (audiologist, otolaryngologist, or physician) must be responsible for the program but does not have to be present when a qualified technician is actually conducting the testing. Professional responsibilities include overseeing the program and the work of the technicians, reviewing problem audiograms and determining whether referral is necessary. Both professionals and trained technicians may conduct audiometric testing. In addition to administering audiometric tests, the tester (or the supervising professional) is also responsible for ensuring that the tests are conducted in an appropriate test environment and that the audiometer works properly, for reviewing audiograms for standard threshold shifts (STS), and for identifying problem audiograms requiring further evaluation by a professional.

a. Audiograms. There are two types of audiograms required in the hearing conservation program: Baseline and annual audiograms. The baseline audiogram is the reference audiogram against which future audiograms are compared. Baseline audiograms must be provided within six months of an employee's first exposure at or above a TWA of 85 dB. Where employers are using mobile test vans to obtain audiograms, baseline audiograms must be completed within one year after an employee's first exposure to workplace noise at or above a TWA of 85 dB. Additionally, where mobile vans are used and employers are allowed to delay baseline testing for up to a year, after 6 months those employees exposed at or above 85 dB must be issued and fitted with hearing protectors to be worn until the baseline audiogram is obtained. Baseline audiograms taken before the effective date of the amendment are acceptable as baselines in the program if the professional supervisor determines that the audiogram is valid. The annual audiogram must be conducted within one year of the baseline. It is important to test hearing on an annual basis in order to identify changes in hearing acuity so that protective follow-up measures can be initiated before hearing loss progresses.

b. Audiogram evaluation. Annual audiograms must be routinely compared to baseline audiograms to determine whether the audiogram is accurate and to determine whether the employee has lost hearing ability (that is, if a standard threshold shift (STS) has occurred). An effective program depends on a uniform and protective definition of STS. STS is defined in the amendment as an average

shift in either ear of 10 dB or more at 2000, 3000 and 4000 Hz. An averaging method of determining STS was chosen because it diminishes the number of persons falsely identified as having STS who are later shown not to have had a significant change in hearing ability.

If an STS is identified, employees must be fitted or refitted with adequate hearing protectors, shown how to use them, and required to wear them. In addition, employees must be notified within 21 days from the time the determination is made that their audiometric test results showed an STS. Some employees with an STS may need to be referred for further testing if the professional determines that their test results are questionable or if they have an ear problem of a medical nature caused or aggravated by wearing hearing protectors. If the suspected medical problem is not thought to be related to wearing protectors, employees must merely be informed that they should see a physician. If subsequent audiometric tests show that the STS identified on a previous audiogram is not persistent, employees whose exposures are less than a TWA of 90-dB may discontinue the wearing of hearing protectors.

A subsequent audiogram may be substituted for the original baseline audiogram if the professional supervising the program determines that the employee has experienced a persistent STS. The substituted audiogram becomes known as the revised baseline audiogram. This substitution will ensure that the same shift is not repeatedly identified. The professional may also decide to revise the baseline audiogram after an improvement in hearing has occurred, which will ensure that the baseline reflects actual thresholds to the extent possible. Where a baseline audiogram is revised, the employer must, of course, also retain the original audiogram. In order to obtain valid audiograms, audiometers must be used, maintained, and calibrated according to specifications given in Appendices C and E of the standard.

Hearing Protectors

Hearing protectors must be available to all workers exposed at or above the action level. This requirement will ensure that employees have access to protectors before they experience a loss in hearing. Where baseline audiograms are delayed because it is inconvenient for mobile test vans to visit the workplace more than once a year, protectors must be worn by employees for any period exceeding 6 months from the time they are first exposed to 8-hour

average noise levels of 85 dB or above until they receive their baseline audiograms. Hearing protector use is also mandatory for employees who have incurred standard threshold shifts, since these workers have demonstrated that they are particularly susceptible to noise.

Employees should decide, with the help of a person who is trained in fitting hearing protectors, which size and type protector is most suitable for their working environment. The protector selected should be comfortable to wear and offer sufficient attenuation to prevent hearing loss. Employees must be shown how to use and care for their protectors and must be supervised on the job to ensure that they continue to wear them correctly.

Hearing protectors must provide adequate attenuation for each employee's work environment. The employer must re-evaluate the suitability of the employee's present protector whenever there is a change in working conditions that may cause the hearing protector being used to be inadequate. If workplace noise levels increase, employees must be given more effective protectors. The protector must reduce employee exposures to at least 90 dB, or to 85 dB when an STS has occurred.

Training

Employee training is important because when workers understand the reasons for the hearing conservation program's requirements and the need to protect their hearing, they will be better motivated to participate actively in the program and to cooperate by wearing their protectors and taking audiometric tests. Employees exposed to TWA's of 85 dB and above must be trained at least annually in the effects of noise; the purpose, advantages, disadvantages and attenuation of various types of hearing protectors; the selection, fitting and care of protectors; and the purpose and procedures of audiometric testing. Training does not have to be accomplished in one session. The program may be structured in any format, and different parts may be conducted by different individuals as long as the required topics are covered. For example, audiometric procedures could be discussed immediately prior to audiometric testing. The training requirements are such that employees must be reminded on a yearly basis that noise is hazardous to hearing and that they can prevent damage by wearing a hearing protector, where appropriate, and participating in audiometric testing.

Recordkeeping

Noise exposure measurement records must be kept for two years. Records of audiometric test results must be maintained for the duration of employment of the affected employee. Audiometric test records must include the name and job classification of the employee, the date, the examiner's name, the date of acoustic or exhaustive calibration, measurements of the background sound pressure levels in audiometric test rooms, and the employee's most recent noise exposure measurement.

II. Introduction

Noise, or unwanted sound, is one of the most pervasive occupational health problems. It is a by-product of many industrial processes. Sound consists of pressure changes in a medium (usually air), caused by vibration or turbulence. These pressure changes produce waves emanating away from the turbulent or vibrating source.

Sound pressure level is a logarithmic measure of the magnitude or intensity of the pressure change: it is perceived as loudness. Sound pressure level is expressed in decibels, abbreviated dB. Because of the logarithmic scale used to measure sound pressure or noise, a small increase in decibels represents a large increase in sound energy (sound pressure is directly related to vibrational energy). Technically, each increase of 3 dB represents a doubling of sound energy; an increase of 10 dB represents a tenfold increase, and a 20 dB increase represents a 100-fold increase in sound energy.¹

The frequency of a sound is the number of times that a complete cycle of compressions and rarefactions occurs in a second. The descriptor, which used to be "cycles per second," is now hertz, abbreviated Hz. Frequency is perceived as pitch. Most everyday sounds contain a mixture of frequencies generated by a variety of sources. A sound's frequency composition is referred to as the spectrum. For a more complete discussion of the physical properties of sound and similar background information, see 46 FR 4079-4081 (January 16, 1981).

Exposure to high levels of noise causes hearing loss and may cause other harmful health effects as well. The extent of damage depends primarily on the intensity of the noise and the

¹For purposes of 29 CFR 1910.95 as well as the hearing conservation amendment, however, a doubling rate of approximately 5 dB is used. That is, a 5 dB increase in level is permitted each time the exposure duration is decreased by half.

duration of the exposure. Noise-induced hearing loss can be temporary or permanent. Temporary hearing loss, also called temporary threshold shift,² results from short-term exposures to noise, with normal hearing returning after a period of rest.

Generally, prolonged exposure to high noise levels over a period of time causes permanent damage. Therefore a person who regularly sustains a temporary loss or shift in hearing threshold from exposure to noise will eventually suffer permanent hearing loss or noise induced permanent threshold shift (NIPTS). This NIPTS is particularly insidious because it occurs very gradually over time. In fact, for a long time the worker may not notice any change in hearing acuity until the hearing loss begins to interfere with everyday communication. By then, it is too late to do anything about the hearing loss that has already been suffered.

Noise induced permanent threshold shift is not reversible and cannot be treated medically. Once a permanent threshold shift has occurred, only the further progression of hearing loss can be prevented. Noise induced hearing loss causes difficulty in interpreting sounds and in perceiving the intensity or loudness of sounds. Even if the sounds are amplified, as with a hearing aid, they remain indistinct.

Noise induced hearing loss typically starts with hearing threshold shifts in the higher frequencies. The loss usually appears first and is most severe at 4000 and 6000 Hz. If damaging noise exposure continues, the loss spreads to the lower frequencies. People with noise induced high frequency hearing loss frequently have difficulty hearing consonant sounds. Because of the crucial role the ability to distinguish consonant sounds has in the ability to understand speech, people with noise induced high frequency hearing loss characteristically have trouble understanding speech. For a more complete discussion of the health affects of noise and hearing loss, see 46 FR 4081-4113 (January 16, 1981), which is hereby incorporated by reference.

The type of hearing loss caused by exposure to noise, sensori-neural hearing loss, can be identified and measured by an audiometric examination even before a person becomes aware of a deterioration in hearing. The record of a given individual's hearing sensitivity is an audiogram. An audiogram shows hearing threshold level measured in decibels as a function of frequency measured in hertz. It indicates how intense or loud a sound at a given

frequency must be before it can be perceived, and thereby provides a graphic representation of the status of the individual's hearing. With periodic audiometric testing it is possible to trace and document hearing loss, and by so doing to prevent further loss from occurring.

Evidence in the record demonstrates that many workplaces are not safe from the hazards posed by noise. Present noise exposures pose significant risk of harm to workers and this risk can be reduced by instituting hearing conservation programs for all workers exposed at or above 85 dB, as an 8-hour time-weighted average.

The hearing conservation program prescribed in the amendment to the occupational noise exposure standard, which is the subject of this document, is designed to protect workers with significant occupational noise exposures from suffering material hearing impairment even if they are subject to such noise exposures over their entire working lifetimes. The hearing conservation amendment requires employers to identify workers exposed to significant levels of workplace noise, to include workers so identified in an audiometric testing program, and to train exposed employees in the proper use and selection of hearing protectors. The provisions contained in the amendment are reasonably necessary and appropriate to provide noise exposed workers with safe and healthful employment (see 46 FR 4105-4107, January 16, 1981, for a general discussion of this issue).

III. Background

In January 1981, OSHA promulgated (46 FR 4078) a hearing conservation amendment to its occupational noise exposure standard (29 CFR 1910.95 (a) and (b)).³ This amendment required that employees whose noise exposures equaled or exceeded an action level of 85 dB, as an 8-hour TWA,⁴ be included in a hearing conservation program.

³The existing standard (29 CFR 1910.95 (a) and (b)) sets a permissible exposure level for noise at 90 dB as an 8-hour time-weighted average and requires the employer to reduce employee exposure to within this level by the use of feasible engineering controls or administrative controls. In addition, the existing standard (29 CFR 1910.95(b)(3)) requires that a "continuing effective hearing conservation program" be implemented when employee exposure exceeds 90 dB, without regard to the use of hearing protectors, but the standard does not spell out the elements of such a hearing conservation program.

⁴Assuming an exchange rate of 5 dB, the action level or trigger for initiating a hearing conservation program occurs when exposures are approximately half of the permissible exposure level (PEL), an 8-hour TWA of 90 dB.

The hearing conservation amendment augmented the existing standard (29 CFR 1910.95 (a) and (b)) and specified numerous specific requirements that had to be included in each employer's hearing conservation program. The amendment added detailed provisions dealing with monitoring employee noise exposures, annual audiometric testing for employees exposed at or above a TWA of 85 dB, retesting under certain circumstances, the selection of adequate hearing protectors, employee education and training, warning signs, and the maintenance of records pertaining to exposure monitoring and audiometric testing (see paragraphs (c)-(s) of 29 CFR 1910.95, 46 FR 4161).

After the hearing conservation amendment was promulgated, the Agency received a number of requests to reconsider the amendment pursuant to the recently adopted Executive Order 12291 (see 46 FR 13193, February 17, 1981) and petitions to administratively stay the amendment. In addition, numerous requests for clarifications and interpretations of various provisions of the hearing conservation amendment were received by the Agency. A number of parties sought judicial relief under section 6(f) of the Act, requesting the court to set aside the hearing conservation amendment, alleging that various provisions were not supported by substantial evidence in the record considered as a whole.⁵ As a result of the controversy and confusion generated by some of the provisions of the hearing conservation amendment, as well as the legal challenges to the amendment, it was necessary to defer the effective date of the amendment several times in order to consider the merits of the various petitions (see 46 FR 21365, April 10, 1981; 46 FR 28845, May 29, 1981; and 46 FR 39137, July 31, 1981.⁶

OSHA carefully reviewed and analyzed the comments, petitions, and requests for clarifications in light of the

⁵*Chocolate Manufacturers Association v. Occupational Safety and Health Administration of the U.S. Dept. of Labor*, No. 81-1210; *American Iron and Steel Institute et al. v. Secretary of Labor and OSHA*, No. 81-1991; *Chamber of Commerce v. OSHA, U.S. Dept. of Labor*, No. 81-1890. These cases were consolidated in the Fourth Circuit Court of Appeals. The Court is holding these cases in abeyance pending completion of the rulemaking proceeding. *Fleck Industries* also sued OSHA, see *Fleck Industries, Inc. v. OSHA*, No. 81-1409 (3rd Cir.), but the petition was subsequently withdrawn.

⁶The AFL-CIO subsequently sued to set aside the Secretary's deferral of the effective date of the hearing conservation amendment. See *AFL-CIO v. Donovan*, No. 81-1667 and 81-1763 (4th Cir.). On September 18, 1981 the Fourth Circuit Court of Appeals denied the motion without prejudice; the AFL-CIO subsequently moved for voluntary dismissal, and the motion was granted on November 6, 1981.

²A person's hearing threshold represents the level of sound that that person can just barely hear.

lengthy preamble to the amendment and consistent with the requirements of E.O. 12291 to evaluate regulations. Based on this review, OSHA decided that major portions of the amendment should be allowed to go into effect. A Regulatory Impact Analysis was prepared for the parts of the amendment going into effect. On August 21, 1981, the Agency lifted the administrative stay of major portions of the hearing conservation amendment, allowing the amendment to go into effect (see 46 FR 42622). The stay was continued, however, and the record reopened for additional comment on a number of other provisions that are discussed in detail below.

Generally, the record was reopened for substantive comment where there was reason to believe, based on the comments received, that there might be a more cost-effective way of accomplishing the desired result of protecting employee hearing, or where new information as to the feasibility or desirability of a particular requirement was submitted which deserved further evaluation. It was suggested that the stayed provisions were too detailed, imposed unnecessary restrictions on the operation of hearing conservation programs, were financially burdensome, and were confusing.

OSHA received a great number of submissions containing comments and evidence in response to the August Federal Register document. While many comments urged that the Agency should revoke the stayed provisions of the hearing conservation amendment, others objected to the stays of various provisions. For example, several labor groups objected to the continuation of the stays, feeling that they had an adverse effect on the enforceability of the standard. In addition, they requested that a hearing be held on the suggested changes. In response to these requests, an informal public hearing was scheduled. The hearing was convened on March 23, 1982, with Administrative Law Judge Stuart A. Levin presiding. The hearing lasted approximately five days, during which time about 50 interested parties offered testimony and evidence. At the close of the hearing, a 60-day period for receipt of post hearing comments was authorized by Judge Levin.

The provisions which went into effect in August 1981 are more performance oriented than the amendment originally promulgated in January 1981. These provisions set out certain basic elements that were thought necessary to include in industrial hearing conservation programs, while affording employers considerable flexibility in achieving the

ultimate goal of the standard: conserving employee hearing. The provisions that went into effect in August allowed employers to adapt hearing conservation programs to their own operations better than those originally promulgated in January 1981.

The revised amendment being issued today has adopted a performance approach insofar as possible. This is in marked contrast with the detailed specifications of the January amendment, which did not fully consider the mandate of section 6(b)(5) of the Act that standards be expressed in terms of performance criteria where practicable. The revised amendment generally allows the employer to choose his own method of complying with the obligations imposed by the amendment. This approach is particularly appropriate where the standard applies to many different types of industrial settings and work environments. The flexibility inherent in the performance approach allows the employer, who is familiar with the unique circumstances and problems of his workplace, to use this knowledge to develop the most effective and efficient mechanism to protect his employees. The employer is given sufficient leeway to adopt a hearing conservation program which will be compatible with all of the peculiarities of the work environment and the needs of his business, rather than having to implement a number of requirements that would be inadequate, inappropriate or unnecessary in his working environment, merely because they are required by the standard. The performance approach allows and even encourages employers to develop creative and innovative methods of meeting the obligations imposed by the amendment.

It is expected that by providing some flexibility, the amendment will encourage compliance because compliance can be achieved in the manner that is the easiest under the circumstances present in the particular working environment. This is also consistent with one of the purposes of the Act, as stated in section 2(b)(1), of stimulating employers and employees to institute new programs and to perfect existing programs to provide healthful working conditions. In addition, the performance approach adopted herein is consistent with the Supreme Court ruling in *American Textile Manufacturers Institute, Inc. v. Donovan*, 452 U.S. 490, 101 S. Ct. 2478 (1981) suggesting that standards must be cost-effective. The revised hearing conservation amendment allows employers to adopt the most efficient

method of compliance which will give the protection mandated by the amendment and achieve the goal of the standard, that is, conserving employee hearing.

As a result of new evidence placed into the record as well as testimony submitted at informal public hearings, OSHA has once again reviewed the record as it pertains to the issues in this proceeding. After carefully reconsidering the entire record, the Agency has decided to take the actions discussed in detail below. The entire hearing conservation amendment, rather than just those portions being revised, is reprinted at the end of this document. This is being done as a matter of convenience to avoid any confusion as to the various requirements of the standard.

IV. Summary of Regulatory Impact and Regulatory Flexibility Analysis

A Regulatory Impact and Regulatory Flexibility Analysis consistent with the requirements of Executive Order 12291 and the Regulatory Flexibility Act of 1980 has been prepared. The document discusses, *inter alia*, the costs of the hearing conservation provisions published in January 1981 and the costs of the provisions contained in this revised hearing conservation amendment, presents information on the relative cost-effectiveness of the two sets of provisions, and describes the impact on small business.

The total costs of the revised amendment are estimated to be \$210.3 million a year, for an average cost of \$41 per worker included in hearing conservation programs mandated by the amendment. For comparison, the Regulatory Impact Analysis also presents costs of the January 1981 amendment, which have been recalculated based on new information in the rulemaking record. That amendment would have cost \$295.3 million a year,⁷ for an average of \$58 per worker, about 40 percent more than the costs of the revised amendment. After allowing for the hearing conservation activities already established, the provisions of the revised amendment are estimated to cost \$197.3 million annually.

The analysis concludes that the regulation is both technologically and economically feasible for both large and small businesses. Even if firms were forced to absorb the total costs of the hearing conservation provisions, these

⁷The January 1981 Regulatory Analysis initially estimated the total costs of the hearing conservation amendment at \$270 million a year (p. IV-2).

costs would represent less than 0.2 percent of profits for the industries studied. A typical small business with under 20 production workers might need to spend about \$163 per year to comply with the hearing conservation amendment requirements.

The Regulatory Impact Analysis relies on the benefits calculations of the Regulatory Analysis that was prepared for the amendment promulgated on January 16, 1981. OSHA estimated that hearing conservation programs for all employees exposed above 85 dB would eliminate 212,000 cases of material impairment of hearing after 10 years, 696,000 after 30 years and 898,000 cases at equilibrium.⁵ OSHA believes that the more performance-oriented provisions of the revised amendment will not significantly reduce these benefits. Therefore, the revised amendment will significantly reduce the risk of hearing impairment present in many workplaces.

Copies of the Regulatory Impact and Regulatory Flexibility Analysis can be obtained from the Docket Office, at the address listed in the "Further Information" section at the beginning of this Federal Register document.

V. Environmental Impact

On February 19, 1974, OSHA announced in the *Federal Register* its intention to prepare an Environmental Impact Statement assessing the impact of a standard that would be proposed for occupational noise exposure (see 39 FR 6119). Information was solicited from the public on a variety of environmentally related issues including possible environmental impacts of the recommended standard and any irreversible commitments of resources which would be involved if the standard should be implemented.

A draft Environmental Impact Statement was made available to the public on June 16, 1975 (40 FR 25525) and environmental impact was specifically an issue at the first hearing held in 1975.

A final Environmental Impact Statement was prepared in accordance with the Council on Environmental Quality (CEQ) Guidelines (40 CFR Part 1500 *et seq.*) and the Department of Labor's regulations (29 CFR Part 11) setting out procedures to be used by Department of Labor agencies to ensure compliance with the National Environmental Policy Act. The final Environmental Impact Statement was made available to the public at the time

the final rule was published. The final Environmental Impact Statement concluded that the hearing conservation amendment would beneficially impact the workplace environment by reducing both the incidence and the degree of hearing loss among workers. It also concluded that the incidence of other adverse health effects associated with noise exposure might also be reduced.

In August 1981, OSHA concluded that staying the various provisions of the amendment would not have any significant environmental impact, and the Environmental Impact Statement was therefore not revised. OSHA also asked for comments on whether the Agency's action would have any significant environmental impact. No substantive comments were received on this issue. Based on the record, OSHA now concludes that the action taken today revising the amendment will have no significant environmental impact. Therefore, no revised Environmental Impact Statement is necessary.

VI. Summary and Explanation of Actions Taken

Monitoring

Monitoring provides a mechanism for measuring and evaluating the significance of an employee's occupational exposure to noise (see discussion, 46 FR at 4131 (January 16, 1981)). This is important because the senses alone are not reliable quantifiers of sound level. For example, people's perception of the relative intensities or loudness of sounds may be affected by the relative pitch of those sounds.

Monitoring of workplace noise levels is necessary for the following reasons:

- (1) To identify employees who must be enrolled in the hearing conservation program;
- (2) To identify employees for whom hearing protection is mandatory;
- (3) To determine the amount of attenuation that hearing protectors need to provide; and
- (4) To familiarize both employers and employees with the degree of the noise hazard.

The monitoring provisions in the January amendment were extensive and detailed. This document required that all employers make an initial determination as to whether any employee's exposure equalled or exceeded an 8-hour TWA of 85 dB. These determinations were to be based on exposure measurements, calculations, or other relevant information, including such elements as employee complaints about noise, indications that employees might be losing their hearing, or difficulties in understanding normal conversation in

the workplace when the speaker and listener faced each other at a distance of two feet. If this initial determination was positive, the employer was required to measure personal noise doses for all or representative employees within 60 days.⁶ The amendment also required that initial determinations and subsequent monitoring (if the initial determination was positive) be repeated every two years and within 60 days of any change in process or working conditions that might increase the noise level and thereby render any hearing protectors being used inadequate or which would result in the inclusion of new employees in the hearing conservation program.

The January amendment also required that all monitoring be conducted with sound level meters or dosimeters meeting certain detailed specifications. It also contained specific requirements for the calibration of measuring equipment.

Many comments, objections, requests for clarification, and petitions for administrative stays were received in response to the monitoring requirements of the January amendment. Many employers objected to the prohibition against area monitoring, asserting that the personal monitoring mandated in the January amendment was burdensome, impractical, and unnecessary for the purposes of implementing successful hearing conservation programs (Exh. 325-266-A, pp. 6-8; Exh. 325-138; Exh. 325-47; Exh. 325-57). These commenters believe that area monitoring is simpler and less costly, and that the adequacy of hearing protector attenuation can be computed from sound levels obtained for the various areas in which employees work.

Some employers maintained that the requirement for an initial determination was unnecessary, and that the conditions determining the need for monitoring were unnecessarily complicated and expensive (Exh. 325-66; Exh. 325-68; Exh. 325-70). Other commenters objected to the requirement that if the employer wished to use representative monitoring the employee with the highest exposure must be selected and measured as representative, asserting that the effect of such a requirement would be to force employers to monitor all employees. In addition, commenters objected to the periodic remonitoring requirement, stating that remonitoring every two years was costly and unnecessary, and

⁵ Final Regulatory Analysis of the Hearing Conservation Amendment, January 1981, p. III-27. Equilibrium is defined as that time in the future after which all current and retired workers would have been enrolled in a hearing conservation program for their entire working lives.

⁶ The January amendment did not permit area monitoring to be used to comply with the monitoring requirements (see 46 FR at 4133).

that remonitoring when there was a change in process or equipment should be sufficient (Exh. 325-68; Exh. 325-66; Exh. 325-57; Exh. 325-138; Exh. 325-214; Exh. 325-256; Exh. 325-252).

In response to these objections, OSHA decided to seek additional public input on the various monitoring provisions published in January. In August, therefore, the administrative stay was continued on many of the detailed monitoring provisions. The monitoring requirements put into effect in August were more performance oriented, and consisted of two provisions:

(e)(1) When information indicates that any employee's exposure may equal or exceed an 8-hour time-weighted average of 85 decibels, the employer shall obtain measurements for employees who may be exposed at or above that level.

(g)(2)(ii)(b) All continuous, intermittent, and impulsive sound levels from 80 dB to 130 dB shall be integrated into the computation.

Many comments were submitted in response to the fourteen questions related to monitoring that were raised in the August 21 Federal Register document (see 46 FR at 42624). Most commenters recognized the need for monitoring to implement hearing conservation programs effectively. Moreover, a majority of the parties submitting comments favored the performance-oriented monitoring requirements in the August document (Exh. 327-20; Exh. 327-51; Exh. 327-70; Exh. 327-71; Exh. 327-86; Exh. 327-99; Exh. 327-102; Exh. 327-138; Exh. 327-143; Tr. Vol. IV, p. 76, March 3, 1982). These participants felt that the rigid specifications contained in the monitoring provisions promulgated in January were not practical and could not effectively accommodate the diverse work situations encountered in the American industrial environment. For example, it was alleged that factors such as worker mobility variations in worker tasks, changing sound sources and levels, and transient work sites made personal monitoring, and even representative personal sampling, difficult and inappropriate in some circumstances (Exh. 327-70 p. 2; Exh. 327-86, p. 3). Most respondents believed that performance requirements for monitoring would allow employers the flexibility to adopt the most cost-effective and appropriate methods of noise monitoring in their particular exposure situations (Exh. 326-55; Exh. 327-70; Exh. 327-71 p. 2; Exh. 327-86; p. 2; Exh. 327-91; Exh. 327-99).

However, several labor groups objected to staying the various monitoring provisions, stating that the stay would have an adverse effect on

the enforceability of the standard (Exh. 327-59; Exh. 327-107; Exh. 327-136; Exh. 329-57; Exh. 345; Tr. Vol. III, pp. 31-48, March 25, 1982; Tr. Vol. IV, pp. 109-114, March 26, 1982; Tr. Vol. V, p. 273 March 29, 1982). In addition, these commenters urged OSHA to reinstate the original specification requirements, contending that they were more protective of employee health (Exh. 331-17; Tr. Vol. V, p. 273, March 29, 1982). These objections are discussed more specifically below.

Area Versus Personal Sampling

The January amendment did not permit the use of area monitoring to fulfill the noise monitoring requirements (see 46 FR at 4133). The more performance-oriented monitoring provisions of the August document, however, allow the employer to use any monitoring technique, including area monitoring, that will correctly identify all employees eligible for inclusion in the hearing conservation program (i.e., those exposed at or above the action level) and will allow the employer to determine that the hearing protectors provided to employees have sufficient attenuation capability to protect the employees in their particular work environment.

The relative merits of area versus personal exposure monitoring generated a great deal of comment. A review of these submittals indicates some misunderstanding (Exh. 327-107, p. 4; Exh. 328-21; Exh. 327-32, p. 1; Exh. 384, pp. 9-11) as to what constitutes "personal" as opposed to "area" monitoring within the meaning of this standard.

Personal monitoring consists of measurements taken with the instrument microphone in the proximity of the exposed employee's ear (for a dosimeter, near the employee's shoulder or head, and for a sound level meter, not less than two inches or more than two feet from the employee's ear). Personal monitoring is generally used to obtain estimates of employee exposures or to determine the effects of different work practices on employee exposure. Personal monitoring can be done with either a sound level meter or a dosimeter.

Personal monitoring with a sound level meter usually requires the person performing the sampling to hand-hold the sound level meter near the employee's ear. Because sound level meters are only capable of taking spot measurements at the instant measured, a sampling strategy which includes sufficient sound level meter readings taken at various times and locations throughout the work shift is necessary to estimate employee exposure accurately.

Personal monitoring using a dosimeter involves positioning the device on the body of the employee, with the microphone located near the employee's ear. The employee carries the dosimeter throughout the day, during which time the dosimeter is continuously recording sound levels. Employee exposure is determined simply by attaching the dosimeter to another instrument or reader and reading out the results. OSHA believes that personal monitoring is one method of providing an accurate estimate of employee exposure, and the Agency routinely uses dosimeters and personal sampling techniques for compliance purposes. As discussed below, OSHA does not believe that personal monitoring is the only method of collecting the information necessary to fulfill the needs of the hearing conservation program.

Area monitoring is any method of sampling with sound measuring instruments when the microphone is not placed in the vicinity of the employee's ear. Area monitoring is used to evaluate workplace noise for various purposes, including the design of engineering controls and estimation of employee exposures. Either a dosimeter or a sound level meter can be used for area monitoring.

A large number of commenters favored permitting the use of either area monitoring or personal monitoring to fulfill the monitoring requirement, noting that the sampling method most appropriate to a particular work situation should be selected (Exh. 327-67; Exh. 327-70; Exh. 327-86; Exh. 327-89; Exh. 327-91; Exh. 327-96; Exh. 327-102; Exh. 327-105; Exh. 327-121; Exh. 327-122; Exh. 327-135-a; Exh. 327-151; Exh. 331-11).

Many respondents pointed out that area monitoring usually is less disruptive of work flow, is generally easier to conduct, and is less costly to perform than personal monitoring (Exh. 326-35; Exh. 327-58; Exh. 327-63A; Exh. 327-103; Exh. 327-110; Exh. 327-122; Exh. 329-2; Exh. 329-16). Further, commenters asserted that area monitoring makes it easier to gauge general changes in the acoustic environment, simplifies recordkeeping, is independent of employee turnover or job reassignment, and can be as effective as personal monitoring in some acoustic environments or in association with certain work regimens (Exh. 326-41; Exh. 327-55; Exh. 327-103; Exh. 327-106; Exh. 329-2).

However, others objected to the use of area monitoring, asserting that OSHA was unjustifiably modifying the January monitoring requirements and that

allowing area monitoring and using performance requirements would be unenforceably vague (Tr. Vol. IV, p. 243, March 26, 1982; Exh. 326-41; Exh. 327-59; Exh. 327-109; Exh. 345). Additionally, other participants stated that area monitoring was not acceptable because they felt it would underestimate exposures and thereby exclude eligible employees from membership in the hearing conservation program (Exh. 326-H; Tr. Vol. III, p. 107, March 25, 1982). They supported this opinion by citing a report by Bolt Beranek and Newman (BBN) (Exh. 327-94-C), which they contended showed evidence of exposure underestimation.

BBN surveyed seven establishments in the Iron and Steel Foundry Industry (SIC 332) having a total sample size of 531 employees, and nine establishments in the Saw Mill and Planer Mill Industry (SIC 242) with a total sample size of 906 employees. The purpose of the initial study (Exh. 373-I, pp. 1-3; Exh. 327-94-C p. 2-2) was to develop a machinery noise computer model that could be used to assess the effect of occupational noise on industrial workers. After completion of the study, the data were reanalyzed to obtain a comparison of personal and area-wide monitoring techniques. All noise measurements were taken using Type 2 (or better) sound level meters. A criterion of ± 3 dB variation was used to define any specific area, and this criterion was applied to all work situations.

According to the BBN study (Exh. 373-I; Exh. 327-94-C), there was little difference in the percentage of employees predicted by area versus personal monitoring as being exposed at or above a TWA of 85 dB.¹⁰ However, when the criterion was changed to 90 dB, a substantial difference in the percentage identified was seen in one industry.¹¹ This difference appeared to increase as sound levels increased. Therefore, BBN concluded in part that area monitoring underestimated personal exposures, particularly at high exposure levels.

Although the BBN report does reflect a problem that would arise if area monitoring was used in all work situations, the report included results obtained with area monitoring in situations where this sampling method might not be considered appropriate. It is not surprising that substantial disagreement between area and personal samples would occur in such a case. A more reasonable use of area

sampling (e.g., when work conditions were favorable) would be expected to yield much closer agreement between personal and area monitoring results.

Despite this shortcoming, the use of area monitoring may have little adverse effect on identifying employees to be included in a hearing conservation program. In fact, BBN even stated that "it is possible that * * * the area monitoring method could be used as an indicator that a hearing conservation program is required (i.e., that one or more workers have TWA's equal to, or greater than, 85 dB)" (Exh. 327-94-C, pp. 2-11).

Additionally, BBN admitted that the procedure for estimating area sound levels involved the subjective determination of the spatial distribution of measurements to encompass all sound level variations within an area. BBN reported that "Consequently, it is possible that different area sound levels could be obtained if measurements were made at arbitrarily selected locations" (Exh. 327-94-C, p. 2-4).

It seems clear that the BBN report (Exh. 373-I; Exh. 327-94-C) has been taken out of context when it is used to develop area versus personal monitoring comparisons. These data were derived, as the report clearly states, "for the purpose of developing a machinery noise computer model to be used in assessing the effect of occupational noise on the health and welfare of industrial workers" (Exh. 327-94-C, p. 2-2). BBN has also explained that, "the end result of the evaluation is a ranking of the machinery items which most contribute to the noise exposure problem in each industry [of the two sampled]" (Exh. 373-I, Executive Summary). Moreover, the inaccuracies involved in area sampling may not be as great as the BBN report leads one to believe. As AISI points out, BBN's sound level meter sampling strategy "was touted as the definitive and most accurate means for determining employee exposure (and against which the allegedly inaccurate 'area monitoring' was compared)" (Exh. 367, p. 7). After reviewing the report's original objectives and study protocols, the AISI felt that BBN's personal monitoring "may in fact have been spot checks of employee exposures at their operating stations," and that "In fact no full shift time weighted average exposure levels were determined for each employee or even for representative employees" (Exh. 367, pp. 7-8). In addition, AISI noted that " * * * area monitoring measurements were actually measurements of a limited number of equipment types which were

not selected with the goal of identifying employee exposures" (Exh. 367, p. 7). In addition, BBN allowed a 6 dB range in defining a given sound level area (i.e., ± 3 dB), which would by definition lead to disagreements between the area and personal monitoring data in certain situations.

OSHA agrees that area monitoring is not appropriate in all situations; nothing in the monitoring provisions encourages its use in inappropriate circumstances. In other words, the indiscriminate application of area monitoring to all work situations is recognized to be inappropriate. For example, where workers are highly mobile, tasks are dissimilar, a large component of impulsive sound is contained in the exposure, or there is a great deal of variation in sound level, area monitoring becomes more difficult and less appropriate. However, as indicated in numerous submittals, area monitoring can be used in many situations and is a valuable tool that should not be overlooked (Exh. 326-15; Exh. 326-34; Exh. 327-34; Exh. 327-55; Exh. 327-86; Exh. 327-89; Exh. 327-90; Exh. 327-103; Exh. 327-113; Exh. 327-133; Exh. 327-140; Exh. 329-2). One of the reasons OSHA prohibited area monitoring in the January amendment was the problem of monitoring workers who move from place to place during their workshifts. However, as unrebutted testimony at the March 1982 hearing indicated, there are many workplaces where in-plant mobility is not a factor (Tr. Vol. III, pp. 101-102, March 25, 1982). Therefore, it would be unwise to prohibit the use of area monitoring in all situations simply because it may not be useful in some circumstances.

