

DEPARTMENT OF LABOR**Mine Safety and Health Administration****30 CFR Parts 56, 57, 62, 70 and 71**

RIN 1219-AA53

Health Standards for Occupational Noise Exposure**AGENCY:** Mine Safety and Health Administration (MSHA), Labor.**ACTION:** Final rule.

SUMMARY: This final comprehensive rule replaces MSHA's existing standards for occupational noise exposure in coal mines and metal and nonmetal mines. The final rule establishes uniform requirements to protect the Nation's miners from occupational noise-induced hearing loss. The rule is derived in part from existing MSHA noise standards, and from the Department of Labor's existing occupational noise exposure standard for general industry promulgated by the Occupational Safety and Health Administration (OSHA).

As a result of the Agency's ongoing review of its safety and health standards, MSHA determined that its existing noise standards, which are more than twenty years old, do not adequately protect miners from occupational noise-induced hearing loss. A significant risk to miners of material impairment of health from workplace exposure to noise over a working lifetime exists when miners' exposure exceeds an 8-hour time-weighted average (TWA₈) of 85 dBA.

MSHA expects that the final rule will significantly reduce the risk of material impairment within the mining industry as a whole.

DATES: The final rule is effective September 13, 2000.

FOR FURTHER INFORMATION CONTACT:

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SUPPLEMENTARY INFORMATION:**I. Background***a. Noise-Induced Hearing Loss*

Noise is one of the most pervasive health hazards in mining. The National Institute for Occupational Safety and Health (NIOSH) has identified noise-induced hearing loss as one of the ten leading work-related diseases and injuries. Exposure to hazardous sound levels results in the development of occupational noise-induced hearing

loss, which is distinguishable from hearing loss associated with aging or with medical conditions. For many years, the risk of acquiring noise-induced hearing loss was accepted as an inevitable consequence of mining occupations, in which the use of mechanized equipment often subjects miners to hazardous noise exposures. But noise-induced hearing loss can be diagnosed, prevented, and its progress delayed.

Prolonged exposure to noise over a period of years generally causes permanent damage to the auditory nerve or its sensory components. Hearing loss is rapid when exposures are over a prolonged period at high sound levels. Hearing loss may also be gradual, so that the impairment is not noticed until after a substantial amount of hearing loss occurs. Noise-induced hearing loss is irreversible. Considerable safety risks arise because workers with noise-induced hearing loss may not hear audible warnings and safety signals. In addition, most people with noise-induced hearing loss have reduced hearing sensitivity to higher frequencies and lose the ability to discriminate consonants, making them unable to distinguish among words differing only by one or more consonants. This impairment jeopardizes the safety of affected miners as well as the safety of those around them, and, as a result, general employee health and productivity.

Revising the existing rules to protect miners from noise-induced hearing loss is necessary because exposure to workplace noise continues to present a significant risk of material impairment of health to miners. MSHA estimates that 13.4% of the mining population of the United States (approximately 13,000 coal miners and 24,000 metal and nonmetal miners) will develop a material hearing impairment during a working lifetime under current working conditions. MSHA anticipates that miners will benefit substantially from the final rule's effect of improving miner health and lessening the personal and social hardships of occupational noise-induced hearing loss.

b. Rulemaking Process

MSHA's existing noise standards in metal and nonmetal mines (30 CFR §§ 56.5050 and 57.5050) and in coal mines (30 CFR §§ 70.500-70.511, and §§ 71.800-71.805) were originally promulgated in the early 1970's. They were derived from the Walsh-Healey Public Contracts Act occupational noise standard, which adopted a permissible exposure level of 90 dBA, a 5-dB exchange rate, and a 90-dBA threshold.

After considering the recurrent incidence of noise-induced hearing loss among miners and repeated recommendations from the mining community that MSHA adopt a single noise standard covering all mines, MSHA published an Advance Notice of Proposed Rulemaking (ANPRM) (54 FR 50209) on December 4, 1989. In response, the Agency received numerous comments from mine operators, trade associations, labor groups, equipment manufacturers, and other interested parties.

After reviewing the comments to the ANPRM, MSHA published a proposed rule (61 FR 66348) on December 17, 1996. The comment period, originally scheduled to close on February 18, 1997, was extended to April 21, 1997 (62 FR 5554), and 6 public hearings were conducted in Beckley, West Virginia; St. Louis, Missouri; Denver, Colorado; Las Vegas, Nevada; Atlanta, Georgia; and Washington, D.C. Transcripts of the proceedings were made available to the public. Supplementary statements and data were received from interested persons until the record closed on August 1, 1997.

After the close of the record, NIOSH sent MSHA a report entitled, "Prevalence of Hearing Loss For Noise-Exposed Metal/Nonmetal Miners." On December 16, 1997, MSHA published a notice (62 FR 65777) announcing that the report was available and had been entered into the rulemaking record. Then, on December 23, 1997, MSHA published a follow-up notice (62 FR 67013) inviting interested persons to comment on the NIOSH report, with the comment period closing on February 23, 1998.

Early commenters on the proposal expressed concern that the spirit of section 103(c) of the Federal Mine Safety and Health Act of 1977 (Mine Act) was not being met. Section 103(c) requires that miners or their representatives be allowed to observe any monitoring or measuring of hazards in their workplaces and to have access to monitoring records. Proposed § 62.120(f) contained a provision requiring operators to establish a system of monitoring for effectively evaluating each miner's noise exposure, but did not require that miners be allowed to observe.

In response, on December 31, 1997, MSHA published a notice (62 FR 68468) supplementing its proposed rule with proposed § 62.120(g), asked for comments, and scheduled a public hearing. The comment period for the supplement closed on February 17, and a public hearing was held in

Washington, DC on March 10. The post-hearing comment period and rulemaking record closed on April 9, 1998.

On May 26, 1998, MSHA published a notice (63 FR 28496) announcing its preliminary determination of no significant environmental impact; requesting comments; and reopening the rulemaking record for the limited purpose of receiving these comments.

The agency received many comments on the proposed noise rule, including the supplemental proposed rule on observation of monitoring. The agency received a total of 182 written and electronic comments. In addition, 57 speakers provided verbal comments at the public hearings. Comments were received from various entities including mine operators, industry trade associations, such as the National Mining Association, National Stone Association, American Iron and Steel Institute and American Portland Cement Alliance; organized labor groups, such as the United Mine Workers of America and the United Steelworkers of America; noise equipment manufacturers; the American Industrial Hygiene Association; the National Hearing Conservation Association; the Acoustical Society of America; colleges and universities; and other Federal agencies, such as NIOSH and the U.S. Small Business Administration.

c. Current Standards

MSHA's existing maximum noise exposure levels for metal and nonmetal mines (30 CFR 56/57.5050) and for coal mines (30 CFR 70.500 through 70.511 and 71.800 through 71.805), were derived from the Walsh-Healey Public Contracts Act occupational noise standard. The standards adopted a permissible exposure level of 90 dBA as an eight-hour time weighted average and a 5-dB exchange rate.

MSHA's existing metal and nonmetal noise standards require the use of feasible engineering or administrative controls when a miner's noise exposure exceeds the permissible exposure level. Hearing protectors are also required if the exposure cannot be reduced to within the permissible exposure level. The existing metal and nonmetal standards do not require the mine operator to post the procedures for any administrative controls used, to conduct specific training, or to enroll miners in hearing conservation programs.

MSHA's existing practices for coal mines are different from those for metal and nonmetal mines due to differences in the circumstances under which the Agency is authorized to issue citations. In metal and nonmetal mines, a citation

is issued based exclusively on the exposure measurement. In coal mines, a citation is not issued if appropriate hearing protectors are being worn. Moreover, when a coal mine operator receives a citation for noise exposure exceeding the permissible exposure level, the operator is required to promptly institute administrative and/or engineering controls to assure compliance. In addition, within 60 days of receiving the citation, a coal mine operator is required to submit a plan to MSHA for the administration of a continuing, effective hearing conservation program.

The Federal Mine Safety and Health Review Commission (Commission) has addressed the "feasibility" of noise controls regarding the existing standards. In determining technological feasibility, the Commission has held that a control is deemed achievable if through reasonable application of existing products, devices, or work methods with human skills and abilities, a workable engineering control can be applied to the noise source. The control does not have to be "off-the-shelf;" but it must have a realistic basis in present technical capabilities. In determining economic feasibility, the Commission has held that MSHA must assess whether the costs of the control are disproportionate to the "expected benefits", and whether the costs are so great that it is irrational to require its use to achieve those results. The Commission has expressly stated that cost-benefit analysis is unnecessary in order to determine whether a noise control is required. According to the Commission, an engineering control may be feasible even though it fails to reduce exposure to permissible levels contained in the standard, as long as there is a significant reduction in exposure. In *Todilto Exploration and Development Corporation*, 5 FMSHRC 1894 (1983), the Commission accepted the Agency's determination that a 3 dBA reduction is significant.

MSHA has interpreted the "expected benefits" to be the amount of noise reduction achievable by the control. MSHA generally considers a reduction of 3 dBA or more to be a significant reduction of the sound level because it represents at least a 50% reduction in sound energy. Consequently, a control that achieves relatively little noise reduction at a high cost could be viewed as not meeting the Commission's test of economic feasibility.

MSHA estimates that the costs attributable to the final rule requirement to use engineering and administrative controls would be significantly offset by the paperwork savings the coal mining

industry will accrue. The existing costly, paperwork-intensive requirements for biannual coal miner noise exposure surveys, supplemental noise surveys, calibration reports, survey reports, and survey certifications are eliminated by the final rule. Rather, the final rule has a flexible requirement for mine operators to establish a monitoring program that effectively evaluates miner exposures.

II. Final Rule

a. General Requirements Applicable to All Mines

The following summarizes general requirements for all mines in the final rule although, the rule and this preamble should be consulted for details. A mine operator must establish a system of monitoring which evaluates each miner's noise exposure. In addition, the mine operator must give prior notice and provide affected miners and their representatives with an opportunity to observe the monitoring. When an exposure equals or exceeds the action level, exceeds the permissible exposure level, or exceeds the dual hearing protection level, the mine operator must notify a miner of his or her exposure. A copy of the notification must be kept for the duration of the affected miner's exposure at or above the action level and for at least 6 months thereafter.

If a miner's noise exposure is less than the action level, no action is required by the mine operator. If the miner's exposure equals or exceeds the action level, but does not exceed the permissible exposure level, the operator must enroll the miner in a hearing conservation program which includes a system of monitoring, voluntary use of operator-provided hearing protectors, voluntary audiometric testing, training, and record keeping. If a miner's exposure exceeds the permissible exposure level, the operator must use or continue to use all feasible engineering and administrative controls to reduce exposure to the permissible exposure level, enroll the miner in a hearing conservation program including ensuring the use of operator-provided hearing protectors, post administrative controls and provide a copy to the affected miner; and must never permit a miner to be exposed to sound levels exceeding 115 dBA. If a miner's exposure exceeds the dual hearing protection level, the operator must enroll the miner in a hearing conservation program, continue to meet all the requirements for exposures above the permissible exposure level, and

ensure the concurrent use of an earplug and earmuff.

b. Major Features of the Final Rule

Consistent with OSHA's noise exposure standard, MSHA has adopted the existing permissible exposure level of 90 dBA as an 8-hour time-weighted average (TWA₈). The final rule, however, requires the use of all feasible engineering and administrative controls to reduce a miner's noise exposure to the permissible exposure level. Such controls may be used separately or in combination. When controls do not reduce exposure to the permissible exposure level, miners must be provided hearing protectors and mine operators are required to ensure that the miners use them.

The final rule also addresses a currently recognized hazard that is not covered by existing standards: noise exposures at or above a TWA₈ of 85 dBA but below the permissible exposure level. Exposure at a TWA₈ of 85 dBA is termed the "action level," and, under the final rule, mine operators are required to enroll miners exposed at or above the action level in a hearing conservation program consisting of exposure monitoring, the use of hearing protectors, audiometric testing, training, and recordkeeping.

The final rule has been revised from the proposal in several respects, which makes it more consistent with existing OSHA regulations:

MSHA had proposed that all sound levels between 80 dBA and 130 dBA be included in determining exposure for both the action level and permissible exposure level. Based on comments received, the final rule requires inclusion of sound levels between 90 dBA and at least 140 dBA for determining exposure with respect to the permissible exposure level. The final rule adopts the proposed inclusion of sound levels from 80 dBA to at least 130 dBA for determining exposure with respect to the action level.

In response to the proposed definition of a hearing conservation program, commenters suggested that, for the sake of consistency, the final rule adopt the existing definition included in the OSHA noise standard. MSHA agrees and has revised the final rule to incorporate all relevant elements of a hearing conservation program under this definition.

The proposed rule would have required mine operators to ensure that miners participate in an audiometric testing program if their noise exposures were above the permissible exposure

level. In response to commenters, the final rule requires only that mine operators offer audiometric testing, leaving it to the miner to decide whether to participate in the testing program.

The proposed rule would have required that mine operators ensure that miners were not exposed to workplace noise during a 14-hour quiet period required before a baseline audiogram is taken. In addition, the use of hearing protectors would not have been permitted as a substitute for the quiet period. Many commenters suggested that prohibiting the use of hearing protectors to meet the quiet period requirement was not practical, because many miners work 12-hour shifts and that OSHA's noise standard allows hearing protection to be used during the quiet period. The final rule permits the use of hearing protectors during the quiet period.

The proposed rule would have required a mine operator, upon termination of a miner's employment, to provide the miner with a copy of the records required under part 62. Commenters overwhelmingly supported giving copies of records only to those miners who request them. In response to comments, the proposed provision was not adopted in the final rule, and the final rule instead requires that mine operators provide copies of records to miners upon request.

The final rule departs from the OSHA noise standard in several respects:

The final rule adopts the proposed "dual hearing protection level" at a TWA₈ of 105 dBA. This requirement for dual hearing protection is supported by research showing that greater noise reduction results from the use of both earplugs and earmuffs than from either type of hearing protector alone. Accordingly, mine operators must provide and require the use of both an earplug and an earmuff at a TWA₈ of 105 dBA.

The final rule does not include detailed, technical procedures and criteria for conducting audiometric testing. Rather, the rule is performance-oriented, requiring only that audiometric testing be conducted in accordance with scientifically validated procedures, such as those in OSHA's noise standard.

Nor does the final rule require determining the adequacy of hearing protectors. Although OSHA's noise standard includes such information in its mandatory Appendix B, MSHA's research on mining applications indicates that hearing protectors provide

less reduction than their ratings suggest and that the reduction achieved is highly variable. These two factors prevent accurate prediction of the effectiveness of hearing protectors for a given individual. However, MSHA recognizes that in some environments it may not be feasible to reduce miners' noise exposures to the permissible exposure level with the use of engineering or administrative controls. In these circumstances, the interim use of personal hearing protectors may offer the best protection until controls become feasible and can be implemented.

The final rule is consistent with Executive Order 12866, the Regulatory Flexibility Act, the Small Business Regulatory Enforcement Fairness Act (SBREFA), the National Environmental Policy Act (NEPA), the Paperwork Reduction Act, the Unfunded Mandates Reform Act, and the Mine Act. MSHA estimates that metal and nonmetal mines with fewer than 20 miners would incur an average cost increase of about \$460 annually. Coal mines with fewer than 20 miners would have an average cost increase of about \$400, reflecting the elimination of the numerous survey and paperwork requirements in the current noise rules for the coal sector.

In accordance with the SBREFA Amendments to the Regulatory Flexibility Act, MSHA has taken steps to minimize the compliance burden on small mines. The effective date of the final rule, one year after promulgation, provides time for small mines to achieve compliance. In addition, MSHA is mailing a copy of the final rule to each mine operator, which benefits small mine operators.

MSHA anticipates that the mining community will benefit substantially from the final rule. The primary benefit will be a sizable reduction, by as much as two-thirds, in the incidence of occupational hearing impairment among miners. The final rule will also serve to mitigate the progression of hearing loss in working miners and preserve the health and quality of life of miners newly entering the industry.

Two charts compare key features of the final standard to MSHA's existing standards. Note that entries in the charts and the discussions in the preamble reflect legal and/or policy interpretations that would not be apparent from the text of the standards. Other parts of this preamble should be consulted for details.

CHART 1: GENERAL REQUIREMENTS

Noise level	Final rule	Existing metal and nonmetal rules	Existing coal rules
At or above a TWA ₈ of 85 dBA (action level).	Enroll miner in HCP which includes requirements for training, monitoring, recordkeeping, voluntary hearing tests, voluntary use of operator-provided HP in most cases, but use of HP is mandatory in particular instances.	No requirements	No requirements.
Above a TWA ₈ of 90 dBA (PEL).	Use or continue to use all feasible engineering and administrative controls to reduce exposure to PEL; enroll miner in an HCP including ensuring use of operator-provided HP, post administrative controls and provide copy to affected miner, never permit miner to be exposed to sound levels exceeding 115 dBA.	Use all feasible engineering or administrative controls and provide HP if noise level cannot be lowered to PEL.	Use all feasible engineering and/or administrative controls, but can first reduce exposure by rated value of HP minus 7 unless cited for failure to require HP use; also must enroll miners in HCP if cited.
At or above 105 dBA (dual hearing protection level).	Ensure concurrent use of earplug and earmuff type HPs in addition to above requirements for the action level and PEL.	Limited requirement for dual HPs.	N/A

Abbreviations: HP (hearing protector), HCP (hearing conservation program), TWA₈ (eight-hour time-weighted average), dBA (decibel, A-weighted), PEL (permissible exposure level); Hz (hertz), and n/a (not applicable).

COMPARISON CHART 2: GENERAL FEATURES

Feature	Final rule	Existing metal and nonmetal rules	Existing coal rules
Monitoring	Operator must establish an effective system of monitoring noise exposure.	No requirement on mine operator.	Mine operator required to conduct periodic monitoring.
Notification of exposure	Operator must notify miner of certain exposures	Not required	Not required.
Dual Threshold (lowest sound level counted).	85 dBA for action level and 90 dBA for PEL	90 dBA for PEL	90 dBA for PEL.
Exchange rate	5 dB	5 dB	5 dB.
Training	Specific training requirements	Part 48	Part 48.
Quiet period prior to audiometric examination.	14 hours for baseline audiogram and use of HP permitted.	N/A	N/A.
Standard Threshold shift	Average of 10 dB at 2000, 3000, and 4000 Hz in either ear.	N/A	N/A.
Reportable hearing loss	Average of 25 dB at 2000, 3000, and 4000 Hz in either ear.	Reporting required but level was undefined.	Reporting required but level was undefined.
Employee access to records	Available upon request	N/A	N/A.

Abbreviations: HP (hearing protector), dBA (decibel, A-weighted), PEL (permissible exposure limit); Hz (hertz), n/a (not applicable).

III. Paperwork Reduction Act of 1995

The information collection requirements contained in this final rule have been submitted to the Office of Management and Budget (OMB) for review under the Paperwork Reduction Act of 1995 (44 U.S.C. 3501–3520), as implemented by OMB in regulations at 5 CFR part 1320. The Paperwork Reduction Act of 1995 (PRA 95) defines collection of information as “the obtaining, causing to be obtained, soliciting, or requiring the disclosure to third parties or the public of facts or opinions by or for an agency regardless of form or format.” (44 U.S.C. 3502(3)(A)). Under PRA 95, no person may be required to respond to, or may be subjected to a penalty for failure to comply with, these information collection requirements until they have been approved and MSHA has announced the assigned OMB control

number. The OMB control number, when assigned, will be announced by separate notice in the **Federal Register**. In accordance with § 1320.11(h) of the implementing regulations, OMB has 60 days from today's publication date in which to approve, disapprove, or instruct MSHA to make a change to the information collection requirements in this final rule.

Recordkeeping requirements in the final rule are found in §§ 62.110, 62.130, 62.170, 62.171, 62.172, 62.173, 62.174, 62.175, 62.180, and 62.190.

MSHA received comments both supporting and opposing the proposed information collection requirements. MSHA has reviewed these comments. Several commenters questioned MSHA's estimates of the paperwork burden reduction of the noise rule. Two commenters noted that the February 1984 Program Information Bulletin 84–1C “eliminated virtually all paperwork

requirements for operators” and that the “paperwork involves one letter and two 32 cent stamps per year per coal operator.” The February 1984 Program Information Bulletin eliminated the requirement for the completion and submission to MSHA of a Coal Mine Noise Data Report Form when operator noise exposure surveys are found to be within compliance. The Program Information Bulletin retained the requirement that a written and signed statement (certification) be submitted to MSHA that the required surveys were made and that the surveys show compliance. The Program Information Bulletin did not drop the requirement for noise surveys to be conducted, exclude the requirement for supplemental noise surveys for exposures at or above the permissible exposure level (and a submission of them), or eliminate the requirement of

surveying all miners and retaining a record.

In addition, as MSHA stated in the proposal, there are labor and equipment costs related to performing the surveys twice a year, completing survey reports and certifications, doing calibration reports annually, and collecting a noise monitoring record for all coal miners. Under PRA 95, all activities related to the generation of a paperwork item must be considered when calculating the costs and burden of paperwork tasks. For these reasons, MSHA's estimates in the final rule are consistent with the requirements of PRA 95.

Other commenters stated that they will still have to conduct surveys, retain survey records, conduct training and audiometric testing, and implement engineering and administrative controls to demonstrate compliance. The existing standards require coal mine operators to perform semiannual monitoring for each miner. Under the final rule, mine operators must establish a system of monitoring that evaluates each miner's noise exposure sufficiently to determine continuing compliance with this part. However, under the final rule mine operators may use their own monitoring records as well as the Agency's data from inspector sampling to determine compliance.

Some commenters stated that the performance-based system of monitoring may result in increased monitoring. MSHA anticipates that a number of mine operators will use some form of representative sampling within job classes or work areas to minimize costs related to dose determination. In addition, large operators who use the same equipment on more than one shift may conduct monitoring on a single shift to determine miner exposures, provided that the circumstances are similar.

The Agency published a supplemental proposal that would give affected miners and their representatives the right to observe operator monitoring. MSHA estimated that the time required for observation of monitoring would take about 2 hours annually at small mines and about 5 hours annually at large mines. Several commenters questioned the Agency's estimates. One commenter questioned the Agency's estimate of 5 hours for a large mine. The commenter believed that for a mine which employed 1,500 workers, 12,000 hours will be spent on noise monitoring (1,500 workers * an 8 hour workday). Under the final rule, mine operators will need to determine miners' exposure; this may be achieved

in a number of ways including the use of existing monitoring records (particularly for coal mine operators), review of MSHA sampling records, or by the use of representative sampling. Since mine operators are not specifically required by the final rule to monitor each employee but may use a more flexible approach, MSHA anticipates that its estimates of an average of 2 hours and 5 hours annually at small and large mines respectively (reflecting 30 minute monitoring for each of four miners in a small mine and ten miners in a large mine) are reasonable.

Another commenter questioned if there will be an observation time limit and also believed that MSHA's estimate of 5 hours annually was too low. Also, a commenter questioned MSHA's estimates of lost production, the length of time needed for observation, and MSHA's average time estimates per small mine and per large mine. A commenter also believed that the total estimated annual information collection burden was low. With the exception of the one commenter who provided the estimate of 12,000 hours annually to observe monitoring, none provided data to support their statements.

At the public hearing, several commenters testified that they considered MSHA's time estimates and photocopy cost estimates high. In particular, they believed that the time to give instructions to the secretary were excessive. Further, they stated MSHA's estimates for the length of time to perform typing and posting were too high. Other commenters stated that the bulk of the paperwork would be completed by safety professionals and industrial hygienists as opposed to clerical workers. Based upon a review of all the comments and MSHA's experience, the Agency believes the estimates in the final rule are reasonable.

The proposed rule would have required mine operators to obtain from the physician, audiologist, or qualified technician who conducts an audiometric test a certification that each test was conducted in accordance with scientifically validated procedures. Commenters stated that requiring mine operators to obtain a certification for each individual audiogram was unduly burdensome. The Agency agrees and the proposed certification requirement has not been adopted in the final rule. Under the final rule, evidence is simply required that the audiograms were conducted in accordance with scientifically validated procedures. For

example, the evidence may consist of a single statement from the audiometric test provider or a single billing record that indicates that required procedures were followed for a number of audiograms.

The proposed rule would have required mine operators to provide miners with a copy of all their records relating to this standard when those miners terminate employment. Commenters stated that this was an unnecessary requirement which generated too much paper and that miners may not even want a copy of the records. In response, the final rule requires mine operators to provide copies of records to a miner if the miner requests such records.

Numerous commenters stated that records should not have to be retained at the mine site. MSHA agrees and the final rule provides that records are not required to be maintained at the mine site, and therefore can be electronically filed in a central location, so long as the records are made available to the authorized representative of the Secretary upon request within a reasonable time, in most cases one day.

Although the final rule does not require backing up the data, some means are necessary to ensure that electronically stored information is not compromised or lost. MSHA encourages mine operators who store records electronically to provide a mechanism that will allow the continued storage and retrieval of records in the year 2000.

MSHA solicited comment on what actions would be required, if any, to facilitate the maintenance of records in electronic form by those mine operators who desire to do so, while ensuring access in accordance with these requirements. The Agency received several comments supporting electronic storage of records, but no specifics regarding actions required to facilitate the maintenance of the records in electronic form. In revising the requirements from those that appeared in the proposed rule, MSHA has evaluated the necessity and usefulness of the collection of information; reevaluated MSHA's estimate of the information collection burden, including the validity of the underlying methodology and assumptions; and minimized the information collection burden on respondents to the greatest extent possible. The following charts provide, by section, the paperwork requirements for Year 1 and for each succeeding year, respectively.

TABLE 1.—SUMMARY OF NET INFORMATION COLLECTION BURDEN HOURS IN YEAR 1

Section	Paperwork requirements and associated tasks	Coal mines		M/NM mines		Total
		Small	Large	Small	Large	
62.110 to 62.130	Evaluate noise exposure; notify miners, prepare, post, and distribute administrative controls; and permit observation of monitoring.	(7,988)	(50,666)	14,605	12,579	(31,471)
62.170	Perform audiograms; and notify miners to appear for testing and of need to avoid high noise levels.	940	4,181	3,577	5,271	13,969
62.171	Compile an audiometric test record; and obtain evidence.	1,021	4,616	3,882	5,820	15,339
62.172	Provide information and audiometric test record; and perform audiometric retests.	1,413	4,374	5,474	5,513	16,774
62.173	Perform otological evaluations; and provide information and notice.	7	27	29	34	98
62.174	Prepare a retraining certification; and review effectiveness of engineering and administrative controls.	105	334	407	420	1,266
62.175	Inform miners of test results and tSTS.	1,038	4,623	3,950	5,829	15,440
62.180	Prepare and file a training certificate.	1,280	4,165	4,957	5,180	15,581
62.190	Provide access to, and transfer, records	244	303	1,027	915	2,489
Total .....	.....	(1,941)	(28,045)	37,909	41,561	49,484

TABLE 2.—SUMMARY OF NET INFORMATION COLLECTION BURDEN HOURS FOR AFTER YEAR 1

Section	Paperwork requirements and associated tasks	Coal mines		M/NM mines		Total
		Small	Large	Small	Large	
62.110 to 62.130	Evaluate noise exposure; notify miners, prepare, post, and distribute administrative controls; and permit observation of monitoring.	(8,532)	(48,006)	6,595	3,567	(46,376)
62.171	Compile an audiometric test record; and obtain evidence.	153	692	582	873	2,301
62.172	Provide information and audiometric test record; and perform audiometric retests.	212	656	821	827	2,516
62.173	Perform otological evaluations; and provide information and notice.	1	4	4	5	15
62.174	Prepare a retraining certification; and review effectiveness of engineering and administrative controls.	16	53	62	67	198
62.175	Inform miners of test results and STS	156	694	593	874	2,316
Total .....	.....	(7,994)	(45,907)	8,658	6,213	(39,029)

Executive Order 12866 and Regulatory Flexibility Analysis

In accordance with Executive Order 12866, MSHA has prepared a final analysis of the estimated costs and benefits associated with the revisions of the noise standards for coal and metal and nonmetal mines.

The final Regulatory Economic Analysis containing this analysis is available from MSHA. The final rule will cost approximately \$8.7 million annually and will prevent or contribute to the prevention of approximately 595 hearing impairment cases annually. The benefits are expressed in terms of cases of hearing impairment that can be avoided and have not been monetized. Although the Agency has attempted to quantify the benefits, it believes that

monetization of these benefits would be difficult and inappropriate.

Based upon the economic analysis, MSHA has determined that this rule is not an economically significant regulatory action pursuant to section 3(f)(1) of Executive Order 12866. The Agency does consider this rulemaking significant under section 3(f)(4) of the Executive Order for other reasons, and has so designated the rule in its annual agenda.

Regulatory Flexibility Certification

In accordance with section 605 of the Regulatory Flexibility Act, the Mine Safety and Health Administration certifies that the final noise rule does not have a significant economic impact on a substantial number of small

entities. Traditionally, MSHA considers small mines to be mines with fewer than 20 employees. Under the Regulatory Flexibility Act, MSHA must use the SBA definition for a small mine of 500 employees or fewer or, after consultation with the SBA Office of Advocacy, establish an alternative definition in the **Federal Register** for notice and comment. The alternative definition could be the Agency's traditional definition of "fewer than 20 miners" or some other definition. As reflected in the certification, MSHA analyzed the costs of this final rule for small and large mines using both the traditional Agency definition and SBA's definition, as required by the Regulatory Flexibility Act, of a small mine. No small governmental jurisdictions or

nonprofit organizations are adversely affected.

Under the Small Business Regulatory Enforcement Fairness Act (SBREFA) amendments to the Regulatory Flexibility Act, MSHA must include in the final rule a factual basis for this certification. The Agency must also publish the regulatory flexibility certification statement in the **Federal Register**, along with the factual basis, followed by an opportunity for the public to comment. The Agency has consulted with the Small Business Administration (SBA) Office of Advocacy and believes that this analysis provides a reasonable basis for the certification in this case.

In the proposal, MSHA specifically solicited comments on the Agency's regulatory flexibility certification statement, including cost estimates and data sources. To facilitate public participation in the rulemaking process, MSHA mailed a copy of the proposal and will mail a copy of the final rule, including the preamble and regulatory flexibility certification statement, to every mine operator and miners' representative.

Factual Basis for Certification

General Approach

The Agency's analysis of impacts on "small entities" and "small mines"

begins with a "screening" analysis. The screening compares the estimated compliance costs of the final rule for small mine operators in the affected sector to the estimated revenues for that sector. When estimated compliance costs are less than 1 percent of estimated revenues (for the size categories considered), the Agency believes it is generally appropriate to conclude that there is no significant impact on a substantial number of small entities. When estimated compliance costs approach or exceed 1 percent of revenue, it tends to indicate that further analysis may be warranted.

Derivation of Costs and Revenues

The Agency performed its analysis separately for two groups of mines: the coal mining sector as a whole, and the metal and nonmetal mining sector as a whole. Based on a review of available sources of public data on the mining industry, the Agency believes that a quantitative analysis of the impacts on various mining subsectors (that is, beyond the 4-digit SIC level) is not feasible. The Agency requested comments, however, on whether there are special circumstances that warrant separate quantification of the impact of this final rule on any mining subsector and information on how it might readily obtain the data necessary to conduct

such a quantitative analysis. The Agency is fully cognizant of the diversity of mining operations in each sector, and has applied that knowledge as it developed the final rule.

In determining revenues for coal mines, MSHA multiplied coal production data (in tons) for mines in specific size categories (reported to MSHA quarterly) by \$18.14 per ton, Department of Energy (1997). For metal and nonmetal mines, the Agency estimated revenues for specific mine size categories as the proportionate share of these mines' contribution to the Gross National Product, Department of Interior (1998).

Results of Screening Analysis

As shown in the following chart, for coal mine operators with fewer than 20 employees, the estimated yearly cost of the final rule is \$400 per mine operator, and estimated yearly costs as a percentage of revenues are 0.08 percent. As shown in the next chart, for coal mine operators with 500 or fewer employees, the estimated yearly savings from the final rule are \$634 per mine operator. The savings are due to the elimination of existing coal industry requirements for performing and recording semiannual surveys and other related surveys and reports.

TABLE 1.—THE IMPACT OF FINAL RULE ON THE COAL MINING INDUSTRY *

Mine type	Estimated costs	Estimated revenue	Estimated cost per mine	Cost as percent of revenue
Small (<20)	\$603,941	\$767,307,869	\$400	0.08
Large (≥20)	763,112	18,964,691,818	727	0.00

* Source: Preliminary Data 1997 from CM441 and Department of Energy/Energy Information Agency. Annual Energy Review 1997. POE/EIA-038497. July 1998. P. 187.

TABLE 2.—THE IMPACT OF FINAL RULE ON THE COAL MINING INDUSTRY *

Mine type	Estimated costs	Estimated revenue	Estimated cost per mine	Cost as percent of revenue
Small (≤500)	\$1,296,461	\$19,038,974,646	\$508	0.01
Large (<500)	70,592	693,025,041	6,403	0.01

* Source: Preliminary Data 1997 from CM441 and Department of Energy/Energy Information Agency. Annual Energy Review 1997. POE/EIA-038497. July 1998. P. 187.

As shown in the following chart, for metal/nonmetal mines with fewer than 20 employees, the estimated yearly cost of the final rule is \$414 per mine

operator, and estimated costs as a percentage of revenues are 0.04 percent. As shown in the next chart, for metal/nonmetal mine operators with 500 or

fewer employees, the estimated yearly cost is \$617 per mine operator, and estimated costs as a percentage of revenues are 0.02 percent.

TABLE 3.—THE IMPACT OF FINAL RULE ON THE METAL/NONMETAL MINING INDUSTRY *

Mine type	Mine costs	Estimated revenue	Estimated Cost per mine	Cost as percent of revenue
Small (<20)	\$4,321,282	\$10,651,022,009	\$460	0.04
Large (≥20)	3,056,036	27,348,977,991	1,945	0.01

* Source: Preliminary Data 1997 from CM441 and Department of Interior, Bureau of Mines, Mineral.

TABLE 4.—DISTRIBUTION OF MINE OPERATIONS AND EMPLOYMENT BY MINE TYPE AND SIZE INCLUDING INDEPENDENT CONTRACTORS AND CONTRACTOR WORKERS POTENTIALLY AFFECTED BY THE FINAL RULE *

Mine Size (No. of employees)	Coal			Metal/nonmetal		
	No. of mines	No. of miners	Miners per mine	No. of mines	No. of miners	Miners per mine
Small (<20)	2,401	14,347	5.97	10,098	56,859	5.63
Large (≥20)	1,133	82,142	72.48	1,666	122,378	73.45
Total	3,535	96,489	27.30	11,764	179,238	15.24

* Source: Table 2 and Table 3. Office workers are not included in these employment figures.

In all cases, the cost of complying with the final rule is less than one percent of revenues, well below the level suggesting that the final rule might have a significant impact on a substantial number of small entities. Accordingly, MSHA has certified that there is no such impact on small coal mines or small metal/nonmetal mines.

Regulatory Alternatives Considered

The limited impacts on small mines, regardless of size definition, reflect decisions by MSHA not to include more costly regulatory alternatives. In considering regulatory alternatives for small mines, MSHA must observe the requirements of its authorizing statute. Section 101(a)(6)(A) of the Mine Act requires the Secretary to set standards which most adequately assure, on the basis of the best available evidence, that no miner will suffer material impairment of health over his/her working lifetime. In addition, the Mine Act requires that the Secretary, when promulgating mandatory standards pertaining to toxic materials or harmful physical agents, consider other factors, such as the latest scientific data in the field, the feasibility of the standard, and experience gained under the Act and other health and safety laws. Thus, the Mine Act requires that the Secretary, in promulgating a standard, attain the highest degree of health and safety protection for the miner, based on the "best available evidence," with feasibility as a consideration.

As a result of this statutory requirement, MSHA considered two alternatives that would have significantly increased costs for small mine operators lowering the permissible exposure level to a TWA₈ of 85 dBA,

and lowering the exchange rate to 3 dB. In both cases, the scientific evidence in favor of these approaches was strong, but commenters offered divergent views on the alternatives. In both cases, for the purpose of this final rule, MSHA has concluded that it would not be feasible for the mining industry to accomplish these more protective approaches. The impact of these approaches on small mine operators was an important consideration in this regard.

Further, MSHA proposed using an 80-dBA threshold for determining the permissible exposure level. If the Agency had done this, the number of mines with exposure levels at or above the permissible exposure level would have increased substantially. Accordingly, with more mines above this level, the total cost of compliance would have been higher, including penalties. Many commenters opposed the change in the threshold. They believed that the current 90-dBA threshold was sufficient for achieving adequate health protection for miners and was compatible with OSHA's noise standard. Additionally, as discussed in more detail later in the preamble, MSHA did not intend to change the permissible exposure level for noise. A change in the threshold would have had this effect. For these reasons, the final rule includes the existing threshold for the permissible exposure level.

Under the proposal, the mine operator would have had to make certain that miners exposed above the permissible exposure level take the audiometric examination. Several commenters expressed concerns about the enforceability of this provision. MSHA considered these concerns, and under the final rule, audiometric testing is

voluntary. In this regard, it is also compatible with OSHA's noise standard.

In addition, under the proposal, mine operators would not have been allowed to use hearing protectors as a substitute for the 14-hour quiet period prior to an audiogram. Mine operators had stated that they could not, without substantial burden to production and management, meet this requirement. Some noted that in cases in which the audiometric testing cannot be scheduled on a day after a non-work day, the only way to ensure a 14-hour quiet period was to pay the miner not to work. Under the final rule, mine operators may use hearing protectors as a substitute for the quiet period. Again, this is compatible with OSHA's noise standard.

Paperwork Impact

In accordance with the Regulatory Flexibility Act and the Paperwork Reduction Act of 1995, MSHA has analyzed the paperwork burden for both metal and nonmetal and coal mines. While the final rule results in a net paperwork burden decrease for large coal mines in year one and both small and large coal mines after year one, there will be an increase in paperwork burden hours for small coal mines in year one and in metal and nonmetal mines' year one and every year thereafter.

For small coal mines with fewer than 20 miners the final rule will result in an increase of about 485 paperwork burden hours in year one. After year one there will be a savings of 4,438 paperwork burden hours for small coal mines. For large coal mines with 20 or more miners, the final rule will result in a decrease of about 10,405 paperwork

burden hours in year one, and a savings of 28,498 each year thereafter. For metal and nonmetal mines, the final rule will result in an increase of paperwork burden hours for both small and large mines. There will be an increase of 33,955 paperwork burden hours for small metal and nonmetal mines and increase of 38,183 paperwork burden hours for large metal and nonmetal mines in year one. After year one, there will be an increase of 15,526 paperwork burden hours per year for small metal and nonmetal mines, and an increase of 14,331 per year for large.

Although the substantial increases in paperwork burden hours result from §§ 62.175 and 62.180 for coal mines, these will be offset by the net savings of §§ 62.110–62.130, which eliminate current requirements for biannual noise surveys and other miscellaneous reports and surveys in that sector. However, for metal and nonmetal mines there will be an increase in paperwork burden hours associated with complying with the final rule.

As required by the Paperwork Reduction Act of 1995, MSHA has included in its paperwork burden estimates the time needed to perform tasks associated with information collection. For example, the final rule requires a mine operator to notify a miner if the miner's noise exposure equals or exceeds the action level. In order to determine if notification is necessary, the mine operator must perform a dose determination. MSHA has included the time needed for dose determination in its burden estimate, as required under PRA 95.

Small Business Regulatory Enforcement Fairness Act (SBREFA)

In accordance with the Small Business Regulatory Enforcement Fairness Act (SBREFA) amendments to the Regulatory Flexibility Act, MSHA carefully considered all of the proposed requirements, in addition to alternatives to the proposal, to ensure that the final rule would provide the least burdensome impact necessary to promote miner health. MSHA believes that it has complied with the SBREFA amendments.

The preamble to the proposed rule included a full discussion of MSHA's preliminary conclusions about regulatory alternatives. The public was invited to suggest additional alternatives for compliance.

MSHA is taking several actions to minimize the compliance burden on small mines. The effective date of the final rule will be a full year after its publication, to provide adequate time for small mines to achieve compliance

and for MSHA to brief the mining community about the rule's requirements. Also, as stated previously, MSHA will mail a copy of the final rule to every mine operator, which benefits small mine operators. The Agency has committed itself to issuance of a compliance guide for all mines; MSHA believes that compliance workshops or other approaches will be valuable and the Agency will hold such workshops if requested.

For this rulemaking's Regulatory Flexibility Analysis, the Agency is using its traditional definition of "small mine" as a mine with fewer than 20 employees, in addition to the SBA's definition of operations with fewer than 500 employees, as required by the Regulatory Flexibility Act. For purposes of this final rule, MSHA has continued its past practice of using "under 20 miners" as the appropriate point of reference, in addition to SBA's definition. Reviewers will note that the paperwork and cost discussions continue to refer to the impacts on "small" mines with fewer than 20 employees. The Agency has not established a definition of "small entity" for purposes of the final rule. Based on this analysis, MSHA concludes that whatever definition of "small entity" is eventually selected, the final noise rule does not have a significant economic impact on a substantial number of small entities.

Executive Order 13045: Protection of Children From Environmental Health Risks and Safety Risks

In accordance with Executive Order 13045, MSHA has evaluated the environmental health and safety effects of the final rule on children. The Agency has determined that the final rule will have no adverse effects on children.

Environmental Assessment

The final noise rule has been reviewed in accordance with the requirements of the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 *et seq.*), the regulations of the Council of Environmental Quality (CEQ) (40 CFR part 1500) and the Department of Labor's NEPA compliance procedures (29 CFR part 11). In the **Federal Register** of May 26, 1998 (63 FR 28496), MSHA made a preliminary determination that the proposed noise rule was of a type that does not have a significant impact on the human environment. In response, one comment was received by the Agency. The commenter expressed a concern that the Agency had not prepared an environmental assessment

in accordance with NEPA, the CEQ and the Department's procedural regulations. MSHA's preliminary determination was based on its Regulatory Impact Analysis which explained the costs and benefits of the proposed rule. MSHA has complied with the requirements of the NEPA, including the Department of Labor's compliance procedures and the regulations of the Council on Environmental Quality. The Agency has not received any new information or comments that would affect its previous determination. As a result of the Agency's review of the final noise rule, MSHA has concluded that the rule will not have significant environmental impacts, and therefore neither an environmental assessment nor an environmental impact statement is required. In addition, MSHA believes that the final rule will indirectly aid the environment since many of the engineering controls which control noise, such as mufflers and curtains, also aid in controlling environmental pollutants.

Executive Order 13084 (Consultation and Coordination With Indian Tribal Governments)

MSHA certifies that the final rule does not impose substantial direct compliance costs on Indian tribal governments. Further, MSHA provided the public, including Indian tribal governments which operated mines, the opportunity to comment on the proposal and to participate in the public hearing process. No Indian tribal government applied for a waiver or commented on the proposal.

Executive Order 12612 Federalism

Executive Order 12612, regarding federalism, requires that agencies, to the extent possible, refrain from limiting state policy options, consult with states prior to taking any actions which would restrict state policy options, and take such actions only when there is clear constitutional authority and the presence of a problem of national scope. Because this final rule does not limit state policy options, it complies with the principles of federalism and with Executive Order 12612.

Unfunded Mandates Reform Act of 1995

MSHA has determined that, for purposes of § 202 of the Unfunded Mandates Reform Act of 1995, this final rule does not include any Federal mandate that may result in increased expenditures by State, local, or tribal governments in the aggregate of more than \$100 million, or increased expenditures by the private sector of

more than \$100 million. Moreover, the Agency has determined that for purposes of § 203 of that Act, this final rule does not significantly or uniquely affect small governments.

Background

The Unfunded Mandates Reform Act was enacted in 1995. While much of the Act is designed to assist the Congress in determining whether its actions will impose costly new mandates on State, local, and tribal governments, the Act also includes requirements to assist Federal agencies to make this same determination with respect to regulatory actions.

Analysis

Based on the analysis in the Agency's final Regulatory Economic Analysis, the annualized cost of this final rule is approximately \$8.9 million. Accordingly, there is no need for further analysis under § 202 of the Unfunded Mandates Reform Act.

MSHA has concluded that small governmental entities are not significantly or uniquely impacted by the final regulation. The final rule will impact approximately 15,299 coal and metal and nonmetal mining operations; however, increased costs will be incurred only by those operations (approximately 10,476 mines) where noise exposures exceed the allowable limits. MSHA estimates that approximately 187 sand and gravel or crushed stone operations are run by state, local, or tribal governments and will be impacted by this rule.

When MSHA issued the proposed rule, the Agency affirmatively sought input of any state, local, and tribal government which may be affected by the noise rulemaking. This included state and local governmental entities who operate sand and gravel mines in the construction and repair of highways and roads. MSHA mailed a copy of the proposed rule to these entities. No state, local or tribal government entity commented on the proposed rule. When the final rule is published, MSHA will mail a copy to all 187 entities.

IV. Miscellaneous

Permissible Exposure Level

The final rule affirms MSHA's initial determination, set out in the proposal, that there is a significant risk for miners of material impairment from noise exposures at or above an 8-hour time-weighted average of 85 dBA. However, the final rule also comports with MSHA's initial conclusion that it would not be either technologically or economically feasible at this time for the

mining industry to implement a reduced permissible exposure level for noise, including a reduction in the exchange rate. For these reasons the final rule does not reduce the permissible exposure level, but it does require mine operators to take a number of other actions that will substantially reduce miners' risk of occupational noise-induced hearing loss.

MSHA will continue to examine closely the feasibility of a reduction in the permissible exposure level for miners' noise exposure. This will include, but is not limited to, assessment of the availability and suitability of equipment retrofits for noise control, evaluation of the state of existing noise control technology appropriate for mining applications, and the availability of alternative, and less noisy, equipment for various mining tasks. MSHA intends to work closely with all segments of the mining community in its continuing assessment of feasibility.

NIOSH Criteria Document

In March 1996, the National Institute for Occupational Safety and Health (NIOSH) released for peer review a draft Criteria Document for Occupational Noise Exposure, which was intended to update an earlier NIOSH Criteria Document for Noise that had been issued in 1972. MSHA summarized the recommendations of the draft Criteria Document in the preamble to the proposed rule (61 FR 66369-66370), and considered the draft Criteria Document recommendations, as well as comments that addressed the draft Criteria Document, in developing this final rule.

In June 1998 NIOSH issued the final Criteria Document for Occupational Noise Exposure, which in large part adopts the recommendations of the 1996 draft Criteria Document, which, as mentioned above, were considered as part of this rulemaking. However, the final Criteria Document does include several recommendations which differ from recommendations in the 1996 draft Criteria Document. The main differences between the draft and the final Criteria Documents are as follows:

1. Action level. In the draft document, NIOSH proposed what was essentially an "action level" that would trigger establishment of a Hearing Loss Prevention Program. The "action level" would have been an 8-hour TWA of 85 dBA. The final Criteria Document does not adopt the "action level" concept, and instead would trigger establishment of a Hearing Loss Prevention Program at the recommended exposure limit of an 85 dBA TWA₈. Under MSHA's final rule, a miner's noise exposure at 85 dBA TWA₈ requires enrollment of the miner in a Hearing Conservation Program.

2. Ceiling Level. The NIOSH draft Criteria Document recommended a ceiling at a 115 dBA sound pressure level. The final Criteria Document recommends a 140 dBA sound pressure level ceiling limit for continuous, varying, intermittent, or impulsive noise.

3. Dual Hearing Protection Level. The draft Criteria Document did not make a recommendation for such a level. However, the final Criteria Document recommends the use of dual hearing protection at exposures exceeding a TWA₈ of 100 dBA.

4. Quiet Period. The draft Criteria Document recommended a 14-hour quiet period prior to a baseline audiogram, and would not permit the use of hearing protectors as a substitute. The final Criteria Document recommends a quiet period of 12 hours, and still would not permit the use of hearing protectors in lieu of the quiet period.

Rule Format

In the preamble to the proposed rule MSHA solicited comments on the appropriate format for the final rule, providing examples for commenters of alternate approaches. There was no clear consensus among commenters to the proposal that the traditional format of MSHA's regulations should be changed. As a result, the final rule adopts the format of existing MSHA regulations.

Unlike the proposal the final rule does not include a question and answer section. Instead, after publication of the final rule, MSHA will develop and issue a compliance guide for the mining community to facilitate its understanding of and compliance with the requirements of the final rule. Additionally, MSHA is receptive to submission by the mining community of suggestions for issues that should be addressed in the compliance guide.

V. Material Impairment

Section 101(a)(6) of the Federal Mine Safety and Health Act of 1977 (Mine Act) provides that, in dealing with toxic materials or harmful physical agents, standards set by the Secretary shall:

* * * most adequately assure on the basis of the best available evidence that no miner will suffer material impairment of health or functional capacity even if such miner has regular exposure to the hazards dealt with by such standard for the period of his working life.

MSHA has determined that there is a significant risk of material impairment of health and functional capacity to miners from exposure to workplace noise despite the existing noise standards, and the Agency's rulemaking evidence supports this. MSHA anticipates that the final rule will reduce, by approximately two-thirds, the number of miners who will suffer a material impairment due to exposure to

occupational noise under the existing regulations.

MSHA's conclusion that there is a significant risk of material impairment of health for workers exposed over their working lifetimes to sound levels of 85 dBA is based on the Agency's definition of material impairment, which is referred to in this preamble as the OSHA/NIOSH-72 definition. Under the OSHA/NIOSH-72 definition, the excess risk of a hearing impairment from occupational noise exposure is 15% or one-hundred fifty-in-a-thousand miners at an 85 dBA TWA₈ exposure for a working lifetime. The Supreme Court has indicated, in discussing significant risk in the context of litigation under section 6(f) of the OSH Act, that OSHA is free to use conservative assumptions in interpreting data so long as they are supported by reputable scientific concepts, and that a one-in-a-thousand risk is significant. *Industrial Union Department, AFL-CIO v. American Petroleum Institute*, 448 U.S. 607, 655 (1980) (the Benzene Case). If the Mine Act were to impose the same risk-finding requirement as the OSH Act, MSHA's determination of a significant risk of material impairment of health falls well within the Supreme Court's direction to OSHA in the Benzene Case.

Exposure to hazardous sound levels results in noise-induced hearing loss. Noise-induced hearing loss is often described in terms of the relationship between the sound level to which a person is exposed and the duration of the exposure. Exposures to noise at sound levels equal to or greater than the 8-hour average sound level of 85 dBA have been shown to lead to hearing loss, which can be temporary or permanent.

Noise-induced hearing loss causes difficulty in hearing and understanding speech. People suffering from significant noise-induced hearing loss require even nearby persons to speak loudly and clearly to be understood, and they are often frustrated by missing vital information. Also, background noise affects the person's ability to distinguish meaningful sounds from ambient noise. Little benefit can be derived from the use of a hearing aid because it amplifies sound indiscriminately, without increasing clarity, decreasing distortion, or screening out unwanted sounds. Noise also produces secondary, non-auditory effects.

Although the secondary effects of noise-induced hearing loss are more difficult to identify, document, and quantify than the hearing loss itself, recent laboratory and field studies have found an association between noise and cardiovascular problems and other illnesses such as hypertension. Studies

also suggest that holding exposure below a time-weighted average of 85 dBA will significantly improve both psychological and physiological stress reactions.

Safety risks at the workplace may arise as a result of noise-induced hearing loss. Workers suffering from noise-induced hearing loss may not hear safety signals because of reduced hearing sensitivity to higher frequencies. In addition, noise-induced hearing loss results in the loss of the ability to distinguish between many pairs of consonants, which makes speech incomprehensible. As a result, miners suffering from noise-induced hearing loss may have trouble understanding directions or warnings given by their supervisors or co-workers.

Definition of Material Impairment

MSHA has determined that a 25 dB hearing level averaged over 1000, 2000, and 3000 Hz in both ears is the most appropriate gauge of a miner's risk of developing significant noise-induced hearing loss. MSHA therefore considers such a loss to constitute a material impairment in hearing. MSHA's definition of material impairment is based on one developed in 1972 by NIOSH and subsequently adopted by OSHA in its noise standard for general industry, referred to below as the OSHA/NIOSH-72 definition. (As noted by a commenter, the preamble to the proposed rule incorrectly stated that the OSHA/NIOSH-72 definition included the phrase "in either ear." This mistake is corrected here and in the final rule.) In addition, as discussed elsewhere in this preamble, MSHA notes that it has not adopted the revised definition of material impairment set forth in the final NIOSH Criteria Document issued in June 1998. Throughout this preamble, therefore, MSHA will continue to refer to the definition of material impairment developed by NIOSH in 1972.

In nearly all studies of risk, material impairment from exposure to noise is defined as a 25-dB hearing level. Hearing level is the deviation in hearing sensitivity from audiometric zero. Positive values indicate poorer hearing sensitivity than audiometric zero, while negative values indicate better hearing. Audiometric zero is the lowest sound pressure level that the average, young adult with normal hearing can hear. Because of the widespread use of this definition in the scientific community, MSHA has used it in the final rule.

Most definitions of hearing impairment are based solely on pure tone audiometry, in which an audiometer is used to measure an

individual's threshold hearing level the lowest level of discrete frequency tones that he or she can hear. The test procedures for pure tone audiometry are relatively simple, widely used, and standardized. Although there is little debate in the scientific community about the usefulness of pure tone audiometry in assessing hearing loss, there is some disagreement about the range of audiometric frequencies that should be used in determining hearing loss.

When OSHA initially published its noise standard establishing noise exposure limits for employees, most medical professionals used the 1959 criteria developed by the American Academy of Ophthalmology and Otolaryngology (AAOO), a subgroup of the American Medical Association (AMA). This definition (AAOO 1959) of hearing impairment is a hearing level exceeding 25 dB, referenced to audiometric zero, averaged over 500, 1000, and 2000 Hz in either ear. The American Academy of Otolaryngology Committee on Hearing and Equilibrium and the American Council of Otolaryngology Committee on the Medical Aspects of Noise (AAO-HNS) modified the 1959 criteria in 1979 by adding the hearing level at 3000 Hz to the 500, 1000, and 2000 Hz frequencies. The AAOO 1959 and AAO-HNS 1979 definitions cover all types of hearing loss and were designed for hearing speech under relatively quiet conditions. The NIOSH-72 definition includes the higher frequencies, which are crucial to the comprehension of speech under everyday conditions.

