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: Proposed rule.

SUMMARY: This proposed rule would replace MSHA's existing standards for occupational noise exposure in coal mines and in metal and nonmetal mines with a single new standard applicable to all mines.

This action is part of the Agency's ongoing review of its safety and health standards. The review found that the Agency's existing noise standards, which had been promulgated more than 20 years ago, are inadequate to prevent the occurrence of occupational noise-induced hearing loss (NIHL) among miners. There remains a significant risk to miners of material impairment of health from workplace exposure to noise over a working lifetime. The risk becomes significant when exposure exceeds an 8-hour time-weighted average of 85 dBA.

DATES: Comments must be received on or before February 18, 1997. Submit written comments on the information collection requirements by February 18, 1997.

ADDRESSES: Comments on the proposed rule may be transmitted by electronic mail, fax, or mail. Comments by electronic mail must be clearly identified as such and sent to this e-mail address: noise@msha.gov. Comments by fax must be clearly identified as such and sent to: Mine Safety and Health Administration, Office of Standards, Regulations, and Variances, 703–235–5551. Send mail comments to: Mine Safety and Health Administration, Office of Standards, Regulations, and Variances, Room 631, 4015 Wilson Boulevard, Arlington, VA 22203–1984. Interested persons are encouraged to supplement written comments with computer files or disks; please contact the Agency with any questions about format. Written comments on the information collection requirements may be submitted directly to the Office of Information and Regulatory Affairs, OMB New Executive Office Building, 725 17th Street, NW., Rm. 10235, Washington, D.C. 20503, Attn: Desk Officer for MSHA.

FOR FURTHER INFORMATION CONTACT: Patricia W. Silvey, Director; MSHA; Office of Standards, Regulations, and Variances; 703–235–1910.

SUPPLEMENTARY INFORMATION:

Comprehensive Summary

The proposal would retain the existing permissible exposure level (PEL) but establish a new ''action level''. The action level would be an 8-hour time-weighted average of 85 dBA; the PEL would remain an 8-hour time-weighted average of 90 dBA.

Whenever a miner's noise exposure exceeds the action level, the miner would receive special training in noise protection.

When the miner's noise exposure exceeds the action level, but is below the PEL, the operator would be required to make annual audiometric (hearing) examinations available to the miner through enrollment in a hearing conservation program, and to provide properly fitted hearing protection in three circumstances—before the initial hearing examination, if a significant threshold shift in hearing acuity is detected, and at any other time upon miner request. If it will take more than 6 months for the initial examination because of the need to wait for a mobile test van, or a significant threshold shift in hearing acuity is detected, the operator would also be required to ensure the miner uses the provided hearing protection.

If a miner's exposure exceeds the PEL, the proposal would require that the mine operator use all engineering and administrative controls which it is feasible for that mine operator to utilize to reduce noise to the PEL. The proper combination of engineering and administrative controls would be left to the discretion of the mine operator.

Should the use of all feasible engineering and administrative controls not reduce a miner's noise exposure to the PEL, the operator would have to use those controls to lower exposure to as close to the PEL as is feasible. In addition, the operator would have to provide any such miner properly fitted hearing protection, ensure the miner uses such protection, and ensure the miner takes the annual audiometric examinations. Should a miner's exposure exceed an 8-hour time-weighted average of 105 dBA, the operator must ensure the miner is provided and uses both a plug and a muff type protector.

MSHA recognizes that successful implementation of these new uniform health rules will require training of MSHA personnel and guidance to miners and mine operators, particularly small mine operators. Accordingly, the Agency proposes that the final rule take effect one year after the date of publication of the final rule, and solicits comments on whether a phased-in approach would permit some elements of the new rule to be implemented more quickly.

The Supplementary Information accompanying this notice is detailed. Accordingly, to facilitate review and comment by the mining community, this material begins with questions and answers summarizing key points about the proposal. Included are two charts comparing the main features of the proposal to existing standards in the mining industry and those applicable to other industries under the Occupational Safety and Health Act. Also included are MSHA's estimates of the impacts of the proposal from the Agency's preliminary Regulatory Impact Analysis (RIA), copies of which are available from the Agency.

I. Questions and Answers, Required Notices, and History

(A) Questions and Answers About Key Features of this Proposal

(1) What Are the Key Features of This Proposal?

MSHA has developed a proposal that it estimates can reduce by two-thirds the number of miners currently projected to suffer a material impairment of their hearing—but which it estimates can be implemented at a cost of less than $9 million to the mining industry as a whole.

The focus of the proposal is on the use of the most effective means to control noise—engineering controls to eliminate the noise, or administrative controls (e.g. rotating miner duties) to minimize noise exposure—whenever feasible.

Specifically, the proposal requires that an operator use all feasible engineering or administrative controls to reduce noise to the PEL—a TWA_8 of 90 dBA. While MSHA has determined there is a significant risk of harm at a TWA_8 of 85 dBA, the Agency believes that it may not be feasible at this time for the mining industry to control noise to this level using engineering and administrative controls.

The proposal would require that steps be taken when noise exceeds a TWA_8 of 85 dBA, the ''action level'', to prevent hearing loss. Operators would have to provide special instruction in noise, make annual hearing examinations available, and provide properly fitted hearing protection—before the initial examination, if a significant threshold shift in hearing acuity is detected, and at any other time upon a miner's

request. If it will take more than 6 months to take the initial examination because of the need to wait for a mobile test van, or if a significant threshold shift is detected, an operator would also be required to ensure that the miner uses the hearing protection.

The proposal also provides for supplemental protection in those cases in which individual operators are unable to reduce noise to the PEL through the use of all feasible engineering or administrative controls. The operator must ensure any miner so exposed takes the annual hearing examinations, must provide properly fitted hearing protection to all miners so exposed, and must ensure the hearing protection is used by all miners so exposed.

The focus on engineering and administrative controls would significantly change the way noise is addressed in the coal mining industry. Currently, hearing protectors generally are allowed when a coal miner's noise exposure exceeds the PEL. The proposal would require a coal mine operator to use all feasible engineering and administrative controls to reduce exposure to the PEL—the practice currently required in the rest of the mining industry. MSHA estimates that this change alone can prevent 3 out of every 5 impairments projected to occur due to occupational noise exposure in the coal mining industry.

While this change would cost the coal mining industry more money for implementation of engineering controls, MSHA estimates these costs would be significantly offset by the paperwork savings the coal mining industry will accrue under the proposal. In particular, MSHA is proposing to replace the costly, paperwork-intensive requirements for biannual coal miner noise exposure surveys, supplemental noise surveys, calibration reports, survey reports, and survey certifications with a performance-oriented requirement that mine operators establish a monitoring program that effectively evaluates miner exposures. MSHA believes the existing requirements have not been effective.

Other parts of the proposal would change current practices throughout the mining industry. No actions are currently required if noise exposures are below the PEL. Moreover, the proposal requires, for the first time, certain explicit protections if an operator cannot feasibly reduce noise exposures to the PEL through the use of all feasible engineering and administrative controls.

MSHA's proposal also incorporates revisions warranted by our increased understanding of the effects of noise, to the extent that the Agency determined such changes would be feasible for the mining industry to implement. For example, to reflect that exposure to sound levels above 80 dBA is now generally recognized as harmful, the proposal would include exposure to such sound levels in determining a miner's noise dose. Such adjustment will result in more miners than at present being determined to have noise exposures over the PEL, but the Agency has determined that the industry can feasibly accommodate this change.

(2) Do I Need To Read This Entire Notice To Understand the Proposal?

The Agency hopes these questions and answers will provide the information most of the mining community will want. Nevertheless, MSHA is accompanying publication of this proposed rule with a detailed discussion of the information it has considered in developing the proposal. That way, those interested in a particular topic can have the benefit of the Agency's thinking in developing their comments.

The information is divided into five parts. Part I includes a review of the projected impacts of the proposal, including benefits, costs and paperwork, taken from the Agency's preliminary RIA. Part II is the Agency's analysis of the current risks to miners from occupational noise exposure. Part III is a section-by-section discussion of the elements of the proposal. Part IV is an analysis of the technological and economic feasibility of the proposal and of key alternatives considered by the Agency. Part V is a complete list of publications referenced by the Agency.

(3) What Are the Projected Impacts of the Proposed Rule?

The estimated benefits and costs and paperwork requirements of the proposed rule are summarized in the following table, ''Summary of Key Impacts of MSHA's Noise Proposal,'' followed by a brief explanation. The Agency's estimates, and a complete description of the methodology used to obtain them, are contained in the Agency's preliminary RIA, a copy of which can be obtained from the Agency.

SUMMARY OF KEY IMPACTS OF MSHA'S NOISE PROPOSAL *

	Coal	Metal/nonmetal	All mining
Benefits:			
% hearing impairments avoided	81	57	67
# miners saved from hearing impairment	15,300	15,300	30,600
Annual costs (in millions of dollars)	$0.3	$8	$8.3
Paperwork burden hours added/saved	(88,740)	73,755	(14,985)

* Rounded.

The analysis of benefits compares the number of miners who are projected to incur a material impairment of their hearing under the current rule with the number of miners who are projected to incur such an impairment under the proposed rule. Overall for the mining community, the proposal would reduce the risk of material impairment by 67%. More than 30,000 miners otherwise expected to develop a material impairment would be spared.

As displayed in the chart entitled ''Benefits of MSHA Noise Proposal in Saving Miners From Hearing Impairment,'' the most significant benefits are expected in the coal sector. Engineering and administrative controls are expected to significantly reduce noise exposures above the PEL. A significant benefit also accrues from the establishment of an action level: based on the assumption that most employees exposed to noise between the action level and the PEL will elect to use hearing protection for the first time at such levels. While the metal and nonmetal mining industry already uses engineering controls above the PEL, additional benefits are anticipated in this regard; primarily because the change in the way noise dose would be measured under the proposal would require the use of engineering and administrative controls in more cases than at present. Like coal, a benefit in

this sector is anticipated from the establishment of an action level.

As indicated by this chart, MSHA projects that even after implementation of the proposal some miners will continue to develop a material impairment of hearing. This is of serious concern to the Agency. The Agency believes, however, that the mining industry may not be able at this time to feasibly take actions which would eliminate the remaining risk (see response to Questions 9 and 13 on this point). MSHA is seeking comments on this issue.

BENEFITS OF MSHA NOISE PROPOSAL IN SAVING MINERS FROM HEARING IMPAIRMENT

		Miners
Coal:		
Current expected impairment	15% of miners	18,947
Saved by eng/admin controls	58% of projected impairment	11,072
Saved by hearing protectors	22% of projected impairment	4,232
Saved by proposal	81% of projected impairment	15,304
Remaining expected impairment	3% of miners	3,643
Metal and Nonmetal:		
Current expected impairment	13% of miners	26,977
Saved by eng/admin controls	11% of projected impairment	2,693
Saved by hearing protectors	46% of projected impairment	12,320
Saved by proposal	57% of projected impairment	15,283
Remaining expected impairment	6% of miners	11,694
Mining Industry as a Whole:		
Current expected impairment	14% of miners	45,924
Saved by eng/admin controls	31% of projected impairment	14,035
Saved by hearing protectors	36% of projected impairment	16,552
Saved by proposal	67% of projected impairment	30,587
Remaining expected impairment	5% of miners	15,377

MSHA's estimates of cost follow a standard approach in which initial costs of compliance (like equipment purchase costs) are amortized over ten years at seven percent and added to costs that recur each year. The assumptions on what controls would be needed, how many hours have to be spent on particular tasks, and the costs of the personnel performing various tasks are set forth in detail in the Agency's preliminary RIA.

MSHA estimates that the proposed rule would increase the mining industry's costs by approximately $8.3 million annually for the first 10 years. MSHA estimates the proposed rule will cost the coal mining industry about $300,000 a year; because while there will be additional costs under the proposal, they will be significantly offset by the elimination of the requirements for biannual noise surveys of coal miners. Costs to the metal and nonmetal industry would rise by about $8 million annually.

The most costly aspect of the proposed rule would be the provision of audiometric examinations—about $3.6 million, with about $2 million of that borne by the metal and nonmetal mining industry. The provision of engineering controls is estimated to cost about $3.5 million, with about $2.2 million of this borne by the coal mining industry—which would no longer be permitted, as at present, to substitute hearing protectors for engineering or administrative controls. MSHA's costing assumptions are described in its preliminary RIA; comments on this methodology are being solicited.

The table entitled ''Cost Impacts of MSHA Noise Proposal'' summarizes the net annual costs of the proposal's requirements. An explanation of the requirements is included in the questions and answers that follow.

COST IMPACTS OF MSHA NOISE PROPOSAL

Task	Total cost	M/NM cost	Coal cost
Engineering Controls	$3,475,700	$1,289,000	$2,186,700
Dose Determination	(1,928,550)	1,734,895	(3,663,445)
Notification	45,910	28,085	17,825
Record of Noise Surveys, et al.	(1,653,565)	.....	(1,653,565)
Administrative Controls	16,595	6,580	10,015
HPDs (provide, selection, fit)	926,710	792,560	134,150
Training	1,834,560	1,071,140	763,420
Audiograms (base, annual); notice to miners	3,574,030	1,964,970	1,609,060
Audiometric Test Procedures	195,835	113,835	82,000
Evaluation of Audiogram	892,215	492,215	400,000
Follow-up Evaluation	145,780	78,865	66,915
Follow-up Corrective Measures	99,440	52,455	46,985
Notification of Results	138,710	74,340	54,370
Access to Records	23,710	18,865	4,845
Transfer of Records	5,040	2,950	2,090
Contractors	541,640	316,320	225,320
Total	8,323,760	8,037,075	286,685

MSHA's estimates of paperwork burden hours reflect the requirements and definitions in the Paperwork Reduction Act. Overall, the proposal would decrease paperwork requirements in the mining industry by about 14,985 burden hours. This reflects a savings to the coal mining industry of 88,740 burden hours, as a result of a proposal to eliminate

existing requirements for biannual surveys of coal miners and other various reports. The metal and nonmetal mining sector would have a net increase of about 73,755 burden hours. The chart entitled ''Paperwork Impacts of MSHA Noise Proposal'' summarizes the projected paperwork burdens.

PAPERWORK IMPACTS OF MSHA NOISE PROPOSAL

Section	Paperwork requirement and associated tasks	Coal	M/NM	Total
62.120	Evaluate miners' noise exposure; notify miner of overexposure, prepare and post administrative controls; give miners copy of administrative controls.	(140,545)	5,295	(135,250)
62.130	Prepare and file a training certification	4,000	6,270	10,270
62.140	Perform audiograms, notify miners to appear for testing and need to avoid high noise	30,655	39,275	69,930
62.150	Compile an audiometric test record, obtain a certification	3,930	5,245	9,175
62.160	Provide information and audiometric test record, perform audiometric retests	9,340	12,015	21,455
62.170	Perform audiometric evaluations and follow-up evaluations	475	570	1,045
62.180	Prepare a training certification for retrained miners, review effectiveness of engineering and administrative controls.	335	365	700
62.190	Inform miner of test results, inform miner of STS	2,715	3,585	6,300
62.200	Provide access to records	255	1,000	1,255
62.210	Transfer records	100	135	235
All	(any discrepancies due to rounding)	(88,740)	73,755	(14,985)

(4) What Special Consideration Did MSHA Give to Alternatives for the Smallest Mines?

MSHA estimates that as a result of this proposal, metal and nonmetal mines with less than 20 miners would incur an average cost increase of about $500 per year in annual costs and annualized first year costs. Coal mines with less than 20 miners would have an average savings per mine of about $30, reflecting the elimination of the numerous survey and paperwork requirements in the current noise rules for the coal sector.

MSHA compared the proposed costs for small mines in each sector to the estimated revenues and profits for small mines in each sector. MSHA did this at various size levels. In each case, the costs as a percentage of revenue are less than 1%, and the costs do not appear to have any appreciable impact on profits. Accordingly, for the purposes of the Regulatory Flexibility Act, MSHA has certified that the proposed rule does not have a significant economic impact on a substantial number of small entities.

The limited impacts on small mines reflect decisions by MSHA not to propose 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 a consideration.

As a result of this requirement, MSHA seriously considered two alternatives that would have significantly increased costs for small mine operators—lowering the PEL to a TWA_8 of 85 dBA, and lowering the exchange rate to 3 dB. In both cases, the evidence in favor of these approaches was strong. But in both cases, MSHA has tentatively concluded that it may 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.

Part IV of this preamble contains a full discussion of MSHA's preliminary conclusions about these alternatives. The graph labeled ''Effect of Alternative Exchange Rates and PELs on Allowable Exposure Times at Various Decibel Levels'' provides an indication of what the Agency's decisions in this regard mean in practice.

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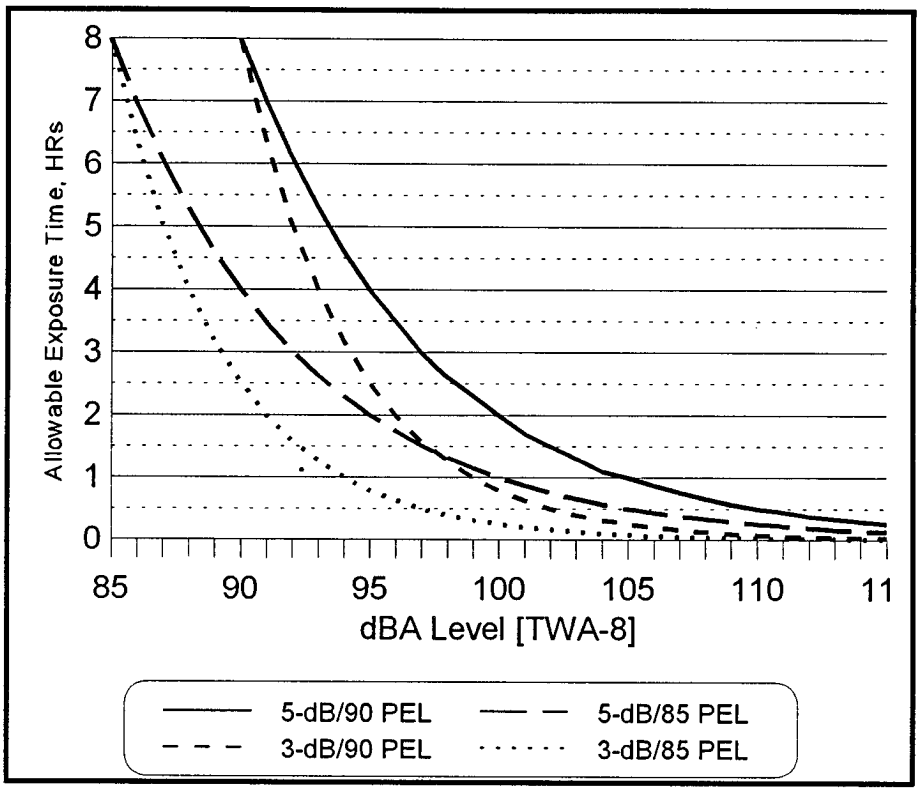

Effect of Alternative Exchange Rates and PELs on Allowable Exposure Time at Various Decibel Levels.