In order to emphasize the point that area monitoring can only be used where it is appropriate, language has been added to the amendment requiring that the sampling strategy employed to measure noise must be capable of properly identifying the correct employees for inclusion in the hearing conservation program.

In addition, the revised amendment prohibits the use of area monitoring in certain situations unless the employer can show that this type of sampling strategy will produce results similar to personal sampling. This prohibition on the use of area sampling to fulfill the monitoring obligation under the hearing conservation amendment is only operative when factors are present that are generally conceded to make area monitoring inappropriate. In most instances, area sampling will not be appropriate where there are significant variations in sound levels, where there

¹⁰ 81.9% to 87.6% for SIC 332 and 70.8% to 68.4% for SIC 242.

¹¹ 5.1% to 63.1% for SIC 332 and 34.2% to 34.0% for SIC 242.

is a significant amount of impulse noise present or where workers move around a lot within a particular work area or between various work areas. In recognition of the extremely wide variation among these situations and the high degree of sophistication that may be used in refining area monitoring techniques, OSHA has decided not to absolutely prohibit the use of area monitoring in the situations described above, but instead to shift the burden to the employer who wishes to use area monitoring under these circumstances to show that the results of such monitoring are equivalent to those that would be obtained using personal or representative personal sampling. The shifting of the burden of proof to the employer to show the adequacy of area sampling is appropriate under these circumstances and strikes a good balance between the need to assure adequate employee protection and the desire to give the employer sufficient flexibility in complying with the requirements to allow the use of new or innovative techniques and to adopt a compliance mode that is the least burdensome to the employer without diminishing necessary employee protection.

Typical of comments supporting the performance monitoring approach was a statement that "Monitoring should be required, but the choice between area and personal should depend upon the particular situation in the workplace" (Exh. 327-102, p. 6).

In fact, when comparing personal representative sampling of similarly situated employees of careful area sampling, Deborah Berkowitz [Health and Safety Director, Food and Beverages Trades Department, AFL-CIO] admitted, "I think you come up with the same results" (Tr. Vol. V, p. 138, March 29, 1982).

Support for a choice of monitoring technique was also voiced by Dan MacLeod, certified Industrial Hygienist with the United Brotherhood of Automobile, Aerospace, and Agricultural Implements Workers of America (UAW). Although he expressed some concern about the ability of small or non-union companies to conduct area monitoring, Mr. MacLeod stated "I think that there are a lot of locations where it would be perfectly okay to do a lot of area sampling" (Tr. Vol. III, p. 102, March 25, 1982). In addition, MacLeod specifically described certain specific work situations involving thousands of employees in which area monitoring would be appropriate (Tr. Vol. III, p. 102, March 25, 1982).

Another concern raised by commenters (Exh. 327-78; p. 5; Exh. 327-

109; p. 5; Exh. 345, p. 5) was that permitting employers to use area monitoring for the purposes of the hearing conservation amendment would be contrary to OSHA's directive to its compliance personnel and field industrial hygienists. Although it is true that the Agency requires its field staff to use personal monitoring for compliance purposes, the question in this case, as John Martonik, OSHA's Deputy Director of Health Standards, pointed out at the public hearing, is "whether this much detail in specification is necessary * * * for the purposes of the Hearing Conservation Amendment * * *" (Tr. Vol. I-A, pp. 31-32, March 23, 1982).

In the compliance context, it is generally simpler for OSHA staff to use the dosimeter, although a sound level meter may also be used to obtain personal samples. This is advisable because compliance personnel are generally not familiar with the details and variations of exposure patterns within individual workplaces, and sometimes must conduct monitoring the first time they are on site. Therefore, personal monitoring is more appropriate in such a situation because it saves the compliance officer the time of determining noise exposure patterns before the sampling begins. However, the employer's familiarity with his or her own workplace should in many instances enable the employer to develop a monitoring program based on area monitoring that is just as protective as personal monitoring. When enforcing the amendment, OSHA inspections will focus on whether employers have included all employees exposed to noise at or above the action level in their hearing conservation programs. OSHA inspectors will in most cases continue to use personal sampling methods because in view of the compliance officer's purpose and lack of familiarity with each particular workplace, this method is generally easier and yields more reproducible results (see Tr. Vol. I-A, pp. 40-41, March 23, 1982).

George Taylor [ALF-CIO] and several other commenters questioned the legality of performance-oriented monitoring requirements; these participants believed that performance monitoring requirements, which remain part of the hearing conservation standard published today, are contrary to the legislative mandate of section 6(b)(7) of the Act (Exh. 327-109, pp. 5-7; Tr. Vol. V, p. 209, March 29, 1982; Tr. Vol. III, pp. 34, 37, March 25, 1982). Section 6(b)(7) of the Act states in pertinent part:

Where appropriate, such standard [promulgated under this subsection] * * *

shall provide for monitoring or measuring employee exposure at such locations and intervals, and in such manner as may be necessary for the protection of employees. [emphasis added]

The performance monitoring requirements contained in the hearing conservation amendment are not contrary to the mandate of section 6(b)(7) of the Act. Nothing in the Act requires personal monitoring to be used as the exclusive monitoring technique. As discussed above, in many instances area monitoring can be as effective as personal monitoring. The most cost-effective method of monitoring should be allowed, if it is appropriate in the situation. As shown above, the area method of monitoring is appropriate in many work areas. Substantial evidence in the record clearly supports the conclusion that the performance monitoring requirements prescribed in the amendment will provide the necessary protection of employees referred to in section 6(b)(7). In other words, the monitoring prescribed will identify the appropriate employees for inclusion in an employer's hearing conservation program and allow the employer to determine that any hearing protectors used have sufficient attenuation capability to protect employees. Moreover, this performance-oriented monitoring approach is clearly consistent with the mandate of section 6(b)(5) of the Act, which states that when practical, standards dealing with harmful physical agents should be drafted "in terms of objective criteria and of the performance desired."

Another objection to the performance-based monitoring provisions now used in the amendment was that they would not be enforceable (Exh. 327-109, p. 6). The Agency disagrees; the Agency believes that the standard does provide fair and reasonable warning of situations in which monitoring is required¹² and does specify what sounds should be included in the measurements.¹³

There is widespread agreement that area monitoring is appropriate in many work situations, and it is also clear that any type of monitoring may be inaccurate if it is applied inappropriately. However, OSHA also believes that the employer should be

¹² Appropriate monitoring is required when information indicates that any employee's exposure may equal or exceed an 8-hour time weighted average of 85 decibels (paragraph (d)(1) of the revised amendment).

¹³ All continuous, intermittent and impulsive sound levels from 80 dB to 130 dB shall be integrated into the noise measurements (paragraph (d)(2) of the revised amendment).

permitted to develop a monitoring program, whether area or personal monitoring is chosen, that will protect exposed employees from occupationally-induced hearing loss. Therefore, it is appropriate to allow the employer to select any monitoring technique that will ensure that the objectives of the standard are met.

Also, many commenters who supported the use of area monitoring use a "worst case" method for determining which employees to include in their hearing conservation programs. These employers attribute the highest sound level in a particular area to all employees in the area (Exh. 326-11; Exh. 327-79; Exh. 327-101; Exh. 327-133; Tr. Vol. I-B, p. 118, March 23, 1982). Use of this approach would lead to the assignment of more than the required number of employees to the program. OSHA encourages employers to take a more protective posture relative to hearing conservation; i.e., to do more than the minimum required.

Some commenters suggested that OSHA provide a simplified non-mandatory monitoring guide as an appendix (Exh. 327-102, p. 7; Exh. 368, p. 2). Such an appendix was seen as being particularly helpful to small businesses who were considering area sampling as an alternative monitoring method. A general non-mandatory appendix (Appendix G) has been included to familiarize employers with various approaches to monitoring as well as resources to which they may look for help in meeting their noise measuring obligations under the amendment.

OSHA's decision to permit employers to choose the most appropriate monitoring sampling strategy parallels the January amendment's performance approach toward selection of monitoring instruments. Although the January preamble (46 FR at 4136) noted that a sound level meter might be less accurate than a dosimeter "in situations where there is a significant impulse noise component," employers were given the "option of using a sound level meter, providing it is used in a manner which * * * ensures the maximum accuracy." Similarly, the monitoring provisions in the revised amendment generally permit either area or personal monitoring, providing it is used in a manner which ensures that valid data are generated.

Initial Determination

The amendment as promulgated in January required employers to make initial determinations, stating that "This determination must be based on the employer's good faith inquiry into any factors which would tend to indicate that noise exposures in the workplace

are in the vicinity of an 8-hour TWA of 85 dB" (46 FR at 4131). The January amendment listed factors meriting a positive initial determination, including employee complaints about noise, difficulties in communication at a distance of approximately two feet, or measurements recording levels at or above the action level made with a sound level meter or dosimeter. OSHA stayed this requirement because "some employers maintained that the requirement for initial determination was unnecessary" (46 FR at 42624).

Although some commenters felt that the initial determination was a normal part of the monitoring process in identifying those employees exposed at or above the action level, they also felt that the initial determination was subsumed by the existing performance monitoring requirements (Exh. 326-15; Exh. 326-34; Exh. 327-101; Exh. 327-122; Exh. 329-2). In addition, some felt that the initial determination should not be a separate requirement (Exh. 327-67; Exh. 326-49; Exh. 326-54; Exh. 326-32; Exh. 326-15; Exh. 326-31; Exh. 327-76; Exh. 327-97).

Russell Hannula [Manager-Noise Services; National Loss Control Service Corporation] objected to the inclusion of employee complaints as a factor meriting a positive initial determination, noting:

"Employee complaints are * * * not valid since these are based on a subjective determination by inexperienced people. It has been my experience that employee complaints are often related to noise that is annoying, as opposed to noise that is hazardous. Difficulties related to understanding normal conversations in the presence of background noise may be related to hearing impairment of the participants in the conversation and not to potentially hazardous noise levels" (Exh. 326-12, p. 1).

Also challenging the necessity of a separate initial determination requirement was Dr. Carl Bohl [Monsanto Fellow, Monsanto Company]. He stated:

"* * * The need for monitoring is not disputed. Normal procedure for evaluating a work area for a hazard requires an initial determination not only to determine if an exposure is probable but, also, what instrumentation is to be used. Then, if needed, samples or measurements are taken and from this data conclusions are reached about the significance of the exposure. This is the way monitoring is performed and trying to separate initial determination from monitoring is foolishness" (Exh. 326-49, p. 1).

On the other hand, some commenters were in favor of retaining the specific language for initial determination (Exh. 326-42, p. 10; Exh. 326-11; Exh. 327-59; Exh. 327-109). They felt that an initial

determination is necessary to specify when monitoring is required and when a hearing conservation program is needed. Margaret Seminario of the AFL-CIO, stated "Deletion of the initial determinations of exposure provision has removed any affirmative obligation of the employer to conduct a preliminary evaluation of noise exposure levels" (Tr. Vol. V, p. 268, March 29, 1982). Moreover, the AFL-CIO claimed it would be difficult for compliance personnel to cite employers for inadequate exposure monitoring without specific criteria such as those contained in the initial determination requirement (Exh. 327-109, p. 4).

Still other commenters favored some modification of the explicit initial determination requirements (Exh. 327-101; Exh. 327-20; Exh. 327-102). For example, some asserted that professionals with a background in acoustics should be allowed to use their judgment about initial determinations, and further that the specific factors listed as meriting a positive determination might result in needless monitoring.

OSHA believes that an initial determination is an inseparable portion of any overall performance-oriented monitoring process, and that the initial determination provision originally included in the January amendment was merely an articulation of the thought process of a person doing the monitoring. As originally promulgated, the initial determination provision might have been difficult to enforce in and of itself, since there was no requirement that it be written. Moreover, the Agency believes an initial determination is implicit in the monitoring requirements in the revised amendment. It is therefore not necessary to require it specifically.¹⁴ Accordingly, the initial determination provisions are being revoked.

Remonitoring

The issue of remonitoring also generated considerable interest. The January promulgation required monitoring to be conducted at least every two years and within sixty days of a change in production, processes, equipment, controls or personnel that changed noise exposures to the extent that employees previously exposed below a TWA of 85 dB would be exposed at or above that level. Remonitoring was also required if the

¹⁴The employer's ultimate obligation is to monitor when noise exposures are at or above the action level. Regardless of the outcome of any initial determination, employers are subject to citation for failing to monitor.

change rendered the hearing protectors issued inadequate.

The January preamble also stated that sound levels tend to be affected as machinery ages, causing changes in employee exposure. Therefore, various hearing conservation amendment requirements might not be implemented without some remonitoring. Another justification for remonitoring was that "workers will be reminded of the nature and extent of their exposures and will be better motivated to participate cooperatively in the hearing conservation program, and to wear properly fitted hearing protectors" (46 FR at 4134).

The January preamble noted that many commenters were opposed to a periodic monitoring requirement, especially where noise levels were uniform over long periods of time (46 FR at 4133). Similarly, other groups (Exh. 142; Exh. 64-4; Exh. 14-862) believed "periodic monitoring was unnecessary unless there was a significant change in production process" (46 FR at 4134).

In August 1981, OSHA continued the stay of this requirement, noting that "comments [received since the promulgation] objected to the periodic monitoring requirement, stating that remonitoring every two years was costly and unnecessary, and that remonitoring when there is a change in process or equipment should be sufficient" (46 FR at 42624).

Comments and testimony submitted since the August publication were overwhelmingly in favor of some form of remonitoring (Exh. 327-59; Exh. 327-88; Exh. 327-109; Exh. 331-17; Exh. 326-62; Exh. 327-20; Exh. 327-95; Exh. 329-16). Some commenters preferred retaining periodic monitoring (Exh. 326-12; Exh. 327-59; Exh. 327-109; Exh. 327-113; Exh. 327-135; Exh. 329-36; Exh. 331-17). Generally, their rationale paraphrased that used in the January 16 preamble, i.e., sound levels tend to increase as machinery ages and may therefore alter the need for or the adequacy of a company's hearing conservation program. Comments by Robert Frase [Director of Health and Safety, United Paperworkers International Union] typified this group's concerns:

"Monitoring of noise exposures should be done every two years to ensure noise levels are not increasing. Many machines will have increased noise as they get older and tolerances increase due to wear. . . . It is imperative that noise level monitoring be done within sixty (60) days of a change to the production process, equipment or controls. Any of these changes could potentially increase noise levels to the extent that hearing protection may be required or that existing protection would not be adequate" (Exh. 327-59, pp. 1-2).

The majority of those favoring remonitoring, however, supported it only when there was a significant change in process or equipment rather than at set time intervals (Exh. 327-89; Exh. 327-98; Exh. 327-112; Exh. 327-122; Exh. 327-149; Exh. 329-15).

For example, Julia Phillips of Du Pont stated:

"Remonitoring is unnecessary absent some change in process, equipment or exposure pattern. Unless there is reason to suspect a change in the noise environment, the remonitoring requirement will simply add additional costs to the hearing conservation program without there being a corresponding benefit" (Exh. 326-28, pp. 2-3).

Similarly, R. W. Murray and Paul E. Toth [Ford Motor Company], indicated "it would be more appropriate to require follow-up monitoring only when there has been a significant change in production, processes, equipment, controls or personnel which impacts on employee noise exposures. Requiring routine periodic monitoring of areas where no significant changes have been made since the last monitoring would result in inefficient use of scarce resources" (Exh. 329-2, p. 1).

OSHA agrees with those commenters who recognize that conditions and sound levels in the work environment are not static over time, and that exposures may be adversely affected by these changes. OSHA believes that under certain conditions remonitoring is necessary to accomplish the objectives of the amendment. Therefore, a remonitoring requirement which is stated in performance terms has been included in this revised hearing conservation amendment. Remonitoring must be done when there is reason to believe that employee exposures may have increased to the extent that employees not already included in the hearing conservation program would need to be included. Additional monitoring must also be undertaken when there are increases in exposure sufficient to render the attenuation provided by any employee's hearing protectors inadequate. In view of the tremendous variation among workplace environments covered by this amendment, a periodic remonitoring requirement is neither necessary nor appropriate to provide adequate employee protection. Therefore, the requirement to remonitor every two years is being revoked.

Some objections were also raised concerning the rigid time frame permitted for remonitoring (60 days) in the January amendment when significant changes did occur. Commenters reported that these specific time constraints presented practical problems in arranging the remonitoring

(Exh. 327-121; Exh. 331-11), because in cases where employers do not do their own monitoring, it would be difficult to arrange for a return visit by a consultant within such a short time. This type of detailed requirement is inconsistent with the performance approach adopted herein and is therefore being revoked. It should be noted, however, that the performance remonitoring provisions adopted herein will require monitoring to be conducted frequently enough to correctly identify those employees who should be included in the hearing conservation program and to allow sufficient information to be gathered to assess the adequacy of hearing protectors.

A few comments stated that it was difficult to obtain meaningful remonitoring data because of the wide variety of tasks and noise exposures of employees in their particular industries (Exh. 329-1; Exh. 360). However, OSHA believes that the performance monitoring approach in this revised amendment will accommodate this type of job site and task variability. It allows the employer the flexibility to determine if and when remonitoring is necessary.

The performance monitoring approach adopted herein also allows for the exercise of professional discretion in conducting noise monitoring, a major component of the hearing conservation program. It also allows the most cost-effective monitoring methods to be applied in establishing and maintaining the mandated hearing conservation program.

Representative Monitoring

The amendment promulgated in January permitted employers to fulfill their monitoring obligation by using representative personal sampling for employees engaged in similar work and exposed to similar noise levels, but required measuring that member of the exposed group reasonably expected to have the highest exposure. Since this result was then attributed to the remaining employees of the group, the exposures of many employees would be overestimated. Therefore, an employer using representative personal monitoring would probably include more employees in the program than were required. This "worst case" representative employee monitoring approach may be overly protective and unnecessarily expensive for the company. The alternative to representative personal monitoring allowed in the January document was to continue to monitor increasing numbers

of employees to ensure that all exposed workers are included in the program ¹⁵.

In many specific work situations, the representative monitoring approach can be more cost-effective in identifying the appropriate employees for inclusion in a hearing conservation program. The employer is not prohibited from using the "worst case" or representative approach, thereby providing a more protective program than required. However, the Agency believes the performance monitoring approach does not require that degree of specificity to accomplish the objectives of the hearing conservation amendment. OSHA is therefore revoking the representative monitoring paragraphs of the January amendment; employers may use any monitoring strategy which correctly identifies the correct employees for inclusion in the hearing conservation program.

Employee Notification

The majority of commenters supported some form of employee notification of noise levels or exposure levels (Tr. Vol. V, pp. 112-113, 3/29/82; Exh. 326-11; Exh. 326-41; Exh. 327-62; Exh. 327-64; Exh. 327-149; Exh. 327-122; Exh. 349-1). Most commenters favored a more performance-oriented approach rather than the detailed notification provisions of the January amendment, which continued to be stayed when the hearing conservation provisions went into effect in August (Exh. 326-28; Exh. 326-34; Exh. 326-35; Exh. 327-62; Exh. 327-64; Exh. 327-70; Exh. 327-76; Exh. 327-89; Exh. 327-90; Exh. 327-97; Exh. 327-101; Exh. 327-103; Exh. 327-106; Exh. 327-122; Exh. 327-129; Exh. 327-138; Exh. 329-2; Exh. 349-1; Exh. 364). Major objections were raised with regard to the detailed specifications requiring individual employee notification in writing and within 21 days, and requiring that specific exposure doses be computed for each employee (Exh. 326-12; Exh. 326-28; Exh. 326-58; Exh. 327-12; Exh. 327-71; Exh. 327-76; Exh. 327-99; Exh. 327-102; Exh. 327-105; Exh. 328-5; Exh. 349-1). Objections were also raised to including a specific notification requirement in the hearing conservation amendment when 29 CFR 1910.20, Access to Records, already provides employees with access to monitoring information (Exh. 327-76; Exh. 327-89; Exh. 327-98; Exh. 327-122;

Exh. 327-136). Moreover, individual notification was said to increase costs and recordkeeping burdens (Exh. 326-35; Exh. 327-21; Exh. 327-103).

The comments that follow are representative of this view. The DuPont Company stated that individual notification is burdensome in light of the fact that " * * * employees receive adequate notification when results of their area or personal monitoring are posted. Employers should be given flexibility to determine the most effective and efficient method of communicating monitoring results to employees" (Exh. 326-28, P. 3). "Notification of employees within 21 days of monitoring is not reasonable when an outside consultant is used" (Kaiser Aluminum and Chemical Company, Exh. 327-62, p. 1). A report submitted by North Carolina OSHA asserted that industry should not be required to determine individual TWA's but instead should be required to inform employees what their area or job-equivalent TWA is (Exh. 327-84, p. 57). "The basic right of all employees to have access to their exposure records is guaranteed by another OSHA standard [29 CFR 1910.20] and need not be reiterated in the hearing conservation amendment" (American Telephone and Telegraph, Exh. 327-89). The Motor Vehicle Manufacturers Association stated that:

"[Employee] notification would require that records of noise measurements be retained for individual employees. For individuals who are reassigned frequently, this would involve extensive remonitoring and recordkeeping. It is more appropriate to notify the employee of the representative exposure he can expect in a work area and/or job classification, and the appropriate protection which may be necessary" (Exh. 327-103, p. 2).

On the other hand, some commenters were opposed to altering the specifications of the stayed employee notification provision. Lonnie L. Johnson [Director of the National Post Office Mail Handlers * * * Union, AFL-CIO] stated: "We strongly object to the total stay of employee [exposure] notification requirements * * *" (Exh. 326-42, p. 11). The Mail Handlers also believe notification is necessary to protect and inform employees of conditions posing significant risks to their health so they may avail themselves of statutory protection. Comments from the AFL-CIO asserted that by staying the employee notification provisions, OSHA was not complying with Section 8(c)(3) of the Act, which mandates that "Each employer shall promptly notify any employee who has been or is being exposed to * * * harmful physical

agents * * * at levels which exceed those prescribed by an applicable occupational safety and health standard promulgated under Section 6 * * *" George Taylor, Director of Occupational Safety and Health, AFL-CIO, contended that staying worker notification of monitoring results is not justified simply by exposure variability because that factor is present for all the hazards addressed by other Section 6(b) standards and because Section 8(c)(3) of the OSH Act mandates notification. However, the AFL-CIO admits that posting is an acceptable way to transmit worker exposure information "as long as such posting methods are fully effective in apprising workers of exposure levels" (Exh. 327-109, p. 15).

Those who opposed including employee notification in the amendment generally felt that other provisions of the hearing conservation program, such as training, would provide adequate notice of exposure (Exh. 326-62, p. 2; Exh. 327-71, p. 2; Exh. 327-93, p. 2; Exh. 327-146, p. 4). OSHA believes employees have a fundamental right to be apprised of the results of monitoring. This is consistent with the mandate of Section 8(c)(3) of the Act to notify employees of exposure. Moreover, this right of notification of exposure goes beyond the provisions of 29 CFR 1910.20 which merely requires that employees have access to exposure records upon request. This explicit requirement to inform employees has educational value and will encourage more effective and enlightened worker participation in hearing conservation programs. In recognition of the many practical objections raised, however, the Agency has decided that the time frame within which to notify employees and the requirement for individual written notifications will be revoked because such specificity is inconsistent with the general performance approach toward monitoring adopted herein. The administrative stay of the more general employee notification requirements will be lifted. The amendment now requires the employer to notify each employee who is exposed at or above the action level of the monitoring results. This allows employers the flexibility needed to communicate monitoring results in what they judge to be the most reasonable and cost-effective manner.

OSHA believes that employers will notify their employees of monitoring results as promptly as possible. Moreover, although it is no longer specifically required, employers may want to inform their employees in writing rather than orally because written notification may be helpful in gaining employee cooperation in the

¹⁵ Employers would have to monitor the "next highest" individual in a stepwise fashion until all of those with a TWA greater than 85 dB are monitored. This technique would reduce the number of employees in the program to those deserving membership, but would also effectively require personal monitoring of most employees exposed above the action level.

hearing conservation program and in protecting the employer against allegations that employees have not been informed.

Methods of Measurement and Instrument Calibration

The method of measurement and calibration sections in the January hearing conservation amendment established specific requirements for instruments and techniques to be employed in measuring noise. In promulgating these requirements, OSHA stated, "These specifications are considered necessary in order to standardize and evaluate the measurement results" (46 FR at 4135).

The January document required dosimeters and sound level meters to meet certain criteria (e.g., ANSI specifications, specified operating ranges and specified dosimeter crest factor capabilities). The preamble stated, "By specifying minimum requirements for noise measuring instruments the Agency believes that it will better identify those workers needing audiometric testing and will help ensure that those workers requiring hearing protectors because of a significant threshold shift will be given protectors with proper attenuation to afford them adequate protection" (46 FR at 4135).

The August document continued the stay on the instrument specification provisions, the calibration requirements, and provisions specifying techniques to be applied in obtaining measurements, in response to many adverse comments about the necessity for and ability of existing equipment to meet these requirements. The August document stated, "The Agency also received comments objecting to the calibration requirements, stating that they were unnecessary" (46 FR at 42624). Additionally, microphone placement and specific sampling instructions (Appendix B in the January amendment) were stayed pending a final decision on the use of area monitoring.

The method of measurement sections which remained constituted a performance requirement. Employers were expected to integrate " * * * all continuous, intermittent, and impulsive sound levels from 80 dB to 130 dB * * * into the computation" (46 FR at 42633). Employers would choose the method and technique of measurement, providing that all appropriate employees were included in the hearing conservation program.

The August document also continued the stay on the specifications for sound measuring equipment, in response to objections about the ability of

equipment to meet the requirements and the need for such specificity. The comments show considerable disagreement on the need for or amount of sound measuring equipment specification needed in the standard. Some respondents would like to retain the requirements exactly as they were stated in the January amendment (Exh. 327-59, pp. 2-3; Exh. 327-78, pp. 5-9; Exh. 345, pp. 7-8). Others wish to eliminate the specifications, so that a performance approach allowing professional judgment to be applied in evaluating specific environmental conditions could be used (e.g., continuous and intermittent noise without an impulse component) (Exh. 326-28, pp. 1-3; Exh. 327-122, p. 3; Exh. 149; Exh. 329-64). Still others preferred a modified specification requirement, which would accommodate concerns for crest factor appropriateness, ability of the equipment to integrate impulse noise, and appropriateness of an instrument operating range of 80 to 130 dB. A few participants wished the OSHA standard only to include what is contained in the current ANSI standards, and some requested a phase-in schedule for companies with existing equipment now in service (Exh. 326-1; Exh. 327-64, p. 4; Exh. 327-82-B; Exh. 327-89, p. 3; Exh. 327-98, p. 9).

Comments supporting implementation of the January amendment stated:

"The stay of provisions * * * stating equipment performance criteria * * * weakens the protection provided by the standard * * * Without these standards, there would be no assurance of the validity and reliability of noise exposure measurements at individual workplaces" (Exh. 345).

Other commenters noted that, " * * * [There is] no justification for eliminating equipment specifications * * * " (Exh. 327-109, p. 8), and that " * * * It is entirely inconsistent to permit employers to use * * * equipment which meets no performance specifications" (Exh. 327-78, p. 8).

However, other comments contended that specifications were not needed in the standard. In addition, some commenters pointed out that "OSHA's [stayed] specification for dosimeters rendered obsolete 23,000 dosimeters * * * it would likely cost OSHA itself around one million dollars to replace its supply of instruments * * * [and] fifteen million dollars [for industry]" (Exh. 326-28, p. 3). Measuring instruments should conform to the specifications of nationally recognized consensus standards, but the specifications should not be mandated, because it might restrict the development and use of new

instruments and methods (Exh. 327-122, p. 4; Exh. 327-149, p. 4).

The Agency recognizes that it is not necessary to specify dosimeter crest factor capability in workplaces without impulsive noise. Similarly, it is not reasonable to require employers to purchase equipment to measure sound levels up to 120 or 130 dB if a particular worksite does not have sound levels above 100 dB. " * * * The employer should be allowed to use any instrument or measurement technique that will provide employee exposure information which will include continuous, intermittent, and impulsive sound levels * * * " (Exh. 329-64).

OSHA believes that the performance approach taken in this document clearly states the objectives of monitoring and the capabilities that will be required, where appropriate, of sound measuring equipment that may be used. All continuous, intermittent and impulsive sounds between 80 dB and 130 dB must be included in the measurement. Additionally, the employer has the ultimate responsibility to ensure that measurements will allow the proper identification and classification of employees with regard to a hearing conservation program. OSHA expects that adherence to the performance approach prescribed in the revised amendment will ensure accurate data and that the appropriate employees will be selected for the hearing conservation program. Adoption of specific ANSI standards on measuring equipment will in some circumstances limit employer flexibility in complying with the amendment without providing additional employee protection. Thus, it is difficult to see how the adoption of the ANSI standard on monitoring equipment¹⁶ will better effectuate the purposes of the Act than the performance approach adopted in the revised amendment. Therefore, the ANSI equipment specifications contained in the January amendment are revoked. OSHA finds that the revised monitoring provisions adopted herein will better effectuate the purposes of the Act within the meaning of section 6(b)(8) than will the adoption of the ANSI standard. This approach will provide the flexibility to apply appropriate methods of measurement using equipment that meet or exceed stated expectations.

Comments concerning monitoring equipment calibration were very similar to those about equipment specifications.

¹⁶ American National Standard Specification for Personal Noise Dosimeters, S1.25-1978 and American National Standard Specification for Sound Level Meters, S1.4-1971 (R 1976).

Supporters of calibration requirements contended that they were needed to ensure valid measurements, were not time consuming (i.e., field calibration), and were a matter of good industrial hygiene practice (Exh. 326-41; Exh. 327-22, p. 2; Exh. 327-103, p. 4).¹⁷ Many felt that the requirement for specific detailed calibration procedures should not be attempted in a hearing conservation amendment.

Dosimeters and sound level meters used to measure employee exposures were required by the January amendment to be calibrated at specific times and in accordance with detailed specifications.¹⁸ In response to comments (Exh. 325-33; Exh. 325-50; Exh. 325-77) that the calibration provisions were too detailed and too burdensome, the August document stayed these requirements. In the interval since August, many commenters have stressed the importance of calibration for the accurate measurement of noise exposures (Exh. 347; Exh. 331-17; Tr. Vol. III, pp. 283-284, 294-295, March 25, 1982; Exh. 345; Exh. 327-103; Exh. 326-11; Exh. 326-41; Exh. 326-12). As J. H. Stenmark [American Iron and Steel Institute] stated:

"Field calibration of sound level meters is essential and should be conducted before the measurements, during the measurements, and after the measurements on each day the instrument is used. For dosimeters which are worn all shift by the worker, field calibration should be conducted on the instrument before the shift and after the shift. Laboratory calibration should be conducted when problems are encountered during field calibrations, anytime the instruments must be repaired, and on a periodic basis" (Exh. 327-105, p. 3).

R. J. Wurm [Quest Electronics] pointed out that the use of noise measuring instruments in industrial settings increases the need for calibration: "Field equipment is always subject to rough use * * * A calibration check after any important measurement is best to confirm the reading" (Exh. 326-11, p. 3). In addition, calibration is not time consuming, burdensome, or costly, and is necessary to ensure accurate measurements (Exh. 326-12). According to Deborah Berkowitz [Food and

Beverages Trades Department, AFL-CIO], "Field calibration of a sound level meter can be performed in a matter of seconds and calibration of a dosimeter may take only several minutes" (Tr. Vol. V, p. 105, March 29, 1982).

Despite the widespread recognition of the need for calibration procedures to ensure measurement accuracy, however, many commenters (Exh. 327-87; Exh. 327-89; Exh. 327-98) objected to the degree of specification in the January calibration requirement. Several respondents argued that the revised amendment should refer employers to the calibration procedures specified by the manufacturer of the particular instrument used (Exh. 327-87, p. 3; Exh. 327-91, p. 13; Exh. 327-98, p. 11; Exh. 327-101, p. 5; Exh. 327-89, pp. 3-4). According to H. M. Williams of the American Telephone and Telegraph Company (Exh. 327-89), " * * * calibration of instruments is usually unique to the instrumentation being used, and it is, therefore, best left to the manufacturer's instructions * * * Other commenters believe that including calibration procedures in a non-mandatory appendix, to be used either by OSHA compliance personnel or employers, would provide sufficient guidance about appropriate calibration techniques (Exh. 327-99, p. 9; Exh. 327-121, p. 2; Exh. 327-102, p. 7). As the Shipbuilders Council of America reported (Exh. 327-104, p. 21):

" * * * we do not think that OSHA should specify the method of calibration of noise measuring equipment. * * * Publishing instructions to OSHA inspectors about calibration techniques * * * can greatly assist by providing models for many companies. Making such guidelines mandatory, however, unnecessarily freezes the state of the art * * *"

J. G. Tritsch, of the American Textile Manufacturers Institute, recommended (Exh. 327-106, p. 3) that "the standard * * * only require the instruments [to] be properly operative and let performance be the criteria [sic]." J. B. Browning of the Union Carbide Corporation asserted that no calibration provision should be included in the revised amendment, because methods of calibration should be determined by the professional taking the exposure measurements (Exh. 329-17).

OSHA agrees with R. K. Meyers, of the Texaco Corporation, among others, that the calibration of sound measuring equipment is essential to obtaining accurate exposure measurements (Exh. 329-15; Exh. 327-87; Exh. 329-14; Exh. 329-16; Exh. 329-57). However, the Agency believes that the diversity of sound measuring instruments and the variability in manufacturers' calibration

instruments precludes total reliance on these instructions to ensure measurement accuracy. For example, some manufacturers' instructions specify calibration intervals and techniques, while others simply recommend periodic calibration. In addition, the Agency finds some merit in the view expressed by G. V. Cox of the Chemical Manufacturers Association (Exh. 327-122), that specifically addressing calibration intervals is inconsistent with the revised amendment's performance approach to monitoring instruments, which permits employers to choose the most appropriate device rather than specifying instrument type and capability.

Consideration of all the comments and testimony received on the issue of measuring instrument calibration has convinced the Agency that adopting the performance approach to instrument calibration will ensure that exposure measurements are accurate and that employers conduct calibration at the intervals and in accordance with the procedures specified in the manufacturer's instructions or those dictated by good practice. Accordingly, the revised amendment requires that all noise measuring instruments be calibrated to ensure the accuracy of exposure measurements. This approach, which was recommended by several rulemaking participants (Exh. 327-102; Exh. 327-106; Exh. 327-140; Exh. 327-149; Exh. 368), has several advantages. First, it is consistent with the revised amendment's performance orientation. In addition, it permits employers to follow the instructions recommended by the instrument's manufacturer, and to adapt these as necessary to particular circumstances of their workplaces. For example, employers are not required to return instruments to the laboratory for calibration unless they cannot be properly calibrated in the field. Moreover, contrary to the opinion expressed by George Taylor of the AFL-CIO (Exh. 327-109), OSHA believes that adopting the performance approach will better effectuate the purpose of the Act than adopting the national consensus standard because it will ensure that employers maintain their noise monitoring instruments within calibration specifications whenever exposure measurements are made. On the other hand, employers will not be required to perform field or laboratory calibrations that are not essential to ensuring measurement accuracy. For these reasons, OSHA is revising the amendment to include a requirement that employers calibrate all sound

¹⁷ The January amendment required that field calibrations be done before and after each day's measurements to verify the accuracy of the measuring equipment. In addition, it required a laboratory calibration when acoustical calibration and manual adjustments could not be used to verify the accuracy of the measuring instrument.