In its draft 1996 Criteria Document for occupational noise exposure, NIOSH indicated that it was considering a new definition for material impairment of a 25 dB or greater hearing loss at 1000, 2000, 3000, and 4000 Hz in both ears. This definition was a recommendation of a Task Force to the American Speech-Language-Hearing Association (ASHA) in 1981. In 1997, NIOSH conducted a reanalysis of the NIOSH-Occupational Noise and Hearing Survey data and reevaluated the excess risk of material hearing impairment incorporating the 4000 hertz audiometric frequency in the definition of material impairment. (Excess risk is defined by NIOSH as the percentage with material impairment of hearing in an occupational noise exposed population after subtracting the percentage who would normally incur such impairment from other causes in a population not exposed to occupational noise.) In 1998, NIOSH published the results of this reanalysis in its final Criteria Document. The excess risk of developing occupational noise induced

hearing loss under the reassessment is 8%. The excess risk of developing occupational noise induced hearing loss under the 1972 NIOSH definition of material impairment is 15% for average noise exposure level of 85 dBA. The final Criteria Document recommends that the reanalysis reaffirms support for the 85 dBA NIOSH recommended exposure limit.

The final rule does not adopt the revised NIOSH definition for hearing impairment. Several commenters noted that this definition has not been adopted by the scientific community, and no state workers' compensation agency awards compensation for hearing impairment based upon the current NIOSH hearing impairment criterion. Despite the fact that noise-induced hearing loss usually first becomes detectable at 4000 Hz, MSHA finds that the scientific evidence does not, as yet, support including 4000 Hz in the frequencies used for calculating hearing impairment. Inclusion of test frequencies above 2000 Hz, however, is necessary to show the effect of noise below 90 dBA on hearing, so MSHA continues to include the 3000 Hz frequency. Several commenters suggested that MSHA use the AAO-HNS 1979 definition of material impairment. There were relatively few commenters in favor of using the AAO-HNS 1979 definition. MSHA has excluded the 500 Hz frequency from the definition of hearing impairment because it is not as critical for understanding speech and is least affected by noise. MSHA chose the hearing levels at 1000, 2000, and 3000 Hz on which to base its definition of material impairment because high frequency hearing is critically important to the understanding of speech, which often takes place in noisy conditions. The Agency's determination is consistent with OSHA's reasoning for its noise standard, and many comments and studies cited support this approach.

Risk of Impairment

The risk of developing a material impairment becomes significant over a working lifetime when workplace exposure to noise exceeds sound levels of 85 dBA. Data reviewed by the Agency indicate that lowering exposure from 90 dBA to 85 dBA does not eliminate the risk, it reduces the risk by approximately half.

Typically, noise-induced hearing loss occurs first at 4000 Hz and then progresses into the lower and higher frequencies. MSHA notes that because noise does not affect hearing sensitivity equally across all frequencies, the population defined as impaired will

differ according to the frequencies that are used in the measurement criteria. For example, AAO 1959 is weighted toward the lower frequencies, because it was developed to determine an individual's ability to communicate under quiet conditions. AAO-HNS, which includes 3000 Hz, is weighted toward the higher frequencies. Because OSHA/NIOSH-72 is weighted even more towards the higher frequencies due to the elimination of the hearing level at 500 Hz, the population of those impaired due to noise exposure will be greater than under the AAO 1959 and AAO-HNS 1979 definition.

MSHA has found that there is no reliable mathematical relationship among the three ways of assessing hearing impairment, so that direct comparisons of their results are not possible. That is, it is not possible to accurately predict the values computed using one definition from values computed using either of the other two methods. In addition, most of the raw data that would allow conversion from one definition to another are no longer available. Nonetheless, the results from all three approaches tend to demonstrate the same result.

Measuring Risk

MSHA could not determine an individual miner's risk from exposure to particular levels of noise because at any given noise exposure, some miners will suffer harm long before others, and a miner's susceptibility cannot be measured in advance of exposure. However, as MSHA noted in the proposal, risks can be determined for entire populations. The probability of acquiring a material impairment of hearing in a given population can be determined by extrapolating from data obtained from a test population exposed to the same sound levels. Three methods are generally used to express this population risk:

- (1) The hearing level of the exposed population;
- (2) The percentage of an exposed population meeting the selected criteria; and
- (3) The percentage of an exposed population meeting the selected criteria minus the percentage of a non-noise exposed population meeting the same criteria, provided both populations are similar, apart from their occupational noise exposures.

MSHA has determined that the third method, commonly known as "excess risk," provides the most accurate picture of the risk of hearing loss resulting from occupational noise exposure. OSHA also used this method in quantifying the degree of risk in the

preamble to its noise standard (46 FR 9739, 1983). This method allows the differentiation of the population expected to develop a hearing impairment due to occupational noise exposure from the population expected to develop an impairment from non-occupational causes, such as aging or medical problems.

Although studies of hearing loss in the rulemaking record consistently indicate that exposure to increased sound levels or increased duration results in increased hearing loss, the reported risk estimates of occupational noise-induced hearing loss vary considerably from one study to another. The variation is due to three factors:

- (1) The definition of "material impairment" used (discussed above);
- (2) The screening of the control (non-noise-exposed) group; and
- (3) The sound level below which material impairment from noise exposure is not expected to occur.

In some of the data used by MSHA, researchers did not screen their study and control populations, while in others they used a variety of screening criteria. Theoretically, screening does not have a significant impact on the magnitude of occupational noise-induced hearing loss experienced by given populations as long as the same criteria are used to screen both the noise-exposed and the non-noise-exposed populations being compared. However, failure to take into account any non-occupational noise exposure, loss of hearing sensitivity due to aging, or both, can have a profound effect when considering whether the subjects have exceeded an established definition of material impairment. For example, if both the exposed and control populations are screened to eliminate persons with a history of military exposure, use of medicines harmful to the ear, noisy hobbies, and conductive hearing loss from acoustic trauma or illness, the excess risk would be significantly different from that determined using unscreened populations.

The studies used by MSHA for the final as well as the proposed rule generally assumed exposures below 80 dBA to be nonhazardous. Although a few researchers—Kryter (1970) and Ambasankaran et al. (1981)—have reported hearing loss from exposure to sound levels below 80 dBA, most scientists believe that the risk of developing a material impairment of hearing from exposure to such low levels over a working lifetime is negligible. Accordingly, almost all noise risk studies consider the population exposed only to average levels of noise below 80 dBA as a "non-noise exposed"

control group. Thus, 80 dBA has become the lower sound level against which other noise exposures are compared to determine the "excess risk." This position was adopted by OSHA in its evaluation of the risk of hearing loss for its existing standard on hearing conservation.

Review of Study Data

As noted in the preamble to the proposed rule, Table 1 is derived from the preamble to OSHA's noise standard (46 FR 4084). It displays the percentage of the population expected to develop a hearing impairment meeting the AAOO 1959 definition if exposed to the specified sound levels over a working

lifetime of 40 years. This is a compilation of data developed by the U.S. Environmental Protection Agency (EPA) in 1973, the International Standards Organization (ISO) in 1975, and NIOSH in 1972. EPA, ISO, and NIOSH developed their risk assessments based on the AAOO 1959 definition, which was used by the original researchers.

TABLE 1.—OSHA RISK TABLE

Sound level (dBA)	Excess risk (%)			
	ISO (1975)	EPA (1973)	NIOSH (1972)	Range
80	0	5	3	0–5
85	10	12	15	10–15
90	21	22	29	21–29

The excess risk of material impairment under the 1997/1998 NIOSH reanalysis is discussed earlier in this preamble under *Definition of Material Impairment*.

Table 1 shows that the excess risk of material impairment after a working lifetime at a noise exposure of 80 dBA is low. On the other hand, a noise exposure of 85 dBA indicates a risk ranging from 10% to 15%. At a noise exposure of 90 dBA, the risk ranges from 21% to 29%.

Table 2 presents additional information on the risk assessments calculated by NIOSH (Table XVII, Criteria Document, 1972), one portion of which was included in Table 1. Table 2 is based on both the AAOO 1959 and the OSHA/NIOSH-72 definitions. It shows that NIOSH's risk assessment found little difference between using the OSHA/NIOSH-72 definition and using the AAOO 1959 criteria.

TABLE 2.—NIOSH RISK TABLE

Sound level (dBA)	Excess risk (%)	
	OSHA/NIOSH-72	AAOO 1959
80	3	3
85	16	15
90	29	29

Regarding how adjustments to the definitions used would affect the excess risk figures above, MSHA agrees with several researchers referred to by commenters. Suter (1988) estimates that the excess risk would be somewhat higher if 500 Hz were excluded and 3000 Hz were included in the definition of material impairment. Sataloff (1984) reports that the effect of including hearing loss at 3000 Hz in the AAOO 1959 definition of hearing impairment would dramatically increase the prevalence of hearing impairment, as follows. After 20 years of exposure to

intermittent noise that peaked at 118 dBA, 3% of the workers experienced hearing impairment according to the AAOO 1959 definition of hearing impairment. If the AAO-HNS 1979 definition is used, the percentage increases to 9%. Royster et al. confirmed that the exclusion of 500 Hz and the inclusion of 3000 Hz increased the number of hearing impaired individuals in their study of potential workers' compensation costs for hearing impairment (Royster et al., 1978). Using an average hearing loss of 25 dB as the criterion, Royster found that 3.5% of the industrial workers developed a hearing impairment according to AAOO 1959, 6.2% according to AAO-HNS 1979, and 8.6% according to the OSHA/NIOSH-72 definition.

MSHA included the following three tables in the preamble to the proposed rule in order to show data regarding the working lifetime risk of material impairment based upon the three different definitions commonly used for material impairment. Table 3 is based on AAO 1959, Table 4 is based on AAO-HNS 1979, and, Table 5 is based on the OSHA/NIOSH-72 definition. MSHA constructed these tables based on data presented in Volume 1 of the Ohio State Research Foundation Report (Melnick et al., 1980) commissioned by OSHA. The hearing level data used to construct the tables are taken from summary graphs in that report. The noise-exposed population was 65 years old, with 40 years of noise exposure. Because the control group was not screened for the cause of hearing loss, a high level of non-occupational hearing loss may undervalue the excess risk from occupational noise exposure. The researchers (Melnick et al., 1980) added

the component of noise-induced permanent threshold shift (the actual shift in hearing level due only to noise exposure) to the control data.

MSHA did not receive any comments on the three tables reflecting the predictable fact that, for any given population, the excess risk of material impairment due to noise exposure will be greater using the AAO-HNS 1979 definition than using the AAOO 1959 definition. Likewise, the excess risk of material impairment due to noise exposure will be greater using the OSHA/NIOSH-72 definition than using the AAO-HNS 1979 definition. All three tables show a smaller excess risk than did the data presented in Table 1.

TABLE 3.—RISK OF IMPAIRMENT USING AAOO 1959 DEFINITION OF IMPAIRMENT AND USING MELNICK ET AL., 1980 DATA

Exposure	Percent with impairment	Excess risk (percent) with noise exposure
non-noise	26.8	0.0
80 dBA	26.8	0.0
85 dBA	27.8	1.0
90 dBA	31.4	4.6

TABLE 4.—RISK OF IMPAIRMENT USING AAO-HNS 1979 DEFINITION OF IMPAIRMENT AND USING MELNICK ET AL., 1980 DATA

Exposure	Percent with impairment	Excess risk (percent) with noise exposure
non-noise	41.6	0.0
80 dBA	41.8	0.2

TABLE 4.—RISK OF IMPAIRMENT USING AAO-HNS 1979 DEFINITION OF IMPAIRMENT AND USING MELNICK ET AL., 1980 DATA—Continued

Exposure	Percent with impairment	Excess risk (percent) with noise exposure
85 dBA	44.4	2.8
90 dBA	50.0	8.4

TABLE 5.—RISK OF IMPAIRMENT USING OSHA/NIOSH-72 DEFINITION OF IMPAIRMENT AND USING MELNICK ET AL., 1980 DATA

Exposure	Percent with impairment	Excess risk (percent) with noise exposure
non-noise	48.5	0.0
80 dBA	48.7	0.2
85 dBA	51.5	3.0
90 dBA	57.9	9.4

The excess risk in Table 1 represents the risk assessments conducted by ISO, EPA, and NIOSH in three different years during the early 1970's. All three agencies used the same definition of impairment (AAOO 1959) in evaluating available studies. Their results are similar.

MSHA applied three different definitions of hearing impairment to the same data (Melnick 1980) to show that the excess risk of impairment varies depending on how you define

impairment. Tables 3, 4, and 5 present the results of this analysis. Because Melnick did not screen his control group for the cause of the hearing loss (could be non-occupational noise exposure), the amount of hearing loss in the supposed non-noise exposed group is high. By subtracting the value for the non-noise exposed (control) group from the values determined for groups with different levels of occupational noise exposure, we determined the excess risk for populations exposed at that level.

Tables 6 and 7 were also included in the preamble to the proposed rule to show data derived by Melnick in *Forensic Audiology* (1982) for risk of impairment due to noise exposure. These tables show the results of applying the AAO-HNS 1979 method to a population that is 60 years old with 40 years of exposure to the specified sound levels. In both tables, the data represent the noise-induced permanent threshold shift calculated by Johnson, but the screening criteria used in the two tables are different. Melnick's data in Table 6 are based upon the screened age-induced hearing loss data (that is, they are screened for non-occupational hearing loss) of Robinson and Passchier-Vermeer, whereas Table 7 is based on unscreened, non-occupational hearing loss data from the 1960–62 U.S. Public Health Survey.

Overall, the excess risk information presented in these tables is closer to that in Table 1 than to that in Tables 3, 4, and 5, but still differs. Tables 6 and 7 directly illustrate the effect of screening

populations in determining excess risk due to occupational noise exposure. Comparison of these tables shows that the percentage of workers with hearing impairment is greater in the table constructed with an unscreened population as the base.

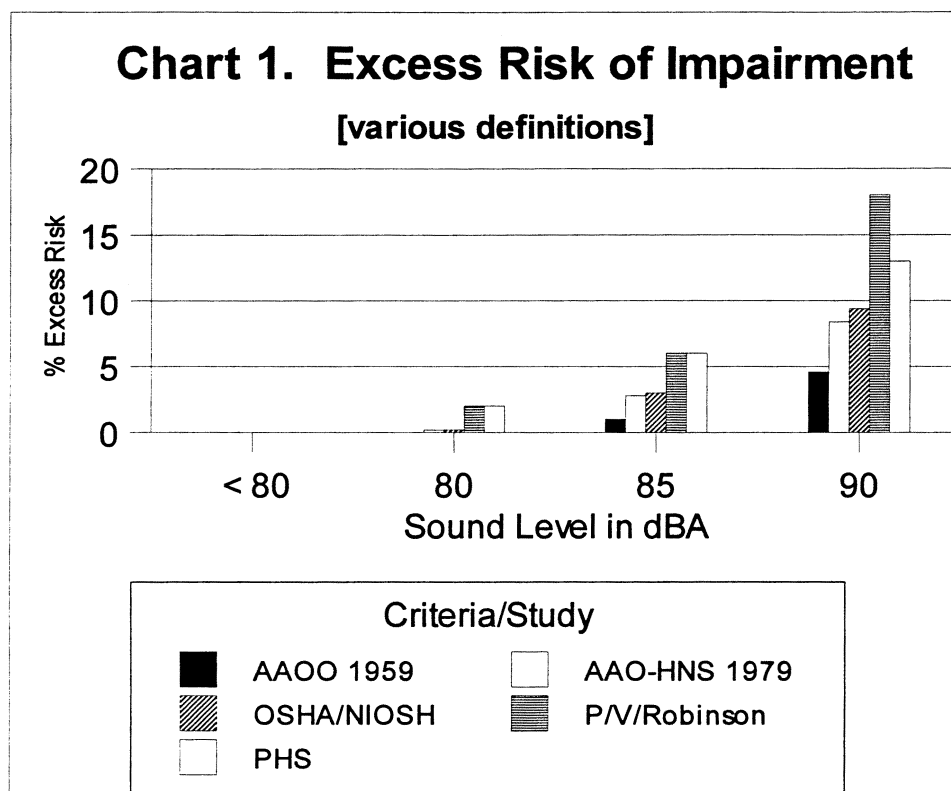
TABLE 6.—RISK OF IMPAIRMENT USING AGE-INDUCED HEARING LOSS DATA OF PASSCHIER-VERMEER AND ROBINSON

Exposure	Percent with impairment	Excess risk (percent) with noise exposure
75 dBA	3	0
80 dBA	5	2
85 dBA	9	6
90 dBA	21	18

TABLE 7.—RISK OF IMPAIRMENT USING NON-OCCUPATIONAL HEARING

Exposure	Percent with impairment	Excess risk (percent) with noise exposure
75 dBA	27	0
80 dBA	29	2
85 dBA	33	6
90 dBA	40	13

Chart 1 incorporates the risk assessment results of Tables 3, 4, 5, 6, and 7.



Note that the data from both Table 6 and Table 7 used the AAO-HNS 1979 definition. The exact numbers of those at risk varies with the study because of the definition of material impairment used, the screening criteria used, and the selection of the control group. Despite these differences, the data consistently demonstrate three points:

(1) The excess risk increases as noise exposure increases;

(2) There is a significant risk of material impairment of hearing loss for workers exposed over their working lifetimes to sound levels of 85 dBA; and

(3) Lowering the exposure from 90 dBA to 85 dBA reduces the excess risk of developing a material impairment by approximately half.

Related Studies of Worker Hearing Loss

The preamble to the proposed rule indicated that MSHA examined a large body of data on the effects of varying industrial sound levels on worker hearing sensitivity, including studies that specifically addressed the mining industry. Regardless of the industry in which the data were collected, MSHA found that exposures to similar sound levels results in similar degrees of material impairment in workers. These studies support the conclusions reached in the previous section about the risk of impairment at different sound levels.

NIOSH (Lempert and Henderson, 1973) published a report in which the

relationship of noise exposure to noise-induced hearing loss was described. NIOSH studied 792 industrial workers whose daily noise exposures were 85 dBA, 90 dBA, and 95 dBA. The noise-exposed workers were compared to a control group whose noise exposures were lower than 80 dBA. The exposures were primarily to steady-state noise, but the exposure levels fluctuated slightly in each category. Both groups were screened to exclude non-occupational noise exposure or medical complications. The subjects ranged in age from 17 to 65 years old. The report clearly shows that workers whose noise exposures were 85 dBA experienced more hearing loss than the control group. In addition, as the noise exposures increased to 90 dBA and 95 dBA, the magnitude of the hearing loss increased.

NIOSH reanalyzed these data in a report, "Reexamination of NIOSH Risk Estimates" (Prince et al., 1997), which was published after MSHA's proposed rule. The authors reanalyzed the data from NIOSH's report (Lempert and Henderson, 1973) that had established a dose-response relationship for noise. In the original study, Lempert and Henderson had interpreted response to be proportional to dose. Prince interpreted the relationship to be a more complex one, and this analysis resulted in a better fit with the data. Prince's

approach also consistently yielded a slightly lower excess risk. Thus, Prince concluded that there is an excess risk of developing a hearing impairment from a noise exposure of 85 dBA and above.

NIOSH (1976) published the results from a study on the effects of prolonged exposure to noise on the hearing sensitivity of 1,349 coal miners. From this study, NIOSH concluded that coal miners were losing their hearing sensitivity at a faster rate than would be expected from the measured environmental sound levels. While the majority of noise exposures were less than a TWA₈ of 90 dBA (only 12% of the noise exposures exceeded a TWA₈ of 90 dBA), the measured hearing loss of the older coal miners was indicative of noise exposures between a TWA₈ of 90 dBA and 95 dBA. NIOSH offered as a possible explanation that some miners are exposed to "very intense noise" for a sufficient number of months to cause the hearing loss.

Coal miners in the NIOSH (1976) study experienced a higher incidence of hearing impairment than the non-occupational-noise-exposed group (control group) at each age. Using the OSHA/NIOSH-72 definition of material impairment, 70% of 60-year-old coal miners were impaired while only a third of the control group were. This would correspond to an excess risk of 37%.

NIOSH also sponsored a study, conducted by Hopkinson (1981), on the

prevalence of middle ear disorders in coal miners. In this study, the hearing sensitivity of 350 underground coal miners was measured. The results of this study supported the results of the 1976 NIOSH study on the hearing sensitivity of underground coal miners (i.e., coal miners had worse hearing than the controls); the measured median hearing levels of the miners were the same in the two studies.

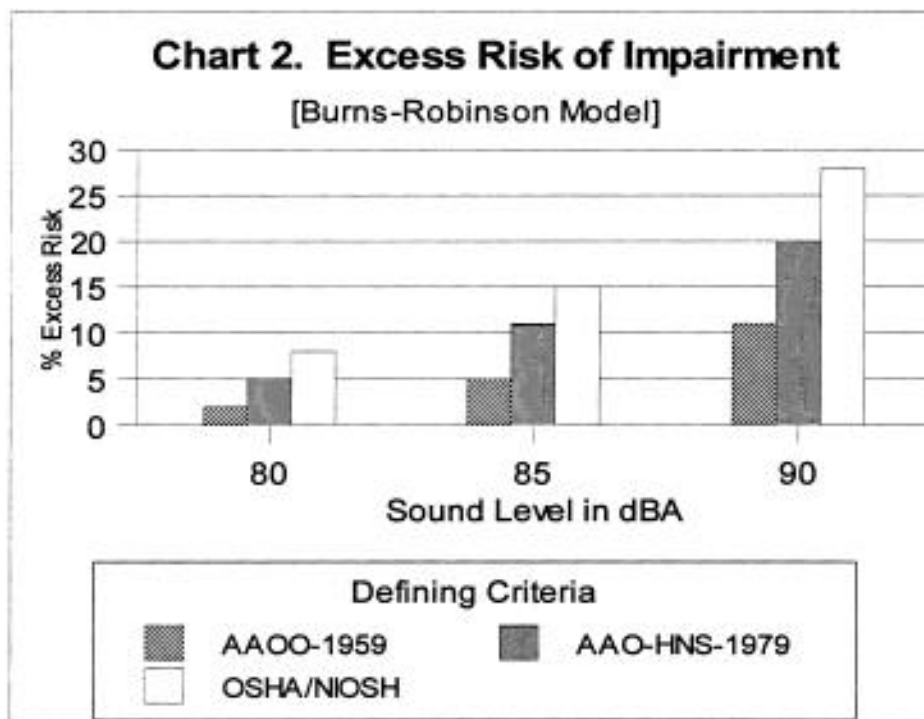
OSHA's 1981 preamble to its Hearing Conservation Amendment referred to studies conducted by Baughn; Burns and Robinson; Martin et al.; and Berger et al. Baughn (1973) studied the effects of average noise exposures of 78 dBA, 86 dBA, and 90 dBA on 6,835 industrial workers employed in midwestern plants producing automobile parts. Noise exposures for these workers were measured for 14 years and, through interviews, exposure histories were estimated as far back as 40 years. Neither the control group nor the noise-exposed groups were screened for anatomical abnormalities of the ear.

Baughn used this data to estimate the hearing levels of workers exposed to 80 dBA, 85 dBA, and 92 dBA and extrapolated the exposures up to 115 dBA. Based upon the analysis, 43% of 58-year-old workers exposed for 40 years to noise at 85 dBA would meet the AAOO 1959 definition for hearing impairment. Thirty-three percent of an identical but non-noise exposed population would be expected to meet the same definition of impairment. The excess risk from exposure to noise at 85 dBA would therefore be 10%. Using the same procedure, the excess risk for 80 dBA is 0% and for 90 dBA is 19%.

Burns and Robinson (1970) studied the effects of noise on 759 British factory workers exposed to average sound levels between 75 dB and 120 dB with durations ranging between one month and 50 years. The control group consisted of 97 non-noise exposed workers. Thorough screening removed workers with unknown exposure histories. Also excluded were people with ear disease or abnormalities and

language difficulty. Burns and Robinson analyzed 4,000 audiograms and found that the hearing levels of workers exposed to low sound levels for long periods of time were equivalent to those of other workers exposed to higher sound levels for shorter durations. From the data, the researchers developed a mathematical model that predicts hearing loss between 500 Hz and 6000 Hz in certain segments of the exposed population.

Using the Burns and Robinson mathematical model, MSHA constructed Chart 2. The chart shows that a noise exposure of 85 dBA over a 40-year career is clearly hazardous to the hearing sensitivity of 60-year-old workers. Chart 2 compares the same three definitions of impairment to the Burns-Robinson Model as used in Tables 3, 4, and 5 with the Melnick data. Chart 2 confirms the relationship between the definition of impairment and the computation of excess risk.



The prevalence of hearing loss in a group of 228 Canadian steel workers, ranging in age from 18 to 65 years of age, was compared to a control group of 143 office workers in a study conducted by Martin et al. (1975). The researchers reported that the risk of hearing impairment (average of 25 dB at 500, 1000, and 2000 Hz) increases significantly between 85 dBA and 90

dBA. Up to 22% of these workers would be at risk of incurring a hearing impairment with a TWA₈ 90 dBA permissible exposure level compared to 4% with a TWA₈ 85 dBA permissible exposure level. Both the noise-exposed and the control groups were screened to exclude workers with non-occupational hearing loss.

Passchier-Vermeer (1974) reviewed the results of eight field investigations

on hearing loss among 20 groups of workers. About 4,600 people were included in the analysis. The researcher concluded that the limit of permissible noise exposure (defined as the maximum level which did not cause measurable noise-induced hearing loss, regardless of years of exposure) was shown to be 80 dBA. Furthermore, the researcher found that noise exposures

above 90 dBA caused considerable hearing loss in a large percentage of employees and recommended that noise control measures be instituted at this level. The researcher also recommended that audiometric testing be implemented when the noise exposure exceeds 80 dBA.

Berger, Royster, and Thomas (1978) studied 42 male and 58 female workers employed at an industrial facility and a control group of 222 persons who were not exposed to occupational noise. Of the 322 individuals included in the study, no one was screened for exposures to non-occupational noise

such as past military service, farming, hunting, or shop work, since these exposures were common to all. The researchers found that exposure to a daily steady-state L_{eq} of 89 dBA for 10 years caused a measurable hearing loss at 4000 Hz (L_{eq} is an average sound level computed on a 3-dB exchange rate). According to the researchers, the measurable loss was in close agreement with the predictions of Burns and Robinson, Baughn, NIOSH, and Passchier-Vermeer.

Studies of Impact of Lower Sound Levels

Table 8 reproduces the most recent data on the harm that can occur at lower

sound levels, found in the International Standards Organization's publication ISO 1999 (1990). The noise exposures for the population ranged between 75 dBA and 100 dBA. Table 8 presents the mean and various percentages of the hearing level of a 60-year-old male exposed to noise for 40 years. The noise-induced permanent threshold shift in hearing was combined with the age-induced hearing loss values to determine the total hearing loss. The age-induced hearing loss values were from an unscreened population representing the general population.

TABLE 8.—HEARING LEVEL RESULTING FROM SELECTED NOISE EXPOSURES

Sound level in dBA	Hearing level in dB			
	500 Hz	1000 Hz	2000 Hz	3000 Hz
80	12	6	10	30
85	12	6	11	33
90	12	6	16	42

Information about the effects of lower noise exposures on hearing are especially valuable in attempting to identify subpopulations particularly sensitive to noise. The Committee on Hearing, Bioacoustics, and Biomechanics of the National Research Council (CHABA) (1993) reviewed the scientific literature on hazardous exposure to noise. The report reaffirmed many of the earlier findings of the Committee. Based on temporary threshold shift (TTS) studies, the report suggests that to prevent noise-induced hearing loss, exposures must remain below 76 dBA to 78 dBA. Based on field studies, the report suggests that, to guard against any permanent hearing loss at 4000 Hz, the sound level should be less than 85 dBA, and possibly less than 80 dBA. Finally, the report suggests that therapeutic drugs, such as aminoglycoside antibiotics and salicylates (aspirin), can interact synergistically with noise to yield more hearing loss than would be expected by either stressor alone.

Few current studies of unprotected U.S. workers exposed to a TWA_8 between 85 and 90 dBA are available, because the hearing conservation program of OSHA's noise standard requires protection at those levels for most industries (the exception being employers engaged in oil and gas well drilling and servicing operations). The difficulty in constructing new retrospective studies of U.S. workers has been noted by Kryter (1984) in his chapter entitled "Noise-Induced

Hearing Loss and Its Prediction." He states that due to the global trend in the last decade to institute noise control and hearing conservation programs, new retrospective studies are no longer feasible. Kryter believes that the retrospective studies of Baughn, Burns and Robinson, and the U.S. Public Health Service are thus the best available on the subject of noise-induced permanent threshold shift. Kryter developed a formula to derive the effective noise exposure level for damage to hearing from the earlier studies and determined the noise-induced permanent threshold shift at various audiometric test frequencies for a population of workers.

Studies of workers in other countries can provide valuable information in assessing the consequences of workplace noise exposure between 85 dBA and 90 dBA. Differences in socioeconomic factors such as recreational noise exposure, use of medicines harmful to the ear, and inflammation of the middle ear (otitis media) make it difficult to directly apply the results of studies of workers from other countries. However, MSHA has determined that these studies can be used as further support for the existence of a risk in the 80 to 90 dBA range.

Rop, Raber, and Fischer (1979) studied the hearing loss of 35,212 male and female workers in several Austrian industries, including mining and quarrying. The researchers measured the hearing levels of workers exposed to

sound levels ranging from less than 80 dBA up to 115 dBA and arranged them into eight study groups based on average exposures. Assuming that exposure to sound levels less than 80 dBA did not cause any hearing loss, they assigned workers exposed to these levels to the control group. The researchers reported that workers with 6 to 15 years of exposure at 85 dBA had significantly worse hearing than the control group. For the five groups whose exposure was between 80 dBA and 103.5 dBA, hearing loss tended to increase steadily during their careers but leveled off after 15 years. In contrast, for workers exposed to sound levels above 103.5 dBA, hearing loss continued to increase beyond 15 years.

A statistical method for predicting hearing loss was developed using the data collected in the Rop study. The researchers predicted that 20.1% of the 55-year old males in the control group with 15 years of work experience would incur hearing loss. For a comparable group of males with exposures at 85 dBA the risk increased to 41.6%; at 92 dBA the risk increased to 43.6%; and at 106.5 dBA the risk increased to 72.3%. The study concluded that exposure to sound levels at or above 85 dBA damaged workers' hearing.

A study (Schwetz et al., 1980) of 25,000 Austrian workers concluded that the workers exposed to sound levels between 85 dBA and 88 dBA experienced greater hearing loss than workers exposed to sound levels less than 85 dBA. The study further

concluded that at 85 dBA there is no hearing recovery, ultimately causing noise-induced hearing loss. Schwetz, therefore, recommended 85 dBA as the critical intensity—the permissible exposure limit.

Stekelenburg (1982) calculated age-induced hearing loss according to Spoor and noise-induced hearing loss according to Passchier-Vermeer. Based upon these calculations, Stekelenburg suggested 80 dBA as the acceptable level for noise exposure over a 40 year work history. At this exposure, Stekelenburg calculates that socially impaired hearing due to noise exposure would be expected in 10% of the population.

A study of 537 textile workers by Bartsch et al. (1989), which defined socially significant hearing loss as a 40 dB hearing level at 3000 Hz, found that the hearing loss resulting from exposures below 90 dBA mainly occurs at frequencies above 8000 Hz (these frequencies are not normally tested during conventional audiometry). Even though the study concluded that the hearing loss was not of "social importance," it did support a reduced hearing loss risk criterion of 85 dBA be used to protect the workers' hearing.

With the exception of the Bartsch study, the results of the foreign studies are generally consistent with those of U.S. workers. The Bartsch conclusion that the hearing loss is not of "social importance" is not supported by the many studies, discussed earlier, that point to the importance of good hearing sensitivity at 3000 Hz in order to understanding speech in everyday, noisy environments. Based on experience, MSHA has found that people will encounter hearing difficulty before their hearing loss level reaches 40 dB at 3000 Hz.

One commenter stated that the studies cited by MSHA in justifying the risk of material impairment at exposures below 90 dBA were based on sound levels determined using older instrumentation. Assuming that MSHA would be using more modern instrumentation for compliance purposes, he suggested that the Agency should not use the old data and studies. The commenter suggested that MSHA either raise or retain the criterion level of a TWA₈ of 90 dBA or have the studies re-done with newer instrumentation before proceeding with rulemaking. MSHA maintains that the studies remain valid, however, because they were conducted using methodologies based on sound level meters. The studies, like the final rule, were based on the standardized definitions of A-weighting network and slow response and usually measured

steady-state noise. Therefore, the studies are reliable and applicable. MSHA's risk assessment is based upon the best scientific data available to the Agency, as required by the Mine Act.

Reported Hearing Loss Among Miners

To confirm the magnitude of the risks of noise-induced hearing loss among miners, MSHA examined the following evidence of reported hearing loss among miners.

Audiometric Databases

Audiometric testing is not currently required in metal and nonmetal mining and is offered in coal mining only after a determination of overexposure to noise. However, in connection with its ongoing assessments of the effectiveness of the current standards in protecting miner health, MSHA has obtained two audiometric databases consisting of 20,022 audiograms conducted on 3,439 coal miners and 42,917 audiograms conducted on 9,050 metal and nonmetal miners. The audiometric evaluations on the coal miners were conducted between 1971 and 1994, mostly during the latter years. The audiograms on metal and nonmetal miners were collected between 1974 and 1995. Each audiogram in the data set contained a miner identification number, age, date of test, and audiometric thresholds for each ear at 500, 1000, 2000, 3000, 4000, and 6000 Hz. Supplemental data such as dates of employment, noise exposures, use of protective equipment, and training histories were not provided. MSHA asked NIOSH to examine the audiometric data and both MSHA and NIOSH (Franks, 1996) have performed analyses of the coal miner database.

Coal Miner Audiometric Data

Franks used a computer expert system to screen the data for year-to-year consistency of the audiograms, test-room background noise, and asymmetry in hearing that might indicate a unilateral loss of hearing (which is not characteristic of occupational noise-induced hearing loss). More than 2,500 questionable audiograms were reviewed by NIOSH audiologists.

The final screened database consisted of 17,260 audiograms representing 2,871 coal miners. It was compared to the database in Annex A of "ISO-1999.2 Acoustics—Determination of Occupational Noise Exposure and Estimation of Noise-Induced Hearing Loss." NIOSH's report entitled "Analysis of Audiograms for a Large Cohort of Noise-Exposed Miners" (NIOSH, 1996) indicates that 90% of these coal miners had a hearing impairment (defined as an average 25-

dB hearing level at 1000, 2000, 3000, and 4000 Hz) by age 51 compared with only 10% of the general population. Even at age 69, only 50% of the non-noise-exposed population acquire a hearing impairment.

By age 35 the average miner has a mild hearing loss, and 20% of miners have a moderate loss. By age 64, fewer than 20% of the miners have marginally normal hearing, while 80% have moderate to profound hearing loss. In contrast, 80% of the non-noise-exposed population will not acquire a hearing loss as severe as the average miner's, regardless of how long they live. Further, Franks concluded that miners, after working 20 to 30 years, could find themselves in life-threatening situations resulting from their inability to hear safety signals and roof talk.

Metal and Nonmetal Miner Audiometric Data

NIOSH used a computer expert system to screen the audiometric data on metal and nonmetal miners. The data were screened for year-to-year consistency of the audiograms, test room background noise, and asymmetry in hearing that might indicate a loss of hearing in only one ear (not characteristic of an occupational noise-induced hearing loss). The expert system identified 20,429 questionable audiograms, and a subset of 1000 were reviewed by an audiologist.

The final screened database consisted of 22,488 audiograms representing 5,244 metal and nonmetal miners. The data were compared to those in Annex A of "ISO-1999.2 Acoustics—Determination of Occupational Noise Exposure and Estimation of Noise-Induced Hearing Loss." NIOSH's report, entitled "Prevalence of Hearing Loss for Noise-Exposed Metal/Nonmetal Miners" (NIOSH, 1997), supports the conclusions of earlier scientific studies that metal and nonmetal miners are losing their hearing sensitivity faster than the general population. It indicates that, "At age 20, approximately 2% have hearing impairment, rising to around 7% at age 30, 25% at age 40, 49% at age 50, and 70% by age 60. By contrast, 9% of the non-occupationally noise-exposed have hearing impairment at age 50." Franks noted a difference in the increase of hearing loss between men and women. He also noted that, due to the NIOSH definition of hearing impairment used in the study (inclusion of 4,000 Hz.), there was a sufficient degree of hearing impairment in the population to cause communications problems, because miners would have difficulty in understanding some consonants whose

frequency is between 3,000 and 4,000 Hz.

MSHA received comments on both NIOSH studies. One commenter asserted that Franks used an incorrect screening process for the audiograms as well as the incorrect control group (ANNEX A of ISO R-1999) and alleged other deficiencies in the studies. This commenter stated that he reanalyzed the data using minimal screening of audiograms, and compared it to the "correct" control group (Annex C of ANSI S3.44-1996, "Acoustics—Determination of Occupational Noise Exposure") estimating that the hearing impairment of the miners was caused by noise exposure. The commenter concluded that both the coal and metal and nonmetal audiometric data suggest that typical occupational noise exposures are on the order of lifetime time-weighted exposures of about 89 dBA. This commenter thus suggests that there is no need for MSHA to continue with rulemaking, as the current regulations are adequate in protecting miners' hearing sensitivity. Some commenters concurred with the reanalysis of the NIOSH studies performed by this commenter. MSHA notes, however, that there was no significant difference between the control groups, as the International Standards Organization 1999.2 standard and the American National Standards Institute S3.44 standard are virtually

identical—the ANSI document having been adapted from the ISO document.

However, MSHA also received a great deal of support for the NIOSH studies, which showed that the use of the Annex A control group—highly screened audiometric data was appropriate and the use of Annex B or C in the reanalysis was inappropriate.

One commenter stated, "The use of Annex B * * * is questionable because these data were not screened to exclude persons with occupational noise exposure."

MSHA agrees with Dr. Franks in that Annex A was the most appropriate database for the analysis conducted because it is the only database in ISO 1999 for which year-to-year changes in hearing and prevalence of hearing impairment could be calculated. MSHA also received support from commenters for the NIOSH studies. Additionally, MSHA conducted its own research and determined that miners are still losing more of their hearing sensitivity than non-noise-exposed workers. Annex A is a more stringent screening method than Annex C which was used by Dr. Clark. Annex A was selected because it represents a highly screened sample, free from "undue noise exposure" and ear disease.

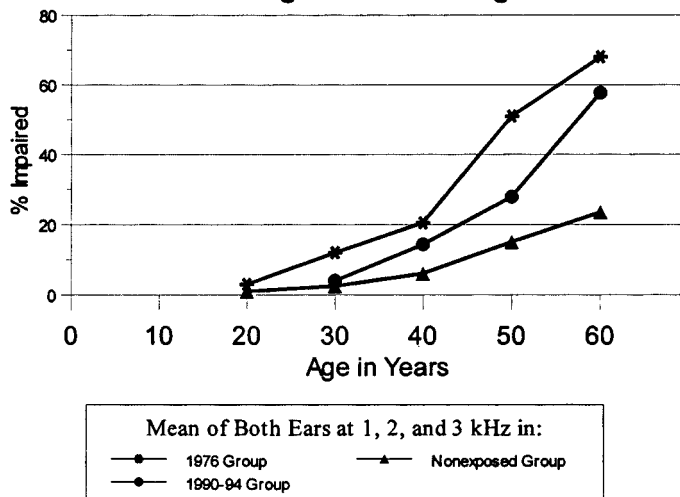
Several researchers who studied the health status of miners provided testimony based on numerous research reports. Their conclusion was that miners have incurred a greater loss of

hearing sensitivity than the general population has. MSHA believes that the NIOSH studies are valid evidence that supports the rule.

MSHA conducted a separate analysis of the audiometric data for coal miners, using the 25 dB hearing level at 1000, 2000, and 3000 Hz definition of material impairment of hearing. In order to reflect current trends, the percentage of current coal miners (whose latest audiogram was taken between 1990 and 1994) with material impairment of hearing was compared to NIOSH's study on coal miners published in 1976. The results are shown in Chart 3, along with NIOSH's 1976 results for both the noise-exposed miners and the non-noise-exposed controls.

The data points for Chart 3 represent the mean hearing loss of both ears at 1000, 2000, and 3000 Hz relative to audiometric zero. The top line represents the 1976 (pre-noise-regulation) group, the middle line represents the 1990-1994 (noise-regulated) group, and the bottom line represents the non-noise-exposed group. Although there has been some progress under the existing regulations, miners are still losing more of their hearing sensitivity than non-noise-exposed workers. This is true even if the analysis is limited to miners under 40 years of age (that is, those who have worked only under the current coal noise regulations).

Chart 3. Percentage of Coal Miners Exceeding 25 dB Hearing Loss



MSHA also analyzed the audiometric data for the number of standard threshold shifts and reportable hearing loss cases. In the preamble to the

proposal, MSHA defined a standard threshold shift as a change in hearing threshold level, relative to the miner's original or supplemental baseline audiogram, of an average of 10 dB or

more at 2000, 3000, and 4000 Hz in either ear. The final rule adopts this definition. The importance of a standard threshold shift is that it reveals that a permanent loss in hearing sensitivity

has occurred. When the change from the baseline averages 25 dB or more at the same frequencies, the hearing loss must be reported to MSHA. "Standard threshold shift" and "reportable hearing loss" are discussed in greater detail below.

For the second analysis, the first audiogram of each miner was assumed to be the baseline. The last audiogram of each miner was compared to the baseline. Neither audiogram was corrected for age-induced hearing loss. Also, because of the lack of supporting

data, it was not possible to exclude non-occupational standard threshold shifts, resulting in a greater number of standard threshold shifts. The results of the 3,102 coal miners audiograms analyzed are presented in Chart 4.

Chart 4. Percentage of Coal Miners Exceeding Selected Criteria

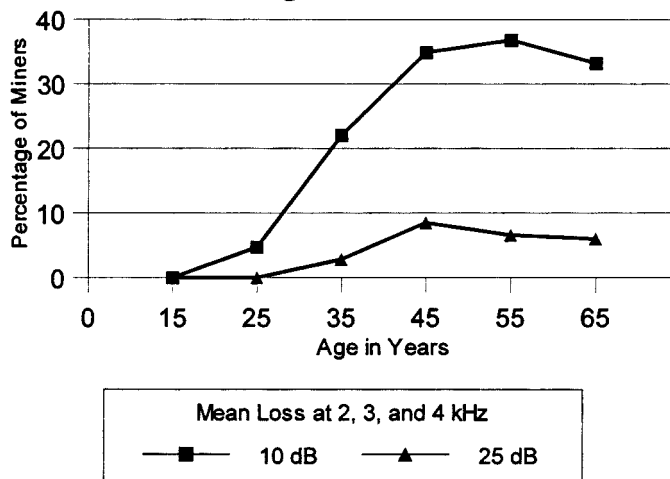


Chart 4 clearly shows that many of the coal miners were found to have a standard threshold shift. The likelihood of acquiring a standard threshold shift generally increases with advancing age. The MSHA analysis was conservative in that only the first and last audiograms were included, resulting in each miner having only one standard threshold shift. In fact, a miner may have experienced multiple standard threshold shifts.

In addition to the above audiometric data, two NIOSH studies mentioned in the section of this preamble on risk of impairment support MSHA's conclusion that miners are at risk of noise-induced hearing loss. In the 1976 NIOSH study, although the majority of noise exposures were less than 90 dBA, approximately 70% of the 60-year old coal miners had experienced a material impairment of hearing using the OSHA/NIOSH-72 definition. The Hopkinson (1981) NIOSH study also supports the earlier NIOSH results.

Data Provided by Commenters

Two commenters to the proposed rule provided information on the hearing sensitivity of miners. The first commenter estimated that 45 to 50% of employed miners have experienced a standard threshold shift (at least 25% if corrected for age-induced hearing loss). Further, this commenter estimated that

about 25% of the miners have an average hearing loss of 25 dB or more at 1000, 2000, and 3000 Hz. Corrected for age-induced hearing loss, the percentage of miners with this level of hearing loss decreased to about 15%.

The second commenter referred to an oral presentation by Smith et al. at the 1989 Alabama Governor's Safety and Health Conference. (MSHA notes that the Smith presentation itself is not part of the rulemaking record, although Smith verified that the comment was correct via letter (December 5, 1994). MSHA believes that the Smith paper is valid evidence which supports the rule.) This commenter stated that Smith et al. reported on the evaluation of serial audiograms from 100 workers exposed to sound levels less than 85 dBA. The authors found that 15% of these workers would have some degree of hearing impairment using the AAO-HNS 1979 definition. They also reported that at least 26% of the mining population would have some degree of hearing impairment using the same definition.

In response to MSHA's request for additional specific information regarding hearing loss among miners, some commenters stated that they had no workers' compensation awards for miners' hearing loss at their operations. No commenters supplied information regarding the cost of compensation awards. Some commenters supplied

specific information on miner's age, occupation, and degree of hearing loss. Several commenters submitted data, some in conjunction with an analysis of the data, in support of their position that hearing protectors can be effective as the primary means of protecting miners against occupational noise-induced hearing loss.

The NIOSH (Franks) analysis of the two databases cited by MSHA and the three analyses conducted by Clark and Bohl under the auspices of the National Mining Association (the first a report summarizing a reanalysis of the NIOSH Coal Miner Study, the second a report containing a reanalysis of the NIOSH Metal and Nonmetal Miner Study, and the third a report containing an analysis of two data bases from the National Mining Association) indicate that miners are developing hearing losses to a degree that constitutes material impairment. These analyses also indicate that the amount of hearing loss and the percentage of the population that is impaired is highly variable. Further, some individual miners received a substantial hearing loss. The differences in the conclusions of these studies are attributable to the different baselines used in the analyses for comparison of the exposed populations. The NIOSH analysis included detailed screening of the data and used a control group (described in Appendix A of

ANSI S3.44, "American National Standard Determination of Occupational Noise Exposure and Estimation of Noise-Induced Hearing Impairment") where the hearing losses of the group are strictly due to aging. In contrast, the Clark-Bohl analyses and conclusions did not include screening of the data and used for comparison the control group (described in Appendix C of ANSI S3.44) where the control group's hearing losses included those due to exposures to less than two weeks of occupational noise, exposures to non-occupational noise, otological abnormalities, as well as those due to aging. There is insufficient information in the studies to allow a determination of which method of analysis is more appropriate or superior. As a result of the differences in approach between these analyses, the analyses arrive at different conclusions regarding the magnitude of the hearing losses exhibited by miners, although all of these analyses do indicate that some miners are developing a material impairment of hearing in varying degrees. Additionally, these analyses do not support the conclusion that a hearing conservation program that relies primarily or exclusively on the use of hearing protectors effectively protects all miners from noise-induced occupational hearing loss.

Other studies and data were submitted by other commenters in support of their position that a hearing conservation program that relies primarily or solely on the use of hearing protectors can adequately protect miners' hearing. These studies and data are discussed later in the preamble.

Reported Hearing Loss Data

Under MSHA's existing regulations at 30 CFR part 50, mine operators are required to report cases of noise-induced hearing loss to MSHA when it is diagnosed by a physician or when the affected miner receives an award of compensation. Between 1985 and 1997, mine operators reported a total of 2,590 cases of noise-induced hearing loss. In a substantial number of these cases, the occupational noise exposures occurred after the implementation of the current noise regulations.

Coal mine operators reported 674 cases among surface miners, 1,098 cases among underground miners, and 14 cases among miners whose positions were not identified. According to coal mine operators, 710 of the 1,786 cases began working at a mine after the implementation of the noise regulations for coal mines—1972 for underground coal mining and 1973 for surface coal mining. Workers with no reported

mining experience were excluded from the analysis.

Metal and nonmetal mine operators reported 650 cases among surface miners and 154 cases among underground miners, a total of 804 cases. According to mine operators, 172 of the 804 cases began working at a mine after the implementation of noise regulations for metal and nonmetal mines in 1975. Again, workers with no reported mining experience were excluded from the analysis.

Comparing the two types of mining, there were significantly more reported hearing loss cases at coal mines than at metal and nonmetal mines, and a higher proportion of those cases were reported of workers who began working after the implementation of the current standards. This is despite the fact that, at present, there are more metal and nonmetal miners than coal miners employed in the United States. A possible explanation of the difference between reported cases of noise-induced hearing loss among coal and metal and nonmetal miners may be that there is more frequent use of engineering noise controls in metal and nonmetal mining. Because the occupational noise standards for coal mines allow inspectors to take into account the use of hearing protectors in determining compliance, most coal mines use hearing protectors for compliance unless the engineering controls are inexpensive or come with the equipment. Metal/nonmetal mines are not allowed to use hearing protectors for compliance unless they have implemented all feasible engineering and administrative controls. Other possible reasons include differences in the severity of the noise exposures, variations among states' criteria for workers' compensation awards, continual use of hearing protectors, and the effectiveness of selected hearing protectors.

MSHA reviewed the narrative associated with each case of noise-induced hearing loss to determine the average degree of hearing loss. Although many narratives included reasons for reporting the noise-induced hearing loss, others only listed the illness as "hearing loss." Approximately half the cases had no information on the severity of the hearing loss. Some contained designations such as standard threshold shift, OSHA reportable case, or percent disability. The narratives did not contain enough information with which to determine an average severity for cases of noise-induced hearing loss.

At least 40% of the reported cases in coal mining resulted in the miner being compensated for noise-induced hearing

loss. Another 7% of the reported cases indicated that a workers' compensation claim for noise-induced hearing loss had been filed. In metal and nonmetal mines, at least 21% of the reported cases resulted from the miner being compensated for noise-induced hearing loss. Nearly another 4% of the reported cases indicated that a workers' compensation claim for noise-induced hearing loss had been filed.

The low number of cases reported to the Agency are believed to be due to either:

(1) The lack of a specific definition of a noise-induced hearing loss in MSHA's part 50 regulations and the resulting confusion on the part of mine operators about which cases to report;

(2) The lack of consistency among state requirements for awarding compensation for a noise-induced hearing loss and among physicians in diagnosing what constitutes a hearing loss caused by noise; or

(3) The lack of required periodic audiometric testing in the mining industry.

In sum, the hearing loss currently reported to MSHA under part 50 cannot be used to accurately characterize the incidence, prevalence, or severity of hearing loss in the mining industry. However, the data clearly show that miners are experiencing noise-induced hearing loss.

Workers' Compensation Data

The preamble to the proposal reviewed a study by Valoski (1994) of the number of miners receiving workers' compensation and the associated indemnity costs of those awards. Despite contacting each state workers' compensation agency and using two national databases, Valoski was unable to obtain data for all states, including those with significant mining activities. Valoski reported that between 1981 and 1985 at least 2,102 coal miners and 312 metal and nonmetal miners were awarded compensation for occupational hearing loss. The identified total indemnity costs of those awards exceeded \$12.5 million, excluding rehabilitation or medical costs.

In a letter to MSHA, NIOSH cited the Chan et al. (1995) investigation for NIOSH of the incidence of noise-induced hearing loss among miners using information from the Bureau of Labor Statistics' (BLS) Supplementary Data System. In the 15 states that participated in the BLS program between 1984 and 1988, a total of 217 miners (93 coal miners and 124 metal and nonmetal miners) were awarded workers' compensation for noise-induced hearing loss. During those

years, mine operators from all states reported 873 cases of noise-induced hearing loss among coal miners and 286 cases among metal and nonmetal miners. Chan et al. stated that because of differing state workers' compensation requirements, it is not possible to directly compare noise-induced hearing losses among the states. These factors limit the usefulness of the data obtained.

MSHA reviewed reports on workers' compensation in Canada and Australia in the preamble to the proposed rule. The noise regulations and mining equipment used in these countries are similar to those in the United States. A recent report on workers' compensation awards to miners in Ontario, Canada (1991) showed that between 1985 and 1989, noise-induced hearing loss was the second leading compensable occupational disease. Approximately 250 claims for noise-induced hearing loss involving miners were awarded annually during that time.

Lescouffair et al. (1980) studied 278 metal and asbestos miners working in Quebec, Canada who claimed compensation for hearing loss. After excluding 28.7% (80) cases of non-mining noise-induced hearing loss, approximately 50% (99) of those diagnosed as having noise-induced hearing loss were shown to have a hearing impairment, based on the AAOO 1959 definition. An estimated

63% (125) showed an impairment based on AAO-HNS 1979 definition. The miners were exposed to noise for 15 to 49 years and showed a similar occurrence of hearing loss in both surface and underground occupations. The researchers also reported that there was no significant difference in noise-induced hearing loss between those miners exposed to a combination of intermittent and continuous noise and those exposed to intermittent noise, except at 2000 Hz.

Eden (1993) reported on the Australian mining industry's experience with hearing conservation. Eden quoted statistics from the Joint Coal Board which revealed that noise-induced hearing loss made up 59% to 80% of the reported occupational diseases from 1982 to 1992. Eden also reported that in New South Wales, 474 of 16,789 coal miners were awarded compensation for noise-induced hearing loss. The incidence rate for the total mining industry in New South Wales was about 23 cases per 1,000 workers during 1990–1991. This was the highest rate for any industry in New South Wales.

Although the compensation data are incomplete and cannot be used for estimating the prevalence of noise-induced hearing loss in the mining industry, the limited data available show that numerous cases are being filed each year, at considerable cost. Furthermore, according to the data

reported by mine operators, many miners who developed noise-induced hearing loss worked in mining only after the implementation of the current noise regulations. This evidence of continued risk, although limited, supplements and supports the data previously presented from scientific studies.

Exposures in the U.S. Mining Industry

Miners in the U.S. are at significant risk of experiencing material impairment as a result of exposure to noise. Exposure levels remain high in all sectors of the mining industry, even though noise regulations have been implemented for some time. Exposures are particularly high in the coal mining sector, where hearing protectors, rather than engineering or administrative controls, remain the primary means of protection against noise-induced hearing loss.

Inspection Data

Noise exposure data has been collected by MSHA inspectors from thousands of samples gathered over many years. Table 9 indicates samples which present readings exceeding the permissible exposure level, (TWA₈ of 90 dBA) and also shows noise dose trends in metal and nonmetal mines based on over 232,500 full-shift samples collected using personal noise dosimeters by MSHA from 1974 through 1997.