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In accordance with the Small Business Regulatory Enforcement and Fairness Act (SBREFA), MSHA is taking actions to minimize the compliance burden on small mines. The proposed effective date of the rule would be a year after final promulgation, to provide adequate time for small mines to achieve compliance. MSHA will also mail a copy of the proposed rule to every mine operator which primarily benefits small mine operators. MSHA is committed to writing the final rule in plain English so it can be readily understood by miners and mine operators. The Agency has committed itself to issuance of a compliance guide, and is inviting comment on whether compliance workshops or other such approaches would be valuable. (These proposed actions are discussed in more detail in other Questions and Answers.)

The approximately 350 small sand and gravel or crushed stone operations run by State, local and tribal governments may also be interested in MSHA's analysis on the impacts of the proposed rule on such entities. Such an analysis is required by the Unfunded Mandates Reform Act of 1995. Like other small metal and nonmetal mines, their costs for prevention of hearing loss are expected to average about $500 per year. Benefits to these governmental entities include fewer hearing impairments and reduced workers' compensation costs.

(5) Why Is the Proposed Rule Needed?

MSHA has concluded that the existing rules to protect miners from workplace noise exposure must be revised because current noise exposures continue to create a significant risk of material impairment of health to miners. MSHA estimates that 14% of U.S. miners—about 46,000 of them—can be expected under current exposure conditions to develop a material impairment of hearing during a working lifetime. The figures are 15% (19,000) of U.S. coal miners and 13% (27,000) of U.S. metal and nonmetal miners.

Generally, prolonged exposure to noise over a period of several years causes permanent damage to the auditory nerve and/or its sensory components: the higher the noise exposure the more rapid the loss. The loss may be so gradual, however, that a person may not realize that he or she is becoming impaired until a substantial amount of hearing is lost. This damage, known as noise-induced hearing loss or NIHL, is irreversible, and makes it difficult to hear as well as understand speech. In addition to the personal and social costs of hearing loss, the loss of the ability to understand speech can have a significant impact on miner safety which is highly dependent upon good communication.

The Agency has carefully analyzed the risk miners currently face of incurring such harm. What follows is a short summary of MSHA's risk analysis (the complete analysis is presented as part II of the Supplemental Information accompanying this notice).

First, the Agency considered the various definitions of impairment used in the risk analyses in the literature. Three definitions of impairment have been widely recognized within the scientific community as useful for the purposes of assessing risk. All three focus on the risks of acquiring a 25 dB hearing ''level''—the deviation from audiometric zero. The three accepted approaches differ in that they examine hearing acuity at a different set of frequencies. For the purpose of its analysis, MSHA chose the approach that measures hearing acuity at those frequencies most relevant to the ability to understand human speech. This is the approach developed in 1972 by the National Institute for Occupational Safety and Health (NIOSH) and subsequently used by the Occupational Safety and Health Administration

(OSHA): a 25 dB hearing level at 1000, 2000 and 3000 Hz. The Agency is aware that NIOSH is now considering a revised approach that would include hearing acuity at 4000 Hz, but believes it is inappropriate to utilize that approach until peer review has validated its utility.

Next, the Agency reviewed the major studies on the level of risk at different noise exposures. The data consistently indicate that the risk of developing a material impairment of hearing, as a result of a working lifetime of occupational exposure, becomes significant when workplace noise exposures exceed an eight-hour time-weighted average (TWA_8) of 85 dBA. The table entitled ''Excess Risk Estimates'' presents estimates by NIOSH of how the excess risk of developing a material impairment (using its 1972 definition) varies with exposure over a working lifetime.

EXCESS RISK ESTIMATES

Exposure (TWA_8)	<80	80–84.9	85–89.9	90–94.9	95–99.9	≥100
Excess Risk	0	3%	15%	29%	43%	54%

MSHA also reviewed a large body of data on the effects of varying industrial noise exposures on worker hearing. These studies are supportive of the same conclusion. MSHA refined its picture of what occurs at lower sound levels by reviewing a number of other studies, particularly those of workers in other countries.

To confirm the magnitude of the risks of NIHL among miners, MSHA asked NIOSH to examine a body of audiometric data collected over the years tracking hearing acuity among coal miners. The analysis (Franks, 1996) supports the data from the risk studies. It indicates that 90% of these miners have a hearing impairment by age 50 as compared with only 10% of the general population. Further, Franks stated that miners, after working 20 to 30 years, could find themselves in life-threatening situations because safety signals and ''roof talk'' could go unheard. (For the purposes of the analysis, NIOSH used a definition of hearing impairment including losses at 4000 Hz; MSHA conducted its own analysis of the data without the 4000 Hz, and the results are generally consistent with those of NIOSH).

MSHA also examined other sources of data that might provide direct confirmation of the risks of hearing loss to miners—comments received in response to the Agency's Advance Notice of Proposed Rulemaking (ANPRM), (December 4, 1989, 54 FR 50209), the reports of hearing loss provided to the Agency by mine operators pursuant to 30 CFR part 50, and workers' compensation data. In each case, the available data are too limited to draw any conclusions. The Agency is requesting the public to provide further information along these lines.

To develop a profile of the mining population at risk, MSHA began by gathering information on noise exposures in the U.S. mining industry.

Current exposures appear to be gradually declining in the metal and nonmetal industry, where engineering or administrative controls are the primary means of miner protection against NIHL. But the data indicate that all sectors of the mining industry continue to have a significant number of overexposures.

Charts II–9 and II–10 display exposure trends based on inspector samples. Only those samples that exceed the PEL are displayed. For 1995, 14.4% of samples from the metal and nonmetal mining industry, and 22.5% of samples from the coal industry, exceeded the PEL. (Because they are 3–D graphs, the data points sometimes look lower than they are; the actual data points can be found in part II, Tables II–9 and II–10.)

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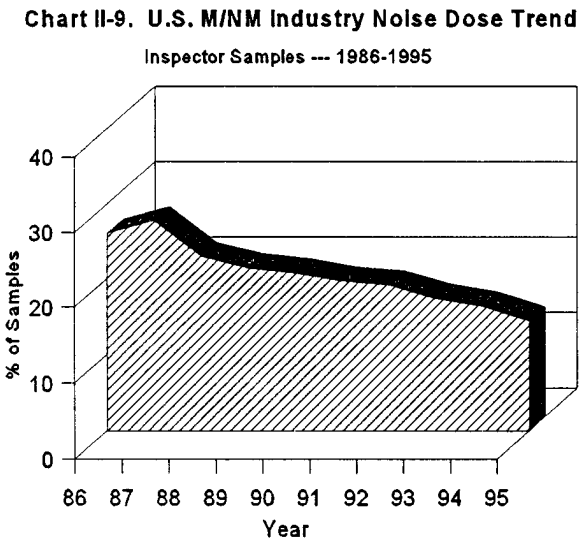

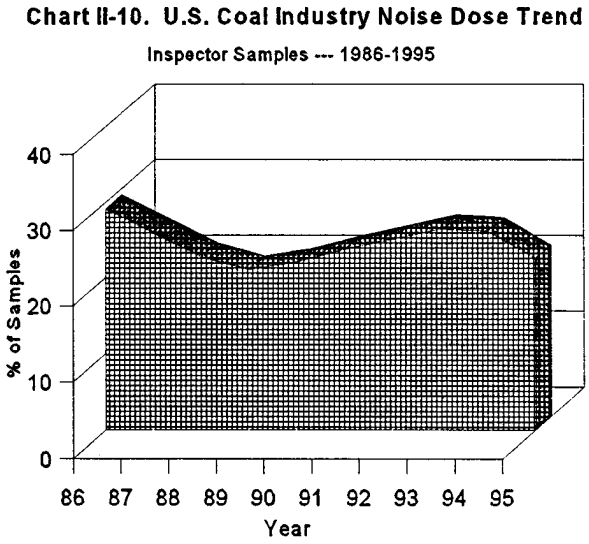

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These figures actually understate truly harmful exposures because the samples were taken in a way that did not count any exposures to sound levels below 90 dBA. As discussed herein (see Question 9), MSHA has concluded that exposures to sound levels above 80 dBA are harmful. Accordingly, to get a better picture of present harmful miner exposures, MSHA examined the results of a special survey taking thousands of

samples that included sound levels as low as 80 dBA. The results indicate that 36.8% of coal samples, and 26.9% of the metal and nonmetal samples would exceed the PEL if the lower, but still harmful, sound levels are counted in the dose measurement.

To derive a risk profile of miners, the Agency utilized the exposure data from the survey and the excess risk estimates. (The methodology for developing the miner risk profile is explained in detail in the Agency's preliminary RIA. Among other adjustments to the sample data, MSHA assumed coal miners were currently receiving some protection from hearing protectors; as a result, the estimates of miners at excess risk are lower than might be suggested by the foregoing figures.) Based on its analysis, MSHA estimates that 14% of U.S. miners—about 46,000 miners—can be expected under current exposure conditions to develop a material impairment of hearing of handicapping or disabling proportions during a working lifetime. The figures are 15% (19,000) of U.S. coal miners as a group and 13% (27,000) of U.S. metal and nonmetal miners.

The Agency is interested in receiving additional data with respect to the risks of noise exposure to workers and to the mining population in particular, as well as comments on its risk methodology and analysis.

(6) Why Proceed Without Waiting for NIOSH To Issue a New Criteria Document on Noise Exposure?

As MSHA was preparing this notice for publication, the National Institute for Occupational Safety and Health (NIOSH) released for peer review a draft criteria document for occupational noise exposure to update the one issued in 1972.

A summary of that draft, prepared and released by NIOSH, is included in the discussion of the rulemaking history in the Supplementary Information accompanying this notice. NIOSH is considering whether the evidence on noise since 1972 warrants a change in its recommendations. In some cases NIOSH is considering reiterating its prior recommendations, and in other cases it is considering changing its recommendations.

MSHA has determined that it would not be appropriate to delay publication of this proposed rule to await the possible issuance of a new NIOSH criteria document. The NIOSH draft is still being peer reviewed, and MSHA does not believe it would be appropriate to delay acting based upon the uncertain timing of the document's redrafting and release. Moreover, many of the issues covered in the NIOSH draft have been considered by MSHA, as part of the Agency's review of all the latest scientific information on noise.

Should a new criteria document be issued before MSHA promulgates a final rule, it will of course consider the NIOSH recommendations. The summary of the NIOSH draft included in this notice should provide ample notice to the mining community of the position NIOSH may take in a new criteria document.

(7) What Mines Are Covered by the Proposal?

The proposal would apply one set of rules uniformly to all mines. Those who responded to MSHA's ANPRM generally agreed that consolidation and simplification of multiple standards into one rule may help to facilitate understanding of, and thus compliance with, the regulatory requirements for controlling noise exposures.

(8) Are There Special Definitions Applicable?

To help mine operators and miners, the proposed rule would include definitions of some technical terms universally used in noise measurement. But the proposed rule also includes some terms used in a way that differs from usage in certain other contexts—e.g., under the OSHA standard.

In particular, MSHA is proposing a non-standard use of the term ''hearing conservation program'' or ''HCP.'' Most hearing conservation programs include provision for hearing examinations, training and the use of hearing protectors. Since audiograms would be new for the mining industry, unlike the other components, the Agency thought it might be less confusing to treat the components separately. Accordingly, under the MSHA proposal, hearing protector and training requirements are established independently, and a ''hearing conservation program'' is defined as a generic reference to those sections of the proposal that set forth the requirements for an audiometric testing program.

(9) How Is a Miner's Noise Dose To Be Determined Under the Proposal?

The proposal sets forth a formula for dose computation, which is to be measured over a full shift, which corresponds to the readouts of most currently used personal noise dosimeters.

The proposal would continue the use of a 5-dB exchange rate. The exchange rate is a measure of how quickly the dose of noise doubles. Accordingly, the measure is the rate determining how much a miner's exposure must be limited to compensate for increasing dose. Using the 5–dB exchange rate, the exposure time permitted at a sound level of 90 dBA is half that permitted at a sound level of 85 dBA—a miner gets the same noise dose in 4 hours at 90 dBA as at 8 hours at 85 dBA.

The Agency gave serious consideration to changing the exchange rate from 5 dB to 3 dB, and is specifically seeking comment on this important matter. There is a consensus in the recent literature that noise dose actually doubles more quickly than measured by the 5-dB rate; the consensus is for an exchange rate of 3 dB. Moreover, the current 5–dB exchange rate incorporates an assumption that there is significant time for hearing to recover from high sound levels. MSHA has concluded that noise exposure under mining conditions does not warrant such an assumption. A 3–dB exchange rate does not incorporate this assumption.

Nevertheless, the Agency is proposing to retain the existing 5-dB exchange rate because of feasibility considerations. Changing to a 3-dB rate from a 5-dB rate would significantly reduce the amount of time that miners could be exposed to higher sound levels without exceeding the PEL. For example, MSHA estimates that the percentage of miners whose exposure would be in violation of the PEL would just about double if a 3-dB exchange rate is used. This means mine operators would have to utilize controls to reduce exposures to the PEL much more frequently. Moreover, more expensive controls would often be required; if doses are doubling more quickly, the controls needed to reduce overexposures to the PEL would have to be more effective. Furthermore, if a 3-dB exchange rate is used, it is extremely difficult to reduce the noise exposures to the PEL with currently available engineering or administrative noise controls or a combination thereof. Accordingly, moving the industry to a 3-dB exchange rate may not be feasible at this time.

The sound levels to be included in a miner's dose are being expanded. At present, only exposures to sounds of 90 dBA and above are included in determining a miner's dose under MSHA's standards. (Thus, 90 dBA is considered the ''threshold.'') The proposed rule would include exposure to sound levels as low as 80 dBA. The Agency has concluded that capturing such sound levels is necessary if it establishes an action level based on an eight-hour time-weighted average of 85 dBA. Among other reasons, exposure of a miner to an extended shift (e.g.,16

hours) at just over 80 dBA can result in an exposure that exceeds the action level. OSHA uses this threshold for its action level, but a higher threshold for the PEL; based on the comments received in response to its Advance Notice of Proposed Rulemaking, MSHA concluded it would be easier for the mining industry to use a single threshold for both purposes.

While necessary, this change will generally result in higher dose readings in both the coal and metal and nonmetal sectors than at present. (See the discussion of exposure data in response to Question 5). In this case, however, MSHA has concluded that this change would clearly be feasible for the industry.

The proposed regulation would not allow dose measurements to be adjusted to reflect the effect of hearing protectors. This provision would reinforce MSHA's intent to preclude the current practice in the coal mining industry of not issuing a citation based upon a noise exposure that exceeds the PEL when the miners are wearing hearing protection. (See Question 11 for additional information on this topic.)

(10) What Controls Are Required Whenever a Miner's Exposure Exceeds the Action Level?

The proposal would require that all miners exposed above the action level be provided special instruction in the hazards of noise and protective methods. The training is to be provided annually for as long as exposure exceeds the action level. (The nature of this instruction, how it is to be provided, and how it can be coordinated with other required miner training are discussed in response to other questions.)

(11) What Additional Controls Are Required If a Miner's Exposure Exceeds the Action Level but Is Below the PEL?

An operator will be required to enroll a miner whose exposure exceeds the action level in a hearing conservation program (HCP). While enrollment in the HCP would require the operator to make annual audiometric testing available to the miner, miners exposed to noise below the PEL would have the right to decline taking any annual audiometric testing. The requirements for such testing are discussed in more detail in response to other questions.

MSHA is seeking comments on how to minimize the burden on mine operators of providing audiometric examinations for those miners with only a temporary attachment to the mining work force (e.g., summer employees), while recognizing the importance of detecting and tracking hearing loss among those who switch jobs.

In addition, the operator must provide properly fitted hearing protection in 3 cases: before the initial hearing examination, if a significant threshold shift in hearing acuity is detected, and at any other time upon miner request.

Both MSHA and OSHA normally require an employer or operator to ensure that personal protective equipment is in fact used; an operator can be cited for failure to enforce rules to this effect. In the case of this proposal, however, MSHA is making two exceptions in that regard. First, should the initial hearing examination take less than 6 months to provide, the operator will not be required to ensure the provided hearing protection be worn. The operator is obligated to ensure protector use if more time is needed for the baseline examination (e.g., to wait for a mobile test van). Second, hearing protection provided because of miner request does not generate an operator obligation to enforce the use of the requested protection. At exposure levels above the action level but below the PEL, the proposal's goal is to encourage the use of hearing protection by training, providing choice, and encouraging proper fit—but the proposal would not require hearing protector use unless the miner has a significant threshold shift or unless the miner has to wait more than 6 months for a baseline examination.

(12) What Controls Are Required If a Miner's Exposure Exceeds the PEL?

If a miner's noise dose exceeds the PEL, the proposal would require the mine operator to use all feasible engineering and administrative controls to reduce the miner's noise exposure to that level. The mine operator has a choice of whether to use engineering controls, administrative controls, or both; but if administrative controls are utilized, a copy of the procedures involved must be posted, and copies given to the affected miners.