¹⁸ The January calibration requirements read in part: Whenever acoustical calibration and manual adjustments of the measuring equipment cannot verify the accuracy of the measuring instrument, laboratory calibration shall be performed to ensure conformance with the requirements of ANSI S1.25-1978 or S1.4-1971, as appropriate.

measuring instruments as necessary to ensure that employee exposure measurements accurately reflect the noise exposure of their employees.

Since the performance approach to monitoring allows either area or personal monitoring, the specifications for microphone placement are no longer consistent with the monitoring requirements and are also being revoked.

Many commenters requested a simplified non-mandatory version of Appendix B, which suggested a monitoring strategy to be used with sound level meters (Exh. 327-99; Exh. 327-102, p. 7; Exh. 327-121, p. 2). Appendix B, as it appeared in the January amendment (46 FR 4166-4176), was designed to implement a personal sampling program; since the amendment has been revised, this Appendix is no longer necessary and it is being revoked. As noted above, a new appendix, Appendix G, has been included to provide employers, particularly small employers, with some useful data to aid in meeting their monitoring obligations under this amendment.

As the above discussion clearly shows, the detailed monitoring requirements being revoked herein are not necessary to ensure that the noise monitoring mandated in the hearing conservation amendment achieves the goals for which it was intended: to select all employees who should be included in the hearing conservation program and to ensure that any hearing protectors used will provide adequate attenuation to protect employees in their particular workplace noise environment.

OSHA agrees with Dr. Harold Dietz [Director of Health and Environmental Services of the BF Goodrich Company], who stated:

"The company has carefully reviewed the proposed monitoring obligations, as well as complied with the performance standard which has been in effect pending the stay of the more complex requirements. In our experience, we have found the performance standard to be far superior to the more detailed monitoring requirements, and we believe that employee protection would in no way be diminished should OSHA retain the performance standard when it promulgates its final rule" (Exh. 327-86, p. 2).

Enforcement of Monitoring

The preceding section discussed the differences between the monitoring requirements of the January 1981 amendment, which contained many specifications for noise monitoring, and the revised amendment, which also requires noise monitoring but allows the employer flexibility under most circumstances to select any method as long as it achieves the defined

performance goals. The revised amendment requires that the employer choose a sampling strategy designed to identify employees for inclusion in the hearing conservation program and to enable the proper selection of hearing protectors. The revised amendment, therefore, requires that the employer must choose a sampling strategy, which could be tailored for his own plant, that results in attaining the monitoring goals. Since OSHA compliance personnel use personal sampling techniques for inspection purposes, employers who use area monitoring in situations where monitoring results would be substantially different from those obtained with personal monitoring will increase their risk of being judged to be out of compliance.

Although OSHA acknowledges that many monitoring procedures may permit employers to identify employees for inclusion in the hearing conservation program, the Agency believes that personal monitoring with a dosimeter is the most accurate method of estimating employee noise exposure (employee noise exposure is expressed as a numerical value that represents the employee's noise dose). For this reason, OSHA uses the dosimeter for compliance determinations in routine workplace inspections. Since the Agency bears the burden of proof when alleging that an employer has violated an occupational safety and health standard, OSHA strives to allege violations only when relatively certain that violations have occurred. The procedures OSHA uses to obtain exposure data are therefore designed to yield the best estimates available.

Dosimeters

During the March hearings, the accuracy of dosimeters was questioned by Paul Hess, appearing for the Chocolate Manufacturers Association. Hess stated that he conducted an experiment using two or three dosimeters from the same manufacturer and that "I found variances as much as 100 percent, 120 percent or more" (Tr. Vol. II, p. 250, March 24, 1982). He concluded that he did not want dosimeters used in his workplace. The revised amendment does not require employers to use dosimeters. However, OSHA does not agree with Hess' conclusion. When Hess compared 8-hour TWA values obtained with dosimeters to calculated 8-hour TWA estimates made by sound level meters, he *assumed* that the sound level meter measurements and sampling strategy were accurate and that the variations were due to dosimeter inaccuracy. John J. Earshen, Chairman of the ANSI

working group on Personal Noise Dosimeters (S1-78), addresses this matter directly (Tr. Vol. III, pp. 135-145, March 24, 1982). Earshen points out that the dosimeter's function is to measure sound in the same way as a sound level meter and to carry out automatic data processing of the measurements to calculate a time-weighted average sound level or noise exposure. When using the sound level meter, measurements must be visually obtained from the instrument and then must be manually processed (e.g., by recording the length of time of the various levels) to calculate the employee's noise exposure. Mr. Earshen stated that if a sound level meter's output were carefully recorded with a device such as a graphic level recorder, the measurement information could be mathematically processed in the same manner as the dosimeter's output. Processing of the sound level meter output in this way will theoretically give the same exposure results as the dosimeter gives. In other words, the difference between a dosimeter and a sound level meter is that the dosimeter integrates sound level information with time electronically whereas the sound level meter produces data that require manual processing. To repeat, if the sound level meter output were processed automatically, the results would be, theoretically, the same (Tr. Vol. III, pp. 135-145, March 24, 1982). The difference in results between dosimeters and sound level meters is caused by differences in human perception during the intergration of sound level meter readings. "Therefore, many of the problems that people attribute to being fundamental differences between sound level meters and dosimeters are really reflections on what an operator can and cannot do" (Tr. Vol. III, p. 137, March 24, 1982).¹⁹

Earshen included in his post-hearing submission an article by Warren R. Kundert entitled, "Dosimeters, Impulsive Noise, and the OSHA Hearing Conservation Amendment," which further supports OSHA's conclusion. When discussing the measurement of impulse noise, Kundert states that:

¹⁹ Earshen claimed that if a high speed motion picture camera recorded the bouncing needle of a sound level meter and if these pictures were analyzed frame by frame to synthesize what the readings were on the sound level meter, the results would be similar to the results produced by a dosimeter. He concluded that the human eye/brain combination was not able to analyze this high speed dynamic motion properly and that this fact, rather than any flaw in the dosimeters, accounted for discrepancies between dosimeter readings and sound level meter readings (Tr. Vol. III, p. 137, March 25, 1982).

"An ordinary ANSI Type 2 sound level meter should not be used. Only an impulsive sound level meter (set to A slow) will provide sufficient accuracy when short duration impulses are present. This instrument is specified by standard IEC 651, 1979 and included in the current ANSI draft standard that will replace S1.4-1971.

We have the task of taking many readings, (10 or possibly many more) assigning to each a duration which we must estimate and then using the equation given in that OSHA regulation to find the percentage dose. It would seem that such a procedure should be automated.

We could take samples from our sound level meter automatically using a mini-computer and special interfacing equipment. Of course this equipment could not easily be moved about in a manufacturing plant. To solve this portability problem, we would record the noise signal using a tape recorder and then play the tape through our stationary impulse sound level meter and computer equipment. Can we afford the time and equipment for such a complicated procedure? Of course not! Fortunately, there is not need to. *The dosimeter will do the job for us.*

The dosimeter is really an automatic system just like the one described. On site, a small wearable package continuously monitors the A weighted sound level and solves the OSHA equation to determine the dose. The dosimeter is clearly more efficient than a manual or even an automated procedure using a sound level meter. Impulsive noises need not be a problem if care is taken to select a dosimeter capable of handling them" (Exh. 380-2, pp. 15-16, emphasis added).

Since January 1981, OSHA has received other information concerning dosimeter accuracy. This information essentially conforms with the information discussed in the January amendment. Therefore, OSHA reaffirms its January 1981 discussion, interpretations, and findings on the use of dosimeters to make measurements under 29 CFR 1910.95 (46 FR 4135 to 4139). They are repeated, in part, below (46 FR 4139):

"It has been stated (Exh. 321-47, pp. 1-2) that in certain conditions a noise dosimeter overestimates the noise dose relative to that which would be obtained using a sound level meter and timing device. OSHA believes that this situation should not occur for the following reasons: A dosimeter essentially consists of a sound level meter followed by a circuit that integrates the proper function of the A-weighted sound level. When only a sound level meter is used, sufficient data as to the temporal distribution of sound levels must be taken so as to enable the integration to be done numerically. Assuming that each instrument performs accurately and that the microphone positions are the same, the noise dose obtained with a dosimeter and that obtained using a sound level meter and a timing device should agree when the daily noise exposure is the result of several essentially constant sound levels, each experienced for an easily determined

duration. OSHA has observed this kind of agreement in its compliance experience. In such cases, the noise dose can easily be obtained with a sound level meter using Table G-16a and the procedures given in Appendix A, I. However, if the sound level varies over a range of more than a few decibels and, particularly, if the sound level undergoes rather rapid excursions due to intermittent or impulse noises, it can be very difficult to obtain accurate noise doses using a sound level meter and a timing device.

OSHA therefore concludes that a properly calibrated dosimeter reads the correct dose but that the use of a sound level meter, for intermittent noise or noise with significant impulse content, may lead to an underestimate of the correct dose."

OSHA will, therefore, allow the employer to use any monitoring equipment. OSHA will evaluate compliance with the monitoring requirements by evaluating the employer's decisions for including employees in the hearing conservation program and for selecting the proper hearing protection using exposure results obtained using the dosimeters. Employers whose monitoring program fails to meet the goals of the monitoring requirements will, however, be subject to citation.

Observation of Monitoring

OSHA's January amendment required employers to provide employees with the opportunity to observe any measurements of employee noise exposure being conducted pursuant to the amendment. The January preamble noted that the right to observe monitoring is mandated by Section 8(c)(3) of the Act. The Agency also reaffirmed its belief that " * * * workers who observ[ed] the monitoring of their exposures [will] gain insight into the nature and extent of the noise hazard, and will become more involved in the hearing conservation program. This involvement should increase the motivation for proper use of ear protection, and thereby increase the effectiveness of the program" (46 FR at 4155).

In addition to the basic right to observe monitoring, the January amendment provided employees with the right to an explanation of the measurement procedures, to observe all steps related to the noise exposure measurements, and to record the results. After publication of the January amendment, OSHA received comments expressing confusion as to the amount of explanation necessary and asserting that this requirement would be overly burdensome (Exh. 325-58; Exh. 325-103; Exh. 325-245; Exh. 325-51 Exh. 325-239). Therefore, in August, OSHA continued the stay of the paragraphs specifically

requiring that employees be given an explanation of procedures, observe all steps involved, and record the results. Information was requested as to whether these stayed provisions are necessary to afford employees a meaningful opportunity to exercise their statutory right to observe monitoring.

OSHA has received many comments asking that the more detailed provisions that were stayed be deleted on the grounds that the general observation requirement on which the stay was lifted in August provides sufficient assurance of employees' right to observe monitoring²⁰ (Exh. 326-21; Exh. 326-31; Exh. 326-32; Exh. 326-62; Exh. 327-13; Exh. 327-20; Exh. 327-28; Exh. 327-51; Exh. 327-62; Exh. 327-71; Exh. 327-80; Exh. 327-90; Exh. 327-102; Exh. 327-105; Exh. 327-111; Exh. 327-129; Exh. 327-135; Exh. 327-138; Exh. 327-139; Exh. 327-141; Exh. 327-145; Exh. 328-5; Exh. 329-15; Exh. 364).

Several commenters suggested the language of the stayed provision concerning explanations was confusing in that it places an open-ended requirement for explanation on employers (Exh. 327-67; Exh. 327-90; Exh. 327-93; Exh. 327-136). Several others asked detailed an explanation is required (Exh. 327-21; Exh. 327-90; Exh. 327-136; Exh. 364). The Diamond Shamrock Corporation suggested " * * * because of the technical nature of the noise measurement [we] suggest that mandatory explanations be limited to the significance of observed measurements and need not include technical explanations of either the physical aspects of the noise being measured or the practice of noise measurement" (Exh. 327-95, p. 4).

The Motor Vehicle Manufacturers Association (Exh. 327-103, p. 4) and the Ford Motor Company (Exh. 329-2, p. 4) opposed the detailed specifications, claiming that they interfere in areas covered in negotiated labor agreements. Other commenters argued that explanations of exposure monitoring are

²⁰ As promulgated in January the observation of monitoring provisions read:

(1) The employer shall provide affected employees or their representatives with an opportunity to observe any measurements of employer noise exposure which are conducted pursuant to * * * this section.

(2) Without interfering with the monitoring procedures the employer shall be entitled to:

(i) Receive an explanation of the measurement procedures;

(ii) Observe all steps related to the noise exposure measurements performed at the place of exposure; and

(iii) Record the results obtained.

The stay of paragraphs (i)(2)(i), (ii) and (iii) was continued in the August Federal Register document. Paragraph (i)(1) was allowed to go into effect.

more easily provided in regular training sessions (Exh. 327-102, p. 7; Exh. 327-139, p. 4).

OSHA also has received many comments attesting to the need to specify the rights of employees when observing monitoring (Exh. 326-41; Exh. 326-42; Exh. 327-59; Exh. 327-78, p. 15; Exh. 327-109, p. 16; Exh. 327-136; Exh. 329-36; Exh. 329-57; Exh. 345; Exh. 347; Tr. Vol. III, p. 63, March 25, 1982; Tr. Vol. IV, p. 245, March 26, 1982; Tr. Vol. V, pp. 243-266, March 29, 1982; Tr. Vol. V, pp. 266-273, March 29, 1982). Frank Grimes of the United Steelworkers of America (Exh. 326-41, p. 3) asserted that observers need sufficient information to understand what is going on. He contended further, " * * * we do not have any indication from any other health standard that problems with the explanation provision is more than a figment of an employer's hyperactive imagination. In fact, the parties often work out any procedures that are necessary to implement this provision." The United Paperworkers International Union (Exh. 327-59, p. 3) recommended that the stay on the provisions be lifted because it " * * * will help to ensure that the worker is involved in the noise measurements and is not a passive observer who does not understand measurement procedures." The Paperworkers also specified a list of items they believe should be included in the explanation of monitoring.

OSHA has reviewed the comments submitted regarding the necessity of retaining the stayed provisions to obtain meaningful observation of monitoring. Virtually all commenters agree that observation of monitoring is an employee right and many are accustomed to providing such opportunities. We do not think that the revocation of these detailed provisions will cause the observation of monitoring provisions to become meaningless in the context of noise measurement. There are two standard ways of measuring noise exposure: The dosimeter and the sound level meter. The results obtained with a sound level meter are readily observable and understandable. When dosimeters are used the Agency assumes that the dosimeter readout would be observed by employees so long as the readout device is located in the plant. The dosimeter readout, in percentage of allowable dose or in decibels, should be self-explanatory.

The fact that provisions similar to the hearing conservation amendment's original observation of monitoring requirements have been included without apparently causing confusion in other health standards is not dispositive

here because this standard covers a far greater number and variety of employers than any other health standard.

Moreover, it should be noted that a number of health standards, including those covering asbestos and vinyl chloride, have observation of monitoring sections that do not specifically accord the right to receive an explanation. We are not aware of employees suffering as a result of the more abbreviated version of the observation of monitoring rights included in those standards.

In addition, OSHA finds the arguments of some commenters, that information on monitoring procedures is more effectively presented in scheduled training sessions than during actual monitoring persuasive (Exh. 327-58; Exh. 327-139; Exh. 329-17). For these reasons, OSHA has determined that in the context of the hearing conservation amendment the stayed provisions of the observation of monitoring requirements are not essential for employees to exercise their right to observe monitoring in a meaningful manner. Therefore, these detailed provisions have been revoked.

Summary

Clearly, substantial evidence in the record considered as a whole supports the conclusion that the performance-oriented monitoring requirements adopted herein are all that is necessary or appropriate to ensure the employee protection contemplated by the hearing conservation amendment. Moreover, this approach is consistent with the mandate of Section 6(b)(5) of the Act, which stipulates that standards be phrased in performance terms insofar as possible. OSHA therefore finds that the monitoring provisions prescribed herein are appropriate. This finding is based on Agency expertise and judgment as to what is necessary to achieve the goals of the amendment and on the fact that the objections raised to the performance approach adopted herein are speculative and conclusory.

Audiometric Testing

The amendment promulgated in January required that employers make audiometric testing available to all employees who had workplace noise exposures equal to or greater than an 8-hour TWA of 85 dB. After the phase-in period, initial or baseline audiograms were to be obtained within 4 months of an employee's first noise exposure at or above the action level. The audiometric testing was to be conducted by a physician, audiologist or otolaryngologist or by a technician under the supervision of one of these professionals. After the baseline

audiogram, employees were to be tested at least annually and the results of this annual audiometric test were to be compared against the baseline audiogram to determine whether any deterioration of hearing had occurred. The amendment used the term significant threshold shift (STS) to denote deterioration of hearing that was substantial enough to initiate follow-up procedures to prevent further hearing loss. In response to some confusion concerning the term "significant threshold shift", OSHA has decided to use instead the term "standard threshold shift" (STS) to describe the point at which follow-up procedures are required. Under certain circumstances, the amendment required that an employee with an STS be retested to determine if the hearing loss was permanent. Under other circumstances, employees exhibiting STS's had to be referred to professionals for evaluation or counseled. Some of the audiometric test provisions generated a good deal of controversy. Some of the other provisions caused confusion and many commenters requested clarifications or interpretations. The audiometric test provisions and interpretations of some of these provisions are discussed below.

Qualifications of Technicians Administering Audiometric Tests

The January amendment²¹ provided that audiometric examinations be administered by a licensed or certified audiologist, otolaryngologist or other qualified physician, or by a certified audiometric technician under the supervision of an audiologist, otolaryngologist or physician. After promulgation, commenters requested clarification of the qualifications of the technicians permitted to administer audiometric tests. In response to these requests, the Agency explained that all persons who can demonstrate "competency in administering tests and in the use and care of audiometers may administer audiometric tests required by the standard" (46 FR 42625). This would include trained technicians, hearing aid specialists, industrial hygienists, and nurses, in addition to the audiologists, otolaryngologists, and physicians who are specifically permitted by the standard to administer these tests. OSHA still endorses this interpretation. Questions raised during the recent public hearing indicate, however, that further clarification would be useful.

The standard recognizes two methods for persons to become trained in administering audiometric tests. The

²¹ 29 CFR 1910.95(j)(3), 46 FR at 4162.

first is to complete a training course administered by a training institution certified by the Council of Accreditation for Occupational Hearing Conservation or a course given by another recognized training organization, and to receive a certificate upon completion of the course. The second method involves demonstrating, to the satisfaction of the professional supervisor of the hearing conservation program, that competence in test administration and audiometer use has been achieved. The wording of the amendment has been changed slightly to clarify the intent; that is, that the technician must be able to show competence in the proper use, maintenance, calibration and functioning of the particular type of audiometer being used, rather than audiometers in general. This on-the-job training approach will permit employers a substantial amount of flexibility in staffing their hearing conservation programs, while ensuring that employee audiograms are properly taken. The standard envisions that persons administering audiometric tests will ensure the appropriateness of the test environment and functionally calibrate and maintain the audiometer; in addition, this person will screen audiograms to identify problem audiograms needing further evaluation by a professional and audiograms with standard threshold shifts. OSHA agrees with J. C. Morrill [Impact Hearing Conservation], however, that the responsibility for direction of the hearing conservation program should remain "in the hands of a professional audiologist, otolaryngologist, or physician" (Exh. 327-35, p. 5), although trained technicians can perform the tasks specified above. We believe that the amendment reflects this intention.

Qualified Physician

As stated above, the hearing conservation amendment requires that certain portions of the audiometric testing program be performed by professionals, while other functions may be carried out by technicians. By the terms of the amendment, professionals include licensed or certified audiologists, otolaryngologists, and "qualified" physicians.

After publication of the January amendment, OSHA received requests for clarification of the term *qualified* preceding physician (see 29 CFR 1910.95(j)(3) and (j)(7)(ii), 46 FR at 4162). In the preamble to the August document, OSHA explained that "qualified" was intended to mean any licensed physician who believes that he or she has adequate training or knowledge to administer audiometric tests and

interpret the results. The Agency gave notice in the August Federal Register document that it believed that the word "qualified" is unnecessary in the amendment because adequate professional judgment and responsibility can be assumed.

In response to the Agency's request for comments on this issue, many commenters (Exh. 327-24, p. 1; Exh. 327-28, p. 2; Exh. 327-35, p. 1; Exh. 327-76, p. 7; Exh. 327-77, p. 2; Exh. 327-88, p. 5; Exh. 327-95, p. 5; Exh. 327-102, p. 7; Exh. 327-106, p. 7; Exh. 327-140, p. 3) agreed with the Agency's position that the term "qualified" should be deleted because licensed physicians who undertake responsibility for audiometric testing programs are assumed to be qualified. Only one commenter, Dr. S. White of the American Speech-Language-Hearing Association, stated that the term should be retained (Exh. 327-154, p. 3). Therefore, in view of the evidence in the record, OSHA has decided to delete the term, "qualified," preceding the word physician in the audiometric testing provisions of the standard.

Baseline Audiogram

The baseline audiogram is extremely important since it is the reference against which future audiograms are compared to determine the extent to which an employee's hearing is deteriorating. If the baseline audiometric test is not conducted properly, it will not reflect the employee's true hearing thresholds, and any real changes between baseline and future tests may be masked. The January amendment required employers to obtain a baseline or first audiogram for each employee within 4 months of the employee's first exposure to workplace noise at or above an 8-hour TWA of 85 dB. The need to perform baseline audiograms early during the employee's exposure to safeguard the purity of the audiogram as much as possible was recognized. In the January preamble, OSHA made a finding that to delay baseline testing more than 4 months was not appropriate since employees might incur some hearing loss during the interval, which would cause the baseline audiogram to be elevated by temporary hearing loss (46 FR 4143). This elevation would mask the true extent of any threshold shift between baseline and future tests and would result in delayed detection of a significant threshold shift. Additionally, OSHA established the 4-month period to enable employers to exclude most seasonal and temporary workers from the audiometric testing program on the basis that audiometric testing and follow-up procedures for seasonal employees would be administratively

difficult or impossible because these workers work for several employers in a season or over the year. Furthermore, OSHA allowed the 4-month period to permit employers who used distant consulting services to schedule mobile test van visits at quarterly intervals.

Commenters argued that companies relying on mobile van audiometric test services would be forced by the 4-month baseline requirement to send newly hired employees to a clinic, which would be considerably more expensive on a per employee basis than using a mobile test van. Mobile testing services frequently impose a minimum fee and it might not be practical to have the test van visit the company more than once a year. In view of the above considerations, the Agency decided to reconsider the 4-month baseline requirement. The stay was therefore continued in August, and the Agency requested data and information on this issue (see 46 FR 42625-42626).

OSHA understands the value of conducting pre-employment baseline audiograms, which are the most accurate indicators of employees' hearing levels before exposure to noise. They help to determine if changes in future audiograms represent actual shifts due to noise exposures. Several organizations and companies, including DuPont (Exh. 327-91), Shell Oil (Exh. 327-102, p. 8), Texaco (Exh. 329-15, p. 5), Motor Vehicle Manufacturers Association (Tr. Vol. II, p. 109, March 24, 1982), Reynolds Metals (Tr. Vol. I-B, pp. 270-271, March 23, 1982), Edison Electric Institute (Tr. Vol. II, p. 219, March 24, 1982), American Iron and Steel Institute (Tr. Vol. III, p. 277, March 25, 1982), and Dresser Industries (Tr. Vol. IV, p. 80, March 26, 1982) either perform or recommend pre-employment audiograms when feasible. OSHA does not believe that pre-employment audiograms are practical in many cases, or essential to protect worker hearing in the context of an industrial hearing conservation program. However, pre-employment audiograms do represent good or "ideal" practice, and OSHA encourages employers to obtain them where it is practical to do so.

Dr. L. Royster (Exh. 327-84, pp. 30-31) and others (Exh. 327-20, pp. 2-3; Exh. 327-135, p. 4; Exh. 327-119, pp. 2-3) urged that different intervals should be allowed for baseline testing, depending on the employee's exposure level. They argued that employees exposed to high levels of noise should be tested sooner than those exposed to moderate or lower levels. However, OSHA agrees with D. C. Gasaway, who stated that using different time frames to establish

baseline audiograms for employees exposed to different levels of noise would lead to administrative confusion and might cause some affected employees to be overlooked (Exh. 327-66, p. 17). Moreover, such a strategy would not solve the problem for those using mobile testing services. Others requested that the period for obtaining baseline audiograms be extended to 6 months to exclude seasonal workers in some industries who work more than 120 days but less than 180 days, and who often have a 100% turnover rate (Tr. Vol. III, p. 8, March 25, 1982; Tr. Vol. IV, p. 203, March 26, 1982).

After carefully considering the record evidence, the Agency has decided that employers who have their own audiometric testing facilities or who send their employees to clinics for testing should obtain baseline audiograms for their employees within 6 months of the employees' first exposures to workplace noise at or above the action level. The requirement to obtain baseline audiograms within 4 months of the employees' first exposure at or above the action level is being revoked. This relaxation of the time period in which to obtain baseline audiograms for those employers with in-house testing capability and those using clinics for audiometric testing is in recognition of the fact that the 4-month period allowed in January to obtain baseline audiograms was too short to permit the exclusion of many seasonal workers from the audiometric testing requirements (see Exh. 326-29; Exh. 326-30; Exh. 374, pp. 199-206; Exh. 325-64). It is neither practical nor appropriate to require audiometric testing of seasonal workers; the tenure of employment is too short to permit the type of hearing evaluation mandated by the amendment in that the employee will not be employed long enough for the employer to obtain an annual audiogram against which to compare the baseline audiogram.²²

In January, the Agency found that it was not appropriate to delay baseline testing more than 4 months since employees' audiograms might be contaminated by temporary threshold shifts (TTS) (46 FR 4143). While this finding was undoubtedly correct when employees are exposed to high noise levels, it did not fully consider the realities of the situation. The occupational noise exposure standard (29 CFR 1910.95(a) and (b)) requires that employee exposures be reduced to within the permissible exposure limits (90 dB as a TWA). Therefore, employees

are not expected to be exposed to extremely high levels of noise at any time during their employment, including during the period before the baseline audiogram is taken. Under these circumstances, the Agency finds that it is appropriate to allow the employer 6 months in which to obtain employee baseline audiograms.

Numerous commenters argued persuasively that the 4-month baseline audiogram requirement contained in the January amendment was unduly restrictive and costly for those who rely on mobile test vans because it would either necessitate three visits by the van a year or require employers to send employees to a clinic, which would involve high cost, travel time, and special testing fees (Exh. 329-15, p. 5; Exh. 327-146, pp. 18-19; Exh. 327-61, p. 2; Exh. 327-96, p. 2; Tr. Vol. I-B, pp. 208-209, 254, March 23, 1982; Tr. Vol. IV, p. 80, March 26, 1982).

Many commenters recommended that OSHA extend the 4-month baseline requirement to 1 year, provided that hearing protectors are used until a baseline audiogram is performed (Exh. 327-143, p. 5; Exh. 327-61, p. 2; Exh. 333, p. 3; Exh. 327-96, p. 2; Tr. Vol. IV, p. 209, March 26, 1982; Tr. Vol. I-B, p. 208, March 23, 1982).²³

These participants maintained that hearing protectors would be effective in minimizing or preventing temporary threshold shift prior to the baseline audiogram (Exh. 327-61, p. 2; Exh. 327-143, p. 5; Exh. 327-96, p. 2; Tr. Vol. IV, pp. 80-81, March 26, 1982). In the words of R. Connelly of Audiometric Associates:

"The implementation of an effective hearing conservation program should eliminate the need to obtain a baseline audiogram within the first 4 months of exposure to workplace noise. Companies should be encouraged to obtain baseline tests as soon as possible for new employees and [be] required to do so within 1 year of exposure" (Tr. Vol. IV, p. 209, March 26, 1982).

W. E. Bodenheimer [Colorado Speech and Hearing Center] noted:

"The intent here [of the 4-month baseline requirement] was to avoid contamination by threshold shifts on the baseline audiogram, to allow employers to exclude most seasonal and temporary workers from the testing program, and avoid the problems of requiring pre-employment baseline tests.

"All of these problems can be solved in a much easier and cost effective manner as far as we are concerned, particularly for those thousands of companies that rely on mobile

testing services that test on-site on an annual basis.

"Since the standard requires the use of personal hearing protectors and emphasizes training in the use and care of these devices, were they provided immediately to any employee at his first exposure to noise at or above a time-weighted average of 85 dB, and were their proper use enforced, a valuable and reliable baseline hearing test would be established for those employees at the time of the annual hearing testing.

"This approach would be effective in preventing any threshold shift until the baseline could be established at the economic convenience of the employer.

"Many companies who rely on mobile service have operations located far from cities and other urban areas. They rely on the mobile operations to go to them for baseline and annual hearing testing and for catch-up tests when possible. It would be economically disastrous for these companies and logistically impossible for the mobile services to travel to each location to conduct baseline tests within four months of exposure, or for the companies to send their employees to a local clinic or physician where the cost per employee would be much higher.

"Effective industrial hearing conservation can be achieved with a program of annual hearing testing conducted in conjunction with a conscientious and enforced program of personal hearing protection use" (Tr. Vol. I-B, pp. 208-209, March 23, 1982).

OSHA agrees in principle with P. Crouch of the Refractories Institute and others (Exh. 327-28; Exh. 327-86; Exh. 327-143; Exh. 327-146) that companies using mobile testing services to satisfy their audiometric testing obligations under the hearing conservation amendment should be allowed one year to obtain baseline audiograms provided that their employees exposed at or above the action level use hearing protectors until such time as the baseline audiogram is obtained. Such an approach would, however, treat employees who are to be tested using mobile test vans differently from those whose employers have their own in-house audiometric testing facilities. The former group of employees would have to wear hearing protectors for up to a year before the baseline audiogram is taken even if their exposure is below the permissible exposure level of 90 dB; the latter group of employees would not need to wear hearing protectors during the six-month period in which the employer has to obtain baseline audiograms if their exposures are below the permissible exposure level. Therefore, the amendment only requires that where the employer is using mobile test vans and wishes to take a full year to obtain baseline audiograms, employees whose exposures are below the permissible exposure level must

²² The same rationale applies in all high turnover situations.

²³ The effect of the continued stay on the provision requiring that baseline audiograms be obtained within 4 months was to allow employers a year to obtain baseline audiograms.

wear hearing protectors from any period exceeding six months after first exposure until the baseline audiogram is obtained. This decision recognizes the practical limitations posed by the use of mobile testing vans and the logistical problems which would arise if the amendment were to require audiometric baselines to be obtained within 6 months, regardless of the size and location of the employer's firm. It also allows some flexibility for scheduling difficulties (Exh. 327-106, p. 4; Exh. 327-51; Exh. 327-91, p. 16) while minimizing the chances that the baselines will be contaminated by temporary threshold shifts as hearing protectors are only being relied upon to provide a very small amount of attenuation. Moreover, this approach is expected to substantially relieve the burden of obtaining baseline audiograms on those employers with highly transient or difficult to reach worksites.²⁴ R. Brisnehan of the Petroleum Equipment Suppliers Association and G. McKown of the International Association of Drilling Contractors admitted that extending the baseline requirement to 1 year would solve several of their industry's problems with complying with the audiometric test provisions of the amendment (Tr. Vol. I-B, p. 295, March 23, 1982).²⁵

14 Quiet Hours

The January amendment required that employees exposed at or above the 85 dB action level be given an audiometric test to establish a baseline audiogram. That test was to be preceded by a minimum period of 14 quiet hours without exposure to workplace noise. This quiet period was intended to allow an employee's hearing to recover from any temporary threshold shift (TTS) caused by pre-test noise exposure, because TTS would mask the employee's true hearing threshold. If the baseline audiogram was contaminated by TTS, subsequent comparisons of the baseline audiogram to the annual audiogram would not show the true extent of the hearing loss since the baseline would not reflect the true hearing threshold at the time it was taken (see 46 FR 4146-4147). The

²⁴ Where employers with these type of workplaces do have an in-house test capability, there would, of course, be no problem in obtaining baseline audiograms within 6 months.

²⁵ Clearly, high employee turnover rates do not render the requirement to obtain baseline audiograms impractical when a full year is allowed to obtain the baseline. The employer has the option of waiting to see which employees stay before obtaining baseline audiograms; this may greatly reduce the number of baseline audiograms the employer will have to obtain (Tr. Vol. I-B, p. 295, March 23, 1982).

wearing of hearing protectors could not be used to provide this quiet period.

After publication of the January amendment, many commenters informed OSHA that prohibiting the use of hearing protectors to provide quiet before the baseline audiogram might prove unnecessarily restrictive (Exh. 325-220; Exh. 325-248; Exh. 325-251; Exh. 325-288). The stay on this prohibition was continued in August and OSHA solicited evidence on whether hearing protectors would be effective in preventing TTS before baseline audiograms.

The Agency received many comments in favor of allowing the use of hearing protectors to supply quiet prior to the baseline audiogram (Exh. 327-103; Exh. 327-101; Exh. 327-105). On the other hand, some commenters argued that hearing protectors should not be substituted for the quiet period (Exh. 326-41; Exh. 326-42; p. 12; Exh. 327-20, p. 3). For example, F. P. Grimes of the United Steelworkers of America asserted that even close supervision of employees wearing hearing protectors before testing is not equivalent to a 14-hour pre-test quiet period (Exh. 326-41). Two professional audiologists, J. Shampan of Impact Hearing Conservation, Inc., and Dr. D. G. Harvey of Audiology Associates, Inc., expressed concern that the use of hearing protectors would not prevent TTS from contaminating the audiogram (Exh. 327-53, p. 1; Tr. Vol. V, p. 45, March 29, 1982).

Most commenters, however, stated that hearing protectors can be effective in minimizing TTS and will not interfere with obtaining a valid audiogram (Exh. 327-114, p. 23; Exh. 327-108, pp. 6-7; Exh. 327-105, p. 4; Exh. 327-101, p. 5; Exh. 327-98, p. 19; Exh. 327-97, p. 3; Exh. 327-93, p. 3; Exh. 327-89, p. 4; Exh. 327-68, pp. 2-3; Tr. Vol. II, pp. 106-107, March 24, 1982).

Dr. H. W. McCurdy, Executive Director of the American Council of Otolaryngology, asserted that a hearing protector that reduces the level of sound energy reaching the ear to 80 dBA or less will effectively reduce TTS; attenuation to this level would limit the amount of baseline contamination to less than the usual amount of audiometric measurement error (Exh. 327-151, p. 3).

An evaluation of more than 40 industrial audiometric data bases, which was conducted by Dr. L. Royster of North Carolina State University, confirms the effectiveness of hearing protection in preventing TTS contamination of the audiogram (Exh. 327-84, p. 41). As Dr. Royster reports, "proper utilization of appropriate

(hearing protectors) will prevent significant contamination of the data base by TTS" (Exh. 327-84, p. 4).

Several comments claimed that valid baseline audiograms could be obtained if hearing protector use was well supervised on the day of the baseline test. In fact, this was felt to be superior to the 14-hour quiet period "without exposure to workplace noise" where employee exposures are unknown and uncontrolled (Exh. 327-113, p. 2; Exh. 327-104, p. 17; Exh. 327-51, p. 3; Exh. 327-39; p. 1; Exh. 327-35, p. 2; Exh. 327-120, pp. 2-3; Tr. Vol. I-B, pp. 193-194, 209, March 23, 1982; Tr. Vol. II, p. 222, March 24, 1982; Tr. Vol. IV, pp. 67, 107-108, March 26, 1982).