TABLE 9.—MNM MINES NOISE DOSE TRENDS CYs 1974–97 *

Fiscal year	Number of samples	Number samples exceeding 90 dBA TWA ₈	Percent exceeding 90 dBA TWA ₈
1974	363	139	38.3
1975	3,826	1,661	43.4
1976	9,164	3,725	40.6
1977	13,485	5,047	37.4
1978	17,326	6,415	37.0
1979	21,176	7,638	36.1
1980	15,185	5,203	34.3
1981	11,278	3,651	32.4
1982	3,208	876	27.3
1983	7,628	2,188	28.7
1984	8,525	2,311	27.1
1985	8,040	2,094	26.0
1986	9,213	2,402	26.1
1987	10,145	2,818	27.8
1988	10,514	2,417	23.0
1989	10,279	2,208	21.5
1990	13,067	2,721	20.8
1991	14,936	2,947	19.7
1992	14,622	2,809	19.2
1993	14,566	2,529	17.4
1994	15,979	2,627	16.4
1995	13,865	1,989	14.4
1996	16,686	2,228	13.4
1997	10,731	1,989	14.3

* From USBM's MIDAS data base. Italicized data not included in chart 9a.

Table 10 shows samples with readings exceeding the permissible exposure level (TWA₈ of 90 dBA) and noise dose trends in coal mines based on 75,691 full-shift samples collected by MSHA from 1986 through 1997 using personal noise dosimeters. MSHA began routine sampling in coal mines in 1978 but did not begin building the database until 1986.

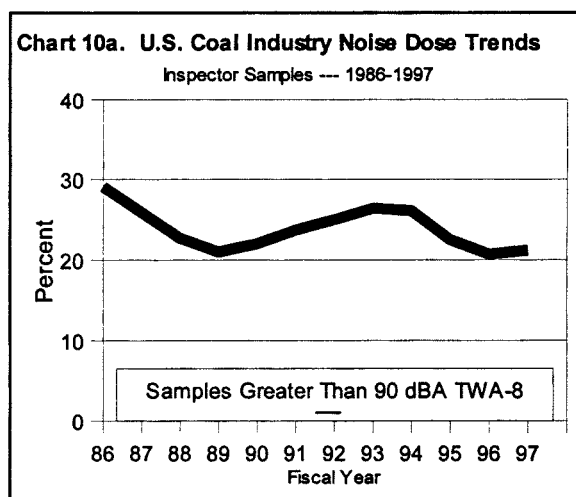
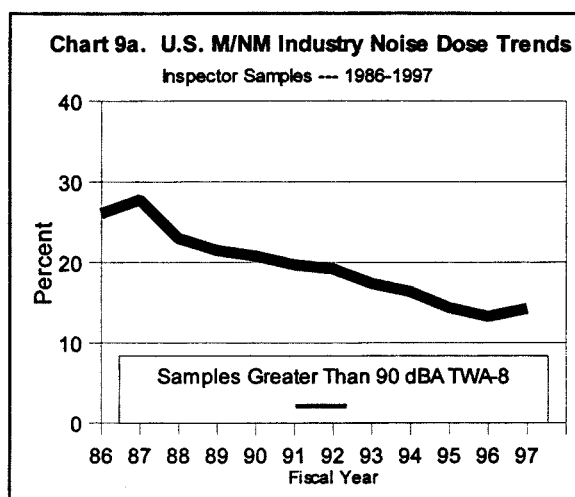
TABLE 10.—COAL MINE NOISE DOSE TRENDS, FYS 86–97

Fiscal year	Number of samples	Number samples exceeding 90 dBA TWA ₈	Percent exceeding 90 dBA TWA ₈
1986	2,037	593	29.1
1987	12,774	3,314	25.9
1988	11,888	2,702	22.7
1989	11,035	2,313	21.0
1990	10,861	2,388	22.0
1991	6,898	1,635	23.7
1992	6,636	1,660	25.0
1993	7,223	1,908	26.4
1994	6,339	1,656	26.1
1995	5,407	1,219	22.5
1996	6,064	1,256	20.7
1997	6,542	1,388	21.2

The inspection data for the coal and metal and nonmetal mining sectors have been graphed in Charts 9a and 10a, which indicate that the metal and nonmetal sector shows a gradual but

consistent downward trend in the percentage of samples exceeding the current permissible exposure level. However, there was no such clear trend for coal mines during the same period.

MSHA attributes this difference to the established use of engineering and administrative controls in metal and nonmetal mines.



MSHA notes that the interaction of two factors in the data represented in these charts may offset each other. First, the database is made up of samples collected in noisier mines and occupations. Second, the database includes both initial overexposure and the results of any resampling to determine compliance after the mine operator has utilized engineering or administrative controls (in the case of an overexposure found during an initial survey).

Dual Survey Data

MSHA conducted a special survey to compare noise exposures at different threshold levels, because the final rule requires integration of sound levels between 80 dBA and at least 130 dBA for the action level and between 90 dBA and at least 140 dBA for the permissible exposure level. The survey, referred to as the dual-threshold survey, involved the collection by MSHA inspectors of data in coal, metal, and nonmetal mines. Each sample was collected using a personal noise dosimeter capable of collecting data at both thresholds simultaneously. All other dosimeter

settings were the same as those used during normal compliance inspections (the 90 dBA criterion level, 5-dB exchange rate, and A-weighting and slow response characteristics). The noise doses were mathematically converted to their corresponding TWA₈.

Tables 11 and 12 display the dual-threshold data in metal and nonmetal mines and in coal mines. Table 11 shows the dual-threshold data collected for metal and nonmetal mines from March 1991 through December 1994 using personal noise dosimeters. This data consisted of more than 42,000 full-shift samples.

TABLE 11.—M/NM DUAL-THRESHOLD NOISE SAMPLES EQUAL TO OR EXCEEDING SPECIFIED TWA₈ SOUND LEVELS—MARCH 1991 THROUGH DECEMBER 1994

TWA ₈ sound level (in dBA)	90 dBA threshold		80 dBA threshold	
	Number of samples	Percent of samples	Number of samples	Percent of samples
90 (PEL)	7,360	17.4	.....	.....

TABLE 11.—M/NM DUAL-THRESHOLD NOISE SAMPLES EQUAL TO OR EXCEEDING SPECIFIED TWA₈ SOUND LEVELS—
MARCH 1991 THROUGH DECEMBER 1994—Continued

TWA ₈ sound level (in dBA)	90 dBA threshold		80 dBA threshold	
	Number of samples	Percent of samples	Number of samples	Percent of samples
85 (action level)	28,250	66.9

As indicated in Table 11, 17.4% of all samples collected by MSHA in metal and nonmetal mines during the specified period equaled or exceeded the permissible exposure level (a TWA₈ of 90 dBA using a 90-dBA threshold)—slightly less than the results of the inspectors' samplings in Table 9. Under

the final rule feasible engineering and administrative controls are required to be implemented in such instances in all mines to reduce the noise exposure to the permissible exposure level. Furthermore, 67% of the samples in metal and nonmetal mines exceeded the

action level (a TWA₈ of 85 dBA using an 80-dBA threshold).

MSHA's dual-threshold sampling data for coal mines is presented in Table 12. These data consist of over 4,200 full-shift samples collected from March 1991 through December 1995 using personal noise dosimeters.

TABLE 12.—COAL DUAL-THRESHOLD NOISE SAMPLES EQUAL TO OR EXCEEDING SPECIFIED TWA₈ SOUND LEVELS
[March 1991 Through December 1995]

TWA ₈ sound level (in dBA)	90 dBA threshold		80 dBA threshold	
	Number of samples	Percent of samples	Number of samples	Percent of samples
90 (PEL)	1,075	25.3	.....	.....
85 (action level) .....	.....	.....	3,268	76.9

As indicated in Table 12, 25.3% of all samples collected by MSHA in coal mines during the specified period equaled or exceeded the permissible exposure level (a TWA₈ of 90 dBA using a 90-dBA threshold). Furthermore,

almost 77% of the survey samples from the coal industry showed noise exposures equaling or exceeding a TWA₈ of 85 dBA using an 80-dBA threshold (the action level).

Tables 13 and 14 present some of the MSHA dual-threshold sampling data by occupation for the most frequently sampled occupations in metal and nonmetal and coal mines, respectively.

TABLE 13.—PERCENTAGE OF MSHA M/NM INSPECTOR NOISE SAMPLES EXCEEDING SPECIFIED TWA₈ SOUND LEVELS,
BY SELECTED OCCUPATION †

Occupation	Number of samples	90 dBA threshold	80 dBA threshold
		Percent of samples >90 dBA (PEL)	Percent of samples ≥85 dBA (action level)
Front-End-Loader Operator	12,812	12.9	67.7
Truck Driver	6,216	13.1	73.7
Crusher Operator	5,357	19.9	65.1
Bulldozer Operator	1,440	50.7	86.2
Bagger	1,308	10.2	65.0
Sizing/Washing Plant Operator	1,246	13.2	59.7
Dredge/Barge Attendant	1,124	27.2	78.7
Clean-up Person	927	19.3	71.3
Dry Screen Operator	871	11.7	57.6
Utility Worker	846	12.4	60.6
Mechanic	761	3.8	43.9
Supervisors/Administrators	730	9.0	32.2
Laborer	642	17.1	65.7
Dragline Operator	583	34.0	82.5
Backhoe Operator	546	8.4	52.6
Dryer/Kiln Operator	517	10.5	55.5
Rotary Drill Operator (electric/hydraulic)	543	39.6	83.1
Rotary Drill Operator (pneumatic)	489	64.4	89.0

† These occupations comprise about 87 percent of the 42,206 MSHA dual-threshold samples collected at metal/nonmetal mines from March 1991 through December 1994 using a personal noise dosimeter over a miner's full shift

TABLE 14.—PERCENTAGE OF MSHA COAL INSPECTOR NOISE SAMPLES EXCEEDING SPECIFIED TWA₈ SOUND LEVELS, BY SELECTED OCCUPATION †

Occupation	Number of samples	90 dBA threshold	80 dBA threshold
		Percent of samples >90 dBA (PEL)	Percent of samples ≥85 dBA (action level)
Continuous Miner Helper	68	33.8	88.2
Continuous Miner Operator	262	49.6	96.2
Roof Bolter Operator (Single)	234	21.8	85.5
Roof Bolter Operator (Twin)	92	31.5	98.9
Shuttle Car Operator	260	13.5	78.5
Scoop Car Operator	94	18.1	74.5
Cutting Machine Operator	22	36.4	63.6
Headgate Operator	20	40.0	100.0
Longwall Operator	34	70.6	100.0
Jack Setter (Longwall)	25	32.0	68.0
Cleaning Plant Operator	107	36.4	77.6
Bulldozer Operator	225	48.9	94.2
Front-End-Loader Operator	244	16.0	76.6
Highwall Drill Operator	83	21.7	77.1
Refuse/Backfill Truck Driver	162	13.6	78.4
Coal Truck Driver	28	17.9	64.3

† These occupations comprise about 71 percent of the 4,247 MSHA dual-threshold samples collected at coal mine from March 1991 to December 1995 using a personal noise dosimeter over a miner's full shift

As shown in these tables, the percentage of miners exceeding the specified noise exposures varied greatly according to occupation. For example, Table 13 shows that only 8.4% of the backhoe operators in metal and nonmetal mines had noise exposures exceeding the permissible exposure level, while 64.4% of the pneumatic rotary drill operators had similar exposures. 52.6% of the backhoe operators and 89.0% of the pneumatic

rotary drill operators would have noise exposures exceeding the action level.

Conclusion: Miners at Significant Risk of Material Impairment

MSHA has concluded that, despite many years under existing standards, noise exposures in all sectors of mining continue to pose a significant risk of material impairment to miners over a working lifetime. Specifically, MSHA estimates in the REA that 14% of coal

miners (13,294 miners) will incur a material impairment of hearing under present exposure conditions.

Table 15 presents MSHA's profile of the projected number of miners currently subjected to a significant risk of developing a material impairment due to occupational noise-induced hearing loss under existing exposure conditions. The totals represent 13% of metal and nonmetal miners and 13.4% of miners as a whole.

TABLE 15.—PROJECTED NUMBER OF MINERS LIKELY TO INCUR NOISE-INDUCED HEARING IMPAIRMENT UNDER MSHA'S EXISTING STANDARDS AND EXPOSURE CONDITIONS

	<80 dBA	80–84.9 dBA	85–89.9 dBA	90–94.9 dBA	95–99.9 dBA	100–104.99 dBA	≥105 dBA	Total*
COAL	0	464	10,954	1,315	456	104	1	13,294
M/NM	0	1,091	15,472	6,030	1,002	48	0	23,643
Total*	0	1,555	26,426	7,345	1,458	152	1	36,937

* Includes contractor employees. Does not include office workers. Discrepancies are due to rounding.

MSHA promulgated noise standards for underground coal mines in 1971, for surface coal mines in 1972, and for metal and nonmetal mines in 1974. At that time, the Agency regarded compliance with the requirements as adequate to prevent the occurrence of noise-induced hearing loss in the mining industry. Since that time, however, there have been numerous awards of compensation for hearing loss among miners. Moreover, in light of MSHA's experience and that of other domestic and foreign regulatory agencies, as well as expert opinion on

what constitutes an effective prevention program, the Agency's requirements are dated. NIOSH, for example, currently recommends a comprehensive program which includes the institution of a hearing conservation program to prevent noise-induced hearing loss, but MSHA's current standards do not include such protection.

Some commenters suggested that the existing standards adequately protect miners against noise-induced hearing loss and that MSHA over-estimates the hazard. However, the vast majority of the current scientific evidence

demonstrates that noise-induced hearing loss constitutes a serious hazard to miners. MSHA's experience in enforcing its existing standards bears this out, necessitating the replacement of those standards with new ones that would provide additional protection to miners consistent with section 101(a)(6)(A) of the Federal Mine Safety and Health Act of 1977 (Mine Act), which states that MSHA's promulgation of health standards must:

* * * [A]dequately assure on the basis of the best available evidence that no miner will

suffer material impairment of health or functional capacity even if such miner has regular exposure to the hazards dealt with by such standard for the period of his working life.

Based on the numerous studies and MSHA's calculations and analysis presented above, the Agency has concluded that the new requirements in this rule are necessary to address the continued excess risk of material impairment due to occupational noise-induced hearing loss.

Compliance will reduce noise-induced hearing loss among miners, as well as the associated workers' compensation costs. The new rule provides the added benefit of making MSHA's noise rule consistent with OSHA's noise standard for general industry, as recommended by many commenters.

VI. Feasibility

Section 101(a)(6)(A) of the Mine Act requires the Secretary to set standards which most adequately assure, on the basis of the best available evidence, that no miner will suffer material impairment of health or functional capacity over his or her working lifetime. Standards promulgated under this section must be based upon research, demonstrations, experiments, and such other information as may be appropriate. MSHA, in setting health standards, is required to achieve the highest degree of health and safety protection for the miner, and must consider the latest available scientific data in the field, the feasibility of the standards, and experience gained under this and other health and safety laws.

In relation to promulgating health standards, the legislative history of the Mine Act states that:

This section further provides that "other considerations" in the setting of health standards are "the latest available scientific data in the field, the feasibility of the standards, and experience gained under this and other health and safety laws." While feasibility of the standard may be taken into consideration with respect to engineering controls, this factor should have a substantially less significant role. Thus, the Secretary may appropriately consider the state of the engineering art in industry at the time the standard is promulgated. However, as the circuit courts of appeals have recognized, occupational safety and health statutes should be viewed as "technology-forcing" legislation, and a proposed health standard should not be rejected as infeasible "when the necessary technology looms in today's horizon". *AFL-CIO v. Brennan*, 530 F.2d 109 (3d Cir. 1975); *Society of Plastics Industry v. OSHA*, 509 F.2d 1301 (2d Cir. 1975) cert. den. 427 U.S. 992 (1975).

Similarly, information on the economic impact of a health standard which is

provided to the Secretary of Labor at a hearing or during the public comment period, may be given weight by the Secretary. In adopting the language of [this section], the Committee wishes to emphasize that it rejects the view that cost benefit ratios alone may be the basis for depriving miners of the health protection which the law was intended to insure.

S. Rep. No. 95-181, 95th Cong., 1st Sess. 21 (1977).

In *American Textile Manufacturers' Institute v. Donovan*, 452 U.S. 490, 508-509 (1981), the Supreme Court defined the word "feasible" as "capable of being done, executed, or effected." The Court further stated, however, that a standard would not be considered economically feasible if an entire industry's competitive structure were threatened.

In promulgating standards, hard and precise predictions from agencies regarding feasibility are not required. The "arbitrary and capricious test" is usually applied to judicial review of rules issued in accordance with the Administrative Procedures Act. The legislative history of the Mine Act indicates that Congress explicitly intended the "arbitrary and capricious test" be applied to judicial review of mandatory MSHA standards. "This test would require the reviewing court to scrutinize the Secretary's action to determine whether it was rational in light of the evidence before him and reasonably related to the law's purposes." * * * S. Rep. No. 95-181, 95th Cong., 1st Sess. 21 (1977). Thus,

MSHA need only base its predictions on reasonable inferences drawn from the existing facts. Accordingly, to establish the economic and technological feasibility of a new rule, an agency is required to produce a reasonable assessment of the likely range of costs that a new standard will have on an industry, and the agency must show that a reasonable probability exists that the typical firm in an industry will be able to develop and install controls that will meet the standard.

Technological Feasibility

MSHA has determined that a permissible exposure level of a TWA₈ of 90 dBA is technologically feasible for the mining industry. An agency must show that modern technology has at least conceived some industrial strategies or devices that are likely to be capable of meeting the standard, and which industry is generally capable of adopting. *American Iron and Steel Institute v. OSHA*, (AISI-II) 939 F.2d 975, 980 (D.C. Cir. 1991); *American Iron and Steel Institute v. OSHA*, (AISI-I) 577 F.2d 825 (3d Cir. 1978) at 832-835;

and *Industrial Union Dep't., AFL-CIO v. Hodgson*, 499 F.2d 467 (D.C. Cir. 1974).

The Secretary may also impose a standard that requires protective equipment, such as respirators, if technology does not exist to lower exposure to safe levels. See *United Steelworkers of America, AFL-CIO-CLC v. Marshall*, 647 F.2d 1189, 1266 (D.C. Cir. 1981).

The Agency has vast experience in working with the mining community in continually refining and improving existing noise control technology. At the request of MSHA's Coal Mine Safety and Health or Metal and Nonmetal Mine Safety and Health, MSHA's Technical Support staff actively assists mine operators in developing effective noise controls. Based on this experience, the Agency has concluded that there are few circumstances in mining where such controls do not exist.

MSHA acknowledges that some mining equipment historically has presented technological feasibility challenges for the mining industry. However, MSHA has evaluated, under actual mining conditions, newly developed noise controls for surface self-propelled equipment, underground diesel-powered haulage equipment, jumbo drills, track drills, hand-held percussive drills, draglines/shovels, portable crushers, channel burners, and mills, and has found them to be effective in producing a significant reduction in a miner's noise exposure. Some of these feasible engineering controls are already designed into new equipment. In many cases, effective and feasible controls are available through retrofitting or the proper use of noise barriers.

Several commenters in the metal and nonmetal sector of the mining industry expressed concern regarding the technological and economic feasibility of controls for their particular operations. In Volume IV of MSHA's Program Policy Manual, which covers an interpretation, application, and guidelines on enforcement of MSHA's existing noise standards in metal and nonmetal mines, the Agency includes a list of feasible noise engineering controls for the major classifications of equipment used in the metal and nonmetal mining industry. The Agency intends to continue applying its existing guidelines on enforcement of the permissible exposure level in the final rule because the permissible exposure level is unchanged from the existing standards. MSHA, therefore, encourages mine operators to use this list so they will be knowledgeable of available noise control technology.

Acoustically Treated Cabs

For mining equipment such as haul trucks, front-end-loaders, bulldozers, track drills, and underground jumbo drills, acoustically treated cabs are among the most effective noise controls. Such cabs are widely available, both from the original equipment manufacturer and the manufacturers of retrofit cabs, for machines manufactured within the past 25 years. Today, most manufacturers include an acoustically treated cab as part of the standard equipment on the newest pieces of mobile mining equipment. The noise reduction of factory-installed, acoustically treated cabs is generally more effective and often less costly than that of retrofit cabs. According to some manufacturers, sound levels at the machine operator's position inside factory cabs are often below 90 dBA and, in some cases, below 85 dBA.

Additionally, environmentally controlled operator's cabs have the added advantages of reducing dust exposure, heat stress, and ergonomic-related hazards.

Occasionally, underground mining conditions are such that full-sized surface haulage equipment can be used. Where this is possible, such equipment can be equipped with a cab as described above.

These engineering noise controls are not new technology. The former United States Bureau of Mines (USBM) published two manuals entitled "Bulldozer Noise Controls" (1980) and "Front-End Loader Noise Controls" (1981) which describe in detail installations of retrofit cabs and acoustical materials.

Barrier Shields

For some equipment, generally over 25 years old, an environmental cab may not be available from the original equipment manufacturer or from manufacturers of retrofit cabs. In such cases, a partial barrier with selective placement of acoustical material can usually be installed at nominal cost to block the noise reaching the equipment operator. These techniques are demonstrated in "Bulldozer Noise Controls" (1980).

Barrier shields and partial enclosures can also be used on track drills where full cabs are infeasible. Such shields and enclosures can be either freestanding or attached to the drill. Typically, however, they are not as effective as cabs and usually do not reduce the miner's noise exposure to the TWA₈ of 90 dBA permissible exposure level. This barrier can be constructed at minimal cost from used conveyor

belting and other materials found at the mine site.

Exhaust Mufflers

Diesel-powered machinery can be equipped with an effective exhaust muffler in addition to an environmental cab or barrier shield. The muffler's exhaust pipe can be relocated away from the equipment operator and the emissions can be redirected away from the operator. For underground mining equipment, exhaust mufflers are ordinarily not needed where water scrubbers are used. A water scrubber offers some noise reduction, but the addition of an exhaust muffler may create excessive back pressure or interfere with the proper functioning of the scrubber. Exhaust mufflers can, however, be installed on underground equipment where catalytic converters are used.

Exhaust mufflers can also be installed on pneumatically powered equipment. For example, exhaust mufflers are offered by the manufacturers of almost every jackleg drill, chipping hammer, and jack hammer. In the few cases where such exhaust mufflers are not available from the original equipment manufacturer, they can be easily constructed by the mine operator. MSHA has a videotape available to the mining community showing the construction of such an exhaust muffler for a jackleg drill. This muffler can be constructed at minimal cost from a section of rubber motorcycle tire.

Acoustical Materials

Various types of acoustical materials can be strategically used for blocking, absorbing, and/or damping sound and vibration. Damping vibration reduces the generated sound field. Generally such materials are installed on the inside walls of equipment cabs or operator compartments, and in control rooms and booths. Barrier and absorptive materials can be used to reduce noise emanating from the engine and transmission compartments, and acoustical material can be applied to the firewall between the employee and transmission compartment. Noise reduction varies depending upon the specific application. Care must be taken to use acoustical materials that will not create a fire hazard or emit toxic fumes if exposed to heat.

Control Rooms and Booths

Acoustically treated control rooms and booths are frequently used in mills, processing plants, or at portable operations to protect miners from noise created by crushing, screening, or processing equipment. Such control

rooms and booths are typically successful in reducing exposures of employees working in them to below 85 dBA.

In addition, remote controlled video cameras can be used to provide visual observation of screens, crushing equipment, or processing equipment, minimizing the need for a miner to be near these loud noise sources.

Substitution of Equipment

In the few cases where sound levels are particularly severe and neither retrofit nor factory controls are available, the equipment may need to be replaced with a type that produces less noise. For example, hand-held channel burners were used for many years in the mining industry to cut granite in dimension stone quarries. Sound levels typically exceeded 120 dBA at the operator's ear. Several years ago, however, alternative and quieter methods of cutting granite, such as high pressure water jet technology, automated channel burners, and diamond wire saws, were developed in the dimension stone industry. Dimension stone operators were notified by MSHA of the availability of these alternatives and given time to phase out the use of diesel-fueled, hand-held burners and replace them with one of the quieter and more protective alternatives.

New Equipment Design

Hand-held channel burners can be replaced with automated channel burners supplied with liquid oxygen. The automated design does not require the operator to be near the channel burner, thereby using distance to attenuate the noise.

The MSHA document entitled, "Summary of Noise Controls for Mining Machinery," (Marraccini et al., 1986) provides case histories of effective noise controls installed on specific makes and models of mining equipment. The case histories describe the controls used, their cost, and the amount of noise reduction achieved. In particular, these include engineering noise control methods for coal cutting equipment, longwall equipment, conveyors, and diesel equipment. Underground coal mining equipment may require some unique noise controls. However, for coal extracting machines such as continuous miners and longwall shearers, the use of remote control is the single most effective noise control. The installation of noise damping materials and enclosure of motors and gear cases can be used to aid in controlling noise of coal transporting equipment such as conveyors and belt systems. Diesel

equipment used underground can be equipped with controls similar to those used on surface equipment. Mufflers, sound controlled cabs, and barriers will provide much of the needed noise control for this type of equipment. MSHA has found that the controls utilized in these specific cases can be extended to other pieces of mining equipment. The Agency is currently updating this publication, and plans to reissue it at a later date in order to assist mine operators in complying with the requirements of the final rule.

Economic Feasibility

MSHA has determined that a permissible exposure level of a TWA₈ of 90 dBA is economically feasible for the mining industry. Economic feasibility does not guarantee the continued existence of individual employers. It would not be inconsistent with the Act to have a company which turned a profit by lagging behind the rest of an industry in providing for the health and safety of its workers to consequently find itself financially unable to comply with a new standard; see, *United Steelworkers*, 647 F.2d at 1265. Although it was not Congress' intent to protect workers by putting their employers out of business, the increase in production costs or the decrease in profits would not be enough to strike down a standard. *Industrial Union Dep't.*, 499 F.2d at 477. Conversely, a standard would not be considered economically feasible if an entire industry's competitive structure were threatened. *Id.* at 478; see also, *AISI-II*, 939 F.2d at 980; *United Steelworkers*, 647 F.2d at 1264-65; *AISI-I*, 577 F.2d at 835-36. This would be of particular concern in the case of foreign competition, if American companies were unable to compete with imports or substitute products. The cost to government and the public, adequacy of supply, questions of employment, and utilization of energy may all be considered.

MSHA has determined that retention of the existing permissible exposure level, threshold, and exchange rate under the final standard would not result in any incremental costs for engineering controls for the metal and nonmetal sector and would result in annualized costs of \$1.6 million for the coal mining sector. As described in more detail in the Agency's final Regulatory Economic Analysis, MSHA evaluated various engineering controls and their related costs.

In determining which engineering controls the metal and nonmetal industry will have to use under the final rule, MSHA considered the engineering

controls that are used under the current rule. MSHA expects that there will be no significant change because the requirements for meeting the permissible exposure level are the same. For the coal industry, however, MSHA expects the cost to differ significantly. Under the current coal standards, personal hearing protectors have typically been substituted for engineering and administrative controls; therefore, the industry has not exhausted the use of feasible controls capable of significantly reducing sound levels. Accordingly, the coal sector is projected to experience relatively higher costs for engineering controls under the final rule than the metal and nonmetal sector.

MSHA believes the requirements for engineering and administrative controls clearly meet the feasibility requirements of the Mine Act, its legislative history, and related case law. The most convincing evidence that the final rule will be economically feasible for the mining industry as a whole is the fact that the total cost of the final rule borne by the mining industry, \$8.7 million annually, is only 0.01 percent of annual industry revenues of approximately \$59.7 billion. Nevertheless, MSHA recognizes that, in a few cases, individual mine operators, particularly small operators, may have difficulty in achieving full compliance with the final rule immediately because of a lack of financial resources to purchase and install engineering controls. However, ultimate compliance with the final rule is expected to be achieved.

Whether controls are feasible for individual mine operators is based in part upon legal guidance from the Federal Mine Safety and Health Review Commission (Commission). According to the Commission, a control is feasible when it: (1) Reduces exposure; (2) is economically achievable; and (3) is technologically achievable. See *Secretary of Labor v. A.H. Smith*, 6 FMSHRC 199 (1984); *Secretary of Labor v. Callanan Industries, Inc.*, 5 FMSHRC 1900 (1983).

In determining the technological feasibility of an engineering control, the Commission has ruled that a control is deemed achievable if, through reasonable application of existing products, devices, or work methods, with human skills and abilities, a workable engineering control can be applied to the noise source. The control does not have to be "off-the-shelf," but it must have a realistic basis in present technical capabilities.

In determining the economic feasibility of an engineering control, the Commission has ruled that MSHA must

assess whether the costs of the control are disproportionate to the "expected benefits," and whether the costs are so great that it is irrational to require its use to achieve those results. The Commission has expressly stated that cost-benefit analysis is unnecessary in order to determine whether a noise control is required.

Consistent with Commission case law, MSHA considers three factors in determining whether engineering controls are feasible at a particular mine: (1) The nature and extent of the overexposure; (2) the demonstrated effectiveness of available technology; and (3) whether the committed resources are wholly out of proportion to the expected results. A violation under the final standard would entail MSHA determining that a miner has been overexposed, that controls are feasible, and that the mine operator failed to install or maintain such controls. According to the Commission, an engineering control may be feasible even though it fails to reduce exposure to permissible levels contained in the standard, as long as there is a significant reduction in a miner's exposure. *Todillo Exploration and Development Corporation v. Secretary of Labor*, 5 FMSHRC 1894, 1897 (1983). MSHA intends to continue its longstanding policy of determining that a control is feasible where a control or a combination of controls could achieve a 3-dBA noise reduction, which represents at least a 50% reduction in sound energy. Where any single control does not provide at least a 3-dBA noise reduction, mine operators must consider the reduction achieved by a combination of all available controls.

Some commenters were uncertain as to whether MSHA's policy referred to a 3-dBA reduction in sound level or a 3-dBA reduction in a miner's noise exposure. Exposure and sound level are not synonymous terms because an exposure includes a time factor. MSHA has determined that a 3-dBA reduction in a miner's exposure is the relevant factor in determining feasibility. This is true because the permissible exposure level is a personal exposure standard, which can be controlled using engineering and administrative controls. MSHA chose a 3-dBA reduction because accuracy of the current noise measurement instrumentation is 2 dBA, a control would not be deemed effective until the measured reduction exceeds the accuracy of the instrumentation. The 3-dBA reduction in a miner's exposure is different from and should not be confused with the discussion of the exchange rate in this preamble.

The Agency is cognizant that there may be instances where all feasible engineering and administrative controls have been used and a miner's noise exposure cannot be reduced to the permissible exposure level. Under those circumstances, in both the coal and metal and nonmetal sectors, MSHA intends to enforce the final rule consistent with its current p code policy for metal and nonmetal mines.

Currently, when MSHA issues a citation for a noise overexposure, the operator must use all feasible engineering and administrative controls to bring noise exposures within the permissible level. Under current MSHA policy where feasible engineering or administrative controls have failed to lower noise exposures to a permissible level at a metal or nonmetal mine, the citation may be terminated on the condition that personal protective equipment is provided and worn. This type of termination, referred to as a "P" code, is permitted after certain procedures have been followed.

If the District Manager where the citation was issued believes a "P" code is warranted, the Manager reviews the situation in consultation with field enforcement staff, headquarters officials, and MSHA technical experts. This review includes an evaluation of the circumstances surrounding the overexposure, with particular emphasis on assessing the feasibility and effectiveness of control options.

If the reviewers determine that a "P" code is appropriate, the citation will be terminated and the termination will state the minimum acceptable performance requirements for hearing protectors, and the minimum acceptable engineering and administrative controls that must be used in conjunction with the hearing protectors. After a "P" code has been issued, MSHA provides the National Institute for Occupational Safety and Health (NIOSH) a copy of the associated technical documentation to alert researchers of the specific instances of noise overexposures where noise exposures cannot be reduced to permissible levels using feasible engineering or administrative controls. MSHA considers both technological capabilities and the economic impact of a control.

MSHA regularly reviews those instances where "P" codes have been issued to determine whether conditions have changed or new technology is available to warrant reconsidering the justification for the "P" code. MSHA may withdraw the "P" code if the original justification for the "P" code is no longer valid. The decision may be based on such factors as a change in

operating conditions, new technology, or failure of the mine operator to comply with the specified control measures.

VII. Section-by-Section Analysis

Section 62.100 Purpose and Scope; Effective Date

The purpose of the mandatory health standard established in part 62 is to prevent the occurrence and reduce the progression of occupational noise-induced hearing loss among miners in every surface and underground metal, nonmetal, and coal mine subject to the Federal Mine Safety and Health Act of 1977.

The final rule establishes a single uniform noise standard applicable to all mines. Most commenters favored the one-rule format, agreeing with the Agency that consolidation and simplification of the existing multiple standards may help to facilitate understanding of, and thus compliance with, regulatory requirements.

Prior to this final rule, MSHA had four sets of noise standards: for surface metal and nonmetal mines (30 CFR 56.5050), for underground metal and nonmetal mines (30 CFR 57.5050), for underground coal mines (30 CFR part 70, subpart F), and for surface coal mines and surface work areas of underground coal mines (30 CFR part 71, subpart I). The surface and underground noise standards for metal and nonmetal mines were identical, and the surface and underground noise standards for coal mines were nearly identical.

MSHA was influenced by several factors in deciding to promulgate this final rule: the prevalence of hearing loss among miners despite experience with the current standard, conditions in the mining industry, MSHA's review of the latest scientific information, the comments submitted in response to the proposed rule, and the requirements of the Mine Act.

The rule contains provisions that are consistent with many of OSHA's requirements yet tailored to meet the specific needs of the mining community. In addition, many of the provisions are similar, if not identical, to the existing MSHA noise standards, which will allow for continuity in the transition to the new rule.

The final rule takes effect one year after the date of publication. MSHA recognizes that successful implementation of the final rule requires training of MSHA personnel and guidance to miners and mine operators, particularly small mine operators. Therefore, in response to

several supportive comments, the Agency has decided that this delayed effective date best meets the needs of the mining community.

Section 62.101 Definitions

The definitions discussed below are included in the final rule to facilitate understanding of technical terms that are used in this part. Some of the proposed definitions have been revised to be consistent with the common usage of such terms. For example, the Agency's proposed use of the term "supplemental baseline audiogram" has been changed to the more commonly used "revised baseline audiogram."

The final rule also includes a definition for action level. MSHA moved the definition of action level from the text of the proposed rule and included it in the definition section of the final rule to be consistent with the terms permissible exposure level and dual hearing protection level which are in the definition section. In addition, on the suggestion of several commenters who expressed confusion over the use of the proposed term "designated representative," MSHA has not adopted this term in the final rule, but instead has substituted the term "miner's designee." Also, because no commenter supported MSHA's proposed definition of a "hearing conservation program," that definition has not been adopted in the final rule. In its place, MSHA is incorporating the elements of a traditional hearing conservation program into the text of the final rule.

Several commenters requested that MSHA provide a definition for "feasible" engineering and administrative controls, indicating that the term is vague and subject to varying interpretations. Because of the performance-oriented nature of the requirements for the use of engineering and administrative controls, MSHA has refrained from including an explicit definition of this term. Rather, MSHA notes in the discussion under "Feasibility" (Part VI of this preamble), that it follows the Federal Mine Safety and Health Review Commission case law as to what constitutes a feasible noise control for enforcement purposes. MSHA further notes in that discussion that it will provide additional guidance in a companion compliance guide to this final rule.

A few comments were received regarding MSHA's use of non-standard terminology and abbreviations in the proposal, in particular, the use of the terms "decibel A-weighted," "dBA," and "sound level (in dBA)." MSHA intends for the terminology used throughout this rule to be both

technically correct and readily understood. Therefore, for technical accuracy and consistency with usage in the mining community for the past 25 years, the Agency is deleting the definition of the term "decibel A-weighted" and is rephrasing the definition of the term "sound level."

The following is a summary of some of the key features of the definitions that are used in the final rule along with a discussion of the comments that the Agency received in response to the proposal.

Access is the right to examine and copy records. MSHA is adopting the definition from the proposal, which is consistent with the term used in several of MSHA's and OSHA's existing health standards. In response to commenters who requested that MSHA include a "no cost" provision in this definition, MSHA notes that such a provision is included in the specific section in which it would be applicable. The term "access" is discussed further under § 62.190, regarding records.

Action level is an 8-hour time-weighted average sound level (TWA_8) of 85 dBA, or equivalently a dose of 50%, integrating all sound levels from 80 dBA to at least 130 dBA. The action level is discussed further under § 62.120 of the preamble.

Audiologist is a professional specializing in the study and rehabilitation of hearing and who is certified by the American Speech-Language-Hearing Association or is licensed by a state board of examiners. The vast majority of commenters indicated no preference for further restrictions to MSHA's proposed definition, which is identical to that used by OSHA in its occupational noise standard.

Some commenters, however, believed that the definition of "audiologist" should specifically require certification by the American Speech-Language-Hearing Association (ASHA), as evidenced by a Certificate of Clinical Competence. Other commenters supported a proviso being added to the definition of "audiologist" that state licensing requirements guarantee that the licensees are as competent as those certified by ASHA. The rationale for this comment was that state licensing boards vary significantly from state to state, and licensing requirements in some states are not as stringent as ASHA certification requirements.

The final rule does not adopt the suggestion of commenters that the final rule accept licensing by only those states whose licensing standards are sufficiently rigorous, because although some state licensing requirements are

more stringent than others, even the least rigorous of the state requirements will provide an acceptable level of competence for audiologists. The final rule adopts the requirement that audiologists hold an ASHA certification or a license from a state board of examiners, which is consistent with MSHA's determination that such a certification or license is essential to the implementation of an effective hearing conservation program. Properly trained and certified audiologists are qualified to conduct audiometric testing, evaluate audiograms, and supervise technicians who conduct and evaluate audiograms.

The licensing requirements for audiologists in the final rule are also consistent with similar requirements in OSHA's noise standard. The term "audiologist" is discussed further under § 62.170 of the preamble regarding audiometric testing.

Baseline audiogram is the audiogram, recorded in accordance with § 62.170 of this part, against which subsequent audiograms are compared to determine the extent of hearing loss, except in those situations in which this part requires the use of a revised baseline audiogram for such a purpose. With the exception of the term "revised," which replaces the term "supplemental," the definition of baseline audiogram is unchanged from the proposal. The baseline audiogram establishes a reference for making hearing loss determinations.

Although many commenters favored the proposal, others believed that a true baseline, by definition, is conducted prior to exposure to noise. MSHA notes that the final rule explicitly allows mine operators to use existing audiograms as the baseline, provided that they were taken under the conditions meeting the testing requirements of this rule. For the final rule, the Agency concludes that the reasons discussed in the preamble to the proposal remain valid. There MSHA discussed the importance of the testing requirements that are to be followed in conducting the baseline audiogram, as it is the reference against which subsequent audiograms are to be compared. If the baseline audiogram is not conducted properly, it will not truly reflect the miner's hearing thresholds. As a result, any changes between the baseline and subsequent tests may be masked. Accordingly, MSHA is adopting the proposed definition.

The definition of baseline audiogram also includes the provision that hearing loss determinations may require the use of a "revised" baseline under specific circumstances. Those circumstances are noted in the further discussion of baseline audiogram and audiometric

testing under § 62.170(a) of the final rule.

Criterion level refers to the sound level which, if applied for 8 hours, results in 100% of the dose permitted by the standard. The definition remains unchanged from the proposal. Under § 62.110(b)(2)(iv) of the final rule, the criterion level is a sound level of 90 dBA. If applied for 8 hours, this sound level will result in a dose of 100% of the permissible exposure level (PEL), established by § 62.130 as an 8-hour time-weighted average (TWA_8) of 90 dBA. The criterion level is a constant. On the other hand, the permissible exposure level is a sound level of 90 dBA for 8 hours or a sound level of 95 dBA for 4 hours. Further discussion is provided under § 62.110(b)(2)(iv) of the preamble regarding dose determination.

Decibel (dB) is a unit of measure of sound pressure levels. It is defined in the final rule in one of two ways, depending upon the use. The proposed definition remains unchanged; it continues to include definitions for measuring sound pressure levels and for measuring hearing threshold levels:

(1) For measuring sound pressure levels, the decibel is 20 times the common logarithm of the ratio of the measured sound pressure to the standard reference sound pressure of 20 micropascals (μPa), which is the threshold of normal hearing sensitivity at 1000 Hertz; and

(2) For measuring hearing threshold levels, the decibel is the difference between audiometric zero (reference pressure equal to 0 hearing threshold level) and the threshold of hearing of the individual being tested at each test frequency.

Dual Hearing Protection Level is a TWA_8 of 105 dBA, or equivalently, a dose of 800% of that permitted by the standard, integrating all sound levels from 90 dBA to at least 140 dBA. In the proposal, the definition was included within the dual hearing protection requirement itself. The term is set forth as a definition in the final rule for the sake of clarity.

Exchange rate is the amount of increase in sound level, in decibels, which would result in reducing the allowable exposure time by half in order to maintain the same noise dose. In response to a comment which requested clarification of this definition, MSHA has added language to the final rule which states that for purposes of this part, the exchange rate is 5 decibels (5 dB). In the final rule, a 5-dB increase or decrease in the sound level corresponds to a halving or doubling of the allowable exposure time. Thus, a 5-dB increase, from 90 dBA to 95 dBA, would result

in halving the allowable exposure time from 8 hours to 4 hours, and a 5-dB decrease, from 100 dBA to 95 dBA, would result in doubling the allowable exposure time from 2 hours to 4 hours. Exchange rate is discussed further under § 62.110(b)(2)(iv), regarding dose determination.

Hearing protector refers to any device or material, capable of being worn on the head or in the ear canal, sold wholly or in part on the basis of its ability to reduce the level of sound entering the ear, and which bears a scientifically accepted indicator of noise reduction value. The proposed definition remains unchanged in the final rule. Although one commenter suggested that the phrase "sold wholly or in part on the basis of its ability to reduce the level of sound" be deleted from this definition because a hearing protector's effectiveness cannot be reliably determined on the basis of the intended purpose for which it is sold, MSHA's definition follows the Environmental Protection Agency's (EPA) labeling standards for hearing protectors (40 CFR § 211.203(m)). Under the EPA labeling standards, a hearing protector is defined as:

* * * any device or material, capable of being worn on the head or in the ear canal, that is sold wholly or in part on the basis of its ability to reduce the level of sound entering the ear.

This includes devices of which hearing protection may not be the primary function, but which are nonetheless sold partially as providing hearing protection to the user.

Accordingly, MSHA is adopting the proposed definition. As a result, not all devices or materials that are inserted in or that cover the ear to reduce the noise exposure qualify as a hearing protector under the final rule. For example, a hearing aid or cotton does not qualify as an acceptable hearing protector under the final rule.

Although several commenters agreed with the proposal that the hearing protector should be required to have a scientifically accepted indicator of noise reduction value, other commenters suggested that MSHA's definition specifically include the manufacturer's noise reduction rating (NRR) or a requirement that the attenuation be measured according to standards of the American National Standards Institute (ANSI). Since EPA requires that all hearing protector manufacturers include labeling information indicating a noise reduction rating, a hearing protector bearing such a label would indicate to a mine operator that it meets MSHA's definition of a hearing protector.

However, MSHA is not limiting the range of hearing protectors only to those

with a noise reduction rating. MSHA noted in the preamble to the proposed rule that the noise reduction ratings do not reflect actual reductions in noise in workplace situations. Moreover, other organizations have recommended that the EPA reconsider its rating system. Therefore, MSHA is adopting the language in the proposed definition which permits any scientifically accepted indicator of noise reduction value. Further discussion of noise reduction ratings is located under § 62.110(b)(2)(i), regarding noise exposure assessment.

Hertz (Hz) is the international unit of frequency, equal to cycles per second. The definition has been changed from the proposal. One commenter suggested that stating the range of audible frequencies for humans with normal hearing is superfluous to a definition for hertz. MSHA agrees, and the reference has not been adopted in the final rule.

Medical pathology is a condition or disease affecting the ear. The definition of medical pathology remains unchanged from the proposal. A few commenters suggested that the definition be reworded. The term, which is also used in OSHA's occupational noise standard, is adopted in MSHA's final rule for use in contexts which do not require actual diagnosis and treatment, but which may ultimately be diagnosed and treated by a physician. The Agency intends that ear injuries be included as a condition or disease affecting the ear. Medical pathology is discussed further in the preamble sections addressing § 62.160(a)(5), regarding hearing protectors, § 62.172(b)(1), regarding evaluation of audiograms, and § 62.173(a) and (b), regarding follow-up evaluation when the audiogram is invalid.

Miner's designee is any individual or organization to whom a miner gives written authorization to exercise the miner's right of access to records. This definition is new to the final rule. MSHA received several comments to the proposal's use of the term "designated representative," which caused confusion with the term "representative of miners" in 30 CFR § 40.1(b). MSHA intended that the two terms have distinct meanings. Accordingly, for clarification, MSHA has replaced the proposed term with the new term, "miner's designee." Further discussion of the term "miner's designee" is found under § 62.190(b), regarding records.

Permissible exposure level is a TWA_s of 90 dBA or equivalently a dose of 100% of that permitted by the standard, integrating all sound levels from 90 dBA to at least 140 dBA. No miner shall be

exposed during any work shift to noise that exceeds the permissible exposure level. The permissible exposure level is discussed further under § 62.130 of the preamble.

Qualified technician is a person who has been certified by the Council for Accreditation in Occupational Hearing Conservation (CAOHC) or by another recognized organization offering equivalent certification. The proposed definition remains unchanged in the final rule.

Several commenters suggested additional requirements while other commenters favored less restrictive requirements for the qualified technician: some commenters did not agree with the proposed requirement that a qualified technician be certified by the Council for Accreditation in Occupational Hearing Conservation or by another recognized organization offering equivalent certification. Several commenters recommended that MSHA adopt the requirements for technicians in the OSHA noise rule, which allows physicians and audiologists discretion to judge the qualifications of technicians. A number of commenters advocated that the final rule be consistent with the OSHA noise standard and exempt technicians who operate microprocessor audiometers from any certification requirement. This was based on the commenters' views that a properly trained technician, under the direction of a physician or an audiologist, would have the competence to perform the tests. These commenters believed that a requirement for certification by CAOHC or an equivalent body would unnecessarily limit the flexibility of mine operators in testing employees, and could result in fewer tests being conducted. One commenter stated that the final rule should require CAOHC certification as the minimum qualification for audiometric technicians, and not accept certifications by other organizations, pointing out that CAOHC is currently the only organization that currently issues such certifications.

MSHA has concluded that a certification requirement for audiometric technicians is not overly restrictive, and it ensures the necessary level of knowledge and proficiency to perform audiometric tests under the final rule. MSHA has also concluded that certifications from organizations other than CAOHC are acceptable, provided that the organization imposes equivalent requirements. Contrary to the statements of some commenters, CAOHC is not the only organization that issues such certifications—the U.S. armed forces train technicians to

perform audiometric tests and issues certifications. Such certifications would be accepted under the final rule.

The final rule also adopts the proposed requirement that technicians who operate microprocessor audiometers have CAOHC or equivalent certification, to ensure that these technicians demonstrate the same level of proficiency as those technicians who operate manual audiometers. Although microprocessor audiometers may be easier to operate than manual audiometers, MSHA has concluded that a certification requirement is still appropriate for technicians who operate this equipment. MSHA's final rule, unlike OSHA's noise standard, does not include detailed procedural requirements for audiometric testing. Instead, the training and expertise of the individuals conducting tests is an essential element of an effective audiometric testing program. For these reasons, MSHA has chosen not to exempt technicians who operate microprocessor audiometers from the certification requirements in the final rule. Further, the requirement for CAOHC or equivalent certification is not overly burdensome on the mining industry, as 19,000 technicians currently hold this qualification due to OSHA's requirement for CAOHC certification. The 19,000 CAOHC technicians are located around the country.

The requirements for audiometric technicians in the final rule are similar to requirements in regulations of the U.S. Army, Air Force, and Navy, which require the technician to be CAOHC-certified or certified through equivalent military medical training and be under the supervision of a physician or audiologist. Qualified technicians are further discussed under § 62.170, regarding audiometric testing and § 62.172(a)(2), regarding evaluation of audiograms.

Reportable hearing loss is a change in hearing sensitivity for the worse, relative to the miner's baseline audiogram or a revised baseline audiogram established in accordance with § 62.170(c)(2), of an average of 25 dB or more at 2000, 3000, and 4000 Hz in either ear. The definition of reportable hearing loss remains essentially unchanged from the proposal, with the exception that the proposal's reference to "supplemental baseline audiogram" has been replaced with "revised baseline audiogram."

Under the final rule, reportable hearing loss is calculated by subtracting the current hearing levels from those on the baseline audiogram at 2000, 3000, and 4000 Hz and may be corrected for

age. When the permanent hearing loss at all three frequencies is averaged, the hearing loss must be reported if the average loss in either ear is 25 dB or greater. In making this calculation, a revised baseline would be established and used where there has been a significant improvement in hearing sensitivity, in accordance with the provisions of § 62.170(c)(2).

MSHA is adopting the proposed definition of reportable hearing loss—the extent of hearing loss that must be reported to the Agency pursuant to § 62.175(b) of the final rule. Some commenters who were satisfied with the proposed 25-dB level for reporting a hearing loss expressed concern that the proposed requirement does not discriminate between occupational and non-occupational hearing loss. Other commenters favored a lower, 10 dB or 15 dB, hearing loss for reportability purposes because the proposed 25-dB hearing loss level permits too much damage to occur before reporting is required. Still other commenters recommended that a hearing loss should be reportable only if it is the subject of a workers' compensation award. These commenters believed that workers' compensation data would make good reporting criteria and also noted that the accuracy of the reported data could be confirmed with state workers' compensation agencies. Additionally, the complex calculations currently necessary for determining whether a reportable hearing loss has occurred could be avoided.

MSHA's definition of a reportable hearing loss represents a substantial loss of hearing, which would provide a reliable indication of the effectiveness of the intervention strategies of the mining industry. The requirement is consistent with the existing OSHA noise standard which requires any 25-dB loss to be recorded in an employer's records. In addition, § 62.175(b) of the final rule, which is identical to § 62.190 of the proposal, creates an exception for reportable hearing loss when a physician or audiologist has determined that the loss is neither work-related nor aggravated by occupational noise exposure. Furthermore, workers' compensation reporting criteria, which are controlled by the states and varies from state to state, may produce inconsistent reporting to MSHA, depending upon the state criteria that are being applied. Further discussion of reportable hearing loss is provided under § 62.175(b), regarding the notification of audiometric test results and reporting requirements.

Revised baseline audiogram is an annual audiogram designated, as a

result of the circumstances set forth in § 62.170(c)(1) or (c)(2), to be used in lieu of the baseline audiogram in measuring changes in hearing sensitivity. With the exception of the clarifying change in terms from "supplemental" baseline audiogram to "revised" baseline audiogram, the definition in the final rule remains unchanged from the proposal. Use of the term "revised" is consistent with the OSHA noise standard. Some commenters suggested using the term "reference" baseline audiogram, however; MSHA believes that less confusion will result by adopting the term used by OSHA. In addition, for further clarity and accuracy, MSHA is replacing the proposed reference to hearing "acuity" with hearing "sensitivity." Further discussion of a revised baseline audiogram is provided under § 62.170(c), in addition to the related discussions on reportable hearing loss and standard threshold shift.

Sound level is the sound pressure level in decibels, measured using the A-weighting network and a slow response. The final definition is essentially unchanged from the proposal but is reworded for accuracy. Sound consists of pressure changes in air caused by vibrations. These pressure changes produce waves that move out from the vibrating source. The sound level is a measure of the amplitude of these pressure changes and is generally perceived as loudness. For the purpose of this rule, the sound level is expressed in the unit "dBA."

Under § 62.110(b)(2)(v) of the final rule, sound pressure levels would be measured using the A-weighting network and the slow response. A-weighting refers to the frequency response network closely corresponding to the frequency response of the human ear. This network reduces sound energy in the upper and lower frequencies (less than 1000 and greater than 5000 Hz) and slightly amplifies sound energy between the frequencies of 1000 and 5000 Hz. The slow-response time refers to the slow exponential-time-averaging characteristic. The specifications of the A-weighting network and the slow-response time are found in ANSI S1.25-1991, "Specification for Personal Noise Dosimeters," and ANSI S1.4-1983, "American National Standard Specification for Sound Level Meters."

A few commenters were concerned that MSHA's abbreviation "dBA" was technically incorrect, because it is the sound level that is A-weighted, not the decibel. MSHA recognizes that there are several scientific fields employing distinct acoustical terminology,

including noise-control engineering, mining engineering and industrial hygiene. A term that is conventional or commonly accepted in one field may not be accepted in another. Because the abbreviation "dBA" has come to be a widely accepted way of succinctly denoting a sound level that is A-weighted and because the majority of the mining community has used this terminology over the past 25 years and did not voice any opposition, MSHA has adopted the proposed abbreviation "dBA" in the final rule. Further discussion of the A-weighting and slow response time are provided under § 62.110(b)(v), regarding noise exposure assessment.

Standard threshold shift is a change in hearing sensitivity for the worse relative to a miner's baseline audiogram or relative to the most recent revised audiogram, where one has been established. The hearing loss is calculated by subtracting the current hearing levels from those measured by the baseline or revised baseline audiogram at 2000, 3000, and 4000 Hz, and, optionally, correcting for age. A standard threshold shift is defined as when the average loss in either ear has reached 10 dB. The proposal is essentially unchanged, except that the term "sensitivity" has replaced the term "acuity."

OSHA defines a standard threshold shift in essentially the same way and requires that an employee's annual audiogram be compared to his or her baseline audiogram to determine if the annual audiogram is valid and if a standard threshold shift has developed.

NIOSH (1995) recommends that the criteria for a standard threshold shift be a 15-dB decrease in hearing sensitivity at any one of the audiometric test frequencies from 500 to 6000 Hz on two sequential audiograms. The shift in hearing sensitivity must be in the same ear. NIOSH believes this criteria is sufficiently stringent to detect developing hearing loss while excluding normal variability in workers' hearing sensitivity. NIOSH's previous (1972) criteria defined standard threshold shift as a change of 10 dB or more at 500, 1000, 2000 or 3000 Hz; or 15 dB or more at 4000 or 6000 Hz.