Under the proposal, a consistent hierarchy of controls is established for all mines. Mine operators must first utilize all feasible engineering and administrative controls to reduce sound levels to the PEL before (as explained in response to question 15) relying on other controls to protect against hearing loss. This approach is consistent with that currently in place for metal and nonmetal mines, but would be a change for coal mines. In the coal mining industry, MSHA inspectors do not cite for noise overexposures without first deducting from the measured dose the attenuating value of hearing protectors being worn by the miners exposed to excessive levels of noise. In practice, this means that personal protective equipment is in most cases accepted as a substitute for engineering and administrative controls.

MSHA has conducted research on the attenuating value of hearing protectors under actual mining conditions and has reviewed the literature on this issue. MSHA is aware that NIOSH is considering new approaches on how to establish a system that will accurately derate hearing protector attenuation values for actual workplace conditions; but the Agency's own research suggests that the attenuation of a hearing protector is highly variable in practice, and that the amount of attenuation cannot be predicted accurately. This is discussed in part III of the Supplementary Information accompanying this notice.

MSHA has also considered the data showing declining noise exposures in the metal and nonmetal industry, and contrasted this with the data on the coal mining industry.

The Agency has concluded that, in practice, reliance upon hearing protectors to reduce noise exposures simply does not provide effective protection against hearing loss to miners. The Agency does not contend that properly fitted and maintained hearing protectors are worthless; on the contrary, the Agency is proposing to rely upon them as a supplemental control, and has taken their value into account in conducting its risk and benefit analyses. MSHA has concluded, however, that hearing protectors should no longer be relied upon as a primary means of control, and that this change can bring about dramatic reductions in the rate at which coal miners would otherwise be expected to incur hearing impairments.

(13) For an Individual Mine Operator, What Are ''Feasible'' Engineering and Administrative Controls?

The proposal would require a mine operator to use only such engineering controls as are technologically feasible, and to use only such engineering and administrative controls as are economically feasible for that mine operator. Those in the metal and nonmetal mining industry are already familiar with the Agency's policies and practices in this regard, but those in the coal mining industry may wish to take note of the following few paragraphs.

The Federal Mine Safety and Health Review Commission (Commission) has addressed the issue of what MSHA must consider, with regard to MSHA's existing noise standard for metal and

nonmetal mines, when determining what is a feasible noise control for enforcement purposes at a particular mine. According to the Commission, a control is considered feasible when: (1) The control reduces exposure, (2) the control is economically achievable, and (3) the control is technologically achievable. See *Secretary of Labor* v. *Callanan Industries, Inc.*, 5 FMSHRC 1900 (1983), and *Secretary of Labor* v. *A. H. Smith*, 6 FMSHRC 199 (1984).

In determining technological feasibility of a proposed 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 economic feasibility, 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. 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. *Todilto Exploration and Development Corporation* v. *Secretary of Labor*, 5 FMSHRC 1894 (1983). No guidance has been provided by the Commission as to what level of reduction is considered significant. However, the Commission has accepted the Agency's determination that a 3 dBA reduction is significant.

In the metal and nonmetal mining industry, 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. 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.

Accordingly, consistent with the case law, MSHA has considered three factors in determining whether engineering controls are feasible at a particular metal and nonmetal mine: first, the nature and extent of the overexposure; second, the demonstrated effectiveness of available technology; and third, whether the committed resources are wholly out of proportion to the expected results. Before a violation of these requirements of the standard could be found, MSHA would have to determine that a worker has been overexposed; that administrative or engineering controls are feasible; and that the mine operator failed to install or maintain such controls.

Part III of the Supplemental Information accompanying this notice provides many examples of engineering controls that are feasible for mine operators to utilize, and the Agency and the former Bureau of Mines (USBOM) have available many other materials in this regard. Nevertheless, the Agency welcomes information about particular operations for which it may be particularly difficult to control noise.

(14) Is It feasible for the Coal Mining Industry, and for the Metal and Nonmetal Mining Industry, To Provide the Controls Proposed To Be Required When Noise Exposures Exceed the PEL?

Part IV of the Supplementary Information in this notice provides a detailed discussion of the statute's requirements and the Agency's analysis in this regard. The Agency has concluded that the coal mining industry as a whole, and the metal and nonmetal mining industry as a whole, can meet these requirements at a PEL set at a TWA_8 of 90 dBA.

In fact, the Agency seriously considered lowering the PEL. As noted in response to Question 5, MSHA has concluded that there is a significant risk of material impairment from noise exposures at or above a TWA_8 of 85 dBA. MSHA believes, however, that such a change may not be feasible at this time for the mining industry. Based on an analysis of exposure survey data, MSHA has concluded that if the PEL were a TWA_8 of 85 dBA, about two-thirds of the mine operators in the metal and nonmetal mining industry, and about three-quarters of the mine operators in the coal mining industry, would need to use engineering and administrative controls to reduce current exposures. Moreover, the engineering controls needed to reduce those exposures would be more expensive, because they would have to be capable of reducing the exposures further than with a PEL set at a TWA_8 of 90 dBA.

(15) What Supplemental Controls Are Required If a Miner's Exposure Cannot Be Feasibly Reduced to the PEL?

If reducing the dose to this level with such controls is not feasible, the proposal requires the mine operator to use such controls to lower the noise exposure as much as is feasible.

In addition, in such cases, the proposal requires that the operator take extra steps to protect miner hearing. The operator must ensure any miner so exposed takes the annual hearing examinations, must provide properly fitted hearing protection to all miners so exposed, and must ensure the hearing protection is used by all miners so exposed.

MSHA believes that when a miner is exposed to such high levels of noise because engineering and administrative controls are not feasible for an operator, these supplemental obligations are necessary to protect miner hearing. Hearing protectors are not without their discomforts, but the risk of hearing loss at such exposure levels ought to be a controlling factor. While audiometric testing is not an invasive procedure, the Agency is concerned that there may be economic pressures and personal reasons that may lead miners to decline to take hearing examinations. The information generated by these tests is necessary, however, to trigger investigation of potentially serious flaws in the layers of noise controls required at these high exposure levels. In addition, the Agency believes that miners operating under such high noise conditions should be aware of the severity of any hearing loss; in a mining environment, this knowledge could have implications for the safety of the miner and the safety of others. Comments on this provision are specifically solicited.

(16) Is There an Absolute Maximum Noise Dose?

Under the proposal, a miner, as at present, is never to be exposed to sound levels exceeding 115 dBA. This is because sound at that level provides the full dose permitted in a matter of minutes.

There is, however, no dose which the Agency would require to be abated without regard to whether it is feasible for an individual mine operator. The proposal does provide that should a miner's noise exposure exceed a TWA_8 of 105 dBA during any workshift, the mine operator shall, in addition to taking all actions required to protect miners exposed above the PEL, also require the miner to use dual hearing protection, i.e., both a plug type and a muff type hearing protector. A TWA_8 of 105 dBA is a dose of 800% of the PEL, using a 5-dB exchange rate. In the notice accompanying this proposal, the Agency presents information about the mining jobs at which the exposures of this level are occurring, and requests comment on

whether there should be an absolute dose ceiling regardless of the feasibility of control by an individual mine operator.

(17) What Are an Operator's Obligations Under the Proposal To Monitor Noise Exposures?

The proposal would require mine operators to establish a system of monitoring which effectively evaluates each miner's noise exposure. This will ensure that mine operators have the means to determine whether a miner's exposure exceeds any of the limitations established by this section, as well as to assess the effectiveness of noise controls. The proposed rule is performance oriented in that the regularity and methodology used to make this evaluation are not specified; MSHA's own measurements will enable it to check on the effectiveness of an operator's monitoring program. Specific requirements for biannual noise surveys, monitoring records, supplemental noise surveys, calibration reports, survey reports, and survey certifications now applicable to the coal sector would be revoked, significantly reducing cost and paperwork burdens.

(18) When Must Miners Be Notified of Monitoring Results?

The proposal would require that miners be notified in writing should their exposure exceed any of the levels specified by this section—whether based on operator or MSHA evaluations of noise. Notice would be required within 15 calendar days.

The proposal has been designed to ensure that miners are made aware of the hazards they currently face. Miners exposed above the action level should be notified of that fact so, for example, they can consider the importance of using provided, properly fitted and maintained hearing protectors. On the other hand, the proposal does not require notification of a particular miner if an exposure measurement indicates that the miner's exposure has not changed and the miner has within the last year been apprised of the same information. No notification is required if a miner's measurement is below the action level—although operators might wish to provide such notification if this indicates a reduction in noise exposure.

(19) What Rules Are There To Ensure That Required Hearing Protectors Provide Effective Protection?

Whenever hearing protectors are to be provided, they must be provided in accordance with specific requirements. The miner is to have a choice from at least one earplug type and muff type protector; and, in the event dual hearing protection is required, a choice of one of each. Whenever the mine operator is required to ensure that hearing protection is worn (the circumstances are noted in response to prior questions), it is worn by the miner when exposed to sound levels required to be integrated into a miner's dose measurement, i.e., any sound levels above 80 dBA. The hearing protector is to be fitted and maintained in accordance with the manufacturer's instructions. Hearing protectors and necessary replacements are to be provided at no cost to the miner. Finally, should the miner suffer a medical pathology of the ear, the miner is to be allowed to select a different hearing protector from among those offered by the mine operator.

MSHA has concluded that existing rating systems for hearing protectors do not provide a reliable measure of effectiveness under normal mining working conditions. The Agency believes that the best way to ensure such devices can provide effective protection is to focus on the conditions affecting hearing protector use.

(20) How Frequently Must Required Training Be Provided?

If a miner's noise exposure exceeds the action level, training is to be provided annually. The training is to be provided when the miner is first determined to have exceeded the action level and every 12 months thereafter that the miner continues to exceed that level.

Annual refresher training is necessary to reinforce the proper procedures for the use and care of hearing protectors, and the importance of administrative and engineering controls. Additionally, it serves to re-emphasize the hazards of noise and the purpose for audiometric testing for those miners exposed above the PEL. MSHA received comments in response to its Advance Notice of Proposed Rulemaking (ANPRM) that supported an annual training requirement. Studies have shown that the effectiveness of an HCP is highly dependent on the proper use of hearing protectors and the commitment of both management and the employees, both of which can be enhanced by training.

(21) What Specifications Are There With Respect to the Instruction To Be Provided During Required Training?

Miners would receive instruction in hearing protection: (1) the need for such protection, (2) selection and fitting, and (3) proper use of such protectors. Miners would also receive instruction about hearing conservation programs: as to the operation of that program and the mine operator's noise control efforts. There are no special qualifications for instructors, nor any specifications on the hours of instruction. Training is required to be provided without cost to the miner. The mine operator would be required to certify the completion of any training required by this part, and maintain the most recent certification for a miner at the mine site for as long as the miner is required to use hearing protectors or be enrolled in an HCP, and at least 6 months thereafter.

(22) Can the Required Training Be Covered During Part 48 Training?

Yes, but it may not always be feasible to do so.

MSHA considered whether the requirements of part 48, ''Training and Retraining of Miners,'' were adequate to ensure the training required under this part. The requirements of part 48 specify the initial and annual retraining of all miners in a list of subjects, many specified in the law itself (section 115 of the Mine Safety and Health Act). The importance of this training is emphasized by statutory requirements for the submittal of training plans, on the specification of the hours to be devoted to the training, and on the qualifications of instructors. Training is required on noise, but it is in general terms, covering the purpose of taking exposure measurements and on any health control plan in effect at the mine. Mine operators may provide additional training, but the topics that need to be covered may make this impracticable within the prescribed time limits.

After considering the available information about the importance of training requirements, and based upon its experience in implementing the requirements of part 48, MSHA has determined that the requirements of part 48 do not provide adequate noise training for those miners for whom exposure is clearly a problem. Most current part 48 training is neither comprehensive enough to provide such miners with the level of education needed for the proper use of hearing protection devices, nor, in the case of noisy mines, detailed enough on methods to reduce sound levels.

Nevertheless, MSHA believes compliance with this proposal can in many cases be fulfilled at the same time as scheduled part 48 training. The Agency does not believe special language in proposed part 62 is required to permit this action under part 48, but welcomes comment in this regard. Mine operators who can do so are free to fulfill their noise training requirements by covering the topics in initial and

annual part 48 training, and may so certify on the separate form required by this part. If incorporated into part 48, mine operators would, however, be required to submit a revised training plan to the appropriate district office for approval. Some mine operators, however, may not be able to incorporate these topics in their part 48 plans. Moreover, it is important to note that there are some circumstances in which training required under the proposal will likely not fit within a regular schedule, e.g., the training required when a miner's exposure is determined to require selection of a hearing protector or a new protector.

MSHA has endeavored to make the training requirements as simple as possible. If conducted separately from part 48 training, there are no specifications on trainer qualifications, no minimal training time, nor any training plans. If, however, the training is incorporated into part 48, then all applicable part 48 requirements will have to be met.

(23) If a Mine Operator Is Required To Offer Audiometric Testing, When Must a Baseline Audiogram Be Taken?

It is critical to obtain a baseline audiogram before exposure to hazardous noise. If this is not possible, then the baseline is to be obtained as soon as is reasonably possible.

Due to remote locations and intermittent operations of many mines, MSHA determined that allowing six months (or 12 months if a mobile test van is used) for offering the baseline audiogram was reasonable. The 12 month period would allow mine operators to schedule many baseline and annual audiograms simultaneously, and thus, substantially reduce the cost when mobile test vans are used. Miners enrolled in a hearing conservation program would be provided hearing protection until such time as the baseline audiogram is conducted. In the case of a miner who has to wait more than 6 months for a baseline examination because of the need for a mobile test van, and in the case of a miner whose exposures cannot be reduced to the PEL through the use of all feasible engineering and administrative controls, the operator would be required to ensure the hearing protection is worn.

MSHA has also determined that a 14-hour quiet period should precede the baseline audiogram to ensure a valid result. Moreover, unlike the OSHA rule, MSHA's proposal would not permit the use of hearing protectors as a substitute for a quiet period. The Agency has determined this is necessary to ensure that a temporary threshold shift in hearing acuity does not occur during the quiet period, rendering the baseline audiogram inaccurate. Moreover, MSHA's research has not shown a reliable method for predicting hearing protector attenuation under actual working conditions. Under the proposal, miners are to be notified of the importance of compliance with the quiet period. MSHA is not proposing to require this quiet period for annual audiograms, although it may be in the mine operator's interest to do so.

(24) What Qualification Requirements Are Proposed for Those Who Will Take Audiograms?

MSHA would require that an ''audiologist'' be certified by the American Speech-Language-Hearing Association or licensed by a state board of examiners. ''Qualified technicians'' would be required to have been certified by the Council for Accreditation in Occupational Hearing Conservation (CAOHC) or another recognized organization offering equivalent certification. CAOHC or equivalent certification would assure that the technicians are qualified. MSHA is not proposing to require qualifications for physicians.

(25) Does the Proposal Specify Audiometric Test Procedures?

MSHA proposes not to include specific procedural requirements for conducting audiometric tests, calibrating audiometers, and qualifying audiometric test rooms. Instead, MSHA proposes a performance-oriented requirement that audiometric testing be conducted in accordance with scientifically validated procedures. MSHA would specify the test frequencies, but would allow the physician or the audiologist to use professional judgement in choosing the appropriate testing procedure(s) and require certification of the scientific validity of the procedures.

While this approach may require somewhat more in the way of paperwork requirements, MSHA believes this is far preferable to the alternative of a detailed specification standard, which could stifle technology and impede improvements in methodology.

(26) What Test Records Must Be Maintained?

The proposal would also specify what records must be maintained at the mine site and the retention duration. The proposed items included in the audiometric test record—name, job classification, audiograms and certifications as to the procedures used to take them, any exposure determinations, and the results of any follow-up examinations—would provide information essential for evaluating a miner's audiogram, among other purposes.

The proposal would require that the audiometric records be retained for at least six months beyond the duration of the miner's employment. The six-month retention period at the mine site would assure that test records are not destroyed during what might be normal breaks in employment and remain available for use by the mine operator to conduct further evaluations upon the miner's return. In practice, MSHA believes that many mine operators will keep a miner's audiograms long after the miner's employment ceases, for use if the miner should file a subsequent workers' compensation claim for hearing loss.

(27) How Are Audiograms To Be Evaluated?

MSHA's proposal would require that the mine operator inform the person evaluating the audiogram of the requirements of this part and provide such person with copies of the miner's audiometric test records. The mine operator would be responsible for having a physician, audiologist, or qualified technician determine if an audiogram is valid, and to determine if a standard threshold shift in hearing acuity (STS) or reportable hearing loss has occurred. Time frames within which these actions must occur are part of the proposal.

The proposal would permit, but not require, mine operators to adjust audiometric test results by applying a correction for presbycusis, the progressive loss of hearing acuity associated with the aging process, before determining whether an STS or reportable hearing loss has occurred, and it includes tables for this purpose. The proposed adjustment for presbycusis is optional, however, if a mine operator uses this approach, it must be applied uniformly to both the baseline and annual audiograms in accordance with the procedures and values listed in the proposed standard. Although this is the position taken in the proposal, MSHA notes that NIOSH recently has advised against the use of presbycusis correction factors. Moreover, the Agency is concerned about locking-in particular presbycusis adjustment tables. MSHA, therefore, requests additional comments on whether to use presbycusis corrections for audiograms and, if so, how to

provide for such adjustment in a regulatory context.

(28) What Happens If an Audiogram Is Not Valid?

A prompt retest is required.

When 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 the wearing of hearing protectors, a miner must be referred for a clinical audiological or otological evaluation as appropriate at mine operator expense.

If the physician or audiologist concludes that the suspected medical pathology of the ear which prevents obtaining a valid audiogram is unrelated to the miner's exposure to noise or the wearing of hearing protectors, the miner is to be advised of the need for an otological evaluation; but in such cases, no financial obligation would be imposed on the mine operator.

A mine operator would be required to 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.

(29) What Corrective Measures Are Required When a Standard Threshold Shift in Hearing Acuity (STS) Is Detected?

STS is defined in this proposal, as in OSHA's standard, as a change in a worker's hearing acuity for the worse, relative to that worker's baseline audiogram, of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear.