Several commenters testified to the difficulties that the prohibition against substituting hearing protectors for the 14-hour quiet period would cause. Among the problems cited were the cost of paying employees overtime wages when they were tested on unscheduled work days (Exh. 326-35; Exh. 326-43; Exh. 327-21; Exh. 327-34; Exh. 327-29; Exh. 329-64; Exh. 331-33), disruption of employee work schedules (Exh. 326-28; Exh. 326-35; Exh. 326-43; Exh. 327-21; Exh. 327-34; Exh. 327-54; Exh. 327-88; Exh. 327-90; Exh. 329-64), and the difficulty and expense associated with scheduling mobile audiometric test vans (Exh. 326-43; Exh. 327-29; Exh. 327-54; Exh. 327-90; Exh. 327-146; Exh. 331-33). Many participants stated that these problems could be overcome by permitting employees to wear hearing protectors during the 14-hour period before the baseline is taken, particularly if employees were made aware of the effects of pre-test noise exposures (Exh. 327-141, p. 4; Exh. 327-61, p. 3; Exh. 327-140, p. 4).

After thorough review and analysis of the comments and testimony received in connection with this issue, OSHA has determined that the use of hearing protectors should be permitted as a substitute for the 14-hour quiet period. The Agency concurs with the large number of commenters who testified that hearing protectors may provide sufficient attenuation to prevent noise-induced TTS from contaminating baseline audiograms. As Dr. McCurdy emphasized, * * * "[the] use of hearing protection to reduce exposure to noise prior to the baseline measurement should be permitted * * * [An] advantage of this allowance is that it may aid in reducing TTS due to non-occupational noise exposure prior to baseline testing, if the employer makes hearing protectors available to employees for use outside the workplace. Informing employees of the

importance of avoiding excessive noise exposure on and off the job is an integral part of any hearing conservation effort * * * (Exh. 327-151, p. 3). OSHA agrees with Dr. McCurdy that the amendment's training provisions, which require that employees be trained in the selection, fitting, use, and care of hearing protectors and the effects of noise on hearing, will also operate to increase the effectiveness of hearing protectors in the workplace.

A number of other suggestions were given to help maximize hearing protector effectiveness in preventing temporary threshold contamination of the baseline audiogram (Exh. 327-114, p. 23; Exh. 327-106, p. 3; Exh. 327-113, p. 2; Exh. 327-105, p. 4; Exh. 327-103, p. 5). For example, Mr. J. Morrill, an industrial audiologist and president of Impact Hearing Conservation, recommended that special steps be taken, such as instruction in the need to avoid high levels of noise both on and off the job and careful fitting of hearing protectors, when using hearing protectors to ensure the integrity of the baseline audiogram (Exh. 327-35). Some commenters believed that only ear muffs are suitable to provide quiet on the day of testing since their visibility makes them easily verifiable (Exh. 327-151, p. 3; Exh. 327-103, p. 5; Exh. 327-62, p. 3; Exh. 327-56, p. 2; Exh. 327-154, p. 3; Tr. Vol. II, p. 151, March 24, 1982). OSHA agrees, but has decided not to require that ear muffs (as opposed to ear plugs) be used to provide quiet before baseline audiograms for the following reasons: ear muffs may be extremely uncomfortable in hot or humid environments, the use of glasses, goggles or respirators may interfere with their effectiveness, and certain hairstyles may make it difficult to get a good seal. The revised amendment allows employers to have sufficient flexibility to choose the most appropriate method of providing a quiet period before the baseline audiogram which is consistent with the particular working environment. In some instances, ear plugs will be used, in others, ear muffs, and in some circumstances employees may be scheduled for baseline testing at the beginning of the work shift. Accordingly, the prohibition on the use of hearing protectors before baseline audiograms is being revoked. Employers or professionals supervising audiometric testing programs are, of course, free to prohibit the use of hearing protectors to provide quiet hours before the baseline audiogram if, in their judgment, the circumstances so warrant.

Avoidance of Noise Before Audiometric Tests. The January

amendment required employers to notify employees of the need to avoid high levels of noise during the 14-hour period preceding their baseline audiograms. This requirement was designed to help ensure that the baseline audiogram was not contaminated with temporary threshold shift (see 29 CFR 1910.95(j)(5)(ii)(b), 46 FR 4162). Some commenters suggested that this requirement was unnecessary and redundant since the effect of noise exposures on audiogram results would be explained during the training required by another provision of the standard (Exh. 327-20, p. 5; Exh. 326-34, p. 5; Exh. 327-91, p. 22).

Other commenters stated that even if employees were notified of the importance of the quiet period as part of the training required by the amendment, there would be no assurance that they would actually receive this training before taking their baseline audiograms (Exh. 326-41, p. 5). Moreover, even if training were completed prior to taking a baseline audiogram, reiterating this information would still be beneficial since "repetition is a good teaching method" (Exh. 327-80, p. 2).

Moreover, other commenters felt that informing employees of the importance of avoiding noise prior to the baseline audiogram is necessary to ensure an accurate baseline (Exh. 326-31, p. 2; Exh. 326-41, p. 5; Exh. 327-12, p. 2; Exh. 327-95, p. 6; Exh. 327-102, p. 8; Exh. 327-104, p. 17; Exh. 327-131, p. 1; Exh. 327-135, p. 4; Exh. 327-143, p. 6; Exh. 327-154, p. 4; Tr. Vol I-B, pp. 200, 212, 252, 3/23/82). According to J. Toupen, attorney for the Shipbuilders Council of America:

"Employees who are so informed [about the necessity for the quiet period] have every reason to protect themselves from excessive noise exposure, since it is in their interest for their baseline audiograms to record their hearing capacity accurately. Workers who are trained in protecting their hearing on the job will have a special incentive to follow the hearing conservation program before their baselines" (Exh. 327-104, p. 17).

Dr. S. White of the American Speech-Language-Hearing Association also believed this provision was important:

"* * * the more information the employee has about why they should avoid the noise [prior to audiometric testing] the better. The employee would be certain * * * to want a valid audiogram * * *" (Tr. Vol. IV, p. 67, March 26, 1982).

After a thorough review of the record, OSHA has decided to lift the administrative stay on the requirement that employers tell their employees to avoid high levels of non-occupational noise during the period preceding their baseline audiograms. The Agency

agrees with Dr. W. E. Bodenheimer of the Colorado Speech and Hearing Center that, "although this paragraph may be redundant because this kind of information would occur during training, which is already required by the standard, * * * retaining this requirement would supply additional support to the goal of obtaining valid and reliable hearing testing results" (Tr. Vol. I-B, p. 212, March 23, 1982).

Although employers are not responsible for employee noise exposures sustained away from the workplace, the likelihood of non-occupational noise exposure contaminating the baseline audiogram can be substantially reduced by counseling workers of the need to avoid such exposures in the period before their baseline tests. Therefore, this requirement is necessary and appropriate for the implementation of a successful hearing conservation program.

Grandfathering of Baseline Audiograms

After publication of the January amendment, many commenters asked the Agency whether audiograms taken before the effective date of the amendment would be accepted as baseline audiograms. Most comments urged OSHA to accept these audiometric baselines, which had been taken using hearing protectors as a substitute for the 14-hour quiet period required by the amendment. In August, OSHA decided to adopt a very lenient policy on accepting baseline audiograms taken before the promulgation of the amendment:

Since the prohibition against the use of hearing protectors to achieve the quiet hours is being stayed, OSHA will accept baseline audiograms that were taken using hearing protectors as a substitute for 14 quiet hours. The Agency will continue to accept these audiograms in the future as valid baseline audiograms regardless of the outcome of the stay, and will accept or "grandfather" older baseline audiograms that reflect substantial compliance with the audiometric test requirements of the amendment. For example, to be acceptable, baseline audiograms should be administered by a trained technician, taken at the required test frequencies (500, 1000, 2000, 3000, 4000 and 6000 Hz), in a reasonably quiet room, and with calibrated equipment. The Agency is prepared to be flexible in accepting or grandfathering old baseline audiograms because in most cases this would be more protective of the employee since old baselines will allow the true extent of the hearing loss over the years to be evaluated. Obtaining a new baseline audiogram after many years of noise exposure might be less protective since the new audiogram might show higher thresholds and the true extent of future losses would

appear smaller than when compared with the original baseline (46 FR at 42626).

The Agency received many comments in response to this statement. There was a groundswell of support for the proposition that pre-existing baseline audiograms should be acceptable and be given "grandfather" status (Exh. 326-49, p. 3; Exh. 326-54, p. 3; Exh. 326-56, p. 4; Exh. 327-19, p. 2; Exh. 327-76, p. 3; Exh. 327-87, p. 4; Exh. 327-89, p. 10; Exh. 327-96, p. 3; Exh. 327-98, p. 17; Exh. 327-101, p. 5; Exh. 327-106, p. 4; Exh. 327-112, p. 15; Exh. 327-115, p. 3; Exh. 327-121, p. 2; Exh. 327-122, pp. 5-6; Exh. 327-140, p. 4; Exh. 327-149, p. 4; Exh. 327-154, p. 5; Tr. Vol. I-B, p. 193, March 23, 1982; Tr. Vol. III, p. 114, March 25, 1982; Tr. Vol. IV, p. 233, March 26, 1982. They reasoned that this policy was in the best interest of employees since in most cases these older audiograms would show lower thresholds and would better reflect the true extent of hearing loss over the years (Exh. 327-76, p. 3; Exh. 327-88, p. 6; Exh. 327-90, p. 4; Exh. 327-96, p. 3; Exh. 327-115, p. 3; Exh. 329-17, p. 3; Tr. Vol. I-B, p. 193, March 23, 1982; Tr. Vol. IV, p. 44, March 26, 1982.) Tr. Vol. IV, p. 233, March 26, 1982. Advocates of this policy also claimed that grandfathering older audiograms would eliminate unnecessary costs (Exh. 327-76, p. 3; Exh. 327-122, pp. 5-6; Exh. 327-140, p. 4).

So great was the support generated in favor of "grandfathering" pre-existing baseline audiograms that many of these commenters requested that OSHA add language to the amendment explicitly stating that audiograms taken prior to the effective date of the amendment are acceptable as baseline audiograms (Exh. 326-49, p. 3; Exh. 326-54, p. 3; Exh. 327-76, p. 3; Exh. 327-87, p. 4; Exh. 327-88, p. 6; Exh. 327-89, p. 10; Exh. 327-98, p. 17; Exh. 327-101, p. 5; Exh. 327-122, p. 5; Exh. 327-149, p. 4; Tr. Vol. I-B, p. 193, March 23, 1982). Other commenters were less enthusiastic, asserting that older audiograms should be considered as acceptable baselines only if they have been determined to be valid and to have been taken under conditions reasonably similar to those required by the amendment (Exh. 326-49, p. 3; Exh. 326-54, p. 3; Exh. 326-56, p. 4; Exh. 327-76, p. 3; Exh. 327-87, p. 4; Exh. 327-90, p. 4; Exh. 327-96, p. 3; Exh. 327-149, p. 4; Exh. 327-154, p. 5; Exh. 329-17, p. 3; Tr. Vol. IV, pp. 44, 233-234, March 26, 1982; Tr. Vol. V, pp. 139-141, March 29, 1982).

However, others claimed that it is unfair to require old baseline audiograms to comply with the requirements of the present amendment (Exh. 327-101, p. 5) and that, at a minimum, audiograms meeting the 1974 proposal's requirements should be

grandfathered (Exh. 327-98, p. 17; Exh. 327-89, p. 10). George Taylor of the AFL-CIO (Exh. 327-109, p. 12) and H. Buoy of the International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers and Helpers (Exh. 327-78, p. 13) recommended that employers conduct new baseline audiograms and then choose from among the old and new audiograms that audiogram with the lowest threshold as the employee's baseline.

OSHA believes that almost any baseline audiogram taken prior to the present amendment can be valuable in evaluating the true extent of an employee's hearing loss over time. As Dr. S. White of the American Speech-Language-Hearing Association cautioned, however:

"The grandfathering of pre-amendment audiograms should only be allowed when the supervising professional agrees that they are valid. Some previous audiograms may reflect, in part, temporary threshold shifts because of pretest noise exposure or high background noise levels in the test area. Therefore, previous test equipment, environment, and personnel should be considered. Obviously, if a hearing conservation program were in place prior to the enactment of the current amendment, the ramifications of allowing a reestablishment of baseline should also be considered. If the hearing loss had occurred prior to August of 1981, and that loss was due to industrial noise, the previous audiograms would reflect that change in hearing. As it presently stands, the reestablishment of baseline * * * would overlook the changes in hearing that took place and were already documented" (Tr. Vol. IV, p. 44, March 26, 1982).

Similarly, R. Connelly of Audiometric Associates stressed the importance of professional opinion in deciding whether to depend on a pre-existing baseline:

"I believe that * * * the older the audiogram * * * the more valuable it becomes in terms of identifying significant change. I believe that audiograms should be grandfathered as long as they appear to be reliable. I don't think there is any particular problem with that, as long as some safeguard is given to the method of comparison by an appropriate professional (Tr. Vol. IV, p. 233, March 26, 1982).

In response to a question about methods of determining the validity of old baseline audiograms, Mr. Connelly explained:

"Generally what is done is that, if they appear to be inconsistent, then the credibility, the validity of the audiogram comes into question. If they are generally consistent, then they are generally accepted as evidence" (Tr. Vol. IV, p. 234, March 26, 1982).

After review of the evidence on this issue, OSHA is reaffirming its position,

stated in the August Federal Register document, of allowing the grandfathering of baseline audiograms. This policy is consistent with the exercise of professional judgment. It is the responsibility of the professional supervising the hearing conservation program to determine which pre-existing audiograms are acceptable and which to choose as the baseline.

Evaluation of Audiogram

The January amendment stipulated that evaluation of audiograms must be performed by an audiologist, otolaryngologist, or qualified physician to determine if the baseline is valid and whether a significant threshold shift has occurred. These professionals are responsible for supervising the employer's audiometric test program and ensuring that tests conducted by technicians are carried out properly, that the test equipment is calibrated, and that the test room is sufficiently quiet. Professional supervisors also determine the need for employee referral for further testing when test results are questionable or when problems of a medical nature are suspected. Because these professionals have extensive education and training in audiometry and the recognition of various types of hearing loss, they are considered to be the most qualified to oversee a testing program.²⁶

The Agency received some comments, however, indicating that commenters had mistakenly interpreted the amendment as prohibiting technicians from reviewing routine audiograms. In the August Federal Register document, OSHA explained that technicians were permitted to review typical audiograms to determine STS, and that only problem audiograms were required to be reviewed by professionals (see 46 FR at 42626). This means that if technicians preliminarily review audiograms, they must refer problem audiograms or audiograms of questionable validity to an audiologist, otolaryngologist, or qualified physician for further evaluation (Exh. 327-66, pp. 50-52; Exh. 327-87, p. 4; Exh. 327-88, p. 7; Exh. 327-102, p. 3; Exh. 327-106, p. 7; Tr. Vol. I-B, p. 120, March 23, 1982). As Dr. S. White of the American Speech-Language-Hearing Association explained, it is acceptable for technicians to screen

²⁶ The preamble to the January amendment explained that in companies and consulting firms where audiometric test results are computerized, professionals do not have to review every audiogram but are responsible for preparing and developing the computer program to ensure that the professional reviews audiograms on a selective basis (see 46 FR 4141).

audiograms as long as the professional in charge establishes the criteria for audiogram review (Exh. 327-154, p. 5).

Some commenters urged that the Agency require professional review of all audiograms indicating STS in addition to problem audiograms (Exh. 327-106, p. 7; Exh. 327-102, p. 3). Mr. Bert Scott [Environmental Technology Corporation] argued that it is important for the professional to review every audiogram.

"ETC does not agree with OSHA's position * * * that technicians may review audiograms and give only problem audiograms to the professionals for review. ETC's 11 years of experience in reviewing hundreds of thousands of audiograms from various industrial sites reveal that trained audiometric technicians are not always capable of determining whether or not an audiogram is valid. This is especially true when a self-recording audiometer is being used. We have rarely if ever, reviewed plant audiograms and not found invalid data. We consistently found it necessary to reject audiograms generated by certified technicians. In addition to invalid testing procedures, unlikely thresholds at one or more frequencies, missing frequencies on manual testing, failure to retest frequencies to determine invalidity by microprocessors or audiometers, reversal of earphones, etc. [sic]

We observed other areas such as omission of names, dates, use of non-standard audiometric symbols on manual audiograms, out-of-date calibrations, and inconsistencies between audiometric data and medical history" (Tr. Vol. IV, pp. 137-138, March 26, 1982).

Dr. McCurdy, Director of the American Council of Otolaryngology—Head and Neck Surgery, and Dr. Summar, Medical Director of MTS Associates, Inc., also recommended that the professional should review every audiogram (Exh. 327-151, p. 5; Exh. 327-69, p. 6). As Dr. Summar explained:

"The entire Hearing Preservation Program, not just the hearing tests, must be under the direction of an experienced otolaryngologist, other physician, or audiologist. He must be personally and intimately involved in all aspects of the program in order to compare threshold results as to whether a change is present, why there is a change, and what followup steps need to be taken" (Exh. 327-69, p. 6).

OSHA does not believe that the record evidence demonstrates a need to require professionals to review every audiogram. Audiometric technicians, under the general supervision of an audiologist, otolaryngologist or physician have the skill necessary to review routine audiograms. The amendment has been revised to more clearly reflect this intent. Of course, if the supervising professional wishes to review every audiogram, he or she is free to do so.

The Agency therefore reaffirms its position, as stated in the August Federal Register document, which would require that professionals review problem audiograms including those of questionable validity. This procedure will help to ensure that employees whose audiograms merit further investigation will receive the necessary professional attention.

Standard Threshold Shift

In the January amendment, OSHA stated that:

"A definition and an understanding of what OSHA considers to be a significant shift of hearing threshold is very important in the proper implementation of the amendment's requirements. Without such a definition, workers and employers are unable to know the seriousness of the noise-induced hearing loss.

Identifying threshold shift as significant means that it is outside the range audiometric error (± 5 dB), and it is serious enough to warrant prompt attention because it is a precursor to material impairment of hearing. When threshold shifts are significant, employers must provide and fit hearing protection, and take other remedial actions depending upon whether or not the shift is permanent.

The definition of the term "significant" is critical to the effective operation of the hearing conservation program. If the definition is too stringent, spurious threshold shifts may occur and workers will be identified because of audiometer or technician error. If the definition is not stringent enough, workers will be allowed to lose too much hearing before protective actions are taken. Correctly identifying significant threshold shifts of hearing is particularly important for workers who have already begun to lose their hearing, so that the progression may be stopped before the hearing loss becomes handicapping" (46 FR 4144).

The January amendment defined a significant threshold shift (STS) as:

(i) A change in hearing threshold relative to the baseline audiogram of 20 dB or greater at any test frequency other than 500 Hz in either ear, if no previous audiograms have thresholds that exceed 25 dB with reference to audiometric zero as specified by American National Standard S3.6-1969; or

(ii) A change in hearing threshold relative to the baseline audiogram of 10 dB or greater at 1,000 or 2,000 Hz, 15 dB at 3,000 or 4,000 Hz, or 20 dB at 6,000 Hz, in either ear, if any previous audiogram has one or more thresholds that exceed 25 dB with reference to audiometric zero; or

(iii) A change in hearing threshold relative to the baseline audiogram of 10 dB or greater at any test frequency other than 500 Hz in either ear, if any previous audiogram has thresholds exceeding an average of 25 dB with reference to audiometric zero at the frequencies 1,000, 2,000 and 3,000 Hz; or

(iv) A change in hearing threshold relative to the baseline audiogram of 10 dB or greater at any test frequency other than 500 Hz in

either ear, if the employee has previously suffered one or more permanent significant threshold shifts.

Thus the January definition of STS reflected a "sliding scale" approach, with the amount of hearing loss constituting a significant threshold shift becoming smaller as the worker's hearing loss becomes greater. (For a more complete discussion of the definition of STS promulgated in January, see 46 FR 4144-4145).

According to many commenters, the STS definition included in the January amendment would permit too many employees, or certain groups of employees, to suffer occupationally-induced hearing loss without detection (Exh. 326-21, p. 3; Exh. 326-28, p. 5; Exh. 327-13, p. 5), while others maintained that OSHA's definition would result in a large number of "false-positives" (i.e., persons initially identified as having STS although subsequent audiometric tests show they have not had a shift in hearing threshold) (Exh. 327-91, p. 30; Exh. 325-30; Exh. 327-101, p. 7; Exh. 327-138, p. 6; Exh. 327-151, p. 10).²⁷ Although a number of contributors supported OSHA's January STS definition (Exh. 327-35, p. 4; Exh. 327-86, p. 6; Exh. 327-97, p. 5; Exh. 327-136, p. 6), others stated that it was too complicated to be used in the field (Tr. Vol. II, pp. 170-171, March 24, 1982; Exh. 326-28, p. 5; Exh. 325-34; Exh. 327-84; Exh. 327-140, p. 4), or would require the use of a computer to analyze statistical trends in audiogram results (Exh. 327-135, p. 7; Exh. 325-48, Exh. 327-22, p. 3; Exh. 327-151, pp. 10-11).

OSHA agrees that defining the STS in a manner that requires computer analysis or extensive computation will not encourage voluntary compliance, and will additionally place a disproportionate burden on small and medium-sized employers. The Agency also believes, after a thorough review of the rulemaking record, that the January amendment's STS definition might require unnecessarily complex calculations and might prove difficult to administer because the definition differs for employees who have previously experienced STS and those who have not.

The August document (46 FR 42622) continued the interim stay on the definition of STS, noting that OSHA had received many comments requesting the Agency to reconsider this important definition (Exh. 325-274; Exh. 325-268). The Agency has reviewed the comments

²⁷ For example, according to W. Carey, Chocolate Manufacturer's Association, this criteria resulted in medical referrals for 30% of the non-noise exposed population and 75% of the noise exposed population (Tr. Vol. II, p. 299, March 24, 1982).

in the record thoroughly and has reevaluated the available evidence pertaining to a definition of STS. The great majority of comments supported the inclusion of a standardized definition of STS in any revised hearing conservation amendment promulgated by the Agency (Exh. 326-42, p. 13; Exh. 326-49, p. 3; Exh. 327-13, p. 5; Exh. 329-16, p. 8; Exh. 331-33; Exh. 327-109; Tr. Vol. V, p. 270, March 29, 1982; Exh. 327-89, p. 6).

The STS concept is essential to the proper working of any hearing conservation program because, as R. F. Boggs of Organization Resources Counselors noted, those conducting audiometric examinations need to have a "flag" to indicate when additional testing or evaluation is needed (Exh. 327-98, p. 15). Further, a standardized definition of STS permits both the seriousness of an employee's hearing loss and the effectiveness of an employer's hearing conservation program to be evaluated and monitored (Exh. 327-66, pp. 48-49; Exh. 327-89, p. 6; Exh. 327-94, p. 3; Exh. 327-99). R. G. Wieneck, of General Motors, summarized the need for a standardized definition of STS by describing it as the benchmark for evaluating audiograms to determine whether hearing is being conserved (Exh. 327-99). Margaret Seminario of the AFL-CIO also pointed out that the absence of a standardized definition would mean that "the level of employees' protection will be highly variable * * * in direct conflict with OSHA Act requirements to set standards that are protective of employee's health" (Tr. Vol. V, p. 270, March 26, 1982).

However, as the American Council of Otolaryngology emphasized (Exh. 327-152, p. 5), it is important to distinguish between threshold shifts defined as significant, which merely trigger in-house hearing conservation program activities such as providing employee training and hearing protectors, and a criterion used for medical referral. As the Council stated, STS should be defined in a way that will detect the least amount of hearing loss in excess of test-retest variability, while otologic referral criteria are intended to detect substantial abnormalities * * * (Exh. 327-152, p. 5). In accordance with these and other comments and recommendations, OSHA reaffirms the need for a standardized definition of significant threshold shift²⁸ in the

hearing conservation amendment. Correctly identifying standard threshold shifts will enable employers and employees to take corrective action so that the progression of hearing loss may be stopped before it becomes handicapping. Moreover, a standardized definition of STS will ensure that the protection afforded to exposed employees is uniform in regard to follow-up procedures.

After much review and reconsideration OSHA reaffirms its position on the ideal criterion for STS which was articulated in the January 16, 1981 promulgation (See 46 FR 4144). The criterion must be sensitive enough to identify meaningful changes in hearing level so that follow-up procedures can be implemented to prevent further deterioration of hearing but must not be so sensitive as to pick up spurious shifts (sometimes referred to as "false positives"). In other words, the criterion selected must be outside the range of audiometric error. Thus, while the ultimate goal of the hearing conservation amendment is to identify and retard hearing loss, this cannot be done effectively if many workers are falsely identified as having threshold shifts when they do not. Falsely or incorrectly identifying large numbers of workers for follow-up procedures is not only costly and unnecessary but as Jack Shampson of Impact Hearing Conservation, Inc. pointed out, large numbers of incorrect identifications will cause both labor and management to lose confidence in their hearing conservation program (Exh. 375, pp. 24-25). Therefore the definition of STS must reflect a careful balancing between these competing considerations.

More than 40 different definitions of STS were recommended to OSHA by various individuals, groups, and organizations in the comments received subsequent to the publication of the January amendment. The most important of these are discussed below.

The definition of STS included in OSHA's Field Operations Manual was recommended by several commenters (Exh. 327-96, p. 12; Exh. 327-108, p. 9; Exh. 327-62, pp. 6-7; Exh. 327-79, p. 3; Exh. 327-88, p. 8); this defines STS as a change of 20 dB at any test frequency in either ear. These participants argued that adopting any other STS definition would make comparing past and future test results difficult (Exh. 327-108, p. 9) and further that the 20 dB criterion was "straight-forward, easy to use, and does not require complex comparisons from computer programs to assure compliance" (Exh. 327-98, p. 12). OSHA agrees that a single-frequency criterion

is simple to use and understand. However, J. L. McGuire [Acoustical Research Associates] argued that, " * * * employing a STS of 20 dB or greater for all employees does not protect the worker effectively" (Exh. 327-115, p. 2).

Both McGuire and J. Ropes of the Environmental Protection Agency (Exh. 327-94, p. 7) believe that a 20 dB criterion is too lenient because it allows too great a threshold shift to occur at individual frequencies before protective action is taken. Further, Drs. Larry and Julia Royster believe (Exh. 327-84, p. 170) that "Use of a 20 dB shift * * * would fail to protect female populations * * *".

OSHA agrees with these and other participants that the 20 dB at any frequency criterion will not provide necessary employee protection, since this definition of STS would permit an employee with a shift as great as 19 dB across the entire test frequency range to go untreated. In addition, OSHA does not find merit to the argument that using any but the 20 dB criterion will make pre-and post-amendment test comparisons difficult, since the audiogram itself, which is the record of actual hearing acuity, is not affected by the choice of definition and can be interpreted according to any definition.

Several organizations and agencies, including the Environmental Protection Agency (Exh. 327-94, p. 4), the United Steelworkers of America (Tr. Vol. III, p. 129, March 25, 1982, the Amalgamated Clothing and Textile Workers Union (Exh. 362-H, p. 3), and the International Union of Electrical, Radio, and Machine Workers (Exh. 331-17, p. 9), have recommended that OSHA adopt the following definition of STS: a 15 dB shift at any frequency other than 500 Hz in either ear relative to the baseline audiogram, adjusted for presbycusis. Many commenters praised the simplicity of this definition (Exh. 327-68, p. 7; Exh. 327-94, p. 4; Exh. 331-17, p. 9) and argued that it is more protective than a single frequency 20 dB criterion (Exh. 327-94, p. 7; Exh. 331-17, p. 9); follow-up procedures are provided at an earlier point in time. Although the 15 dB at any frequency (other than 500 Hz) criterion has the advantage of simplicity, OSHA has not adopted it because it is not appropriate. The Agency believes that use of this definition would produce an unacceptable number of false positive identifications. Clearly more false positive identifications than the 20 dB criterion would result because the amount of shift required to identify employees and implement follow-up procedures is smaller.

²⁸As noted earlier, OSHA has decided to use the term standard threshold shift rather than significant threshold shift in the final version of the hearing conservation amendment.

Although the Royster's report, "Comparing the Effectiveness of STS Criteria for Industrial Hearing Conservation Programs," found that the 15 dB criterion had the most appropriate identification rate and the lowest false positive rate, the Royster's criteria was not the same as that recommended by the commenters. The Royster's criterion required that the 15 dB shift occur on two successive audiometric tests rather than on just one (see Exh. 378, pp. 1-2). This criterion would mean that employees would not receive appropriate follow-up attention after their annual audiograms showed STS until a subsequent audiogram confirmed the initial STS. Since the audiometric testing is only required annually, in some cases this could result in the delay of follow-up procedures for as long as three or more years (Exh. 387, pp. 3-10). OSHA does not believe that this criterion adequately protects the employee. When the Roysters evaluated the effectiveness of a 15 dB shift once (as opposed to twice) at the appropriate test frequencies, they came up with a very high percentage of false positives and a relatively low percentage of appropriate identifications (Exh. 366, pp. 53, 63). It is clear therefore that using a 15 dB shift (once) will not be as effective as other criteria in effectuating the purposes of the hearing conservation amendment.

A number of commenters (Exh. 327-91-D, p. 5; Exh. 327-20, p. 5; Exh. 327-96, p. 4) advocated multi-level definitions, which specify different shifts at different frequencies. These definitions usually are relatively stringent for the lower frequencies and more lenient for the higher frequencies (see Exh. 327-96, p. 4; Exh. 327-98, pp. 12-13; and Exh. 327-122, p. 7). For example DuPont, the American Textile Manufacturers Institute and the American Paper Institute, recommended that OSHA adopt the National Institute for Occupational Safety and Health (NIOSH) definition of STS (Exh. 372-91; Exh. 327, p. 148; Exh. 327-20, p. 5). The NIOSH criterion is a 10 dB or greater shift at 500, 1000, or 2000 Hz, a 15 dB shift at 3000 Hz, and a 20 dB shift at 4000 or 6000 Hz in either ear relative to the baseline audiogram. Julia Phillips, speaking for the DuPont Company, asserted that this criterion is reasonable and will permit employers to distinguish between an STS caused by presbycusis and one caused by occupational exposure (Exh. 327-91-D, pp. 4-5). However, J. Ropes of the Environmental Protection Agency's Office of Noise Control Programs stated that a STS criterion using multiple level and frequency measurements, i.e., different

thresholds at different frequencies, does not provide any additional diagnostic information and may interfere with early detection of hearing loss (Exh. 327-94, p. 7). Moreover such a definition which targets different amounts of hearing loss at different frequencies is somewhat complicated by its very nature.

Many commenters advocated that OSHA adopt a simple to understand and easy to use definition. For example, D. C. Gasaway, an Air Force hearing specialist with many years of experience, advised that " * * * [the method selected] by OSHA [should] be a simple, uncomplicated, numeric method that can be easily understood and used by those who will actually conduct the task" (Exh. 327-66, p. 65). OSHA believes that a definition of STS that specifies different hearing thresholds for different frequencies may be too complex and therefore will be subject to error in field and industrial use. In addition, many commenters have pointed out that any formula specifying a shift of only 10 dB in individual frequencies will be very likely to produce false positive identifications (Exh. 327-151 and 327-152, p. 10; Exh. 327-62, p. 7; Exh. 327-98, p. 12). Therefore, OSHA has decided not to adopt the NIOSH definition described above.

A large number of companies and organizations, including the Chemical Manufacturers Association (Exh. 326-54, p. 2), the Dow Chemical Company (Exh. 327-76, p. 2), and the Monsanto Company (Exh. 326-49, p. 3) urged OSHA to define STS in accordance with "the American Academy of Otolaryngology's (AAO) definition." These participants mistakenly believed that the AAO's STS criterion was: a shift of more than 15 dB at 500, 1000, or 2000 Hz, more than 20 dB at 3000 Hz, or more than 30 dB at 4000 or 6000 Hz (Exh. 326-54; Exh. 327-76; Exh. 326-49). However, the AAO's successor organization, the American Council of Otolaryngology, emphatically states (Exh. 327-151) that this criterion is intended to be used only for otologic referrals; it is not suitable for use as an STS criterion to trigger hearing conservation program follow-up procedures. According to the Council (Exh. 327-151, p. 4), "[This criterion] * * * can be used to select those workers who are most likely to have *non-occupational hearing loss* for referral for otologic evaluation" [italics added]. Since OSHA is concerned in this amendment with occupationally induced rather than non-occupationally induced hearing loss, and is not

specifically addressing other otologic disorders, adoption of this criterion would be inappropriate for the purposes of the hearing conservation amendment.

The three STS criteria specifically considered above (that is: 20 dB any frequency; 15 dB at any frequency from 1000 Hz to 6000 Hz; and the NIOSH criteria) and the OSHA January 16, 1981, criterion have a common feature. All indicate that a STS has occurred when a hearing loss exceeds a certain value as measured at a single frequency. Although the specifications differ for each definition, all have the characteristic of having a high false positive rate. This is caused, in part, by intrinsic variation of the audiometric testing instrumentation. As a result, a large hearing loss might be measured at only one frequency which would, by the nature of the STS criterion, give the illusion that an STS has occurred. If the audiogram is taken again, the hearing loss measured at that frequency may not be as large as previously measured, and therefore no real STS has occurred. The initial observation that an STS occurred was thus due only to the instrumentation and testing variability and the nature of the STS criterion.

OSHA believes that any definition that is triggered by a specified amount of hearing loss at a given frequency is more likely to produce false positives than a definition that averages hearing levels over a number of frequencies. For example, with the two single number criteria considered above (15 dB at any test frequency or 20 dB at any test frequency) as well as the different level for different frequency NIOSH definition, a testing error at any frequency would trigger the prescribed follow-up procedures regardless of how improbable the results appeared to be.²⁹ Even where a very lenient criteria such as 20 dB is used, the flaws of this method are apparent: the criteria itself is not sufficiently protective and the defined change at any single frequency can trigger follow-up procedures. This is not necessarily a theoretical problem. The American Council of Otolaryngology—Head and Neck Surgery (ACO) and the American Academy of Otolaryngology (AAO) reported that in a study of 260 aluminum and chemical workers, 19.6% of the test population had shifts of 20 dB or more, whereas nearly that many (16.15%) had changes toward better hearing (negative shifts) of 20 dB or more (Exh. 327-151 and Exh. 327-157, p. 13). The ACO concludes that this problem is due to the

²⁹ Audiograms showing large shifts at only one frequency might be considered questionable.

use of an STS definition that specifies "any frequency, either ear," and recommends that the definition of STS adopted require that hearing levels be averaged over several frequencies to avoid this problem (Exh. 327-151, pp. 12-14).

In addition, a number of commenters have testified that averaging shifts over adjacent frequencies minimizes normal test error (Exh. 327-150, pp. 1-2; Exh. 327-151, p. 10; Exh. 327-152, p. 10; Exh. 376A, p. 4). Acoustician W. Dixon Ward, on behalf of the American Iron and Steel Institute, argued "Any multiple frequency criterion has an advantage over a single frequency criterion because random errors will tend to cancel each other" (Tr. Vol. III, p. 225, March 25, 1982). The ACO-AAO reported that, even under clinical conditions, the probability of exceeding a testing error of 10 dB³⁰ at a single frequency could be as great as 56%, assuming that the measurement of all audiometric frequencies varied independently (Exh. 327-151 and 152, p. 10).³¹ Test-retest variability would probably be even greater in industrial settings.