MSHA's definition of standard threshold shift in the final rule will identify individuals suffering shifts as large as 30 dB at 4000 Hz with no shifts at the lower frequencies. This permits the early identification of individuals at risk, so that corrective measures may be instituted. For example, there are some instances where significant threshold shifts in hearing level occur at higher test frequencies (4000 and 6000 Hz)

with little or no change in hearing level at the middle frequencies. While such large shifts are uncommon, they may occur in noise-sensitive individuals, especially in the early stages of noise-induced hearing loss.

Many commenters voiced concern that any hearing loss would be considered a result of occupational noise exposure. These commenters believed that many non-occupational causes could produce a hearing loss and that MSHA should recognize such non-occupational origins of hearing loss. As stated elsewhere in this preamble, MSHA leaves it to the professional judgement of medical and technical personnel to determine, through interviewing and thorough examination, whether the origin of hearing loss is occupational or non-occupational.

MSHA believes, after considering the relevant factors and reviewing current U.S. armed forces and international standards, that the definition of a standard threshold shift in the final rule is the most appropriate. Further discussion is provided under § 62.172, regarding the evaluation of audiograms.

Time-weighted average-8 hour (TWA₈) is the sound level which, if constant over 8 hours, would result in the noise dose measured. The proposed definition remains unchanged in the final rule. This value is used in the final rule in connection with various limits; for example, the permissible exposure level is a TWA₈ of 90 dBA and the action level is a TWA₈ of 85 dBA.

Not all noise-measurement instruments provide readouts in terms of an 8-hour time-weighted average. Personal noise dosimeters, for example, measure noise as a percentage of permitted dosage, with the permissible exposure level equated to 100%. Noise dose may be converted, in accordance with § 62.110 of the final rule, to an equivalent TWA₈ to determine if the action level or the permissible exposure level has been exceeded and to evaluate the impact of engineering and administrative controls. Accordingly, MSHA has provided a list of TWA₈ conversion values in Table 62-2 of the final rule, based on a criterion level of 90 dBA for 8 hours.

Noise exposure must be determined for the entire shift, but regardless of the length of the work shift, a determination of noncompliance with the noise standard will be based upon exceeding 100% exposure and the TWA₈ (and a 5-dB exchange rate). It would thus be improper to adjust a TWA₈ reading for an extended work shift.

Section 62.110 Noise Exposure Assessment

The requirements of § 62.110 of the final rule have been adopted from both the proposal and supplemental proposal to include in one section all provisions that address mine operators' assessment and evaluation of miners' noise exposures. The provisions of this section of the final rule include the requirements that mine operators:

- (1) Establish a system to monitor miners' noise exposures;
- (2) Evaluate each miner's noise exposure to determine continuing compliance with this part;
- (3) Provide affected miners and their representatives the opportunity to observe noise exposure monitoring; and
- (4) Notify miners when their noise exposure equals or exceeds certain limits set by this final rule.

The provisions of this section are similar to provisions in § 62.120(a) and (f) of the proposal and § 62.120(g) of the supplemental proposal. The final rule, like the proposal, requires the mine operator to establish a system of monitoring to evaluate each miner's noise exposure. The monitoring requirement establishes specific goals for a mine operator's monitoring system, including:

- (1) Determining if miners' noise exposures reach any of the limits established by this final rule;
- (2) Assessing the effectiveness of the engineering and administrative noise controls in place;
- (3) Identifying areas of the mine where the use of hearing protectors is required; and
- (4) Ensuring that the noise exposure information necessary for proper evaluation of miners' audiograms is furnished to audiometric test providers.

The rule is flexible, that is, it does not prescribe how the mine operator will accomplish the goals it sets, but rather leaves it to the mine operator to determine the best means by which to achieve those goals.

Like the supplemental proposal, the final rule requires the mine operator to give prior notice to affected miners and their representatives of the date and time of exposure monitoring by the mine operator, and to provide miners and their representatives the opportunity to observe such monitoring.

The final rule also requires that the mine operator notify miners in a timely manner if their noise exposures reach the levels specified. This ensures that miners are aware that they have been exposed to excessive noise and may encourage them to use the hearing protectors provided by the mine

operator and participate in the audiometric testing program provided by the mine operator. Miners must also be notified of the corrective action taken if their exposures exceed the permissible exposure level.

System of Monitoring

Paragraph (a) of § 62.110 of the final rule requires mine operators to establish a system of monitoring that evaluates each miner's noise exposure sufficiently to determine continuing compliance with all aspects of the final rule. The final rule, like the proposal, takes a performance-oriented approach, and neither the methodology nor the intervals of monitoring are specified. Under § 62.120(f) of the proposed rule, mine operators would have been required to establish a system of monitoring "which effectively evaluates each miner's noise exposure."

Despite a number of commenters who questioned the need for monitoring by the mine operator, MSHA has determined that operator monitoring is needed to identify those miners who are subjected to noise exposures that may be injurious to their hearing, so that protective measures can be implemented. Most commenters supported the need for monitoring and favored a performance-oriented approach, but some suggested a detailed specification-oriented monitoring program similar to the program previously applicable to coal mines. Those commenters questioned how MSHA would evaluate "an effective system of monitoring," urging MSHA to define this term. Other commenters questioned mine operators' ability to conduct reliable noise exposure monitoring.

MSHA intends to evaluate the effectiveness of mine operators' monitoring programs by how well the programs achieve the specified goals. During mine inspections, MSHA will continue to evaluate miners' noise exposures. Overexposures may indicate deficiencies in the mine operator's noise monitoring program, and may result in close scrutiny of the program by MSHA. In view of the wide variety of mining operations to which the final rule applies, MSHA has concluded that the establishment of rigid and specific monitoring requirements would be unnecessarily inflexible and stifle innovation and improvements in monitoring technology. The test of whether the monitoring system is effective is how well the monitoring system protects miners. Thus, a monitoring program which meets the specified goals will be considered effective under the final rule.

Another concern of commenters was the proposed requirement that mine operators establish a system of monitoring which "effectively evaluates each miner's noise exposure." These commenters expressed concern that this provision could place an undue burden on mine operators. Many of these commenters suggested that monitoring areas of the mine, representative job tasks, or similar occupations would be sufficient to meet the intent of the rule. A few commenters suggested that monitoring should occur only when information exists that a miner's noise exposure equals or exceeds the action level. According to one commenter, because a mine operator's insurance carrier may conduct noise exposure monitoring, monitoring by the mine operator would not be necessary.

In response to these commenters, the language of this section of the final rule has been reworded to provide that the mine operator must establish a system of monitoring that "evaluates each miner's noise exposure sufficiently to determine continuing compliance with this part." This reflects the intent of both the proposal and the final rule, and does not require that each miner be individually evaluated for noise exposure, provided that the established monitoring system serves to detect individual miner exposures equaling or exceeding the specified levels in the final rule. As noted by commenters, depending upon the circumstances, monitoring of areas of the mine or representative job tasks may provide a mine operator with sufficient information to determine compliance with the final rule. Regardless of the system of monitoring that a mine operator implements, mine operators continue to be fully responsible for ensuring that no miner is exposed to noise above permissible limits, and for ensuring that the required corrective actions are taken if a miner's noise exposure equals or exceeds the action level or exceeds the permissible exposure level or the dual hearing protection level. As indicated in the preamble to the proposed rule, a mine operator could use results of MSHA sampling or information from equipment manufacturers on the sound levels produced by their equipment in determining compliance with this rule. Additionally, as suggested by one commenter, a mine operator could also consider the results of other sampling, such as sampling conducted by an insurance carrier, in determining compliance. It would nonetheless benefit mine operators to determine miners' noise exposure using a personal

noise dosimeter or the formula included in paragraph (b) of this section of the final rule.

Determination of Dose

Paragraphs (b)(1) and (b)(2) of § 62.110 of the final rule include requirements for determining a miner's noise dose. These requirements are essentially the same as those in § 62.120(a) of the proposal. They contain several revisions in language to accommodate the changes in the threshold and range of integration for the permissible exposure level and dual hearing protection level. Additionally, the final rule, unlike the proposal, specifically refers to the use of personal noise dosimeters in determining a miner's noise dose. Finally, the final rule does not adopt the term "miner's noise exposure measurement" used in the proposal, but instead substitutes the term "miner's noise dose determination" to be consistent with the flexible and performance-oriented approach taken by the final rule. This change in terminology reflects the fact that mine operators may choose to determine a miner's noise dose and comply with the requirements of the final rule without taking an actual, physical measurement of a miner's personal noise exposure.

Paragraph (b)(1) of § 62.110 provides that a miner's noise dose may be determined in one of two ways:

- (1) Through the use of a personal noise dosimeter; or
- (2) When sound levels and corresponding exposure times are known, the dose is computed using the specified formula.

In order to use the formula, it is necessary to know the distribution of sound levels and exposure times throughout the work shift. Table 62-1 provides reference durations for the sound levels to be used in the calculation of dose, and Table 62-2 addresses converting from dose readings to equivalent TWA₈ values.

The ratios of the actual exposure times to the reference duration for each specified sound level equal to or exceeding the threshold (lower bound on the integration range) are summed and expressed as a percentage of the permitted standard. A reference duration is the time over which a miner, exposed at the associated sound level, receives 100% of the permissible noise dose. The reference duration for an 80-dBA sound level was added to the table in the final rule to reflect the use of the 80-dBA threshold for the determination of conformance with the action level, and is consistent with OSHA's noise standard.

Formula for Computing a Miner's Noise Exposure

If a sound level meter is used, corresponding discrete exposure times for each sound level are determined, and the formula established in this section is used to compute the miner's noise exposure. A personal noise dosimeter automatically computes a miner's noise exposure in the same manner as the formula does for readings taken with a sound level meter over the entire measurement period.

Like the proposal, the final rule includes Table 62-1, which lists incremental sound levels and their associated reference durations. The table in the final rule differs from the table included in the proposal because the sound levels that must be integrated into the noise exposure determination under the final rule are different than they would have been under the proposal for the permissible exposure level and the dual hearing protection level (see §§ 62.120, 62.130, and 62.140). These sound levels are essentially the same as those shown in Table G-16a in the OSHA noise standard, except that values above 115 dBA are excluded.

Although sound levels in excess of 115 dBA are not shown in Table 62-1, they are to be integrated into the noise exposure determination. However, inclusion of these values in Table 62-1 might lead the reader to erroneously infer that a miner is permitted to be exposed to sound at such levels, contrary to § 62.130(c) of the final rule, which prohibits the exposure of miners to sound levels exceeding 115 dBA. To avoid any such confusion, Table 62-1 has not been expanded to include the corresponding reference durations for sound levels greater than 115 dBA. Additionally, the Table includes the notation that at no time must any excursion exceed 115 dBA. MSHA notes that, in any case, the reference durations for sound levels that are not in the table can be calculated in accordance with the formula in the table's note. Further, discussion of the range of sound levels that are integrated into a miner's noise dose is included under § 62.110(b)(2), regarding range of integration.

Conversion From Dose to TWA₈

Table 62-2 is provided to allow conversion of the dose (percent) to the equivalent eight-hour time-weighted average (TWA₈). The requirements of paragraph (b)(1) have been adopted unchanged from § 62.120(a)(2) of the proposal. However, the full shift over which the dose determination is made may be shorter or longer than 8 hours.

Thus, the table is included because it provides an easy reference for converting the noise dose expressed as a percentage of the permissible exposures to the corresponding TWA₈.

MSHA noted in the preamble to the proposed rule that the TWA₈ and the dose are to be used interchangeably, and that the TWA₈ is not to be adjusted for extended work shifts, because the criterion level is based on eight hours. Noise exposures must reflect the entire shift in order to determine compliance with the final rule. If the noise dose exceeds 100 percent, regardless of the length of the work shift, the miner will be considered to be overexposed to noise. MSHA requested that commenters provide suggestions to help the Agency ensure that its intent is clearly conveyed in this final rule, but received no additional comments. The Agency provides the following additional guidance. If a miner's noise dose exceeds 800 percent, regardless of the length of the work shift, the miner will be considered to be exposed above the dual hearing protection level. If a miner's noise dose equals or exceeds a TWA₈ of 85 dBA, regardless of the length of the work shift, the miner will be considered to be exposed above the action level. Since the action level and permissible exposure level are determined using 80-dBA and 90-dBA thresholds, respectively, the noise dose using the 90-dBA threshold will always be lower or equal to the noise dose using the 80-dBA threshold.

Table 62-2 has been constructed by equating the permissible exposure level to a dose of 100 percent (criterion level of a TWA₈ of 90 dBA). More specifically, the TWA₈ conversion values in Table 62-2 are based on the use of a 90-dBA criterion level and a 5-dB exchange rate. Interpolation for values not found in this table can be determined using the following formula:

$$TWA_8 = 16.61 \log_{10} (D/100) + 90,$$
where D is the dose. Table 62-2 can be used to determine the equivalent TWA₈ from the percent noise dose. The conversion is made from dose in percent to TWA₈, regardless of the work shift time, and compared to the action level (TWA₈ of 85 dBA), the permissible exposure level (TWA₈ of 90 dBA), or dual hearing protection level (TWA₈ of 105 dBA). Some models of personal noise dosimeters will provide readings in both the percent dose and TWA₈, and in such cases the conversion table would not be needed.

MSHA notes here, as it did in the preamble to the proposal, that noise exposure is interpreted as if averaged over 8 hours. For example, a dose of 200 percent is equivalent to a TWA₈ of 95

dBA, whether it is collected for 4 hours, 8 hours, or 12 hours, and would indicate noncompliance with the permissible exposure level. A miner working only 5 or 6 hours can be exposed to higher sound levels during those hours than during an 8-hour shift. Thus, although exposure at 95 dBA is not permitted for 8 hours, exposure at that level would be permitted for a 4-hour work shift. Conversely, if a miner works a shift longer than 8 hours, the sound levels would need to be lower. Thus, although exposure at 90 dBA is permitted for 8 hours, it is not permitted for a 10-hour work shift. In this way, the conversion of percent dose to TWA₈ simplifies compliance determination.

Paragraph (b)(2) of this section (1) prohibits adjustments of dose determinations for the use of hearing protectors; (2) specifies the minimum range of sound levels that must be included in a miner's noise dose determination; (3) requires that the dose determination reflect the miner's full shift; (4) requires the use of a 90-dB criterion level and a 5-dB exchange rate; and (5) requires the use of an A-weighting and slow response instrument setting.

Noise Reduction Ratings

Section 62.110(b)(2)(i) of the final rule remains unchanged from § 62.120(a)(3)(i) of the proposal and requires that a miner's noise exposure be determined without adjusting for the use of any hearing protector. MSHA chose not to require the use of any method to determine the effectiveness of hearing protectors. Similarly, the Agency also chose not to provide for any scheme for the use or derating of the noise reduction rating (NRR) currently determined by manufacturers for hearing protectors based on laboratory testing under Environmental Protection Agency (EPA) regulations at 40 CFR §§ 211.201 through 211.214. The noise reduction rating is an estimate of the noise reduction achievable under optimal conditions and was designed to be used with C-weighted sound levels. EPA regulations require every hearing protector manufactured for distribution in the United States to bear a label that includes the protector's noise reduction rating.

Several commenters supported this aspect of the proposal, and agreed that the noise reduction provided by a hearing protector worn by a miner should not be considered in determining the miner's noise exposure. They believed the noise should be controlled by using engineering methods, rather than by relying on

miners to wear hearing protectors. These commenters observed that under MSHA's existing enforcement policy for coal mining, in many cases, once adjustment is made for hearing protector use when determining compliance, previously installed engineering noise controls are not maintained. Other commenters stated that the EPA noise reduction rating is a poor predictor of field performance; still others were of the opinion that the noise reduction of hearing protectors should be determined for individual wearers, not using average values such as the EPA noise reduction ratings.

On the other hand, many other commenters believed that some consideration of the noise reduction value of a hearing protector is called for in determining noncompliance. Some of these commenters stated that the EPA noise reduction rating is a scientifically accepted indicator of noise reduction value and should be retained. A number of those commenters believed that hearing protectors could be used effectively and were the most cost-effective method to achieve compliance with the rule. Other commenters recommended that hearing protectors be rated using methods recommended by the National Hearing Conservation Association, while others stated that the NIOSH method of adjusting hearing protector ratings should be used. Both of these methods are discussed below.

Several commenters provided audiometric data from their hearing conservation programs, claiming that the data showed that hearing protectors adequately protect the hearing sensitivity of miners. As discussed earlier, the NIOSH (Franks) analysis of the two databases cited by MSHA and the three analyses conducted by Clark and Bohl under the auspices of the National Mining Association indicate that miners are developing hearing loss of a degree that constitutes material impairment. The differences in the conclusions of these studies are largely attributable to different attributes of the control groups, *i.e.* prior noise exposure or the existence of otological abnormalities (which generally results in poor hearing), which were used in the studies. As noted earlier in the preamble, Franks' analysis used a non-noise exposed population and the audiograms of miners who had experienced otological abnormalities were screened out. Clark and Bohl, however, used a population that could have had an occupational noise exposure or an otological abnormality. Because of the different baselines, the conclusions reached by Clark and Bohl are different from those reached by

Franks regarding the magnitude of the hearing losses exhibited by miners. In any event, although the analyses arrive at different conclusions, all of these analyses indicate that some miners are developing varying degrees of a material impairment of hearing. Additionally, these analyses do not support the conclusion that a hearing conservation program that relies primarily or exclusively on the use of hearing protectors effectively protects all miners from noise-induced occupational hearing loss. The Agency also notes that it has examined data submitted by mine operators in accordance with the Agency's notification regulations under 30 CFR Part 50. This data shows that a number of miners have incurred a hearing loss despite the use of hearing protectors.

Other studies and data were submitted by TU Services, Rochester Group, Kerr-McGee Coal Corporation, and BHP Minerals Inc., in support of their position that a hearing conservation program that relies primarily or solely on the use of hearing protectors can adequately protect miners' hearing. However, all these studies lack sufficient data to allow such a conclusion to be drawn because no information has been provided that indicates the miners' history of noise exposure; the history of the use of hearing protectors; the type of hearing protectors used or the circumstances of use; and what type, if any, of engineering or administrative controls that may have been implemented. In addition, the data or studies lacked information on employment history and training history. Also, no details of the audiometric testing procedures were provided to the Agency. One study submitted by Kerr-McGee used an internal control to which the hearing of miners were compared. However, the noise exposure of the control group was not indicated. Because of the lack of such essential information for all the raw data or studies submitted to the Agency, it is impossible for MSHA to determine with any degree of certainty the level of effectiveness of any hearing protectors that may have been used, and as a result to give any of these studies significant weight in the development of the final rule. Moreover data by BHP and the Rochester Group showed the rates for a standard threshold shift (STS) to be unacceptably high, in excess of 5% (BHP had a 7% rate and the Rochester Group had a 6.6% STS rate in 1996 and a 7.9% STS rate between 1988 and 1997).

Some commenters recommended a requirement for NIOSH Method No. 1, which uses the spectrum of the noise

and the attenuation of the hearing protector at individual frequencies to estimate the sound level beneath the hearing protector. Other commenters stated their belief that mine operators lack the sophistication to use this method. The NIOSH Method No. 1 requires the use of advanced instrumentation and MSHA believes that few mine operators would have the expensive instruments. In addition, because noise in mining is almost constantly changing its frequency, content, or sound level, many measurements of individual noises will need to be conducted before an appropriate hearing protector could be recommended.

In its *Compendium of Hearing Protection Devices* (1994), NIOSH compares several sets of laboratory-measured noise reduction values (obtained using various standardized methods), including the noise reduction rating. NIOSH lists the noise reduction of various hearing protectors estimated by these various methods. Also, listed are the physical attributes, composition, and compatibility with other personal safety equipment of the hearing protectors.

NIOSH (1995) recommends a rating adjustment scheme based on the type of hearing protector, resulting in the following field-adjusted ratings:

- (1) Earmuffs—75% of the noise reduction rating;
- (2) Formable earplugs—50% of the noise reduction rating; and
- (3) All other earplugs—30% of the noise reduction rating.

The National Hearing Conservation Association's Task Force on Hearing Protector Effectiveness (Royster, 1995) recommends that the EPA's noise reduction rating be replaced with a noise reduction rating-subject fit, or NRR(SF). According to the researchers, the NRR(SF) more realistically reflects the field performance of hearing protectors. The noise reduction rating-subject fit is determined by laboratory testing after a person fits the hearing protector to his or her head. This differs from EPA's noise reduction rating, which is determined after a researcher fits the hearing protector to the person. Both are averages for general populations, but the noise reduction rating-subject fit is more realistic because it more closely approximates field conditions by having the user insert or put on the hearing protection device. The Task Force also recommends continued audiometric testing whenever hearing protectors are used.

MSHA notes that the American Industrial Hygiene Association (AIHA,

1995) requested that EPA revise its noise rule on noise labeling requirements for hearing protectors. The reasons given for this request included:

(1) The current method of rating hearing protectors overestimates the actual workplace protection by 140 to almost 2000 percent.

(2) Absolute levels of protection from labeled values cannot be predicted.

(3) The labeled values are a poor predictor of relative performance of one hearing protector versus another.

(4) There are no provisions for retesting the hearing protectors on a recurring basis.

(5) There is no requirement for quality assessment or accreditation of the test laboratory.

Despite the fact that OSHA's noise standard includes methods to estimate the effectiveness of hearing protectors, MSHA has concluded that there is no scientific consensus regarding the method that should be used to determine the noise reduction of a hearing protector.

Many field studies have been conducted on the effectiveness of hearing protectors in the mining industry. With one exception, these studies report that hearing protectors, whether old or new, provide much less noise reduction than was measured in the laboratory. In many instances, noise reduction was minimal and highly variable, indicating that hearing protector effectiveness cannot be reliably predicted under actual use conditions and is substantially less than that indicated by the noise reduction rating of the manufacturer. These studies are summarized below.

Durkt (1993) studied the effectiveness of 11 models of new earmuffs using miniature microphones inside and outside the ear cups. A total of 107 tests were conducted at surface mines on operators of equipment that included bulldozers, front-end-loaders, and overburden drills. When the noise spectrum included significant amounts of low frequency noise, the measured noise reduction was much less than the noise reduction rating. This is relevant in mining because most diesel-powered equipment, including the machines used at the surface mines, generate noise primarily in the low frequency range.

Kogut and Goff (1994) studied the effectiveness of earmuffs being used in surface and underground mines. A total of 540 miners were tested wearing their normal earmuffs. The procedure was similar, but not identical, to the procedure used by Durkt (1993). Like Durkt, the researchers concluded the noise reduction provided by earmuffs

was related to the spectrum of the noise. According to the researchers, "The earmuffs' effectiveness in reducing noise exhibited great variability and frequently fell far short of the NRR." The researchers did develop a method for predicting the effectiveness of earmuffs, but it is complex as well as impractical.

Giardino and Durkt (1996) and Giardino and Durkt (1994) expanded on the two previously discussed studies. A total of 1,265 tests were performed on 545 distinct machines of 20 different types. According to the researchers, earmuffs provided minimal noise reduction for operators of equipment powered by internal combustion engines. They concluded that the noise reduction rating was a poor predictor of earmuff performance under actual mining conditions.

Bertrand and Zeiden (1993), the exception noted above, determined the effectiveness of hearing protectors by measuring the hearing levels of miners exposed to sound levels exceeding 115 dBA. They found that, although the hearing protectors provided less noise reduction than their ratings indicated, the difference was not significant. For example, miners exposed to 118 dBA experienced hearing levels consistent with exposure to 98 dBA, indicating that the hearing protector rated at 24 dBA provided 20 dBA of noise reduction.

Several research studies performed in other industries by Pfeiffer (1992), Hempstock and Hill (1990), Green et al. (1989), Behar (1985), Lempert and Edwards (1983), Crawford and Nozza (1981), and Regan (1975) also indicate that hearing protector effectiveness is substantially less than the noise reduction rating indicated by the manufacturer.

Other findings by these researchers sometimes conflict with one or more of the others, underscoring the logic of MSHA's decision not to mandate any rating adjustment system at this time:

Regan (1975) found that earmuff-type protectors provide the most noise reduction and custom molded earplugs the least.

Behar (1985) found that the measured noise reduction rating in industrial settings averaged 14.9 dB lower and reached 25 dB lower than the manufacturer's rated value.

Green et al. (1989) report workers who used earplugs and were receiving one-third to one-half of the laboratory-based noise reduction rating value, and workers enrolled in an effective hearing conservation program obtain greater noise reduction from their hearing protectors.

Crawford and Nozza (1981) report that the average noise reduction of the earplugs was typically 50% of the manufacturer's values, except for user-molded earplugs, whose actual noise reduction in the field was near the laboratory values.

Lempert and Edwards (1983) report that, in the majority of cases, workers received less than one-half of the potential noise reduction of earplugs. They conclude that regardless of the type of earplug used at a facility, a large portion of the workers obtained little or no noise reduction.

Hempstock and Hill (1990) report that the workplace performance of earmuffs more closely approximated the laboratory performance than earplugs. For both earmuffs and earplugs, the measured workplace noise reductions were lower and the standard deviations higher than those measured in the laboratory. The researchers attribute these results to the ease of fitting an earmuff compared to fitting an earplug. Their study also revealed that the decrease in effectiveness was dependent upon the model of hearing protector and even differed between sites; safety glasses substantially degraded the performance of earmuffs; workers wearing safety glasses received approximately one-half of the laboratory noise reduction.

Royster et al. (1996) also found that personal protective equipment such as hard hats and safety glasses worn by miners may affect the noise reduction of hearing protectors. In their study, wearing safety glasses reduced the noise reduction of earmuffs by about 5 dB at all frequencies.

Pfeiffer (1992) surveyed studies of hearing protector effectiveness in German industry, and reports that at industrial sites, earplugs provided between 10 and 15 dB less noise reduction, and earmuffs about 6 dB less, than they did in the laboratory. In another part of the study, used but not defective earmuffs were tested against new ones. The used earmuffs provided significantly less noise reduction than new ones. The decrease in reduction depended on the model and frequency tested, exceeding 7 dB for some frequencies.

Abel and Rokas (1986) report that the noise reduction of earplugs decreases with wearing time, and that head and jaw movement accelerate the decline. Cluff (1989) investigated the effect of jaw movement on the noise reduction provided by earplugs and determined that the change in reduction depended on the type of earplug. Self-expanding viscose foam earplugs retained more of

their noise reduction ability than multi-flanged or glass-fiber earplugs.

At Noise-Con 81, Berger (1981) concluded that the performance of hearing protectors decreased with wearing time. Kasden and D'Aniello (1976, 1978) found that custom molded earplugs retained their noise reduction after three hours of use during normal activity, but typical earplug performance decreased after three hours of use. Krutt and Mazor (1980) report that the noise reduction of mineral down earplugs decreases over a three-hour period of wear, but the noise reduction of expandable foam earplugs does not. Casali and Grenell (1989) tested the effect of activity on the noise reduction provided by an earmuff and found that there was significant decrease only at 125 Hz and that the noise reduction was highly dependent on the fit.

Royster and Royster (1990) report that the noise reduction rating cannot be used to determine or even rank the field effectiveness of hearing protectors. They found that two individuals, using the same model of hearing protector, can obtain vastly different levels of noise reduction. They conclude that "Products that are more goof-proof (earmuffs and foam earplugs) provided higher real-world attenuation than other HPDs [hearing protection devices]."

Casali and Park (1992) report that the noise reduction at 500 or 1000 Hz showed a high correlation with the overall noise reduction of hearing protectors. Therefore, they believe, models can be developed to predict the overall reduction of hearing protectors based upon the measured reduction at a single frequency, eliminating the need to adjust the noise reduction rating to accurately reflect noise reduction in the field. Casali and Park also believe that this model could be used to fit hearing protectors objectively.

Berger (1992), in "Field Effectiveness and Physical Characteristics of Hearing Protectors," reports on the progress of the American National Standards Institute (ANSI) Working Group S12/WG11, which is charged with developing a laboratory methodology of rating hearing protectors that reflects the noise reduction obtained by workers in the field. Berger also summarizes the results of 16 studies involving over 2,600 subjects on the field performance of hearing protectors. Earplug field ratings averaged about 25% of the published U.S. laboratory ratings (ranging from 6% to 52%) and earmuff reduction rates averaged about 60% of the laboratory rates (ranging from 33% to 74%).

Royster et al. (1996) also report on the progress of the American National Standards Institute Working Group that has developed a methodology that reflects the reduction achieved by workers in a well managed hearing conservation program, and is in the process of drafting an ANSI standard around it. While testing their methodology, the researchers concluded that because some test subjects could not properly insert an earplug by simply reading the manufacturer's instructions, these instructions may be inadequate.

As summarized above, many researchers have compared the results of standardized methods of measuring the noise reduction of hearing protectors in a laboratory setting to estimated or measured field reductions. Researchers have yet to develop a standardized test for measuring the noise reduction of hearing protectors in the field. In general, commenters concurred with MSHA's preliminary conclusion in the proposal that, while methods exist to measure the noise reduction provided to an individual by a hearing protector, none of these methods has been standardized or shown to be effective in field usage or applies equally to all types of hearing protectors. This makes it virtually impossible to accurately predict in any systematic way the in-mine effectiveness of hearing protectors in reducing noise exposures for individual miners.

In addition to the studies that have been summarized above, MSHA has reviewed the procedures for exposure measurement in regulations and codes of practice (mandatory or recommended) of OSHA, selected branches of the U. S. armed services, international communities, the International Standards Organization, American National Standards Institute, and the American Conference of Governmental Industrial Hygienists. A variety of methods are used by these organizations, but nearly all of the entities either specify or imply that noise reduction provided by hearing protectors should not be considered in determining a worker's noise exposure.

Accordingly, based on the rulemaking record, and consistent with OSHA's noise standard, the final rule adopts the proposed requirement that a miner's noise dose be measured or computed without regard to any noise reduction provided by the use of personal hearing protectors. This is consistent with MSHA's determination that there are other factors that may be as important or even more important than a hearing protector's noise reduction in ensuring that a miner is protected from occupational noise-induced hearing

loss. These factors include comfort, training, fit, maintenance, and consistent use. Because engineering and administrative controls are more reliable and measurable, they must be the first line of defense in reducing noise exposures. This fact does not, however, diminish the usefulness of hearing protectors as part of a continuing and effective hearing conservation program. In recognition of the role played by hearing protectors in a hearing conservation program, MSHA will provide guidance to the mining community in estimating the adequacy of hearing protectors as applied to individuals in the form of a compliance guide that will be issued after the publication of the final rule.

Range of Integration

Section 62.110(b)(2)(ii) of the final rule requires the integration of all sound levels over the appropriate range in determining a miner's noise dose. Under the proposal, the range of integration for the action level, the permissible exposure level, and the dual hearing protection level would have been from 80 to 130 dBA. The "range of integration" means the level at which the dosimeter starts recognizing the sound level and counting it to the sound level where the dosimeter stops counting. Unlike the proposal, the final rule establishes dual thresholds: § 62.120 of the final rule sets the range of integration for the action level from 80 to at least 130 dBA, while the range of integration for both the permissible exposure level and the dual hearing protection level is from 90 to at least 140 dBA (§§ 62.130(a) and 62.140). To accommodate the dual thresholds, the language of the final rule has been revised to require the "appropriate range" of integration of sound levels, rather than specifying the range of integration set forth in the proposed rule for all dose determinations.

The term "all sound levels" in the final rule includes, but is not limited to, continuous, intermittent, fluctuating, impulse, and impact noises. A discussion of impulse and impact noise is provided at the end of this section.

Dual Thresholds

Many commenters urged MSHA to develop a rule consistent with the OSHA noise standard, which requires an 80-dBA threshold for the action level and a 90-dBA threshold for the permissible exposure level. Some commenters, however, supported the proposed 80-dBA threshold for both the action level and permissible exposure level. Also, a few commenters requested that MSHA adopt a threshold of 85 dBA

for the permissible exposure level, while other commenters recommended that MSHA retain the 90-dBA threshold used under MSHA's existing noise standards, believing that sound levels less than 90 dBA were not hazardous and that an 80-dBA threshold for compliance with the permissible exposure level would merely increase the number of citations without significantly benefitting the miners.

MSHA has concluded that the adoption of a dual threshold in the final rule is protective and will decrease a miner's risk of developing noise-induced hearing loss. In not adopting the proposed 80-dBA threshold for both the permissible exposure level and the action level, MSHA is not ignoring the scientific evidence, noted in Part V, *Material Impairment*, which demonstrates that there is a risk of hearing loss from exposure to sound levels at or above 80 dBA. The Agency addressed the risk of hearing impairment from prolonged exposure above 80 dBA in the preamble to the proposed rule. However, MSHA concludes that the dual thresholds in the final rule will protect miners against noise-induced hearing loss which occurs at those sound levels, primarily because the final rule incorporates significant changes to the proposed hearing conservation program.

MSHA has concluded that the protection provided by the final rule adequately addresses the risk of noise-induced hearing loss which occurs at exposures between a TWA₈ of 85 dBA and a TWA₈ of 90 dBA. Under the final rule, mine operators are required to implement a system of monitoring that evaluates each miner's noise exposure sufficiently to determine compliance with part 62. All sound levels ranging from 80 to at least 130 dBA must be integrated to determine whether a miner's noise exposure equals or exceeds a TWA₈ of 85 dBA—the action level. Mine operators are required to enroll miners whose noise exposure equals or exceeds the action level into a hearing conservation program. Under the hearing conservation program, mine operators are required to provide enrolled miners with hearing protectors, audiometric testing, and training, all in accordance with specific requirements.

Commenters noted that, in addition to being protective, a dual threshold is workable. Many mine operators are currently using personal noise dosimeters with dual threshold capability for measuring noise exposures. Some commenters, familiar with both OSHA and MSHA regulations, recommend that MSHA require measuring a worker's noise

exposure using dual thresholds in order to be consistent with OSHA. Nearly all personal noise dosimeters currently being manufactured have variable threshold settings that facilitate the collection of noise exposures using two different thresholds. Some older personal noise dosimeters that lack the capability of dual thresholds but which have been used to measure a miner's noise exposure under MSHA's existing noise regulations—may be somewhat obsolete, but can still be used to make a noise exposure measurement to determine conformance with either the action level or the permissible exposure level. They simply cannot do both simultaneously. Additionally, some of the older instruments may not be capable of integrating the required range of sound under the final rule, and will need to be replaced.

Impulse/Impact Noise

As noted above, § 62.110(b)(2)(ii) of the final rule requires that "all sound levels," including impulse and impact noise, be integrated into a miner's noise dose determination. Impulse noise sources, such as gunshots, or impact noise sources, such as a sledge hammer striking metal, result in high sound pressure levels being generated almost instantaneously. These sources are hazardous because their duration is so short that the protective mechanisms of the ear do not have sufficient time to react. The final rule, like the proposal, does not include a separate provision for impulse or impact noise.

In the preamble to the proposed rule, MSHA discussed in depth the many factors it considered in determining the merit of proposing an impulse/impact noise limit for the mining industry. Although there is evidence in the literature on the harmful effects of impulse/impact noise, MSHA concluded that, currently, there is insufficient scientific consensus to support a separate impulse/impact noise standard. Further, existing procedures for identifying and measuring such sounds lack the practicality to enable its effective measurement. This is due, in part, to the complexity of the phenomena, where consideration must be given to such technical factors as the peak sound pressure level, the shape of the wave form, the number of impulses per day, the presence or absence of steady-state (background) sound, the frequency spectrum of the sound, and the protective effect of the middle ear acoustic reflex.

As discussed in Part V, *Material Impairment*, when impulse/impact noise is combined with continuous noise, hearing loss is exacerbated.

Because industrial impulse noises are almost always superimposed on a background of moderate-to-high levels of continuous noise, and because both can be harmful, it is reasonable to consider their combined effect, rather than to treat each separately. MSHA has therefore concluded, and the final rule reflects, that impulse/impact noise must be combined with continuous noise when a miner's noise exposure is determined. This is consistent with provisions in OSHA's noise standard.

MSHA has received comments on whether impulse and impact noise can be accurately integrated into determining a miner's noise dose. The studies cited by these commenters predated the new ANSI S1.25-1991 "American National Standard Specification for Personal Noise Dosimeters." Personal noise dosimeters meeting this standard cover the ranges of sound levels that are to be integrated into a miner's noise dose under §§ 62.120, 62.130(a), and 62.140 and accurately integrate impulse and impact noise into a worker's noise exposure.

MSHA received comments in response to its request for data addressing a critical level to prevent a traumatic hearing loss. A critical level is one which causes immediate and irreparable damage to the hearing mechanism. The comments received dealt primarily with impulse and impact noise as it pertained to the proposed ceiling level of 115 dBA, and these comments are therefore addressed under § 62.130 of this preamble.

Full Work Shift

Section 62.110(b)(2)(iii) of the final rule has been adopted with some changes from proposed § 62.120(a)(3)(ii), and requires that a miner's noise dose determination reflect the miner's full work shift. Under the proposed rule, a miner's noise exposure measurement would have been required to integrate all sound levels from 80 dBA to 130 dBA during the miner's full work shift. Many commenters supported the proposal, based on their belief that a miner's noise exposure should be monitored for the entire work shift. Several commenters specifically recommended that full-shift sampling also include extended work shifts, that is, those that are longer than 8 hours. Another supported the use of dosimetry to determine a miner's noise exposure.

MSHA received several comments suggesting alternatives to full-shift sampling. Several commenters suggested that miners could be monitored only during the loudest portion of their work shift, assuming that this portion was predictable. Under

this suggested approach, if monitoring during the loudest portion of the work shift did not indicate an overexposure, a full-shift measurement would be unnecessary. One commenter wanted MSHA to specify that the noise measurement be conducted for at least two-thirds of the work shift, because this commenter believed that a mine operator cannot always monitor a miner for the complete work shift, and because two-thirds of a work shift would provide sufficient information to accurately characterize the shift.

MSHA noted in the preamble to the proposal that because most mining jobs have highly variable work tasks, high mobility, and irregular work schedules, measurement of a miner's noise exposure for a partial shift may not reliably project the miner's noise exposure for a full work shift (one that is at least 8 hours), and monitoring the loudest part of the work shift could overestimate the miner's exposure.

MSHA also received several comments suggesting other ways to measure sound levels or a miner's noise exposure. A few commenters suggested that if the sound level measured with an area sample indicated that no possible overexposure exists, a full-shift measurement would be unnecessary. A few commenters suggested that the final rule require a 40-hour multiple-shift sampling period in order to better define a representative work exposure.

The monitoring requirements of the final rule are intended to be highly performance-oriented. The final rule simply requires that mine operators effectively evaluate a miner's noise exposure to determine compliance with part 62.

To be consistent with this performance-oriented approach, the language of this section of the final rule has been revised from the proposal to require that the miner's dose determination reflects the miner's full shift. This means that the mine operator has flexibility in determining a miner's noise dose, and may choose to use a method that does not necessitate sampling over the course of the entire shift.

For example, if a miner who works an eight-hour shift typically spends four hours in a noisy area of the mine and the other four hours in a quiet area, such as a mine office, the mine operator may choose to sample the miner's noise exposure only during the four-hour period that the miner is exposed to higher noise levels. In such a case, the mine operator would have a reasonable basis for concluding that a full-shift measurement is not needed to verify that the miner is not being overexposed.

Mine operators are free to select the sampling methodology that is appropriate for their mines. However, mine operators should be aware that a full work shift sample is typically more indicative of a miner's noise exposure than is a partial-shift sample, and that mine operators are responsible under the final rule for ensuring that miners are protected from exposures in excess of the permissible exposure level. Mine operators also must ensure that miners with noise exposures that equal or exceed the action level must be enrolled in a hearing conservation program.

MSHA therefore recommends that, when a personal noise dosimeter is used for measurement, the determination be made over the duration of the entire shift. Alternatively, if another dose determination methodology is used, it must reflect the noise dose for the miner's full shift. For example, the multiple-shift sampling approach recommended by a commenter would produce results that are not relevant to compliance with the standard, which is based upon a miner's exposure over a full work shift.

One commenter expressed concern that personal noise dosimeters would only integrate sound levels for 8 hours. On the contrary, it has been MSHA's experience that personal noise dosimeters integrate sound levels for at least 8 hours, or until the personal noise dosimeters are either turned off or placed in a standby mode. Therefore, personal noise dosimeters can measure a miner's noise exposure during an extended shift.

Criterion Level and Exchange Rate

Section 62.110(b)(2)(iv) of the final rule remains unchanged from proposed § 62.120(a)(3)(iii) and establishes the criterion level of 90 dBA. Because commenters who referenced the criterion level did so in the context of the permissible exposure level, their comments are addressed under § 62.130 of the preamble.

Section 62.110(b)(2)(iv) of the final rule also adopts the 5-dB exchange rate, which was proposed in § 62.120(a)(3)(iii). The exchange rate is the change in sound level which corresponds to a doubling or a halving of the exposure duration. For example, using a 5-dB exchange rate, a miner who receives the maximum permitted noise dose over an 8-hour exposure to 90 dBA would have accumulated the same dose as a result of only a 4-hour exposure at 95 dBA, or 2-hour exposure at 100 dBA. If the exchange rate were reduced to 3 dB, a miner would receive the same dose with a 4-hour exposure at only 93 dBA or a 2-hour exposure at 96 dBA. In

the preamble to the proposal, MSHA specifically sought comments on changing the exchange rate from 5 dB to 3 dB.

Many commenters favored the 5-dB exchange rate because they thought that implementing a 3-dB exchange rate was infeasible. Some of these commenters, believing that a 5-dB exchange rate is based on work shifts with intermittent noise exposure, felt that a 5-dB exchange rate is more appropriate because mining noise exposures are generally intermittent. A few of the commenters believed the 3-dB exchange rate was not supported by scientific evidence. Some commenters also suggested that, if the 5-dB exchange rate is retained, the permissible exposure level should be lowered to 88 or 85 dBA, and that either a 3-dB exchange rate apply above 115 dBA, or mine operators be prohibited from implementing administrative controls to control exposures to sound levels exceeding 100 or 105 dBA.

As indicated in the preamble to the proposal, MSHA evaluated the impact a 3-dB exchange rate would have on the measured noise exposure of miners working in U.S. metal and nonmetal mines. Federal mine inspectors collected measurements during the course of their regular inspections using personal noise dosimeters, collecting data using 5-dB and 3-dB exchange rates simultaneously.

The measurements for a 5-dB exchange rate were made using a 90-dBA threshold, while the 3-dB exchange rate data were obtained without a threshold, allowing for analysis of data at values below a TWA_8 of 90 dBA, which is not possible with a 90-dBA threshold. The results of the study indicated the selection of an exchange rate substantially affects the measured noise exposure in the following ways:

(1) The percentage of miners whose noise exposures would be calculated to exceed a TWA_8 of 90 dBA permissible exposure level (or an $L_{eq,8}$ of 90 dBA in the case of a 3-dB exchange rate) increased from 26.9% to 49.9% when the exchange rate changed from 5 dB to 3 dB;

(2) Switching to a 3-dB exchange rate and setting the permissible exposure level at an $L_{eq,8}$ of 85 dBA would increase the percentage of miners whose exposure is out of compliance with the permissible exposure level from 67.6% to 85.5%; and

(3) Additional engineering and administrative noise controls would be required under the 3-dB exchange rate, and they would be more expensive.

Although the Agency has not compiled similar data for coal mines, MSHA has concluded that the consequences of adopting a 3-dB exchange rate would be similar. This conclusion is based on the similarity of mining operations and equipment and the consistency of the exposure data at the 5-dB exchange rate in either sector of the mining industry.

Several commenters advocated the use of a 3-dB exchange rate, citing scientific studies to support their position.

In the preamble to the proposed rule, MSHA noted its awareness of a consensus in the recent literature that noise dose actually doubles more quickly than measured by the 5-dB exchange rate, and that there appears to be a consensus for an exchange rate of 3 dB. However, the Agency also noted in the preamble to the proposal that it intended to retain the proposed 5-dB exchange rate because of feasibility considerations.

Under the Mine Act, MSHA is required, when promulgating a standard, to make a reasonable prediction, based on the "best available evidence," that the industry can generally comply with the standard within an allotted period of time. The Agency must demonstrate a reasonable probability that the typical mine operator will be able to develop and install controls meeting the standard. MSHA noted in the preamble to the proposal that the exposure data, in conjunction with the study referenced above, suggested that it would be difficult for MSHA to make such a showing in proposing a 3-dB exchange rate. This is particularly true at smaller mines, where many mines would not have enough employees to allow implementation of certain administrative controls, such as job rotation. Although some commenters were not persuaded by the discussion in the preamble to the proposal that a 3-dB exchange rate would be infeasible in the mining industry, MSHA received no additional data from commenters contradicting this determination.

Additionally, MSHA believes that any decision on the appropriate exchange rate for noise dose determinations is closely linked to a decision on the appropriate permissible exposure level, and should be considered as part of that process. As indicated in the preamble discussion of feasibility and under § 62.130, MSHA has concluded that the existing permissible exposure level should not be revised at this time. Revision of the applicable exchange rate should also be deferred. Accordingly, MSHA continues to conclude that it

would be extremely difficult and prohibitively expensive for the mining industry to comply with the existing permissible exposure level with a 3-dB exchange rate, using currently available engineering and administrative noise controls. MSHA therefore cannot demonstrate that implementation of such an exchange rate would be feasible. However, the Agency will continue to monitor the feasibility of adopting a 3-dB exchange rate.

A-Weighting and Slow Response Instrument Setting

Section 62.110(b)(2)(v) of the final rule, like § 62.120(a)(3)(iv) of the proposed rule, requires that instruments used for measuring noise exposures be set for the A-weighting network and slow response. OSHA also uses the A-weighting network and the slow response for evaluating exposure to noise.

Weighting networks were originally designed to approximate the loudness-level-sensitivity of the human ear to pure tones. The human ear does not respond uniformly to all frequencies of tones. At low sound pressure levels (e.g., 50 dB), the ear is less responsive to low- and high-frequency tones. At higher sound pressure levels (that is, 90 dB), the ear responds more uniformly to low- and high-frequency tones. Low-frequency tones are, however, less damaging to hearing than mid-frequency tones.

Several weighting networks have been developed to take these differences into account and have been designated as A, B, and C. Early researchers suggested the use of the A-weighting network when the sound pressure level was less than 55 dB; the B-weighting network between 55 and 85 dB; and the C-weighting network for sound pressure levels exceeding 85 dB (Scott, 1957). Since that time, however, a scientific consensus has developed on the use of the A-weighting network to measure occupational noise exposure at all sound levels.

The acoustical performance of the A-weighting network has been defined in consensus standards established by the American National Standards Institute (ANSI). ANSI S1.4-1983, "American National Standard Specification for Sound Level Meters," and ANSI S1.25-1991, "American National Standard Specification for Personal Noise Dosimeters," define the identical A-weighting networks for the respective instruments. No comments were received recommending the use of a weighting network other than the A-weighting network.

Response time is a measurement of the speed at which an instrument responds to a fluctuating noise. There are several instrument response times that have been standardized fast, slow, impulse, exponential, and peak. The quickest response is the peak response and the slowest is the slow. Originally the slow response (1000 milliseconds) was used to characterize occupational noise exposure, because reading the needle deflections on a meter in rapidly fluctuating noise was easier. Using the fast response (125 milliseconds) resulted in needle deflections that were too difficult for the human eye to follow. The slow response was in use to characterize noise exposure at the time when most damage risk criteria were developed. As a result, both the previously referenced ANSI S1.4 and S1.25 instrumentation standards for sound level meters and personal noise dosimeters, respectively, contain specifications for the slow response.

Some commenters suggested that MSHA adopt the fast response for all measurements. Others objected to the use of the slow response only with personal noise dosimeters, where, they believe, the slow response overestimates the noise exposure for fluctuating or intermittent noise. These commenters had no objection to using the slow response with sound level meters where the effect of intermittency could be taken into account. One commenter stated MSHA should use the fast response to conform with an international consensus standard.

However, the majority of the scientific community and most international regulatory authorities accept slow response as the appropriate measurement parameter for characterizing occupational noise exposures, and it has been used by the U.S. Department of Labor since the adoption of the Walsh-Healey Public Contracts Act noise regulations of 1969 to measure occupational noise exposure. Based upon data included in Part V, *Material Impairment*, which showed good correlation between hearing loss and A-weighted noise exposures, and the accepted use of the slow response setting, the final rule adopts the proposed A-weighting and slow response settings for instruments that are used to determine a miner's noise exposure.

Observation of Monitoring

Paragraph (c) of § 62.110 of the final rule, like proposed § 62.120(g), requires mine operators to provide affected miners and their representatives with an opportunity to observe any monitoring required under this rule. In addition, the

final rule requires mine operators to give prior notice to miners and their representatives of the dates and times when the mine operators intend to conduct the monitoring. MSHA has no existing requirement in this area.

This provision is consistent with section 103(c) of the Mine Act, which requires that regulations issued by MSHA for monitoring or measuring toxic materials or harmful physical agents such as noise provide miners or their representatives with an opportunity to observe such monitoring. MSHA views mine operator monitoring as an important component in operators' efforts to protect the hearing of the miners they employ. The primary purpose of operator monitoring is protection of miners. Monitoring provides operators with an awareness of the miners' noise exposures at their mines and the specific sound levels to which miners are exposed. In addition, it reminds operators of their obligations to reduce excessive sound levels to ensure protection of miners.

The Agency received a number of comments on this aspect of the proposal. Several commenters supported providing miners and their representatives with an opportunity to observe required monitoring. Several commenters stated that miners should be paid when observing monitoring. On the other hand, many commenters stated that section 103(f) of the Mine Act, which requires mine operators to compensate representatives of miners who accompany MSHA inspectors on inspections, does not apply to observation of operator monitoring because it is not conducted as part of an MSHA inspection. MSHA agrees. Section 103(f) of the Mine Act requires "walkaround pay" when a representative of miners who is employed by the operator accompanies an MSHA inspector during an inspection of the mine. Section 103(f) does not authorize "walkaround pay" for time spent by a representative of miners observing a mine operator's monitoring program. The final rule, therefore, does not include a requirement for mine operators to compensate a representative of miners for participating in the observation of monitoring.

One commenter stated that by requiring mine operators to provide miners' representatives with an opportunity to observe noise monitoring, MSHA is improperly expanding the scope of section 103(c) of the Mine Act, which addresses monitoring of "toxic materials" or "harmful physical agents."

MSHA has consistently considered noise to be a "harmful physical agent" covered under section 103(c) of the Mine Act. The legislative history of the Federal Coal Mine Health and Safety Act of 1969, Conference Report 91-761, indicates that excessive noise was one of the harmful physical agents that Congress anticipated would be the subject of health standards. Also, the legislative history of the Federal Mine Safety and Health Act of 1977 reveals that NIOSH had conducted studies on "toxic substances," including substances in metal and nonmetal mines, and had developed criteria documents on those substances, which included noise. In addition, a U.S. Circuit Court of Appeals has determined that noise is a "harmful physical agent" under the Occupational Safety and Health Act. *Forging Industry Association v. Secretary of Labor*, 773 F.2d 1436, 1444 (4th Cir. 1985). Accordingly, MSHA has concluded that noise falls within the scope of section 103(c) of the Mine Act, and that MSHA has the authority to establish regulations that provide miners and their representatives access to noise exposure monitoring conducted by mine operators.

Several commenters recommended that the Agency substitute the term "representatives of miners" for "their representatives," because they believed that it was important to clarify that the representatives referred to in this section are miners' representatives designated under MSHA's regulations at 30 CFR part 40.

Under part 40, the definition of "representative of miners" includes "representatives authorized by the miners," "miners or their representative," "authorized miner representative," and other similar terms as they appear in the Act." Consequently, MSHA believes that the terminology used in the final rule is sufficient to indicate that the "representative" referred to in this section is a "miner's representative" designated under part 40. The final rule therefore does not adopt the suggestion of commenters.

Many commenters were opposed to allowing both miners and their representatives to observe operator monitoring. Several commenters stated that because most mine operators use personal noise dosimeters, which must be placed on the miner, the miner is effectively participating in the monitoring, and is told of the results at the end of the day. These commenters believe that requiring a miners' representative to observe would be redundant and result in adversarial relations between labor and

management. The final rule does not adopt this comment, because MSHA broadly interprets the opportunity for observation of this monitoring to extend to both miners and their representatives, consistent with the underlying purposes of the Mine Act. Further, participation by miners and their representatives will enhance miner safety and health awareness and contribute to greater understanding of the nature and extent of the noise hazard.

In its Preliminary Regulatory Impact Analysis for the proposed rule, MSHA used the terms "off-duty" and "non-duty" miners in the context of observation of monitoring. One commenter raised concerns about MSHA's use of these terms, and questioned whether MSHA intended to create a new category of miner. MSHA did not intend by using this term to create a new category of miner. Instead, MSHA used the two terms interchangeably to refer to a miner who works on a shift other than the one where he or she is observing the monitoring. To avoid any confusion, MSHA uses only the term "off-duty" miner in the final Regulatory Economic Analysis.

One commenter was opposed to letting an off-duty miner or miners' representative on the property to observe noise monitoring. The commenter stated that this raised a number of issues, including:

Who would be responsible for escorting these people around the property? Is the operator supposed to provide them with transportation? What happens if they should get injured? They are off duty but still on the mine property. How would this be classified?

The final rule does not specify how the requirement of observation of monitoring must be implemented. Instead, mine operators have the flexibility to determine, based on an assessment of their unique mining operations, how to best implement this provision. MSHA does not believe that it is either necessary or in the best interest of miners' health to impose additional restrictions on who should be allowed to observe monitoring, or how the observation of monitoring should be conducted. Most if not all of the hypothetical situations raised by the commenter could occur in contexts other than the observation of monitoring. MSHA expects that these questions will be resolved through the labor-management processes already in place.

Several commenters were concerned that allowing miners' representatives to observe could place the miners' representative in unsafe positions,

especially in the case of single occupancy equipment such as a shuttle car, scraper, or bulldozer. The Agency does not intend that the exercise of the right to observe noise monitoring will expose miners or their representatives to unsafe working conditions. The purpose of observation by the miners' representative is to ensure that the miner is operating the equipment under normal working conditions and that the instrumentation is being used properly. Thus, in those cases where mobile, single-occupancy equipment is involved, the miners' representative can observe the monitoring from a safe distance.