If the STS is determined to be permanent, a supplemental baseline is established and this becomes the baseline for determining any future STS. This definition is sufficiently restrictive to locate meaningful shifts in hearing, yet not so stringent as to create unnecessary follow-up procedures. The frequencies were chosen for this purpose to ensure hearing losses are detected as soon as feasible. While NIOSH is currently considering an approach that would not require averaging at several frequencies, this remains under peer review; moreover, the averaging of hearing levels at adjacent frequencies will reduce the effect of testing errors at single frequencies.

MSHA's proposal would require that, unless a physician or audiologist determines that an STS is neither work-related nor aggravated by occupational noise exposure, mine operators would have 30 days after the finding of an STS to—

(1) Retrain the miner;

(2) Provide the miner with the opportunity to select a hearing protector, or a different hearing protector if the miner has previously selected one; and

(3) Review the effectiveness of any engineering and administrative controls to identify and correct any deficiencies. The proposal also requires that an operator ensure that a miner with an STS wear the provided hearing protector.

A hearing loss of 10 dB from a miner's prior hearing level is of enough significance to warrant intervention by a mine operator, unless it is determined the loss is not work-related. If the controls in place are effective, including the training, this loss should not be occurring. It should be noted that the retraining required is to take place within 30 days after the finding of the STS, and thus it is unlikely mine operators can satisfy this requirement through their part 48 training programs.

MSHA's proposal does not include a provision for transferring a miner who incurs repeated STS's. A miner transfer program would be complex to administer, and would probably not be feasible in the metal and nonmetal sector. This sector consists largely of smaller mines which may be unable to feasibly rotate workers to other assignments on a long-term basis.

(30) When Must MSHA Be Notified About Hearing Loss?

Pursuant to 30 CFR part 50, MSHA must be notified of any ''reportable'' hearing loss. There is currently no uniform definition of this term. The proposed rule would establish a uniform definition for reporting a miner's hearing loss—a change in hearing acuity 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. MSHA intends that a loss for any miner need not be reported again until there is an additional 25 dB loss. Having a uniform definition will ease reporting burdens on mine operators while promoting the development of an improved data base on hearing loss in the mining community.

MSHA has two specific questions in this regard on which it is seeking comment. First, MSHA would like comment on how to define ''reportable'' hearing loss for those operators who do not have audiometric test data. Not all mine operators will be required to obtain audiometric test data under the proposed rule; thus, such operators may not be able to use a definition of reportable hearing loss defined in this manner.

Second, MSHA is concerned that reporting only losses of 25 dB may not provide MSHA a full picture of hearing loss in the mining industry. A loss of 25 dB is used by many states as a basis for making disability awards. Some have recommended that any STS (10 dB loss) should be captured in a hearing loss data base. OSHA, which currently requires any 25 dB loss to be captured in an employer's log, has proposed to capture any 15 dB loss. MSHA accordingly solicits comment on this point.

(31) When Must a Miner Be Notified of Audiometric Testing Results?

The proposal would require the mine operator, within 10 working days of receiving the results of an audiogram, or receiving the results of a follow-up evaluation, to notify the miner in writing of the results and interpretations, including any finding that an STS or reportable hearing loss has occurred. The notification would include an explanation of the need and reasons for any further testing or evaluation that may be required.

MSHA believes that informing miners of the results of their audiometric tests in a timely manner is critical to the success of an HCP. Immediate feedback upon completion of the testing provides the greatest benefit.

(32) Who Has Access to Exposure and Test Records Maintained by Mine Operators?

Authorized representatives of the Secretaries of Labor and Health and Human Services would have access to all records required under this part.

Moreover under the proposal, a miner or former miner, or his/her designated representative with written consent, would have access to all the records that the mine operator is required to maintain under this part for that individual miner or former miner. Also, the miners' representative is in all cases to have access, for miners they represent, to noise training records and to notices required to be made to miners exposed to noise above various levels.

The mine operator would have 15 days from receipt of a written request to provide such access. The proposal would define ''access'' as the right to examine and copy records. The first copy of any record requested by a person is to be provided without cost to that person, and any additional copies requested by that person are to be provided at reasonable cost.

Upon termination of employment, mine operators would be required to provide a miner, without cost, an actual copy of all his or her own records (those required under this part).

The proposed standard would require mine operators to transfer all records (or a copy thereof) required by this part to any successor mine operator. The successor mine operator would be required to receive these records and maintain them for the period required. Additionally, the successor mine operator would be required to use the baseline audiogram obtained from the original mine operator (or supplemental baseline audiogram as appropriate) for determining an STS and reportable hearing loss.

MSHA has no uniform records access provision. The provisions proposed here are similar to those in other health standards proposed in recent years by the Agency. The Agency welcomes comment on whether it needs to make changes to facilitate the use of electronic recordkeeping systems.

(33) How Does the Proposal Compare With the Existing Standards?

MSHA has prepared two charts comparing some of the key features of the proposed standard to MSHA's existing standards. A comparison to OSHA's noise standard is also provided since many mine operators and others are familiar with that standard.

It is important the reviewers exercise some caution in using these charts. The entries were ''shorthanded'' to fit into the chart. Accordingly, other parts of this preamble should be consulted for details. In comparing the proposed rule with OSHA's standard, for example, reviewers interested in differences on the definition of a hearing conservation program should consult the answer to Question 8; those interested in differences on the threshold should consult the answer to Question 9; those interested in differences on employer obligations to ensure the wearing of provided hearing protections should consult the answer to Question 11; and those interested in differences about the use of hearing protection in lieu of a quiet period before a baseline audiogram should consult the answer to Question 23.

Care should also be taken in consulting the existing standards themselves. The entries in the charts and the discussions in the preamble reflect legal and/or policy interpretations of the various standards that now determine their meaning, something that would not be apparent from an examination of the text of the standards.

To conserve space, the following abbreviations are used in the charts: HP (hearing protection), HCP (hearing conservation program), STS (standard threshold shift), TWA_8 (time-weighted eight-hour average), dBA (decibel, A-weighted), PEL (permissible exposure limit); ''admin'' (administrative), kHz (kilohertz), and N/A (none or not applicable).

COMPARISON CHART 1: EXPOSURE/DOSE TRIGGERS

TWA_8 noise above	Proposal	Existing metal/nonmetal	Existing coal	OSHA
85 dBA	Provide training on noise; enroll miner in HCP (must offer annual hearing test); provide HP before baseline audiogram taken, if STS detected or upon request of miner; must ensure miner uses HP if more than 6 months for baseline (mobile van) or STS detected.	No action required	No action required	Enroll employee in HCP (must offer annual hearing test); if more than 6 months before baseline audiogram taken (mobile van), employee must be provided and wear HP; employee must also be provided and use HP if STS detected.
90 dBA	Use all feasible engineering and admin. controls to reach; if can't reach 90 using such controls, use controls to get as low as possible, provide HP to all miners, ensure HP used and ensure hearing tests taken.	Use all feasible engineering or admin. controls to reach; if can't reach 90 using such controls, then must also provide HP.	Use all feasible engineering or admin. controls to reach * * * but can first reduce exposure reading by rated value of HP minus 7 unless cited for failure to require HP use; must enroll miners in HCP if cited.	Use all feasible engineering or admin. controls to reach * * * but if exposure less than 100 dBA, can first reduce reading by value of HP attenuation =.50 x (rated value of HP minus 7).
105 dBA	Dual HP must be provided and used.	Limited requirement for dual HP.	n/a	n/a.

COMPARISON CHART 2: ISSUES

Issue	Proposal	Existing metal/nonmetal	Existing coal	OSHA
Monitoring	Operator must establish system of monitoring exposures.	No requirement on mine operator.	Mine operator required to conduct periodic monitoring.	Employer must conduct represent. personal sampling if info suggests noise exceeds action level.
Notification of exposure level.	Notify miner of measured exposure level if: (a) exposure changed, or (b) even if shows no change if miner not notified within last year.	Not required	Not required	Notify employee if exposure exceeds action level.

COMPARISON CHART 2: ISSUES—Continued

Issue	Proposal	Existing metal/nonmetal	Existing coal	OSHA
Threshold: lowest sound levels counted.	80 dBA	90 dBA	90 dBA	80 dBA for monitoring & HCP enrollment but 90 dBA for PEL.
Exchange rate	5 dB	5 dB	5 dB	5 dB.
Ceiling	115 dBA	115 dBA	115 dBA	115 dBA.
Training on hearing protector selection & use.	Annual if above action level.	Part 48 general discussion	Part 48 general discussion	Annual if exposure exceeds TWA_8 of 85 dBA.
Training on audiology & employer program.	Annual if above action level.	No	No	Audiology only; annual if enrolled in HCP.
Quiet period before aud. exam.	14 hours for baseline audiogram; can not use hearing protectors.	n/a	n/a	14 hours for baseline audiogram; can use hearing protectors.
Standard threshold shift	10 dB av. shift @ 2, 3, & 4 KHz.	n/a	n/a	10 dB av. shift @ 2, 3, & 4 KHz.
Reportable hearing loss	Must report 25 dB av. shift @ 2, 3, & 4 kHz, either ear.	Reporting required but level not defined.	Reporting required but level not defined.	No reporting; must record 25 dB av. shift @ 2, 3, & 4 kHz, either ear; 1/96 proposal would drop to 15 dB.
Employee access to records.	Yes	No	No	Yes.

(34) Is MSHA Going To Write the Final Rule in Plain English so Miners and Mine Operators Can Understand Their Obligations?

The text of the proposed rule can be found at the very end of this notice. While the Agency endeavored to write clearly, it is interested in suggestions to make the final rule as comprehensible as possible to mine operators and miners.

MSHA has developed two examples, based on the proposed rule, to illustrate some alternative approaches it could take.

The first example illustrates one way in which a rule's organization can be reformulated so as to serve as a more useful reference tool. This proposal's table of contents begins as follows:

62.100 Purpose and scope; effective date.
62.110 Definitions
62.120 Limitations on noise exposure

The alternative version presents the table of contents as a series of practical questions that are likely to be asked by the mining community. The sections have been subdivided so as to address questions one at a time. In the mining industry, the Department of the Interior has also experimented with this approach, e.g., proposed coalbed methane regulations (60 FR 47920).

62.100 What is the purpose of requiring mine operators to limit miner noise exposure?
62.101 What kinds of mining operations are covered by this regulation?
62.102 When does this regulation take effect?
62.110 What is meant by various technical terms used in this regulation?
62.120 How is a miner's noise dose calculated?
62.121 How is dose converted to 8-hour time-weighted averages?
62.122 Can a miner's dose measurement be adjusted to reflect the type of hearing protection being worn by the miner?
62.123 What are a mine operator's obligations to evaluate miner noise exposure?
62.124 When must miners and/or their representatives be notified of measured exposures?
62.130 What must a mine operator do whenever a miner's noise dose exceeds the action level?
62.131 What else must a mine operator do if a miner's noise dose exceeds the action level but remains below the PEL?
62.132 What else must a mine operator do if a miner's noise dose exceeds the PEL?
62.133 What is the highest sound level to which a miner may be lawfully exposed?

The contents of several of these sections might be more clear if presented in a tabular format. This would be particularly useful where the mine operator may have choices or has to do more than one thing. An example involves the controls required at the action level. The current proposal, as it would appear in the Code of Federal Regulations, as paragraph (b) of proposed § 62.120, is:

(b) *Action level.* When a miner's noise exposure exceeds a TWA_8 of 85 dBA during any workshift, or equivalently a dose of 50%, the operator shall take the actions specified in paragraphs (b) (1) and (2) of this section and, at the request of the miner, also take the actions specified in paragraph (b)(3) of this section.

(1) An operator shall provide the miner training that includes the instruction required by § 62.130, at the time exposure exceeds the action level and every 12 months thereafter that exposure continues to exceed the action level.

(2) An operator shall enroll the miner in a hearing conservation program which shall meet the requirements of §§ 62.140 through 62.190. Moreover, the operator shall, with respect to any miner enrolled in such program, provide hearing protection in accordance with the requirements of § 62.125 until such time as a baseline audiogram has been obtained. If it takes more than 6 months to conduct the baseline audiogram, or if the miner is determined to have incurred an STS, the operator shall ensure that the hearing protection is provided to the miner and worn by the miner.

(3) At the request of any miner, the operator shall provide hearing protection to the miner in accordance with the requirements of § 62.125.

The alternative format would appear, using the revised numbering and naming conventions from example 1, somewhat like the following:

62.131 What specifically must a mine operator do if a miner's noise dose exceeds the action level?

If a miner's noise exposure exceeds a dose of 50% (a TWA_8 of 85 dBA):

You must	Which means you
(a) Provide training.	Provide a miner with the training required by MSHA's rules— (1) When his or her exposure exceeds the action level; and (2) Every 12 months thereafter that his or her exposure continues to exceed the action level.

You must	Which means you
(b) Enroll the miner in a hearing conservation program.	(1) Offer the miner annual audiometric examinations that comply with MSHA's rules for hearing conservation programs; and (2) Provide a miner with hearing protection until a baseline audiogram has been taken; and in the event that will take more than 6 months due to the needs to wait for a mobile test van, require the miner to use the hearing protector; and (3) Provide a miner with hearing protection, and require its use, whenever an STS is detected.
(c) At the request of a miner, provide the miner with hearing protection.	Provide hearing protection in accordance with MSHA's rules.

MSHA's rules for training are discussed in § 62.137. MSHA's rules for hearing conservation programs are discussed in §§ 62.140 through 62.190. MSHA's rules for hearing protection are discussed in § 62.135.

MSHA has not yet consulted with the Office of the Federal Register on the specifics of such approaches; moreover, the examples noted above should not be considered as necessarily accurately representing the content of MSHA's proposed rule. These caveats notwithstanding, the Agency is interested in the potential of these approaches, and would welcome comment on these specific examples.

(35) Is MSHA Going To Provide Adequate Guidance Before Implementing the Rule?

The Agency plans to take several steps toward this end.

First, the Agency is proposing that the new standard not take effect until one year after the date of publication of the final rule. This should provide time to train MSHA personnel and provide mine operators with technical assistance and guidance. An alternative would be to phase in the new requirements. The Agency believes some could be phased in quickly, but wants to avoid confusion. The Agency requests comment on whether a phased-in approach is appropriate and how it might most effectively be designed.

In addition, the Agency is committed to issuing a compliance guide for mine operators before a final rule takes effect. MSHA would welcome suggestions on matters that should be discussed in such a guide.

MSHA would also welcome comments on other actions it could take to facilitate implementation, and in particular whether a series of workshops would be useful.

(36) Are There Special Enforcement Issues of Which the Mining Community Should Take Note?

Question 13 addresses the question of what constitutes ''feasible'' engineering and administrative controls.

Operators in the mining industry are aware that the Agency has traditionally not cited an operator for exceeding the PEL unless the Agency's measurement of noise shows that it exceeds a TWA_8 of 92 dBA. This provides adequate room to accommodate, in an enforcement context, any technical questions about MSHA's measurements. MSHA's citation policy does not, however, alter operator obligations of the rule, including those based on operator exposure readings.

The Agency is interested in comment on whether the new final rule should include a provision requiring operators to develop a written plan in certain cases. At the present time, coal operators in violation of the PEL must submit for approval a plan for the administration of a continuing, effective program to assure compliance including provision for reducing environmental noise levels, hearing protectors, and audiograms. No such plans are provided in the metal and nonmetal sector. The proposed rule, which would establish a uniform approach to noise for both sectors, would eliminate the current coal requirement, because MSHA does not believe such plans need to be created every time an operator violates the PEL. The Agency recognizes, however, that achieving effective compliance in some cases would be furthered by the existence of a written plan. In particular, such plans may be appropriate when there is a history of multiple noise violations, or a failure to effectively abate. Such plans would include specific details on how operators will comply with the final rule; a failure to comply with the plan's specifications would be enforceable through MSHA's normal citation/order process. Making explicit provision in the standard for such plans would ensure clarity about the Agency's enforcement policy on noise.

The Agency notes that in some cases the proposal would require operators to ensure certain miners wear hearing protection that is provided, and ensure certain miners take tests that are offered. Comment is welcome on how Agency personnel could distinguish these miners from others.

(B) Executive Order 12866

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

The preliminary RIA containing this analysis is available from MSHA. MSHA welcomes comments on its analysis and methodology. The proposal would cost approximately $8.3 million and would save 765 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. This means that while the Office of Management and Budget was provided an opportunity to review this proposal and the preliminary RIA (as discussed in the History section of this preamble), specific determinations of the costs and benefits are not required pursuant to section 6(a)(3)(C) of the Executive Order.

(C) Paperwork Reduction Act

This proposed rule contains information collections which are subject to review by the Office of Management and Budget (OMB) under the Paperwork Reduction Act of 1995 (PRA95). The title, description, and respondent description of the information collection are shown below with an estimate of the annual reporting burden. Included in the estimate is the time for reviewing instructions, gathering and maintaining the data needed, and completing and reviewing the collection of information. With respect to the following collection of information, MSHA invites comments on: (1) Whether the proposed collection of information is necessary for proper performance of MSHA's functions, including whether the information will have practical utility; (2) the accuracy of MSHA's estimate of the burden of the proposed collection of information, including the validity of the methodology and assumptions used; (3) ways to enhance the quality, utility, and

clarity of information to be collected; and (4) ways to minimize the burden of the collection of information on respondents, including through the use of automated collection techniques, when appropriate, and other forms of information technology.

These estimates are an approximation of the average time expected to be necessary for a collection of information. They are based on such information as is available to MSHA.

Submission

The Agency has submitted a copy of this proposed rule to OMB for its review and approval of these information collections. Interested persons are requested to send comments regarding this information collection, including suggestions for reducing this burden, to the Office of Information and Regulatory Affairs, OMB New Executive Office Bldg., 725 17th St. NW., Rm. 10235, Washington, DC 20503, Attn: Desk Officer for MSHA. Submit written comments on the information collection not later than February 18, 1997.

Description of Respondents

Those required to provide the information are mine operators and individuals who are paid to perform tasks for the mine operator (e.g., physicians reporting the results of audiograms to the mine operator).

Description

The proposal contains information collection requirements in §§ 62.120, 62.130, 62.140, 62.150, 62.160, 62.170, 62.180, 62.190, 62.200, and 62.210. The following chart presents the paperwork requirements by section.