Dr. R. A. Dobie suggested using the following criteria for STS: a change for the worse of 10 dB or more in the pure-tone average at either 500, 1000, and 2000 Hz or at 3000, 4000 and 6000 Hz, in either ear (Exh. 327-152, p. 11). Using this definition, the technician takes 12 measurements (six frequencies, two ears), after which the average shift for the lower three frequencies (500, 1000, and 2000 Hz) is calculated, followed by the average shift for the three upper frequencies (3000, 4000, and 6000 Hz). If an average shift of 10 dB or more is detected for either the upper or the lower group of frequencies, the audiogram is deemed to demonstrate STS.

This definition appears to be protective and has several other advantages as well. According to Dr. Dobie, this STS definition is sensitive both to early noise-induced hearing loss

and the later, more severe losses, as well as to other otologic conditions (Exh. 378, p. 1). In addition, the definition employs an averaging technique, which discourages false positive identifications and reduces the degree of testing error commonly associated with the use of a single level at any frequency definition.

On the other hand, this definition appears to have been articulated only recently and has been tested on only one industrial population in one study. Because relatively little information on Dr. Dobie's investigation has been submitted to the record, it is difficult to compare his results with those of the Roysters or other investigators. Moreover, the definition is relatively complicated, requiring a number of computations and comparisons and it may be difficult for people to understand and use. OSHA believes that any formula that is difficult may contribute to technician error and may ultimately result in a less effective hearing conservation program (cf Exh. 327-66, pp. 51-54). While one group, the American Academy of Otolaryngology and the American Council of Otolaryngology (AAO-ACO) has endorsed the definition, it is generally unknown to professionals involved in industrial hearing conservation and untried by professionals in the hearing conservation community. In view of these shortcomings and the fact that another acceptable definition of STS exists (see discussion below), OSHA has decided not to adopt this definition.³²

OSHA has decided to adopt the following definition of STS: an average shift of 10 dB or more at 2000, 3000 and 4000 Hz relative to the baseline audiogram in either ear. This definition is similar to the definition originally proposed in 1974 (see 39 FR at 37775, October 24, 1974)³³ and meets all the criteria for an appropriate definition of STS. The formula is sensitive enough to give an early indication of noise-induced hearing loss because of the frequencies used. The importance of using 4000 Hz,

which is generally considered to be one of the frequencies which is affected by noise earliest and most severely (see 46 FR at 4085), is clear. The hearing threshold level at 3,000 Hz tends to follow the level at 4,000 Hz fairly closely (46 FR 4088; Exh. 17, p. 12; Exh. 12, Appendix 10; and Exh. 327-94, p. 7) and is also severely affected by noise damage. Hearing loss at the 2,000 Hz frequency usually begins after the higher frequencies have been affected; because of this phenomenon, the 2,000 Hz frequency is an indicator of additional hearing loss in employees who have already lost some hearing. As noted previously (46 FR 4082), the 2,000 and 3,000 Hz frequencies are very important for the understanding of speech, and should therefore be included in any definition of threshold shift that will trigger follow-up procedures.

The OSHA STS definition is sufficiently restrictive to locate meaningful shifts in hearing yet not so stringent that it will result in the implementation of unnecessary follow-up procedures for numerous employees. In addition, the OSHA definition requires averaging hearing levels at adjacent frequencies which reduces the effect of testing errors at single frequencies (Tr. Vol. V, pp. 24-25, March 29, 1982).

The OSHA definition has a number of additional advantages. As noted above, many commenters urged OSHA to adopt a simple formula and praised the simplicity of the 2,000 and 3,000 and 4,000 Hz average criterion (Exh. 376A, p. 4; Exh. 327-13, p. 3; Tr. Vol. I-B, pp. 192 and 198, March 23, 1982; Exh. 349-1, p. 11; Exh. 327-142, p. 5).

Further, the average shift of 10 dB at 2,000, 3,000, and 4,000 Hz definition has been "field tested" by industrial audiologists and many industry groups (Exh. 376A, p. 3; Exh. 327-105, p. 6; Exh. 327-138, p. 6), and it has also been systematically compared to other STS formulas. In a large study of military and civilian Air Force employees, a number of definitions were tested and the 2,000, 3,000, and 4,000 Hz criterion identified a reasonable number of STS cases compared to the number tagged by other definitions (Exh. 329-50C, Tables 2-4). In addition, the Royster study was essentially favorable to the definition of STS which OSHA is adopting. The Royster study found that an STS of 10 dB or greater average at 2,000, 3,000, and 4,000 Hz produced the lowest annual percentage of unnecessary identifications of the various definitions evaluated. In addition, the Roysters found that the OSHA definition appropriately identified a higher

³⁰ The January amendment states that the range of audiometric error is ± 5 dB. This value, that is ± 5 dB, reflects the precision and accuracy of the audiometric instrumentation. Variability in audiograms also result from test subject response and slight procedural changes from one test to the next, which increases the variability greater than ± 5 dB. OSHA recognizes that false positives are caused by this variability as well as real, but temporary, changes in hearing levels (generally referred to as a temporary threshold shift).

³¹ Dr. Ward cited a study by Berger, Royster and Thomas (Exh. 266A) in which the use of the 2,000, 3,000 and 4,000 Hz criterion rather than the single-number 20 dB criterion reduced the percentages of workers whom he judged "incorrectly" identified as having STS by more than half (Tr. Vol. III, p. 225, March 25, 1982).

³² Several commenters have noted (Exh. 331-40; pp. 4-5; Exh. 327-66 pp. 60-65) that the 6000 Hz frequency is particularly susceptible to test variability. OSHA believes that averaging hearing levels at 3000 Hz, 4000 Hz and 6000 Hz in this definition will reduce the impact of the 6000 Hz test variability, but does not know the magnitude of the effect. This issue was not addressed at the hearing. OSHA believes that adopting an STS definition that contains the 6000 Hz frequency involves unnecessary speculation regarding the number of resulting false positives.

³³ In 1974 OSHA proposed that STS should be defined as an average shift of more than 10 dB at 2000, 3000 and 4000 Hz in either ear, relative to the baseline audiogram.

percentage of employees suffering STS than most of the other definitions studied (Exh. 366, pp. 61-62).³⁴ Because of its concentration on the frequencies that are the earliest or the most severely affected by noise, the resulting high degree of appropriate identifications for follow-up and the simplicity of the definition, OSHA believes that the definition of STS which it is adopting today will contribute more to the effectiveness of hearing conservation programs than any other definition considered.

The definition that OSHA has decided to adopt, that is, an average change in hearing level of 10 dB or greater at 2,000, 3,000, and 4,000 Hz is a slight change from the STS definition proposed in 1974 which included average shifts *greater than* 10 dB at these same frequencies. This change is in recognition of the fact that the definition as originally proposed was not sufficiently protective of employee hearing in all circumstances. (See, e.g. Exh. 9, pp. 37, 41, 51; Exh. 5, p. 43802; Exh. 51, pp. 10-11; Exh. 80, p. 2; Exh. 82, attach. 1, p. 2). There are some instances where large shifts in hearing level could occur in the highest test frequencies (4,000 and 6,000 Hz), with little or no change in hearing level occurring in the middle frequencies. While shifts of this magnitude are not common, they may occur in noise-sensitive individuals especially in the early stages of noise-induced hearing loss. Under the 1974 proposed definition, individuals suffering shifts as large as 30 dB at 4,000 Hz would not be identified provided that hearing thresholds at the lower frequencies had not shifted. Such individuals should be identified so that protective action can be taken. The change in the STS definition will allow for earlier identification of individuals at risk and earlier intervention in the process of hearing deterioration for these individuals.³⁵

In addition to the fact that the OSHA STS criteria is more protective than that originally proposed, this change will clarify the Agency's intention and will help avoid some of the confusion suffered in the past between self-recording and manual audiometers (see 46 FR 42628, 42629, August 21, 1981).

The definition of STS contained in the January amendment is being revoked. Further evaluation of the record has convinced the Agency that the original

definition was too complex to be workable especially in view of the extremely diverse workplaces and working populations covered by the amendment.

While some may feel that even the changed definition is not protective enough because under certain circumstances a shift of up to 25 dB could go untreated, OSHA believes that the definition of STS which it is adopting is as protective of the general population as the January, 1981 STS definition which was subject to the same flaws as all single frequency definitions. The ACO-AAO has labeled the single frequency criteria "equally vulnerable" and noted that:

"If set at practical levels, e.g., 20 dB, they allow [to go undetected] broad shifts—up to 15 dB for the entire audiogram—which * * * are more common than isolated large shifts and are more significant both medically and in terms of communication handicap" Exh. 327-151, p. 14; Exh. 327-152, p. 14).

In many ways the new definition is a better definition than the original STS definition; it provides the necessary protection but is more cost effective in that it reduces the number of false positive identifications. Therefore, in view of all of the relevant factors, the new OSHA definition of STS is the most appropriate and consistent with the purposes of the hearing conservation amendment.

The standard requires that audiograms include as a minimum measurements taken at 500, 1000, 2000, 3000, 4000 and 6000 Hz, while the STS criterion only uses the 2000, 3000, and 4000 Hz frequencies, OSHA believes that requiring the measuring of these other frequencies adds other benefits justifying its inclusion in the standard. Testing at all frequencies is important to have a complete record of the employee's hearing ability and may be invaluable to the audiologist or physician upon referral.

Failure to do so might mean that medical problems that could easily be treated might be ignored.³⁶ OSHA believes that testing these frequencies constitutes good industrial hygiene and medical practice. Moreover, testing at frequencies other than those specified in the STS criteria will impose minimal burden the employer.

³⁶Further, some employers may choose to use the American Academy of Otolaryngology's otologic referral definition, in addition to this standard's definition of STS, to provide employee protection against medically caused hearing loss. Since the amendment still requires testing at all the usual test frequencies, employers will have little difficulty applying this definition.

Aging

OSHA has also decided, after careful consideration of the data in the record, to permit employers to interpret audiograms using a presbycusis or aging correction before determining whether an STS has occurred. Many commenters (Exh. 327-106; Exh. 327-105; Exh. 327-103; Exh. 327-100; Exh. 327-101; Exh. 327-94; Exh. 327-147) urged the Agency to allow presbycusis correction factors to be used. A substantial number of comments recommended the use of an age correction, many stating that hearing loss can occur from aging, non-occupational noise, and other factors, and such hearing loss should not be considered part of a significant threshold shift within the context of the OSHA standard (Exh. 14-110, p. 2; Exh. 14-150, p. 2; Exh. 14-160, p. 2; Exh. 14-188, p. 1; Exh. 14-200, p. 1; Exh. 14-215, p. 3; Exh. 14-248, p. 3).

The NIOSH criteria document (Exh. 1, pp. 1-14 to 1-17, III-6) recommended adjusting the baseline audiogram for hearing loss that occurs naturally due to the aging process. The adjusted baseline could then be subtracted from the most recent annual audiogram in order to determine whether or not an STS had occurred. If employers wish to correct for aging, the amendment directs them to make the adjustment to the annual audiogram rather than to the baseline, so that the baseline will not be changed by mistake. The NIOSH presbycusis values are similar to those of other well known presbycusis data bases. Although there may be slight variations at individual frequencies, the NIOSH values are generally consistent with other presbycusis data such as the U.S. Public Health Service data, and those used by Robinson and Burns, and by Passchier-Vermeer (found in "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", (Exh. 310, p. 31)). When applying an age correction, the most recent audiogram is corrected according to the procedures outlined in Appendix F. In the appendix, OSHA has adopted the procedures and the age correction tables used by NIOSH in the criteria document (Exh. 1, pp. 1-14 to 1-17).

OSHA believes that these correction factors will aid in distinguishing between occupationally induced and age-induced hearing loss. This is particularly important because the pattern of hearing loss due to aging closely resembles that of noise-induced hearing loss. Therefore, although the Agency agrees with D. C. Gasaway that

³⁴The only criteria that fared better was 15 dB twice.

³⁵In addition, it should be noted that both the Air Force and the Roysters used the OSHA definition rather than the proposed criteria to analyze their data (Exh. 329-50B, Exh. 329-50C; Exh. 366). Therefore the change is consistent with the findings of these studies.

requiring the use of a correction factor may complicate calculation procedures (Exh. 327-667, pp. 66-67) and cause some errors, we believe that professional supervision of the hearing conservation program will ensure that audiometric technicians understand how to use the age-correction chart, included in Appendix F of this revised amendment. Further, since the use of presbycusis factors is discretionary, employers are free to use OSHA's STS criterion without a correction for the effects of age. The Agency believes that allowing the consideration of the contribution of aging to hearing loss is both reasonable and appropriate and will allow the employer to discern how well the hearing conservation program is working by determining the amount of hearing loss attributable primarily to aging. Therefore, the stay on Appendix F is being lifted.

Determination of Work Relatedness

The January amendment required that the professional reviewing employee audiograms determine whether any significant threshold shifts detected were caused by occupational noise exposure. The preamble explained that under most circumstances the professional supervising the hearing conservation program would refer the employee for medical evaluation to ascertain whether the hearing loss was work related, unless the employer was willing to record the hearing loss as such on the OSHA Form 200, Log of Occupational Illnesses and Injuries (see 46 FR 4146). The preamble stated that in most cases, occupational hearing loss constituted the major component of a worker's hearing loss, because the average person generally spends more time at work than in recreational activities that may also cause hearing loss, such as hunting.

The August document continued the administrative stay on this requirement pending review of the many comments objecting to this provision. Commenters stated that in some cases it is very difficult, even for an audiologist or otolaryngologist, to determine the cause, or work relatedness, of a significant threshold shift because of the similarity between an occupational and nonoccupational audiometric hearing loss configuration on the audiogram (Exh. 325-130; Exh. 325-239; Exh. 325-248; Exh. 325-96). Specifically, the Agency stayed the paragraphs requiring determination of the work-relatedness or cause of a significant threshold shift, and the paragraph requiring employers to record the existence of a significant threshold shift on the OSHA Form 200 when the professional reviewer

determines that the shift is work related. OSHA asked for comments and information regarding the necessity of determining the cause of a significant threshold shift to protect a worker's hearing and on methods for distinguishing between occupational and non-occupational hearing loss.

A number of participants claimed that this requirement would not offer additional protection to workers and that determining causality is irrelevant to the effectiveness of the hearing conservation program (Exh. 327-79, p. 2; Exh. 327-90, pp. 4-5; Exh. 327-104, p. 13; Exh. 327-120, p. 3).

"In any case, it is not necessary to determine the cause of a significant threshold shift in order to take the necessary steps to protect a worker's hearing. When significant hearing loss is discovered, regardless of the source, the employee should be informed and counseled regarding the effects of noisy activities both on and off the job. Ear protectors should be fitted and the employee trained in their use and care. If ear protectors are currently in use, they should be checked for fit and attenuation" (Exh. 327-108, p. 8).

Others agreed with this position (Exh. 327-141, p. 4; Tr. Vol. II, p. 109, March 24, 1982; Exh. 327-143, p. 5).

OSHA does not regard the determination of STS causality as central to the effectiveness of the hearing conservation program. STS is a means of identifying a change in hearing that triggers certain follow-up actions to prevent further change. Once STS is found, the same actions are required, whether or not the STS is work related. The determination of causality, therefore, does not enhance hearing protection as far as the hearing conservation program is concerned. (See generally the discussion of this issue in 46 FR 4146.) Therefore, the requirement to determine the causality of the STS is being revoked. In addition, OSHA has determined that the paragraph directing employers to record STS's on the OSHA Form 200 is unnecessary. Employers are already required pursuant to 29 CFR 1904.2 to record work related injuries and illnesses on the OSHA Form 200. Since this reiteration of the employer's obligation is duplicative, the requirement as stated in the hearing conservation amendment is hereby revoked.

Retest Audiogram

The January amendment required employers to provide employees with a retest audiogram within 60 days if the annual audiogram showed that the employee had a significant threshold shift (STS). The preamble explained that the purpose of the retest was to determine whether the significant

threshold shift was permanent (46 FR 4144). In August, the stay of the retest requirement was continued in response to comments concerned with the difficulty of determining the permanency of an STS (Exh. 325-57, p. 26). In addition, many persons objected to the shortness of the time period for the retest, asserting that the definition of STS contained in the January amendment resulted in many persons being falsely identified as having an STS, thereby requiring more retesting than necessary (Exh. 325-48, p. 4; Exh. 325-57, p. 2). Moreover, it was claimed that retesting was burdensome for those employers using the services of a mobile test van (Exh. 325-130, p. 2).

OSHA also requested information on whether retesting within a short period of time to confirm the presence of a STS was necessary to protect employee hearing and, if retesting was necessary, whether it was appropriate to require retesting within 60 days. OSHA received many comments in response to this request for information. Several commenters stated that a retest audiogram and the interval to perform any retest audiogram should be left to the discretion of the professional supervising the hearing conservation program and should not be firmly fixed by the standard (Exh. 327-101, p. 6; Exh. 327-154, p. 6; Exh. 327-141, p. 4; Exh. 329-22, p. 5; Exh. 326-15, p. 7; Exh. 327-20, p. 5; Exh. 327-121, p. 3; Exh. 327-98, p. 14). Dr. S. White of the American Speech-Language-Hearing Association explained that he favored this more flexible approach because it was not possible to determine whether the STS was permanent on the basis of a test performed in an industrial setting by a technician. According to Dr. White, such a determination could only be made after a diagnostic evaluation had been performed in a clinical setting. For these reasons, Dr. White recommended that professionals in charge of the program be allowed to decide, on a case-by-case basis, whether a retest or referral was appropriate (Exh. 327-154, p. 6; Tr. Vol. IV, p. 46, March 26, 1982).

Richard Crewdson [Industrial Health, Inc.] also observed that:

"* * * the majority of shifts found in this way are artifacts * * * caused by the normal inaccuracies inherent in audiometric testing * * * the supervisor [should] determine the necessity to retest" (Exh. 327-83, p. 3).

Other commenters claimed that it was not necessary to perform a retest or to determine whether an STS is permanent since simply identifying an STS triggers protective action (Exh. 327-28; Exh. 327-61; Exh. 327-62). In addition, the costs

and complications of scheduling retest audiograms, especially for employers who contract their audiometric work out to mobile van services or whose firms are located in remote areas, were emphasized by several commenters (Exh. 327-146, pp. 5-6; Exh. 327-120, p. 3; Exh. 329-22, pp. 4-5).

Despite these considerations, however, representatives of several companies reported they would perform a retest audiogram after an STS was identified even if such a requirement was not mandatory. In fact, J. Stenmark of the American Iron and Steel Institute asserted that employers will usually elect to retest because in many cases the shift will be caused by subjective problems or testing artifacts (Exh. 327-105, p. 5). Dr. McCurdy of the American Council of Otolaryngology thought that retesting would reduce the costs of the hearing conservation program by eliminating the need for further preventive action if the retest showed that the shift was not persistent (Exh. 327-151, p. 7). In a similar vein, a number of commenters suggested that retesting reduces the number of unnecessary referrals (Exh. 327-57, p. 2; Exh. 329-8, p. 2; Exh. 327-12, p. 3; Exh. 327-135, p. 5; Exh. 329-14, p. 6; Exh. 327-68, p. 5; Exh. 326-21, p. 3; Exh. 327-86, pp. 34-43). Richard Boggs of Organization Resources Counselors and H. M. Williams of the American Telephone and Telegraph Company also believed that most employers would wish to retest to avoid unnecessary referral fees (Exh. 327-98, p. 14; Exh. 327-89, p. 5).

Several participants indicated that although they felt a retest was necessary, OSHA should allow employers more time to conduct retests, especially if mobile van test services were used (Exh. 327-20; Exh. 327-84A). A few commenters suggested that the retest interval, rather than the decision to retest, should be determined by the professional supervising the program, and others recommended that a flexible time period be permitted for employers using mobile vans to obtain retest audiograms (Exh. 327-139, p. 7; Exh. 327-138, p. 5; Exh. 327-142, p. 4; Exh. 327-140, p. 4; Exh. 327-106, p. 5; Exh. 327-103, p. 5; Exh. 327-80, p. 5; Exh. 327-81, p. 27).

After careful consideration of the evidence in the record, OSHA has concluded that it is not necessary to require employers to conduct retest audiograms. Deleting the retest requirements from the hearing conservation amendment would not in any way diminish employee protection. However, a number of participants

indicated that they wished to conduct retest audiograms to validate the results of earlier audiograms showing STS and did not wish to implement follow-up procedures until this had been accomplished. The stay of the retest provisions had the effect of disallowing this approach in many cases because of time constraints. OSHA has decided to amend the retest provisions to allow but not require a retest within 30 days where the annual audiogram shows that an employee has suffered a standard threshold shift. An employer wishing to retest under these conditions may consider the retest audiogram as the annual audiogram. Therefore, if a valid retest audiogram does not show that the employee has suffered a STS, no follow-up procedures need be implemented. This change will permit employers and the professionals who direct their hearing conservation programs to decide, on a case-by-case basis, whether a retest audiogram is necessary or desirable.

In response to comments received after publication of the January amendment, the stay of the word "permanent" before the phrase "significant threshold shift" in the follow-up procedures section of the audiometric testing provisions was continued in the August document.³⁷ Some commenters have argued that making the distinction between permanent and temporary threshold shifts is irrelevant in relation to a hearing conservation program in that the employer should provide protection as soon as any STS is discovered. (Tr. Vol. I-B, pp. 212-213, March 23, 1982; Tr. Vol. II, pp. 108-109, March 24, 1982). This would be true of course in the absence of a retest. OSHA believes that labeling the STS as permanent is not important in this context and may even be misleading. The term "permanent" implies that shifts identified on successive audiograms are never subsequently determined to be temporary. There is ample evidence in the record to indicate the variability of

³⁷ As originally promulgated, paragraph (j)(8)(iv)(a) and (b) read:

(iv) If a significant threshold shift has been determined to be *permanent* on the basis of a retest audiogram or an annual audiogram conducted after 14 hours without exposure to workplace noise, the employer shall:

(a) Inform the employee in writing, within 21 days of the determination, of the existence of a *permanent* significant threshold shift;

(b) Refer the employee for a clinical audiological evaluation or an otological examination, as appropriate, if additional testing is necessary to determine the cause of the *permanent* significant threshold shift, or if the employer suspects that a medical pathology of the ear (as defined in Appendix I) is caused or aggravated by the wearing of hearing protectors. (Italics added)

audiometric test results (Exh. 327-12, p. 3; 327-19, p. 2), and thus the artifactual nature of many threshold shifts. The word "permanent" as it relates to the term "STS" has therefore been deleted. Accordingly, an STS subsequently confirmed by another audiogram is termed "persistent" rather than "permanent" in the revised amendment.

Follow-up Procedures

The January amendment permitted employees initially identified as having STS to discontinue the wearing of hearing protectors if retesting showed that the STS was not permanent, unless such employees were required to wear hearing protectors anyway because they were exposed over the permissible exposure level, a TWA of 90 dB. Since the retest requirement of the January amendment has been revoked, the language of the paragraph³⁸ has been amended to be consistent with these revisions, and the provision now reads "subsequent tests" rather than "retesting." The provision would not permit employees exposed to an 8-hour TWA of less than 90 dB to discontinue the use of hearing protectors "if subsequent audiometric testing of an employee * * * indicates that the standard threshold shift is not *persistent* * * *" (emphasis added).

Revised Baseline Audiograms.

The January amendment³⁹ required revision of the baseline audiogram when a subsequent audiogram revealed an improved hearing threshold at two or more test frequencies with respect to the baseline audiogram or when a subsequent audiogram revealed a permanent significant threshold shift. In either case, the baseline was revised by substituting the annual or retest audiogram for the original baseline audiogram. In the case of an improved hearing threshold, the preamble explained that the revised baseline would more closely resemble the employee's actual non-noise exposed baseline. Revising the baseline after an STS had been identified would prevent the same STS from being identified repeatedly for the same employee.

After publication of the January amendment, the Agency received requests for clarification of the amount of improvement in thresholds needed to

³⁸ As originally promulgated, paragraph (j)(8)(iii) read: If *retesting* of an employee reveals that the significant threshold shift is not *permanent*, the use of hearing protectors by that employee may be discontinued, unless the employee is required to wear hearing protectors pursuant to paragraph (b)(1) of this section. (Italics added)

³⁹ 29 CFR 1910.95(j)(9) (i) and (ii), 46 FR at 4163.

trigger a revision of the baseline and methods of handling the situation in which an annual audiogram shows improvement at some frequencies and losses at others. To consider these comments, the Agency continued to stay on this requirement in the August Federal Register document.

OSHA received a variety of comments and opinions on revising the baseline following the continuation of the interim stay. Many comments supported the January amendment's requirement to revise baselines when improved thresholds or an STS occurs (Exh. 329-14, p. 6; Exh. 327-154, p. 6; Exh. 327-142, p. 4; Exh. 327-139, p. 7; Exh. 327-138, p. 5; Exh. 327-119, p. 3; Exh. 327-105, p. 6; Exh. 327-101, p. 6; Exh. 327-102, p. 10; Exh. 327-103, p. 6; Exh. 327-98, p. 14; Exh. 327-94, p. 8; Exh. 327-89, p. 6; Exh. 327-53, p. 2; Exh. 326-21, p. 3; Exh. 327-84, p. 27). These commenters stated that if the baseline were not allowed to be revised when an STS occurs, the employee would be classified as having an STS on each subsequent audiogram, and the employer would repeatedly be required to institute follow-up measures. Dr. S. White of the American Speech-Language-Hearing Association maintained that baseline revision is essential for accurate audiogram comparison. He recommended that the original baseline be revised after a significant threshold shift when two successive annual tests confirm a change in hearing, either for better or worse (Exh. 327-154, p. 6). Other commenters also supported revising the baseline but favored different criteria for determining an improved hearing threshold (Exh. 327-119, p. 3; Exh. 327-115, p. 3; Exh. 327-105, p. 6; Exh. 327-102, p. 10; Exh. 327-98, p. 14; Exh. 327-35, p. 4; Exh. 327-29, p. 2; Exh. 327-84, p. 25; Exh. 327-142, p. 4; Exh. 327-139, p. 7; Exh. 327-138, p. 5). For example, some participants defined improvements as a shift for the better of 10 dB or more beyond any test-retest error. J. Morrill of Impact Hearing Conservation, Inc., believed that revising the baseline when STS occurs is only appropriate if a sliding scale STS criteria, such as that included in the January amendment, is used (Exh. 327-35, p. 4).

J. Shampan of Impact Hearing Conservation, Inc., reported at the OSHA hearing that his company intends to retest before revising the baseline to eliminate the problem of revising the baseline on the basis of a temporary threshold shift (Tr. Vol. V, p. 52, March 29, 1982). Other commenters supported revising the baseline only on the basis of a confirmed STS or a permanent threshold shift, implying that the

baseline should not be revised if a retest audiogram had not been performed (Exh. 327-98, p. 14; Exh. 327-103, p. 6; Exh. 327-139, p. 7).

Some commenters advocated revising baselines only when subsequent audiograms showed improved thresholds (Exh. 327-135, p. 6; Exh. 327-95, p. 8). Dr. W. G. Thomas of the North Carolina Memorial Hospital stated that employee hearing thresholds could improve by as much as 20 to 40 dB after the initiation of a hearing conservation program. Dr. Thomas stressed the importance of revising the baseline to reflect such an improved threshold because otherwise the initial baseline would be contaminated by temporary threshold shift, which would render any comparison of audiograms meaningless (Exh. 329-26, p. 2). D. C. Gasaway, a hearing conservation specialist, discussed the results of an Air Force study which had led him to conclude that:

" * * * negative [improved] threshold values greater than 10 dB (i.e., 15 dB or more) at 500 Hz and/or 6000 Hz should be used to require re-establishment of reference audiograms and/or negative differences of 10 dB or more at 1000 through 4000 Hz. This approach would be simplified further if only the differences (negative) at only 1000 through 4000 Hz, either ear, were used. If adopted, then negative values of threshold shift would * * * [be] equal to, or exceeding, 10 dB at two or more frequencies between 1000 and 4000 Hz, either ear. Under these conditions the reference audiogram should be re-established. Of course, the re-established reference should be accomplished only after the individual has been free from noise a minimum period of time * * * " (Exh. 327-66, pp. 46-47).

Other commenters stated that the baseline should be revised only when a significant threshold shift occurs and not when an improvement in hearing has occurred. These participants believed that revising the baseline when hearing improved would cause confusion, and require the use of a computer to track employee baselines (Exh. 329-18, pp. 6-7; Exh. 329-16, pp. 7-8).

Two commenters suggested that OSHA should require revised baselines for audiograms showing STS, but that a professional should decide whether to revise them after an improvement in hearing had occurred. D. McCurdy of the American Council of Otolaryngology explained that after a permanent significant threshold shift occurs it is no longer suitable to compare subsequent audiograms to the initial baseline since even if no further change occurred the reviewer would repeatedly identify the same shift. However, with regard to improved thresholds, he felt that the decision to revise the baseline should be

left to the discretion of the supervising professional since many variables, such as results of otologic referral, instrument calibration, and the test environment, must be considered. Dr. McCurdy also criticized the criterion for improved thresholds in the January amendment because he felt that a majority of audiograms would meet this criterion without showing a consistent change in hearing across different frequencies (Exh. 327-151, pp. 8-9). Dr. S. White of the American Speech-Language-Hearing Association also recommended that the professional determine the revision criteria for improved thresholds (Tr. Vol. IV, p. 72, March 28, 1982).

A number of other commenters also believed that the professional should be the one to decide whether it is necessary to revise the baseline either for STS or improved thresholds (Exh. 329-22, p. 5; Exh. 329-15, p. 6; Exh. 327-143, p. 6; Exh. 327-91, p. 29; Exh. 327-76, p. 10; Exh. 327-20, p. 5).

A few commenters objected to permitting any revision of the baseline at all (Exh. 327-120, p. 3; Exh. 327-108, p. 9; Exh. 327-106, p. 5; Exh. 327-71, p. 3; Exh. 327-69, p. 7; Tr. Vol. I-B, p. 244, March 23, 1982). Many felt that revisions will lead to confusion and tampering with audiometric records, and will not contribute to the overall hearing conservation program (Exh. 327-120, p. 3; Exh. 327-108). Some reasoned that the annual audiogram should be compared to the baseline as well as to any subsequent audiogram rather than revising the baseline (Exh. 327-71, p. 3) and another commenter recommended that noting the date of the change would be sufficient (Exh. 327-69, p. 7).

In light of the evidence in the record, OSHA has decided that an annual audiogram may be substituted for the baseline audiogram if the professional supervising the program determines that the employee has experienced a persistent STS or has shown a significant improvement in hearing acuity. The Agency agrees with the view expressed by Robert Connelly, an industrial audiologist with Audiometric Associates:

"Revising the baseline test would provide an effective means of monitoring hearing levels over time" (Exh. 327-119, p. 3).

In addition, OSHA agrees with Dr. McCurdy of the American Council of Otolaryngology (Exh. 327-151) and Richard Klinzing of the American Paper Institute (Exh. 329-22, p. 6), among others, that the professional supervising the employer's hearing conservation program can best determine when an annual audiogram should be substituted

for the baseline audiogram. For these reasons, the mandatory requirements in the January amendment concerning revision of the baseline audiogram have been restated in non-mandatory performance language. In addition, it should be noted that all audiograms must be retained for the length of employment of the affected employee. This revision of the provisions concerning revised baseline audiograms does not in any way permit the destruction of any original baseline audiograms.

Microprocessor Audiometers

The January amendment required audiometric tests to be conducted with equipment meeting the specifications of the American National Standard Specification for Audiometers, S3.6-1969. The preamble to the August Federal Register document (46 FR 42628) noted that although microprocessor audiometers were not specifically mentioned as acceptable instruments, they were allowed by the amendment if they meet the requirements of ANSI 3.6-1969. In August OSHA indicated it was considering adding language to the amendment explicitly permitting the use of this equipment. Two commenters, D. E. Rapp of Dow Chemical (Exh. 327-76) and H. T. Buelter of the American Center for Occupational Health (Exh. 329-95), requested that the Agency specifically permit the use of microprocessor audiometers in the revised amendment. OSHA agrees with these suggestions and is adding clarifying language to the provisions describing acceptable audiometric measuring instruments.

Background Levels in Audiometric Test Rooms

The January amendment required that, within two years, audiometric testing must be conducted in test rooms meeting the background sound pressure level specifications of Table D-1 in Appendix D. In the January amendment, Table D-1's specifications were essentially those of the American National Standard Institute's (ANSI) S3.1-1977 standard, except that the background sound pressure levels permitted at 500 Hz (27 dB) were higher than those of the ANSI standard (21.5 dB).

OSHA relaxed ANSI's requirement for a background sound pressure level of 21.5 dB at 500 Hz to 27 dB in response to data suggesting that this level could not be met at 500 Hz in industrial settings and that audiometric precision was not as important at 500 Hz as at other frequencies (see 46 FR 4148-4149). After publication of the January amendment,

OSHA received comments stating that the sound pressure levels in Table D-1 are not necessary and are not feasible for industrial audiometric testing programs. For example, some comments indicated that double-walled rooms would have to be used to meet the permissible background sound pressure levels (46 FR at 42628). The stay of the requirement that employers meet the specifications of Table D-1 was continued in August 1981. In the interim, employers conducting audiometric examinations have been required to meet the less stringent background sound pressure level specifications of Table D-2.

Many comments submitted since the August publication have addressed the issue of whether Table D-1 or Table D-2 is the most appropriate for industrial audiometric testing. Background sound levels required by Table D-1 are essentially the same as those specified in the ANSI S3.1-1977 standards, while Table D-2 was adopted directly from the older ANSI S3.1-1960 standard.

There is widespread agreement that the audiometric testing requirements of this amendment describe "industrial audiometry" rather than "clinical audiometry." Industrial audiometry consists of obtaining actual air conduction thresholds at specified frequencies. Paragraph (h)(1) of the amendment requires, in part, that audiometric test examinations consist of pure tone, air conduction thresholds, with test frequencies including as a minimum 500, 1000, 2000, 3000, 4000 and 6000 Hz. Clinical audiometry, however, is comprehensive, and includes, as a minimum, air and bone conduction threshold measurements at each frequency for the purpose of diagnosis and rehabilitation. Since this amendment does not require audiological diagnosis but rather only requires employee referral for a clinical audiological evaluation or an otological examination, under certain special circumstances, the audiometric test program is not considered a clinical program. Richard L. Stepkin, an industrial audiologist and President of Enviromed Corporation, best describes the difference between clinical and industrial audiometric testing:

"The best criteria for establishing differences between clinical and industrial audiometric test programs are by the types of tests performed. Industrial audiometric evaluations require only an air conducted threshold and nothing more. Clinical audiometry includes anything and everything beyond this process.

It should be noted that industrial audiometric threshold testing is not to be confused with "screening" programs. A

screening procedure is where the test is presented at one intensity level and it is an all or none response. Audiometric threshold testing requires the identification of threshold at the selective frequencies, as should be [done] in industry" (Exh. 327-56 p. 7).

Commenters who favored Table D-1 essentially paraphrased the rationale given in the January 16, 1981, preamble (46 FR 4148): background sound pressure levels in audiometric test rooms must be quiet enough to permit accurate threshold measurements (Exh. 327-62, p. 7; Exh. 327-137 B, p. 1; Exh. 331-17, p. 14; Exh. 376 A, p. 2; Tr. Vol. IV, pp. 143, 211, March 26, 1982; Tr. Vol. V, p. 22, March 29, 1982).