Several commenters questioned whether the number of observers or the observation time would be limited. The final rule does not limit the number of miners, their representatives, or time spent observing monitoring. Therefore, under the final rule miners have the option of observing monitoring for the full shift, part of the shift, or not at all.

MSHA considers field calibration of the instruments, and any recording of results to be included within the right of observation. MSHA believes that miners who observe operator's monitoring procedures gain insight into the nature and extent of the noise hazard, and are more likely to become more involved in the hearing conservation program. This involvement should increase the motivation for proper use of hearing protectors, thereby increasing the effectiveness of the program and allowing them to share their knowledge with their fellow miners, thus improving overall health at the mine.

Paragraph (c) also requires mine operators to give prior notice to affected miners and their representatives of the date and time they intend to conduct monitoring. One commenter supported the provision as proposed, stating that it is an acceptable and reasonable practice.

Several commenters stated that requiring notification of both miners and their representatives of operator monitoring would be unduly burdensome, and would not enhance health and safety. One commenter recommended that MSHA adopt OSHA's provision, which simply requires employees or their representatives to be afforded an opportunity to observe noise measurements.

The Agency concludes that miners and miners' representatives need time to make necessary preparations to exercise their right to observe monitoring, and that notification is necessary to achieve this goal. Notification may be needed in order to alert the miner and the miners'

representative of the need to come to the mine on an off-shift, or to arrive early at the mine to observe field calibration of instrumentation. Other commenters stated that providing prior notice compromises integrity and the ability of the mine operator to inspect for safety or conduct health surveys for the benefit of workers. Because miners and their representatives will only be observing monitoring and not actually conducting monitoring, prior notice will not compromise the integrity of the monitoring. Nonetheless, MSHA emphasizes that the exercise of the right to observe monitoring should not interfere with the monitoring process.

Several commenters stated that requiring mine operators to provide prior notification of monitoring would interfere with spot area sampling. Another commenter stated that providing prior notice is not always possible, such as during the introduction of a new piece of equipment or machinery. Several commenters also questioned whether MSHA intended to require mine operators to give prior notice of all operator monitoring and whether miners and their representatives should have the opportunity to observe any and all such monitoring. These commenters suggested that the final rule require that the mine operator provide notice and the opportunity for observation only of a reasonably representative number of such monitoring events.

The final rule does not require prior notice of such activities as spot area sampling or measurement of the sound produced by a new piece of equipment before the equipment is placed into service. Under the final rule, mine operators are required to give prior notice only of monitoring that is conducted to determine whether a miner's noise dose equals or exceeds the action level, or exceeds the permissible exposure level or the dual hearing protection level.

Additionally, paragraph (c) of this section of the final rule, like the proposal, does not specify a required method of notification. One commenter supported the provision because of its flexibility with respect to such notification. Another commenter stated that for notice to be unambiguous it must be in writing and either mailed or posted on the mine bulletin board. Several commenters also questioned what would constitute adequate prior notice. For example, one commenter supported requiring prior notice but stated that the notice should be given at least five days in advance so that miners and their representatives had sufficient time to prepare to observe. Several

commenters, on the other hand, stated that requiring five days' written notice would be extremely restrictive and would reduce the flexibility of the vast majority of mine operators to adjust to a changing work environment.

MSHA agrees with these commenters, and the final rule, like the proposal, requires prior notice to miners and their representatives but does not specify how this notice is to be given. The Agency considers "prior notice" under the final rule to be a reasonable amount of time which is practical under the circumstances to allow miners and their representatives to exercise the opportunity to observe monitoring. Under the final rule, the operator may use any method of notification—including oral, written, and posted notification—which effectively informs miners and their representatives of intended monitoring. For example, some mine operators may use informal talks as an effective means of keeping miners informed on a day-to-day basis. Other mine operators may elect to inform miners in writing to avoid confusion and to demonstrate compliance. Finally, some mine operators may elect posting because miners know where the bulletin board is located and because posting is an accepted and well established method of disseminating information at mine sites. Any of these methods would be an effective means of providing the notification required under the final rule. Therefore, this provision is adopted as proposed.

Miner Notification

Paragraph (d) of § 62.110, like § 62.120(f)(2) of the proposal, requires notification when a miner's noise exposure equals or exceeds the action level or exceeds the permissible exposure level or the dual hearing protection level. Whenever a miner's exposure is determined to exceed any of the levels established in §§ 62.120, 62.130, or 62.140 of this part, based on exposure evaluations conducted either by the mine operator or by MSHA, and the miner has not received notification of exposure at such level within the prior 12 months, the mine operator must notify the miner in writing within 15 calendar days of the exposure determination and of the corrective action being taken. The mine operator must maintain a copy of any such miner notification, or a list on which the relevant information about that miner's notification is recorded, for the duration of the affected miner's exposure at or above the action level and for at least 6 months thereafter.

The notification requirement in the final rule is consistent with section 103(c) of the Mine Act, which states in pertinent part:

Each operator shall promptly notify any miner who has been or is being exposed to * * * harmful physical agents * * * at levels which exceed those prescribed by an applicable mandatory health or safety standard promulgated under section 101 * * * and shall inform the miner who is being thus exposed of the corrective action being taken.

Several commenters supported the requirement for written notification and requested that MSHA also require written notification to the miners' representative. Other commenters suggested that the required written notification also be submitted to MSHA. One commenter believed that notification should not be required if all miners are enrolled in a hearing conservation program. A number of other commenters questioned the need to notify affected miners in writing. Some of these commenters stated that posting the exposure determination results would be sufficient notification for the affected miner and any other miners working in the area. Other commenters believed that the mine operator should be able to choose any method of notification as long as the miner received the required notice. One commenter supported the notification requirement, and suggested including a statement concerning the mandatory use of hearing protectors, if appropriate.

The notification provided for in this paragraph is required under section 103(c) of the Mine Act. In addition, MSHA has determined that such notification is an integral part of the protection afforded to miners whose noise exposures may be injurious to their hearing. The Agency also believes that in order to ensure that all affected miners are properly notified and informed of the additional precautions necessary to protect their hearing, such notification must be in writing and must be recorded. Noise exposures at or above the action level present a significant risk of material impairment (as discussed under Part V of this preamble, *Material Impairment*). Miners must be notified when their noise exposures are at or above the action level because of this risk, and also because such exposures trigger specific corrective actions by the mine operator under the final rule—training miners, providing miners with hearing protectors, and offering miners audiometric testing. Notification alerts miners of the need to conscientiously wear their hearing protectors and may also provide some additional incentive

for participation in the voluntary audiometric testing program.

MSHA has also concluded, and the final rule reflects, that the notification should be in writing. This ensures that the miner understands the exposure determination and the corrective actions being taken.

Several commenters agreed with the approach taken by the proposal that would make notification unnecessary if the mine operator had already notified the affected miner of the exposure level during the past 12 months. One of the primary objectives of notification, as explained above, is to ensure that miners are aware of the importance of taking the additional precautions to protect their hearing. If a miner's noise exposure has not changed, there would be no additional benefit to be gained by repeated notification. In any case, annual retraining is required for those miners whose noise exposures continue to equal or exceed the action level.

Many commenters took issue with the proposed time frame of 15 calendar days for mine operators to notify a miner in writing that the miner's noise exposure exceeded any limit prescribed in proposed § 62.120. Most of the commenters believed that the 15-day time frame was too restrictive and suggested that this period be extended. Among the reasons given in support for this suggestion were delays in obtaining exposure reports from consultants and employee vacations. Commenters recommended time frames for notification that ranged from 15 to 60 days. A few recommended that the mine operator be allowed to determine the appropriate time frame. One commenter, however, suggested that the time allowed for notification be reduced to 24 hours for exposure determinations and 7 days for reporting the mine operator's plan of corrective actions to reduce the noise exposure. One commenter was opposed to the notification requirement, because OSHA's noise standard lacks this provision.

MSHA believes that timely notification is an important first step in protecting miners from excessive noise exposure. The final rule therefore adopts the proposed requirement that the mine operator notify the miner within 15 calendar days of any noise exposure that equals or exceeds the action level or exceeds the permissible exposure level or the dual hearing protection level. The 15-day time frame is adopted from the proposal based on MSHA's determination that 15 days affords the mine operator sufficient time to provide this notification. This determination takes into account the

fact that administrative delays may arise, but balances these delays against the need for miners to be alerted promptly of potentially harmful noise exposures, and to be informed of the steps that are being taken to remedy the situation.

The proposal would have required that records of required notification be maintained at the mine site. Several commenters requested that the final rule allow the required records to be maintained at a central location, such as a corporate office, to ease the burden of managing the records of multiple mine sites. Commenters also stated that they believed this would make it easier for MSHA to review the required records for these sites.

As stated in Part III of this preamble, MSHA agrees with the points made by these commenters, particularly in light of the fact that electronic records are common in the mining industry, and that many or all of a mine's records may be stored on computer at a centralized location. The final rule therefore does not adopt the proposed requirement that these records be maintained at the mine site, and does not specify a location where the records must be maintained. However, the records must be stored in a location that will allow the mine operator to produce them for an MSHA inspector within a relatively short period of time, which in most cases will be no longer than one business day.

Commenters also presented their views on record retention. Under the proposal, records of miner notification would have been required to be retained for the duration of the miner's exposure above the action level and for 6 months thereafter. A few commenters believed a requirement for record retention was unnecessary. Other commenters believed the records should be maintained for longer than 6 months beyond the duration of exposure. The recommended record retention time ranged up to 40 years. Several commenters believed the exposure records should be treated as medical records. Another commenter believed the exposure records should be retained for at least the duration of the affected miner's employment.

MSHA has concluded, and the final rule reflects, that it is sufficient for the mine operator to retain exposure notification records for the duration of the miner's exposure at or above the action level and for at least 6 months thereafter. The retention period provided for by the final rule calls for records to be retained for a relatively short period of time after cessation of exposure at or above the action level, minimizing the recordkeeping burden

on mine operators. The extended record retention periods recommended by some commenters would be appropriate if the records were to be used for epidemiological purposes. However, the records required to be maintained under this section of the final rule are not the type of dose determinations that would be suitable for epidemiological analysis. Additionally, unlike the effects of exposure to carcinogens, hearing loss due to noise exposure manifests itself shortly after the exposure. The effects of exposure to carcinogens may not be seen until years after exposure. Requiring the retention of noise exposure records for many years therefore serves no purpose. The final rule therefore does not adopt this comment.

Warning Signs

The proposed rule did not include any requirements for the posting of warning signs at mines to alert miners of noise hazards that may be present. In the preamble to the proposed rule, MSHA acknowledged the possible value of warning signs but concluded that the constantly changing mining environment presents significant obstacles to effective posting. MSHA therefore determined that the miner training requirements of the final rule will ensure that miners are sufficiently informed of the noise hazards to which they may be exposed.

Although MSHA did not solicit comments in the proposed preamble on warning signs, several commenters did express their opinions on this issue. Some commenters believed the warning signs should be required, other commenters believed posting signs is appropriate only where hearing protectors must be worn. Several other commenters believed that posted warning signs were not effective because they were ignored.

MSHA continues to conclude that the posting of warning signs should be optional and is best left to the discretion of the operator. As stated in the proposed preamble, MSHA expects that many mine operators will voluntarily post signs to indicate areas of the mine where hearing protectors should be worn.

Section 62.120 Action Level

Like the proposal, § 62.120 of the final rule requires mine operators to take certain actions when a miner's noise exposure equals or exceeds an 8-hour time-weighted average of 85 dBA during any work shift. Under proposed § 62.120(b)(1) and (b)(2), mine operators would have been required to provide training to a miner exposed above the

action level, provide hearing protection to such miner, and enroll the miner in a hearing conservation program that included audiometric testing.

Under the final rule, the mine operator is required to enroll a miner in a hearing conservation program that complies with § 62.150, which consolidates the elements of a hearing conservation program into a single section. These elements include a system of monitoring that complies with § 62.110; the use of hearing protectors under § 62.160; audiometric testing under §§ 62.170 through 62.175; training under § 62.180; and recordkeeping under § 62.190. Although the language of the final rule differs from that of the proposal, the requirements are essentially the same. This reorganization of the rule was made in response to commenters who recommended that the final rule take a more traditional approach to the hearing conservation program. This issue is discussed in greater detail under § 62.150 of the preamble.

The final rule requires that the mine operator enroll a miner in a hearing conservation program if, during any work shift, the miner's noise exposure equals or exceeds a TWA₈ of 85 dBA or, equivalently, a dose of 50%. Like the proposal, the final rule requires that all sound levels from 80 dBA to at least 130 dBA be integrated into the noise exposure determination for the action level. This integration range requirement is identical to the one in OSHA's noise standard. Sound levels below the 80-dBA threshold are not integrated into the noise exposure measurement. It should be noted that a noise dose determination for the permissible exposure level requires the use of a 90-dBA threshold. In practice, when a noise exposure measurement is performed, either two separate noise dosimeters (one set for an 80-dBA threshold for the action level, and one set for a 90-dBA threshold for the permissible exposure level), or a single dosimeter with dual threshold capabilities would be required.

The final rule clarifies that the mine operator must enroll a miner in a hearing conservation program if during any work shift the miner's exposure equals or exceeds the action level. The proposal would have provided that the mine operator take action if the miner's exposure exceeded the action level. A number of commenters recommended this clarification to ensure that the final rule was consistent with OSHA's noise standard. The final rule has been revised accordingly.

Many commenters supported the concept of an action level but wanted

MSHA to be consistent with the requirements of OSHA's noise standard. In particular, the commenters supported the proposed requirement for taking initial protective action at the level of 85 dBA, and the threshold of 80 dBA for integrating all sound levels when computing the action level. These commenters stated that the 85-dBA action level and 80-dBA threshold were more protective of miners and based on the best available scientific information, and were also compatible with OSHA's noise standard.

However, a number of commenters were opposed to the proposed establishment of an action level. Several commenters questioned the appropriate action level, stating that the level should be set at a TWA₈ of 90 dBA. Some of these commenters believed that noise control technology for complying with an action level of a TWA₈ of 85 dBA is not available, and that an allowance for the use of hearing protectors should be made when determining compliance with the action level.

MSHA's determination that it is necessary to establish an action level in the final rule is based on several considerations. The first and most important of these factors is that MSHA's review of the scientific literature and Agency risk data, coupled with the comments submitted under this rulemaking, indicates that there is a significant risk of material impairment to miners from a lifetime of exposure to noise at a TWA₈ of 85 dBA, as discussed in the preamble section on material impairment. For that reason, miners need to be protected from noise exposures at or above this level. However, as explained in greater detail under the preamble discussion of the permissible exposure level, the Agency has determined that it is not feasible at this time for the mining industry to comply with a lower permissible exposure level. The issue of risk to miners is discussed in greater detail under the material impairment section of this preamble.

MSHA has nonetheless concluded that it is necessary to provide miners with protection at this level in order to reduce instances of new hearing loss and to prevent the progression of existing hearing loss. Agency data reveal that a miner's risk of developing a significant hearing loss drops by approximately half under the new action level requirements of the final rule.

As stated above, the hearing conservation program in which miners are enrolled under the final rule must comply with § 62.150, and must address the use of hearing protectors, provide

miners with audiometric testing, and provide effective monitoring of their noise exposures. Although some commenters disputed the effectiveness of hearing conservation programs, MSHA has reviewed the research concerning such programs, especially the OSHA hearing conservation program, and has determined that hearing conservation programs are effective in protecting workers.

Under the final rule, a miner who is exposed to noise at or above the action level must, as part of the enrollment in a hearing conservation program, receive specialized training that addresses the hazards of noise and protective methods. Specific topics that must be addressed by this training include the effects of noise on hearing, the purpose and value of wearing hearing protectors, and the mine operator's and miner's respective tasks in maintaining noise controls.

Additionally, a miner who is enrolled in a hearing conservation program must be provided with properly fitted hearing protectors and receive training on their use. Although MSHA has concluded that the difficulty in determining the noise reduction provided by a given hearing protector makes it inappropriate to adjust a dose determination on that basis, hearing protectors can serve as an effective means of protecting miners from the hazards of excessive noise.

Miners enrolled in a hearing conservation program must also be offered annual audiograms at no cost. Annual audiometric testing will enable mine operators and miners to take protective measures in response to identified early hearing loss, and enable the prevention of further deterioration of hearing.

As discussed in the preamble to the proposed rule, a number of studies have addressed the effectiveness of hearing conservation programs in preventing hearing loss. Many of the studies indicate that a hearing conservation program can be effective in reducing and controlling noise-induced hearing loss, but only if management and employees strictly follow the program requirements.

MSHA has therefore concluded that enrollment in a hearing conservation program for miners whose noise exposure equals or exceeds the action level can protect miners from occupational hearing loss. Consistent with this determination, the final rule requires these miners to be enrolled in such a program. However, as stated above, the effectiveness of the program in protecting miners depends on the commitment of mine operators and

miners to conscientious compliance with the requirements of the program.

MSHA agrees with the commenters who stated that noise control technology may not always be available to reduce the noise exposure below the action level. The lack of available technology was one of the bases for MSHA's determination that a permissible exposure level of a TWA_8 of 85 dBA is not feasible for the mining industry at this time. Consistent with that determination, the final rule does not require that noise controls be implemented to reduce miners' noise exposures to the action level. Instead, mine operators are required to enroll miners in a hearing conservation program if the miners' exposures reaches the action level.

Some commenters stated that the proposed action level requirement would create unnecessary paperwork and cost burdens for mine operators. MSHA has evaluated all of the paperwork provisions in the final rule and has chosen the alternatives which impose minimal paperwork burdens on the industry. Although the final rule does eliminate some existing paperwork requirements, MSHA believes that the remaining paperwork provisions in the final rule are necessary for improving protection for miners.

Many commenters supported the proposed integration of all sound levels from 80 dBA to at least 130 dBA when computing the action level. They stated that this was consistent with OSHA's noise standard, would be more protective of miners, and would allow resources to be directed at the worst exposures. Other commenters opposed the proposed integration range of 80 dBA to 130 dBA, stating that it would unnecessarily inflate the calculated noise dose and dramatically increase the time-weighted average daily exposure dose. Based on a review of the entire record, the final rule reflects the proposed integration range of 80 dBA to at least 130 dBA as appropriate for protecting miners from experiencing additional hearing impairment.

MSHA notes that the requirements in § 62.110(b) of the final rule, which apply to miners' dose determinations, must be complied with when a noise exposure assessment is conducted for the action level. This means that, in addition to integrating all sound levels over the appropriate range, the determination must be made without adjustment for hearing protectors; must reflect the miner's full work shift; must use a 90-dB criterion level and a 5-dB exchange rate; and use the A-weighting and slow response instrument settings.

The requirements in proposed § 62.120(b)(2) that the mine operator provide hearing protectors to the affected miners and ensure their use, if it would take more than 6 months to conduct the baseline audiogram or if a miner is determined to have incurred a standard threshold shift, have been adopted in § 62.160(c)(1) and (c)(2) of the final rule.

Additionally, as indicated under § 62.160 of the preamble, proposed § 62.120(b)(3), which would have required that the mine operator provide any miner who has been exposed to noise above the action level with hearing protectors upon request, is not specifically adopted in the final rule. Because the final rule requires that such a miner be enrolled in a hearing conservation program, which must include the provision of hearing protectors under § 62.160 of the final rule, the adoption of the proposed requirement is unnecessary.

Section 62.130 Permissible Exposure Level (PEL)

Section 62.130(a) of the final rule adopts proposed § 62.130(c) and establishes a permissible exposure level of an 8-hour time-weighted average (TWA_8) of 90 dBA, which represents no substantive change from the existing standards. Under the final rule, a TWA_8 of 90 dBA is equivalent to a dose of 100%. The final rule provides that no miner be exposed during any work shift to noise that exceeds the permissible exposure level. Paragraph (a) also provides that if during any work shift a miner's noise exposure exceeds the permissible exposure level, the mine operator must use all feasible engineering and administrative controls to reduce the miner's noise exposure to the permissible level, and enroll the miner in a hearing conservation program.

Under the current metal and nonmetal noise standard, feasible engineering or administrative controls are required to be used when a miner's noise exposure exceeds the permissible exposure level. The noise reduction provided by a hearing protector is not considered in determining a miner's exposure at metal and nonmetal mines. Under the current coal noise standard, feasible engineering and/or administrative controls are required to be used when a miner's exposure exceeds the permissible exposure level.

Unlike the metal and nonmetal standard, however, the coal standard states that required controls may include hearing protectors in specific circumstances. Credit is also given at coal mines for the noise reduction value

of hearing protectors in determining a miner's noise exposure.

The final rule specifies that mine operators must integrate sound levels from 90 dBA to at least 140 dBA. MSHA proposed integrating sound levels between 80 dBA and 130 dBA into the permissible exposure level, but stated in the proposed preamble that MSHA was not recommending a lower permissible exposure level, since it would be infeasible for the mining industry. However, in evaluating and reviewing the rulemaking record, MSHA has concluded that lowering the threshold of sound levels integrated into the permissible exposure level determination for purposes of measuring a miner's noise exposure would in fact result in a lower permissible exposure level, something that the Agency did not intend. The final provision is therefore less restrictive than the proposed provision would have been, but is consistent with MSHA's findings on feasibility.

The final rule requires that mine operators use all feasible engineering and administrative noise controls to bring miners' noise exposures within permissible levels. Mine operators must provide miners with hearing protectors and ensure that the protectors are properly used if engineering and administrative controls fail to reduce exposure to the permissible exposure level.

Unlike the enforcement policy at metal and nonmetal mines, current coal enforcement policy allows mine inspectors to subtract the estimated noise reduction provided by hearing protectors when determining a miner's noise exposure. When a coal mine operator does receive a citation for a miner's exposure exceeding the permissible exposure level, the operator must promptly institute engineering or administrative controls, or both. Within 60 days of receipt of the citation, the mine operator must submit to MSHA a plan for the administration of a continuing, effective hearing conservation program, which includes provisions for reducing environmental sound levels to achieve compliance, providing hearing protectors, and pre-employment and periodic audiograms.

The final rule now requires that mine operators in both the coal sector and metal and nonmetal sectors use all feasible engineering and administrative controls to reduce a miner's noise exposure to the permissible exposure level. The final rule does not place preference on the use of engineering controls over administrative controls. MSHA intends for mine operators to have a choice of which type of control

they use, as long as mine operators use all feasible controls necessary to bring a miner's exposure to within the permissible exposure level.

Section 62.130(a) of the final rule also requires that if a miner's noise exposure exceeds the permissible exposure level, the mine operator must enroll the miner in a hearing conservation program that complies with § 62.150 of the final rule. Implementation of a hearing conservation program is a new requirement for metal and nonmetal mine operators and for some coal mine operators.

The final rule adopts the proposed requirement for mine operators who use administrative controls. Those mine operators must now post procedures for such controls on the mine bulletin board and provide a copy of the procedures to each affected miner.

Paragraph (b) of § 62.130 of the final rule, like the proposal, provides that if feasible engineering and administrative controls fail to reduce a miner's exposure to the permissible exposure level, the mine operator must continue to use all engineering and administrative controls to reduce the miner's exposure to as low a level as is feasible.

The proposed rule would have also required that the mine operator ensure that a miner exposed above the permissible exposure level submit to the audiometric testing provided as part of the hearing conservation program. The final rule, however, does not adopt this provision. Further discussion of this issue is provided under § 62.170, addressing audiometric testing.

Section 62.130(c) of the final rule adopts the proposed provision that at no time must a miner be exposed to sound levels exceeding 115 dBA, and also clarifies that the sound level must be determined without adjustment for the use of hearing protectors.

Finally, proposed § 62.120(d), which addressed the dual hearing protection level, has been moved to § 62.140 of the final rule.

Section 62.130 of the final rule establishes a permissible exposure level of a TWA₈ of 90 dBA, which represents no substantive change from existing MSHA standards. The permissible exposure level is the maximum time-weighted average sound level to which a miner may be exposed. The exposure needed to reach the permissible exposure level varies by sound level and duration. For example, a miner's exposure would reach the permissible exposure level if the miner is exposed to a sound level of 90 dBA for 8 hours or to a sound level of 95 dBA for only 4 hours.

A number of commenters favored a permissible exposure level of a TWA₈ of 85 dBA, stating that because a significant risk of impairment occurs at this level, miners need greater protection. MSHA gave serious consideration to establishing a lower permissible exposure level, including a reduced exchange rate, based on its determination that there is a significant risk to miners of a material impairment of health when noise exposures equal or exceed a TWA₈ of 85 dBA. MSHA has concluded, however, that it is infeasible at this time for the mining industry to achieve a more protective level by using engineering and administrative controls. Therefore, under the final rule, MSHA continues to require a permissible exposure level of a TWA₈ of 90 dBA, but miner protection is increased from that provided under existing MSHA noise standards by requiring that mine operators take protective measures at an action level of a TWA₈ of 85 dBA.

Some commenters believe that MSHA did not adequately justify that a permissible exposure level of a TWA₈ of 85 dBA was technologically and economically infeasible. Also, one commenter objected to considering economic infeasibility in the rationale for not reducing the permissible exposure level to a TWA₈ of 85 dBA. Section 101(a)(6)(A) of the Mine Act directs that the Secretary's rulemaking authority be exercised within the boundaries of feasibility, and, as discussed in the preamble to the proposal, MSHA considered both technological capabilities and the economic impact of a lower permissible exposure level. MSHA made a preliminary determination, set forth in the preamble to the proposal, that a lower permissible exposure level was not feasible. MSHA also requested that commenters submit relevant additional data on this issue but did not receive adequate supporting data in response to this request.

Regarding the feasibility of a TWA₈ of 85 dBA, MSHA has found that a typical mine operator will not be able to develop and install engineering controls at this time which will meet a permissible exposure level lower than a TWA₈ of 90 dBA. The Agency's finding is based on the large number of mines which would require engineering and administrative controls to reduce current exposures and on an evaluation of noise control technology under actual mining conditions, including retrofitting equipment, and the cost of implementing such controls. As stated in the preamble to the proposed rule, MSHA conducted a survey of noise exposures in the mining industry to

assess the capability of the industry to comply with a permissible exposure level lower than the current TWA_8 of 90 dBA through the use of engineering and administrative controls. The survey is referenced as the "dual-threshold survey" in the section that addresses material impairment in this preamble. Exposure data collected by MSHA indicated that with a permissible exposure level of a TWA_8 of 85 dBA and an 80-dBA threshold, over two-thirds of the metal and nonmetal mining industry and over three-quarters of the coal mining industry would need to use engineering and administrative controls to reduce current exposures (see Tables 11 and 12 in Part V of this preamble).

A typical mine operator would not be able to develop and install engineering controls at this time which would result in compliance with a permissible exposure level lower than a TWA_8 of 90 dBA. Although the discussion of feasibility in this preamble references control rooms and booths and acoustically treated cabs as being capable of reducing exposures to below 85 dBA, MSHA has found that, for the most part, sound levels for most mining equipment cannot be reduced to that extent using engineering controls. This includes consideration of retrofit noise control technology to achieve 85 dBA or less which is not available for the majority of mining equipment without major redesign of the equipment. The Agency's finding is based, in part, on the evaluation of newly developed noise controls under actual mining conditions described in "Summary of Noise Controls for Mining Machinery" (Marraccini et al., 1986). Therefore, the Agency has concluded that a typical mine operator will not be able to develop and install engineering controls at this time that will result in compliance with a permissible exposure level lower than a TWA_8 of 90 dBA.

In addition, the Agency has found that, where available, the cost of implementing controls would be prohibitively expensive, based on the large percentage of mines that would be out of compliance if a lower permissible exposure level were to be adopted. As reflected under the preamble discussion of feasibility, MSHA has determined that retention of the existing permissible exposure level and threshold under the final rule would not result in any incremental costs for engineering controls for the metal and nonmetal sector, but would result in costs of \$1.79 million for engineering controls for the coal sector. Costs would be incurred only by the coal mining sector under the final rule, because hearing protectors have generally been substituted for

engineering controls in coal mines under the current regulations. Thus, unlike the metal and nonmetal mining industry, the coal mining industry has not exhausted the use of feasible engineering and administrative controls to reduce noise exposures to within the permissible exposure level of a TWA_8 of 90 dBA. However, significant costs would be incurred by the entire mining industry if the permissible exposure level were to be reduced to a TWA_8 of 85 dBA and an 80-dBA threshold.

MSHA's "dual-threshold survey" shows that a significant percentage of all mines, which would be out of compliance if a lower permissible exposure level were adopted, would incur costs. Engineering controls that are needed to reduce exposure levels to a TWA_8 of 85 dBA are more costly than those which reduce exposure to a TWA_8 of 90 dBA. MSHA's analysis indicates that where it is available, retrofitting equipment to achieve a permissible exposure level of a TWA_8 of 85 dBA can cost \$15,000 or more per piece of equipment. Remote control in conjunction with a fully-treated, environmentally-controlled operator's booth can cost \$10,000 or more depending on the size of the booth and the extent of technology needed to run the process or equipment remotely. MSHA has estimated that a permissible exposure level of a TWA_8 of 85 dBA with a 3 dB exchange rate would cost over \$54 million annually just to retrofit equipment. However, retrofitting existing equipment alone would not enable most mines to achieve compliance with a permissible exposure level of 85 dBA as a TWA_8 . For some of these mines, capital equipment would need to be replaced by quieter equipment capable of meeting the lower 85 dBA level, but the cost would be enormous. For example, where new equipment exists, depending on its size, costs range from approximately \$260,000 to \$360,000 for single boom drills with fully treated operator cabs, to approximately \$2,000,000 for a 240 ton haul truck with a fully treated operator cab. However, as previously noted, for many types of capital equipment, no compliant replacement equipment currently exists. Because most mines could not fully meet a lower permissible exposure level using currently available technology, the Agency has determined that a lower permissible exposure level would not be feasible at this time. Accordingly, the Agency is adopting the existing permissible exposure level of a TWA_8 of 90 dBA, but is also requiring hearing conservation measures when the exposure reaches a TWA_8 of 85 dBA.

Another commenter suggested that a long phase-in period, such as 10 years, be adopted for a permissible exposure level of a TWA_8 of 85 dBA. In considering the technological and economic impact of a new standard, MSHA must make a reasonable prediction, based on the best available evidence, as to whether the mining industry can generally comply with the rule within an allotted period of time. MSHA seriously considered establishing a permissible exposure level of a TWA_8 of 85 dBA in conjunction with an extended phase-in schedule for compliance. However, the Agency could not project, with any reasonable certainty, when the mining industry would be capable of developing and installing the necessary control technology to meet such a permissible exposure level. In the preamble to the proposal, MSHA made no assumptions about the development of new technologies to further assist mine operators in controlling noise. The Agency requested commenters to provide information but received none. Although enforcement of the final rule requires that individual mine operators only use those controls which are feasible for the particular mine operator, MSHA is unable to demonstrate a reasonable probability that the mining industry as a whole would be able to comply, even with a long phase-in period.

Several commenters wanted MSHA to adjust the permissible exposure level of a TWA_8 of 90 dBA for those miners working extended work shifts, and one commenter believed that it was important to include extended work shifts in the definition of the permissible exposure level. The final rule requires mine operators to determine a miner's noise exposure for the full work shift, regardless of length of time the miner works on the shift. MSHA acknowledges that extended work shifts are becoming a more common practice in the mining industry and intends for miners working on these shifts to receive the full protection of the final rule. Sampling for a full shift is consistent with the OSHA standard as well as current noise regulations for both coal and metal and nonmetal mines.

Section 62.130(a) of the final rule differs from the proposal in that a miner's exposure determination for comparison to the permissible exposure level requires the integration of all sound levels from 90 to at least 140 dBA. The proposal would have required integration of sound levels from 80 to at least 130 dBA. Several commenters to the proposed standard brought to

MSHA's attention that the proposed range of sound integration would result in a lower permissible exposure level for the mining industry, an unintended result of the rule, discussed earlier. Moreover, the final rule's adoption of the proposed 80-dBA threshold for determining whether miners' exposures equal or exceed the action level ensures that miners are afforded protection at or above an exposure of a TWA_8 of 85 dBA.

Section 62.130(a) also requires that when a miner's noise exposure exceeds the permissible exposure level, the mine operator must use all feasible engineering and administrative controls to reduce a miner's exposure to the permissible exposure level before relying on hearing protectors. In addition, mine operators must establish a hearing conservation program for affected miners.

The final rule does not place preference on the use of engineering controls over administrative controls to protect miners exposed above the permissible exposure level. All feasible controls, of both types if necessary, must be implemented to reduce noise exposure to the permissible exposure level, or to the lowest feasible level if the permissible exposure level cannot be achieved. In response to commenters who questioned which controls mine operators must use, MSHA emphasizes that mine operators have a choice of which control method they will use first. Under the final rule, they may use engineering controls, administrative controls, or both; but if administrative controls are utilized, a copy of such procedures must be posted and given to each affected miner. The final rule affords mine operators flexibility in selecting the most appropriate control method applicable under the circumstances.

Although the final rule does not give preference to engineering controls over administrative controls, engineering controls provide a permanent method of modifying the noise source, the noise path, or the environment of the miner exposed to the noise, thereby decreasing the miner's exposure to harmful sound levels. Engineering controls do not depend upon individual performance or human intervention to function. Moreover, the effectiveness of engineering controls can be readily determined using standardized acoustical measurement and assessment procedures. In addition, routine maintenance ensures the long-term effectiveness of engineering controls. Thus, MSHA has concluded that the use of engineering controls provides the

most consistent and reliable protection to miners.

Administrative controls reduce exposure by limiting the amount of time that a miner is exposed to noise through such actions as rotation of miners to areas with lower sound levels, rescheduling of tasks, and modifying work activities. MSHA believes that administrative controls can be as effective as engineering controls and are typically less costly than engineering controls, and MSHA anticipates growing interest in implementation of administrative controls by the mining community. MSHA will make guidance materials pertaining to administrative controls available to the mining community before the effective date of the final rule.

In the proposed preamble, MSHA had requested comment from the mining community on the primacy of engineering and administrative controls. The Agency received a number of comments from the public in support of the primacy of engineering and administrative controls, as well as a number of comments in support of equating personal hearing protectors with controls. These comments are discussed below.

Commenters who favored permitting the use of hearing protectors to meet the permissible exposure level asserted that hearing protectors adequately protect the hearing of miners, are more cost effective, and provide greater noise reduction than engineering controls. In addition, some commenters believe that personal hearing protectors used in conjunction with a hearing conservation program are as effective as engineering and administrative controls.

Other commenters wanted MSHA to permit the use of hearing protectors in lieu of engineering and administrative controls, provided that the noise exposure did not exceed a TWA_8 of 100 dBA. These commenters stressed that this is allowed by OSHA's current enforcement policy.

The OSHA noise standard at 29 CFR § 1910.95 requires employers to use engineering and administrative controls. Under the OSHA noise standard, hearing protectors may be used only to supplement controls. Current OSHA enforcement policy allows employers to rely on personal protective equipment and a hearing conservation program rather than engineering and/or administrative controls when hearing protectors will effectively attenuate the noise to which the employee is exposed to acceptable levels as specified in Tables G-16 or G-16a of the standard. Furthermore, hearing protectors may not reliably be used when employee

exposure levels border on 100 dBA. MSHA's rulemaking record indicates that a number of professional organizations have recommended that OSHA rescind this policy and rely on engineering and administrative controls.

As explained in the preamble discussion of § 62.110 of the final rule, MSHA has decided to adopt the approach of the proposal, which is not to accept personal hearing protectors in lieu of engineering or administrative controls. The Agency's position is supported by its own research on noise reduction values of hearing protectors under actual mining conditions. Additionally, this position is supported by studies referenced in the preamble discussion of § 62.110 that address noise dose determination without adjustment for the use of hearing protectors.

Moreover, promulgating a rule which is consistent with OSHA policy would result in a diminution of safety to miners in the metal and nonmetal sectors of the mining industry. Section 101(a)(9) of the Mine Act requires that no new standard reduce the protection afforded miners by an existing standard. For metal and nonmetal mines, MSHA currently requires the use of engineering or administrative controls to the extent feasible to reduce exposures to the permissible exposure level. Under existing standards if the permissible exposure level cannot be achieved, hearing protectors must be made available to miners. If OSHA's policy were to be adopted into the final rule, the benefits of using feasible engineering and administrative controls would be lost. In addition, OSHA's noise enforcement policy is based on a judicial interpretation of "feasible" as used in the context of OSHA's noise standard which is an established federal standard adopted without rulemaking at the OSH Act's inception under Section 6(a) of the OSH Act rather than the product of a regular OSHA rulemaking under Section 6(b) of the OSH Act.

Under the Mine Act, one of the roles of the National Institute for Occupational Safety and Health (NIOSH) is to advise MSHA in establishing mandatory health and safety standards. While MSHA is aware that NIOSH is seeking to develop an approach that would more accurately adjust the noise reduction ratings of hearing protectors in actual workplace use, the prospects for this remain uncertain. In addition, adjustment methods that are appropriate for general industry may not be appropriate in the mining environment. As explained in the preamble discussion of § 62.110 of the final rule, MSHA has found that hearing protectors provide much less

noise reduction under actual mining conditions than was measured in the laboratory. In many instances, noise reduction was minimal and highly variable, indicating that hearing protector effectiveness cannot be reliably predicted under actual use conditions.

During the rulemaking process, MSHA requested that NIOSH provide its opinion on the hierarchy of noise controls. NIOSH stated in its December 16, 1994, response (NIOSH, 1994) that there are three elements in the hierarchy of effective noise controls:

- (1) Preventing or containing workplace noise at its source;
- (2) Removing the noise by modifying the pathway between the worker and the noise source; and
- (3) Controlling the worker's exposure by providing a barrier between the worker and the noise source.

NIOSH further stated that noise controls must provide reliable, consistent, and adequate levels of protection for each individual worker throughout the life span of the controls, minimize dependence on human intervention, consider all routes of entry (bone and air conduction), and not exacerbate existing health or safety problems or create additional problems of its own.

The conclusions of a report published by the Office of Technology Assessment in 1985, entitled "Preventing Illness and Injury in the Workplace," also support MSHA's position. This report found that health professionals rank engineering controls as the priority means of controlling exposure, followed by administrative controls, with personal protective equipment as a last resort.

In addition, Nilsson et al. (1977) studied hearing loss in shipbuilding workers. The workers were divided into two groups. The first group was exposed to sound levels of 94 dBA, with 95% of the workers using hearing protectors. The second group was exposed to sound levels of 88 dBA, with 90% of workers wearing hearing protectors. Both groups were subjected to impulse noise up to 135 dB.

Despite the fact that the vast majority of the workers in both groups wore hearing protectors, cases of noise-induced hearing loss were common. As exposure durations increased, the amount of noise-induced hearing loss increased, so workers exposed to sound at 94 dBA exhibited more hearing loss than those exposed to 88 dBA. Slightly more than fifty-eight percent of all of the workers had some degree of hearing impairment, only 1.8% of which was caused by factors other than noise. According to the researchers, the

hearing protectors should have reduced the noise by at least 13 dBA. They concluded that reliance on hearing protectors alone is not sufficient to protect the hearing sensitivity of the workers.

Although many commenters may prefer to use hearing protectors in lieu of engineering or administrative controls to protect miners from noise overexposures, MSHA has concluded that the scientific evidence does not support this position, and that the approach taken in the final rule best protects miners from further noise-induced hearing loss.

A few commenters were concerned that the miner would suffer a loss of pay if administrative controls were instituted and the miner was rotated to a lower-paying job. However, the Mine Act does not authorize the Secretary to require pay retention for miners rotated for the purpose of reducing exposure to a harmful physical agent, and the final rule does not adopt that comment.

Paragraph (a) of § 62.130 of the final rule also adopts the requirement of proposed § 62.120(c)(1) that mine operators post on the mine bulletin board the procedures for the administrative controls in effect at the mine and provide all affected miners with a copy. MSHA believes that miners must be specifically notified of the administrative controls being used and actively follow them to achieve effective results. Posting informs miners of critical work practices necessary for reducing their noise exposures, especially when miners are temporarily assigned to a different job. Moreover, this requirement is consistent with section 109 of the Mine Act, which requires a mine operator to have a bulletin board at the mine office or in an obvious place near a mine entrance for posting of certain documents, including notices required by MSHA regulations.

A number of commenters objected to a requirement for written notification of miners of the administrative controls in use at the mine. Some of these commenters were of the opinion that written notification may not be the best method for alerting miners of administrative control procedures, since these procedures may need to be revised on a daily basis. Some commenters suggested that MSHA accept informal workplace talks and safety meetings as compliance with the written notification provision, which they believed would be burdensome for mine operators.

MSHA has reviewed alternative methods for compliance under this provision and has concluded that a notification provision with a narrow

application, such as in the final rule, appropriately informs miners of critical measures to protect their hearing. Moreover, commenters are encouraged to review the summary of the Regulatory Economic Analysis.

Most commenters requested that MSHA clarify the meaning of the term "feasible." Many commenters specifically requested that MSHA include economic considerations in the definition of feasibility. What constitute "feasible" engineering and administrative noise controls is discussed in Part VI of this preamble. As part of that discussion, MSHA cites applicable case law, which specifically provides that a consideration of feasibility must include both technological and economic factors.

Some commenters suggested that "feasible" engineering controls need to be capable of reducing a miner's noise exposure to the permissible exposure level rather than to the lowest level achievable for the control. Others suggested that a control should produce at least a 3-dBA noise reduction before that control is considered "feasible," which corresponds with MSHA's current policy. The applicable case law on this issue provides that an engineering control may be feasible even though it fails to reduce exposure to the permissible level set by the standard, as long as there is a significant reduction in exposure. As stated in the proposed preamble and reiterated in the discussion of feasibility in this preamble, MSHA considers a significant noise reduction to be a 3-dBA reduction in the miner's noise exposure.

Several commenters were concerned about the development and availability of engineering controls, including retrofit packages in the marketplace. Engineering noise controls, including retrofit equipment, are currently available for many types of mining machinery, and many manufacturers sell noise control packages as options. Furthermore, mining equipment manufacturers are diligently developing new engineering controls to reduce exposure to noise. The preamble discussion on feasibility includes a list of available controls for commonly used mining equipment. Suggestions are also included in that section for retrofitting existing mining equipment. MSHA is also available to assist mine operators with obtaining retrofit packages and other necessary controls for reducing noise sources.

Several commenters questioned whether the assumption that engineering controls currently feasible in metal and nonmetal mines could be adapted for use in coal mines. In fact,

MSHA's experience has been that many of the engineering noise controls developed for machinery used in metal and nonmetal mines could be easily used on the same types of machinery in coal mining, and vice versa.

A few commenters requested that MSHA continue to "grandfather" older equipment, as the Agency does at metal and nonmetal mines. Current metal and nonmetal enforcement policy allows a mine operator, upon written request to the District Manager, up to 12 months to retire a piece of machinery once it has been identified as the source of a noise overexposure.

This comment has not been adopted in the final rule. Protection of miners from the harmful effects of noise must be the first consideration. The final rule does not take effect until 12 months after the date of publication, which provides all mine operators with adequate time to retire older, noisy equipment. After the final rule takes effect no exceptions will be allowed for equipment that may be nearing the end of its useful life.

One commenter stated that the final rule should not be technology-forcing. However, Congress intended that MSHA health standards advance technology in order to better protect miners' health. It is therefore appropriate for MSHA to take into account, in determining feasibility, the state-of-the-art engineering that exists in the mining industry at the time the standard is promulgated.

A few commenters suggested that the final rule require mine operators to develop a written plan for eliminating overexposures, so that both miners and MSHA will be aware of the specifics of how a mine operator intends to abate noise overexposures at a particular mine. MSHA does not believe that requiring a written plan under the final rule enhances health protection beyond that afforded by an action level and implementation of all feasible controls. MSHA is also mindful of its responsibilities under section 103(e) of the Mine Act, which cautions the Agency not to impose an unreasonable burden on mine operators, especially those operating small businesses, when requesting information consistent with the underlying purposes of the Mine Act. It should be noted, however, that § 62.110(d) of the final rule requires mine operators to notify a miner whose noise exposure equals or exceeds the action level of the corrective action being taken to address that exposure.

Paragraph (b) of § 62.130 of the final rule, like proposed § 62.120(c)(2)(i), requires that if feasible engineering and administrative controls fail to reduce a

miner's exposure to the permissible exposure level, the mine operator must continue to use the controls to reduce the miner's exposure to as low a level as is feasible.

Section 62.130(c) of the final rule adopts proposed § 62.120(e) and provides that at no time must a miner be exposed to sound levels exceeding 115 dBA. Some commenters found the proposal somewhat confusing, questioning whether there is a complete prohibition against exposure to noise above 115 dBA or whether, under proposed Table 62-1 regarding reference durations, the rule permits a period of exposure to noise above this level that is incorporated into a miner's dose determination. MSHA intends the requirement of this paragraph to be applied as has the existing prohibition in metal and nonmetal regulations that no miner must be exposed to non-impulsive sound levels exceeding 115 dBA. A clarifying notation has been added to Table 62-1 that at no time must any excursion exceed 115 dBA. To avoid confusion, the term "ceiling level," which was used in the proposal, has not been adopted in the final rule. MSHA notes that OSHA's noise standard does not use the term "ceiling level." The preamble to OSHA's noise standard further indicates that OSHA's " * * * current standard does not permit exposures above 115 dB, regardless of duration" (46 FR 4078, 4132). In addition, to be consistent with exposure determinations under § 62.110(b)(2)(i), the final rule clarifies that exposure determinations under this paragraph must be made without adjustment for the use of any hearing protectors.

NIOSH's 1972 criteria document recommended a ceiling limit of 115 dBA. In its 1996 draft Criteria Document, NIOSH reaffirmed its recommendation of a 115 dBA limit. Under this draft recommendation, exposures to sound levels greater than 115 dBA would not be permitted regardless of the duration of the exposure. NIOSH indicated that recent research with animals indicates that the critical level is between 115 and 120 dBA. Below this critical level, the amount of hearing loss is related to the intensity and duration of exposure; but above this critical level, the amount of hearing loss is related only to intensity. MSHA proposed the 115 dBA sound level limit based on these recommendations, and also on the fact that MSHA's noise standard at metal and nonmetal mines currently includes this limit.

Commenters took various positions on whether 115 dBA is the correct level for

maximum exposure. A number of commenters, however, believed that the proposed prohibition of noise exposure above 115 dBA would be too restrictive and unrealistic for the mining industry. Some of these commenters suggested that occasional exposures above this level are unavoidable when performing certain job tasks and that the level should include a specified allowable time limit for these exposures, ranging from 5 to 15 minutes. MSHA is not persuaded by these commenters' concerns. In fact, the 115 dBA limit has been in effect at metal and nonmetal mines for a number of years. Further, the potential damage to miners' hearing when exposed to sound at such levels is so great that it is not unreasonable to expect mine operators to take extra steps to prevent miners' exposures.

It must be emphasized that this provision prohibits exposures above 115 dBA for any duration, not as a time-weighted average. This means that Table 62-1, which includes reference durations of noise exposures at various sound levels, should not be read as allowing excursions above 115 dBA, even though the average over a quarter of an hour would not exceed 115 dBA. However, it should also be noted that MSHA intends to apply this prohibition as it has enforced the same limit under the metal and nonmetal standard. This means that miners may not be exposed to sound levels exceeding 115 dBA as measured using A-weighting and slow response. As a practical matter, there may be some exposure to sound above this level which is of such limited duration that it cannot be measured. Obviously, compliance and enforcement are affected by the limitations of the instrumentation used to measure sound.

Some commenters stated that older mining machinery as well as equipment such as pneumatic tools, jackleg drills, welding machines, and relief valves typically exceed the 115 dBA limit. MSHA is aware that there are noise sources in the mining industry, which may also include unmuffled pneumatic rock drills and hand-held channel burners, that produce sound levels which exceed 115 dBA. However, based on MSHA's experience, practically all of these noise sources can be managed with engineering controls and kept below the sound level of 115 dBA. For example, there is a muffler available for the jackleg drill, and burner tips are available for the hand-held channel burner, that in many cases will lower the sound level to below 115 dBA. Sound from other pneumatic tools can also be muffled.

In addition, mine operators should be aware that significant noise reductions

can be achieved by using alternative equipment, such as the diamond wire saw and water jet, instead of a hand-held channel burner. In the coal mining sector, for example, roof bolting machines have replaced stopers, which are hand-held pneumatic roof drills. The roof bolting machines produce much less noise than the stoper.

Some commenters requested that MSHA permit exposures to exceed 115 dBA when the noise source is a warning signal or an alarm. The Agency does not intend that the 115 dBA sound level limit apply to warning signals or alarms; the ability to hear these signals is critical to the safety of miners. However, alarm and warning signal sound levels must be integrated into the overall noise exposure of miners.

Several commenters objected to enforcing a ceiling level with personal noise dosimeters. They believed that shouting, bumping the microphone, or whistling could give false readings which may be interpreted as exceeding the 115-dBA level. As a practical matter, the fact that the indicator on a personal noise dosimeter shows that the 115-dBA sound level was exceeded does not mean that MSHA will take enforcement action. Rather, the duration of the sound level would need to be sufficient for it to exceed 115 dBA when measured using the slow response on a sound level meter, or on an equivalent type of instrument. This measurement procedure should also serve to eliminate concerns that impulse/impact noise would exceed the 115 dBA limit and result in a citation.

In the preamble to the proposed rule, MSHA requested comments on whether there should be an absolute dose ceiling, regardless of the economic feasibility of control by an individual mine operator. One commenter stated that it would be inappropriate to include a maximum dose ceiling in the final rule without taking feasibility considerations into account. As a result of the lack of scientific consensus on this issue, MSHA has determined that a separate provision for a dose ceiling is unnecessary. The 115-dBA sound level limit, in conjunction with the requirement for dual hearing protectors at a TWA_8 of 105 dBA in § 62.140 of the final rule, adequately protects the hearing sensitivity of miners.

The final rule, like the proposal, does not include a separate provision for impact or impulse noise. Presently, there is insufficient scientific data to support such a standard. MSHA is unaware of any effective sampling methodology for identifying and measuring sound at this level. Since industrial impulse and impact noise are

almost always superimposed on a background of moderate-to-high levels of continuous noise, and since both types of noise may be harmful, MSHA believes that it is only reasonable to consider their effect together, rather than to treat each separately. Accordingly, under the final rule all sounds from 90 dBA to at least 140 dBA are to be included in the range of integration. Impact or impulse noise is therefore considered with continuous noise when determining a miner's noise exposure level.

Section 62.140 Dual Hearing Protection Level

This section of the final rule establishes requirements for the use of dual hearing protection. Included in this section is the requirement that the mine operator must provide and ensure that both an earplug-and an earmuff-type hearing protector are used simultaneously when a miner's noise exposure exceeds the dual hearing protection level of a TWA_8 of 105 dBA, or equivalently, a dose of 800% of that permitted by the standard during any work shift.

Two features of the final rule are slightly different from § 62.120(d) of the proposal. First, explicit language has been added that the dual hearing protector requirement is in addition to the actions required for noise exposure that exceed the permissible exposure level. The preamble discussion of proposed § 62.120(d) reflected this intent. This language has been added to § 62.140 of the final rule for the purpose of clarifying the requirements of this section, which are set forth separately from the section on the permissible exposure level.

In addition, the final rule also includes the range of sound levels, from 90 dBA to at least 140 dBA, which must be integrated in determining a miner's exposure under this section. The range is included in the definition of "dual hearing protection level" in final § 62.101. MSHA had proposed that a miner's noise exposure measurement integrate all sound levels between 80 dBA to at least 130 dBA during the miner's full work shift. MSHA decided, however, not to lower the range of integrated sound levels for a miner's dose determination under § 62.130 of the final rule regarding the permissible exposure level (see discussion of § 62.130). The dual hearing protection requirement of § 62.140 is directly related to § 62.130, in that it requires dual hearing protection in addition to engineering and administrative controls. A more detailed explanation of the range of integration is provided in the

preamble discussion on § 62.110(b)(2)(ii), regarding noise exposure assessment.

The proposed dual hearing protection requirement generated many comments. The proposal was favored by some commenters, and a few who favored the use of dual hearing protection also suggested that MSHA reduce the dual hearing protection level to 100 dBA. Most commenters who opposed the proposal suggested that a single hearing protector with a sufficient noise reduction rating can attenuate sound levels and reduce miner exposures below the permissible exposure level. One commenter believed that MSHA should replace the proposal with performance-oriented language which would require the use of "adequate" hearing protection. Also, one commenter questioned the adequacy of the scientific studies upon which MSHA based the proposed requirement.

MSHA is adopting the proposed dual hearing protection requirement because the scientific evidence shows that the additional noise reduction that is gained by the use of dual hearing protection will protect the hearing sensitivity of miners who are exposed to high sound levels. In addition, the scientific evidence supports MSHA's conviction that a TWA_8 of 105 dBA (800%) is an appropriate level above which dual hearing protection should be required, since this level of noise exposure can quickly damage the hearing sensitivity of the exposed miner. MSHA is also relying upon the research which shows that a single hearing protector may not adequately protect workers whose noise exposures exceed a TWA_8 of 105 dBA.

The research discussed in the preamble to the proposal (Berger, 1984; Berger, 1986; and Nixon and Berger, 1991) shows that dual hearing protectors provide significantly greater protection than a single hearing protector and is effective for protecting workers above a TWA_8 of 105 dBA.

For example, Berger, in EARLOG 13 (1984), has shown that the use of dual hearing protectors provides greater noise reduction, on the order of at least 5 dB greater than the reduction of either hearing protector alone. Berger recommends dual hearing protectors whenever the TWA_8 exceeds 105 dBA. In addition, Nixon and Berger (1991) report that earplugs worn in combination with earmuffs or helmets typically provided more attenuation than either hearing protector alone.

The use of dual hearing protection is also required by the U.S. armed services when workers are exposed to high sound levels. Additionally, MSHA's policy under the existing standards for

coal, metal, and nonmetal sectors requires the use of dual hearing protectors whenever the noise reduction of a single hearing protector does not reduce the miner's noise exposure to within the permissible exposure level. Current metal and nonmetal policy indicates the need to consider dual hearing protection specifically at sound levels exceeding 105 dBA where hand-held percussive drills are used. Also, dual hearing protection is recommended by policy where hand-held channel burners and jumbo drills are used, but no sound level is specified at which such protection should be used.