NET INFORMATION COLLECTION BURDEN HOURS BY PROPOSED SECTION

Section	Paperwork requirement and associated tasks	Hours
62.120	Evaluate miners' noise exposure; notify miner of overexposure; prepare and post administrative controls; give miners copy of administrative controls.	(135,250)
62.130	Prepare and file a training certification	10,270
62.140	Perform audiograms; notify miners to appear for testing and need to avoid high noise	69,930
62.150	Compile an audiometric test record; obtain a certification	9,175
62.160	Provide information and audiometric test record; perform audiometric retests	21,350
62.170	Perform otological evaluations and provide information and notice	1,045
62.180	Prepare a training certification for retrained miners; review effectiveness of engineering and administrative controls	700
62.190	Inform miner of test results; inform miner of STS	6,300
62.200	Provide access to records	1,255
62.210	Transfer records	235
Total		(14,985)

These paperwork requirements have been submitted to the Office of Management and Budget (OMB) for review under section 3504(h) of the Paperwork Reduction Act of 1995 (PRA 95). Respondents are not required to respond to any collection of information unless it displays a currently valid OMB control number.

The following chart summaries MSHA's estimates by section in tabular form. Data is distributed by commodity. All numbers have been rounded.

NET INFORMATION COLLECTION BURDEN HOURS BY COMMODITY

Task		Coal	Metal/ nonmetal
62.120	Limitations on Noise Exposure	(140,545)	5,295
62.130	Training	4,000	6,270
62.140	Audiometric Testing Program	30,655	39,275
62.150	Audiometric Test Procedures	3,930	5,245
62.160	Evaluation of Audiograms	9,340	12,015
62.170	Followup Evaluation	475	570
62.180	Followup Corrective Measures	335	365
62.190	Notification of Results	2,715	3,585
62.200	Access to Records	255	1,000
62.210	Transfer of Records	100	135
Total (discrepancies due to rounding)		(88,740)	73,755

Alternatively, the paperwork hours may be distributed between small and large mines. The following table provides this analysis. Small mines are those with less than 20 employees.

NET INFORMATION COLLECTION BURDEN HOURS BY MINE SIZE

Task		Small	Large
62.120	Limitations on Noise Exposure	(15,510)	(119,740)
62.130	Training	2,965	7,305
62.140	Audiometric Testing Program	19,270	50,660
62.150	Audiometric Test Procedures	2,885	6,290
62.160	Evaluation of Audiograms	6,185	15,170
62.170	Followup Evaluation	250	800
62.180	Followup Corrective Measures	160	540

NET INFORMATION COLLECTION BURDEN HOURS BY MINE SIZE—Continued

Task	Small	Large
62.190 Notification of Results	1,935	4,365
62.200 Access to Records	500	755
62.210 Transfer of Records	185	50
Total (discrepancies due to rounding)	18,825	(33,805)

Metal/nonmetal mines would incur 75,080 burden hours under the proposal and coal mines would incur 55,675 hours. For metal/nonmetal mines, the existing burden is 1,325 hours as defined and calculated under PRA 95; this makes the net burden for metal/nonmetal mines 73,755 hours. For coal mines, the net burden is 88,740 fewer hours than the existing burden as calculated under PRA 95. The proposal would result in a net decrease of 14,985 burden hours associated with information collection from that associated with the current requirements. It should be noted that the existing burden hours are currently approved in three separate paperwork packages and reflect burden hours calculated under the provisions of the 1980 Paperwork Reduction Act (PRA 80). MSHA is in the process of updating and combining these three packages. The Agency's official paperwork submission accompanying this proposal includes a chart comparing the existing burden hours under PRA 80, the existing burden hours under PRA 95, and the proposed burden hours under PRA 95.

Additional detail is presented in the charts that follow. These charts provide annual and annualized paperwork burden hours as measured by PRA 95. Burden hours for tasks which predominantly would occur in the first year only, dose determination and notification, are presented in annualized form. Proposed §§ 62.140(b)(3), 62.250 (b) and (c), 62.160 (a)(1) and (a)(3), 62.170 (b) and (c), 62.180(a), 62.190 (a)(1) and (a)(2), 62.200(b) and 62.210(a) are anticipated to require the paperwork burden of the mine operator providing instructions to the clerical worker. This burden is included in the total hours per regulation column.

Regulation	Number of respondents	Hours per response	Number of responses	Number of responses per respondent	Total hours per regulation	Maintenance and operating costs	Annualized capital costs
Small Metal and Nonmetal Mines							
62.120(f)(1)	6,218	2.00	n/a	n/a	3,530	$597,922	$1,315,604
62.120(f)(2)	6,218	0.08	35,300	6	490	1,253	0
62.120(c)(1)	18	1.75	18	1	25	0	0
62.120(c)(1)	18	0.05	103	5	5	26	0
62.130(b)	6,218	0.05	35,300	6	2,385	8,825	0
62.140(b)(1)	2,430	1.00	13,779	6	13,780	413,370	0
62.140(b)(3)	2,430	0.08	13,779	6	1,345	3,445	0
62.150(b)	2,430	0.08	13,779	6	1,345	3,445	0
62.150(c)	2,430	0.05	13,779	6	930	3,445	0
62.160(b)(1)	300	1.50	1,720	6	2,585	86,000	0
62.160(a)(1)	2,430	0.08	13,779	6	1,345	3,445	0
62.160(a)(3)	2,430	0.05	13,779	6	930	3,445	0
62.170(a)	15	2.00	90	6	180	22,500	0
62.170(b)	15	0.08	90	6	9	23	0
62.170(c)	15	0.08	90	6	9	23	0
62.180(a)	320	0.05	1,808	6	90	452	0
62.180(c)	15	2.00	15	1	20	0	0
62.190(a)(1)	2,430	0.08	13,779	6	1,345	3,445	0
62.190(a)(2)	320	0.08	1,812	6	180	1,461	0
62.200(b)	60	0.10	4,374	12	440	1,094	0
62.210(a)	361	0.25	361	1	125	0	0
Monitoring (existing)	1,705	2.00	n/a	n/a	970	163,953	360,744
Large Metal and Nonmetal Mines							
62.120(f)(1)	1,023	5.00	n/a	n/a	1,455	$98,372	$216,446
62.120(f)(2)	1,023	0.08	75,700	75	875	2,687	0
62.120(c)(1)	40	2.25	40	1	90	0	0
62.120(c)(1)	40	0.05	2,972	70	150	726	0
62.130(b)	1,023	0.05	75,700	75	3,885	18,925	0
62.140(b)(1)	301	1.00	22,328	75	22,330	669,840	0
62.140(b)(3)	301	0.08	22,328	75	1,820	5,582	0
62.150(b)	301	0.08	22,328	75	1,820	5,582	0
62.150(c)	301	0.05	22,328	75	1,150	5,582	0
62.160(b)(1)	40	1.50	2,790	70	4,185	139,500	0
62.160(a)(1)	301	0.08	22,328	70	1,820	5,582	0
62.160(a)(3)	301	0.05	22,328	70	1,150	5,582	0
62.170(a)	2	2.00	174	85	344	43,500	0
62.170(b)	2	0.08	174	85	15	44	0

Regulation	Number of respondents	Hours per response	Number of responses	Number of responses per respondent	Total hours per regulation	Maintenance and operating costs	Annualized capital costs
62.170(c)	2	0.08	174	85	15	44	0
62.180(a)	50	0.05	3,490	70	175	873	0
62.180(c)	35	2.25	35	1	80	0	0
62.190(a)(1)	301	0.08	22,328	75	1,820	5,582	0
62.190(a)(2)	40	0.08	2,965	70	240	742	0
62.200(b)	10	0.10	5,601	560	560	1,400	0
62.210(a)	10	1.00	10	1	10	0	0
Monitoring (existing)	250	5.00	n/a	n/a	355	24,040	52,895
Small Coal Mines							
62.120(f)(1)	1,255	2.00	n/a	n/a	715	$120,681	$265,533
62.120(f)(2)	1,255	0.08	9,020	7	120	320	0
62.120(c)(1)	20	1.75	20	1	30	0	0
62.120(c)(1)	20	0.05	173	7	10	43	0
62.130(b)	1,255	0.05	9,020	7	580	2,255	0
62.140(b)(1)	536	1.00	3,851	7	3,851	115,530	0
62.140(b)(3)	536	0.08	3,851	7	360	963	0
62.150(b)	536	0.08	3,851	7	360	963	0
62.150(c)	536	0.05	3,851	7	250	963	0
62.160(b)(1)	70	1.50	480	7	720	24,050	0
62.160(a)(1)	536	0.08	3,851	7	360	1,926	0
62.160(a)(3)	536	0.05	3,851	7	250	0	0
62.170(a)	4	2.00	24	6	48	6,000	0
62.170(b)	4	0.08	24	6	2	6	0
62.170(c)	4	0.08	24	6	2	6	0
62.180(a)	60	0.05	507	8	25	127	0
62.180(c)	20	1.25	20	1	25	0	0
62.190(a)(1)	536	0.05	3,851	7	360	963	0
62.190(a)(2)	73	0.05	505	7	50	126	0
62.200(b)	15	0.10	610	40	60	131	0
62.210(a)	160	0.25	160	1	60	0	0
Monitoring (existing)	1,762	0.50	25,334	14	12,670	357,492	169,434
Audiograms (existing)	35	1.00	74	2	70	2,220	0
Supplemental Noise Survey	420	0.05	840	2	(120)	0	0
Supplemental Noise Survey	420	0.25	5,980	14	(2,990)	0	0
Written HCP	90	6.00	90	1	(535)	0	0
Calibration Reports	1,762	0.25	1,762	1	(440)	0	0
Survey Reports	1,762	0.05	1,762	1	(90)	0	0
Monitoring Records	1,762	0.10	25,334	14	(2,530)	0	0
Survey Certificates	1,762	0.05	1,762	1	(90)	0	0
Large Coal Mines							
62.120(f)(1)	890	5.00	n/a	n/a	1,265	$85,582	$188,306
62.120(f)(2)	890	0.08	66,667	75	770	2,367	0
62.120(c)(1)	45	2.25	45	1	75	1,309	0
62.120(c)(1)	45	0.05	5,237	75	290	0	0
62.130(b)	890	0.05	66,667	75	3,420	16,667	0
62.140(b)(1)	334	1.00	25,007	75	25,007	750,210	0
62.140(b)(3)	334	0.08	25,007	75	2,035	6,252	0
62.150(b)	334	0.08	25,007	75	2,035	6,252	0
62.150(c)	334	0.05	25,007	75	1,285	6,252	0
62.160(b)(1)	40	1.50	3,126	80	4,690	156,300	0
62.160(a)(1)	334	0.08	25,007	80	2,035	6,252	0
62.160(a)(3)	334	0.05	25,007	80	1,285	6,252	0
62.170(a)	3	2.00	196	65	392	49,000	0
62.170(b)	3	0.08	196	65	16	49	0
62.170(c)	3	0.08	196	65	16	49	0
62.180(a)	400	0.05	3,908	35	195	977	0
62.180(c)	40	2.25	40	1	90	0	0
62.190(a)(1)	334	0.05	25,007	75	2,035	6,252	0
62.190(a)(2)	40	0.05	3,322	80	270	831	0
62.200(b)	10	0.10	1,934	194	195	484	0
62.210(c)	40	1.00	40	1	40	0	0
Monitoring existing	1,134	0.50	169,424	150	84,710	230,077	239,932
Audiograms (existing)	6	1.00	542	90	540	0	0

Regulation	Number of respondents	Hours per response	Number of responses	Number of responses per respondent	Total hours per regulation	Maintenance and operating costs	Annualized capital costs
Supplemental Noise Survey	293	0.05	43,712	150	(21,860)	0	0
Supplemental Noise Survey	293	0.25	293	1	(40)	0	0
Written HCP	67	6.00	67	1	(405)	0	0
Calibration Reports	1,134	0.25	1,134	1	(280)	0	0
Survey Reports	1,134	0.05	1,134	1	(60)	0	0
Monitoring Records	1,134	0.10	169,424	150	(16,940)	0	0
Survey Certificates	1,134	0.05	1,134	1	(60)	0	0

(D) Regulatory Flexibility Act

In accordance with § 605 of the Regulatory Flexibility Act (RFA), the Mine Safety and Health Administration certifies that the noise proposal does not have a significant economic impact on a substantial number of small entities. MSHA considers small mines to be mines with fewer than 20 employees. However, for the purposes of the RFA and this certification, MSHA has also evaluated the impact of the proposal on mines up to and including those with fewer than 500 employees. No small governmental jurisdictions or nonprofit organizations are affected. Under the Small Business Regulatory Enforcement Fairness Act (SBREFA) amendments to the RFA, MSHA must include in the proposal a factual basis for this certification. The Agency also must publish the regulatory flexibility certification statement in the Federal Register, along with the factual basis, followed by an opportunity for comment by the public. 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.

MSHA specifically solicits comment on the Agency's determination in this regulatory flexibility certification statement, including cost data and data sources. To facilitate the public participation in the rulemaking process, MSHA will mail a copy of the proposed rule, including the preamble and regulatory flexibility certification statement, to every mine operator.

Factual Basis for Certification

The Agency has used a quantitative approach in concluding that the proposed rule does not have a significant impact on a substantial number of small entities. 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 (i.e., beyond the 4-digit SIC level) may not be feasible. The Agency requests comments, however, on whether there are special circumstances that warrant separate quantification of the impact of this proposal 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 proposal.

Under the RFA, 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 for the mining industry by publishing that 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 proposal for small and large mines using both the traditional Agency definition, and SBA's definition, as required by RFA, of a small mine. The Agency compared the costs of the proposal for small mines in each sector to the revenues and profits for each sector for every size category analyzed. In each case, the results indicated that the costs as a percent of revenue are less than 1%. Further, the costs do not appear to have any appreciable impact on profits.

The following table summarizes the results of this analysis for mines which employ fewer than 500 miners, at various sizes.

SMALL MINES: COSTS COMPARED TO REVENUES AND PROFITS

	Estimated costs (thous.)	Estimated revenue (millions)	Average profit as % of revenue	Total estimated profits (millions)	Estimated cost per small mine	Cost as % of revenue	Cost as % of profit
Coal Mines:							
Small <20	($45)	$855	3.82	$33	($26)	−0.01	−0.14
Large >=20	332	19,094	3.82	729	293	0.00	0.05
Small <50	586	3,542	3.82	135	237	0.02	0.43
Large >=50	(300)	16,408	3.82	627	(709)	0.00	−0.05
Small <100	832	6,061	3.82	232	309	0.01	0.36
Large >=100	(545)	13,888	3.82	531	(2,684)	0.00	−0.10
Small <250	677	12,624	3.82	482	240	0.01	0.14
Large >=250	(391)	7,326	3.82	280	(5,140)	−0.01	−0.14
Small <500	382	19,117	3.82	730	132	0.00	0.05
Large >=500	(95)	831	3.82	32	(8,660)	−0.01	-0.30
M/NM Mines:							
Small <20	4,437	11,929	4.55	543	479	0.04	0.82
Large >=20	3,600	26,071	4.55	1,186	2,324	0.01	0.30
Small <50	5,731	18,814	4.55	856	557	0.03	0.67
Large >=50	2,306	19,186	4.55	873	4,359	0.01	0.26

SMALL MINES: COSTS COMPARED TO REVENUES AND PROFITS—Continued

	Estimated costs (thous.)	Estimated revenue (millions)	Average profit as % of revenue	Total estimated profits (millions)	Estimated cost per small mine	Cost as % of revenue	Cost as % of profit
Small <100	6,323	23,047	4.55	1,049	599	0.03	0.60
Large >=100	1,714	14,953	4.55	680	6,418	0.01	0.25
Small <250	7,037	29,558	4.55	1,345	655	0.02	0.52
Large >=250	1,000	8,442	4.55	384	14,492	0.01	0.26
Small <500	7,571	32,134	4.55	1,462	702	0.02	0.52
Large >=500	466	5,866	4.55	267	17,249	0.01	0.17

In determining revenues for coal mines, MSHA multiplied coal production data (in tons) for mines in specific size categories (reported to MSHA quarterly) by the average price per ton (from the Department of Energy, Energy Information Administration, *Annual Energy Review 1995*). 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 (from the Department of the Interior, former Bureau of Mines, *Mineral Commodity Summaries 1996*). Average profit as a percent of revenue for both coal mines and metal and nonmetal mines comes from Dun & Bradstreet Information Services, *Industry Norms & Key Business Ratios*, 1993–94.

Based on the information in the Agency's preliminary Regulatory Impact Analysis (summarized in the ''costs'' table in the Question and Answer section of this preamble), the costs of the proposal for all metal and nonmetal mines with fewer than 20 employees would be $4.6 million; the average cost of the proposal for a small metal and nonmetal mine with fewer than 20 employees is about $500. The average cost of the proposal for a small metal and nonmetal mine with fewer than 500 employees is about $700. For small coal mines with fewer than 20 employees, the proposal is estimated to result in a small net savings of about $30. This savings results from the proposed elimination of a substantial paperwork burden that now exists in the coal mine sector for monitoring miners' noise exposures. For small coal mines with fewer than 500 employees, the proposal is estimated to result in a small net cost of about $130.

Regulatory Alternatives Rejected

The limited impacts on small mines, regardless of size definition, reflect decisions by MSHA not to propose 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 seriously considered two alternatives that would have significantly increased costs for small mine operators—lowering the PEL to a TWA_8 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 in both cases, for the purpose of this proposal, MSHA has concluded that it may 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. Part IV of this preamble contains a full discussion of MSHA's preliminary conclusions about these alternatives. The public is invited to propose other alternatives for consideration.