Dr. Francis I. Catlin [American Academy of Otolaryngology—Head and Neck Surgery] emphasized the Academy's concern. He asserted that the background sound pressure levels permitted by Table D-2 would result in a loss of ability to identify early hearing losses from hazardous noise exposures. At these levels, the hearing test program would only identify problems after employees have experienced significant hearing loss close to that of material impairment, or when the noise levels were high enough to produce temporary threshold shifts of more than 25 dB (Exh. 327-152, p. 19).

An overwhelming number of commenters recommended the use of Table D-2 rather than Table D-1, contending that Table D-2 is adequate for determining STS and for obtaining valid measurements (Exh. 327-112, p. 14; Exh. 327-122, p. 7; Exh. 327-149, p. 6; Exh. 329-17, p. 4). James T. McCallum, Corporation Audiologist at the Reynolds Metal Company and others asserted that the more stringent sound pressure levels of Table D-1 are necessary in a clinical setting for diagnostic purposes. (Tr. Vol. I-B, p. 264, March 23, 1982; Exh. 326-34, p. 3; Exh. 327-61, p. 4; Exh. 327-84, p. 32; Exh. 327-56, p. 7; Exh. 327-91, p. 36; Exh. 327-103, p. 7; Exh. 327-114, p. 26; Exh. 327-139, p. 8; Exh. 329-11, p. 4; Tr. Vol. I-B, p. 194, March 23, 1982). However, an industrial audiometric testing program which is intended merely for identification of persons susceptible to noise does not require such rigorous levels. Dr. S. White of the American Speech-Language-Hearing Association stated the following:

Concerning the appendix to the audiometric test rooms, there is an express purpose for the allowable octave band sound pressure levels as recommended by the American National Standard for Permissible Ambient Noise during Audiometric Testing or ANSI S3.1 1977. That purpose is to ensure ability to achieve hearing threshold levels to zero decibels. These are the background levels required for hearing research and

accurate diagnostic measurement of absolute thresholds of people with normal hearing. A monitoring program does not need such rigorous levels.

Authorities cite a range of normal hearing and the levels presently permitted by OSHA as indicated in Table D-2 would allow measurement of hearing to well within the range of 0 to 25 decibels during threshold levels. Table D-1 levels should only be mandated if precise scientific measurement is to be accomplished with highly trained personnel and highly calibrated instrumentation (Tr. Vol. IV, pp. 49-50, March 26, 1982).

After thorough review and analysis of the comments in the record in connection with this issue, OSHA has determined that the background sound pressure levels specified in Table D-1 are not necessary for the purposes of the hearing conservation amendment. OSHA concurs with Dr. S. White and J. McCallum, and many others, that the intent of the audiometric testing program required by this amendment is to identify persons with hearing loss before the loss progresses to material impairment. The fact that the employer is not required to make a determination of work relatedness, and the fact that employees are advised to seek referral where a medical pathology is suspect, are evidence that "medical or audiological diagnosis" is beyond the scope of the audiometric test program.

The Agency reaffirms its position as stated in the preamble of January 16, 1981 (46 FR 4148) that background sound levels in audiometric test rooms must be quiet enough to permit valid measurements of audiometric thresholds. However, OSHA is now convinced that the levels of Table D-2 are sufficient for obtaining valid threshold measurements for purposes of industrial hearing conservation programs. Thus, OSHA no longer believes that the sound pressure levels specified in Table D-1 are necessary to achieve this goal. The comments submitted which reflect a variety of professional experiences have persuaded OSHA that the background levels in Table D-2 will ensure an adequate environment for audiometric testing. Ronald D. Poole, Director of the Audiology Clinic, Mankato State University, summarized the opinions of those who favor Table D-2:

"In the past 5-6 years I have seen the audiograms of literally hundreds of employees tested in rooms where the maximum allowable background noise conformed to that contained in Table D-2 and their thresholds were found to be well within that range of normal between 0-25 dB, and in most instances were even closer to those minimum (0 dB) than the maximum (25 dB). I do not feel any test accuracy or integrity will be sacrificed by retaining those

values presently acceptable in Table D-2 (Exh. 329-97, pp. 1 to 2)."

Therefore, Table D-1 of Appendix D, required by the January amendment is revoked. The background sound pressure levels for audiometric test rooms which are required by this amendment are contained in Table D of Appendix D.

Audiometer Calibration

The January promulgation of the hearing conservation amendment required that audiometers be given a functional check each day they are in use. This process involves a biological calibration and a listening check. This is done by testing a person with known, stable hearing thresholds and by listening to the audiometer's output to make sure it is free of distorted or unwanted sounds. Such sounds might lead to invalid audiograms.

When the biologic calibration resulted in "deviations of more than 5 dB" in hearing level from the subject's known audiogram, the January amendment required an acoustic calibration. An acoustic calibration is one in which the audiometer is checked with a sound level meter and earphone coupler to make sure the instrument is producing the correct level of pure tones at specific frequencies. Also included in the acoustic calibration is a linearity check to ensure that the sound pressure output is increasing at the proper increments.

The January amendment also stipulated that "deviations of more than 10 dB" on the sound pressure output check and linearity check triggered an exhaustive calibration. Exhaustive calibration involves a thorough instrument check and, where necessary, an adjustment to conform with requirements of the ANSI Standard Specification for Audiometers (S3.6-1969). The audiometer usually must be sent back to the manufacturer or to a laboratory for the exhaustive calibration because specialized equipment is needed to perform this calibration.

Commenters (Exh. 327-66, p. 68; Exh. 347-141, p. 5; Exh. 327-91; Exh. 349-1; Exh. 327-154) pointed out that since self-recording audiometers trace thresholds in 1 dB increments, "deviations of more than 5 dB" could be interpreted to mean that a 6 dB deviation would trigger an acoustic calibration. Similarly, "deviations of more than 10 dB" would imply that an employer using a self-recording audiometer would be required to send the audiometer back to the manufacturer or to a laboratory for an exhaustive calibration when only an 11 dB deviation was found. This would result in a much more stringent rule than the Agency intended. In promulgating

the requirements detailed above, the Agency assumed that manual audiometers, which trace thresholds in 5 dB increments, were being used. It was intended that the trigger for an acoustic calibration be deviations of 10 dB and the trigger for an exhaustive calibration be deviations of 15 dB or more.⁴⁰

The Agency's position on this issue was discussed in the August Federal Register document and an interpretation consistent with the above discussion was given (see 46 FR 42628-42629). After evaluating the comments on this issue, OSHA has decided to incorporate into the text of the amendment explicit language to clarify these points. The revised amendment therefore specifies that an acoustic calibration is necessary if the results of the biological calibration indicate "deviations of 10 dB or greater" and an exhaustive calibration is necessary when an acoustic calibration results in "deviations of 15 dB or greater."

Summary

The audiometric test provisions of this revised hearing conservation amendment are somewhat less detailed than those promulgated in January 1981, although they have not been simplified as much as the amendment's monitoring provisions. It was not possible to embrace the performance approach completely for the audiometric testing provisions. Based upon a thorough review of the information and comments in the record, OSHA believes that a certain degree of specificity in the audiometric test provisions is absolutely necessary to protect employees in the hearing conservation program adequately and to realize fully the benefits the Agency has predicted will occur as a result of such program (see Regulatory Analysis).

OSHA recognizes that employers may employ different professionals to supervise their audiometric test program from year to year. Moreover, the professional supervising the program may use any number of audiometric technicians to obtain the required audiograms. As a result, it is quite possible that there will be little continuity of personnel responsible for the program from year to year. It is crucial to ensure that certain basic elements of the program are performed in a relatively uniform manner so that the evaluation of audiometric test data

⁴⁰These performance triggers were in addition to the stated frequency with which such calibrations must be done: at least yearly for acoustic calibration and every two years for exhaustive calibration. For a more complete discussion of audiometer calibration, see 46 FR 4149-4151.

and comparison of results are meaningful. Therefore, it was necessary to specify certain items, such as audiometric test frequencies, permissible background sound pressure levels in audiometric test booths, a definition of standard threshold shift, and certain follow-up procedures.

Whenever OSHA felt that the specific details of a particular provision were not absolutely essential to the protection of employees, however, we have tried to allow for the use of professional discretion. For example, OSHA revoked the retest requirements because we anticipate that employees will be provided the same amount of protection whether an STS is temporary or permanent. A professional directing a particular program, however, may deem it important to determine whether an employee's STS is temporary. The revised amendment is designed to give the supervising professional a considerable amount of latitude in making these decisions, while simultaneously affording the greatest amount of employee protection.

Hearing Protector Attenuation

The amendment requires that when an employee has suffered a STS, the employee must wear hearing protectors that attenuate exposure to a TWA of 85 dB or below. There may be some circumstances or environments where it is not possible to attenuate noise down to the appropriate level with hearing protectors. It should be noted that impossibility of compliance is recognized as a defense to any citation by the Review Commission.

In August, 1981, OSHA reopened the record and requested data and information on whether Appendix G⁴¹ should be amended so that estimations of hearing protector attenuation would more accurately reflect the amount of attenuation received in actual industrial use. The value of hearing protectors lies in their ability to attenuate or reduce the noise that reaches the ear. Hearing protector manufacturers are required by the Environmental Protection Agency (EPA) to identify clearly in a uniform manner, the noise reduction capability of all hearing protectors sold in the United States. This measure of effectiveness is called the noise reduction rating (NRR). The NRR is a laboratory derived numerical estimate of attenuation that is provided by the hearing protector. Appendix G (subsequently redesignated as Appendix

B), which is mandatory, describes the NRR and three alternative NIOSH methods that may be used to estimate hearing protector attenuation.

In response to the August 1981 request for information, some commenters suggested that the noise reduction rating (NRR) method produces an accurate estimate of real-world attenuation and should be continued (Exh. 327-34; Exh. 327-91, pp. 40-41; Exh. 327-85, p. 9; Exh. 327-95, p. 10; Exh. 327-131; Exh. 327-142, p. 7). Others stated that the NRR should not be adopted as part of the standard at all (Exh. 327-80, p. 3; Exh. 327-35, p. 5; Exh. 327-13, p. 7; Exh. 327-77, p. 9; Exh. 327-28, p. 3; Exh. 327-106, p. 7). Several comments suggested alternative methods of evaluating hearing protection (Exh. 327-47; Exh. 327-46; Exh. 327-62-A, p. 8; Exh. 327-99), while others supported de-rating of the laboratory derived attenuation values of hearing protectors to reflect the actual attenuation achieved under real-world conditions which is often significantly less than the NRR would indicate. (Exh. 327-84; Exh. 327-81; Exh. 327-86; Exh. 327-116). OSHA plans in the near future to propose a new rule to modify the existing noise standard (29 CFR 1910.95(b)). At that time the Agency will assess the overall effectiveness of the hearing conservation program, administrative and engineering controls, and personal protective equipment (i.e. hearing protectors). Since the issue raised in the present rulemaking—whether the Appendix should be modified so that estimations of hearing protector attenuation more accurately reflect the amount of attenuation achieved in "real use" situations—will be the central focus in that proposal, OSHA is not changing the provisions dealing with hearing protector attenuation at this time. Comments received in connection with this portion of the rulemaking on the hearing conservation amendment will be considered in the development of the proposed occupational noise standard.

Training Program

In the January amendment, OSHA required training to be repeated annually for all employees included in hearing conservation programs. The contents of the training program were specified in detail. Employees were required to be informed about: (1) OSHA's noise standard and the hearing conservation program; (2) the effects of noise on hearing; (3) identification of the specific machinery at the jobsite that could produce hazardous noise exposures; (4) the role of engineering and administrative controls in the reduction of noise exposure; (5) the

contents of any noise control compliance plan in effect; (6) the purpose of hearing protectors, the advantages and disadvantages of various types of protectors, and instructions on their selection, fitting, use, and care; and (7) the purpose and procedures of audiometric testing.

After publication of the January amendment, OSHA received numerous comments contending that the training requirements were too detailed and did not provide employers with enough flexibility to tailor their training programs to the specific needs of their employees. In August, OSHA continued the stay of several training provisions, which are listed above (1, 3, 4, and 5) and requested information on the necessity of these training requirements for an effective hearing conservation program.

Many commenters stressed the importance of training in obtaining the full cooperation of employees in the hearing conservation program. However, these commenters also stated that such detailed training requirements were too rigid (Exh. 326-15, p. 9; Exh. 326-30, p. 2; Exh. 326-32, p. 1; Exh. 326-34, p. 9; Exh. 327-20, pp. 5-6; Exh. 327-70, p. 2; Exh. 327-76, pp. 13-14; Exh. 327-87, p. 4; Exh. 327-89, p. 9; Exh. 327-97, p. 6; Exh. 327-146, p. 7; Exh. 327-145, p. 7; Exh. 329-22, p. 6). For example, the DuPont Company stated:

"DuPont believes it is appropriate for the agency to stay and modify the employee training provisions of the amendment because the specifications contained in the original version [January standard] were more detailed than necessary and did not permit enough employer discretion in determining what communications will guarantee them the best employee participation and cooperation in the hearing conservation program. DuPont agrees with OSHA that employee training is important but does not believe OSHA's specifications would elicit employee attention and compliance with necessary safety precautions" (Exh. 326-28, p. 7-8).

Other commenters indicated that the training requirements would be administratively burdensome and of little benefit (Exh. 326-12, p. 5; Exh. 327-51, p. 5; Exh. 327-93, p. 3; Tr. Vol. IV, p. 111, March 26, 1982). Some participants noted that professionally prepared and packaged programs that are often less costly and of higher quality than those developed in-house could be used if the stayed portions of the January amendment were revoked (Exh. 327-145, p. 9; Exh. 327-89, p. 9; Exh. 329-13, p. 4). In fact, the Dow Chemical Company declared that of some of the requirements listed above (3, 4 and 5) "are not necessary as they do not

⁴¹ In the revised amendment, Appendix G: Methods for Estimating the Adequacy of Hearing Protector Attenuation, has been redesignated as Appendix B.

pertain to a hearing conservation program" (Exh. 327-76, pp. 13-14).

Other commenters addressed the role of training in industrial hearing conservation programs. Dr. Larry Royster, of the Department of Mechanical and Aerospace Engineering of North Carolina State University, stressed that successful training must reflect the company's commitment to hearing conservation and should include an explanation of how hearing loss occurs and how each employee can be protected, the mechanics of the program and the employee's and employer's respective responsibilities, detailed instructions on hearing protection devices, and an explanation of audiometer tests and procedures (Exh. 327-84).

Several participants, however, supported the inclusion of detailed training requirements (Exh. 326-41, p. 6; Exh. 326-42, p. 13; Exh. 327-59, p. 4; Exh. 327-66, pp. 92-94; Exh. 327-78, pp. 15-16; Exh. 327-107, p. 7; Exh. 327-109, p. 16-17; Exh. 327-136B, p. 6; Exh. 329-57, p. 2; Exh. 345, p. 11; Exh. 347, p. 9). For example, Frank Grimes of the United Steelworkers of America stated:

"It is essential that the persons affected get as much detail as possible on the requirements and controls so that the program will be properly implemented" (Exh. 347, p. 9).

George Taylor, Director of Occupational Safety and Health for the AFL-CIO, also generally supported this view (Exh. 327-109, p. 17).

In general, the great majority of commenters agreed that employee training is an important part of any hearing conservation program. However, OSHA agrees with those commenters who contended that some details of the training program should be left to the judgment of the employer or the professional administering the hearing conservation program. In addition, several commenters (Exh. 327-88, p. 20; Exh. 327-110, p. 5; Exh. 327-59, p. 4) argued that the requirement to inform employees of the contents of the amendment is redundant with another requirement in the amendment: the requirement to post a copy of the standard in the workplace. OSHA does not believe it is necessary to include a specific requirement to inform employees of the contents of the standard in the training program when these documents are required to be readily available to employees and copies must be posted. The Agency also believes that it is not necessary to require the items listed, as 3, 4, and 5 above to be included in the training requirements because information about

engineering and administrative controls and the employer's compliance plan is not essential to the employee's understanding of or cooperation in the hearing conservation program.

OSHA does not agree with the suggestion of the International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers and Helpers that section 6(b)(7) of the Act requires training in the identification of specific machinery at the jobsite that could produce hazardous noise exposures (Exh. 327-78, p. 16). Section 6(b)(7) of the Act states in part that "any standard promulgated under this subsection shall prescribe the use of labels or other appropriate forms of warning as are necessary to insure that employees are apprised of all hazards to which they are exposed * * *." Noise is the hazard to which employees are exposed and the requirement to include training on the effects of noise on hearing certainly meets the statutory obligation of apprising employees of the hazards encountered in the workplace.

For these reasons those provisions of the training requirements on which the stay was continued in August are hereby revoked. The revocation of some of these detailed requirements will allow employers to avail themselves of pre-prepared materials such as pamphlets and films, where appropriate, which may be more effective and less expensive than individually prepared programs. As written, the training provisions in the hearing conservation amendment require employers to conduct annual training for all employees included in their hearing conservation programs. Such training must include, at a minimum, information on the effects of noise on hearing; the purpose of hearing protectors; the advantages and disadvantages of various types of protectors; instructions in the selection, fitting, use, and care of protectors; and the purposes and procedures of audiometric testing.

Warning Signs

The January amendment required signs to be posted at entrances to or on the periphery of all well-defined work areas where employees might be exposed at or above a TWA of 85 dB. These signs were intended to alert employees that they were entering a high noise area and that hearing protectors might be required (see 29 CFR 1910.95(p), 46 FR 4164, January 16, 1981). The stay of this provision was continued in the August Federal Register document because of objections asserting that warning signs would be costly and inconvenient and that employees might be confused as to whether hearing

protection was advisory or mandatory in certain areas (see 46 FR at 42630, August 21, 1981).

Warning signs by their nature describe area noise levels rather than individual exposures (Exh. 64-6, pp. 1-2). The need for warning signs depends on the nature and extent of the occupational exposure (Exh. 327-143, p. 8). For example, an employee in an area with 92 dB of noise for two hours a day with no significant noise exposure for the rest of the day would not need to wear hearing protectors, whereas the employee who spends the whole day in that area would (see Exh. 326-62, p. 3). Therefore, in cases where employees move in and out of noisy areas, such warning signs might be unduly confusing.

Similarly, many commenters felt that the fact that only *some* employees (those with STS) exposed above 85 dB were required to wear hearing protectors would contribute to the confusion.⁴² Accordingly, they suggested that warning signs be required only when exposures were at or above an 8-hour TWA of 90 dB (Exh. 327-62, p. 8; Exh. 327-71, p. 4; Exh. 327-145, p. 9; Exh. 329-2, p. 4; Tr. Vol. I-B, p. 265, March 23, 1982; see also Exh. 327-101, p. 8).

Despite these considerations, W. J. Rheume of the Teamsters Union stated that "warning signs are an integral part of any hearing conservation program." He added that they are inexpensive indicators of high noise areas and have been common industrial practice for years (Tr. Vol. III, p. 62, March 25, 1982). Wayne Bodenheimer of the Colorado Hearing and Speech Center also favored the use of warning signs, characterizing them as "constant reminders to everyone about high noise areas and the need to protect themselves." Moreover, he felt it "naive" to assume that everyone would remember the high noise areas on a day-to-day basis without such visual reinforcement (Tr. Vol. I-B, p. 215, March 3, 1982). Similarly, Dan MacLeod, an industrial hygienist for the International Union of United Automobile, Aerospace and Agricultural Implements Workers of America, testified from personal experience about the educational value of warning signs (Tr. Vol. III, p. 98-99, March 25, 1982). In addition, a number of other commenters such as the International Brotherhood of

⁴²Hearing protector use is mandatory for employees exposed below an 8-hour TWA of 90 dBA in only two situations: after experiencing a standard threshold shift and, where employee baselines are delayed beyond six months because mobile testing vans are used, for that period beyond six months until the baselines are obtained.

Boilermakers, Iron Ship Builders, Blacksmiths, Forgers, and Helpers Union and the Air Products and Chemicals Corporation also felt that warning signs were helpful in a hearing conservation program (see Exh. 327-13, p. 7; Exh. 327-56, p. 8; Exh. 327-58, p. 4; Tr. Vol. IV, p. 61, March 26, 1982; Exh. 327-78, p. 17; Exh. 327-86, p. 8; Exh. 327-135, p. 9; Exh. 327-138, pp. 6-7).

On the other hand, a number of participants questioned the educational value of warning signs (Exh. 327-70, p. 2; Exh. 327-76, p. 14; Exh. 327-97, p. 6; Exh. 327-89, p. 7). For example, Dr. Thomas Summar, who based his opinion on 25 years of experience in directing industrial hearing conservation programs, felt that warning signs had "minimal" educational value (Exh. 327-69, p. 9; Tr. Vol. I-B, p. 126, March 23, 1982). Others questioned the wisdom of the requirement and stated that warning signs would be ignored after a short period of time, becoming, in effect, part of the "scenery" (Exh. 327-116, p. 3; see also Exh. 326-62, p. 3; Tr. Vol. I-B, p. 265, March 23, 1982). Some commenters indicated that while warning signs have some educational value (Exh. 329-14, p. 10; Exh. 329-15, p. 7), good training and enforcement practices contribute far more to the success of the hearing conservation program (Exh. 329-19, p. 2; Exh. 327-51, p. 5; Exh. 327-129, p. 3). Moreover, Dow Chemical (Exh. 327-76, p. 14) and the Motor Vehicle Manufacturers Association (Exh. 327-103, p. 9), among others, suggested that warning signs are not necessary for an effective hearing conservation program.

Many commenters, including General Motors Corporation (Exh. 327-99), felt that while warning signs might be useful in some work environments, they serve no useful purpose in others; therefore the decision as to whether or not to post warning signs should be left to the discretion of the employer (see Exh. 327-89, pp. 7-8; Exh. 327-120, p. 4; Exh. 327-105, p. 7).

After a careful analysis of the record comments, OSHA agrees with the position taken by General Motors and the others cited above that the use of signs to warn employees about noise hazards in high noise areas should be left to the discretion of the employer. In so doing, OSHA finds some merit in the view that noise is more readily discernible than other harmful physical agents and therefore a specific warning sign requirement may not be necessary to protect employees and that in certain circumstances such signs might confuse rather than serve a useful educational purpose.

Therefore, the provision requiring that warning signs be posted in *all* areas

where high noise exposures may occur will be revoked. The revocation of this requirement is not meant to discourage employers from posting any warning signs. Rather, it recognizes that the employer is more familiar with the workplace environment and will be in a better position to determine if the posting of signs in a given situation will aid in the success of the company's hearing conservation program. A number of those commenting noted that warning signs may be helpful in enforcing hearing protector use where required. Therefore we expect that, where appropriate, employers will voluntarily adopt the use of warning signs as part of their hearing conservation program.

Several unions argued that Section 6(b)(7) of the Act required the use of warning signs (Exh. 327-109, p. 18; Exh. 327-78, p. 17). Section 6(b)(7) of the Act merely requires that standards "prescribe the use of labels or other appropriate forms of warnings as are necessary to insure that employees are apprised of all hazards to which they are exposed * * * [*italics added*]. It should be clear from the above discussion that warning signs are not generally necessary, nor are they always the most appropriate method of apprising employees of the hazards of noise. Training may be a more appropriate vehicle to inform workers of the hazards of noise to their hearing and, in fact, employers are required to include this in their training program (see discussion above). Therefore, substantial evidence in the record supports the conclusion that the revocation of the warning sign requirement is not contrary to Section 6(b)(7) of the Act.

Recordkeeping

The January amendment required that extensive and detailed records be maintained of exposure measurements, audiometric tests, audiometric test room sound levels, and calibration of audiometers. OSHA explained (46 FR 4159) that recordkeeping is necessary to enable professional reviewers to " * * * make sure that the audiometric tests were carried out under proper conditions and that audiograms reflect employees' true hearing levels. Records [serve an] * * * educational purpose for employees because they enable employees to assess the continuing status of their hearing. In addition, they provide employers with a way of assessing the success or failure of the hearing conservation program."

After the amendment was promulgated in January, OSHA received many objections to the detailed nature

and redundancy of some of these recordkeeping provisions. Therefore, on August 21, 1981 (46 FR 42630) OSHA continued the stay of several specific recordkeeping provisions and asked for comments on whether they were necessary for an effective hearing conservation program.

OSHA received many requests that the detailed recordkeeping provisions for noise exposure monitoring be revoked⁴³ (Exh. 326-31, p. 3; Exh. 327-93, p. 3; Exh. 327-145, pp. 9-10; Exh. 327-110, p. 5; Exh. 327-89, p. 10; Exh. 327-88, p. 10; Exh. 327-121, p. 3; Exh. 328-5; Exh. 329-17, p. 4). Objections focused on the excessive amount of detail required and argued that such detailed records are not necessary for an effective hearing conservation program. Many stated that the performance language at the beginning of the exposure monitoring recordkeeping requirement was sufficient.⁴⁴

OSHA has concluded that the detailed exposure monitoring information originally required in the January amendment is not essential to an effective hearing conservation program. Since the recordkeeping provisions for audiometric tests require that a record of the latest exposure measurement be retained with the employee's audiometric test record, much of the information required by the exposure monitoring recordkeeping requirements would be redundant.⁴⁵ OSHA believes that the detailed exposure measurement data required in January 1981 has extremely limited usefulness and this level of detail is not essential to the effective implementation of a hearing conservation program. Therefore, the stayed provisions concerning exposure monitoring recordkeeping have been

⁴³The January amendment required that the exposure record include the employee's name and job classification; the date, location, and result of each measurement taken; and the number of measurements (where sound level meters are used to make the measurement), as well as a description of the noise measurement equipment used and the date of its last laboratory calibration. The stay of these provisions was continued in August.

⁴⁴That provision simply stated that the employer must keep accurate records of all employee exposure measurements required by the amendment.

⁴⁵As it now reads, the employer must keep the following information with audiometric test records:

- (i) The employer shall retain all employee audiometric test records obtained pursuant to paragraph (g) of this section;
- (ii) This record shall include:
 - (a) Name and job classification of the employee;
 - (b) Date of the audiogram;
 - (c) The examiner's name;
 - (d) Date of the last acoustic or exhaustive calibration of the audiometer; and
 - (e) Employee's most recent noise exposure assessment.

revoked. Thus, only the general exposure recordkeeping requirement is being retained. This is consistent with the mandates of sections 8(c)(3) and 8(d) of the Act which require that employers keep accurate records of employee exposures to harmful physical agents which are required to be monitored but that the burden of such an obligation be reduced to the maximum extent feasible.

OSHA also received many comments asking for the revocation of the stayed provisions regarding audiometric test records ⁴⁶ (Exh. 326-62, p. 4; Exh. 327-20, p. 6; Exh. 327-90, p. 6; Exh. 327-88, p. 10; Exh. 327-121, p. 3; Exh. 327-145, pp. 9-10; Exh. 328-5; Exh. 329-17, p. 4). For example, the DuPont Company (Exh. 326-28, pp. 8-9) pointed out that it is unnecessary for each employee's audiogram to include general information, such as manufacturer and model of the audiometer and a statement of whether sound pressure levels in the test room comply with Table D-1 of Appendix D, when this information is available from other records. OSHA has determined that having a record of the qualifications of the examiner and of the manufacturer and model of the audiometer is not essential to determining the validity of the test. In addition, the requirement for a statement as to whether the sound pressure levels in the test room meet the levels of Table D-1 or Table D-2 of Appendix D is being revoked to be consistent with the revocation of Table D-1. The remaining requirement that a record be kept of background sound pressure levels in audiometric test rooms is sufficient to ensure adequate information to enable proper audiogram evaluation.⁴⁷ For these reasons, OSHA has revoked the stayed provisions on audiometric test records.

There is some confusion (Exh. 327-91, p. 46; Exh. 327-149, p. 8) about whether OSHA intended the audiometric information required to be kept to be entered on the face of audiograms.⁴⁸ It

⁴⁶In August 1981, OSHA continued the stay of the following audiometric test recordkeeping provisions: qualifications of the person who administered the audiometric test, name of the manufacturer and model of the audiometer, and a statement of whether the sound pressure levels in the test room meet those specified in Table D-1 or D-2.

⁴⁷The amendment requires that "the employer shall maintain accurate records of the measurements of the background sound pressure levels in audiometric test rooms (see paragraph (m)(2)(ii)(f) below).

⁴⁸This information includes such things as measurements of background sound pressure level in the audiometric test room, and the examiner's name and date of the last calibration. Where this information is the same for an entire group of audiograms, this information may be maintained on

has been pointed out that some audiometric forms are not sufficiently large to permit this information to be actually recorded on them. It was not OSHA's intention to require that this information be entered on the actual audiogram; the wording of this provision has therefore been changed to permit this information to be kept *with* the audiometric records. Employers may maintain the information in a separate document that is kept or filed with the audiometric test results.

Several commenters requested revocation of the stayed provision that specified the audiometric frequencies for which background sound pressure level measurement records were to be kept and the date of the measurement (Exh. 327-145, pp. 9-10; Exh. 326-62, p. 4; Exh. 327-20, p. 6; Exh. 327-90, p. 6; Exh. 329-22). OSHA has concluded that this requirement is unnecessary since Table D-1 in Appendix D specifies the required frequencies.⁴⁹ Further, standard audiometric practice provides that the date of sound pressure measurements be recorded. OSHA has therefore revoked the stayed portions of the provision (see footnote 49, above).

Several commenters also asked that the stayed requirement to maintain records of acoustical and exhaustive audiometer calibrations be revoked because it is unnecessary (Exh. 326-62, p. 4; Exh. 327-20, p. 6; Exh. 327-90, p. 6; Exh. 327-141, p. 6; Exh. 329-22). OSHA agrees that this provision is redundant, since the date of the last acoustic or exhaustive calibration must be kept with the employee's audiometric test record. OSHA has therefore revoked this provision in its entirety.

By its actions today, OSHA has revoked those detailed recordkeeping requirements found to be unnecessarily burdensome or redundant. This is consistent with the mandate of the Paperwork Reduction Act of 1980, 44 U.S.C. 3501 *et seq* and section 8(d) of the OSH Act. OSHA does not agree with the Teamsters assertion (Exh. 345, p. 12) that trimming the recordkeeping requirements in this manner will reduce the effectiveness of the hearing conservation program. The recordkeeping requirements remaining

one sheet of paper rather than separately for each audiogram.

⁴⁹In January, employers were required to keep the following information concerning audiometric test rooms. (i) The employer shall maintain accurate records of the measurements of the background sound pressure levels in audiometric test rooms. (ii) *This record shall include: (a) Background sound pressure level measurements at each of the following octave bands: 500, 1000, 2000, 4000, and 8000 Hz; and (b) Date of measurement.* The stay was continued on the italicized portion of this provision in August.

in the revised amendment are essential and sufficient to insure the effectiveness of the hearing conservation program and OSHA so finds.

Record Retention

In August, OSHA stayed the provisions requiring records of test room sound pressure levels and audiometer calibrations to be kept for 5 years. The requirement for retaining audiometric test records was partially stayed insofar as it required employers to retain audiometric test records for 5 years after termination of employment. OSHA received many requests that these stayed provisions regarding record retention be revoked (Exh. 327-90, p. 6; Exh. 327-122, pp. 10-11; Exh. 327-125; Exh. 327-145, pp. 9-10; Exh. 327-149, pp. 8-10; Exh. 329-15, p. 7; Exh. 327-110, p. 5; Exh. 327-129, p. 3; Exh. 327-105, pp. 7-8; Exh. 327-143, p. 8). Some commenters cited the costs of retaining individual records and asserted that such records are not necessary to employee health or safety.

OSHA has decided to revoke the requirements to retain separate records of sound pressure levels and audiometer calibrations since this information must be kept with or on the audiogram. In addition, OSHA has concluded that retention of audiometric records for 5 years beyond termination of employment is not necessary, since this section also requires the employer to provide employees with access to their records. Since employees can obtain a copy of audiological records during their employment or upon termination of employment, the requirement to retain such records for 5 years after termination is not necessary. OSHA has concluded that it is more appropriate to require retention of audiometric test records for the length of employment rather than the longer period originally specified. Therefore the requirement to keep audiometric test records for 5 years after the termination of employment is being revoked.

Other Issues

Other Alternatives. In the August 21, 1981, Federal Register (46 FR 42631), OSHA noted that alternatives to the hearing conservation amendment had been suggested to the Agency. OSHA published and asked for comments on the following performance provisions, which are referred to as the alternative provisions or the three-paragraph alternative.

1. Employers shall conduct audiograms annually of every employee exposed to noise in excess of an 8-hour time weighted average sound level

(TWA) of 85 dBA,⁵⁰ according to standards on audiometers and audiometric test rooms established by the American National Standards Institute,⁵¹ and under the supervision of a qualified technician;

2. Such audiograms shall be reviewed annually by a qualified audiologist, otolaryngologist or physician to identify employees whose hearing acuity has diminished more than normal;

3. Employers shall instruct all employees identified under paragraph 2 in the proper use of hearing protection when working in noisy areas and shall take appropriate measures to enforce the use of suitable protective devices for those employees when they are exposed to noise levels in excess of an 8-hour time weighted average sound level (TWA) of 85 dBA.

The August document noted that the purpose of publishing these alternatives was to "determine whether the goal of hearing conservation could be achieved by a performance standard that does not contain detailed compliance requirements but rather leaves implementation to physicians and other experts in the field" (46 FR 42631).

Many comments have been received regarding the adequacy of the employee protection that might be provided by implementation of these alternative provisions. Many commenters asserted, in general terms, that the alternatives would be as protective as the provisions contained in the January and August documents (Exh. 327-20; Exh. 327-26; Exh. 327-27; Exh. 327-28; Exh. 327-34; Exh. 327-51; Exh. 327-55; Exh. 327-62; Exh. 327-67; Exh. 327-89; Exh. 327-93; Exh. 327-101; Exh. 327-129; Exh. 327-145; Exh. 329-5; Exh. 329-10; Exh. 329-19; Exh. 329-42; Tr. Vol. III, pp. 179-180, March 25, 1982). These participants generally favored the simplicity and flexibility of the alternative provisions.

The Chocolate Manufacturers Association (Exh. 327-112, p. 7) thought that the three-paragraph alternative would increase compliance, and therefore worker protection, because it would be better understood by employers and employees and would be easier for small businesses to comply with. On the other hand, other commenters felt that the alternative standard would be more difficult for

employers without strong technical capabilities to comply with effectively and suggested that the alternative standard would result in lack of uniform enforcement from one employer to another (see generally Exh. 327-78, p. 17; Exh. 327-113, p. 3; Exh. 327-98, p. 21).

Several commenters who generally supported the three-paragraph alternative suggested specific changes. For example, Owens Illinois (Exh. 326-15, p. 3), the Chocolate Manufacturer's Association (Exh. 327-112, p. 17-18), the National Soft Drink Association (Exh. 327-90, p. 6), and the Edison Electric Institute (Exh. 327-108, pp. 1-2) objected to the incorporation by reference of American National Standard Institute standards. Air Products and Chemicals (Exh. 327-58) suggested that a requirement be added stating that the employer should have a written description of the program to make all persons aware of it. R. C. Crewdson of Industrial Health, Inc. (Exh. 327-83, p. 5) requested addition of a requirement stating that the program be under the supervision of an audiologist, otolaryngologist, or physician.

Other comments were concerned that exceptions for temporary employees would not be provided (Exh. 327-90, p. 6; Exh. 327-110, pp. 1-2). The National Screw Machine Products Association (Exh. 327-124) and Lewis Goodfriend and Associates (Exh. 327-23, p. 5) suggested adding a provision that employers require hearing protection when noise exposures exceed a given level. Lewis Goodfriend and Associates (Exh. 327-23, pp. 4-5) also indicated that any alternative should clearly require the employer to provide the employees with hearing protectors and should "state how effective the hearing protection devices should be." The DuPont Company (Exh. 327-91, pp. 52-54) also recommended many additions to the alternative provisions, including the addition of a definition of significant threshold shift.