Regarding the commenters who supported the requirement for dual hearing protection, but requested that MSHA reduce the dual hearing protection level to a TWA_8 of 100 dBA, the Agency does not believe that there is adequate scientific evidence to support lowering the proposed level. Rather, the Agency is relying upon the scientific studies noted above which recommend dual hearing protectors whenever the TWA_8 exceeds 105 dBA.

With respect to the use of canal cap-type hearing protectors under this paragraph of the final rule, MSHA notes that it considers a canal cap-type hearing protector to be neither an earplug-type or earmuff-type hearing protector. A canal cap hearing protector is an acceptable single-type hearing protector but cannot be combined with either a plug-type or muff-type protector, because a proper seal or fit cannot be achieved. Therefore, the Agency intends that a canal cap-type hearing protector may not be used for compliance with the dual hearing protector requirements of this paragraph.

Several commenters believed that the proposed dual hearing protection requirement created a safety hazard because the hearing protectors would prevent a miner from hearing warning signals, audible alarms, verbal communication, and roof talk. MSHA believes that the use of dual hearing protectors would not create an additional safety hazard because the high sound levels generated by some mining equipment will interfere with the detection of roof talk, verbal communications, and audible alarms. In fact, research by Prout, 1973, discussed under § 62.160 of the preamble, shows that the noise emitted by mining equipment operating in close proximity to a miner's assigned work area masks roof talk. Moreover, if hearing protectors are not worn, a temporary threshold shift will impair a miner's ability to hear roof talk, verbal communications, or warning signals when the mining

equipment ceases to operate. Because the use of dual hearing protectors will minimize the extent of any temporary threshold shift experienced during exposure to high sound levels, MSHA expects that the dual hearing protection will be used in high sound level environments and removed in quiet environments. This procedure would enhance safety.

A few commenters who opposed the proposal for dual hearing protection were concerned that the use of earmuffs may interfere with the use of other personal protective equipment such as hard hats, safety glasses, and welding shields. MSHA believes that the proper selection and combination of hearing protectors should alleviate this concern. For example, newer models of ear muffs, which are readily available, are specifically designed to be used with hard hats. Other models which were specifically designed for use with safety glasses or welding shields are also readily available.

In response to the commenter who expressed a concern regarding compliance with this section under the circumstances where a medical condition would preclude the use of a hearing protector, MSHA notes that the dual hearing protection requirement of this section must be provided in accordance with § 62.160. Section 62.160(a)(5) allows the miner to choose a different hearing protector if wearing the selected hearing protectors is subsequently precluded due to a medical pathology of the ear.

Section 62.150 Hearing Conservation Program

Under the proposed rule, the individual elements of a hearing conservation program were located in several separate sections. "Hearing conservation program" was defined in § 62.110 of the proposal as a "generic reference" to the requirements in proposed §§ 62.140 through 62.190, which addressed audiometric testing requirements and miner notification and reporting requirements.

In the interest of clarity and in response to commenters, this section consolidates the elements of a hearing conservation program in one location in the final rule, rendering a definition of "hearing conservation program" unnecessary, and the proposed definition has therefore not been adopted in the final rule. In addition to the elements referenced in the proposed definition of "hearing conservation program," this section also includes as program elements a system of monitoring under § 62.110, the use of hearing protectors under § 62.160, miner

training under § 62.180, and recordkeeping under § 62.190. This new section is consistent with OSHA's definition of a hearing conservation program.

MSHA received a number of general comments on specific elements that commenters believed should be included in any hearing conservation program. MSHA also received many comments on specific requirements that were proposed for each of those elements, such as appropriate audiometric test procedures and the use and maintenance of hearing protectors. Comments addressing the elements that should be included in a hearing conservation program are discussed under this section of the preamble. Comments which address the specific requirements for each program element are discussed under the section where the specific requirements are located. For example, a comment that addresses the role of hearing protectors in a hearing conservation program is discussed here, while a comment dealing with fitting of hearing protectors is discussed in the preamble under § 62.160.

None of the commenters supported MSHA's proposed definition of "hearing conservation program." Some commenters pointed out that the proposed definition constituted an audiometric testing program only, not a hearing conservation program. These commenters recommended that the use of hearing protectors should also be included. A number of commenters recommended that MSHA adopt the traditional definition of a hearing conservation program used by OSHA, stating that any other definition would be confusing. These commenters stated that the term "hearing conservation program" has been used in general industry since the 1970's to refer to a comprehensive package of actions, including noise exposure monitoring, noise controls, hearing evaluation and protection, training, and recordkeeping.

MSHA agrees with the commenters who believed that the proposed definition of "hearing conservation program" was too narrow and that adoption of a definition that was similar in scope to OSHA's would avoid unnecessary confusion. Accordingly, the elements identified for inclusion in a hearing conservation program under this section of the final rule are, with one exception, consistent with OSHA's definition of "hearing conservation program."

Like OSHA's noise standard, MSHA's final rule does not include the use of engineering and administrative controls as an element of a hearing conservation

program. However, § 62.130 of the final rule requires the implementation of all feasible engineering and administrative noise controls whenever a miner's noise exposure exceeds the permissible exposure level. Therefore, although a "hearing conservation program" under the final rule does not specifically include the use of engineering and administrative controls, the application of such controls is required to remedy miner overexposure. MSHA regards an effective hearing conservation program as a supplement to the first line of defense against noise overexposures, which is the implementation of all feasible engineering and administrative noise controls.

This section of the final rule provides that, when a miner's noise exposure equals or exceeds the action level of TWA_8 of 85 dBA, the mine operator must promptly enroll the miner in a hearing conservation program. This requirement is derived in part from proposed requirements in § 62.120(b)(2) and (c)(1), which would have provided for a miner's enrollment in a hearing conservation program if the miner's noise exposure exceeded either the action level or the permissible exposure level. Proposed § 62.120 would also have required miner training, hearing protector use, and a system of monitoring, but did not specifically designate those items as elements of a hearing conservation program, as does the final rule.

Paragraphs (a) through (e) of § 62.150 of the final rule enumerate the elements of a hearing conservation program, which include a system of monitoring, the use of hearing protectors, audiometric testing, training, and recordkeeping. Each paragraph also refers to the specific section of the final rule where the detailed requirements of each program element are located.

Paragraph (a) of § 62.150 of the final rule requires that the hearing conservation program include a system of monitoring in accordance with § 62.110, which provides that the system of monitoring must evaluate each miner's noise exposure sufficiently to determine continuing compliance with the requirements of part 62. This requirement is derived from proposed § 62.120(f), which would have required a system of monitoring, but which did not include monitoring as an element of the hearing conservation program. A more detailed discussion of exposure monitoring is included in the preamble under § 62.110.

Paragraph (b) of § 62.150 of the final rule includes the use of hearing protectors, in accordance with § 62.160, as an element of the hearing

conservation program. This requirement is derived from proposed § 62.120(b)(3). A detailed discussion of hearing protectors is found under § 62.160 of the preamble.

Paragraph (c) of § 62.150 of the final rule includes audiometric testing, in accordance with §§ 62.170 through 62.175 of the final rule, as a hearing conservation program element. As discussed above, audiometric testing would have been included as a program element under the proposal, and has been adopted as an element in the final rule. Detailed discussion of audiometric testing, test procedures, evaluation of audiograms, and other related issues can be found in the preamble under §§ 62.170 through 62.175.

Paragraph (d) of § 62.150 of the final rule includes miner training, to be conducted in accordance with § 62.180 of the final rule, as an element of the hearing conservation program. Under § 62.120(b)(1) of the proposal, training would have been required for miners whose exposure exceeded the action level, but the proposed rule would not have included training as a hearing conservation program element. Extensive discussion of miner training under the final rule can be found in the preamble under § 62.180.

Finally, paragraph (e) of § 62.150 of the final rule provides that the hearing conservation program must include recordkeeping in accordance with § 62.190 of the final rule. Issues related to access to records, maintenance, and retention are discussed in detail in the preamble under § 62.190.

Section 62.160 Hearing Protectors

Section 62.160 specifies the requirements for hearing protectors. The final rule is essentially identical to proposed § 62.125 with a few minor changes. Proposed § 62.125 required that miners have a choice of one plug-type and one muff-type hearing protector. Under § 62.160(a)(2) of the final rule, miners must be allowed to choose from at least two of each type. In the event that, under § 62.140, dual hearing protection is required, miners must be allowed to choose one of each type from the selection offered under § 62.160(a)(2).

Under §§ 62.120 and 62.125 of the proposal, mine operators would have been required to ensure that miners wore hearing protection in specific circumstances: when a miner's exposure exceeded the permissible exposure level; or when a miner's exposure exceeded the action level and the miner was determined to have a standard threshold shift or would have to wait 6 months before a baseline audiogram.

The hearing protectors would have been required to be worn at any sound level between 80 and 130 dBA. In its place, § 62.160(b) of the final rule specifies that mine operators must ensure that miners wear hearing protectors under similar circumstances. Under the final rule the mine operator must ensure that hearing protectors are worn by miners whenever their noise exposure exceeds the permissible exposure level, either until feasible engineering and administrative controls have been implemented, or despite the use of all feasible engineering and administrative controls. Additionally, mine operators must ensure that a miner whose exposure equals or exceeds the action level wears hearing protectors, either if the miner has experienced a standard threshold shift or more than 6 months will pass before a baseline audiogram can be conducted. The final rule, however, does not adopt the provision proposed at § 62.125(b) that in those cases where hearing protectors are required to be worn, the mine operator must ensure that the protector is worn by the miner when exposed to sound levels required to be integrated into a miner's noise exposure measurement.

The final rule adopts the proposed provisions that the hearing protector is to be fitted and maintained in accordance with the manufacturer's instructions; that hearing protectors and necessary replacements are to be provided by the mine operator at no cost to the miner; a miner whose hearing protector causes or aggravates a medical pathology of the ear must be allowed to select a different hearing protector from among those offered.

Selection of Hearing Protectors

MSHA's existing noise standards require mine operators to provide adequate hearing protectors but do not specify that a variety of hearing protectors be offered. OSHA's noise standard requires that employees be allowed to select from a variety of suitable hearing protectors provided by the employer but does not define variety. OSHA states in the 1981 preamble to its noise standard that "[T]he company must make a concerted effort to find the right protector for each worker—one that offers the appropriate amount of attenuation, is accepted in terms of comfort, and is used by the employee."

MSHA considered several studies and comments before concluding that the minimum selection appropriate for miners consists of at least two types of earmuffs and two types of earplugs that would provide adequate noise reduction.

The National Hearing Conservation Association's Task Force on Hearing Protector Effectiveness (Royster, 1995) recommends that employers consider numerous criteria when selecting the variety of hearing protectors to be made available to their workers. According to the Task Force, the most important criterion for choosing a hearing protector is "the ability of a wearer to achieve a comfortable noise-blocking seal which can be maintained during all noise exposures." Other criteria include the hearing protector's reduction of noise, the wearer's daily noise exposure, variations in sound level during a work shift, user preference, communication needs, hearing sensitivity of the wearer, compatibility with other safety equipment, the wearer's physical limitations, climate, and working conditions.

Berger (1986) stresses the importance of comfort, arguing that if a miner will not wear a highly rated but uncomfortable hearing protector, its actual effectiveness is greatly reduced (or nonexistent). Conversely, the miner may wear a comfortable but less effective hearing protector consistently, thereby gaining greater effective protection. Berger (1981) also recommends that an employee should have two weeks to try out an adequate hearing protector and select another one if the original selection does not perform satisfactorily.

MSHA believes that such a trial period further encourages miners' acceptance of the use of hearing protectors and may be necessary for miners to determine if the hearing protectors they have selected are comfortable and appropriate for prolonged periods of use. If significant discomfort occurs, MSHA encourages the mine operator to allow the affected miner to select an alternate hearing protector. In any case, provision of an alternative hearing protector is mandatory under the final rule if required by a medical condition or because the miner has experienced a standard threshold shift.

Mine conditions such as dust, temperature, and humidity can cause one type of hearing protector to be more comfortable than another. For example, even under normal mining conditions, some miners may experience problems with earmuffs because of a buildup of perspiration under the seals. The report *Communication in Noisy Environments* (Coleman et al., 1984) finds earmuffs to be better suited to mining conditions than earplugs, because helmet-mounted earmuffs are comfortable, easy to fit and remove, effective, and hygienic. However, compressible foam earplugs

interfere less with communication and awareness of surroundings than do earmuffs, and may be more comfortable in hot, humid conditions.

Comfort alone does not determine a miner's choice of hearing protector. Coleman et al. (1984) state that other factors, such as:

* * * concern with hygiene, belief in (real or presumed) communication difficulties, and social constraints * * * can influence the extent to which workers will use the protection provided * * * Sweetland (1981) found concern about communication difficulties to be a major factor in mine workers' acceptance of protectors.

One commenter suggested that because earmuffs might not provide adequate noise reduction, mine operators should be allowed to require specific hearing protectors to ensure that their employees receive the best protection. MSHA agrees that employees should receive the best available protection.

Accordingly, the final rule does not prevent mine operators from selecting among the wide variety of styles, types, and noise-reduction ratings available in hearing protectors which would afford miners the best protection available. Moreover, MSHA maintains that the requirement that mine operators encourage the safe and effective use of hearing protectors gives them incentive to provide an appropriate variety of types. MSHA further maintains that if miners are allowed to choose from a selection of hearing protectors, particularly if given appropriate training, as required under this rule, they will be more likely to wear and maintain their hearing protectors for optimal noise reduction.

The comment that "miners will only wear plugs that are comfortable" represents the consensus view, and a number of comments to the proposed rule noted that a choice from at least one of each type is inadequate. On the basis of comments reviewed and the international consensus (including the U. S. armed services) that workers should choose from a selection of several hearing protectors, MSHA has concluded that the use of hearing protectors will be better accepted by miners if they have the opportunity to choose appropriate hearing protectors from an expanded, but not unlimited, selection. Thus, the final rule requires that at least two plug-type and two muff-type protectors be offered to miners.

Hearing Protectors for Miners With Significant Hearing Loss

Hearing loss due to noise and aging both affect the ear at higher sound

frequencies, and most earplugs and earmuffs are more effective at reducing sounds of higher than lower frequencies. As a result, a miner with significant hearing loss who is wearing a normal hearing protector would experience even further reduction in hearing at the higher frequencies. In this situation, the miner could run the risk of not hearing or comprehending otherwise audible warnings.

Pfeiffer (1992) supports this reasoning, suggesting that greater care be exercised when selecting hearing protectors for workers experiencing hearing loss. He notes that it is important not to overprotect workers, because if workers experience difficulty in communicating, they will be reluctant to wear hearing protectors.

An alternative is the communication-type hearing protector, which combines an earmuff with a radio receiver so that the wearer can hear important conversations or warnings. Although no comments were received on the use of communication-type hearing protection devices for hearing impaired miners, MSHA cautions mine operators against their use in very high noise areas because the sound level transmitted into the ear cup may be hazardous. Some manufacturers of communication-type hearing protectors, however, have placed limiters in the electronics to prevent potentially hazardous sound levels being transmitted.

Even though some researchers have indicated that using a hearing protector may cause communication problems for a hearing impaired miner, MSHA has determined not to require special hearing protectors and not to limit the choices of hearing protectors for the hearing impaired. As a result, the rule allows mine operators the maximum flexibility in addressing this matter in ways appropriate to local conditions and individual needs.

Use of Hearing Protectors Above 80 dBA

Under § 62.125(b) of the proposal, the use of hearing protectors would have been required when the sound levels exceed those which were proposed to be integrated into the noise exposure measurement. This requirement has not been adopted in the final rule. This provision, while intended to require the use of hearing protectors above 80 dBA when the miner's exposure exceeded the permissible exposure level, would in effect have required hearing protector usage above 80 dBA, and some commenters to the proposed rule were concerned that this would result in all miners having to wear hearing protectors throughout every shift. A number of commenters who objected to

the proposal noted that miners should be permitted to remove hearing protectors when the sound level falls below 80 dBA, and that MSHA should recommend wearing hearing protectors above 85 dBA and require them above 90 dBA. One commenter noted that it is impossible to enforce the use of hearing protectors based on the sound level unless there is a practical means of knowing what the sound level is at all times, in order to know when it exceeds the threshold level.

MSHA agrees with the commenters who pointed out that the provision in the proposal would have required hearing protector usage above 80 dBA, which would have resulted in miners having to wear hearing protectors throughout every shift. MSHA did not intend for the use of hearing protectors to be based on the threshold level, thus the proposed provision has not been adopted. The final rule does set forth specific circumstances under which mine operators must ensure that miners use hearing protectors: when the miner's noise exposure exceeds the permissible exposure level, until engineering and administrative controls have been implemented, or despite the use of such controls; and when the miner's exposure is at or above the action level, and the miner has incurred a standard threshold shift, or more than 6 months will pass before the miner's baseline audiogram can be conducted.

Use of hearing protectors is not based on the threshold levels. MSHA has determined that it is the responsibility of the mine operator to determine when beyond the specific requirements of the final rule hearing protectors should be worn. This is one goal of the mine operator's monitoring program.

Fitting of Hearing Protectors

Section 62.160(a)(3) of the final rule addresses the fitting of hearing protectors, and is identical to § 62.125(c) of the proposed rule. The final rule requires that mine operators ensure that hearing protectors be fitted in accordance with manufacturer's instructions.

Many commenters supported the requirement that hearing protectors be properly fitted. A number of commenters observed that earplugs vary more from laboratory data than earmuffs because earplugs are harder to fit properly. Several commented that proper fit depends upon the wearer's ear canal size and shape, manual dexterity, and motivation. Others stated that people often select a comfortable earplug that does not effectively seal the ear canal, so that it provides little protection. MSHA recognizes a lack of

consensus on fitting procedures but notes that research demonstrates that proper fitting can increase the effectiveness of hearing protectors.

For example, Chung et al. (1983) report that the major factor in the performance of earmuffs is the fit, which is dependent on headband tension. They report that, while adequate tension is necessary for effective noise reduction, high headband tension also generally causes discomfort. Chung et al. concluded that proper fitting can increase the effectiveness of earmuffs.

MSHA considered the use of audiometric data base analysis the long-term collection of audiograms to determine the effectiveness of hearing protectors and concluded that audiometric data base analysis is inappropriate for determining fit because it does not provide immediate feedback on individual fit. Audiometric data base analysis requires multiple subjects, and is useful for determining the adequacy of the hearing conservation program (protecting the hearing sensitivity of a group of workers) but not the adequacy in protecting an individual. Furthermore, audiometric data base analysis requires audiograms to be conducted on an annual basis. If no interim protection is provided between audiograms, a miner's hearing sensitivity could be irreversibly damaged.

As stated in the preamble to the proposal, MSHA agrees that proper fitting is necessary to ensure optimal effectiveness of hearing protectors and that it should not be left solely up to the individual miner to determine if the hearing protector fits properly.

Some commenters saw the need for an accurate, reliable, and inexpensive method of testing the fit of earplugs and earmuffs. MSHA agrees that such a fit test for earplugs and earmuffs is needed in order to determine the amount of protection an individual obtains from a hearing protector, but none exists at this time. MSHA believes that, until such a test is developed, the manufacturer's instructions should be used to fit earmuffs and earplugs.

Some commenters noted that not all manufacturers' instructions are adequate to ensure proper fit. In addition, one commenter was opposed to mandating the manufacturers' instructions, claiming that doing so was an unlawful delegation of MSHA's responsibility. MSHA disagrees. There are many instances of regulations requiring that manufacturers' instructions be followed, because the manufacturer of the instrument, machine, or protective device is the

most knowledgeable of the features, performance, and use of the device. For example, the safety standards for explosives at metal and nonmetal mines require that initiation systems be used in accordance with the manufacturer's instructions. Therefore, in light of the wide variety of hearing protectors available, the broad range of subjective fitting procedures, and the lack of consensus on an objective fitting method, MSHA has concluded that the manufacturers' instructions provide the best model for fit at this time.

One commenter noted that the best fit is obtained when individualized training is available to the user. MSHA agrees that training is a key element in the fitting of hearing protectors, as reflected in the final rule (see § 62.180).

Maintenance of Hearing Protectors

Section 62.160(a)(3) of the final rule requires that mine operators ensure that a hearing protector is maintained in accordance with the manufacturer's instructions. Many manufacturers recommend soap, warm water, and careful rinsing to clean the hearing protector. Manufacturers also discourage solvents and disinfectants as cleaning agents because they can cause skin irritation and some can damage the hearing protector. In most cases, the proper insertion technique for earplugs includes proper basic hygiene cleaning the hands before rolling or inserting earplugs.

MSHA reviewed standards of hearing protector maintenance among the U.S. armed forces and the international community. The consensus of the standards was that damaged or deteriorated hearing protectors must be replaced. Research also demonstrates that non-disposable hearing protectors should be replaced between 2 and 12 times per year (Berger, 1980). Constant wear causes hearing protectors to lose their effectiveness. For example, headbands on earmuffs can lose their compression ability; the soft seals surrounding the ear cup on earmuffs can become inflexible; and plastic earplugs can develop cracks, shrink, or lose their elasticity. All types are susceptible to contamination.

MSHA recognizes that it is difficult to keep hearing protectors clean in the mining environment. Using contaminated hearing protectors, however, may contribute to a medical pathology of the ear. Once the skin has been abraded or inflamed, microorganisms in the ear or on a hearing protector can invade the skin. When hearing protectors appear to be the cause of inflammation of the external ear canal (otitis externa), the

hearing protector is often found to be contaminated with an irritating or abrasive substance. This situation can be corrected with proper cleaning of the hearing protector before use.

As noted in the proposed rule, miners have been known to alter hearing protectors to make them more comfortable. Such alterations have included cutting off the ends of earplugs or stretching out the head-band on earmuffs to decrease the tension. These alterations can significantly decrease the hearing protector's effectiveness. In addition, hearing protectors can be damaged from exposure to heat, cold, ozone, chemicals, or dirt. Because such conditions are common in the mining industry, hearing protectors must be periodically checked and replaced if damage is found. While MSHA recognizes that it is difficult to keep hearing protectors clean and undamaged in the mining environment, the final rule requires mine operators to ensure that hearing protectors are maintained in accordance with manufacturers' instructions.

Replacement of Hearing Protectors

Section 62.160(a)(4) of the final rule is identical to proposed § 62.125(d). This section requires the mine operator to provide the hearing protector and necessary replacements at no cost to the miner. MSHA intends for this section to include repairs to a miner's hearing protector when it becomes damaged or deteriorated to the point that the required protection is compromised. Commenters agreed that this should be the case.

Replacement of hearing protectors would take place according to the manufacturer's instructions upon finding any deterioration that could adversely affect the hearing protector's effectiveness or upon diagnosis of a medical pathology caused or aggravated by the hearing protector provided (see following section for discussion of medical pathology). For example, manufacturers of disposable earplugs may state in their instructions that the earplugs should be replaced after each use.

Replacement Due to Medical Pathology

Section 62.160(a)(5) of the final rule is identical to proposed § 62.125(e). This section requires the mine operator to provide an individual miner with a different, more appropriate, type of hearing protector when presented with

evidence of a medical pathology (for example, otitis externa or contact dermatitis). The definition of "medical pathology" is intended to cover injuries. If, for example, a miner suffered a burn in the ear canal and could no longer use the earplugs he or she had earlier selected, he or she must be allowed to select an earmuff. Comments to the proposed rule indicated a consensus that miners should be permitted to change their choice of hearing protector on the basis of the opinion of a medical professional. A preliminary diagnosis of medical pathology by a family physician or nurse must be accepted by a mine operator for the purposes of this requirement.

One commenter stated that people wearing hearing protectors are prone to ear infections. Berger (1985), however, reports that although there are some preexisting ear canal conditions and environmental conditions that prevent the use of certain hearing protectors, in general, otitis externa occurs in approximately 2% of both users and nonusers of hearing protectors. He therefore concludes that regular wear of hearing protectors does not increase a person's chances of contracting otitis externa. In any case, disposable hearing protectors may be warranted for individuals prone to infections.

MSHA's existing noise standards do not specifically address the replacement of hearing protectors. OSHA's noise standard simply requires that hearing protectors be replaced as necessary. Based upon the research and several international standards, MSHA believes that hearing protectors need to be replaced whenever a medical pathology is present. Such replacements must also be available at no cost to the miner.

Circumstances Requiring the Use of Hearing Protection

Section 62.160(b) of the final rule sets forth the circumstances in which mine operators must ensure that hearing protectors are worn. Section 62.160(b) incorporates requirements of proposed §§ 62.125(b)(2) and 62.125(c)(2)(iii). Section 62.160(b) requires that mine operators ensure the use of hearing protectors when the miner's exposure exceeds the permissible exposure level before the implementation of all feasible engineering and administrative controls, or if the miner's exposure continues to exceed the permissible level despite the use of all feasible controls. Sections 62.160(c)(1) and (c)(2) require that mine

operators ensure the use of hearing protectors when the miner's noise exposure is at or above the action level and the miner has experienced a standard threshold shift or it takes more than 6 months to conduct the baseline audiogram.

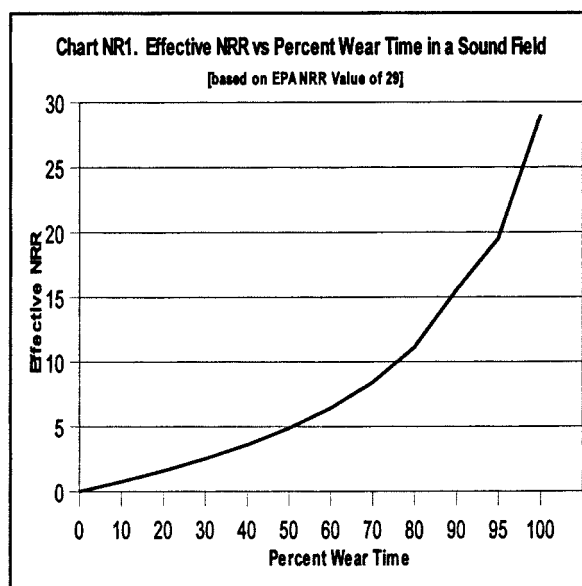
The proposal's requirement that the mine operator ensure the use of hearing protectors under particular circumstances generated comments concerning convenience, comfort, and noise reduction. One commenter to the proposed rule noted that to meet the proposed requirement, miners would need to wear hearing protectors throughout entire shifts, which would be very inconvenient.

Some research supports the assumption that miners would resist wearing hearing protectors as prescribed. Despite mandatory use of hearing protectors, most workers in the Abel (1986) study admitted to wearing their hearing protectors less than 50% of the time. Further, many modified their hearing protectors to provide greater comfort. Many of the modifications lowered the effectiveness of the hearing protectors.

As noted by Berger (1981), persons with medical pathologies of the ear are more likely than others to resist wearing hearing protectors because of pain or extreme discomfort associated with their use. Berger suggests that persons who are more prone to otitis externa would need to be monitored more closely for failure to wear their hearing protectors.

As many have emphasized, hearing protectors are only effective if they are worn. Their effectiveness is diminished if they are not worn for the duration of any exposure. Chart NR1, below, illustrates that the amount of noise reduction provided is directly dependent upon the proportion of exposed time during which the hearing protector is worn.

For example, if a hearing protector with a noise reduction rating (NRR) of 29 dB is worn during only half the exposure time, the wearer will effectively obtain only about 5 dB of noise reduction. A noise reduction rating of 29 dB is among the highest reported by hearing protector manufacturers; yet, if a hearing protector with this rating is not worn 100% of the time that the wearer is exposed to noise, it is no more effective than a much lower-rated protector.



Many commenters oppose mandatory use of hearing protectors because they believe that they would interfere with the aural detection of warning signals and alarms at mine sites. Also, some commenters believe that the use of hearing protectors hampers an underground coal miner's ability to hear sounds generated by changing stresses in the geologic structure of the mine—commonly known as “roof talk.” MSHA acknowledges that miners need to be aware of the location and movement of equipment in the mining environment. These commenters stated that the ability to hear these sounds allows miners to retreat from an unsafe area before the roof collapses, saving their lives and the lives of others wearing hearing protectors. These commenters submitted anecdotal information to MSHA in support of their position. Other commenters were concerned that hearing protectors limit the ability of miners to communicate, hear warning signals, and properly operate mining machinery. Still others, however, stated that miners can hear roof talk while wearing hearing protectors, and that roof fall accidents could not have been prevented if hearing protectors had not been worn.

The rulemaking record contains evidence from which MSHA concludes that for persons with normal hearing, the use of hearing protectors will not interfere with the aural detection of warning signals and alarms at mine sites. Nixon and Berger (1991), have concluded that “[h]earing protection devices equally attenuate the levels of both the noise of the environment and auditory signals. An auditory warning signal may sound different when a

hearing protection device is worn, yet recognition is ordinarily the same whether the ears are protected or unprotected.” Prout et al. (1975), found that hearing protectors do not generally prevent a miner from hearing and analyzing roof talk when the noise level is high enough to require hearing protectors, but they diminish the ability to interpret roof warning signals in quiet. Thus hearing protectors should not be worn in quiet conditions. In addition, Berger (1986) found that the use of hearing protectors by persons with normal hearing had no significant effect on the ability to detect warning signals and that for persons with non-normal hearing, “[w]arning sounds may be adjusted in pitch and loudness to achieve optimum perceptibility.” Berger (1986) also referenced additional studies which showed that the use of hearing protectors reduced rather than increased the number of industrial mishaps.

The U.S. armed services and many international communities have specified sound levels above which hearing protectors must be worn. However, MSHA concludes that requiring specific trigger levels for hearing protectors in specific circumstances would be burdensome and require mine operators to conduct a comprehensive survey on each piece of equipment. Instead, the Agency is taking the more practical approach of requiring mine operators to ensure through their policies that hearing protectors are worn whenever noise-producing equipment is operating in the miner's work area and that miners are permitted to remove their hearing protectors in areas with low sound levels. This should minimize

communication difficulties and the sense of isolation caused by wearing hearing protectors in such areas.

The final rule does not adopt proposed § 62.120(b)(3), which would have required mine operators to provide hearing protection, upon request, to a miner whose exposure exceeded the action level. Because the final rule requires mine operators to enroll miners whose exposures equal or exceed the action level, and hearing protectors are provided to miners as a part of that program, the proposed requirement is unnecessary, and has not been adopted in the final rule.

Section 62.170 Audiometric Testing

This section of the final rule establishes requirements for the audiometric testing conducted as part of the hearing conservation program under § 62.150 of the final rule. Included in this section are specific qualification requirements for persons who conduct audiometric testing; a requirement that audiometric testing performed under this part be offered at no cost to the miner; and procedures for baseline audiograms, annual audiograms, and revised baseline audiograms.

The requirements in this section of the final rule are nearly identical to the requirements of proposed § 62.140, with a few relatively minor changes that are described in detail below. This section requires that audiometric tests performed to satisfy the requirements of part 62 be provided by the mine operator at no cost to the miner, and be conducted by a physician or an audiologist, or by a qualified technician under the direction of a physician or an audiologist. Section 62.101 of the final rule defines “audiologist” as 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. "Qualified technician" is defined in § 62.101 of the final rule as a technician who has been certified by the Council for Accreditation in Occupational Hearing Conservation (CAOHC) or another recognized organization offering equivalent certification. A number of comments were received regarding the appropriate qualifications for audiologists or technicians who perform audiometric testing. These issues are discussed in greater detail in the preamble under § 62.101, addressing the definitions provided in that section.

Commenters disagreed as to what qualifications were necessary for physicians performing audiometric testing. Some commenters were concerned that physicians may not have the specific knowledge necessary to conduct audiometric testing, while other commenters believed that physicians were appropriately qualified. Several commenters stated that many, if not most, physicians do not have the training, the expertise, or the equipment to perform the audiometric testing called for under this part. Some commenters suggested that physicians conducting audiometric testing under the final rule be required to be board-certified otolaryngologists; others were of the opinion that the final rule should require that physicians conducting the testing have expertise in hearing and hearing loss. Several commenters preferred a requirement for both certification and licensure or that the physician be an otolaryngologist or an otologist. However, MSHA recognizes that many miners working in outlying areas may not have easy access to an audiologist who is both licensed and certified.

The final rule does not adopt the suggestion of some commenters that minimum qualifications be included in the rule for physicians who conduct audiometric testing. MSHA recognizes that a license to practice medicine does not guarantee that a physician has the specialized training or experience needed to conduct audiometric testing, evaluate audiograms, and supervise those technicians who perform such activities. However, states enforce stringent medical licensing requirements, and the medical profession maintains a high degree of accountability for physicians and has established strict ethical standards for medical practitioners. In light of these controls, the Agency expects physicians to exercise professional judgment in

assessing whether they possess the experience and qualifications to conduct audiometric testing and evaluate audiograms. The final rule therefore does not adopt commenters' suggestions that additional licensing or qualification requirements be established for physicians conducting audiometric testing and evaluating audiograms.

The final rule adopts the proposed requirement that qualified technicians conducting audiometric tests be under the direction or supervision of a physician or an audiologist. Although the final rule does not require that the physician or audiologist be present when the technician conducts the audiometric testing, the physician or audiologist must oversee the activities of the technician enough to ensure adherence to the appropriate test procedures.

This section provides that all audiometric tests performed pursuant to part 62 must be provided by the mine operator at no cost to the miner. This requirement essentially adopts the proposed requirement that participation in a hearing conservation program would be provided by the mine operator at no cost to the miner. The proposed elements of a hearing conservation program would have included the annual audiometric testing and required follow-up examinations and actions.

Baseline Audiogram

The requirements in paragraphs (a)(1) through (a)(3) of § 62.170 of the final rule are derived from virtually identical requirements in proposed § 62.140(b). Under these requirements:

- (1) A miner enrolled in a hearing conservation program must be offered an audiometric test within specified time periods to establish a valid baseline audiogram;
- (2) The mine operator must provide the miner with a 14-hour quiet period prior to the baseline audiogram; and
- (3) Revisions in the miner's baseline audiogram are not permitted because of changes in the miner's enrollment status in the hearing conservation program. However, a new baseline may be established for a miner who is away from the mine for more than 6 consecutive months.

Unlike the proposal, the final rule allows the use of hearing protectors as a substitute for the 14-hour quiet period.

Commenters who addressed the issue of audiometric testing generally acknowledged the need for a valid baseline audiogram as part of an effective hearing conservation program. However, commenters disagreed on whether audiometric testing under the

final rule should be mandatory and on the appropriate time frame for establishing the miner's baseline. Some commenters suggested pre-employment audiograms be used as the baseline.

The final rule, like the proposal, requires mine operators to offer miners whose noise exposure exceeds the action level the opportunity for audiometric testing to establish a baseline and at least annually after the baseline has been established. The proposed rule would have also required, under § 62.120(c)(2)(ii), that mine operators ensure that a miner whose exposure to noise exceeded the permissible exposure level actually submitted to the audiometric testing offered as part of the hearing conservation program. MSHA proposed this mandatory testing requirement for several reasons, including a concern that without mandatory testing, standard threshold shifts and reportable hearing losses would go undetected. MSHA was also concerned that a voluntary program might have a low rate of participation. Finally, the Agency was concerned that unless participation was mandatory, the costs of miner testing would provide an incentive for mine operators, who will bear the costs of such testing, to discourage miners from participating. MSHA recognized that this provision would be controversial for many in the mining community, and specifically solicited comments on this issue in the proposed preamble.

The mandatory audiometric testing requirement has not been adopted in the final rule, in response to a number of commenters who were opposed either to any type of mandatory audiometric testing or to placing the burden on the mine operator to ensure that the miner submit to such testing. Some commenters stated that mine operators could not force miners to take hearing examinations. These commenters believed that mine operators should be required to offer miners such testing, but should not be penalized if miners do not take advantage of the offer. Other commenters believed that MSHA should directly require miner participation in the testing, not put the responsibility on the mine operator to see that miners participate. Finally, one other commenter believed that forcing a miner to participate in an audiometric testing program may violate existing labor contracts.

A number of commenters supported the concept of mandatory audiometric testing. One commenter stated that audiometric testing is essential to assess an employee's hearing and determine future changes in hearing sensitivity.

This commenter further stated that the audiogram could therefore not be an optional medical evaluation, but is the keystone of a comprehensive hearing conservation program. Other commenters were of the opinion that if audiometric testing were voluntary, miners would be sent the wrong message and a mine operator's efforts to run an effective hearing conservation program would be undermined. These commenters further stated that if audiometric testing is voluntary and a miner refuses the offer of an audiogram, any hearing loss should be presumed to be non-work-related. Another commenter questioned whether a miner would have the right to refuse to participate in an audiometric testing program. This commenter stated that if a miner could refuse, mine operators would be placed at a disadvantage in monitoring work-related hearing loss, and be subject to unwarranted workers' compensation claims. This commenter was also concerned that, without mandatory audiometric testing, mine operators would be unable to collect accurate data to identify hearing-related problems, hampering mine operators' ability to take appropriate corrective action to provide a healthier workplace.

MSHA notes that the commenters who supported the concept of mandatory audiometric testing for miners varied greatly as to when such tests should be required. A number of commenters believed that audiometric testing should be mandatory for miners whose noise exposures equal or exceed the action level, and that all miners enrolled in a hearing conservation program should be required to submit to audiometric examinations. Other commenters supported mandatory audiometric testing for all miners, regardless of their noise exposures. One commenter who supported mandatory testing stated that the Americans with Disabilities Act (ADA) protects miners from discrimination based on hearing disability, and any confidentiality concerns would be addressed both by the ADA and the protections in the proposed rule.

MSHA has concluded that mandatory audiometric testing is inappropriate at all levels of noise exposure, based on several considerations. MSHA acknowledges the concerns of the commenters who believe that a voluntary audiometric testing program could allow miner hearing loss to go undetected and unaddressed. However, MSHA is reluctant to require miners, either directly or indirectly, to submit to medical examinations that they do not wish to undergo. MSHA is also reluctant to require miners to submit to testing

when the miners may have concerns about the privacy and confidentiality of audiometric test records and follow-up evaluations. MSHA also believes that a miner who voluntarily participates in audiometric testing will more likely wear hearing protectors, maintain engineering noise controls, and comply with administrative noise controls. Mine operators remain free to make audiometric testing mandatory for their miners. However, a miner's refusal to participate in a mandatory audiometric testing program would be a labor-management issue rather than an MSHA enforcement issue, and is outside the scope of this rule.

Under § 62.120 of the final rule, mine operators must enroll miners whose exposure to noise exceeds the action level in a hearing conservation program, and offer those miners the opportunity for regular audiometric tests. Information from these tests indicating that miners are experiencing hearing loss should prompt both the mine operator and the Agency to examine the effectiveness of existing noise controls. For example, if a miner incurs a standard threshold shift, the mine operator, at the very minimum, should ensure that a hearing protector is provided to and worn by the miner (see preamble for § 62.160(c)(1) for further discussion). If the miner already has a hearing protector, the mine operator should determine whether the hearing protector needs to be changed. The information obtained through audiometric testing may indicate the need to pinpoint the source of the noise causing the problem, and may reveal an undetected failure of existing noise controls, failure to properly fit, maintain or utilize hearing protectors, or failure of the training to provide adequate instruction.

Paragraph (a) of § 62.170 of the final rule, like the proposal, requires that a miner be offered the opportunity for audiometric testing to establish a baseline audiogram, against which subsequent annual audiograms can be compared. An existing audiogram may be used as the baseline audiogram if it meets the audiometric testing requirements of § 62.171 of the final rule. OSHA also accepts existing audiograms as a baseline because, in most cases, use of an existing baseline audiogram is more protective for the employee. Establishing a miner's baseline after the miner has been exposed to high levels of noise for many years is likely to result in less protection for the miner, because the new audiogram would typically show higher thresholds. Consequently, the true extent of future hearing losses would

appear smaller than if they had been compared to a baseline that had been established prior to the years of noise exposure.

A few commenters believed that the audiogram should be conducted within 12 months of the effective date of the rule to be considered a baseline. Other commenters believed an existing baseline should be used; otherwise, experienced miners would be placed at a disadvantage if their baselines were established after the implementation of the final rule.

MSHA encourages the use of existing audiograms as baselines because, as explained above, this approach would provide a greater degree of protection for the affected miner. Therefore, the final rule adopts the proposed provision that permits the use of existing audiograms as the baseline at the discretion of the mine operator, if the audiograms meet the testing requirements of this part. MSHA acknowledges the concerns of commenters about miners who may already have incurred a hearing loss before the effective date of the final rule, whose hearing loss may not be accurately assessed if new baseline audiograms are used under this rule. However, the establishment of a comprehensive scheme that addresses existing hearing loss among miners is outside the scope of the final rule, whose purpose is the prevention of occupational noise-induced hearing loss among miners and the reduction of the progression of such hearing loss.

Paragraph (a)(1) adopts the proposed requirement that the audiometric testing which results in a baseline audiogram be offered to the miner within 6 months of enrollment of the miner in a hearing conservation program, or, if mobile test vans are used, within 12 months of the miner's enrollment. These requirements are consistent with the requirements of OSHA's noise standard. MSHA's existing noise standards for coal mines do not specify a deadline for baseline audiograms for those miners under a hearing conservation plan, and the existing noise standards for metal and nonmetal mines do not require baseline audiograms.

Commenters offered differing views on the appropriate period within which a baseline audiogram should be conducted. One commenter believed that a miner's audiometric baseline should be determined within 90 days of the miner's enrollment in the hearing conservation program, rather than 6 months or a year. Others were of the opinion that 6 months for a baseline (12 months if a mobile test van is used) established in the proposal was a

reasonable deadline. In contrast, the National Institute for Occupational Safety and Health (NIOSH) has recommended that baseline audiograms be conducted within 30 days of enrollment in a hearing conservation program, even if a mobile test van is used. NIOSH believes that waiting up to 6 months for a baseline audiogram is unacceptable, because exposure to high sound levels for a relatively short period of time can adversely affect the hearing sensitivity of susceptible individuals. Other commenters advocated the use of pre-employment audiometric testing, under the rationale that such examinations should be part of the battery of tests conducted when a miner is hired. These commenters believed that there is a need to document a miner's existing hearing loss at the point that the miner is hired, so that mine operators can establish what part of a miner's hearing loss can be attributed to noise exposure at that mine. Another commenter requested that the first annual or periodic audiogram conducted after the effective date of the noise rule should be considered the baseline audiogram.

Baseline audiograms provide an essential point of comparison for subsequent audiograms, and are critical in determining the extent of a miner's hearing loss. If the baseline audiometric test is not conducted properly and at the appropriate time, it may not accurately reflect the miner's hearing thresholds, and any changes between the baseline audiograms and subsequent audiograms may be masked. Because of the importance of the baseline audiogram, it is highly desirable to conduct the baseline testing before a miner is exposed to hazardous noise.

MSHA has determined that a deadline of 6 months (or 12 months if a mobile test van is used) for obtaining the baseline audiogram is reasonable. This is because in many cases it is not possible to conduct it any sooner due to the remote location and intermittent operation of many mines and to the unavailability of adequate audiometric testing facilities. MSHA recommends that testing should take place as soon as possible.

The 12-month period for testing by a mobile van allows mine operators to schedule baseline and annual audiograms simultaneously, and thus substantially reduce the cost when mobile test vans are used. The 12-month deadline for mobile van testing recognizes that there may be significant logistical and scheduling considerations in a visit to a mine by a mobile test van. Scheduling may need to be done months in advance.

It should be noted that § 62.160(c)(2) of the final rule requires mine operators not only to provide all miners enrolled in a hearing conservation program with hearing protectors, but also to ensure the hearing protectors are used if the baseline audiogram cannot be conducted within the 6-month deadline. The final rule's requirements for baseline audiograms, including the use of hearing protectors, are consistent with the OSHA rule.

14-hour Quiet Period

Paragraph (a)(2) of § 62.170 of the final rule has been adopted with a substantive change from proposed §§ 62.140(b)(2) and (b)(3). This paragraph, like the proposal, requires that the mine operator notify the miner of the need to avoid high levels of noise for at least 14 hours immediately preceding the baseline audiogram. This paragraph also requires that the mine operator not expose the affected miner to workplace noise for at least a 14-hour period immediately prior to receiving the baseline audiogram. The final rule, unlike the proposal, allows the use of hearing protectors as a substitute for this quiet period. Although existing MSHA standards for noise do not include provisions for a quiet period before a baseline audiogram, these requirements are similar to a provision in OSHA's noise standard.

The 14-hour quiet period provides a miner's hearing sufficient rest to allow recovery from any temporary elevation of hearing levels due to noise exposure (temporary threshold shift) caused by pre-test noise exposure. Hearing levels return to normal after a period of quiet. If the baseline audiogram is skewed by a temporary threshold shift, comparisons of the baseline to subsequent annual audiograms will not provide an accurate indication of the extent of damage incurred during the time between the baseline and subsequent tests. It is critical that a miner's baseline audiogram reflect no temporary threshold shift. Otherwise, it will be essentially impossible to determine the magnitude or progression of future hearing loss.

Some commenters supported extending the quiet period requirement to annual audiograms as well as baseline audiograms. Other commenters opposed a mandatory 14-hour quiet period, maintaining that requiring miners to be protected from workplace noise prior to the baseline test was unreasonable for mines with extended shifts. In those mines, unless the miner missed all or part of the work shift, he or she would not receive 14 hours of quiet time. This would severely disrupt

the operation of those mines. Another commenter questioned how a mine operator could possibly ensure that a miner was not exposed to high levels of non-occupational noise.

MSHA agrees that the mine operator has no control over a miner's exposure to noise away from work. However, the training required under the final rule should encourage miners to avoid high noise exposures off the job before audiometric testing. One commenter also suggested that the 14-hour quiet period be reduced to 12 hours, because it would minimize any interference with normal work shifts.

Research has been conducted on the length of the hearing recovery period from a temporary threshold shift due to exposure to noise. Fodor and Oleinick (1986), in their study on workers' compensation programs in the United States, reported that the initial recovery from a temporary threshold shift appeared to be very rapid at the end of the noise exposure, but that the rate of recovery appeared to slow as time went on. Most researchers, however, report complete recovery from a temporary threshold shift taking no longer than 16 hours, provided that the temporary threshold shift did not exceed 40 dB. On the other hand, some states require that a worker be away from noise exposure for 6 months before hearing loss is evaluated for workers' compensation purposes. Standards of the U.S. Navy require a quiet period of at least 14 hours, and the U.S. Air Force requires a 15-hour quiet period before audiometric testing.

After consideration of all of the comments and a review of the available scientific literature on the subject, MSHA has concluded that a quiet period is necessary to obtain a valid baseline audiogram, and that a 14-hour quiet period is the most appropriate of several alternatives. This conclusion is consistent with the requirements in OSHA's noise standard and should provide sufficient time to avoid or recover from a temporary threshold shift before the baseline audiogram is conducted.

A quiet period of longer than 14 hours would place an undue burden on mine operators, because in many instances the miner would have to stay away from the work site to comply with the quiet period when the miner works a slightly extended shift; many work shifts exceed 8 hours, especially when a lunch period is taken into account.

The proposal, like the final rule, prohibits the exposure of miners to "workplace noise" during the 14-hour quiet period. Several commenters requested a definition for "workplace

noise," suggesting that the final rule provide that miners would be considered to be protected from "workplace noise" if they are not exposed to noise above the action level or above the permissible exposure level.

Two researchers, Shaw (1985) and Suter (1983), contend that sound levels must be below 72 dBA to be considered "effective quiet." Schwetz et al. (1980) found that a sound level below 85 dBA is needed for recovery from a temporary threshold shift. Studies have shown that individuals with a temporary threshold shift recovered their normal hearing more quickly when exposed to a 75-dBA sound level than they did when they were exposed to an 85-dBA sound level. The 1972 NIOSH Criteria Document recommends a sound pressure level of 65 dB as "effective quiet," based on work by Schmidek et al. (1972). Hodge and Price (1978) concluded that a sound level must fall below 60 dBA to provide effective quiet and not contribute to the development of a temporary threshold shift.

Recovery from a temporary threshold shift requires exposures below 80 dBA, and based on scientific studies, extended exposure to noise above 80 dBA may lead to a material hearing impairment. MSHA has therefore concluded that an acceptable definition of "workplace noise" is a sound level that exceeds 80 dBA, without taking into account the noise reduction provided by a hearing protector.

Because the mine operator has no control over the non-occupational noise exposure of a miner, the final rule does not limit non-occupational noise to a specified sound level during the quiet period; however, as noted below, the final rule does require that the mine operator notify miners of the need to avoid high levels of noise during the 14-hour period preceding the test. It is to the miner's benefit to limit non-occupational exposure to noise in order to obtain accurate audiometric testing.

As mentioned above, the final rule, unlike the proposal, adopts the suggestion of a number of commenters to permit the use of hearing protectors as a substitute for the quiet period. The specific prohibition against hearing protectors as a substitute for a quiet period in § 62.140(b)(2) of the proposal elicited a number of comments. Many commenters believed that the use of hearing protectors should be allowed because they would provide adequate protection for miners. Many also believed that a mandatory 14-hour quiet period would be impractical without the use of hearing protectors. Several commenters advocated that hearing protectors be permitted to be used to

satisfy the 14-hour quiet period providing the following conditions were met: required retraining of the miner on the use of hearing protectors within 5 days prior to the baseline audiogram; a requirement that an earmuff-type hearing protector or a foam earplug be used, and that the protector be in satisfactory condition; and mandatory use of dual hearing protectors if the noise exposure exceeds 100 dBA. Many of the commenters who opposed the use of hearing protectors as a quiet period substitute were those who opposed the use of hearing protectors for any reason (see the preamble discussion of engineering and administrative controls under § 62.130). As discussed elsewhere, although hearing protectors are not as effective as engineering and administrative controls in protecting miners, MSHA has concluded that they have an appropriate place in a hearing conservation scheme.

OSHA's noise standard allows the use of hearing protectors as an alternative to the 14-hour quiet period prior to the baseline audiogram, under the rationale that they may provide sufficient noise reduction to prevent a noise-induced temporary threshold shift from contaminating a baseline audiogram, and that the previous restriction on hearing protectors as a quiet period substitute was unnecessarily restrictive.

MSHA's final rule is consistent with OSHA's noise standard in that it allows hearing protectors to be substituted for the 14-hour quiet period prior to the baseline audiogram. Although MSHA recognizes that this decision may result in some miners having measured thresholds that are higher than their actual thresholds, as a result of exposure to some high sound levels, the magnitude of the elevated thresholds should be small unless the noise exposure is severe.

Data indicate that in order to prevent contamination of the baseline, the sound levels encountered during the quiet period would need to be below 80 dBA. MSHA is particularly concerned with the ability of hearing protectors to reduce noise to such low levels. Some researchers have concluded that even an 80 dBA level may be inadequate to protect the most susceptible individuals. However, MSHA has concluded that prohibiting the use of hearing protectors to fulfill the 14-hour quiet period is too impractical a restriction for most mine operators. Such a restriction may be too disruptive of the operations at many mines. Hearing protectors that are correctly fitted and used should provide an acceptable quiet period. The final rule, like OSHA's noise standard, therefore

allows the use of hearing protectors as a substitute for the 14-hour quiet period.

MSHA nonetheless strongly recommends that mine operators make reasonable attempts to provide a quiet period for miners before their baseline audiogram, instead of relying on hearing protectors. For example, a mine operator could provide a miner with a quiet period by scheduling the baseline audiogram after a miner's regularly scheduled day off or immediately following a weekend during which the miner does not work. This avoids any disruption of operations, while at the same time ensuring that the audiogram is not contaminated.

Sound Level Avoidance

Paragraph (a)(2) of § 62.170 of the final rule, like § 62.140(b)(3) of the proposal, requires mine operators to notify the miner of the need to avoid high levels of noise during the 14-hour period immediately preceding the baseline audiogram. This requirement is identical to provisions in OSHA's noise standard.

Only a few commenters addressed this issue. Some commenters agreed that workers need to be advised to avoid non-occupational noise exposure prior to taking the baseline audiogram. Several commenters were concerned that notifying the miners to avoid high levels of noise could lead to fraud in workers' compensation cases. These commenters were concerned that miners might intentionally expose themselves to high levels of noise prior to the baseline audiogram in order to provoke a temporary threshold shift and eventually receive an award of compensation. MSHA expects that competent audiologists and physicians will be able to determine if a miner has purposely incurred a temporary threshold shift.

The 1983 preamble to revisions to OSHA's noise standard (48 FR 9757) reflects OSHA's conclusion that 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. MSHA agrees with OSHA's conclusion regarding worker notification, and the final rule reflects this determination. It should be noted that the final rule does not require written notification. However, it may be in a mine operator's interest to put the notification in writing, because it provides the mine operator with proof of notification.

Exceptions for Revising Baseline Audiograms or Revised Baseline Audiograms

The requirements of paragraph (a)(3) of § 62.170 of the final rule are nearly identical to proposed § 62.140(b)(4) in that a mine operator must not establish a new baseline audiogram or revised baseline audiogram, where one has been established, due to changes in the miner's enrollment status in the hearing conservation program. However, baseline audiograms may be revised if a miner is away from the mine for a period of time exceeding 6 consecutive months. OSHA's noise standard does not contain such a requirement. This restriction is intended to ensure that a new baseline audiogram is not established or a miner's baseline audiogram is not revised even if a miner moves in and out of enrollment in a hearing conservation program because of time away from the mine due to unemployment or extended periods of vacation. Otherwise, a miner's incremental losses of hearing may be erased by revised baseline audiograms, and the true extent of a miner's hearing loss may escape accurate measurement.

Some commenters believed a new baseline should be established if the affected miner is away from the mine for at least 6 or 12 months. Another commenter stated the mine operator should be allowed to obtain a new baseline for a miner who returns to work after working for another mine operator, regardless of how long the miner had been away. These commenters were concerned about being held responsible for a miner's hearing loss that results from overexposure to noise during other employment. A large number of contract and transient employees work in the mining industry. Additionally, many metal and nonmetal mines operate seasonally or otherwise intermittently throughout the year. As a result, a large number of miners are typically away from the job site for long periods of time. MSHA agrees that mine operators should not be held responsible for a miner's hearing loss incurred during employment at other mines or during extended periods of unemployment. Therefore, the final rule adopts the proposed provision that allows for the revision of the baseline audiograms or revised baseline audiograms, where one has been established, for those miners who have been away from their employment at a particular mine for periods longer than 6 consecutive months.