Paperwork Impact

In accordance with the Regulatory Flexibility Act and the Paperwork Reduction Act of 1995 (PRA 95), MSHA has analyzed the paperwork burden for small mines. While the proposal results in a net paperwork burden decrease for all mines, it results in an increase in paperwork hours. For mines with fewer than 20 miners the proposal would result in an increase of about 18,800 hours, and with fewer than 500 miners it would result in a decrease of about 14,985 hours. The bulk of the new hours (greater than 80%) is derived from the audiometric testing program and procedures. While mines with fewer than 20 employees in the coal and metal and nonmetal sectors will have extra burden hours associated with new requirements, the net burden hours for small coal mines are actually reduced, because the proposal would eliminate current requirements for biannual noise surveys and other miscellaneous reports and surveys in that sector. However, at this size level, there are more metal and nonmetal mines than there are coal mines. Thus, at this size level, the proposal would result in a net gain in paperwork burdens.

As required by PRA 95, MSHA has included in its paperwork burden estimates the time needed to perform tasks associated with information collection. For example, the proposed rule requires a mine operator to notify a miner if the miner's noise exposure exceeds the action level. In order to determine if notification is necessary, the mine operator must perform dose determination monitoring. Although completion of the notification would take 0.05 hour on average, the time for dose determination must be included in the burden estimate according to the new paperwork law. The proposal's average paperwork burden per small metal and nonmetal mine is 4.8 hours and per small coal mine is 6 hours per year.

Other Relevant Matters

In accordance with the Small Business Regulatory Enforcement Fairness Act (SBREFA), MSHA is taking actions to minimize the compliance burden on small mines. As discussed in the ''Questions and Answers'' section of this preamble, MSHA is committed to writing the final rule in plain English, so that it can be easily understood by small mine operators. The proposed effective date of the rule would be a year after final promulgation, to provide adequate time for small mines to achieve compliance. Also, as stated

previously, MSHA will mail a copy of the proposed rule to every mine operator which primarily benefits small mine operators. The Agency has committed itself to issuance of a compliance guide for all mines, and has invited comment on whether compliance workshops or other such approaches would be valuable.

MSHA is considering whether to continue to use ''fewer than 20 miners'' as the definition of a small mine for purposes of the Regulatory Flexibility Act (RFA). For this rulemaking's Regulatory Flexibility Analysis, the Agency is using fewer than 20 employees, in addition to the SBA's definition of fewer than 500, as required by the RFA. MSHA presently is consulting with the SBA Office of the Chief Counsel for Advocacy in order to determine an appropriate definition to propose to the public for comment in the future. For purposes of this proposed rule on noise, 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 proposed noise rule does not have a significant economic impact on a substantial number of small entities.

(E) Unfunded Mandates Act

MSHA has determined that, for purposes of § 202 of the Unfunded Mandates Reform Act of 1995, this proposal 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 proposed 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 preliminary Regulatory Impact Statement (summarized in the ''cost'' table in the Questions and Answers section of this preamble), the cost of this proposed rule for the entire mining industry is less than $10 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 proposed regulation. The proposed rule will impact approximately 14,000 coal and metal and nonmetal mining operations; however, increased costs would be incurred only by those operations where noise exposures exceed the allowable limits. MSHA estimates that approximately 350 sand and gravel or crushed stone operations are run by state, local, or tribal governments and would be impacted by this rule. MSHA anticipates that these entities would be able to reduce noise exposure below the PEL via engineering and administrative controls and would not need to use a Hearing Conservation Program, thereby minimizing their costs. MSHA estimates that increased costs for these entities would be about $500 per year which would be partially offset by reduced worker compensation costs. Other tangible benefits include reduction in the number of cases of hearing impairment in these entities.

When MSHA issues the proposed rule, the Agency will affirmatively seek input of any state, local, and tribal government which may be affected by the noise rulemaking. This would include state and local governmental entities who operate sand and gravel mines in the construction and repair of highways and roads. MSHA will mail a copy of the proposed rule to approximately 350 such entities.

Following is MSHA's state-by-state listing of sand and gravel mines owned or operated by state or local governments.

The Agency welcomes any corrections.

STATE/COUNTY OWNED/OPERATED SAND AND GRAVEL OPERATIONS

[As of 12/08/95]

State	State owned	County owned	City owned
ARIZONA	2	2	.....
ARKANSAS	.....	5	.....
CALIFORNIA	.....	4	.....
COLORADO	4	27	.....
IDAHO	.....	13	.....
ILLINOIS	.....	2	.....
INDIANA	.....	5	.....
IOWA	.....	2	.....
KANSAS	.....	2	.....
MAINE	5	.....	.....
MARYLAND	.....	.....	6
MICHIGAN	.....	8	.....
MISSISSIPPI	.....	5	.....
MISSOURI	.....	8	.....
MONTANA	8	34	.....
NEBRASKA	.....	2	.....
NEVADA	.....	1	.....
NEW MEXICO	.....	4	.....
NEW YORK	.....	15	95
OKLAHOMA	.....	2	.....
OREGON	.....	11	.....
PENNSYLVANIA	.....	.....	1
SOUTH CAROLINA	.....	1	.....
SOUTH DAKOTA	.....	15	.....
TENNESSEE	.....	3	.....
TEXAS	.....	6	.....
UTAH	1	5	.....
VERMONT	.....	.....	11
WASHINGTON	.....	9	.....
WISCONSIN	.....	20	1
WYOMING	.....	1	.....
Total 346	20	212	114

(F) Rulemaking History

MSHA's noise standards in metal and nonmetal mines (30 CFR 56/57.5050) and in coal mines (§§ 70.500 through 70.511, and §§ 71.800 through 71.805) were first published in the early 1970's. These standards, derived from the Walsh-Healey Public Contracts Act occupational noise standard, adopted a TWA_8 PEL of 90 dBA and a 5-dB exchange rate.

Because of the differences between the standards for coal mines and those for metal and nonmetal mines, members of the mining community with operations in coal and metal and nonmetal requested that MSHA revise its standards to provide one set of noise standards covering all mines. Other mine operators with facilities regulated by both MSHA and OSHA suggested that MSHA promulgate noise standards which are generally consistent with OSHA standards. The United Mine Workers also requested that the Agency reconsider the existing standards to address several asserted deficiencies.

Based on these comments and the incidence of noise-induced hearing loss (NIHL) among miners, the Agency published an Advanced Notice of Proposed Rulemaking (ANPRM) on December 4, 1989 (54 FR 50209). In this

ANPRM, the Agency solicited information for revision of the noise standards for coal and metal and nonmetal mines. The Agency received numerous comments which are reflected in this proposal from mine operators, trade associations, labor groups, equipment manufacturers, and other interested parties.

A draft of the proposed rule and accompanying analyses was sent to the Office of Management and Budget and to the Chief Counsel for Advocacy of the Small Business Administration, in accordance with law and Executive Order. Consultations with these two agencies were completed within 90 days. No substantive changes to the proposal were recommended during these consultations, nor were any made by MSHA. The Agency did receive valuable advice on the presentation of its initial Regulatory Flexibility Analysis and on displaying the results of its paperwork analysis, so as to better highlight the Agency's compliance with PRA 95 and SBREFA.

In the Spring of 1996, the National Institute for Occupational Safety and Health (NIOSH) released for peer review a draft criteria document for occupational noise exposure to update the one issued in 1972. As indicated previously (see response to Question 6 in ''Questions and Answers''), MSHA has determined that it would not be appropriate to delay publication of this proposed rule to await the issuance of the final NIOSH criteria document.

A summary of the draft criteria document, prepared by NIOSH, is reprinted here verbatim for those in the mining community who have not otherwise received copies. This summary should provide ample notice of the position NIOSH may be taking in a new criteria document.

April 16, 1996—(NIOSH) Summary of Recommendations, Criteria for a Recommended Standard: Occupational Noise Exposure

1. Hearing Impairment and Risk Assessment

The protection goal incorporated in most definitions of hearing impairment has been to preserve hearing at critical audiometric frequencies for speech discrimination. Hearing impairment as defined by NIOSH in 1972 was an average of the hearing threshold levels (HTLs) at the audiometric frequencies of 1000, 2000 and 3000 Hertz (Hz) that exceeded 25 decibels (dB). The 4000-Hz audiometric frequency has been recognized as being not only sensitive to noise but also extremely important for hearing and understanding speech in unfavorable or noisy listening conditions. Because listening conditions are not always ideal in everyday life, and on the basis of the American Speech Language-Hearing Association Task Force's proposal made in 1981, NIOSH has modified its definition of hearing impairment to include the 4000-Hz audiometric frequency for use in assessing the risk of occupational NIHL. Hence, with this modification, NIOSH defines material hearing impairment as an average of the HTLs at 1000, 2000, 3000 and 4000 Hz that exceeds 25 dB.

Because of the prolific occupational use of hearing protectors since the early 1980's, new data that can be used to determine dose-response relationships for NIHL in U.S. workers are not known to exist. NIOSH recently conducted a risk assessment on occupational noise-induced hearing loss (NIHL) using the original definition of hearing impairment and the hearing data from the 1972 criteria document. Although the risk model used in the new assessment is different from the risk model used in 1972, the excess risk estimates derived in the new assessment are comparable to those published in 1972. The excess risk at age 60 from a 40-year occupational exposure to an average daily noise level of 85 decibels, a weighted network (dBA) is approximately 14%, versus the 16% published in 1972. With the new NIOSH definition of hearing impairment, and based on the new risk assessment, the excess risk at the 85-dBA REL is 8%. Thus, the new risk assessment did not revise the excess risk at the 85-dBA REL upward, and although there is still evidence of excess risk at exposure levels below 85 dBA, NIOSH is recommending that the current REL be retained.

2. Exchange Rate

Health effect outcomes are dependent on exposure level and duration. This relationship is called the ''exchange rate,'' which is the increment in decibels that requires the halving of exposure time. The most commonly used exchange rates are 3 dB and 5 dB. A 3-dB exchange rate requires that noise exposure time be halved for each 3-dB increase in noise level; likewise, a 5-dB exchange rate requires that exposure time be halved for each 5-dB increase. NIOSH now recommends the 3-dB exchange rate. The 1972 criteria document recommended the 5-dB exchange rate, which is what OSHA and MSHA currently enforce. There is more scientific, although not unequivocal, support for the 3-dB exchange rate than for the 5-dB exchange rate, which is not based on scientific data and is derived from a series of over-simplifications of the original criteria. The 3-dB exchange rate is recommended by the International Organization for Standardization (ISO), and it is now enforced by most European countries and some provinces of Canada. In the U.S., there have been recent ''converts'' to the 3-dB exchange rate: the U.S. Air Force in 1993; and the American Conference of Governmental Industrial Hygienists and the U.S. Army in 1994.

3. Ceiling Limit

In the 1972 criteria document, NIOSH recommended a ceiling limit of 115 dBA, which is retained in this draft criteria document. Exposures to noise levels greater than 115 dBA would not be permitted regardless of the duration of the exposure. This ceiling limit is based on the assumption that above a critical intensity level the ear's response to energy no longer has a relation to the duration of the exposure, but is only related to the intensity of the exposure. 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 relationship does not hold. For a noise standard to be protective, there should be a noise ceiling level above which no unprotected exposure is permitted. Given the recent data, 115 dBA is a reasonable ceiling limit beyond which no unprotected exposure should be permitted.

4. Hearing Protectors

One consideration for selecting a hearing protector would be its noise reduction capabilities, which are expressed in terms of a noise reduction rating (NRR). The NRR is a single-number, laboratory-derived rating required by the Environmental Protection Agency (EPA) to be shown on the label of each hearing protector sold in the U.S. In the late 1970's and early 1980's, two NIOSH field studies found that insert-type hearing protectors in the field provided less than one-half the attenuation measured in the laboratory, and since the 1970's, 22 additional studies of ''real-world'' attenuation with a variety of hearing protectors have shown similar results.

In calculating the noise exposure to the wearer of a hearing protector, OSHA has implemented the practice of derating the NRR by one-half for all types of hearing protectors. In the 1972 criteria document, NIOSH recommended the use of the equivalent full NRR value, but now it recommends derating the NRR by 25%, 50% and 70% for earmuffs, formable earplugs and all other earplugs, respectively. This derating scheme is not perfect and is intended only as an interim recommendation. If the testing and labeling requirements for hearing protectors are to be changed, EPA must initiate the rulemaking procedures because it has the statutory authority. Given that the funding for EPA's Office of Noise Abatement and Control was eliminated in the early 1980's, this change is unlikely to occur in the near future.

The draft also recommends that hearing protectors be worn for any noise exposure over 85 dBA, regardless of exposure duration. This measure is simplistic but extremely protective because its implementation does not require the calculation of time-weighted-average (TWA) exposures. This ''hard-hat'' approach, as opposed to predicating the requirement on TWA exposures, is a departure from what was recommended in 1972. It appears to be a prudent policy, which the U.S. Army has been using for years, but there are no data in the document to support this recommendation.

5. Exposure Level Requiring a Hearing Loss Prevention Program

In this draft document, the requirement for a hearing loss prevention program (HLPP), which includes audiometry, worker education, etc., is triggered by the exposure level of 82 dBA, 8-hour TWA (i.e., ½ of the REL). This level is essentially an ''action level''—a concept developed in the mid-

1970's to address interday exposure variability and later adopted in the Standards Completion Program as ½ of an exposure limit. In the 1972 criteria document, which preceded the Standards Completion Program, the requirement for a HLPP began at the REL of 85 dBA, 8-hour TWA.

6. Types and Frequency of Audiometric Examinations

In this draft document, the recommended types (i.e., baseline, monitoring, confirmation and exit audiograms) and frequency of audiometric examinations are different from those in the 1972 criteria document. The new recommendations are in line with current practices in HLPPs.

7. Significant Threshold Shift

Significant threshold shift is a shift in hearing threshold levels, outside the range of audiometric testing variability (±5 dB), that warrants follow-up action to prevent further hearing loss. NIOSH recommends an improved significant threshold shift criterion, which is an increase of 15 dB in hearing threshold at 500, 1000, 2000, 3000, 4000, or 6000 Hz that is repeated for the same ear and frequency in back-to-back tests. This criterion is different from that in the 1972 criteria document, and has been selected from among several criteria on the bases of their relative sensitivity and specificity. The new criterion has the advantages of a high identification rate (identifying those workers whose hearing thresholds have shifted toward higher levels) and a low false-positive rate.

8. Age Correction on Audiogram

NIOSH recommends that age correction not be applied to an individual's audiogram for the calculation of a significant threshold shift. Although many people experience some decrease in hearing sensitivity with age, age correction cannot be accurately applied to audiograms in determining an individual's significant threshold shift because the data on age-related hearing losses describe only the statistical distributions in populations. Thus, the median hearing loss attributable to presbycusis for a given age group will not be generalizable to the presbycusis experienced by an individual in that age group. The argument for age correction has been that the employer should not be penalized for hearing losses due to ageing. In the 1972 criteria document, NIOSH recommended age correction but did not provide a rationale for it.

9. Evaluation of Program Effectiveness

To assess the effectiveness of a HLPP, it is necessary to have an evaluation method that can monitor trends in the population of workers enrolled in the program and thus indicate program effectiveness before many individual shifts occur. In general, NIOSH suggests that the success of a smaller HLPP should be judged by the audiometric results of individual workers. An overall program evaluation becomes critical when the number of workers grows so large that one cannot simply look at each worker's audiometric results and get an adequate picture of the program's efficacy. At the present time, there is not one generally accepted method for the overall evaluation of HLPPs. NIOSH recommends a significant threshold shift incidence rate of 5% or less as evidence of an effective HLPP. This method is currently the simplest procedure available, and has no more disadvantages than other potential evaluation methods.

10. American National Standards Institute (ANSI)

In the 1972 criteria document, NIOSH recommended several ANSI standards for quality assurance in audiometry and in noise measurements. Since then, these standards have been updated several times. In the draft document, NIOSH recommends that these standards be superseded with the latest versions as they become available. The major advantage for this ''blanket'' endorsement is that the revised criteria document will stay current with changing technology.

II. The Risks to Miners

This part of the preamble sets out the evidence collected by MSHA to date with respect to whether there is a continuing risk to miners of exposure to harmful levels of noise, despite existing standards, and evidence on the level of that risk. Based upon this information, MSHA has concluded that workplace noise exposure does continue to pose a significant risk of material impairment of health and functional capacity to miners.

The data presented in this part provide a profile of the mining population at risk at different levels of workplace noise exposure. The noise exposure limitations being proposed by the Agency, described in part III, would not eliminate the risk of material impairment—although they would cut the present risk by two-thirds. (The feasibility of further reducing risk is discussed in part IV. The data in this part II were utilized by the Agency to assist it in determining the cost to industry of reducing risk to various levels, and thus in reaching the Agency's conclusions about economic feasibility.)

There are a number of technical terms used throughout this section. Reviewers not familiar with noise terminology should refer to the discussion in part III of this preamble concerning proposed § 62.110, *Definitions.*

All the studies discussed and cited in this part are included in the references listed in part V, along with similar studies reviewed by the Agency. All constitute part of the Agency's rulemaking record.

The Agency is interested in receiving additional data with respect to the risks of noise exposure.

Defining the Problem

Noise is one of the most pervasive health hazards in mining. Exposure to hazardous sound levels results in the development of occupational noise-induced hearing loss (NIHL), a serious physical, psychological, and social problem. NIHL can be distinguished from aging and medical factors, diagnosed, and prevented.

The National Institute for Occupational Safety and Health (NIOSH) has identified the ten leading work-related diseases and injuries in the publication, ''Proposed National Strategies for the Prevention of Leading Work-Related Diseases and Injuries, Part 2.'' According to NIOSH, NIHL is among these ''top ten'' diseases and injuries.

For many years, the risk of acquiring an NIHL was accepted as an inevitable consequence associated with mining occupations. Miners use mechanized equipment and work under conditions that often expose them to hazardous sound levels. But MSHA standards, OSHA standards, military standards, and others around the world have been established in recognition of the controllability of this risk. Quieter equipment, isolation of workers from noise sources, and limiting worker exposure times are among the many well accepted methods now used to reduce the costly incidence of NIHL.

NIHL can be temporary or permanent depending on the intensity and duration of the noise exposure. Temporary hearing loss results from short term exposures to noise, with normal hearing returning after a period of rest. Generally, prolonged exposure to noise over a period of several years causes permanent damage to the auditory nerve: the higher the sound level the more rapid the loss. The loss may be so gradual, however, that a person may not realize that he or she is becoming impaired until a substantial amount of hearing acuity is lost.