OSHA also received a large number of comments asserting that the alternative provisions would not provide employee protection equivalent to that offered by the August amendment (Exh. 327-22; Exh. 327-35; Exh. 327-59; Exh. 327-68; Exh. 327-76; Exh. 327-78; Exh. 327-82; Exh. 327-84; Exh. 327-87; Exh. 327-94; Exh. 327-102; Exh. 327-119; Exh. 327-148; Exh. 331-17; Exh. 345; Tr. Vol. IV, pp. 242, March 26, 1982). The American Textile Manufacturer's Institute (Exh. 327-106, p. 1), although generally in favor of a performance-oriented standard, stated that the three-paragraph alternative "certainly would not provide needed protection to

workers * * *." The International Brotherhood of Teamsters (Exh. 345, p. 12) argued that " * * * it offers no improvement over the previous standard [29 CFR 1910.95(b)(3)] * * *."

Some comments contained more specific criticism. For example, submissions by Dow Chemical (Exh. 327-76, p. 17), Shell Oil (Exh. 327-102, p. 13) and others emphasized the need for an explicit monitoring requirement, or offered alternative performance language for the monitoring provision (Exh. 327-87, p. 5; Exh. 327-91, p. 52; Exh. 327-99; Exh. 327-106, p. 1; Exh. 345, pp. 12-13). In addition, one commenter pointed out that the three-paragraph alternative fails to indicate the types and levels of sounds to be included in the noise exposure measurement (Exh. 327-82). He suggested that the lack of such a specification could result in underestimates of exposure.

The National Screw Machine Products Association (Exh. 327-124) and the Alliance of Metal Working Industries (Exh. 327-72, p. 4) noted that the alternative provisions suggest that only employees who have experienced a significant threshold shift be instructed in the use of, and required to wear, hearing protectors. They suggested that the three-paragraph alternative be modified to require that employers instruct all employees to wear hearing protection where noise levels exceed those shown in Table G-16a. Shell Oil (Exh. 327-102, pp. 13-14) pointed out, "The * * * alternative fails to provide for employee education and training, except for employees who have already suffered a hearing loss. To prevent hearing loss, employees must know when and how to wear hearing protectors, and what is gained by their use."

The DuPont (Exh. 327-91, p. 53) and General Motors companies (Exh. 327-99) added definitions of significant threshold shift in their suggested performance alternatives. The Motor Vehicle Manufacturers Association (Exh. 327-103, p. 9) contended that the alternative's lack of a definition of significant threshold shift is a "serious omission." The American Textile Manufacturers Institute (Exh. 327-106, p. 1) asserted that referral criteria are needed for evaluation of workers who develop medical abnormalities. In addition, commenters called attention to what they felt was ambiguous language in the three-paragraph alternative. For example, the National Soft Drink Association (Exh. 327-90, p. 6) pointed out that the language "hearing acuity * * * diminished more than normal" is ambiguous.

⁵⁰ See Appendix A.

⁵¹ American National Standards Institute (ANSI) Specification for Audiometers, S3.6-1969, and the Institute's Specification for Audiometric Test Rooms, ANSI S3.1-1977. Audiometers shall be calibrated annually to ensure the standard is met. ANSI S3.1-1977 must be followed for testing performed at frequencies of 1,000 Hz and above; for testing below 1,000 Hz, ANSI S3.1-1960 may be used.

A few commenters suggested that the three-paragraph alternative would result in fewer enforcement problems than would a more specification-oriented standard. The Chamber of Commerce (Exh. 329-10, p. 6), for example, stated "The alternative would afford more flexibility for compliance officers * * * by being freed from enforcing overly specific requirements * * * [compliance officers] could perform less intensive but more expeditious and results-oriented inspections." Others, however, viewed such lack of specificity with alarm. The Portland Cement Association, for example, (Exh. 327-113, p. 3) stated, "The less specific a standard is, the more room there is for subjectivity on the part of the inspector * * *. Unduly vague standards can open the way for abuses and arbitrary action, without any positive effect on hearing conservation" (see also Exh. 327-78, p. 19). Similarly, Standard Oil of Indiana (Exh. 327-87, p. 5) asserted, "the problem with * * * the proposed alternative is that there is no way to measure compliance because many of the terms are vague. Consequently, each compliance officer becomes an interpreter of the law and uniform enforcement is lost." Others simply stated that the 3-paragraph alternative is absolutely unenforceable (Exh. 327-78, p. 17; Tr. Vol. III, p. 52-65, March 25, 1982).

Organization Resources Counselors (Exh. 327-98, p. 21) noted that implementing the alternative provisions could be difficult for employers without strong technical capability. R. C. Crewdson of Industrial Health, Inc. (Exh. 327-82, p. 6) pointed out that hearing conservation programs should be supervised by professionals. This requirement was not included in the three-paragraph alternative. In a similar vein, Pelton/Blum, Inc. (Exh. 329-12) commented, "It has been our experience that most small and medium sized companies do not necessarily have the knowledge to carry out a hearing conservation program when it is stated [as] in the 3 paragraph alternative provisions. The Amendment as * * * in August * * * would allow even the individual that is not knowledgeable to begin to see how a program * * * works."

OSHA has carefully reviewed the comments in the record regarding the efficacy of the three paragraph alternative provisions. Ideally, an occupational safety and health standard should be specific enough to give employers adequate notice of what is expected of them and to allow for uniform enforcement from one employer to another, and be flexible enough to

allow employers to comply in the manner that best fits the circumstances of the company. These considerations must be balanced against the need to be able to enforce the standard vigorously against any recalcitrant employer who fails to provide employees with meaningful protection. Although the Agency supports the use of performance language whenever possible, and has used the performance approach in several sections of this revised amendment, the alternative provisions do not provide the degree of specification needed to ensure employee protection against occupational hearing loss. The Agency position on this matter is generally corroborated by the American Textile Manufacturers Institute:

"ATMI supports performance standards with minimum specification and any such standard in the area of hearing conservation would have to include the following elements; required monitoring of noise exposures, feasible engineering controls, adequate protective devices, periodic audiometric evaluation and referral criteria for evaluation of workers developing abnormalities. Obviously, the proposal [three-paragraph alternative] in the notice does not meet those criteria. In striking contrast, the regulation made effective in the August 21 notice meets those criteria and in our judgment, would be adequate" (Exh. 327-106, p. 1).

For example, a specific index of hearing damage serious enough to trigger follow-up action is needed to provide guidance to employers. Without a standardized definition of STS, OSHA believes there would be great variability in the protective actions taken (see Exh. 327-78, p. 19). Approximately forty definitions of STS have been suggested to OSHA (see discussion in audiometry section above), indicating the range of opinion on the correct interpretation of this important term. Therefore, the Agency considers that the alternative provisions' lack of a definition of STS would result in less than uniform protection for noise-exposed employees.

OSHA also finds the 3-paragraph alternative's lack of minimum requirements for audiometer calibration a serious problem. Calibration requirements are essential to ensure the validity and comparability of tests. If audiometers are not properly calibrated, employers may expend substantial resources with little assurance that test results can be compared from one year to the next, and without assurance that employees are receiving adequate protection.

OSHA believes that the lack of a requirement that employees be instructed in hearing protector use

before a hearing loss occurs is a serious oversight of the 3-paragraph alternative. The absence of such a provision runs counter to the Agency's emphasis on preventive measures in occupational safety and health.

Similarly, to help avoid hearing loss OSHA's amendment requires that hearing protectors be properly fitted. The amount of protection offered by hearing protectors is greatly dependent on proper fit. Further, hearing protectors themselves vary considerably in the degree of attenuation offered. Without an assessment of the protection actually offered by hearing protectors in specific noise environments, employers may believe that sufficient protection is being provided when in fact it is inadequate. OSHA feels that the failure to require fitting and attenuation evaluations of hearing protectors would seriously reduce the degree of protection provided to employees.

Further, OSHA believes there are serious questions regarding the Agency's ability to enforce the 3-paragraph alternative. Some have suggested that OSHA enforcement would be improved since it would have to focus on results, i.e., whether protection is being provided rather than on the specifics of program implementation (Exh. 327-99, pp. 4-5; Exh. 329-10, p. 6). Consequently, others noted that OSHA compliance officers would have to be given special training in evaluating audiometric data bases (Exh. 327-98, pp. 21-22; see also Exh. 327-89, p. 9). However, no commenter suggested how OSHA compliance personnel would determine at what point a given hearing conservation program was protective enough to be considered "in compliance." In addition, many of the phrases used in the three-paragraph alternative, such as "more than normal" and "noisy areas" are subject to many interpretations and would therefore be difficult to enforce in practice. Moreover, if the Agency were to revise the three paragraph alternative by adding the various specific requirements that many of the participants felt were necessary to protect employees adequately, the alternative would become as long and as specific as the revised amendment published today.

For the reasons discussed above, OSHA has concluded that the 3-paragraph alternative would not be as protective as the hearing conservation amendment published in August. In particular, the failure of the alternative provisions to provide guidance to employers in the areas of pre-impairment hearing protection use, the

definition of a standard threshold shift, and employee training is felt to be sufficient to support this conclusion. Therefore, the alternative provisions will not be adopted.

Performance Criteria

The preamble to the August Federal Register document discussed a study (see post-promulgation comment #266a) recommending that performance criteria be developed for determining the effectiveness of an employer's hearing conservation program.⁵² That study, which was prepared for the Rockefeller Foundation, suggested that results of analyses of audiometric data be the index of such effectiveness. Comments and information were requested on the advisability of adopting such an approach in the hearing conservation amendment. The comments and testimony received in response to this recommendation generally agreed that evaluating the effectiveness of hearing conservation programs is desirable, but there was little consensus among commenters regarding what performance criteria should be used.

A number of commenters felt that audiometric data analysis would be a useful tool for demonstrating the effectiveness of a hearing conservation program but made no recommendations concerning the minimum appropriate criteria for judging a program (Exh. 327-99; Exh. 327-113, p. 3; Exh. 327-125). Some participants stated that audiometric data showing an incidence of significant threshold shift rates greater than 5 to 10 percent should indicate a problem with a given hearing conservation program (Exh. 327-54; Exh. 327-58; Tr. Vol. II, p. 128, 3/29/82; Tr. Vol. II, p. 59, March 26, 1982). Others recommended using analysis of audiometric data as an indicator but only after the data has been adjusted for variables such as age, sex, race, years or exposure at various sound levels, and so forth (Exh. 327-84; Exh. 327-77, pp. 7-8; Exh. 327-66, pp. 11-85; Exh. 327-120, p. 4).

Some stated that analysis of audiometric data by individual employers would not really indicate the effectiveness of a hearing conservation program (Exh. 327-15; Exh. 327-147, p. 6-7). In his testimony, Dr. Crewdson, a physicist, suggested that the inaccuracy and variability of individual test results would make it impossible to assess trends by simply looking at audiogram results. He recommended evaluation of several years' worth of data by

experienced professionals (Tr. Vol. V, pp. 146-162, March 29, 1982). Another commenter stated:

"[There is] no generally accepted method * * * available to evaluate the effectiveness of individual hearing conservation programs. * * * With computer-assisted data collection, and a uniform criteria [sic] for describing threshold shift, the analysis of audiometric test data may prove to be a tool for the future. However, the current methods of data collection and retrieval do not make the analysis of audiometric test data a feasible method for evaluating the effectiveness of a hearing conservation program" (Exh. 327-103).

Other commenters agreed, stating:

"[We] do not believe objective or quantitative evaluation of HCP's could be statistically significant or an adequate indicator of program effectiveness" (Exh. 327-120, p. 4).

and

"* * * The analysis of audiometric data is an incomplete approach to an effective and enforceable HCP" (Exh. 327-141).

A number of commenters stated that responsibility for determining program effectiveness should be left in the hands of professional audiologists, otolaryngologists and physicians (Exh. 327-35, p. 5; Exh. 327-105, p. 7; Exh. 327-112, p. 17; Tr. Vol. V, p. 159-160, March 29, 1982). In addition, several stated that OSHA should not attempt to specify mandatory criteria for evaluating hearing conservation programs (Exh. 327-35, p. 5; Exh. 327-77, p. 7-8; Exh. 327-143, p. 2; Exh. 331-11).

OSHA agrees with the large number of commenters who stressed the importance of professional judgment in evaluating audiometric test data. The Agency believes that it would not be useful to draw conclusions on the effectiveness of specific hearing conservation programs on the basis of test data alone, because of the many variables that may affect these results. OSHA believes that it should be left to the judgment of the professionals supervising the audiometric examinations and analyzing the results to advise the employer concerning the effectiveness of the employer's hearing conservation program. Therefore, the final standard does not contain a specific requirement for employer assessment of the effectiveness of hearing conservation programs.

At this time the Agency does not know of any specific performance criteria which would unequivocally demonstrate the effectiveness of any hearing conservation program.

Exemptions

At the present time, the agency is exempting the gas and oil well drilling

and servicing industry from the requirements of this revised amendment. OSHA is granting this exemption because of the unique characteristics of this industry, which characteristics have also convinced the agency to initiate rulemaking that addresses the unique hazards for the gas and oil well drillers and servicers.⁵³

Appendices Paragraph (r)

The August 1981 Federal Register document continued stays on Appendix B (Temporal Sampling Procedures for Use with a Sound Level Meter) and Appendix F (Calculations and Application of Age Corrections to Audiograms). As discussed in the monitoring section above, OSHA is revoking Appendix B. In addition, the stay on Appendix F is being lifted (see discussion under standard threshold shift above) and that appendix is being redesignated as Appendix B.

Effective Dates

The hearing conservation amendment was originally promulgated on January 16, 1981 (46 FR 4078) to become effective on April 15, 1981. After several temporary stays, portions of the amendment went into effect on August 22, 1981 (46 FR 42622, August 21, 1981). Those provisions which went into effect on August 22, 1981, and which were not substantially amended in this final rule are listed in Table I below (with new paragraph designations, where appropriate). In the original promulgation, employers were allowed until February 22, 1982, to complete noise monitoring. The August 22, 1981, effective date of the amendment and the start-up date for monitoring remain unchanged.

Table I

Provisions Which Went into Effect on August 22, 1981, and Have Not Been Amended

Paragraph (c)(1)
Paragraph (d)(2)(i)
Paragraphs (g) (1) and (2)
Paragraph (g)(4)
Paragraph (g)(6)
Paragraphs (g)(7)(iii) (A), (B), (C) and (D)
Paragraphs (g)(8)(ii) (A) and (B)
Paragraphs (h) (1), (3) and (4)
Paragraph (h)(5)(iii)
Paragraphs (i) (1) and (2)
Paragraph (i)(2)(ii)

⁵³ A combination of factors, including tremendous variation in working conditions, high mobility of operations, extremely high employee turnover rates, and limited accessibility of many worksites, convinced OSHA that the interests of both employers and employees would be better served by developing a standard more specifically tailored to the needs of this industry (Exh. 329-34, pp. 1-2; Exh. 329-33; Exh. 329-29, p. 2; Tr. Vol. I-B, pp. 156-157, 167-169; Tr. Vol. V, pp. 73-75).

⁵² Berger, E. H. and L. H. Royster. "The Effects of Noise Exposure On One Industrial Population," October 1976.

Paragraphs (i) (3), (4) and (5)
 Paragraphs (j) (1), (2) and (4)
 Paragraph (k)
 Paragraph (l)
 Paragraphs (m) (2), (3), (4) and (5)
 Paragraph (n)
 Appendices A, B, C, D, E, H and I

Portions of the original hearing conservation amendment were stayed beyond August 22, 1981, and were the subject of this rulemaking. In addition, some provisions which went into effect on August 22, 1981, are also being modified by this final rule. The provisions being issued today in final form will be effective on April 7, 1983, to allow employers enough time to familiarize themselves with the revisions. Table II below lists the provisions and modified provisions (as indicated) which will be effective April 7, 1983.

Table II

Provisions Which Are Effective April 7, 1983

Paragraph (c)(2)
 *Paragraph (d)(1)
 Paragraphs (d)(1) (i) and (ii)
 Paragraph (d)(2)(ii)
 Paragraphs (d)(3) (i) and (ii)
 Paragraph (e)
 *Paragraph (f)
 *Paragraph (g)(3)
 *Paragraph (g)(5)(i)
 Paragraph (g)(5)(ii)
 *Paragraph (g)(5)(iii)
 Paragraph (g)(5)(iv)
 *Paragraph (g)(7)(i)
 Paragraph (g)(7)(ii)
 *Paragraph (g)(7)(iii)
 *Paragraph (g)(8)(i)
 Paragraph (g) (8)(ii)
 *Paragraphs (g)(8)(ii) (C) and (D)
 Paragraph (g)(8)(iii)
 Paragraph (g)(9)
 Paragraph (g)(10)
 *Paragraph (h)(2)
 *Paragraphs (h)(5) (i) and (ii)
 Paragraph (i)(2)(i)
 Paragraph (i)(2)(ii)(A)
 *Paragraph (i)(2)(ii)(B)
 *Paragraph (j)(3)
 *Paragraph (m) (1)
 Paragraph (o)
 *Paragraph (p)
 Appendix F (from January 16, 1981)
 Appendix G

*An asterisk denotes those provisions which are amendments of provisions that were effective August 22, 1981.

Initially, employers were allowed until August 22, 1982, to complete baseline audiograms. OSHA received a number of requests for extensions of the time allowed to obtain baseline audiograms. Some commenters indicated that they needed more time to comply for various practical and resource reasons (Exh. 329-3; Exh. 327-106). Others stated that OSHA's final decisions on critical technical issues were necessary before baseline

audiograms could be obtained (Exh. 327-88; Tr. Vol. IV, p. 202, March 26, 1982.) One commenter stated that an extension of time to obtain baseline audiograms would avoid the paperwork of asking for a variance (Ex. 329-3). OSHA agrees that an extension of time in which to obtain employee audiograms of approximately one year is appropriate under the circumstances of this proceeding. A number of important elements of the audiometric testing provisions have been reconsidered and revised. Employers could not have performed baseline audiograms until these issues were resolved. Employers now need sufficient time to incorporate these requirements into their hearing conservation programs and to purchase the necessary equipment to run such a testing program or to make the necessary arrangements for consultants to perform these services. In the January 1981 amendments, OSHA allowed approximately one year from the effective date of the standard for employers to obtain baseline audiograms. Since a number of elements related to the baseline audiogram were stayed, OSHA will extend the date for completion of baseline audiograms until March 1, 1984, which is approximately one year after the publication of this document.⁵⁴

List of Subjects in 29 CFR Part 1910

Occupational safety and health,
 Health.

Authority: This document was prepared under the direction of Thorne G. Aughter, Assistant Secretary of Labor for Occupational Safety and Health, 200 Constitution Avenue, N.W., Washington, D.C. 20210.

Pursuant to sections 6(b) and 8(c) of the Occupational Safety and Health Act of 1970 (84 Stat. 1593, 1599, 29 U.S.C. 655, 657), Secretary of Labor's Order No. 8-76 (41 FR 25059) and 29 CFR Part 1911, § 1910.95 of 29 CFR Part 1910 is amended as set forth below. (Secs. 4, 6, 8, 84 Stat. 1592, 1593, 1599, [29 U.S.C. 653, 655, 657]; 5 U.S.C. 553; Secretary of Labor's Order No. 8-76 (41 FR 25059))

Signed at Washington, D.C. this 28th day of February 1983.

Thorne G. Aughter,
 Assistant Secretary of Labor.

PART 1910—[AMENDED]

Paragraphs (c) through (p) and Appendices A through I of 29 CFR 1910.95 are revised to read as follows:

⁵⁴ It should be noted, however, that this delayed effective date is not in addition to the amount of time employers are normally given to obtain baseline audiograms under paragraph (g)(5)(i). Thus, all current employees must have baseline audiograms taken by March 1, 1984, or six months from the date of their first exposure at or above the action level, whichever is longer.

§ 1910.95 Occupational noise exposure.

(c) *Hearing conservation program.* (1) The employer shall administer a continuing, effective hearing conservation program, as described in paragraphs (c) through (o) of this section, whenever employee noise exposures equal or exceed an 8-hour time-weighted average sound level (TWA) of 85 decibels measured on the A scale (slow response) or, equivalently, a dose of fifty percent. For purposes of the hearing conservation program, employee noise exposures shall be computed in accordance with Appendix A and Table G-16a, and without regard to any attenuation provided by the use of personal protective equipment.

(2) For purposes of paragraphs (c) through (n) of this section, an 8-hour time-weighted average of 85 decibels or a dose of fifty percent shall also be referred to as the action level.

(d) *Monitoring.* (1) When information indicates that any employee's exposure may equal or exceed an 8-hour time-weighted average of 85 decibels, the employer shall develop and implement a monitoring program. (i) The sampling strategy shall be designed to identify employees for inclusion in the hearing conservation program and to enable the proper selection of hearing protectors.

(ii) Where circumstances such as high worker mobility, significant variations in sound level, or a significant component of impulse noise make area monitoring generally inappropriate, the employer shall use representative personal sampling to comply with the monitoring requirements of this paragraph unless the employer can show that area sampling produces equivalent results.

(2)(i) All continuous, intermittent and impulsive sound levels from 80 decibels to 130 decibels shall be integrated into the noise measurements.

(ii) Instruments used to measure employee noise exposure shall be calibrated to ensure measurement accuracy.

(3) Monitoring shall be repeated whenever a change in production, process, equipment or controls increases noise exposures to the extent that:

- (i) Additional employees may be exposed at or above the action level; or
- (ii) The attenuation provided by hearing protectors being used by employees may be rendered inadequate to meet the requirements of paragraph (j) of this section.

(e) *Employee notification.* The employer shall notify each employee exposed at or above an 8-hour time-weighted average of 85 decibels of the results of the monitoring.

(f) *Observation of monitoring.* The employer shall provide affected employees or their representatives with an opportunity to observe any noise measurements conducted pursuant to this section.

(g) *Audiometric testing program.* (1) The employer shall establish and maintain an audiometric testing program as provided in this paragraph by making audiometric testing available to all employees whose exposures equal or exceed an 8-hour time-weighted average of 85 decibels.

(2) The program shall be provided at no cost to employees.

(3) Audiometric tests shall be performed by a licensed or certified audiologist, otolaryngologist, or other physician, or by a technician who is certified by the Council of Accreditation in Occupational Hearing Conservation, or who has satisfactorily demonstrated competence in administering audiometric examinations, obtaining valid audiograms, and properly using, maintaining and checking calibration and proper functioning of the audiometers being used. A technician who operates microprocessor audiometers does not need to be certified. A technician who performs audiometric tests must be responsible to an audiologist, otolaryngologist or physician.

(4) All audiograms obtained pursuant to this section shall meet the requirements of Appendix C:

Audiometric Measuring Instruments.

(5) *Baseline audiogram.* (i) Within 6 months of an employee's first exposure at or above the action level, the employer shall establish a valid baseline audiogram against which subsequent audiograms can be compared.

(ii) *Mobile test van exception.* Where mobile test vans are used to meet the audiometric testing obligation, the employer shall obtain a valid baseline audiogram within 1 year of an employee's first exposure at or above the action level. Where baseline audiograms are obtained more than 6 months after the employee's first exposure at or above the action level, employees shall wearing hearing protectors for any period exceeding six months after first exposure until the baseline audiogram is obtained.

(iii) Testing to establish a baseline audiogram shall be preceded by at least 14 hours without exposure to workplace noise. Hearing protectors may be used as a substitute for the requirement that baseline audiograms be preceded by 14 hours without exposure to workplace noise.

(iv) The employer shall notify employees of the need to avoid high

levels of non-occupational noise exposure during the 14-hour period immediately preceding the audiometric examination.

(6) *Annual audiogram.* At least annually after obtaining the baseline audiogram, the employer shall obtain a new audiogram for each employee exposed at or above an 8-hour time-weighted average of 85 decibels.

(7) *Evaluation of audiogram.* (i) Each employee's annual audiogram shall be compared to that employee's baseline audiogram to determine if the audiogram is valid and if a standard threshold shift as defined in paragraph (g)(10) of this section has occurred. This comparison may be done by a technician.

(ii) If the annual audiogram shows that an employee has suffered a standard threshold shift, the employer may obtain a retest within 30 days and consider the results of the retest as the annual audiogram.

(iii) The audiologist, otolaryngologist, or physician shall review problem audiograms and shall determine whether there is a need for further evaluation. The employer shall provide to the person performing this evaluation the following information:

(A) A copy of the requirements for hearing conservation as set forth in paragraphs (c) through (n) of this section;

(B) The baseline audiogram and most recent audiogram of the employee to be evaluated;

(C) Measurements of background sound pressure levels in the audiometric test room as required in Appendix D: Audiometric Test Rooms.

(D) Records of audiometer calibrations required by paragraph (h)(5) of this section.

(8) *Follow-up procedures.* (i) If a comparison of the annual audiogram to the baseline audiogram indicates a standard threshold shift as defined in paragraph (g)(10) of this section has occurred, the employee shall be informed of this fact in writing, within 21 days of the determination.

(ii) Unless a physician determines that the standard threshold shift is not work related or aggravated by occupational noise exposure, the employer shall ensure that the following steps are taken when a standard threshold shift occurs:

(A) Employees not using hearing protectors shall be fitted with hearing protectors, trained in their use and care, and required to use them.

(B) Employees already using hearing protectors shall be refitted and retained in the use of hearing protectors and provided with hearing protectors offering greater attenuation if necessary.

(C) The employee shall be referred for a clinical audiological evaluation or an otological examination, as appropriate, if additional testing is necessary or if the employer suspects that a medical pathology of the ear is caused or aggravated by the wearing of hearing protectors.

(D) The employee is informed of the need for an otological examination if a medical pathology of the ear that is unrelated to the use of hearing protectors is suspected.

(iii) If subsequent audiometric testing of an employee whose exposure to noise is less than an 8-hour TWA of 90 decibels indicates that a standard threshold shift is not persistent, the employer:

(A) Shall inform the employee of the new audiometric interpretation; and

(B) May discontinue the required use of hearing protectors for that employee.

(9) *Revised baseline.* An annual audiogram may be substituted for the baseline audiogram when, in the judgment of the audiologist, otolaryngologist or physician who is evaluating the audiogram:

(i) The standard threshold shift revealed by the audiogram is persistent; or

(ii) The hearing threshold shown in the annual audiogram indicates significant improvement over the baseline audiogram.

(10) *Standard threshold shift.* (1) As used in this section, a standard threshold shift is a change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear.

(ii) In determining whether a standard threshold shift has occurred, allowance may be made for the contribution of aging (presbycusis) to the change in hearing level by correcting the annual audiogram according to the procedure described in Appendix F: *Calculation and Application of Age Correction to Audiograms.*

(h) *Audiometric test requirements.* (1) 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. Tests at each frequency shall be taken separately for each ear.

(2) Audiometric tests shall be conducted with audiometers (including microprocessor audiometers) that meet the specifications of, and are maintained and used in accordance with, American National Standard Specification for Audiometers, S3.6-1969.

(3) Pulsed-tone and self-recording audiometers, if used, shall meet the requirements specified in Appendix C: *Audiometric Measuring Instruments*.

(4) Audiometric examinations shall be administered in a room meeting the requirements listed in Appendix D: *Audiometric Test Rooms*.

(5) *Audiometer calibration.* (i) The functional operation of the audiometer shall be checked before each day's use by testing a person with known, stable hearing thresholds, and by listening to the audiometer's output to make sure that the output is free from distorted or unwanted sounds. Deviations of 10 decibels or greater require an acoustic calibration.

(ii) Audiometer calibration shall be checked acoustically at least annually in accordance with Appendix E: *Acoustic Calibration of Audiometers*. Test frequencies below 500 Hz and above 6000 Hz may be omitted from this check. Deviations of 15 decibels or greater require an exhaustive calibration.

(iii) An exhaustive calibration shall be performed at least every two years in accordance with sections 4.1.2; 4.1.3; 4.1.4.3; 4.2; 4.4.1; 4.4.2; 4.4.3; and 4.5 of the American National Standard Specification for Audiometers, S3.6-1969. Test frequencies below 500 Hz and above 6000 Hz may be omitted from this calibration.

(i) *Hearing protectors.* (1) Employers shall make hearing protectors available to all employees exposed to an 8-hour time-weighted average of 85 decibels or greater at no cost to the employees. Hearing protectors shall be replaced as necessary.

(2) Employers shall ensure that hearing protectors are worn:

(i) By an employee who is required by paragraph (b)(1) of this section to wear personal protective equipment; and

(ii) By any employee who is exposed to an 8-hour time-weighted average of 85 decibels or greater, and who:

(A) Has not yet had a baseline audiogram established pursuant to paragraph (g)(5)(ii); or

(B) Has experienced a standard threshold shift.

(3) Employees shall be given the opportunity to select their hearing protectors from a variety of suitable hearing protectors provided by the employer.

(4) The employer shall provide training in the use and care of all hearing protectors provided to employees.

(5) The employer shall ensure proper initial fitting and supervise the correct

use of all hearing protectors.

(j) *Hearing protector attenuation.* (1) The employer shall evaluate hearing protector attenuation for the specific noise environments in which the protector will be used. The employer shall use one of the evaluation methods described in Appendix B: *Methods for Estimating the Adequacy of Hearing Protection Attenuation*.

(2) Hearing protectors must attenuate employee exposure at least to an 8-hour time-weighted average of 90 decibels as required by paragraph (b) of this section.

(3) For employees who have experienced a standard threshold shift, hearing protectors must attenuate employee exposure to an 8-hour time-weighted average of 85 decibels or below.

(4) The adequacy of hearing protector attenuation shall be re-evaluated whenever employee noise exposures increase to the extent that the hearing protectors provided may no longer provide adequate attenuation. The employee shall provide more effective hearing protectors where necessary.

(k) *Training program.* (1) The employer shall institute a training program for all employees who are exposed to noise at or above an 8-hour time-weighted average of 85 decibels, and shall ensure employee participation in such program.

(2) The training program shall be repeated annually for each employee included in the hearing conservation program. Information provided in the training program shall be updated to be consistent with changes in protective equipment and work processes.

(3) The employer shall ensure that each employee is informed of the following:

(i) The effects of noise on hearing;

(ii) The purpose of hearing protectors, the advantages, disadvantages, and attenuation of various types, and instructions on selection, fitting, use, and care; and

(iii) The purpose of audiometric testing, and an explanation of the test procedures.

(l) *Access to information and training materials.* (1) The employer shall make available to affected employees or their representatives copies of this standard and shall also post a copy in the workplace.

(2) The employer shall provide to affected employees any informational materials pertaining to the standard that are supplied to the employer by the Assistant Secretary.

(3) The employer shall provide, upon request, all materials related to the employer's training and education program pertaining to this standard to the Assistant Secretary and the Director.

(m) *Recordkeeping.*—(1) *Exposure measurements.* The employer shall maintain an accurate record of all employee exposure measurements required by paragraph (d) of this section.

(2) *Audiometric tests.* (i) The employer shall retain all employee audiometric test records obtained pursuant to paragraph (g) of this section:

(ii) This record shall include:

(A) Name and job classification of the employee;

(B) Date of the audiogram;

(C) The examiner's name;

(D) Date of the last acoustic or exhaustive calibration of the audiometer; and

(E) Employee's most recent noise exposure assessment.

(F) The employer shall maintain accurate records of the measurements of the background sound pressure levels in audiometric test rooms.

(3) *Record retention.* The employer shall retain records required in this paragraph (m) for at least the following periods.

(i) Noise exposure measurement records shall be retained for two years.

(ii) Audiometric test records shall be retained for the duration of the affected employee's employment.

(4) *Access to records.* All records required by this section shall be provided upon request to employees, former employees, representatives designated by the individual employee, and the Assistant Secretary. The provisions of 29 CFR 1910.20 (a)-(e) and (g)-(i) apply to access to records under this section.

(5) *Transfer of records.* If the employer ceases to do business, the employer shall transfer to the successor employer all records required to be maintained by this section, and the successor employer shall retain them for the remainder of the period prescribed in paragraph (m) (3) of this section.

(n) *Appendices.* (1) Appendices A, B, C, D, and E to this section are incorporated as part of this section and the contents of these Appendices are mandatory.

(2) Appendices F and G to this section are informational and are not intended to create any additional obligations not

otherwise imposed or to detract from any existing obligations.

(o) *Exemptions.* Paragraphs (c) through (n) of this section shall not apply to employers engaged in oil and gas well drilling and servicing operations.

(p) *Startup date.* Baseline audiograms required by paragraph (g) of this section shall be completed by March 1, 1984.

Appendix A: Noise Exposure Computation

This Appendix is Mandatory

I. Computation of Employee Noise Exposure

(1) Noise dose is computed using Table G-16a as follows:

(i) When the sound level, L, is constant over the entire work shift, the noise dose, D, in percent, is given by: $D = 100 C/T$ where C is the total length of the work day, in hours, and T is the reference duration corresponding to the measured sound level, L, as given in Table G-16a or by the formula shown as a footnote to that table.

(ii) When the workshift noise exposure is composed of two or more periods of noise at different levels, the total noise dose over the work day is given by:

$$D = 100 (C_1/T_1 + C_2/T_2 + \dots + C_n/T_n),$$

where C_n indicates the total time of exposure at a specific noise level, and T_n indicates the reference duration for that level as given by Table G-16a.

(2) The eight-hour time-weighted average sound level (TWA), in decibels, may be computed from the dose, in percent, by means of the formula: $TWA = 16.61 \log_{10} (D/100) + 90$. For an eight-hour workshift with the noise level constant over the entire shift, the TWA is equal to the measured sound level.

(3) A table relating dose and TWA is given in Section II.

TABLE G-16a

A-weighted sound level, L (decibel)	Reference duration, T (hour)
80	32
81	27.9
82	24.3
83	21.1
84	18.4
85	16
86	13.9
87	12.1
88	10.6
89	9.2
90	8
91	7.0
92	6.1
93	5.3
94	4.6
95	4
96	3.5
97	3.0
98	2.6
99	2.3
100	2
101	1.7
102	1.5
103	1.3
104	1.1
105	1
106	0.87

TABLE G-16a—Continued

A-weighted sound level, L (decibel)	Reference duration, T (hour)
107	0.76
108	0.66
109	0.57
110	0.5
111	0.44
112	0.38
113	0.33
114	0.29
115	0.25
116	0.22
117	0.19
118	0.16
119	0.14
120	0.125
121	0.11
122	0.095
123	0.082
124	0.072
125	0.063
126	0.054
127	0.047
128	0.041
129	0.036
130	0.031

In the above table the reference duration, T, is computed by

$$T = \frac{8}{2^{(L-90)/5}}$$

where L is the measured A-weighted sound level.

II. Conversion Between "Dose" and "8-Hour Time-Weighted Average" Sound Level

Compliance with paragraphs (c)-(r) of this regulation is determined by the amount of exposure to noise in the workplace. The amount of such exposure is usually measured with an audiodosimeter which gives a readout in terms of "dose." In order to better understand the requirements of the amendment, dosimeter readings can be converted to an "8-hour time-weighted average sound level." (TWA).

In order to convert the reading of a dosimeter into TWA, see Table A-1, below. This table applies to dosimeters that are set by the manufacturer to calculate dose or percent exposure according to the relationships in Table G-16a. So, for example, a dose of 91 percent over an eight hour day results in a TWA of 89.3 dB, and, a dose of 50 percent corresponds to a TWA of 85 dB.