Annual Audiogram

Paragraph (b) of § 62.170 of the final rule adopts the requirement of § 62.140(c) of the proposal that, after the baseline audiogram has been established, the mine operator must continue to offer the miner subsequent audiometric tests every 12 months as long as the miner remains enrolled in a hearing conservation program.

Existing MSHA standards for metal and nonmetal mines do not require audiometric testing. Under existing standards for coal mines, pre-employment and periodic audiograms are offered to miners at mines operating under a hearing conservation plan, but no procedures or time frames for these audiograms are specified (although MSHA policy provides that periodic audiograms must be offered at least every two years). Because MSHA policy has allowed consideration of the noise reduction value of hearing protectors to be considered when determining compliance with the permissible exposure level in coal mining, few coal mines have hearing conservation plans, and only one percent of coal miners are currently covered by such plans.

Some commenters supported annual audiometric testing, while several others supported periodic audiometric testing but recommended different intervals, ranging from once a year to once every three years depending upon the severity of the noise exposure or of the existing hearing loss. However, none of these commenters offered suggestions for the relationship between the severity of a miner's noise exposure and the frequency of audiometric testing. One commenter requested clarification as to whether the annual audiometric tests would be required to be administered once each year or once each 12 months. Several commenters questioned how a mine operator could be protected from liability for non-occupational hearing loss that occurs between the annual audiometric tests. Once baseline audiograms have been obtained, OSHA requires that an audiogram be offered annually to each employee exposed at or above the action level in order to identify changes in hearing sensitivity. This allows the use of hearing protectors to be prescribed or other follow-up measures initiated before the miner's hearing loss can worsen. OSHA adopted the annual audiometric test requirement because of the potential seriousness of the hearing damage that can occur within a 2-year period, before the hearing loss is identified by an audiogram.

MSHA has concluded that annual audiometric testing is necessary for

evaluating the hearing level of miners whose exposure equals or exceeds the action level for extended periods of time. These annual audiograms can be used to detect changes in a miner's hearing sensitivity, thus triggering several important actions provided for in the final rule. For example, retraining of the miner could be required. If a miner is enrolled in the hearing conservation program as a result of noise exposure at or above the action level, but the miner's noise exposure is below the permissible exposure level, detection of a standard threshold shift will require the mine operator to provide the miner with a hearing protector and ensure its use. If a miner is already using a hearing protector, the miner must be allowed to select a different hearing protector. Detection of a standard threshold shift also requires reevaluation of the engineering and administrative controls being used at the mine.

With regard to those commenters who were concerned about being held responsible for non-occupational hearing loss that occurs between annual audiograms, MSHA has concluded that the physicians or audiologists who conduct the audiometric tests are in a position to determine whether any hearing loss detected by the test is due to non-occupational causes.

The intervals between annual audiometric testing conducted under the final rule must not exceed 12 months. This means that testing once every calendar year would not be acceptable unless the interval between the tests is 12 months or less. For example, an annual audiogram in January of one calendar year cannot be followed by testing any later than January of the following calendar year. Otherwise, the interval between annual audiograms could extend to nearly 24 months, an unacceptably long time period, for the reasons explained above.

After a review of comments, the relevant scientific literature, and regulations of other governmental agencies, MSHA has concluded, and the final rule reflects, that annual audiometric testing is both necessary and appropriate, and is an integral part of a comprehensive hearing conservation program.

Revised Baseline Audiogram

Paragraphs (c)(1) and (c)(2) of § 62.170 of the final rule, which have been adopted from proposed §§ 62.140(d)(1) and (d)(2), require that the mine operator establish a revised baseline audiogram when:

(1) the standard threshold shift revealed by the annual audiogram is persistent; or

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

These requirements are the same as those in OSHA's noise standard, and, in response to commenters, MSHA has adopted the term used by OSHA of "revised baseline audiogram" rather than "supplemental baseline audiogram" used in the proposed rule.

Many commenters favored revising the baseline if a standard threshold shift is persistent. Several commenters suggested that MSHA adopt the guidelines of the National Hearing Conservation Association for revising baseline audiograms, to establish some consistency in determinations.

MSHA has concluded that allowing revision of the baseline after a standard threshold shift has been identified will prevent the same standard threshold shift from being identified repeatedly. The annual audiogram on which the standard threshold shift is identified then becomes the revised baseline audiogram. In addition, MSHA intends that each ear be treated separately when the baseline audiogram is revised. If the baseline is revised for both ears when only one has a standard threshold shift, detection of a standard threshold shift in the other ear may not be possible, even if the miner has lost a substantial amount of hearing sensitivity.

Under the final rule, the revised baseline audiogram should be compared with future annual audiograms to identify a second standard threshold shift. The original baseline audiogram continues to be used to quantify the total hearing loss, and is considered in determining whether the hearing loss constitutes a "reportable hearing loss."

Some commenters favored revising the baseline if the annual audiogram showed an improvement in hearing. One commenter recommended that a revised baseline be permitted only if the improvement in the miner's hearing was consistent for multiple consecutive tests. Another commenter stated that MSHA should not adopt the provision for revised audiograms in the final rule, because hearing sensitivity does not improve with noise exposure or increasing age. While it is true that hearing sensitivity does not improve; MSHA recognizes that audiometric tests can sometimes reflect an apparent improvement. Under the final rule, MSHA leaves it to the professional judgement of the medical professional or audiologist to conduct multiple tests

to confirm that the apparent improvement is real.

Paragraph (c)(2) requires revision of the baseline if the annual audiogram shows significant improvement in hearing level. This provision has been adopted unchanged from the proposal, and provides additional protection to the miner because it allows more accurate evaluation of the true extent of hearing loss that may occur in the future. When a baseline audiogram is revised due to an improvement in hearing sensitivity, the revised baseline must be considered the original baseline for determining when a standard threshold shift occurs and for quantifying the total reportable hearing loss under part 50. The latter is reflected in § 62.101 of the final rule, under the definition of a "reportable hearing loss."

Finally, one commenter suggested that separate baselines be kept for a standard threshold shift and otologic referrals. This measure is not needed, however, because the final rule requires that all audiograms be retained as part of the audiometric test record under § 62.171(b)(2). Revision of the baseline audiogram does not permit the destruction of the original baseline audiogram.

Temporary and Seasonal Miners

In the preamble to proposed § 62.120, MSHA solicited comments on how to best protect temporary or seasonal miners whose occupational noise exposures equal or exceed the action level. MSHA raised this issue because mines producing certain commodities, such as sand, gravel, and crushed stone frequently cease operations during the winter months. As a result, miners at these operations may only work part of the year, and protecting the hearing of these miners can be extremely problematic, given the long periods when miners are away from the mine site.

Some commenters believed that the fact that the proposal would allow mine operators 6 months to arrange for miners to receive baseline audiograms would effectively exclude most temporary or seasonal miners, because their employment relationship with the mine operator would end before the deadline for their audiometric testing had passed. Other commenters suggested that the use of hearing protectors on the job would adequately protect temporary miners from experiencing an occupational noise-induced hearing loss. One commenter suggested that it would be too burdensome for a mine operator to enroll miners who had worked less than one year in the audiometric testing program. Several

commenters opposed any exemption that would result in temporary miners receiving less protection than that provided to other miners.

OSHA has no exemption for audiometric testing for temporary or seasonal workers, and, like the proposal, MSHA's final rule does not provide any exemption for temporary or seasonal miners from the final rule's audiometric testing requirements. MSHA has determined that such an exemption would mean that miners who work intermittently in the mining industry may never receive an audiometric test to detect hearing loss, even if they work under very noisy conditions, and would never receive any of the protections required under the final rule for miners who have incurred hearing loss.

Although the 6-month time period (12 months where a mobile van is used) allowed under the final rule for obtaining an audiogram could effectively exclude many temporary or seasonal miners from the audiometric testing program, prudent mine operators will offer audiometric tests to temporary or seasonal miners and not take advantage of the 6-month period to avoid offering these miners audiometric tests.

Section 62.171 Audiometric Test Procedures

This section of the final rule establishes the procedural and recordkeeping requirements for the audiometric testing conducted under this part. This section specifies the frequencies to be used in the testing, and requires the mine operator to compile and maintain an audiometric test record for each miner tested. The requirements of this section are essentially the same as those proposed in § 62.150, with several relatively minor changes.

Paragraph (a) of this section of the final rule adopts the proposed requirement that audiometric testing under part 62 be conducted in accordance with scientifically validated procedures. MSHA's metal and nonmetal noise standards do not contain audiometric testing provisions. While MSHA's noise standards applicable to coal mines require audiometric testing, they do not include any procedural requirements for this testing. The final rule does not specify detailed procedures for audiometric testing, calibration of audiometers, or qualifying of audiometric test rooms. Instead, the final rule takes a performance-oriented approach, not only to allow flexibility in compliance but also to accommodate technology developed in the future. The final rule

specifies basic parameters for the testing while allowing the physician or the audiologist to use professional judgment in selecting the appropriate testing procedures.

This aspect of the proposal generated a significant amount of comment. Several commenters stated that the proposed requirement that tests be conducted in accordance with "scientifically validated procedures" was too vague, and recommended that the final rule clarify or define the phrase "scientifically validated procedures." Some commenters believed that if the Agency failed to specify the test procedures that should be followed, audiometric test results would not be uniform. Other commenters, some of whom strongly supported a performance-oriented approach to testing procedures, suggested that the final rule include an appendix specifying the level of testing performance expected, or at least providing examples of acceptable procedures that may be followed. Commenters stated that this would allow mine operators to determine if the procedures they have adopted comply with the requirements of the final rule.

Several commenters recommended specific changes regarding audiometric testing, including audiometric test instruments, calibration procedures, and audiometric test rooms. Several commenters believed that the audiometric testing procedures required by the final rule should be identical to OSHA's requirements, which contain detailed testing procedures in 29 CFR § 1910.95(h) and in associated appendices. Others recommended that the final rule require audiometric testing to be conducted in accordance with several standards of the American National Standards Institute (ANSI), including ANSI S3.21-1978, "Methods for Manual Pure-Tone Threshold Audiometry," which provides detailed procedures for conducting audiometric tests; ANSI S3.1-1991, "Maximum Permissible Ambient Noise Levels for Audiometric Test Rooms," which provides a criterion for the maximum background sound pressure levels to obtain a valid audiogram; and ANSI S3.6-1996, "Specification for Audiometers," which provides design criteria for various classes of audiometers.

Some commenters suggested that MSHA specify calibration procedures for audiometers. The suggestions included requiring daily calibration of audiometers as well as annual laboratory calibration. Other commenters recommended that MSHA specify the maximum background

sound pressure levels acceptable during audiometric testing.

Several commenters suggested, in the absence of a definition for "scientifically validated procedures," that the final rule provide that if the qualified professional who conducts the audiometric tests certifies the test's scientific validity, the mine operator is permitted to rely in good faith on such certification.

After reviewing the comments, the scientific literature, and several governmental standards, MSHA has concluded that the final rule should adopt the proposed performance-oriented approach, and should not include detailed, highly technical procedures and criteria for conducting audiometric testing in the final rule. Instead, the final rule adopts the proposed requirement that audiometric testing procedures be governed by scientifically validated procedures, which would be any method or procedure that has been proven to be effective and is generally recognized by experts in the technical field. Such procedures may be incorporated, for example, into consensus standards, governmental specifications, or military regulations, including OSHA's audiometric testing procedures and criteria or the procedures included in the three ANSI standards referenced above.

MSHA anticipates that most audiograms conducted under the final rule will employ the procedures specified in OSHA's noise standard, in large part because many physicians and audiologists are already familiar with those procedures, and many computer programs used for or in conjunction with audiometric testing are based on that standard. Further, many audiology texts and training courses of the Council for Accreditation in Occupational Hearing Conservation (CAOHC) reference OSHA's audiometric testing procedures and criteria in detail. OSHA's audiometric testing requirements and associated appendices can be found in 29 CFR § 1910.95. To assist the mining community in complying with the audiometric requirements in the final rule, MSHA will post OSHA's requirements on our Internet Home Page at www.msha.gov.

Another possible source of acceptable procedures under the final rule are the recommendations provided by audiometer manufacturers on audiometer use and calibration (in both the laboratory and the field). These equipment manufacturers are in a position to issue specific recommendations on the use and calibration of their audiometers. By

following manufacturer's recommendations, accurate audiometric testing will be ensured.

Under the final rule the individual who conducts the testing must have the specialized qualifications of a physician, audiologist, or technician, all of whom should be knowledgeable and familiar with scientifically validated procedures and capable of exercising professional judgment in choosing the appropriate testing procedures. Further, the final rule allows the use of any scientifically validated procedure, which provides flexibility for the use of new procedures or technology that may be developed in the future. This means that if a new, possibly more accurate, procedure is developed and has been scientifically validated, the physicians and audiologists who perform audiometric testing under this part may readily adopt its use.

Test Parameters

Paragraph (a) of § 62.171 of the final rule, like the proposal, requires that audiometric tests be pure tone, air conduction, hearing threshold examinations, with test frequencies at 500, 1000, 2000, 3000, 4000, and 6000 Hz. The final rule also requires that each ear is to be tested separately. This aspect of the final rule is consistent both with OSHA's requirements for audiometric testing frequencies and with NIOSH's recommendations in its 1972 Criteria Document. Existing MSHA regulations do not include any specifications for audiometric testing.

A few commenters directly addressed the audiometric test parameters in the proposal. Of these, one commenter specifically supported the test frequencies as proposed. A few other commenters supported the adoption of the test frequencies either in the OSHA noise standard or in ANSI S3.21-1978, "Methods for Manual Pure-Tone Threshold Audiometry," and ANSI S3.6-1996, "Specification for Audiometers," or a combination of these standards. As stated above, the test frequencies required by the final rule are identical to those required in OSHA's noise standard. The ANSI standards include the additional test frequencies of 250 and 8000 Hz. Other commenters supported adding 8000 Hz to the test frequencies included in the proposal. These commenters believed that adding the frequency of 8000 Hz would assist the evaluator of the audiogram in determining the cause of the hearing loss more accurately. Commenters pointed out that because this frequency is standard on audiometers manufactured since 1974, inclusion of this frequency would not

present a significant burden on the individual conducting the test.

As noted elsewhere in this preamble, noise-induced hearing loss is a permanent sensorineural condition that cannot be improved medically, and is characterized by a declining sensitivity to high frequency sounds. This loss usually appears first and is most severe at the 4000 Hz frequency, and the "4000 Hz notch" in the audiogram is typical of noise-induced hearing loss. Continued exposure causes the loss to include other audiometric test frequencies, with 500 Hz being the least affected. While 500, 1000, and 6000 Hz are not included in the definition of a standard threshold shift, MSHA, like OSHA, believes that these test frequencies contribute to a more thorough audiometric profile and are helpful in assessing the validity of the audiogram as a whole. Testing at 500 and 1000 Hz makes it easier for an audiologist or physician to differentiate conductive hearing loss from noise-induced hearing loss, and testing at 6000 Hz allows better differentiation between age-induced and noise-induced hearing loss, so testing at 8000 Hz is unnecessary. However, this would not prevent testing at additional frequencies.

Audiometric Testing Records

The requirements of paragraphs (b)(1) through (b)(5) of § 62.171 of the final rule specify which audiometric testing records a mine operator must maintain. They have been adopted from proposed § 62.150(c) with one change. Under the final rule mine operators are required to compile an audiometric test record for each miner tested, including the miner's name and job classification, copies of all of the miner's audiograms required under part 62, evidence that the audiometric tests were conducted in accordance with paragraph (a) of this section, any exposure determinations for the miner, and the results of any follow-up examinations. The proposal would have required the mine operator to obtain a certification from the physician or audiologist that the audiometric testing had been conducted in accordance with scientifically validated procedures. In lieu of this requirement, the final rule provides greater flexibility by requiring evidence that the audiograms were conducted in accordance with the final rule's requirements. MSHA's existing standards currently contain no recordkeeping or record maintenance requirements.

Many commenters raised issues concerning the proposed requirements for audiometric testing records. Several commenters proposed that MSHA adopt

the requirements of OSHA's noise standard, which requires not only the name and job classification of the employee, but also the date of the last acoustic or exhaustive calibration of the audiometer. OSHA also requires employers or audiometric test service providers to maintain an accurate record of background sound pressure levels in audiometric test rooms. However, as discussed above, OSHA's noise standard includes specific procedures for audiometric testing, and the additional records required under OSHA's standard are intended to show that the required procedures have been followed. Without such specific procedures, these additional records are unnecessary. OSHA's noise standard, like the final rule, requires that employers maintain a record of audiometric test results.

One commenter requested clarification of the recordkeeping requirement, asking if it was limited to individual readings for specific miners or also included records of area or group monitoring. The requirement covers only personal noise exposure determinations, because this information will allow persons evaluating audiometric testing results to make a better determination regarding the nature of a miner's hearing loss.

The recordkeeping requirements for audiometric testing in the final rule provide essential information to MSHA and to health professionals for the evaluation of a miner's audiogram. The information is also necessary for identifying the audiograms, for evaluating whether the audiometric tests have been conducted properly, and for determining whether the results are valid. Further, the information is critical to the evaluator in determining whether an identified hearing loss is occupationally induced or aggravated by occupational noise exposure.

Section 62.150(b) of the proposal would have required mine operators to obtain a certification from the physician or audiologist responsible for conducting audiometric tests under this part that such tests had been conducted in accordance with scientifically validated procedures. In its place paragraph (b)(3) of this section of the final rule requires that the audiometric test record include evidence that the audiometric tests conducted under part 62 have been conducted in accordance with the scientifically validated procedures required under paragraph (a) of this section.

One commenter was of the opinion that mine operators should be allowed to rely on the professionals certifying the audiometric test results, and should

not be held responsible for improper procedures if they have received a certification from the professional conducting the test. Another commenter believed that, since the proposal would already require that the person conducting the test have minimum qualifications, such a certification would be unnecessary.

Some commenters, who believed that requiring mine operators to obtain a certification for each individual audiogram was unduly burdensome, stated that the final rule should allow mine operators to obtain a certification for a group of audiograms.

The Agency agrees with commenters that the certification requirement set forth in the proposal would be unnecessarily rigid. However, MSHA has also concluded that some type of evidence is necessary to indicate that the audiometric tests conducted under this part are in accordance with scientifically validated procedures. Therefore, the final rule provides that audiometric test records required to be maintained must include evidence that the audiograms were conducted in accordance with paragraph (a) of this section of the final rule, which provides that scientifically validated procedures must be followed. Such evidence could include a letter from a physician, audiologist, or qualified technician that states which audiometric test procedures have been followed. A billing record that indicates the test procedures used would also be acceptable. Finally, the audiogram itself may include information about the test procedures used sufficient to satisfy this requirement. Other types of evidence not listed here may also be acceptable under the final rule, provided they reflect compliance with the procedural requirements of the final rule. Evidence that a group of audiograms were conducted in accordance with required procedures would also be sufficient, provided that it makes clear which audiograms are involved. This responds to commenters who believed the proposed requirements, which could have been read to require an individual certification for each audiogram, were unnecessarily burdensome.

MSHA agrees that the mine operator would ordinarily not have sufficient medical knowledge to determine if the tests were properly conducted, and would ordinarily rely on the physician, audiologist, or qualified technician to provide the evidence required under this paragraph. The final rule does hold the mine operator responsible for obtaining this evidence from these professionals—MSHA assumes that mine operators, as a result of their

business or contractual relationships with providers of audiometric tests, can easily specify that such evidence must be provided as part of the terms and conditions of the service agreement.

Paragraph (c) of § 62.171 of the final rule, which has been adopted with two changes from proposed § 62.150(d), specifies the location and duration for maintenance of the testing records compiled under paragraph (b). In response to commenters, the final rule does not adopt the proposed requirement that the records be maintained at the mine site. The final rule also clarifies that these records must be made available for inspection by an authorized representative of the Secretary of Labor. MSHA's existing standards contain no requirements in this area. OSHA standards require that audiometric testing records, along with all other employee medical records required to be kept under OSHA standards, be maintained for at least the duration of the worker's employment plus 30 years, with the exception of employees who have worked for less than one year for the employer. Additionally, the OSHA rule provides that employee medical records need not be retained beyond the term of employment if they are provided to the employee upon termination.

MSHA received a number of comments specifically addressing time frames for maintaining audiometric test records. Commenters recommended several different periods of record retention beyond the duration of the miner's employment—6 months, 12 months, or 30 years, which is the retention period required by OSHA. Requirements for maintenance and retention of audiometric test records of the U. S. armed forces, including the Navy, the Air Force, and the Army, and several foreign countries require the retention of audiometric test records for at least the duration of the test subject's employment, and in most cases for some period of time after the termination of employment.

MSHA's rationale in requiring retention of audiometric test records for at least 6 months beyond the duration of the miner's employment is that the miner's risk of occupational hearing loss stops with the cessation of employment.

Retention of audiometric records for an additional 6 months will ensure that the records remain available for use by the mine operator to conduct further evaluations should the miner return to employment within that period. This 6-month retention period does not place an unduly heavy paperwork burden on mine operators, but also addresses the seasonal operations in the metal and

nonmetal mining industry, which cease operations during the winter months every year. MSHA expects that the periods of unemployment experienced by miners at those operations generally will not exceed 6 months, thus ensuring that these miners' audiometric records will be retained throughout their cycles of employment.

Under the final rule, "duration of employment" is the period of time between the date of a miner's initial hiring and the date on which the miner is released, quits, retires, or is otherwise separated. There must be a period of at least 6 months after formal termination of employment before a mine operator can destroy the audiometric test records. Moreover, under the final rule, a layoff, strike, lockout, furlough, period of leave (paid or unpaid), or other temporary break in service is not considered a formal termination of employment, even if it exceeds 6 months.

MSHA expects that many mine operators will retain miners' audiograms long after the miners' employment ceases, because the records could prove to be relevant if a miner should file a subsequent workers' compensation claim for hearing loss, especially because some states allow workers to file such a compensation claim many years after termination of employment.

Many commenters took issue with the proposed requirement that audiometric testing records be maintained at the mine site, and requested that MSHA permit the records to be stored at a site remote from the mine. These commenters believed maintaining these records at the mine would be burdensome, and that it may be much more efficient for many mine operators to store records at a central site, especially if several small mining operations were in the same general vicinity.

MSHA agrees with the points made by these commenters, particularly in light of the fact that electronic records are becoming more common in the mining industry, and may be stored on computer at a centralized location. The final rule therefore allows mine operators to keep audiometric test records at a location other than the mine site. However, the records must be stored within sufficient proximity to the mine to allow the mine operator to produce them to an MSHA inspector within a relatively short time. MSHA expects that in most cases this period will be no longer than one business day.

The final rule also clarifies that these records must be available for review by an authorized representative of the Secretary of Labor. MSHA inspectors already have the authority to review

records required to be kept by the Mine Act or by the regulations established under it; this added language merely affirms this authority.

Section 62.172 Evaluation of Audiograms

This section of the final rule has been adopted unchanged from proposed § 62.160. It establishes the requirements for evaluating audiograms conducted under part 62. This section requires that the mine operator inform the person evaluating the audiogram of the requirements of this part and provide the evaluator with copies of the miner's audiometric test records. Additionally, the mine operator is responsible for having a physician, audiologist, or qualified technician determine if an audiogram is valid and if a standard threshold shift or reportable hearing loss has occurred.

This section also includes a provision to protect miners' non-occupational medical findings or diagnoses from disclosure to the mine operator and requires a prompt audiometric retest if a miner's audiogram is invalid. Finally, this section permits, but does not require, the adjustment of results of audiometric tests for age-induced hearing loss. Tables for this purpose are included in the final rule.

MSHA's existing noise standards do not address the evaluation of audiograms. The requirements in this section are similar to the requirements of OSHA's noise standard; the few differences are noted below.

A number of commenters noted that, although a doctor can distinguish hearing loss that has been caused by illness or injury from hearing loss caused by noise exposure, it is not possible to distinguish between hearing loss from work-related noise exposure and from non-work-related noise exposure. These commenters pointed out that many of their employees were very active during their non-working hours and had hobbies that could expose them to high sound levels, such as woodworking, hunting, motorcycling, snowmobiling, etc. These commenters took issue with the fact that, under the proposed rule, mine operators would be held responsible for all noise-induced hearing loss, regardless of whether it is occupationally related. MSHA agrees that hearing loss may result from many causes, not all of which are occupationally related. Under the final rule physicians and audiologists have the obligation to determine if the hearing loss was the result of or aggravated by occupational noise exposure or a medical condition aggravated by the use of hearing

protectors. If the hearing loss is not the result of or aggravated by occupational noise exposure or aggravated by the wearing of hearing protectors, mine operators would not be responsible for corrective action. In addition, the final rule allows correction of audiograms for hearing loss due to aging.

MSHA acknowledges that determining whether hearing loss is occupationally related is not always straightforward. However, physicians and audiologists conducting audiometric testing should routinely ask about a miner's employment history and both occupational and non-occupational noise exposures, in order to make reasoned assessments and conclusions about the source of any hearing loss that may be detected in the course of audiometric testing. If the miner's occupational noise exposures are minimal, and yet the miner has incurred a severe hearing loss, this should indicate to the physician or audiologist that he or she must look beyond the workplace for the cause of the hearing loss. The doctor can make an educated determination that a hearing loss is occupational based on certain patterns commonly seen in occupational loss. Some of these indicators are—

1. If the hearing loss is consistent in both ears;
2. If the loss is more severe in the higher speech frequencies;
3. If the patient has a history of exposures to noisy workplaces; and
4. If the patient has no evidence of illness or injury to the head or ears and there is no history of familial hearing loss or noisy pastimes (rock music, motorcycles, hunting). MSHA has concluded that taking this approach in such instances of uncertainty provides the best protection for miners.

Paragraph (a)(1) of § 62.172 of the final rule is adopted from proposed § 62.160(a)(1), and requires that the mine operator inform the person evaluating the audiogram of the requirements of part 62 and provide the evaluator with copies of the miner's audiometric test records.

The intent of this provision is to ensure that physicians and audiologists are sufficiently familiar with the final rule's requirements to evaluate miners' audiograms in compliance with the regulations. For example, the evaluator should be aware of how the final rule defines a standard threshold shift, the criteria in the final rule for audiometric retesting or medical follow-up, procedures for correction for age-induced hearing loss, and recordkeeping requirements. OSHA's noise standard requires employers to provide the evaluator of the audiograms with a copy

of the requirements of its standard, copies of the employee's baseline and most recent audiometric test records, the background sound pressure levels in the audiometric test room, and a record of audiometer calibrations. Under MSHA's final rule, the person conducting the audiometric testing and evaluation of the audiogram is required to use scientifically validated procedures, and therefore has some discretion over which procedures are used. No comments were received addressing this aspect of the proposal, and it has been adopted unchanged in the final rule.

Under paragraphs (a)(2)(i) and (a)(2)(ii) of this section, which have been adopted from § 62.160(a)(2) of the proposal, the mine operator must have a physician or an audiologist, or a qualified technician under the direction or supervision of a physician or an audiologist, determine if an audiogram is valid and if a standard threshold shift or reportable hearing loss has occurred. This requirement is consistent with provisions in OSHA's noise standard.

Several commenters stated that only those physicians with experience and expertise in hearing and hearing loss should be permitted to review audiograms. MSHA has concluded that physicians should be included among those professionals who may evaluate audiograms, for reasons addressed in greater detail in the preamble discussion for § 62.170 of the final rule.

Other commenters stated that the final rule should define what constitutes an invalid audiogram, in light of the fact that physicians, audiologists, and qualified technicians, under the direction of a physician or audiologist, are required to determine whether the audiogram is invalid. One commenter recommended that the final rule adopt the Head and Neck Surgery referral criteria of the American Academy of Otolaryngology for determining whether an audiogram is invalid.

MSHA has not adopted the suggestion above and does not provide a definition for invalid audiogram, or a list in the final rule of the deficiencies that could render an audiogram invalid. Instead, the final rule requires that this assessment be made by qualified professionals—physicians, audiologists, and qualified technicians—and relies on their professional judgment and expertise in determining whether an audiogram is valid. These professionals are free to use whatever criteria they deem appropriate in making such a determination, including the American Academy of Otolaryngology referral criteria referenced above. In any case, it would not be possible to provide an

exhaustive list of indicators of possible invalid audiograms. However, some factors that may indicate an invalid audiogram include, but are not limited to: large differences in hearing thresholds between the two ears; unusual frequency patterns that are not typical of noise-induced hearing loss; thresholds that are not repeatable; or an unusually large hearing loss incurred in less than a year.

One commenter advocated that the final rule require the supervising physician or audiologist to establish specific criteria for a technician to follow in determining whether the audiogram is valid or a standard threshold shift or a reportable hearing loss has occurred. This comment has not been adopted in the final rule, because the rule already requires that a qualified technician work under the supervision or direction of a physician or an audiologist. The physician or audiologist is ultimately responsible under the final rule for ensuring that the technician performs audiometric testing and evaluation with the requisite level of proficiency. MSHA has therefore concluded that it is unnecessary to include a specific requirement for making this determination.

Another commenter challenged the proposed requirement that the mine operator instruct the physician, audiologist, or qualified technician to determine if an audiogram is valid, maintaining that mine operators should rely on the medical professional's judgement instead.

MSHA agrees with commenters that mine operators typically would not have the expertise to determine the validity of an audiogram. However, the final rule places on mine operators the responsibility to ensure that miners are protected from occupational hearing loss. One part of an effective hearing conservation program is regular audiometric testing for miners at risk, and MSHA has concluded that it is appropriate to require mine operators to ensure that the professionals who conduct and evaluate audiometric tests do so in accordance with the requirements of the final rule.

Paragraph (a)(2)(ii) also requires the evaluator of the audiogram to determine whether a miner has incurred a standard threshold shift in hearing. Determination of a standard threshold shift triggers specific remedial actions, designed to prevent additional hearing loss. Commenters raised a number of issues concerning the appropriate definition for "standard threshold shift," defined in § 62.101 of the final rule, which are addressed in detail in the preamble discussion of that section.

Paragraph (a)(2)(ii) of this section of the final rule also requires the evaluator of audiograms to determine if there has been a "reportable hearing loss." Under part 50 of MSHA regulations, mine operators must notify MSHA within ten working days of detection of a miner's hearing loss. "Reportable hearing loss" is defined in § 62.101 of the final rule as a change in hearing sensitivity for the worse relative to a miner's baseline audiogram, of an average of 25 dB or more at 2000, 3000, and 4000 Hz in either ear. Several commenters disagreed with the proposed definition of "reportable hearing loss," and this issue is discussed in detail in the preamble in § 62.101.

Paragraph (a)(3) of this section of the final rule adopts proposed § 62.160(a)(3), with one addition, and requires the mine operator to instruct the physician, audiologist, or qualified technician not to reveal to the mine operator, without the written consent of the miner, specific findings or diagnoses unrelated to the miner's exposure to occupational noise or the wearing of hearing protectors. In response to commenters, the final rule includes qualified technicians among those who would receive this instruction. Although OSHA's air quality standards and benzene and lead standards contain similar provisions, neither MSHA's nor OSHA's noise standard currently includes such a restriction.

This aspect of the proposal elicited many comments. A number of commenters opposed the proposed restriction, for a variety of reasons. Some stated that if the physician or audiologist discovers a condition that could affect the safety or health of the miner or other miners in the workplace, the mine operator should be provided with that information, and the miner should not be permitted to withhold it. Others believed that if mine operators are required to pay for the testing, they are entitled to have access to the information. Still others believe that because mine operators are responsible for protecting miners against noise-induced hearing loss, all information relating to the miner's hearing loss, whether occupationally related or not, should be made available to mine operators or persons employed by operators to administer hearing conservation programs or who are responsible for the working conditions and job assignments of individual miners. On the other hand, one commenter stated that voluntary audiometric testing results should be treated as confidential medical information, and not be disclosed to anyone without the miner's consent.

MSHA has concluded that some protection must be provided to individual miners' medical information that is not occupationally related. Accordingly, to safeguard the privacy of individual miners, the final rule adopts the proposed provision that requires mine operators to instruct the physician or audiologist conducting the audiometric test not to reveal to the mine operator information that is not occupationally related.

Although MSHA agrees that it is conceivable that some non-occupational medical conditions (such as an inner ear condition that affects the miner's balance) discovered during an audiometric examination could have a bearing on a miner's safety at the mine site, it has concluded that concerns for the miner's privacy outweigh the mine operator's need for such information. Any greater access to results of audiometric testing could discourage miners from submitting to this voluntary testing. In any case, the miner is free to share such information with the mine operator if he or she chooses to do so.

Other commenters were concerned about the impact the proposed restriction would have on the ability of mine operators to defend against hearing loss claims filed under state workers' compensation laws. These commenters were afraid that the restriction would limit mine operators' access to relevant information on non-occupationally related conditions discovered during the course of audiometric testing, and would therefore prevent them from using this information as a defense. Nothing in the final rule would prevent a mine operator from arranging a medical examination for a miner to determine the validity of a workers' compensation claim. Such an examination would be outside the purview of this rule and not subject to the limitations imposed under this section. Additionally, information that is relevant to a workers' compensation claim may be subject to the discovery process in civil litigation and may be required to be produced under state law. The restriction in the final rule would not preclude such disclosure.

One commenter suggested that the final rule should make clear that physicians and audiologists who are employees of the mine operator have the same access to test findings and diagnoses as any other physician or audiologist, even though the company-employed professionals could be considered to be agents of the mine operator. The commenter believed that a literal interpretation of this provision

would preclude company physicians or audiologists from either conducting audiometric tests or evaluating audiograms. MSHA agrees that medical professionals conducting audiometric testing who are employees of the mine operator should have the same access to test findings and diagnoses, and are bound by the same strictures on confidentiality as professionals who are independently employed. However, MSHA has concluded that clarification of this interpretation in the preamble is sufficient, and no specific provision needs to be included in the final rule.

Several commenters pointed out that the proposal would require the mine operator to instruct the physician or audiologist not to reveal information to the mine operator, but would not require a qualified technician performing the audiometric testing to be similarly instructed. This commenter believed that technicians should be given the same direction by the mine operator. As stated above, MSHA has adopted this comment in the final rule for consistency. The expectation is that the physician, audiologist, or qualified technician will receive the instruction from the mine operator and will ensure that the information will be protected.

Under paragraph (a)(4) of § 62.172 of the final rule, which has been adopted without change from § 62.160(a)(4) of the proposal, the mine operator must obtain the audiometric test results and the interpretation of the results from the person evaluating the audiogram within 30 days of the testing. OSHA's noise standard does not specify a deadline for the evaluation of audiograms.

Some commenters stated that 30 calendar days may not be sufficient for a mine operator to obtain audiometric test results from the test provider. Several commenters expressed concerns about this deadline, and felt that it would be unrealistic, particularly if a mobile test van provides the audiometric testing. A number of commenters suggested the deadline be extended to 60 days. One other commenter believed that 75 days would be appropriate. Other commenters believed it would be unfair to penalize the mine operator, who has little or no control over the promptness with which the test provider furnishes test results to the operator. Several commenters suggested that the final rule require mine operators to do what they can to obtain test results within 30 days, but should not penalize operators for late results when the delay is beyond their control. In contrast, one commenter recommended that the time limit be reduced to 15 days.

MSHA has determined that a 30-calendar-day time limit for the evaluation of audiograms is reasonable, and is necessary to prevent undue delays in the evaluation of the audiogram and in notification of the miner of the results. Because § 62.175 of the final rule allows mine operators 10 working days after receipt of test results to notify a miner of those results, more than 40 days may pass from the date of an audiometric test until the miner receives notification of the test results. In those cases where an audiometric retest is appropriate, miners may not receive their test results more than 100 days after the initial testing. MSHA has concluded that increasing the deadline to 60 or 75 days would result in unacceptably long delays in miner notification. Moreover, contrary to the assertions of commenters, MSHA does not believe that mine operators have little or no control over the promptness with which test results will be furnished. Under the final rule mine operators will either directly employ test providers, in which case meeting the 30-day time frame will be directly within their control, or contract for this service, in which case they may ensure that compliance with the 30-day deadline is a requirement of the contract. Accordingly, MSHA has concluded and the final rule reflects that the mine operator must obtain the requisite evaluation of an audiogram within 30 days.

Paragraph (b)(1) of § 62.172 of the final rule, which is adopted from § 62.160(b)(1) of the proposal, requires the mine operator to offer an audiometric retest within 30 calendar days of receiving a determination that an audiogram is invalid, provided any medical pathology has improved to the point that a valid audiogram may be obtained. If the results of an annual audiogram demonstrate a standard threshold shift or a reportable hearing loss, paragraph (b)(2) of this section allows a mine operator to offer the miner one retest within 30 calendar days of receiving the results. This will allow mine operators to verify the results of the annual audiogram. The mine operator may then substitute the results of the retest for the annual audiogram. These provisions are similar to provisions in OSHA's noise standard, which permits a retest within 30 days to confirm a standard threshold shift, but which does not specifically require a retest if the audiogram is judged to be invalid.

Few comments were received on this aspect of the proposal. One commenter stated that scheduling miners for a retest can be difficult, and recommended that

the final rule allow 60 days for a mine operator to offer a miner a retest. One other commenter recommended that MSHA adopt the provisions in OSHA's standard for audiometric retests if a standard threshold shift is found.

Under the final rule, audiometric retesting where a miner's initial audiogram has been determined to be invalid must occur within 30 calendar days, provided that any medical pathology that may have prevented the taking of a valid audiogram has improved to the point where a valid retest can be conducted. It should be noted that the 30-day period does not begin until the medical pathology causing the problem has improved. The provision in paragraph (b)(2) for a retest after detection of a standard threshold shift allows the mine operator to substantiate that the shift has occurred and confirm that the hearing loss detected is permanent before taking required corrective actions such as miner retraining and review of the effectiveness of noise controls at the operator's mine. In the event that the miner declines to submit to a retest, the 30-day period within which corrective action must be taken would begin from the date of the miner's refusal of a retest.

MSHA has concluded that 30 days is a reasonable deadline for audiometric retesting, recognizing that 30 days may not be sufficient time for a retest if a mine operator must rely on a mobile test van to provide the retesting. However, where retesting is necessary, MSHA believes that it should be conducted as quickly as possible, and the mine operator may find it necessary to send the miner to the nearest available testing facility rather than waiting for a mobile test van.

Paragraph (c) of § 62.172, which is adopted unchanged from proposed § 62.160(c), allows the adjustment of audiometric test results for the contribution of age-induced hearing loss in determining whether a standard threshold shift or reportable hearing loss has occurred. Adjustment of audiometric test results for age-induced hearing loss is optional under the final rule; however, any such adjustment must be made to both the baseline and annual audiograms, in accordance with the procedures set forth in paragraphs (c)(1) through (c)(3). For each audiometric test frequency, determine from Table 62-3 or 62-4 the age correction values for the miner by: (1) Finding the age at which the baseline audiogram or revised baseline audiogram was taken and recording the corresponding values of age corrections at 2000 Hz through 4000 Hz;

(2) Finding the age at which the most recent audiogram was taken and recording the corresponding values of age corrections at 2000 Hz through 4000 Hz; and (3) Subtracting the values found in step (1) from the value found in step (2). The differences calculated represent that portion of the change in hearing that may be due to aging. For example: the miner is a 32-year-old male. The audiometric history for his right ear is shown in decibels below.

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

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 62-3 and find the age correction values, in dB, for 4000 Hz at age 27 and age 32.

	Frequency (Hz)		
	2000	3000	4000
Age 32	5	7	10
Age 27	4	6	7
Difference	1	1	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).

OSHA's noise standard also permits the use of age-induced hearing loss

correction factors at the employer's option. OSHA's rationale for inclusion of these correction factors is that they 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 hearing loss due to noise exposure.

Many commenters who addressed this issue supported the use of age correction factors. Some of these commenters believed that failure to adjust audiometric test results based on a miner's age would result in inaccurate data, and may indicate that there is a higher incidence of hearing loss due to workplace noise exposure than actually would be occurring. Some commenters stated that many older miners would be found to have a standard threshold shift. As a result, mine operators would be required to take unnecessary corrective measures at their mines to address these miners' hearing loss, which may be unrelated to occupational noise exposure. One commenter stated that adjustment for age-induced hearing loss is a widely accepted practice, and is supported by the scientific community and by the relevant scientific literature. Some commenters opposed the use of age corrections, because they were concerned that it could interfere with the detection of noise-induced hearing loss in some miners, and because necessary corrective actions would not be taken, and the miners' hearing would be permitted to deteriorate even further.

NIOSH currently recommends that audiograms not be corrected for age, based on the reasoning that it is inappropriate to apply age correction factors from a population to an individual. NIOSH maintains that if a worker's audiogram is to be corrected for age, the hearing loss of a non-occupational noise-exposed group with the same demographic characteristics as the worker should be used.

MSHA has concluded that the optional use of age correction factors is appropriate, and has adopted in the final rule the proposed provisions that allow it. Such adjustments are consistent with current scientific practice and with OSHA's noise standard.

MSHA agrees that not all individuals' hearing is affected to the same degree by age. Additionally, studies have shown that individuals in environments free from noise exposure display little evidence of age-induced hearing loss. However, MSHA agrees with the commenters who stated that failure to allow age correction in the final rule would result in many miners being

found to have incurred standard threshold shifts, when the primary cause of the shift is the aging process.

The age correction procedures and tables included in the proposal and adopted in the final rule are those that were used by NIOSH in its 1972 Criteria Document on Occupational Exposure to Noise. Although there may be slight variations in adjustment at individual frequencies among similar tables developed by other researchers, the NIOSH age values are similar to those of other widely accepted and applied age-induced hearing loss data bases, such as the database of the U.S. Public Health Service, the data used by Robinson and Burns, and those of Passchier-Vermeer. The NIOSH data are derived from a highly screened population, that is, one which excluded individuals with any significant noise exposure on the job, off the job, or during military service. Use of a single set of age values will standardize the process of determining standard threshold shifts nationwide. Proposed Tables 62-3 and 62-4 have been adopted under the same numbers in the final rule.

Section 62.173 Follow-Up Evaluation When an Audiogram Is Invalid

This section of the final rule has been adopted from § 62.170 of the proposal, and establishes requirements for a follow-up evaluation of a miner's hearing if a valid audiogram cannot be obtained because of a suspected medical pathology caused or aggravated by noise exposure or the use of hearing protectors. This section also provides that, in the event that the medical pathology is unrelated to noise exposure or to the use of hearing protectors, the mine operator must instruct the physician or audiologist to inform the miner of the need for an examination. Finally, mine operators must instruct the physician, audiologist, or qualified technician not to reveal to the mine operator findings or diagnoses unrelated to the miner's occupational noise exposure or the wearing of hearing protectors. MSHA's current noise standards have no provisions that address follow-up evaluations.

Paragraph (a) of § 62.173 of the final rule provides that if a valid audiogram cannot be obtained due to a suspected medical pathology of the ear, and the physician or audiologist evaluating the audiogram believes that the problem was caused or aggravated by the miner's exposure to noise or wearing of hearing protectors, a miner must be referred for a clinical-audiological or otological evaluation, as appropriate, at the mine operator's expense. Section 62.101 of

the final rule defines "medical pathology" as "a condition or disease."

Several commenters maintained that physicians should not be included among those who may determine that a miner needs a follow-up evaluation, because physicians who are not hearing specialists may not be qualified to determine that a miner needs a follow-up examination. MSHA has not adopted the suggestion of these commenters in light of the licensing and ethical standards that apply to physicians. The Agency expects that physicians will exercise professional judgment in assessing whether they possess the experience and qualifications to make the required medical determinations. This issue of the qualification of physicians is addressed in greater detail in the preamble discussion of § 62.170.

If the physician or audiologist believes that the suspected pathology that prevents taking a valid audiogram is related to occupational noise exposure or to the wearing of hearing protectors, the final rule requires the mine operator to pay for the miner's follow-up medical evaluations. Several commenters to the proposed rule were concerned that this could be read to require the mine operator to pay for a follow-up examination for an ear infection, if the audiologist or physician merely "believes" that the infection is aggravated by occupational noise exposure or the wearing of hearing protectors. These commenters stated that the mine operator should be required to pay only for treatment of conditions that actually result from noise exposure that occurs or hearing protectors that are used at the mine operator's facility.

The final rule reflects MSHA's conclusion that mine operators have primary responsibility for work-related medical problems. Under the final rule, if the physician or audiologist determines that the suspected medical pathology is unrelated to the miner's occupational noise exposure or to the wearing of hearing protectors, the mine operator must instruct the medical professional to inform the miner of the need for an otological examination. The final rule does not require the mine operator to pay for this examination, which will be at the miner's expense.

Another commenter suggested that mine operators be required to pay for follow-up evaluations only if there has been a determination of significant occupational noise exposure. The final rule does not adopt this comment, because a determination of the need for a clinical-audiological or an otological examination under this section should not be based solely on a miner's noise

exposure, but should be made after a review of a miner's audiometric records and a finding of a suspected medical pathology related to occupational noise exposure or the wearing of hearing protectors. In some cases information on a miner's noise exposure may be scarce or nonexistent. Although noise exposure measurements provided by the mine operator may form part of the basis upon which the qualified reviewer makes a determination, the final rule does not adopt the commenter's suggestion that mine operators be required to pay for follow-up examinations only when the miner has been exposed to significant occupational noise.

The preamble to the proposal noted that the type of follow-up evaluation that should be conducted as a result of the suspected medical pathology (clinical-audiological or otological) depends upon the specific circumstances in each case. Standards found in the international community and the U. S. armed forces vary to some degree regarding certain elements, such as the extent of follow-up examinations. A clinical-audiological evaluation is generally more comprehensive, intensive, and accurate than the routine audiometric testing conducted to identify a hearing loss, and may be warranted if, for example, an unusually large threshold shift occurs in one year given relatively low noise exposures. An otological evaluation, on the other hand, is a medical procedure conducted by a medical specialist such as an otolaryngologist to identify a medical pathology of the ear, such as an acoustic neuroma, a type of tumor. Another more common reason for an otological examination is for the removal of impacted ear wax, which reduces hearing sensitivity and can be aggravated by the use of earplug-type hearing protectors. Audiometric testing can indicate the existence of such medical pathologies.

Making the determinations under this section will not require a diagnosis by a physician-specialist confirming a medical pathology. The rule is intended to allow the audiologist or physician authorized to review the audiograms to make a determination as to whether a follow-up examination is appropriate and who pays for it. Accordingly, the word "suspected" precedes the words "medical pathology" in this section.

Finally, one commenter suggested changing the term "medical pathology" in this paragraph to "medical condition", because the term "pathology" implies illness. The final rule does not adopt the suggestion of this commenter, because the definition

of "medical pathology" in § 62.101 of the final rule is not limited to illness, and encompasses not only a "disease" but also a "condition" affecting the ear.

Paragraph (b) provides that if the physician or audiologist has concluded that the suspected medical pathology of the ear which prevents obtaining a valid audiogram is unrelated to the miner's exposure to occupational noise or the wearing of hearing protectors, the mine operator must instruct the physician or audiologist to inform the miner of the need for an otological evaluation. In such cases, the final rule imposes no financial obligation on the mine operator.

Paragraph (c) of § 62.173 adopts, with one addition, the proposed requirement that the mine operator instruct the physician or audiologist not to reveal to the mine operator any specific findings or diagnoses unrelated to the miner's exposure to noise or the wearing of hearing protectors without the written consent of the miner. As under the similar requirement in § 62.172, commenters suggested adding qualified technician to the list of persons that the mine operator must instruct. MSHA has adopted this suggested change in the final rule.

Some commenters were concerned that this restriction would be counterproductive and harmful to the miner in cases where the miner's medical condition should be better understood by the mine operator in order to allow the miner to be more effectively protected on the job. This aspect of the proposal, which is similar to the restriction in § 62.172(a)(3) of the final rule, was the subject of several comments. Some commenters were opposed to the proposed restriction for a variety of reasons. Some of these commenters stated that if the physician or audiologist discovers a condition that could affect the safety or health of the miner in the workplace, the mine operator should be provided with that information, and the miner should not be permitted to withhold it. One commenter was concerned about the impact the proposed restriction would have on the ability of mine operators to defend against hearing loss claims filed under state workers' compensation laws. Others maintained that because the mine operator is responsible for protecting miners against noise-induced hearing loss, all information relating to the miner's hearing loss, whether occupationally related or not, should be made available to the mine operator.

MSHA has concluded that some protection must be given to individual miners' medical information that is not occupationally related. Accordingly, to

safeguard the privacy of individual miners, the final rule adopts the proposed provision that requires mine operators to instruct the physician or audiologist not to reveal to the mine operator information not occupationally related. A more detailed discussion of the basis for MSHA's conclusion on this issue can be found in the preamble under § 62.172(a)(3).

Section 62.174 Follow-Up Corrective Measures When a Standard Threshold Shift Is Detected

This section of the final rule, which adopts the requirements of proposed § 62.180, establishes the corrective measures that must be taken by a mine operator when a miner is determined to have incurred a standard threshold shift in hearing sensitivity. This section provides that, unless a physician or audiologist determines that the standard threshold shift is neither work-related nor aggravated by occupational noise exposure, mine operators must take specified corrective actions within 30 calendar days after receiving evidence or confirmation of a standard threshold shift. "Standard threshold shift" is defined in § 62.101 of the final rule as a change in hearing sensitivity for the worse relative to the miner's baseline audiogram (or revised baseline audiogram) of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear.

The corrective actions that mine operators are required to take under § 62.174 of the final rule when a miner experiences a standard threshold shift include: Retraining the affected miner in accordance with § 62.180 of the final rule, providing the miner with the opportunity to select a different hearing protector, and reviewing the effectiveness of any engineering and administrative controls to identify and correct any deficiencies.

A number of commenters supported the need for intervention by the mine operator when a miner has experienced a standard threshold shift. Several of these commenters stated that it should not matter whether or not a standard threshold shift is work-related, and that intervention should be required in any case to prevent further hearing loss. One of these commenters stated that it is probably not realistic to believe that the mining industry can identify outside causes of hearing loss. Another commenter was of the opinion that miners whose audiograms indicate such a degree of hearing loss should still be provided with information and training on how they can protect themselves. Still another commenter stated that the final rule should require additional

actions, including examination of the noise exposure of the affected miner or of other miners with similar occupations. This commenter strongly supported a requirement that the mine operator investigate the cause of the miner's standard threshold shift.

One commenter believed that effective training and audiometric testing would make corrective measures after the detection of a standard threshold shift unnecessary. This commenter added that miners should be encouraged to take responsibility for their own health. Several other commenters stated that the proposed requirements for corrective action underscored a need for mandatory participation by miners in audiometric testing. These commenters maintained that an effective hearing conservation program must require miners to submit to such tests.

MSHA has concluded that it is essential that mine operators be required to take certain corrective measures to prevent further deterioration of miners' hearing sensitivity after a standard threshold shift has been detected. A hearing loss of 10 dB is sufficiently significant to warrant intervention by a mine operator, unless it is determined the loss is not work-related. If miners are experiencing that level of occupationally related noise-induced hearing loss, as determined by a physician or audiologist, it is a clear indication that the noise controls in place at the work site have been ineffective. In such situations further action is appropriate to determine why the miner has not been adequately protected.

Paragraph (a) of § 62.174 of the final rule requires that the miner be retrained, which includes the instruction required by § 62.180 of the final rule, under which training must address such topics as the effects of noise on hearing, the value and effective use of hearing protectors, the operator's and miner's respective tasks in maintaining mine noise controls, and the value of audiometric testing. Commenters on this aspect of the proposal generally supported the training requirement.

As indicated in the preamble to the proposal, if the noise controls in place are effective—including the training—this hearing loss should not be occurring. Providing the miner with retraining after the miner has experienced a standard threshold shift is intended to ensure that the miner is not inadvertently being overexposed to noise because of a lack of awareness about effective use of noise controls or hearing protectors. This retraining may also emphasize to the miner the

importance of regular audiometric testing, to ensure that the hearing loss does not progress. Also as indicated in the preamble to the proposal, the required training may be conducted in conjunction with annual refresher training under 30 CFR Part 48, but only if the training will be conducted within 30 days of the detection of the standard threshold shift, the time frame established in this section.

Paragraph (b), like the proposal, requires the mine operator to provide the miner with an opportunity to select a hearing protector, or a different hearing protector if the miner has previously selected a hearing protector, from among those offered by the mine operator in accordance with § 62.160. Several commenters advocated the inclusion of the additional requirement that the hearing protector be checked to ensure that it is in good condition, and replaced if necessary. These commenters also recommended that miners should be encouraged to select a hearing protector providing greater noise reduction.

The final rule, like the proposal, allows miners to select their own hearing protectors. The effectiveness of any hearing protector depends on a number of factors, only one of which is its noise reduction rating value. Even though a miner may not select the hearing protector with the highest noise reduction rating, factors such as comfort, fit, and personal preference are critical in ensuring that the miner will fully utilize this essential piece of personal protective equipment. Moreover, there is no standardized objective method to determine the degree of protection a given hearing protector will provide a miner. MSHA has therefore determined that requiring that miners be encouraged to select a hearing protector based primarily or exclusively on the protector's noise reduction rating value would not be well advised, and this comment has therefore not been adopted in the final rule. The final rule also does not adopt commenters' suggestions that mine operators be required to check the fit and condition of the hearing protector and replace it, if necessary, because these concerns are already addressed in other sections of the final rule. As § 62.180 of the final rule requires that miner training address the care, fitting, and use of hearing protectors, miners will be trained to evaluate the condition of their hearing protectors and notify the mine operator when the condition of the protector has deteriorated and needs to be replaced. The issue of selection and effectiveness of hearing protectors is

addressed in greater detail in the preamble discussion of § 62.160.

Several commenters supported the addition of a requirement that the miner use a hearing protector and the mine operator enforce its use when a standard threshold shift is detected. The final rule also requires that the mine operator provide and ensure that miners wear hearing protectors under certain conditions, including when the miner incurs a standard threshold shift and is exposed to noise at or above the action level. A more detailed discussion of mandatory use of hearing protectors is included under § 62.130 of the preamble, which addresses the permissible exposure level.