Damage to the inner ear hair cells and auditory nerve makes it difficult to hear as well as understand speech. This damage is irreversible. Although people with NIHL sometimes can benefit from the use of a hearing aid, the aid can never ''correct'' a hearing loss the way eyeglasses usually can correct impaired vision. That is because hearing aids primarily amplify sound without making it clearer or less distorted. Also, they amplify the unwanted noise as well as the wanted speech signals.

People with significant NIHL have difficulty with the perception of speech. They are often frustrated by missing information that is vital for social or vocational functioning, and can produce workplace safety hazards. Also, people around them need to speak louder, and more clearly to be understood. In addition, background noise has a much more disruptive effect on hearing-

impaired individuals because they are less able to differentiate between the wanted signal and the unwanted background noise.

There is a wealth of information on the relationship between noise exposure and its auditory (hearing loss) and non-auditory (physiological and psychosocial) effects.

Numerous studies are available which describe the effects of noise on hearing as a function of sound level and duration. Dose-response relationships have been well established for noise equal to or greater than average sound levels of 85 dBA (see, e.g., Lempert and Henderson, 1973).

Although the non-auditory effects of noise are more difficult to identify, document, and quantify than is hearing loss, recent laboratory and field studies have implicated noise as a causative factor in cardiovascular problems (Tomei et al., 1992 and Lercher et al., 1993) and other illnesses such as hypertension (Talbott, 1990, and Jansen, 1991). Decreasing the noise exposure from greater than 85 dBA to less than 85 dBA significantly improved both the psychological and physiological stress reactions (Melamed and Bruhis, 1996). However, these studies of health effects have not been conclusive.

In Earlog 6, Berger (1981) discussed the adverse non-auditory effects of noise exposure. He suggests that effective hearing conservation programs may not only prevent NIHL, but also improve general employee health and productivity.

Schmidt, et al. (1980) studied injury rates among workers in a North Carolina cotton manufacturer exposed to noise ranging from 92 to 96 dBA. During the ten year time period studied, a significant reduction in injury rates was observed for those workers who were in an HCP, compared to those who were not.

Safety risks can specifically be created because workers harmed by NIHL can no longer hear safety signals. Most people with an NIHL have reduced hearing acuity at the higher frequencies and lose their ability to distinguish consonants on which the intelligibility of speech depends. For example, they would have difficulty in distinguishing between ''fish'' and ''fist.''

Although MSHA recognizes that non-auditory effects of noise can be significant, they are difficult to quantify; by contrast, the auditory risks have a well-established dose-response relationship, and thus provide a solid foundation on which to base regulatory action. The Agency believes that reducing sound levels and protecting miners from hazardous noise exposures will also reduce the non-auditory effects of noise.

Definition of Material Impairment

Section 101(a)(6) of the Mine Safety and Health Act provides that in setting standards to protect workers from the risks of harmful physical agents, the Secretary ''shall 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 even if such miner has regular exposure to the hazards dealt with by such standard for the period of his working life.''

While the material impairment to which the law refers is material impairment of ''health or functional capacity'', the term material impairment in the literature on noise risk generally refers to a level of harm which is considered handicapping or even disabling—a 25 dB hearing level (deviation from audiometric zero)—so this had to be the basis of MSHA's estimates of the risk of material impairment. The scientific community has actually utilized over time at least three different definitions of what constitutes ''material impairment'' in the case of NIHL. All use a 25 dB hearing level, but each definition has used a different set of frequencies. Of these, the Agency believes the one developed in 1972 by NIOSH and subsequently used by OSHA is most appropriate of the three for evaluating the risks faced by miners of developing disabling NIHL. The OSHA/NIOSH definition of material impairment of hearing is a 25 dB hearing level averaged over 1000, 2000, and 3000 Hertz (Hz) in either ear. As noted in the History section of this preamble, the Agency is aware that NIOSH is currently considering a new definition that also includes hearing loss at 4000 Hz; but until such an approach is peer reviewed and approved, MSHA believes it is not an appropriate basis for evaluating risk.

Background

Ideally, a definition of material impairment based solely upon audiometric tests that measure individual ability to understand speech would best characterize the debilitating effects of an NIHL. Unfortunately, these tests are complicated, not well standardized, and therefore seldom used to determine hearing impairment. For these reasons, most definitions of impairment are based solely on pure tone audiometry.

Pure tone audiometric tests utilize an audiometer to measure the hearing level threshold of an individual by determining the lowest level of discrete frequency tones that the individual can hear. The test procedures for conducting pure tone audiometry are relatively simple, widely used, and have been standardized. Although there is little debate among the scientific community about the usefulness of pure tone audiometry in assessing hearing loss, some disagreement exists as to the hearing level where hearing impairment begins and the range of audiometric frequencies to use in making the assessment.

In issuing its Hearing Conservation Amendment (46 FR 4078), OSHA defined hearing impairment as exceeding a 25 dB ''hearing level'' averaged over 1000, 2000, and 3000 Hertz (Hz) in either ear. Hearing level is the deviation in hearing acuity from audiometric zero, the lowest sound pressure level audible to the average normal-hearing young adult. Positive values indicate poorer hearing acuity than audiometric zero, while negative values indicate better hearing. Because OSHA based its definition on a 1972 recommendation by NIOSH (1972), MSHA refers to this definition as the OSHA/NIOSH criteria for hearing impairment.

NIOSH specifically developed its definition of hearing impairment for understanding speech under everyday (noisy) conditions. NIOSH concluded that ''the basis of hearing impairment should be not only the ability to hear speech, but also to understand speech,'' and this is best predicted by the hearing levels at 1000, 2000, and 3000 Hz.

When OSHA initially published its Hearing Conservation Amendment, 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 criteria (AAOO 1959) defined hearing impairment as exceeding a 25 dB hearing level, referenced to audiometric zero, averaged over 500, 1000, and 2000 Hz in either ear (1959).

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) has since modified the 1959 criteria by adding the hearing level at 3000 Hz to the hearing levels at 500, 1000, and 2000 Hz (1979).

Unlike the OSHA/NIOSH criteria, the AAOO 1959 and AAO–HNS 1979 criteria are for all types of hearing loss, including noise-induced hearing loss (NIHL), and were mainly designed for hearing speech under relatively quiet conditions.

In its ANPRM, MSHA asked for comments on a definition of hearing impairment. Many commenters either directly or indirectly endorsed the OSHA/NIOSH definition of hearing impairment. One commenter suggested defining a significant material impairment as an average permanent threshold shift of 25 dB or more at 1000, 2000, 3000, and 4000 Hz in either ear. Other commenters supported the AAO–HNS 1979 criteria as the level where impairment begins. (Several commenters suggested that MSHA separately address a definition of hearing loss for reporting purposes; this has been done, as discussed in part III of this preamble in connection with proposed § 62.190(b).)

Discussion

MSHA has determined that with respect to mine safety and health, any definition of material impairment of hearing should relate to a permanent, measurable loss of hearing which, unchecked, will limit the ability to understand speech, as it is spoken in everyday social (noisy) conditions. This is because speech comprehension is essential for mine safety.

Measures of hearing impairment depend upon the frequencies used in calculating the hearing impairment. At relatively low sound levels (between 80 dBA and 90 dBA) the hearing loss is confined to the higher audiometric frequencies. In order to show the effect of noise below 90 dBA on hearing, inclusion of test frequencies above 2000 Hz is necessary. MSHA agrees with the many comments and studies cited to show that high frequency hearing is critically important for the understanding of speech and that every day speech is sometimes distorted and often takes place in noisy conditions.

Therefore, MSHA has determined that for purposes of mine safety and health, 3000 Hz should be included in any definition of material impairment. In addition, 500 Hz should be excluded from any definition, since it is not as critical for understanding speech and least affected by noise. Of the three generally utilized definitions of noise—the AAOO 1959, the AAO–HNS 1979, and the OSHA/NIOSH criteria—only the latter meets this test.

All three of the aforementioned definitions of noise use a 25 dB hearing level. As noted previously, this level of hearing loss relative to audiometric zero is actually well beyond that at which there is harm to health and also well beyond that at which workers suffer a loss of functional capacity. Nevertheless, this is the measure used in almost all of the studies of risk of noise exposure that have been done. This constrains the definition of material impairment the Agency utilizes to evaluate the available risk data.

Accordingly, solely for the purposes of evaluating the significance of the available risk studies for miners, MSHA is adopting the OSHA/NIOSH criteria, a 25 dB hearing level averaged over 1000, 2000, and 3000 Hertz (Hz) in either ear, as its definition of material impairment.

With respect to risk evaluations, the number of persons meeting the definition of impairment in any noise-exposed population will be higher under the OSHA/NIOSH criteria than under the other criteria (AAOO 1959 and AAO–HNS 1979). This is because noise does not affect hearing acuity equally across all frequencies. Typically, NIHL occurs first at 4000 Hz, then progresses into the lower and higher frequencies. The AAOO 1959 criteria is weighted toward the lower frequencies and was developed to determine an individual's ability to communicate under quiet conditions. Recognizing that an individual's ability to hear speech in a noisy environment depends upon that person's ability to hear sounds in the higher frequency range, the AAO–HNS added 3000 Hz to the frequencies used in the AAOO 1959 criteria. The impact of this modification is that the number of persons meeting the impairment criteria in any noise-exposed population will be higher under the AAO–HNS 1979 criteria than under the AAOO 1959 criteria. With the elimination of the hearing level at 500 Hz from the frequency range used, the OSHA/NIOSH definition is weighted even more toward the higher frequencies than the AAO–HNS 1979 criteria, and thus even more are determined to be impaired.

Moreover, selection of a criterion places some limitations on direct comparisons of data sources available for risk assessment. Data compiled using one definition of impairment are not readily translatable to the others. Since there is no reliable mathematical relationship among the three criteria for hearing impairment, it is not possible to accurately predict the impact on a population using the other two criteria when only the impact of one criterion is known. The ideal way to convert from one hearing impairment criterion to another would be to use the hearing level data for individual frequencies (raw data), if still available from the individual audiograms. It is also possible to crudely estimate the impact of one criterion to another provided that summary data on individual frequencies are available. Unfortunately, most of the data necessary to complete such conversions are no longer available.

In the discussion of risk that follows in the next section of this preamble, sources of data based on all three definitions of impairment are presented, so this caveat about translation needs to be kept in mind. As it turns out, however, data using all three definitions tend to demonstrate the same result.

Risk of Impairment

The studies of risk reviewed in this section consistently indicate that the risk of developing a material impairment (as defined in the prior section for purposes of this discussion) becomes significant over a working lifetime when workplace exposure exceeds average sound levels of 85 dBA. The data indicate that while lowering exposure from an average sound level of 90 dBA to one of 85 dBA does not eliminate the risk, it does reduce the risk by approximately half.

Measuring Risk

It is not possible to determine the risk to individual miners of particular levels of noise. Some miners will suffer harm long before other miners from the same level of noise, and it is not possible to measure susceptibility in advance. Risks can, however, be determined for entire populations. According to Melnick (1982), professor emeritus of audiology at Ohio State University:

> Experts agree that information is available for deriving the relationship of noise exposure to hearing loss. This information serves as the basis for development of damage risk criteria. * * * The relationship of noise to hearing is in the scientific domain. The decisions inherent in development of damage risk criteria are social, political, and economic. Damage risk criteria are statistical concepts. Use of these criteria should be limited to considerations of populations. Damage risk criteria are not appropriate for use with individuals no matter how tempting such an application might be.

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 percent of an exposed population meeting the selected criteria; and

(3) the percent of an exposed population meeting the selected criteria minus the percent of a non-noise exposed population meeting the same criteria, provided both populations are

similar except for the occupational noise exposure.

The latter of these expressions is more commonly known as ''excess risk''. The excess risk method separates that percentage of the population expected to develop a hearing impairment from occupational noise exposure from that percentage expected to develop an impairment from non-occupational causes—for example, the normal aging process or medical problems. Hearing impairment risk data will be presented here using the excess risk method, because MSHA has concluded that this method 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 Hearing Conservation Amendment.

Although studies of hearing loss consistently indicate that increased noise exposure (either level or duration) results in increased hearing loss, the reported risk estimates of occupational NIHL can vary considerably from one study to another. As noted in the prior section, the definition of ''material impairment'' used plays a role. But two additional factors can be involved: the screening of the control group (non-noise exposed group), and the threshold used to define that group.

Some researchers do not screen their study and control populations, while others use a variety of different screening criteria. Theoretically, screening would not have a significant impact on the magnitude of occupational NIHL experienced by given populations as long as the same criteria are used to screen both the noise and the non-noise populations being compared. However, when considering whether the subjects have exceeded an established definition of material impairment, failure to take into account any non-occupational noise exposure and/or presbycusis (loss of hearing acuity due to aging) can have a profound effect on the estimates of hearing acuity of an exposed population. For example, if both the exposed and control populations are screened to eliminate persons with a history of military exposure, use of ototoxic medicines, noisy hobbies, conductive hearing loss from acoustic trauma or illness, etc., the excess risk would be significantly different from that determined using unscreened populations.

The data presented here all use the same threshold. The threshold refers to that average sound level below which no adverse effects from noise exposure are expected to occur. Although researchers Kryter (1970) and Ambasankaran et al. (1981) have reported hearing loss from exposure to average sound levels below 80 dBA, most believe that the risk of developing a material impairment of hearing from exposure to such 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. In turn, this becomes the baseline from which the excess risk of being exposed to noise at higher levels is measured. When OSHA evaluated the risk of hearing loss for its hearing conservation amendment, it took the position that it was appropriate to consider the non-noise exposed control group to those exposed to sound levels below 80 dBA. MSHA, for the purpose of this proposal, agrees with OSHA's assessment.

As a result of these variations, the data available present a range of risk estimates. As discussed later in the ''Conclusions'' section of this part, for purposes of estimating the risks to miners, the Agency has determined it should properly utilize the range of risk in those studies based upon the OSHA/NIOSH definition of material impairment. As noted in that discussion, however, even using the full range of the data presented here would lead to a similar conclusion.

Review of Study Data

Table 1 is taken from the preamble to OSHA's Hearing Conservation Amendment (46 FR 4084). It displays the percentage of the industrial population expected to develop a hearing impairment meeting the AAOO 1959 criteria if exposed to the specified sound levels over a working lifetime (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 using the AAOO 1959 criteria because this was the format used by the original researchers in presenting their data. OSHA's risk table was developed primarily from studies of noise exposed populations in many sectors of general industry.

TABLE II–1.—OSHA RISK TABLE

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

As seen in Table II–1, the excess risk of material impairment after a working lifetime at an average noise exposure of 80 dBA is low, at an average noise exposure of 85 dBA ranges from 10–15%, and at an average noise exposure of 90 dBA it ranges from 21–29%. Table II–2 presents further information on the risk assessments developed by NIOSH in their criteria document (1972), one portion of which was included in Table II–1. In Table II–2, data are based on both the AAOO 1959 criteria and the OSHA/NIOSH criteria.

TABLE II–2.—NIOSH RISK TABLE

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

As shown in Table II–2, NIOSH's risk assessment (1972) found little difference using OSHA/NIOSH criteria when compared to AAOO 1959 criteria. However, as previously noted, NIOSH recommends using the OSHA/NIOSH criteria for making risk assessments.

Several researchers have commented on how adjustments to the criteria used would affect such excess risk figures. Suter (1988) estimates that the excess risk would be somewhat higher if 500 Hz was excluded and 3000 Hz was included in the definition of material impairment. Sataloff (1984) also reported on the effect of adding 3000 Hz into the impairment criteria. He recalculated the effect of including hearing loss at 3000 Hz to the AAOO 1959 definition of hearing impairment and found that the prevalence of hearing impairment increased considerably. 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. (1978) confirmed that the exclusion of 500 Hz and the inclusion of 3000 Hz increased the number of hearing impaired individuals during a study of potential

workers' compensation costs for hearing impairment. Using an average hearing loss of 25 dB as the criteria, 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 OSHA/NIOSH.

Table II–3, II–4 and II–5 display another set of data on the working lifetime risk of material impairment, based upon the three different criteria commonly used for defining material impairment. Table II–3 is based on the AAO 1959 criteria, Table II–4 is based on the AAO–HNS 1979 criteria, and Table II–5 is based on the OSHA/NIOSH criteria. 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, were taken from summary graphs in the report. The noise exposed population is 65 years old with 40 years of noise exposure. The control group was not screened as to the cause of any hearing loss; therefore, the high level of non-occupational hearing loss may underestimate the excess risk from occupational noise exposure. The researchers added the noise-induced permanent threshold shift component to the control data. Noise-induced permanent threshold shift (NIPTS) is the actual shift in hearing level only due to noise exposure after corrections.

As expected, the three tables produce different results, reflecting that, for any given population, the excess risk for material impairment will be greater using the AAO–HNS 1979 criteria than using the AAOO 1959. Likewise, the excess risk for material impairment will be greater using the OSHA/NIOSH criteria than using the AAO–HNS 1979. All three tables produce a smaller excess risk than did the data presented in Table II–1.

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

Exposure	Percent with impairment	Excess risk (%) 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 II–4.—RISK OF IMPAIRMENT USING AAO–HNS 1979 DEFINITION OF IMPAIRMENT USING MELNICK, ET AL., 1980 DATA

Exposure	Percent with impairment	Excess risk (%) with noise exposure
Non-noise	41.6	0.0
80 dBA	41.8	0.2
85 dBA	44.4	2.8
90 dBA	50.0	8.4

TABLE II–5.—RISK OF IMPAIRMENT USING OSHA/NIOSH DEFINITION OF IMPAIRMENT USING MELNICK, ET AL., 1980 DATA

Exposure	Percent with impairment	Excess risk (%) 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

Tables II–6 and II–7 present data derived by Melnick in *Forensic Audiology* (1982) for damage risk due to noise exposure. These tables use the AAO–HNS 1979 criteria. In these tables, the population is 60 years old with 40 years of exposure to the specified sound levels. In both tables, the data represent NIPTS (noise induced permanent threshold shift) calculated by Johnson, but the screening used in the two tables is different. Melnick's data in Table II–6 is based upon the screened presbycusis data (i.e. screened for non-occupational hearing loss) of Robinson and Passchier-Vermeer, whereas Table II–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 II–1 than to that in Tables II–3, II–4, and II–5, but still different. Tables II–6 and II–7 directly illustrate the effect of screening populations in determining excess risk due to occupational noise exposure. As seen in these tables, the percent with impairment is greater in the table constructed with an unscreened population as the base.