If the dose as read on the dosimeter is less than or greater than the values found in Table A-1, the TWA may be calculated by using the formula: $TWA = 16.61 \log_{10} (D/100) + 90$ where TWA = 8-hour time-weighted average sound level and D = accumulated dose in percent exposure.

TABLE A-1.—CONVERSION FROM "PERCENT NOISE EXPOSURE" OR "DOSE" TO "8-HOUR TIME-WEIGHTED AVERAGE SOUND LEVEL" (TWA)

Dose or percent noise exposure	TWA
10	73.4
15	76.3
20	78.4
25	80.0
30	81.3
35	82.4
40	83.4
45	84.2
50	85.0
55	85.7
60	86.3
65	86.9
70	87.4
75	87.9
80	88.4
81	88.5
82	88.6
83	88.7
84	88.7
85	88.8
86	88.9
87	89.0
88	89.1
89	89.2
90	89.2
91	89.3
92	89.4
93	89.5
94	89.6
95	89.6
96	89.7
97	89.8
98	89.9
99	89.9
100	90.0
101	90.1
102	90.1
103	90.2
104	90.3
105	90.4
106	90.4
107	90.5
108	90.6
109	90.6
110	90.7
111	90.8
112	90.8
113	90.9
114	90.9
115	91.1
116	91.1
117	91.1
118	91.2
119	91.3
120	91.3
125	91.6
130	91.9
135	92.2
140	92.4
145	92.7
150	92.9
155	93.2
160	93.4
165	93.6
170	93.8
175	94.0
180	94.2
185	94.4
190	94.6
195	94.8
200	95.0
210	95.4
220	95.7
230	96.0
240	96.3
250	96.6
260	96.9
270	97.2
280	97.4
290	97.7
300	97.9
310	98.2
320	98.4
330	98.6
340	98.8
350	99.0
360	99.2
370	99.4

TABLE A-1.—CONVERSION FROM "PERCENT NOISE EXPOSURE" OR "DOSE" TO "8-HOUR TIME-WEIGHTED AVERAGE SOUND LEVEL" (TWA)—Continued

Dose or percent noise exposure	TWA
380	99.6
390	99.8
400	100.0
410	100.2
420	100.4
430	100.5
440	100.7
450	100.8
460	101.0
470	101.2
480	101.3
490	101.5
500	101.6
510	101.8
520	101.9
530	102.0
540	102.2
550	102.3
560	102.4
570	102.6
580	102.7
590	102.8
600	102.9
610	103.0
620	103.2
630	103.3
640	103.4
650	103.5
660	103.6
670	103.7
680	103.8
690	103.9
700	104.0
710	104.1
720	104.2
730	104.3
740	104.4
750	104.5
760	104.6
770	104.7
780	104.8
790	104.9
800	105.0
810	105.1
820	105.2
830	105.3
840	105.4
850	105.4
860	105.5
870	105.6
880	105.7
890	105.8
900	105.8
910	105.9
920	106.0
930	106.1
940	106.2
950	106.2
960	106.3
970	106.4
980	106.5
990	106.5
999	106.6

Appendix B: Methods for Estimating the Adequacy of Hearing Protector Attenuation

This Appendix is Mandatory

For employees who have experienced a significant threshold shift, hearing protector attenuation must be sufficient to reduce employee exposure to a TWA of 85 dB. Employers must select one of the following methods by which to estimate the adequacy of hearing protector attenuation.

The most convenient method is the Noise Reduction Rating (NRR) developed by the Environmental

Protection Agency (EPA). According to EPA regulation, the NRR must be shown on the hearing protector package. The NRR is then related to an individual worker's noise environment in order to assess the adequacy of the attenuation of a given hearing protector. This Appendix describes four methods of using the NRR to determine whether a particular hearing protector provides adequate protection within a given exposure environment. Selection among the four procedures is dependent upon the employer's noise measuring instruments.

Instead of using the NRR, employers may evaluate the adequacy of hearing protector attenuation by using one of the three methods developed by the National Institute for Occupational Safety and Health (NIOSH), which are described in the "List of Personal Hearing Protectors and Attenuation Data," HEW Publication No. 76-120, 1975, pages 21-37. These methods are known as NIOSH methods #1, #2 and #3. The NRR described below is a simplification of NIOSH method #2. The most complex method is NIOSH method #1, which is probably the most accurate method since it uses the largest amount of spectral information from the individual employee's noise environment. As in the case of the NRR method described below, if one of the NIOSH methods is used, the selected method must be applied to an individual's noise environment to assess the adequacy of the attenuation. Employers should be careful to take a sufficient number of measurements in order to achieve a representative sample for each time segment.

Note.—The employer must remember that calculated attenuation values reflect realistic values only to the extent that the protectors are properly fitted and worn.

When using the NRR to assess hearing protector adequacy, one of the following methods must be used:

- (i) When using a dosimeter that is capable of C-weighted measurements:
 - (A) Obtain the employee's C-weighted dose for the entire workshift, and convert to TWA (see Appendix A, II).
 - (B) Subtract the NRR from the C-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.
- (ii) When using a dosimeter that is not capable of C-weighted measurements, the following method may be used:
 - (A) Convert the A-weighted dose to TWA (see Appendix A).
 - (B) Subtract 7 dB from the NRR.
 - (C) Subtract the remainder from the A-weighted TWA to obtain the

estimated A-weighted TWA under the ear protector.

(iii) When using a sound level meter set to the A-weighting network:

(A) Obtain the employee's A-weighted TWA.

(B) Subtract 7 dB from the NRR, and subtract the remainder from the A-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

(iv) When using a sound level meter set on the C-weighting network:

(A) Obtain a representative sample of the C-weighted sound levels in the employee's environment.

(B) Subtract the NRR from the C-weighted average sound level to obtain the estimated A-weighted TWA under the ear protector.

(v) When using area monitoring procedures and a sound level meter set to the A-weighting network:

(A) Obtain a representative sound level for the area in question.

(B) Subtract 7 dB from the NRR and subtract the remainder from the A-weighted sound level for that area.

(vi) When using area monitoring procedures and a sound level meter set to the C-weighting network:

(A) Obtain a representative sound level for the area in question.

(B) Subtract the NRR from the C-weighted sound level for that area.

Appendix C: Audiometric Measuring Instruments

This Appendix is Mandatory

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

2. 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 increments are optional. The audiogram pen tracings shall not exceed 2 dB in width.

(B) It shall be possible to set the stylus manually at the 10-dB increment 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 (\pm 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) 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.

Appendix D: Audiometric Test Rooms

This Appendix is Mandatory

Rooms used for audiometric testing shall not have background sound pressure levels exceeding those in Table D-1 when measured by equipment conforming at least to the Type 2 requirements of American National Standard Specification for Sound Level Meters, S1.4-1971 (R1976), and to the Class II requirements of American National Standard Specification for Octave, Half-Octave, and Third-Octave Band Filter Sets, S1.11-1971 (R1976).

TABLE D-1.—MAXIMUM ALLOWABLE OCTAVE-BAND SOUND PRESSURE LEVELS FOR AUDIO-METRIC TEST ROOMS

Octave-band center frequency (Hz)	500	1000	2000	4000	8000
Sound pressure level (dB)	40	40	47	57	62

Appendix E: Acoustic Calibration of Audiometers

This Appendix is Mandatory

Audiometer calibration shall be checked acoustically, at least annually, according to the procedures described in this Appendix. The equipment necessary to perform these measurements is a sound level meter, octave-band filter set, and a National Bureau of Standards 9A coupler. In making these measurements, the accuracy of the calibrating equipment shall be sufficient to determine that the audiometer is within the tolerances permitted by American Standard Specification for Audiometers, S3.6-1969.

(1) Sound Pressure Output Check

A. Place the earphone coupler over the microphone of the sound level meter and place the earphone on the coupler.

B. Set the audiometer's hearing threshold level (HTL) dial to 70 dB.

C. Measure the sound pressure level of the tones that each test frequency from 500 Hz through 6000 Hz for each earphone.

D. At each frequency the readout on the sound level meter should correspond to the levels in Table E-1 or Table E-2, as appropriate, for the type of earphone, in the column entitled "sound level meter reading."

(2) Linearity Check

A. With the earphone in place, set the frequency to 1000 Hz and the HTL dial on the audiometer to 70 dB.

B. Measure the sound levels in the coupler at each 10-dB decrement from 70 dB to 10 dB, noting the sound level meter reading at each setting.

C. For each 10-dB decrement on the audiometer the sound level meter should indicate a corresponding 10 dB decrease.

D. This measurement may be made electrically with a voltmeter connected to the earphone terminals.

(3) Tolerances

When any of the measured sound levels deviate from the levels in Table E-1 or Table E-2 by ± 3 dB at any test frequency between 500 and 3000 Hz, 4 dB at 4000 Hz, or 5 dB at 6000 Hz, an exhaustive calibration is advised. An exhaustive calibration is required if the deviations are greater than 10 dB at any test frequency.

TABLE E-1.—REFERENCE THRESHOLD LEVELS FOR TELEPHONICS—TDH-39 EARPHONES

Frequency, Hz	Reference threshold level for TDH-39 ear-phones, dB	Sound level meter reading, dB
500	11.5	81.5
1000	7	77
2000	9	79
3000	10	80
4000	9.5	79.5
6000	15.5	85.5

TABLE E-2.—REFERENCE THRESHOLD LEVELS FOR TELEPHONICS—TDH-49 EARPHONES

Frequency, Hz	Refer-ence threshold level for TDH-49 ear-phones, dB	Sound level meter reading, dB
500	13.5	83.5
1000	7.5	77.5
2000	11	81.0
3000	9.5	79.5
4000	10.5	80.5
6000	13.5	83.5

Appendix F: Calculations and Application of Age Corrections to Audiograms

This Appendix Is Non-Mandatory

In determining whether a standard threshold shift has occurred, allowance may be made for the contribution of

aging to the change in hearing level by adjusting the most recent audiogram. If the employer chooses to adjust the audiogram, the employer shall follow the procedure described below. This procedure and the age correction tables were developed by the National Institute for Occupational Safety and Health in the criteria document entitled "Criteria for a Recommended Standard . . . Occupational Exposure to Noise," ((HSM)-11001).

For each audiometric test frequency;

(i) Determine from Tables F-1 or F-2 the age correction values for the employee by:

(A) Finding the age at which the most recent audiogram was taken and recording the corresponding values of age corrections at 1000 Hz through 6000 Hz;

(B) Finding the age at which the baseline audiogram was taken and recording the corresponding values of age corrections at 1000 Hz through 6000 Hz.

(ii) Subtract the values found in step (i)(A) from the value found in step (i)(B).

(iii) The differences calculated in step (ii) represented that portion of the change in hearing that may be due to aging.

Example: Employee is a 32-year-old male. The audiometric history for his right ear is shown in decibels below.

Employee's age	Audiometric test frequency (Hz)				
	1000	2000	3000	4000	6000
26	10	5	5	10	5
*27	0	0	0	5	5
28	0	0	0	10	5
29	5	0	5	15	5
30	0	5	10	20	10
31	5	10	20	15	15
*32	5	10	10	25	20

The audiogram at age 27 is considered the baseline since it shows the best hearing threshold levels. Asterisks have been used to identify the baseline and most recent audiogram. A threshold shift of 20 dB exists at 4000 Hz between the audiograms taken at ages 27 and 32.

(The threshold shift is computed by subtracting the hearing threshold at age 27, which was 5, from the hearing threshold at age 32, which is 25). A retest audiogram has confirmed this shift. The contribution of aging to this change in hearing may be estimated in the following manner:

Go to Table F-1 and find the age correction values (in dB) for 4000 Hz at age 27 and age 32.

	Frequency (Hz)				
	1000	2000	3000	4000	6000
Age 32.....	6	5	7	10	14
Age 27.....	5	4	6	7	11
Difference.....	1	1	1	3	3

The difference represents the amount of hearing loss that may be attributed to aging in the time period between the baseline audiogram and the most recent audiogram. In this example, the difference at 4000 Hz is 3 dB. This value is subtracted from the hearing level at 4000 Hz, which in the most recent audiogram is 25, yielding 22 after adjustment. Then the hearing threshold in the baseline audiogram at 4000 Hz (5) is subtracted from the adjusted annual audiogram hearing threshold at 4000 Hz (22). Thus the age-corrected threshold shift would be 17 dB (as opposed to a threshold shift of 20 dB without age correction).

TABLE F-1.—AGE CORRECTION VALUES IN DECIBELS FOR MALES

Years	Audiometric Test Frequencies (Hz)				
	1000	2000	3000	4000	6000
20 or younger.....	5	3	4	5	8
21.....	5	3	4	5	8
22.....	5	3	4	5	8
23.....	5	3	4	6	9
24.....	5	3	5	6	9
25.....	5	3	5	7	10
26.....	5	4	5	7	10
27.....	5	4	6	7	11
28.....	6	4	6	8	11
29.....	6	4	6	8	12
30.....	6	4	6	9	12
31.....	6	4	7	9	13
32.....	6	5	7	10	14
33.....	6	5	7	10	14
34.....	6	5	8	11	15
35.....	7	5	8	11	15
36.....	7	5	9	12	16
37.....	7	6	9	12	17
38.....	7	6	9	13	17
39.....	7	6	10	14	18
40.....	7	6	10	14	19
41.....	7	6	10	14	20
42.....	8	7	11	16	20
43.....	8	7	12	16	21
44.....	8	7	12	17	22
45.....	8	7	13	18	23
46.....	8	8	13	19	24
47.....	8	8	14	19	24
48.....	9	8	14	20	25
49.....	9	9	15	21	26
50.....	9	9	16	22	27
51.....	9	9	16	23	28
52.....	9	10	17	24	29
53.....	9	10	18	25	30
54.....	10	10	18	26	31
55.....	10	11	19	27	32
56.....	10	11	20	28	34
57.....	10	11	21	29	35
58.....	10	12	22	31	36
59.....	11	12	22	32	37
60 or older.....	11	13	23	33	38

TABLE F-2.—AGE CORRECTION VALUES IN DECIBELS FOR FEMALES

Years	Audiometric Test Frequencies (Hz)				
	1000	2000	3000	4000	6000
20 or younger.....	7	4	3	3	6
21.....	7	4	4	3	6

TABLE F-2.—AGE CORRECTION VALUES IN DECIBELS FOR FEMALES—Continued

Years	Audiometric Test Frequencies (Hz)				
	1000	2000	3000	4000	6000
22.....	7	4	4	4	6
23.....	7	5	4	4	7
24.....	7	5	4	4	7
25.....	8	5	4	4	7
26.....	8	5	5	4	8
27.....	8	5	5	5	8
28.....	8	5	5	5	8
29.....	8	5	5	5	9
30.....	8	6	5	5	9
31.....	8	6	6	5	9
32.....	9	6	6	6	10
33.....	9	6	6	6	10
34.....	9	6	6	6	10
35.....	9	6	7	7	11
36.....	9	7	7	7	11
37.....	9	7	7	7	12
38.....	10	7	7	7	12
39.....	10	7	8	8	12
40.....	10	7	8	8	13
41.....	10	8	8	8	13
42.....	10	8	9	9	13
43.....	11	8	9	9	14
44.....	11	8	9	9	14
45.....	11	8	10	10	15
46.....	11	9	10	10	15
47.....	11	9	10	11	16
48.....	12	9	11	11	16
49.....	12	9	11	11	16
50.....	12	10	11	12	17
51.....	12	10	12	12	17
52.....	12	10	12	13	18
53.....	13	10	13	13	18
54.....	13	11	13	14	19
55.....	13	11	14	14	19
56.....	13	11	14	15	20
57.....	13	11	15	15	20
58.....	14	12	15	16	21
59.....	14	12	16	16	21
60 or older.....	14	12	16	17	22

Appendix G: Monitoring Noise Levels Non-Mandatory Informational Appendix

This appendix provides information to help employers comply with the noise monitoring obligations that are part of the hearing conservation amendment.

What is the purpose of noise monitoring?

This revised amendment requires that employees be placed in a hearing conservation program if they are exposed to average noise levels of 85 dB or greater during an 8 hour workday. In order to determine if exposures are at or above this level, it may be necessary to measure or monitor the actual noise levels in the workplace and to estimate the noise exposure or "dose" received by employees during the workday.

When is it necessary to implement a noise monitoring program?

It is not necessary for every employer to measure workplace noise. Noise monitoring or measuring must be conducted only when exposures are at or above 85 dB. Factors which suggest that noise exposures in the workplace may be at this level include employee complaints about the loudness of noise, indications that employees are losing their hearing, or noisy conditions which make normal conversation difficult. The employer should also consider any

information available regarding noise emitted from specific machines. In addition, actual workplace noise measurements can suggest whether or not a monitoring program should be initiated.

How is noise measured?

Basically, there are two different instruments to measure noise exposures: the sound level meter and the dosimeter. A sound level meter is a device that measures the intensity of sound at a given moment. Since sound level meters provide a measure of sound intensity at only one point in time, it is generally necessary to take a number of measurements at different times during the day to estimate noise exposure over a workday. If noise levels fluctuate, the amount of time noise remains at each of the various measured levels must be determined.

To estimate employee noise exposures with a sound level meter it is also generally necessary to take several measurements at different locations within the workplace. After appropriate sound level meter readings are obtained, people sometimes draw "maps" of the sound levels within different areas of the workplace. By using a sound level "map" and information on employee locations throughout the day, estimates of individual exposure levels can be developed. This measurement method is generally referred to as *area* noise monitoring.

A dosimeter is like a sound level meter except that it stores sound level measurements and integrates these measurements over time, providing an average noise exposure reading for a given period of time, such as an 8-hour workday. With a dosimeter, a microphone is attached to the employee's clothing and the exposure measurement is simply read at the end of the desired time period. A reader may be used to read-out the dosimeter's measurements. Since the dosimeter is worn by the employee, it measures noise levels in those locations in which the employee travels. A sound level meter can also be positioned within the immediate vicinity of the exposed worker to obtain an individual exposure estimate. Such procedures are generally referred to as *personal* noise monitoring.

Area monitoring can be used to estimate noise exposure when the noise levels are relatively constant and employees are not mobile. In workplaces where employees move about in different areas or where the noise intensity tends to fluctuate over time, noise exposure is generally more accurately estimated by the personal monitoring approach.

In situations where personal monitoring is appropriate, proper positioning of the microphone is necessary to obtain accurate measurements. With a dosimeter, the microphone is generally located on the shoulder and remains in that position for the entire workday. With a sound level meter, the microphone is stationed near the employee's head, and the instrument is usually held by an individual who follows the employee as he or she moves about.

Manufacturer's instructions, contained in dosimeter and sound level meter operating manuals, should be followed for calibration and maintenance. To ensure accurate results, it is considered good professional practice to calibrate instruments before and after each use.

How often is it necessary to monitor noise levels?

The amendment requires that when there are significant changes in

machinery or production processes that may result in increased noise levels, remonitoring must be conducted to determine whether additional employees need to be included in the hearing conservation program. Many companies choose to remonitor periodically (once every year or two) to ensure that all exposed employees are included in their hearing conservation programs.

Where can equipment and technical advice be obtained?

Noise monitoring equipment may be either purchased or rented. Sound level meters cost about \$500 to \$1,000, while dosimeters range in price from about \$750 to \$1,500. Smaller companies may find it more economical to rent equipment rather than to purchase it. Names of equipment suppliers may be found in the telephone book (Yellow Pages) under headings such as: "Safety Equipment," "Industrial Hygiene," or

"Engineers-Acoustical." In addition to providing information on obtaining noise monitoring equipment, many companies and individuals included under such listings can provide professional advice on how to conduct a valid noise monitoring program. Some audiological testing firms and industrial hygiene firms also provide noise monitoring services. Universities with audiology, industrial hygiene, or acoustical engineering departments may also provide information or may be able to help employers meet their obligations under this amendment.

Free, on-site assistance may be obtained from OSHA-supported state and private consultation organizations. These safety and health consultative entities generally give priority to the needs of small businesses. See the attached directory for a listing of organizations to contact for aid.

OSHA ONSITE CONSULTATION PROJECT DIRECTORY

State	Office and address	Contact
Alabama	Alabama Consultation Program, P.O. Box 6005, University, Alabama 35486	(205) 348-7136, Mr. William Weems, Director.
Alaska	State of Alaska, Department of Labor, Occupational Safety & Health, 3301 Eagle St., Pouch 7-022, Anchorage, Alaska 99510.	(907) 276-5013, Mr. Stan Godsoe, Project Manager (Air Mail).
American Samoa	Service not yet available.	
Arizona	Consultation and Training, Arizona Division of Occupational Safety and Health, P.O. Box 19070, 1624 W. Adams, Phoenix, Ariz. 85005.	(602) 255-5795, Mr. Thomas Ramaley, Manager.
Arkansas	OSHA Consultation, Arkansas Department of Labor, 1022 High St., Little Rock, Ark. 72202	(501) 371-2992, Mr. George Smith, Project Director.
California	CAL/OSHA Consultation Service, 2nd Floor, 525 Golden Gate Avenue, San Francisco, Calif. 94102.	(415) 557-2870, Mr. Emmett Jones, Chief.
Colorado	Occupational Safety & Health Section, Colorado State University, Institute of Rural Environmental Health, 110 Veterinary Science Building, Fort Collins, Colo. 80523.	(303) 491-6151, Dr. Roy M. Buchan, Project Director.
Connecticut	Division of Occupational Safety & Health, Connecticut Department of Labor, 200 Folly Brook Boulevard, Wethersfield, Conn. 06109.	(203) 566-4550, Mr. Leo Alix, Director.
Delaware	Delaware Department of Labor, Division of Industrial Affairs, 820 North French Street, 6th Floor, Wilmington, Del. 19801.	(302) 571-3908, Mr. Bruno Salvadori, Director.
District of Columbia	Occupational Safety & Health Division, District of Columbia, Department Employment Services, Office of Labor Standards, 2900 Newton Street NE., Washington, D.C. 20018.	(202) 832-1230, Mr. Lorenzo M. White, Acting Associate Director.
Florida	Department of Labor & Employment Security, Bureau of Industrial Safety and Health, LaFayette Building, Room 204, 2551 Executive Center Circle West, Tallahassee, Fla. 32301.	(904) 488-3044, Mr. John C. Glenn, Administrator.
Georgia	Economic Development Division, Technology and Development Laboratory, Engineering Experiment Station, Georgia Institute of Technology, Atlanta, Ga. 30332.	(404) 894-3806, Mr. William C. Howard, Assistant to Director, Mr. James Burson, Project Manager.
Guam	Department of Labor, Government of Guam, 23548 Guam Main Facility, Agana, Guam 96921	(671) 772-6291, Joe R. San Agustin, Director.
Hawaii	Education and Information Branch, Division of Occupational Safety and Health, Suite 910, 677 Ala Moana, Honolulu, Hawaii 96813.	(808) 548-2511, Mr. Don Alper, Manager (Air Mail).
Idaho	OSHA Onsite Consultation Program, Boise State University, Community and Environmental Health, 1910 University Drive, Boise, Idaho 83725.	(208) 385-3929, Dr. Eldon Edmundson, Director.
Illinois	Division of Industrial Services, Dept. of Commerce and Community Affairs, 310 S. Michigan Avenue, 10 Floor, Chicago, Ill. 60601.	(800) 972-4140/4216 (Toll-free in State), (312) 793-3270, Mr. Stan Czwiniski, Assistant Director.
Iowa	Bureau of Labor, 307 E. Seventh Street, Des Moines, Iowa 50319	(515) 281-3606, Mr. Allen J. Meier, Commissioner.
Indiana	Bureau of Safety, Education and Training, Indiana Division of Labor, 1013 State Office Building, Indianapolis, Indiana 46204.	(317) 633-5845, Mr. Harold Mills, Director.
Kansas	Kansas Dept. of Human Resources, 401 Topeka Ave., Topeka, Kans. 66603	(913) 296-4086, Mr. Jerry Abbott, Secretary.
Kentucky	Education and Training, Occupational Safety and Health, Kentucky Department of Labor, 127 Building, 127 South, Frankfort, Ky. 40601.	(502) 564-6895, Mr. Larry Potter, Director.
Louisiana	No services available as yet (Pending FY 83).	
Maine	Division of Industrial Safety, Maine Dept. of Labor, Labor Station 45, State Office Building, Augusta, Maine 04333.	(207) 289-3331, Mr. Lester Wood, Director.
Maryland	Consultation Services, Division of Labor & Industry, 501 St. Paul Place, Baltimore, Maryland 21202	(301) 659-4210, Ms. Ileana O'Brien, Project Manager, 7(c)(1) Agreement.
Massachusetts	Division of Industrial Safety, Massachusetts Department of Labor and Industries, 100 Cambridge Street, Boston, Massachusetts 02202.	(617) 727-3567, Mr. Edward Noseworthy, Project Director.
Michigan (Health)	Special Programs Section, Division of Occupational Health, Michigan Dept. of Public Health, 3500 N. Logan, Lansing, Mich. 48909.	(517) 373-1410, Mr. Irving Davis, Chief.
Michigan (Safety)	Safety Education & Training Division Bureau of Safety and Regulation, Michigan Department of Labor, 7150 Harris Drive, Box 30015, Lansing, Michigan 48909.	(517) 322-1809, Mr. Alan Harvie, Chief.
Minnesota	Training and Education Unit, Department of Labor and Industry, 5th Floor, 444 Lafayette Road, St. Paul, Minn. 55101.	(612) 296-2973, Mr. Timothy Tierney, Project Manager.
Mississippi	Division of Occupational Safety and Health, Mississippi State Board of Health, P.O. Box 1700, Jackson, Mississippi 39205.	(601) 982-6315, Mr. Henry L. Laird, Director.
Missouri	Missouri Department of Labor and Industrial Relations, 722 Jefferson Street, Jefferson City, Missouri 65101.	1-(800) 392-0208, (314) 751-3403, Ms. Paula Smith, Mr. Jim Brake.
Montana	Montana Bureau of Safety & Health, Division of Workers Compensation, 815 Front Street, Helena, Montana 59601.	(406) 449-3402, Mr. Ed Gatzemeier, Chief.
Nebraska	Nebraska Department of Labor, State House Station, State Capitol, P.O. Box 94600, Lincoln, Nebraska 68509.	475-8451 Ext. 258, Mr. Joseph Carroll, Commissioner.

OSHA ONSITE CONSULTATION PROJECT DIRECTORY—Continued

State	Office and address	Contact
Nevada	Department of Occupational Safety and Health, Nevada Industrial Commission, 515 E. Muffer Street, Carson City, Nev. 89714.	(702) 885-5240, Mr. Allen Traenkner, Director.
New Hampshire	For information contact	Office of Consultation Programs, Room N3472 200 Constitution Avenue, N.W. Washington, D.C. 20210, Phone: (202) 523-8985.
New Jersey	New Jersey Department of Labor and Industry Division of Work Place Standards, CN-054, Trenton, New Jersey 08625.	(609) 292-2313, FTS-8-477-2213, Mr. William Clark, Assistant Commissioner.
New Mexico	OSHA Consultation, Health and Environment Department, Environmental Improvement Division, Occupational Health & Safety Section, 4215 Montgomery Boulevard, NE., Albuquerque, New Mexico 87109.	(505) 842-3387, Mr. Albert M. Stevens, Project Manager.
New York	Division of Safety and Health, New York State Department of Labor, 2 World Trade Center, Room 6995, New York, New York 10047.	(212) 488-7746/7, Mr. Joseph Aliava, Project Manager, DOSH.
North Carolina	Consultation Services, North Carolina Department of Labor, 4 West Edenton Street, Raleigh, N.C. 27601.	(919) 733-4865, Mr. David Pierce, Director.
North Dakota	Division of Environmental Research, Department of Health, Missouri Office Building, 1200 Missouri Avenue, Bismarck, N. Dak. 58505.	(701) 224-2348, Mr. Jay Crawford, Director.
Ohio	Department of Industrial Relations, Division of Onsite Consultation, P.O. Box 825, 2323 5th Avenue, Columbus, Ohio 43216.	(800) 292-1425 (Toll-free in State), (614) 466-7485, Mr. Andrew Doehrel, Project Manager.
Oklahoma	OSHA Division, Oklahoma Department of Labor, State Capitol, Suite 118, Oklahoma City, Okla. 73105.	(405) 521-2461, Mr. Charles W. McGlon, Director.
Oregon	Consultative Section, Department of Workers' Compensation, Accident Prevention Division, Room 102, Building 1, 2110 Front Street NE., Salem, Oregon 97310.	(503) 378-2890, Mr. Jack Buckland, Supervisor.
Pennsylvania	For information contact	Office of Consultation Programs, Room N3472, 200 Constitution Avenue NW., Washington, D.C. 20210, Phone: (202) 523-8985.
Puerto Rico	Occupational Safety & Health, Puerto Rico Department of Labor and Human Resources, 505 Munoz Rivera Ave., 21st Floor, Hato Rey, Puerto Rico 00919.	(809) 754-2134, Mr. John Cinque, Assistant Secretary, (Air Mail).
Rhode Island	Division of Occupational Health, Rhode Island Department of Health, The Cannon Building, 206 Health Department Building, Providence, R.I. 02903.	(401) 277-2436, Mr. James E. Hickoy, Chief.
South Carolina	Consultation and Monitoring, South Carolina Department of Labor, P.O. Box 11329, Columbia, S.C. 29211.	(803) 758-8921, Mr. Robert Peck, Director, 7(c)(1), Project.
South Dakota	South Dakota Consultation Program, South Dakota State University, S.T.A.T.E.-Engineering Extension, 201 Pugsley Center-SDSO, Brookings, S. Dak. 57007.	(605) 688-4101, Mr. James Ceglian, Director.
Tennessee	OSHA Consultative Services, Tennessee Department of Labor, 2nd Floor, 501 Union Building, Nashville, Tennessee 37219.	(615) 741-2793, Mr. L. H. Craig Director.
Texas	Division of Occupational Safety and State Safety Engineer, Texas Department of Health and Resources, 1100 West 49th Street, Austin, Texas 78756.	(512) 458-7287, Mr. Walter G. Martin, P.E. Director.
Trust Territories	Service not yet available.	
Utah	Utah Job Safety and Health Consultation Service, Suite 4004, Crane Building, 307 West 200 South, Salt Lake City, Utah 84101.	(801) 533-7927/6/9, Mr. H. M. Bergeson, Project Director.
Vermont	Division of Occupational Safety and Health, Vermont Department of Labor and Industry, 118 State Street, Montpelier, Vt. 05602.	(802) 828-2765, Mr. Robert Mcleod, Project Director.
Virginia	Department of Labor and Industry, P.O. Box 12064, 205 N. 4th Street, Richmond, Va. 23241.	(804) 786-5875, Mr. Robert Beard, Commissioner.
Virgin Islands	Division of Occupational Safety and Health, Virgin Islands Department of Labor, Lagoon Street, Room 207, Frederiksted, Virgin Islands 00840.	(809) 772-1315, Mr. Louis Llanos, Deputy Director-DOSH.
Washington	Department of Labor and Industry, P.O. Box 207, Olympia, Wash. 98504.	(206) 753-8500, Mr. James Sullivan, Assistant Director.
West Virginia	West Virginia Department of Labor, Room 451B, State Capitol, 1900 Washington Street, Charleston, W. Va. 25305.	FTS 8-885-7890, Mr. Lawrence Barker, Commissioner.
Wisconsin (Health)	Section of Occupational Health, Department of Health and Social Services, P.O. Box 309, Madison, Wisconsin 53701.	(608) 266-0417, Ms. Patricia Natzke, Acting Chief.
Wisconsin (Safety)	Division of Safety and Buildings, Department of Industry, Labor and Human Relations, 1570 E. Moreland Blvd., Waukesha, Wis. 53186.	(414) 544-8686, Mr. Richard Michalski, Supervisor.
Wyoming	Wyoming Occupational Health and Safety Department, 200 East 8th Avenue, Cheyenne, Wyo. 82002.	(307) 777-7786, Mr. Donald Owsley, Health and Safety Administrator.

Appendix H: Availability of Referenced Documents

Paragraphs (c) through (o) of 29 CFR 1910.95 and the accompanying appendices contain provisions which incorporate publications by reference. Generally, the publications provide criteria for instruments to be used in

monitoring and audiometric testing. These criteria are intended to be mandatory when so indicated in the applicable paragraphs of Section 1910.95 and appendices.

It should be noted that OSHA does not require that employers purchase a copy of the referenced publications. Employers, however, may desire to

obtain a copy of the referenced publications for their own information.

The designation of the paragraph of the standard in which the referenced publications appear, the titles of the publications, and the availability of the publications are as follows:

Paragraph designation	Referenced publication	Available from—
Appendix B	"List of Personal Hearing Protectors and Attenuation Data," HEW Pub. No. 78-120, 1975. NTIS-PB267461.	National Technical Information Service, Port Royal Road, Springfield, VA 22161.
Appendix D	"Specification for Sound Level Meters," S1.4-1971 (R1976).	American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.
§ 1910.95(k)(2), appendix E	"Specifications for Audiometers," S3.6-1969.	American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.
Appendix D	"Specification for Octave, Half-Octave and Third-Octave Band Filter Sets," S1.11-1971 (R1976).	Back Numbers Department, Dept. STD, American Institute of Physics, 333 E. 45th St., New York, NY 10017; American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.

The referenced publications (or a microfiche of the publications) are available for review at many universities and public libraries throughout the country. These publications may also be examined at the OSHA Technical Data Center, Room N2439, United States Department of Labor, 200 Constitution Avenue, NW., Washington, D.C. 20210, (202) 523-9700 or at any OSHA Regional Office (see telephone directories under United States Government—Labor Department).

Appendix I: Definitions

These definitions apply to the following terms as used in paragraphs (c) through (n) of 29 CFR 1910.95.

Action level—An 8-hour time-weighted average of 85 decibels measured on the A-scale, slow response, or equivalently, a dose of fifty percent.

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 rehabilitation of hearing, who is certified by the American Speech-Language-Hearing Association or licensed by a state board of examiners.

Baseline audiogram—The audiogram against which future audiograms are compared.

Criterion sound level—A sound level of 90 decibels.

Decibel (dB)—Unit of measurement of sound level.

Hertz (Hz)—Unit of measurement of frequency, numerically equal to cycles per second.

Medical pathology—A disorder or disease. For purposes of this regulation, a condition or disease affecting the ear, which should be treated by a physician specialist.

Noise dose—The ratio, expressed as a percentage, of (1) the time integral, over a stated time or event, of the 0.6 power of the measured SLOW exponential time-averaged, squared A-weighted sound pressure and (2) the product of the criterion duration (8 hours) and the 0.6 power of the squared sound pressure corresponding to the criterion sound level (90 dB).

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.

Otolaryngologist—A physician specializing in diagnosis and treatment of disorders of the ear, nose and throat.

Representative exposure—Measurements of an employee's noise dose or 8-hour time-weighted average sound level that the employers deem to be representative of the exposures of other employees in the workplace.

Sound level—Ten times the common logarithm of the ratio of the square of the measured A-weighted sound pressure to the square of the standard reference pressure of 20 micropascals. Unit: decibels (dB). For use with this regulation, SLOW time response, in accordance with ANSI S1.4-1971 (R1976), is required.

Sound level meter—An instrument for the measurement of sound level.

Time-weighted average sound level—That sound level, which if constant over an 8-hour exposure, would result in the same noise dose as is measured.

[FR Doc. 83-5702 Filed 3-3-83; 8:45 am]

BILLING CODE 4510-26-M