Paragraph (c) of this section of the final rule requires the mine operator to review the effectiveness of any engineering and administrative noise controls, in order to identify and correct any deficiencies. The implementation and maintenance of engineering and administrative noise controls when miners are subjected to noise exposures above the permissible exposure level is the primary method for reducing miners' noise exposure and their risk of hearing loss. Because ineffective engineering and administrative controls may be the primary cause of a miner's standard threshold shift, the final rule requires the mine operator to review the effectiveness of existing controls and update or modify them to enhance the protection provided to miners. OSHA's existing noise standard does not require such a review when a standard threshold shift is detected.

Some commenters supported the proposed review of engineering and administrative controls when a miner experiences a standard threshold shift. However, several commenters noted that a mine operator should not be required to review the effectiveness of engineering and administrative noise controls if the standard threshold shift occurs in a single miner and can be positively attributed to the inaction of that miner.

This comment has not been adopted in the final rule. Mine operators are responsible for protecting miners from overexposures to noise at the mine site. The mine operator must determine which are the best and most protective controls for the particular operation. The degree to which the noise controls that have been implemented rely on the actions of individuals may have some bearing on how well the controls work. Effective engineering noise controls protect the miner without the need for the miner's active participation. If the controls in place rely too heavily on the participation of a miner and have

proven to be inadequate (as evidenced by the detection of a standard threshold shift), a prudent mine operator will explore implementation of engineering controls that will be effective regardless of the miner's actions. The mine operator determines working conditions at the mine site and is responsible for ensuring the design, implementation, and use of effective controls to protect miners from overexposure to noise and resulting hearing loss.

Although the proposed rule would not have provided for the transfer of a miner with a diagnosed occupational hearing loss to a low-noise work environment, MSHA did solicit comments on whether a miner transfer provision was necessary. Some commenters stated that it would not be appropriate to include a miner transfer provision in the final rule, arguing that miners could manipulate audiogram results (for example, by listening to loud music prior to the test) in an attempt to force mine operators to move them to different, more desirable jobs. Other commenters supported the concept of a miner transfer provision, arguing that this is appropriate when other efforts to halt the progression of the miner's hearing loss have failed and that miners who were transferred should suffer no loss in wages or benefits as a result, similar to the provisions in MSHA's part 90 regulations for coal miners who have evidence of black lung disease.

The preamble to the proposed rule suggested that a miner transfer program would be extremely complex for mine operators to administer, and may be quite infeasible for the metal and nonmetal mining industry. The majority of metal and nonmetal mines are smaller mines, many of which would be unable to rotate miners with hearing loss to other, less noisy assignments on a long-term basis. Although MSHA encourages mine operators to transfer miners who have incurred a hearing impairment to jobs with reduced noise exposure, it has concluded that a miner transfer provision is not feasible at most small mining operations, due to the small number of employees and the limited number of positions with low noise exposure to which miners with hearing loss could be transferred. Because of the significant feasibility problems presented by mandatory miner transfer and the lack of consensus in the mining community on the advisability of a transfer program, the final rule does not adopt a miner transfer provision.

Section 62.175 Notification of Results; Reporting Requirements

This section of the final rule is identical to § 62.190 of the proposal,

providing for miner notification of audiometric test findings and for notification to MSHA of any instances of "reportable hearing loss," as defined in § 62.101 of the final rule.

Paragraph (a) of this section of the final rule requires that mine operators notify the miner in writing of the results of an audiogram or a follow-up evaluation within 10 working days of receiving the results. There are no existing MSHA regulations that impose such a requirement.

MSHA received no comments opposing a miner notification requirement, although several commenters believed that mine operators should be required to notify a miner of test results only when the results indicate a significant shift in the miner's hearing level, consistent with OSHA requirements. These commenters believed that miner notification was not warranted if the audiometric test indicated no additional hearing loss.

Commenters disagreed on the length of the period within which such notification should occur. Several commenters recommended that MSHA adopt the provision in OSHA's noise standard that requires employee notification within 21 days. Other commenters recommended a 15-day deadline, while still others believed that a 30-day deadline was appropriate. The commenters who supported a longer period believed that 10 days was insufficient to allow mine operators to review the audiograms and to provide the required notification, particularly if large numbers of miner audiograms were conducted and processed at the same time. One commenter stated that miners should be informed of a standard threshold shift at the time of the test, and provided with the results of audiograms within 5 days rather than 10.

Although no commenter specifically objected to the requirement that the miner notification be in writing, several commenters stated that the method of notification should be left to the discretion of the mine operator. Another commenter recommended that mine operators notify miners in a timely manner and also share the results with other miners during annual refresher training, apparently based on the belief that if miners hear of co-workers' hearing losses, it might serve to reinforce their own understanding of the need for noise controls and the importance of using hearing protectors.

After considering the comments, MSHA has concluded that informing miners of the results of their audiometric tests in a timely manner is critical to the effectiveness of a hearing

conservation program. Immediate feedback to the miner at the completion of the test provides the greatest benefit, because that is the point at which miners typically have the greatest interest in information on the effects of noise on their hearing, and are more likely to take action, such as wearing hearing protectors conscientiously; stringently complying with administrative noise controls; or continuing to submit to audiometric testing.

The Agency realizes that it may not be practical to inform miners immediately of the results of their audiometric tests. However, because of the importance of the information, it is necessary to establish a maximum time frame for mine operators to inform miners of the audiometric test findings and results. Therefore, the final rule adopts the requirements of the proposed rule and allows mine operators up to 10 working days after the receipt of test results to inform the miner. This means that mine operators will have up to two weeks to make this notification, which is a sufficient time frame for this notification.

MSHA has also concluded that it is appropriate to require written notification to miners of their test results. Important that miners are made aware of their test results, and written notice minimizes the risk of misunderstanding on the part of miners. Some commenters stated that notification is necessary only when a standard threshold shift has occurred, but MSHA believes that notification of good results serves to reinforce effective practices and strengthens the effects of a hearing conservation program.

Because of the confidentiality of audiometric test results, it would be inappropriate, as suggested by a commenter, for the final rule to require a mine operator to share an individual miner's test results with other miners. The final rule therefore does not adopt this comment.

Paragraph (a)(1) of this section adopts without change § 62.190(a)(1) of the proposal, and requires that the mine operator inform the miner of the results and interpretation of the audiometric test, including any finding of a standard threshold shift or reportable hearing loss. This differs from OSHA's noise standard, which only requires notification of a confirmed standard threshold shift. The requirements of this paragraph ensure that miners receive timely information of the results of their audiometric tests, and can take appropriate actions in conjunction with the mine operator, in order to reduce

further occupational noise-induced hearing loss.

Paragraph (a)(2) of § 62.175, like the proposal, requires that the mine operator notify the miner of the need and reasons for any further testing or evaluation, if applicable.

One commenter stated that a mine operator could not notify miners of the reason for further testing or evaluation, because under the proposal, adopted in § 62.173(c) of the final rule, mine operators would not be told of findings or diagnoses when the condition diagnosed is not work-related. MSHA has concluded that this limitation does not present an obstacle to mine operators notifying miners of the need and reasons for further testing or evaluation. If the problem encountered is occupationally related, the mine operator will be informed of the specific reasons why a follow-up is needed. If the problem is not occupationally related, the mine operator will be informed only that a follow-up is warranted and must pass that information on to the miner as part of the notification required under this section. MSHA expects that in most if not all cases miners will already be aware of both the need and reasons why a follow-up is recommended, because the person performing the audiometric tests will convey this information to them during the course of the test. Notification by the mine operator will reinforce any information that may have been provided to the miner during the test procedure.

Paragraph (b) of § 62.175 of the final rule, like the proposal, requires mine operators to inform MSHA when a miner has incurred a reportable hearing loss as defined in part 62, unless the physician or audiologist has determined the loss is neither work-related nor aggravated by occupational noise exposure. This provision parallels existing requirements in part 50, which require mine operators to report a miner's hearing loss whenever a physician determines that it is work-related, or whenever an award of compensation is made. Section 50.20-6 specifically includes noise-induced hearing loss as an example of a reportable occupational illness. However, § 62.101 of the final rule now provides an explicit definition of "reportable hearing loss," in order to clarify mine operators' compliance responsibilities and promote the development of improved data on hearing loss in the mining community.

Section 62.101 of the final rule adopts the proposed definition of "reportable hearing loss" as a change in hearing sensitivity for the worse, relative to the

miner's baseline audiogram, of an average of 25 dB or more at 2000, 3000, and 4000 Hz in either ear. The issue of the definition of reportable hearing loss is discussed in the preamble under § 62.101.

An important goal of the final rule is to clarify the level of hearing loss that is reportable to MSHA under part 50. MSHA acknowledges that its current reporting requirements have resulted in inconsistent reporting; some mine operators have reported even small hearing losses, while other operators only report a miner's hearing loss when the miner has received an award of compensation. In other cases, mine operators have not reported a miner's hearing loss even when an award of compensation was made because the miner had retired. Inconsistent reporting of miners' hearing loss may also stem from the fact that the definition of compensable hearing loss under workers' compensation laws varies widely from state to state. For these reasons, MSHA had concluded that its miner hearing loss data under part 50 tends to underestimate the prevalence or degree of hearing loss in the mining industry.

Providing a specific definition in the final rule for "reportable hearing loss" as it is used under part 50 is intended to eliminate exclusive reliance on workers' compensation awards as a criterion for defining when noise-induced hearing loss must be reported. Nevertheless, part 50 will still require that mine operators report to MSHA hearing loss for which an award of compensation has been made if the hearing loss has not been previously reported. Two examples of such cases are: (1) If the miner incurred the hearing loss before the current mine operator conducted the baseline or pre-employment audiogram and subsequent testing did not measure a reportable loss; and (2) if the miner has not been in a hearing conservation program or has not received an audiometric test while employed by the mine operator.

In determining what degree of occupational hearing loss should be reportable under part 50, MSHA gave serious consideration to the fact that a hearing loss of 25 dB diminishes the quality of life. The hearing loss that is reportable under the final rule, although not equal to material impairment, is substantial enough to diminish the quality of life, and it provides a reliable indication of the effectiveness of the existing action level and permissible exposure level.

Several commenters expressed support for the proposed provision, which is adopted unchanged in this

section of the final rule, that a mine operator is not required to report a miner's hearing loss to MSHA if a physician or audiologist has determined that the loss is neither work-related nor aggravated by occupational noise exposure. However, some commenters advocated that any hearing loss be presumed to be non-occupationally related, and that the final rule should require the physician or audiologist to determine definitively that the hearing loss is work-related before the hearing loss would be reportable. These commenters objected to the fact that the proposal seemed to presume that any hearing loss detected would be both noise-induced and work-related.

The final rule reflects MSHA's determination that it is reasonable to place the responsibility on the physician or audiologist to determine when a hearing loss is unrelated to the miner's occupational exposure to noise or to the wearing of hearing protectors. Although in some cases it may not be easy to determine whether an identified hearing loss is work-related or not, the final rule follows the approach of the proposal that the loss would be reportable in the absence of evidence that the hearing loss is not work-related. MSHA has concluded that this approach is the most protective for miners, and has adopted it in the final rule.

Several commenters stated that the rule is unclear regarding who would be responsible for reporting a loss when a miner has been employed by several operators. MSHA specifically solicited comments in the proposal on how to capture data on work-related noise-induced hearing loss that is not discovered until after the miner's employment is terminated, or that the miner had accumulated from work with several employers. Commenters did not provide any data, information, or suggestions. The final rule requires the mine operator currently employing the affected miner to report the hearing loss no matter where the miner may have incurred the loss, provided it has not been previously reported.

The final rule does not require that mine operators report the same "reportable hearing loss" to MSHA each year that the miner works at the mine. An additional report to MSHA under part 50 of a hearing loss involving the same miner is required only if the miner has incurred an additional 25-dB shift (50-dB shift from the original baseline). However, each ear should be treated independently in terms of reporting hearing loss, unless the reportable loss occurs in both ears during a particular year. Although not specifically required in the final rule, MSHA anticipates that

mine operators will report under part 50 the actual average hearing loss, the ear(s) in which the reportable loss occurred, and whether the audiograms were corrected for age-induced hearing loss.

Section 62.180 Training

This section establishes specific requirements for training miners under the final rule. These requirements are very similar to requirements proposed under §§ 62.120(b)(1) and 62.130. Under the final rule, training of miners is one of the elements of a hearing conservation program. Mine operators are required to enroll miners in hearing conservation programs under § 62.120, and to provide training under § 62.180 to miners whose noise exposure equals or exceeds the action level under § 62.120. Miners are also required under § 62.160(a)(1) to be trained before they select hearing protectors. Retraining the miner, including the instruction required under this section, is also required under § 62.174(a) when the miner is determined to have experienced a standard threshold shift.

Section 62.180(a) requires that mine operators provide miners with initial training under this section within 30 days of their enrollment in a hearing conservation program. Retraining at least every 12 months thereafter must be provided if a miner's exposure continues to equal or exceed the action level under § 62.120. The proposal would have required that mine operators provide a miner with initial training at the time that the miner's exposure exceeded the action level. In response to commenters who were concerned that the proposal did not set a deadline for such training, the final rule requires that initial training be conducted within 30 days of a miner's enrollment in the hearing conservation program. OSHA's noise standard includes training requirements that are similar to those in the final rule.

Paragraphs (a)(1) through (a)(7) of § 62.180 of the final rule, like § 62.130(a) of the proposal, establish specific requirements for the training and retraining of miners. Under the final rule, the mine operator must provide the miner with instruction in the areas of: the effects of noise on hearing; the purpose and value of wearing hearing protectors; the advantages and disadvantages of the hearing protectors to be offered; the care, fitting, and use of the hearing protector worn by the miner, and the various types of hearing protectors offered by the mine operator; the general requirements of part 62; the mine operator's and miner's respective tasks in maintaining mine noise

controls; and the purpose and value of audiometric testing and a summary of the procedures. Few commenters specifically addressed the topics in the noise training program. However, several commenters stated that it was important to stress the selection, fitting, use, and limitations of hearing protectors.

Although all commenters appeared to support the concept of training miners on noise-related topics, they disagreed about whether a separate training requirement was warranted. Some commenters believed that training miners under this part was unnecessary because miners are already required to receive training under existing MSHA regulations in part 48, which require regular training of miners on a variety of safety- and health-related topics, including the purpose of taking noise measurements. Some of these commenters were concerned that the training requirements under this part would create additional recordkeeping requirements for mine operators and would not serve any purpose, and they opposed adding additional training requirements under this part.

Other commenters stated that there is not enough time to cover all the topics required under part 48 training, and therefore separate training under this part was appropriate, to ensure that miners were well informed about the hazards of noise and how to ensure that they are adequately protected. Some of these commenters supported training on work-related noise hazards as well as proper fitting of hearing protectors. They argued that miners need training to make them aware of the damage acoustical energy can do to hearing, and that the proposed rule seemed to suggest that there was no need to train workers until they have been enrolled in a hearing conservation program. These commenters advocated training as a preventive measure rather than as after-the-fact treatment.

In the preamble to the proposed rule, MSHA stated that there is considerable precedent for requiring training as part of hearing conservation programs. As indicated in the preamble, Suter (1986) states, "Workers who understand the mechanism of hearing and how it is lost will be more motivated to protect themselves." Other researchers concur with this opinion (Wright, 1980; Royster et al., 1982). Moreover, the first line of defense against risks in mining has always been training. Accordingly, the final rule provides for annual instruction to enhance awareness of noise risks, operator requirements, and available controls. This training is required for any miner whose noise

exposure is at or above the action level, an exposure which MSHA has identified to be hazardous.

MSHA has determined that specialized training on the hazards of noise and the importance of hearing conservation is necessary because, as several commenters pointed out, part 48 training typically does not routinely include detailed training on noise and hearing loss. One reason for this, as commenters also pointed out, is that there are a number of safety and health topics required to be covered under part 48 in a relatively short period of time. This does not allow the type of in-depth training on a narrow topic that is contemplated under this final rule.

Several commenters took issue with the proposed requirement that the training be provided "at the time" that the miner's noise exposure exceeds the action level. These commenters stated that the language should be modified to allow the mine operator more flexibility regarding how and when training is conducted. Some commenters recommended one week, while others suggested that mine operators be allowed 30 days to satisfy this requirement, in order to accommodate varying shift schedules and to develop and conduct an effective training program. One commenter recommended that the final rule specify at least one hour of initial training be given and at least 30 minutes of annual retraining be given.

MSHA agrees that the language of the proposed rule could be read to allow mine operators little time to provide training under this part, and the final rule allows mine operators 30 days to provide the training after a miner has been enrolled in a hearing conservation program. Under § 62.120 of the final rule, mine operators must enroll a miner in a hearing conservation program when the miner's noise exposure equals or exceeds the action level. This time frame will ensure that miners receive the necessary training in a timely manner, while at the same time providing mine operators with a reasonable amount of time to provide the training.

The final rule does not provide detailed requirements for the training provided by the mine operator. Instead, like other performance-oriented aspects of this final rule, mine operators have the flexibility under this section to determine how best to provide the training as well as which programs are best suited to conditions at their mines. The final rule requires that certain topics be covered by this training, but does not specify how long the training must last nor what qualifications the

training instructors must have. Unlike part 48, the final rule does not require MSHA approval of the mine operator's training plan. However, mine operators may satisfy the requirements of the final rule and part 48 with the same training, provided that training complies with both sets of requirements.

MSHA intends that the training required under the final rule address the advantages and disadvantages of different types of hearing protectors, including earmuffs, earplugs, and canal caps as they relate to the needs of the miner and the specific conditions at the mine. In addition, the mine operator should discuss the specific advantages and disadvantages of any special hearing protectors offered.

MSHA recommends that mine operators tailor the training provided under the final rule to the operations at their mines, and may choose to emphasize certain topics more than others. Although the final rule provides a basic framework for minimum areas of instruction, the training requirements provided here are intended to be performance-oriented and allow for training to be tailored to the individual mine's circumstances or to individual needs.

Effective training of miners serves to enlist miner participation in hearing conservation, which is critically important for proper use of hearing protectors and compliance with applicable administrative noise controls. Effective training of miners also helps to ensure that miners will submit to regular audiometric testing, which is completely voluntary on the part of miners under the final rule. Studies have shown a correlation between instruction and the amount of protection afforded a miner by the use of hearing protectors. These include Merry et al. (1992), Park and Casali (1991), Barham et al. (1989), and Casali and Lam (1986).

Section 62.180(b) of the final rule adopts the proposed requirement that the mine operator certify the date and type of training given each miner and maintain the miner's most recent certification for as long as the miner is enrolled in the hearing conservation program and for at least 6 months thereafter. The final rule does not adopt the proposed requirement that the person conducting the training sign the certification, nor that the certification be maintained at the mine site.

A few commenters recommended that the miner be required to sign the training certificate. This comment has not been adopted in the final rule. MSHA does not believe that requiring the miner to sign a certificate furthers

the goal of providing quality training. This is appropriate, given the fact that the mine operator is ultimately responsible for providing adequate training to miners under this final rule. For the same reason, the proposed requirement that the training provider sign the certification has not been adopted.

Some commenters strongly urged that the final rule allow training certification to be maintained at locations other than the mine site, since it may be more efficient for some mine operators to store records at a central location. MSHA agrees, particularly in light of the fact that electronic records are becoming more common in the mining industry and may be stored on computer at centralized locations. The final rule therefore allows mine operators to store training certifications at a location other than the mine site. However, they must be stored in sufficient proximity to the mine to be produced for an MSHA inspector within a relatively short period of time. MSHA expects that in most cases this will be no longer than one business day.

Mine operators must retain the most recent training certification for as long as a miner is in the hearing conservation program and for at least 6 months thereafter. There were only a few comments on this issue. One commenter suggested that the training records should be maintained for 12 months, rather than 6 months, beyond the miner's enrollment in a hearing conservation program, but did not explain why that would be preferable.

The final rule adopts the proposed requirement that training records be kept as long as the miner is in the hearing conservation program and for at least 6 months thereafter. As stated in the proposed preamble, the retention period is short and not burdensome—only the most recent certifications must be retained and only for 6 months after the miner's enrollment in the hearing conservation program has ended. These records will serve to allow MSHA inspectors to verify that the required training has been provided.

Section 62.190 Records

The requirements of proposed §§ 62.200 and 62.210 are combined in § 62.190 of the final rule, and address access to and transfer of records required to be kept under this rule. The final rule defines "access" as the right to examine and copy records. MSHA's final rule is essentially the same as OSHA's requirements.

Under paragraph (a), as in the proposal, the mine operator must provide authorized representatives of

the Secretaries of Labor and Health and Human Services with access to all records required under this part. Several commenters stated that confidential medical records should be accessible to government agencies only with the written consent of the miner. MSHA has a statutory right to have access to records, including medical records. Section 103(h) of the Federal Mine Safety and Health Act of 1977 (Mine Act) provides that:

In addition to such records as are specifically required by this Act, every operator of a coal or other mine shall establish and maintain such records, make such reports, and provide such information, as the Secretary or the Secretary of Health, Education, and Welfare [now Health and Human Services] may reasonably require from time to time to enable him to perform his functions under this Act * * *

The Agency believes that access to medical records is essential; the records will be valuable in enforcement of the final rule, will be useful in research into the effects of occupational noise exposure, and will help to evaluate the effectiveness of hearing conservation programs.

Another commenter noted that the preamble stated that mine operators would have to provide authorized representatives of the Secretaries with immediate access to all records required under this part. It was not MSHA's intent that records be provided immediately to authorized representatives of the Secretaries. MSHA agrees that requiring immediate access to records to authorized representatives of the Secretaries might be too restrictive or burdensome on the mine operator. Although the preamble to the proposal contained the term "immediate," the final rule does not. Following current practice, MSHA intends that authorized representatives of the Secretaries have access to records within a reasonable amount of time that does not hinder the authorized representatives' conduct of business. In most cases MSHA expects that this will be no longer than one business day.

MSHA solicited comment on what actions would be required, if any, to facilitate the maintenance of records in electronic form by those mine operators who desire to do so, while ensuring access in accordance with these requirements. The Agency received several comments supporting electronic storage of records, but no specifics regarding actions required to facilitate the maintenance of the records in electronic form.

As in the proposal, paragraph (a) of the final rule also provides that, upon written request, the mine operator must

provide, within 15 calendar days of the request, access to records to miners, former miners, miners' designees, and representatives of miners. The first copy must be provided at no cost, and any additional copies at reasonable cost.

Several commenters supported the provisions of access and transfer of records, but suggested that MSHA have a separate standard, as OSHA does. The provisions in this final rule are similar to those in other health standards proposed in recent years by MSHA and are similar to OSHA's. MSHA and NIOSH have statutory rights to access of records, but since MSHA does not have generic recordkeeping and access requirements, including recordkeeping and retention requirements in the substantive noise regulation will facilitate compliance. This will provide the regulated community with better clarity regarding applicable requirements.

Paragraph (a)(1) of this section of the final rule remains relatively unchanged from the proposal and provides that a miner, or a miner's designee with the miner's written consent, has access to all the records that the mine operator is required to maintain for that miner under this part. Several commenters asked whether the term "miner's designated representative" used in § 62.200(a)(1) of the proposal referred to the representative designated by two or more miners under part 40 of MSHA's regulations. In fact, the term "miner's designated representative" used in § 62.200(a)(1) of the proposal was intended to refer to a representative specifically designated by the miner to have access to records. MSHA agrees that the terms used in the proposed rule are imprecise; the final rule now substitutes the term "miner's designee" in paragraph (a)(1) for "miner's designated representative." The term "miner's designee" has also been defined in § 62.101 of the final rule as "an individual or organization to whom a miner gives written authorization to exercise a right of access to records." These changes are intended to make clear that the "miner's designee" referred to in this section is not a representative of miners designated under part 40.

Paragraph (a)(2) clarifies that the miners' representative referred to is the representative designated under part 40 of the regulations. Section 62.200(a)(2) of the proposal used the ambiguous term "miners' representative" and left doubt in some commenters' minds as to whether this was the miners' representatives under part 40. Commenters expressed concern that although the Mine Act gave the part 40

miners' representative access only to training records and exposure records, not to confidential medical records, the proposed rule language was unclear on this distinction. Paragraph (a)(2) of this section of the final rule clarifies the intent of the proposed rule that miners' representatives designated under part 40 have access to training certifications compiled in accordance with § 62.180(b) of the final rule, and to notices of exposure determinations in accordance with § 62.110(d). Paragraph (a)(2) does not provide for access to medical records by the part 40 miners' representative. This is consistent with the requirements of the Mine Act, and responds to commenters who were concerned about maintaining the confidentiality of miners' medical records.

The final rule does not adopt the provision in proposed § 62.200(a)(1) that would have provided former miners with access to all records that the mine operator would be required to maintain under part 62. Instead, the final rule provides that any former miner may have access to records which indicate his or her own noise exposures. This revision results from MSHA's recognition that the Mine Act gives former miners limited access to records. Section 103(c) of the Mine Act explicitly provides that "[s]uch regulations [those dealing with toxic substances and harmful physical agents] shall also make appropriate provisions for each miner or former miner to have access to such records as will indicate his own exposure to toxic materials or harmful physical agents." Paragraph (a)(3) has therefore been added to the final rule to make clear that a former miner may have access to those records which indicate his or her own noise exposures, but not to other records that are required to be kept by the mine operator under this part, as would have been required under the proposal.

One commenter stated that the operator should not be responsible for providing access to records for anyone other than the affected employee unless such employee is totally incapacitated, arguing that review of the preamble and the section-by-section analysis provides no rationale for including persons other than the employee to have access to records. MSHA has determined, however, that miners should have the right to designate someone to access records on their behalf, if they so desire. For example, a miner who is ill can authorize a designee (who may be a family member) to retrieve a copy of his or her records.

Several commenters stated that records should not be directly accessible

to any private organizations. Under the final rule, a private organization may only have access if a miner selects the organization as his or her designee. In that case, the organization would have access as the miner's designee to all records required to be kept under this part for that individual miner.

One commenter maintained that the miner's designee should not be required to have written permission to see his or her records when no other person with access is required to have it. The commenter argues further that if this is due to the confidentiality of medical records, then anyone should be required to have the written permission of the miner, including MSHA and NIOSH. However, these agencies have a statutory right to access to records and do not need the written consent of the miner, but a designee does not and would therefore need written authorization to access records that may contain personal, private information.

Paragraph (a)(2) requires that any representative of miners designated under part 40 of this title must have access to noise training certifications required under § 62.180(b) as well as any notice of exposure determination in accordance with § 62.110(d) of this part for the miners he or she represents. Several commenters stated that the miners' representative should not have access to miners' records unless the miner has given written consent. One commenter stated that MSHA should change this section to provide access only to the individual miner involved. Several commenters stated that MSHA should clarify that the miners' representative will only have access to the training certificate.

MSHA intends that the miners' representative have access to training certifications and exposure determination records for miners they represent, without the written consent of individual miners. Providing access to training certifications is consistent with the Agency's part 48 training regulations at §§ 48.9 and 48.29, which require training certificates for each miner to be available for inspection by the miners' representative. Further, section 103(c) of the Mine Act states:

The Secretary, in cooperation with the Secretary of Health, Education, and Welfare, [now Health and Human Services] shall issue regulations requiring operators to maintain accurate records of employee exposures to potentially toxic materials or harmful physical agents which are required to be monitored or measured under any applicable mandatory health or safety standard promulgated under this Act. Such regulations shall provide miners or their representatives with an opportunity to observe such

monitoring or measuring, and to have access to the records thereof * * *

The final rule does not adopt proposed paragraph (b) of this section, which would have required an operator, upon termination of a miner's employment, to provide the miner (at no cost) a copy of all records that the operator is required to maintain for that individual miner under this part. The majority of commenters stated that it would be unduly burdensome to supply records to all terminated employees, that the provision was redundant with paragraph (c), and that records should only be provided to those employees who provide a written request for them. MSHA agrees that mine operators should not have to provide copies of records to miners unless requested to do so. Paragraph (c) of this section of the final rule, therefore, like the proposal, allows persons who have access to records to request a copy of all records from the mine operator. MSHA believes that this requirement will provide miners necessary information about their health. Proposed paragraph (b) has therefore not been adopted in the final rule.

Paragraph (a)(3), which is identical to proposed 62.200(c), states that when a person with access to records requests a copy of a record, the first copy must be provided without cost to that person, and any additional copies requested by that person must be provided at reasonable cost. Several commenters suggested that MSHA define "reasonable cost" so that mine operators can properly determine whether they are complying with the requirements of this part when charging for additional copies. The Agency expects mine operators to charge reasonable copying costs and labor rates which are generally applicable in their geographical locations for the same or similar services and which may vary somewhat from place to place. Therefore, the final rule does not adopt this comment.

Paragraph (b)(1) is similar to proposed § 62.210(a), requiring the mine operator to transfer all records required to be maintained by this part, or copies of them, to a successor mine operator who must maintain the records for the length of time required by this part. Several commenters supported the provision as proposed. One commenter stated that MSHA should clarify that this requirement does not apply to a successor operator hiring a miner who has never worked at that mine location. MSHA considers paragraph (b)(1) clear in stating that the mine operator must transfer all records required to be maintained by this part to a successor

mine operator who then becomes responsible for maintaining them for the period required.

Paragraph (b)(2) is identical to proposed § 62.210(b), requiring the successor operator to use the baseline audiogram, or revised baseline audiogram as appropriate, obtained by the original operator for determining the existence of a standard threshold shift or reportable hearing loss. MSHA believes that requiring successor mine operators to maintain the prior baseline audiogram will provide miners with the greatest possible degree of protection. Otherwise, if a new baseline were allowed to be established by the arrival of a successor mine operator, the record of any existing hearing loss would be wiped out and reporting or corrective action postponed. The Agency did not receive any comments on this provision, and paragraph (b)(2) is adopted as proposed.

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List of Subjects

30 CFR Parts 56 and 57

Metals, Mine safety and health, Noise control.

30 CFR Part 62

Mine safety and health, Noise control.

30 CFR Parts 70 and 71

Coal, Mine safety and health, Noise control.

Dated: August 30, 1999.

J. Davitt McAteer,

Assistant Secretary for Mine Safety and Health.

Accordingly, Chapter I of Title 30 of the Code of Federal Regulations is amended as follows:

PART 56—[AMENDED]

1. The authority citation for part 56 continues to read as follows:

Authority: 30 U.S.C. 811.

§ 56.5050 [Removed]

2. Section 56.5050 and the undesignated center heading preceding it are removed.

PART 57—[AMENDED]

3. The authority citation for part 57 continues to read as follows:

Authority: 30 U.S.C. 811.

§ 57.5050 [Removed]

4. Section 57.5050 and the undesignated center heading preceding it are removed.

PART 70—[AMENDED]

5. The authority citation for part 70 continues to read as follows:

Authority: 30 U.S.C. 811 and 961.

Subpart F—[Removed]

6. Subpart F (§§ 70.500 through 70.511) is removed.

PART 71—[AMENDED]

7. The authority citation for part 71 continues to read as follows:

Authority: 30 U.S.C. 811, 951, 957, 961.

Subpart I—[Removed]

8. Subpart I (§§ 71.800 through 71.805) is removed.

Subchapters M and N—[Redesignated]

9. Subchapter M is redesignated as Subchapter I, Subchapter N is redesignated as Subchapter K, and Subchapter N is reserved.

10. A new Subchapter M is added, "Uniform Mine Health Regulations."

11. A new part 62 is added to new Subchapter M to read as follows:

PART 62—OCCUPATIONAL NOISE EXPOSURE

Sec.

- 62.100 Purpose and scope; effective date
 - 62.101 Definitions
 - 62.110 Noise exposure assessment
 - 62.120 Action level
 - 62.130 Permissible exposure level
 - 62.140 Dual hearing protection level
 - 62.150 Hearing conservation program
 - 62.160 Hearing protectors
 - 62.170 Audiometric testing
 - 62.171 Audiometric test procedures
 - 62.172 Evaluation of audiograms
 - 62.173 Follow-up evaluation when an audiogram is invalid
 - 62.174 Follow-up corrective measures when a standard threshold shift is detected
 - 62.175 Notification of results; reporting requirements
 - 62.180 Training
 - 62.190 Records
- Appendix to part 62

Authority: 30 U.S.C. 811.

§ 62.100 Purpose and scope; effective date.

The purpose of these standards is to prevent the occurrence and reduce the progression of occupational noise-induced hearing loss among miners. This part sets forth mandatory health standards for each surface and underground metal, nonmetal, and coal mine subject to the Federal Mine Safety and Health Act of 1977. The provisions of this part become effective September 13, 2000.

§ 62.101 Definitions.

The following definitions apply in this part:

Access. The right to examine and copy records.

Action level. An 8-hour time-weighted average sound level (TWA₈) of 85 dBA, or equivalently a dose of 50%, integrating all sound levels from 80 dBA to at least 130 dBA.

Audiologist. A professional, specializing in the study and rehabilitation of hearing, who is certified by the American Speech-Language-Hearing Association (ASHA) or licensed by a state board of examiners.

Baseline audiogram. The audiogram recorded in accordance with § 62.170(a) of this part against which subsequent audiograms are compared to determine the extent of hearing loss.

Criterion level. The sound level which if constantly applied for 8 hours results in a dose of 100% of that permitted by the standard.

Decibel (dB). A unit of measure of sound pressure levels, defined in one of two ways, depending upon the use:

(1) For measuring sound pressure levels, the decibel is 20 times the common logarithm of the ratio of the measured sound pressure to the standard reference sound pressure of 20 micropascals (μPa), which is the threshold of normal hearing sensitivity at 1000 Hertz (Hz).

(2) For measuring hearing threshold levels, the decibel is the difference between audiometric zero (reference pressure equal to 0 hearing threshold level) and the threshold of hearing of the individual being tested at each test frequency.

Dual Hearing Protection Level. A TWA₈ of 105 dBA, or equivalently, a dose of 800% of that permitted by the standard, integrating all sound levels from 90 dBA to at least 140 dBA.

Exchange rate. The amount of increase in sound level, in decibels, which would require halving of the allowable exposure time to maintain the same noise dose. For the purposes of this part, the exchange rate is 5 decibels (5 dB).

Hearing protector. Any device or material, capable of being worn on the head or in the ear canal, sold wholly or in part on the basis of its ability to reduce the level of sound entering the ear, and which has a scientifically accepted indicator of noise reduction value.

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

Medical pathology. A condition or disease affecting the ear.

Miner's designee. Any individual or organization to whom a miner gives written authorization to exercise a right of access to records.

Qualified technician. A technician who has been certified by the Council for Accreditation in Occupational Hearing Conservation (CAOHC), or by another recognized organization offering equivalent certification.

Permissible exposure level. A TWA₈ of 90 dBA or equivalently a dose of 100% of that permitted by the standard, integrating all sound levels from 90 dBA to at least 140 dBA.

Reportable hearing loss. A change in hearing sensitivity for the worse, relative to the miner's baseline audiogram, or the miner's revised baseline audiogram where one has been established in accordance with § 62.170(c)(2), of an average of 25 dB or more at 2000, 3000, and 4000 Hz in either ear.

Revised baseline audiogram. An annual audiogram designated to be used in lieu of a miner's original baseline audiogram in measuring changes in hearing sensitivity as a result of the circumstances set forth in §§ 62.170(c)(1) or 62.170(c)(2) of this part.

Sound level. The sound pressure level in decibels measured using the A-weighting network and a slow response, expressed in the unit dBA.

Standard threshold shift. A change in hearing sensitivity for the worse relative to the miner's baseline audiogram, or relative to the most recent revised baseline audiogram where one has been established, of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear.

Time-weighted average—8 hour (TWA₈). The sound level which, if constant over 8 hours, would result in the same noise dose as is measured.

§ 62.110 Noise exposure assessment.

(a) The mine operator must establish a system of monitoring that evaluates each miner's noise exposure sufficiently to determine continuing compliance with this part.

(b) The mine operator must determine a miner's noise dose (D, in percent) by using a noise dosimeter or by computing the formula: $D = 100(C_1/T_1 + C_2/T_2 + \dots + C_n/T_n)$, where C_n is the total time the miner is exposed at a specified sound level, and T_n is the reference duration of exposure at that sound level shown in Table 62-1.

(1) The mine operator must use Table 62-2 when converting from dose readings to equivalent TWA₈ readings.

(2) A miner's noise dose determination must:

(i) Be made without adjustment for the use of any hearing protector;

(ii) Integrate all sound levels over the appropriate range;

(iii) Reflect the miner's full work shift;
(iv) Use a 90-dB criterion level and a 5-dB exchange rate; and
(v) Use the A-weighting and slow response instrument settings.

(c) *Observation of monitoring.* The mine operator must provide affected miners and their representatives with an opportunity to observe noise exposure monitoring required by this section and must give prior notice of the date and time of intended exposure monitoring to affected miners and their representatives.

(d) *Miner notification.* The mine operator must notify a miner of his or her exposure when the miner's exposure is determined to equal or exceed the action level, exceed the permissible exposure level, or exceed the dual hearing protection level, provided the mine operator has not notified the miner of an exposure at such level within the prior 12 months. The mine operator must base the notification on an exposure evaluation conducted either by the mine operator or by an authorized representative of the Secretary of Labor. The mine operator must notify the miner in writing within 15 calendar days of:

- (1) The exposure determination; and
- (2) the corrective action being taken.

(e) The mine operator must maintain a copy of any such miner notification, or a list on which the relevant information about that miner's notice is recorded, for the duration of the affected miner's exposure at or above the action level and for at least 6 months thereafter.

§ 62.120 Action level.

If during any work shift a miner's noise exposure equals or exceeds the action level the mine operator must enroll the miner in a hearing conservation program that complies with § 62.150 of this part.

§ 62.130 Permissible exposure level.

(a) The mine operator must assure that no miner is exposed during any work shift to noise that exceeds the permissible exposure level. If during any work shift a miner's noise exposure exceeds the permissible exposure level, the mine operator must use all feasible engineering and administrative controls to reduce the miner's noise exposure to the permissible exposure level, and enroll the miner in a hearing conservation program that complies with § 62.150 of this part. When a mine operator uses administrative controls to reduce a miner's exposure, the mine

operator must post the procedures for such controls on the mine bulletin board and provide a copy to the affected miner.

(b) If a miner's noise exposure continues to exceed the permissible exposure level despite the use of all feasible engineering and administrative controls, the mine operator must continue to use the engineering and administrative controls to reduce the miner's noise exposure to as low a level as is feasible.

(c) The mine operator must assure that no miner is exposed at any time to sound levels exceeding 115 dBA, as determined without adjustment for the use of any hearing protector.

§ 62.140 Dual hearing protection level.

If during any work shift a miner's noise exposure exceeds the dual hearing protection level, the mine operator must, in addition to the actions required for noise exposures that exceed the permissible exposure level, provide and ensure the concurrent use of both an ear plug and an ear muff type hearing protector. The following table sets out mine operator actions under MSHA's noise standard.

Provision	Condition	Action required by the mine operator
§ 62.120	Miner's noise exposure is less than the action level.	None.
§ 62.120	Miner's exposure equals or exceeds the action level, but does not exceed the permissible exposure level (PEL).	Operator enrolls the miner in hearing conservation program (HCP) which includes (1) a system of monitoring, (2) voluntary, with two exceptions, use of operator-provided hearing protectors, (3) voluntary audiometric testing, (4) training, and (5) record keeping.
§ 62.130	Miner's exposure exceeds the PEL	Operator uses/continues to use all feasible engineering and administrative controls to reduce exposure to PEL; enrolls the miner in a HCP including ensured use of operator-provided hearing protectors; posts administrative controls and provides copy to affected miner; must never permit a miner to be exposed to sound levels exceeding 115 dBA.
§ 62.140	Miner's exposure exceeds the dual hearing protection level.	Operator enrolls the miner in a HCP, continues to meet all the requirements of § 62.130, ensures concurrent use of earplug and earmuff.

§ 62.150 Hearing conservation program.

A hearing conservation program established under this part must include:

- (a) A system of monitoring under § 62.110 of this part;
- (b) The provision and use of hearing protectors under § 62.160 of this part;
- (c) Audiometric testing under §§ 62.170 through 62.175 of this part;
- (d) Training under § 62.180 of this part; and
- (e) Recordkeeping under § 62.190 of this part.

§ 62.160 Hearing protectors.

(a) A mine operator must provide a hearing protector to a miner whose noise exposure equals or exceeds the

action level under § 62.120 of this part. In addition, the mine operator must:

- (1) Train the miner in accordance with § 62.180 of this part;
- (2) Allow the miner to choose a hearing protector from at least two muff types and two plug types, and in the event dual hearing protectors are required, to choose one of each type;
- (3) Ensure that the hearing protector is in good condition and is fitted and maintained in accordance with the manufacturer's instructions;
- (4) Provide the hearing protector and necessary replacements at no cost to the miner; and
- (5) Allow the miner to choose a different hearing protector(s), if wearing the selected hearing protector(s) is

subsequently precluded due to medical pathology of the ear.

(b) The mine operator must ensure, after satisfying the requirements of paragraph (a) of this section, that a miner wears a hearing protector whenever the miner's noise exposure exceeds the permissible exposure level before the implementation of engineering and administrative controls, or if the miner's noise exposure continues to exceed the permissible exposure level despite the use of all feasible engineering and administrative controls.

(c) The mine operator must ensure, after satisfying the requirements of paragraph (a) of this section, that a miner wears a hearing protector when

the miner's noise exposure is at or above the action level, if:

- (1) The miner has incurred a standard threshold shift; or
- (2) More than 6 months will pass before the miner can take a baseline audiogram.

§ 62.170 Audiometric testing.

The mine operator must provide audiometric tests to satisfy the requirements of this part at no cost to the miner. A physician or an audiologist, or a qualified technician under the direction or supervision of a physician or an audiologist must conduct the tests.

(a) *Baseline audiogram.* The mine operator must offer miners the opportunity for audiometric testing of the miner's hearing sensitivity for the purpose of establishing a valid baseline audiogram to compare with subsequent annual audiograms. The mine operator may use an existing audiogram of the miner's hearing sensitivity as the baseline audiogram if it meets the audiometric testing requirements of § 62.171 of this part.

(1) The mine operator must offer and provide within 6 months of enrolling the miner in a hearing conservation program, audiometric testing which results in a valid baseline audiogram, or offer and provide the testing within 12 months where the operator uses mobile test vans to do the testing.

(2) The mine operator must notify the miner to avoid high levels of noise for at least 14 hours immediately preceding the baseline audiogram. The mine operator must not expose the miner to workplace noise for the 14-hour quiet period before conducting the audiometric testing to determine a baseline audiogram. The operator may substitute the use of hearing protectors for this quiet period.

(3) The mine operator must not establish a new baseline audiogram or a new revised baseline audiogram, where one has been established, due to changes in enrollment status in the hearing conservation program. The mine operator may establish a new baseline or revised baseline audiogram for a miner who is away from the mine for more than 6 consecutive months.

(b) *Annual audiogram.* After the baseline audiogram is established, the mine operator must continue to offer subsequent audiometric tests at intervals not exceeding 12 months for as long as the miner remains in the hearing conservation program.

(c) *Revised baseline audiogram.* An annual audiogram must be deemed to be a revised baseline audiogram when, in

the judgment of the physician or audiologist:

- (1) A standard threshold shift revealed by the audiogram is permanent; or (2) The hearing threshold shown in the annual audiogram indicates significant improvement over the baseline audiogram.

§ 62.171 Audiometric test procedures.

(a) All audiometric testing under this part must be conducted in accordance with scientifically validated procedures. Audiometric tests must be pure tone, air conduction, hearing threshold examinations, with test frequencies including 500, 1000, 2000, 3000, 4000, and 6000 Hz. Each ear must be tested separately.

(b) The mine operator must compile an audiometric test record for each miner tested. The record must include:

- (1) Name and job classification of the miner tested;
- (2) A copy of all of the miner's audiograms conducted under this part;
- (3) Evidence that the audiograms were conducted in accordance with paragraph (a) of this section;
- (4) Any exposure determination for the miner conducted in accordance with § 62.110 of this part; and
- (5) The results of follow-up examination(s), if any.

(c) The operator must maintain audiometric test records for the duration of the affected miner's employment, plus at least 6 months, and make the records available for inspection by an authorized representative of the Secretary of Labor.

§ 62.172 Evaluation of audiograms.

(a) The mine operator must:

- (1) Inform persons evaluating audiograms of the requirements of this part and provide those persons with a copy of the miner's audiometric test records;
- (2) Have a physician or an audiologist, or a qualified technician who is under the direction or supervision of a physician or audiologist:

- (i) Determine if the audiogram is valid; and
- (ii) Determine if a standard threshold shift or a reportable hearing loss, as defined in this part, has occurred.

(3) Instruct the physician, audiologist, or qualified technician not to reveal to the mine operator, without the written consent of the miner, any specific findings or diagnoses unrelated to the miner's hearing loss due to occupational noise or the wearing of hearing protectors; and

(4) Obtain the results and the interpretation of the results of audiograms conducted under this part

within 30 calendar days of conducting the audiogram.

(b)(1) The mine operator must provide an audiometric retest within 30 calendar days of receiving a determination that an audiogram is invalid, provided any medical pathology has improved to the point that a valid audiogram may be obtained.

(2) If an annual audiogram demonstrates that the miner has incurred a standard threshold shift or reportable hearing loss, the mine operator may provide one retest within 30 calendar days of receiving the results of the audiogram and may use the results of the retest as the annual audiogram.

(c) In determining whether a standard threshold shift or reportable hearing loss has occurred, allowance may be made for the contribution of aging (presbycusis) to the change in hearing level. The baseline, or the revised baseline as appropriate, and the annual audiograms used in making the determination should be adjusted according to the following procedure:

(1) Determine from Tables 62-3 or 62-4 the age correction values for the miner by:

(i) Finding the age at which the baseline audiogram or revised baseline audiogram, as appropriate, was taken, and recording the corresponding values of age corrections at 2000, 3000, and 4000 Hz;

(ii) Finding the age at which the most recent annual audiogram was obtained and recording the corresponding values of age corrections at 2000, 3000, and 4000 Hz; and

(iii) Subtracting the values determined in paragraph (c)(1)(i) of this section from the values determined in paragraph (c)(1)(ii) of this section. The differences calculated represent that portion of the change in hearing that may be due to aging.

(2) Subtract the values determined in paragraph (c)(1)(iii) of this section from the hearing threshold levels found in the annual audiogram to obtain the adjusted annual audiogram hearing threshold levels.

(3) Subtract the hearing threshold levels in the baseline audiogram or revised baseline audiogram from the adjusted annual audiogram hearing threshold levels determined in paragraph (c)(2) of this section to obtain the age-corrected threshold shifts.

§ 62.173 Follow-up evaluation when an audiogram is invalid.

(a) If a valid audiogram cannot be obtained due to a suspected medical pathology of the ear that the physician or audiologist believes was caused or

aggravated by the miner's occupational exposure to noise or the wearing of hearing protectors, the mine operator must refer the miner for a clinical-audiological evaluation or an otological examination, as appropriate, at no cost to the miner.

(b) If a valid audiogram cannot be obtained due to a suspected medical pathology of the ear that the physician or audiologist concludes is unrelated to the miner's occupational exposure to noise or the wearing of hearing protectors, the mine operator must instruct the physician or audiologist to inform the miner of the need for an otological examination.

(c) The mine operator must instruct the physician, audiologist, or qualified technician not to reveal to the mine operator, without the written consent of the miner, any specific findings or diagnoses unrelated to the miner's occupational exposure to noise or the wearing of hearing protectors.

§ 62.174 Follow-up corrective measures when a standard threshold shift is detected.

The mine operator must, within 30 calendar days of receiving evidence or confirmation of a standard threshold shift, unless a physician or audiologist determines the standard threshold shift is neither work-related nor aggravated by occupational noise exposure:

(a) Retrain the miner, including the instruction required by § 62.180 of this part;

(b) Provide the miner with the opportunity to select a hearing protector, or a different hearing protector if the miner has previously selected a hearing protector, from among those offered by the mine operator in accordance with § 62.160 of this part; and

(c) Review the effectiveness of any engineering and administrative controls to identify and correct any deficiencies.

§ 62.175 Notification of results; reporting requirements.

(a) The mine operator must, within 10 working days of receiving the results of an audiogram, or receiving the results of a follow-up evaluation required under § 62.173 of this part, notify the miner in writing of:

(1) The results and interpretation of the audiometric test, including any finding of a standard threshold shift or reportable hearing loss; and

(2) The need and reasons for any further testing or evaluation, if applicable.

(b) When evaluation of the audiogram shows that a miner has incurred a reportable hearing loss as defined in this part, the mine operator must report such

loss to MSHA as a noise-induced hearing loss in accordance with part 50 of this title, unless a physician or audiologist has determined that the loss is neither work-related nor aggravated by occupational noise exposure.

§ 62.180 Training.

(a) The mine operator must, within 30 days of a miner's enrollment into a hearing conservation program, provide the miner with training. The mine operator must give training every 12 months thereafter if the miner's noise exposure continues to equal or exceed the action level. Training must include:

(1) The effects of noise on hearing;

(2) The purpose and value of wearing hearing protectors;

(3) The advantages and disadvantages of the hearing protectors to be offered;

(4) The various types of hearing protectors offered by the mine operator and the care, fitting, and use of each type;

(5) The general requirements of this part;

(6) The mine operator's and miner's respective tasks in maintaining mine noise controls; and

(7) The purpose and value of audiometric testing and a summary of the procedures.

(b) The mine operator must certify the date and type of training given each miner, and maintain the miner's most recent certification for as long as the miner is enrolled in the hearing conservation program and for at least 6 months thereafter.

§ 62.190 Records.

(a) The authorized representatives of the Secretaries of Labor and Health and Human Services must have access to all records required under this part. Upon written request, the mine operator must provide, within 15 calendar days of the request, access to records to:

(1) The miner, or with the miner's written consent, the miner's designee, for all records that the mine operator must maintain for that individual miner under this part;

(2) Any representative of miners designated under part 40 of this title, to training certifications compiled under § 62.180(b) of this part and to any notice of exposure determination under § 62.110(d) of this part, for the miners whom he or she represents; and

(3) Any former miner, for records which indicate his or her own exposure.

(b) When a person with access to records under paragraphs (a)(1), (a)(2), or (a)(3) of this section requests a copy of a record, the mine operator must provide the first copy of such record at no cost to that person, and any

additional copies requested by that person at reasonable cost.

(c) Transfer of records. (1) The mine operator must transfer all records required to be maintained by this part, or a copy thereof, to a successor mine operator who must maintain the records for the time period required by this part.

(2) The successor mine operator must use the baseline audiogram, or revised baseline audiogram, as appropriate, obtained by the original mine operator to determine the existence of a standard threshold shift or reportable hearing loss.

Appendix to Part 62

TABLE 62-1.—REFERENCE DURATION

dBA	T (hours)
80	32.0
85	16.0
86	13.9
87	12.1
88	10.6
89	9.2
90	8.0
91	7.0
92	6.1
93	5.3
94	4.6
95	4.0
96	3.5
97	3.0
98	2.6
99	2.3
100	2.0
101	1.7
102	1.5
103	1.3
104	1.1
105	1.0
106	0.87
107	0.76
108	0.66
109	0.57
110	0.50
111	0.44
112	0.38
113	0.33
114	0.29
115	0.25

At no time shall any excursion exceed 115 dBA. For any value, the reference duration (T) in hours is computed by: $T = 8/2^{(L-90)/5}$ where L is the measured A-weighted, slow-response sound pressure level.

TABLE 62-2.—“DOSE”/TWA₈ EQUIVALENT

Dose (percent)	TWA ₈
25	80
29	81
33	82
38	83
44	84
50	85
57	86
66	87

TABLE 62-2.—“DOSE”/TWA₈
Equivalent—Continued

Dose (percent)	TWA ₈
76	88
87	89
100	90
115	91
132	92
152	93
174	94
200	95
230	96
264	97
303	98
350	99
400	100
460	101
530	102
610	103
700	104
800	105
920	106
1056	107
1213	108
1393	109
1600	110
1838	111
2111	112
2425	113
2786	114
3200	115

Interpolate between the values found in this Table, or extend the Table, by using the formula: $TWA_8 = 16.61 \log_{10} (D/100) + 90$.

TABLE 62-3.—AGE CORRECTION
VALUE IN DECIBELS FOR MALES (SE-
LECTED FREQUENCIES)

Age (years)	kHz		
	2	3	4
20 or less	3	4	5
21	3	4	5
22	3	4	5
23	3	4	6
24	3	5	6
25	3	5	7

TABLE 62-3.—AGE CORRECTION
VALUE IN DECIBELS FOR MALES (SE-
LECTED FREQUENCIES)—Continued

Age (years)	kHz		
	2	3	4
26	4	5	7
27	4	6	7
28	4	6	8
29	4	6	8
30	4	6	9
31	4	7	9
32	5	7	10
33	5	7	10
34	5	8	11
35	5	8	11
36	5	9	12
37	6	9	12
38	6	9	13
39	6	10	14
40	6	10	14
41	6	10	14
42	7	11	16
43	7	12	16
44	7	12	17
45	7	13	18
46	8	13	19
47	8	14	19
48	8	14	20
49	9	15	21
50	9	16	22
51	9	16	23
52	10	17	24
53	10	18	25
54	10	18	26
55	11	19	27
56	11	20	28
57	11	21	29
58	12	22	31
59	12	22	32
60 or more	13	23	33

TABLE 62-4.—AGE CORRECTION
VALUE IN DECIBELS FOR FEMALES
(SELECTED FREQUENCIES)

Age (years)	kHz		
	2	3	4
20 or less	4	3	3
21	4	4	3
22	4	4	4
23	5	4	4
24	5	4	4
25	5	4	4
26	5	5	4
27	5	5	5
28	5	5	5
29	5	5	5
30	6	5	5
31	6	6	5
32	6	6	6
33	6	6	6
34	6	6	6
35	6	7	7
36	7	7	7
37	7	7	7
38	7	7	7
39	7	8	8
40	7	8	8
41	8	8	8
42	8	9	9
43	8	9	9
44	8	9	9
45	8	10	10
46	9	10	10
47	9	10	11
48	9	11	11
49	9	11	11
50	10	11	12
51	10	11	12
52	10	12	13
53	10	13	13
54	11	13	14
55	11	14	14
56	11	14	15
57	11	15	15
58	12	15	16
59	12	16	16
60 or more	12	16	17

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