TABLE II–6.—RISK OF IMPAIRMENT USING PRESBYCUSIS DATA OF PASSCHIER-VERMEER AND ROBINSON

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

TABLE II–7.—RISK OF IMPAIRMENT USING NON-OCCUPATIONAL HEARING LOSS DATA OF PUBLIC HEALTH SURVEY

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

Chart ER1 displays the results of the various models. It should be noted that both the P/V/Robinson (data from Table II–6) and the PHS model (data from Table II–7) used the AAO–HNS 1979 criteria.

As noted in the History section of this preamble, the Agency is aware that NIOSH is currently working on revising its estimates using a different model and taking hearing loss at an additional frequency into account; but until such an approach is peer reviewed and finalized, MSHA has concluded it should not be considered here.

As illustrated by Chart ER1, the exact numbers of those at risk varies with the study—because of the definition of material impairment used, and because of the selection and threshold of the control group. Notwithstanding 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 average sound levels of 85 dBA; and (3) lowering the exposure from average sound levels of 90 dBA to average sound levels of 85 dBA reduces the excess risk of developing a material impairment by approximately half.

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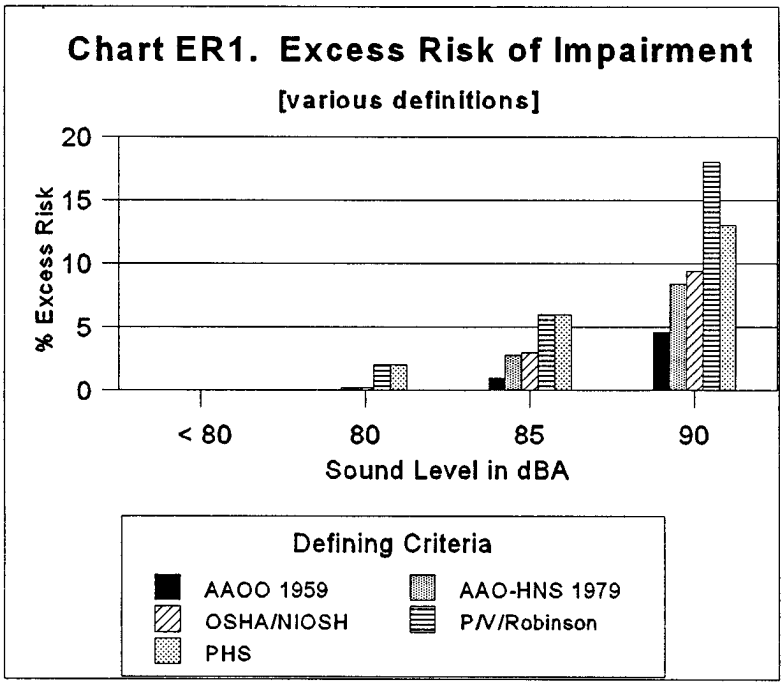

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Related Studies of Worker Hearing Loss

There is a large body of data on the effects of varying industrial sound levels on worker hearing. Some of these studies specifically address the mining industry; moreover, MSHA has determined that regardless of the industry in which the data were collected, exposures to similar sound levels will result in similar degrees of material impairment in the workers. These studies are supportive of the conclusions reached in the previous section about noise risks at different sound levels.

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. The control and the noise-exposed groups were not screened for anatomical abnormalities of the ear.

Baughn used his data to provide estimates of 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, the researcher constructed an idealized graph which illustrated that 43% of 58-year old workers exposed for 40 years to noise at 85 dBA would meet the AAOO 1959 criteria for hearing impairment. However, 33% of an identical non-noise exposed population would be expected to meet the same impairment criteria. The excess risk from exposure to noise at 85 dBA, therefore, would be 10%. Using the same procedure, the excess risk for 80 dBA is 0% and for 90 dBA it 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 the workers with exposure histories which were not readily quantifiable, exposure to gunfire, ear disease or abnormality, and language difficulty.

For this study, 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 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 Burns and Robinson's mathematical model, MSHA constructed Chart ER2. The chart shows that a noise exposure of 85 dBA over a 40-year career is clearly hazardous to the hearing acuity of 60-year-old workers.

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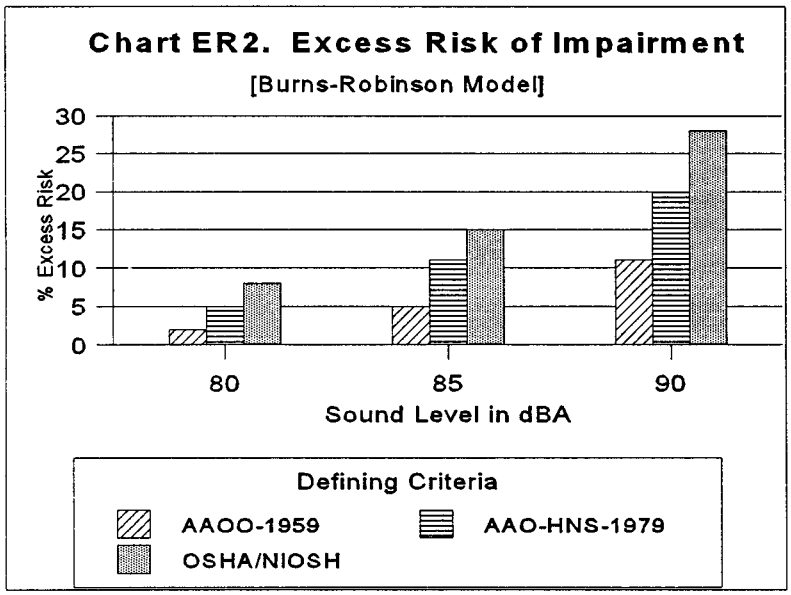

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Martin et al. (1975) studied the prevalence of hearing loss in a group of 228 Canadian steel workers, ranging in age from 18 to 65 years of age, by comparing them to a control group of 143 office workers. The researchers reported that the risk of hearing impairment (average of 25 dB at 500, 1000, and 2000 Hz) increases significantly between 85 dBA and 90 dBA. Up to 22% of the population would be at risk of incurring a hearing impairment with a 90 dBA PEL compared to 4% with an 85 dBA PEL. Both the noise exposed and the control groups were screened to exclude those workers with non-occupational hearing loss.

Berger, Royster, and Thomas (1978) studied 42 male and 58 female workers employed at an industrial facility. The study included a control group of 222 persons that was not exposed to occupational noise. Of the 322 individuals included in the study, no one was screened for exposures to non-occupational noise from 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. According to the researchers, the measurable loss was in close agreement with the predictions of Burns and Robinson, Baughn, NIOSH, and Passchier-Vermeer.

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 therefore, 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.

NIOSH (Lempert and Henderson, 1973) published a report in which the dose-response relationship for noise-induced hearing loss was described. NIOSH studied 792 industrial workers whose average daily noise exposures were 85 dBA, 90 dBA, and 95 dBA. The noise-exposed workers were compared to a group of controls whose noise exposures were lower than 80 dBA. The subjects ranged in age from 17 to 65 years old. The exposures were primarily to steady-state noise but the exposure levels fluctuated slightly in each category. Both the noise-exposed and control groups were screened to exclude those exposed to gunfire as well as those who showed some sign of ear disease or audiometric abnormality. The report clearly shows that workers whose noise exposures were 85 dBA experienced more hearing loss than the controls. As the noise exposures increased to 90 dBA and 95 dBA, the magnitude of the hearing loss increased.

NIOSH (1976) published the results from a study on the effects of prolonged exposure to noise on the hearing acuity of 1,349 coal miners. From this study, NIOSH concluded that coal miners were losing their hearing acuity at a faster rate than would be expected from the measured environmental sound levels. While the majority of noise exposures were less than a TWA_8 of 90 dBA, the measured hearing loss of the older coal miners was indicative of noise exposures between 90 dBA and 95 dBA. Only 12% of the noise exposures exceeded a TWA_8 of 90 dBA. NIOSH, however, 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 had a greater percent of impairment than the non-occupational exposed group (control group) at each age level. Using OSHA/NIOSH definition of impairment, 70% of 60-year-old coal miners were impaired while only a third of the control group were impaired. 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. As part of this study, the hearing acuity of 350 underground coal miners was measured. The results of this study corroborated the results of the earlier NIOSH study on the hearing acuity of underground coal miners. In both studies the measured median hearing levels of the miners were the same. However, the study did not present statistics on the percent of miners incurring a hearing impairment nor the job classification of the miners.

Studies of Harm at Lower Sound Levels

As our knowledge about the effects of noise increases, there is increased need

to examine data that focuses on the harm that can occur at lower sound levels. This section reviews some of the studies, particularly those of workers from other countries, available in this regard.

The most recent data are derived using the International Standards Organization's publication ISO 1999 (1990). The information in that publication can be used to calculate the mean and various percentages of a population's hearing levels. The noise exposures for the population can range between 75 dBA and 100 dBA. Table II–8 presents the hearing level of a 60-year-old male exposed to noise for 40 years. The noise induced hearing permanent threshold shift was combined with presbycusis values to determine the total hearing loss. The presbycusis values were those from an unscreened population. The unscreened population is believed to more accurately represent the mining population since people with nonoccupational hearing loss would not be excluded from becoming miners.

TABLE II–8.—HEARING LEVEL FOR 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 on hearing of lower noise exposures can be particularly valuable in directing attention to the possibility of identifying 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, reaffirming many of the earlier findings of the Committee, suggests that exposures below 76 dBA to 78 dBA are needed to prevent a NIHL based upon temporary threshold shift (TTS) studies; moreover, the report suggests that the sound level be less than 85 dBA, and possibly less than 80 dBA, to guard against any permanent hearing loss at 4000 Hz based upon field studies. But of particular interest is the suggestion that therapeutic drugs, such as aminoglycoside antibiotics and salicylates, can interact synergistically with noise to yield more hearing loss than would be expected by either stressor. Given the increasing use of salicylates (aspirin) in heart maintenance regimens, the potential synergistic effect may warrant further study.

Few current studies of unprotected U.S. workers exposed to a TWA_8 between 85 and 90 dBA are available because the OSHA hearing conservation standard requires some protection at those levels for most industries. The difficulty in constructing new retrospective studies of U.S. workers has been noted by Kryter (1984) in his chapter on Noise-Induced Hearing Loss and Its Prediction. He believes that the retrospective studies of Baughn, Burns and Robinson, and the U.S. Public Health Service are the best available on the subject of NIPTS. Regarding current retrospective studies he states:

> Furthermore, imposition of noise control and hearing conservation programs in many industries in many countries over the past 10 years or so make somewhat remote the possibility of performing a meaningful retrospective study of the effects in industry of noise on the unprotected ear.

Kryter included a formula for deriving the effective noise exposure level for damage to hearing. This was used to determine, from a population of workers, NIPTS at different percentiles of sensitivity at various audiometric test frequencies.

Studies of workers from other countries can provide information of particular value in assessing the consequences of workplace noise exposure between 85 dBA and 90 dBA. MSHA has determined that while differences in socioeconomic factors (e.g., recreational noise exposure, use of ototoxic medicines, otitis media) make it difficult to directly apply the results of studies of workers from other countries to quantify the risk for U.S. workers, they can be used to establish 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 upon average exposures. They assumed that exposure to sound levels less than 80 dBA did not cause any hearing loss and workers exposed to these levels were assigned to the control group.

Rop et al. 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 exposed between 80 dBA and 103.5 dBA, hearing loss tended to increase steadily during their careers, but leveled off after 15 years. However, for workers exposed to sound levels above 103.5 dBA, hearing loss continued to increase beyond 15 years.

Using the data collected during the study, Rop et al. developed a statistical method for predicting hearing loss. 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%. Rop et al. concluded that exposure to sound levels at or above 85 dBA damaged workers' hearing.

Schwetz et al. (1980) reported on a study of 25,000 Austrian workers. The study 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. Because of this, Schwetz recommended 85 dBA as the critical intensity (i.e., PEL). Furthermore, the study concluded that a lack of hearing recovery occurs at 85 dBA which is the ultimate cause of noise-induced hearing loss (NIHL).

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

Bartsch et al. (1989) studied 537 textile workers. These researchers defined hearing loss of social importance as a 40 dB hearing level at 3000 Hz. The researchers found that hearing loss resulting from exposures below 90 dBA mainly occurs at frequencies above 8000 Hz (these frequencies are not normally tested during conventional audiometry), and so concluded that this hearing loss was not of ''social importance.'' Nevertheless, they recommended a hearing loss risk criterion of 85 dBA be used to protect the workers' hearing.

These results are generally consistent with those of U.S. workers. MSHA would, however, note its disagreement with the characterization of the amount of hearing loss not being of ''social importance'' as expressed in the Bartsch et. al (1989) study. The Agency has concluded that a person will encounter hearing difficulty before their hearing level reaches 40 dB at 3000 Hz. Studies, discussed earlier in *Definition of Material Impairment,* address the importance of having good hearing

acuity at 3000 Hz in order to adequately understand speech in everyday noisy environments.

Reported Hearing Loss Among Miners

To confirm the magnitude of the risks of NIHL among miners, MSHA examined evidence of reported hearing loss among miners—audiometric data collected over the years tracking hearing acuity among miners, the comments received in response to the Agency's ANPRM, reports of hearing loss by mine operators pursuant to 30 CFR part 50, and workers' compensation data. Such data could provide a quantitative determination of material impairment.

With respect to audiometric data, MSHA asked NIOSH to examine a set of data on coal miners. The analysis (Franks, 1996) supports the data from scientific studies. It indicates that 90% of these coal miners have a hearing impairment by age 50 as compared with only 10% of the general population. Further, Franks stated that miners, after working 20 to 30 years, could find themselves in life threatening situations since safety signals and ''roof talk'' could go unheard. (For the purposes of the analysis, NIOSH used the definition of hearing impairment it is now considering, an average 25 dB hearing level at 1000, 2000, 3000, and 4000 Hz; MSHA conducted its own analysis of the data without the 4000 Hz, and the results are generally consistent with those of NIOSH).

This section also reviews several other sources of data that might provide direct information about the risks of hearing loss to miners: the comments received in response to the Agency's ANPRM, the reports of hearing loss provided to the Agency by mine operators pursuant to 30 CFR part 50, and workers' compensation data. In each case, the available data are too limited to draw any conclusions. The Agency is requesting the public to provide further information along these lines.

Audiometric Data Bases

Audiometric testing is not currently required in metal and nonmetal mining and is only required when an overexposure to noise is determined in coal mining. Certain mining companies conduct routine audiometric testing on their employees, but the results of these tests are confidential and are not published for public use. In addition, summary reports of these audiometric tests are generally not available.

MSHA, however, has obtained an audiometric data base consisting of 20,021 audiograms conducted on 3,433 individual coal miners, in connection with its ongoing efforts to assess the effectiveness of the current standards in protecting miner health. The audiometric evaluations were conducted between 1971 and 1994 with the bulk of the audiograms conducted during the latter years.

NIOSH (Franks, 1996) has analyzed this data base. Each audiogram was reviewed for validity and NIOSH audiologists directly reviewed more than 2,500 audiograms. The review reduced the number of audiograms by 8.8% and the number of miners by 8.3%.

After deleting those audiograms judged to be invalid, NIOSH's analysis indicates that 90% of these miners have a hearing impairment by age 50 as compared with only 10% of the general population. Even at age 69, only 50% of the non-noise exposed population acquire a hearing impairment. Franks defined material impairment as an average 25 dB hearing level at 1000, 2000, 3000, and 4000 Hz. This definition differs from the MSHA definition of hearing impairment by the inclusion of 4000 Hz in the average.

By age 35 the average miner has a mild hearing loss and 20% have a moderate loss. By contrast, fewer than 20% of the miners having marginally normal hearing by age 64 while the upper 80% have moderate to profound hearing loss. The lower 80% of the non-noise exposed population will not acquire a hearing loss as severe as the one obtained by the average miner regardless of how long they live.

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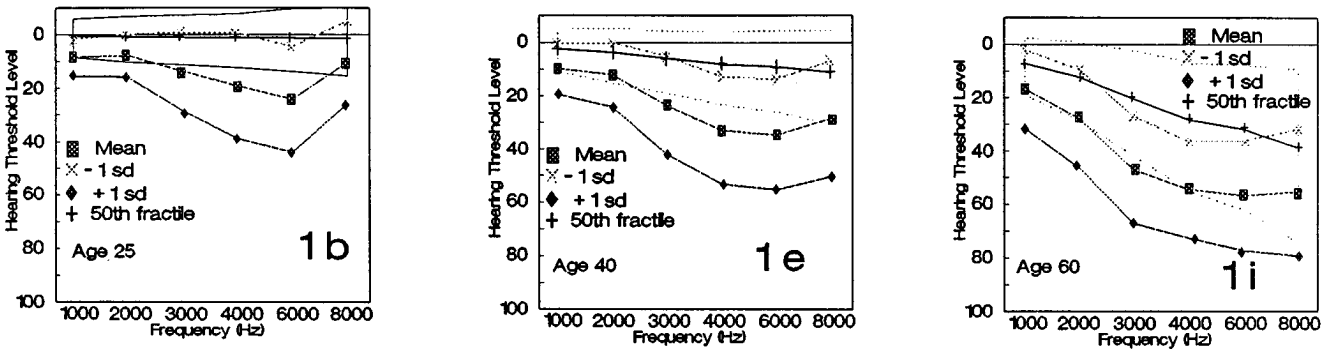

Franks, 1996. Audiograms showing mean hearing threshold level, + 1 standard deviation, - 1 standard deviation, of miners age 25 (1b), 40 (1e), and 60 (1i); other ages in original. Also shown are the 50th fractiles for Annex A of ISO-1999.

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Further, Franks stated that miners, after working 20 to 30 years, could find themselves in life threatening situations since safety signal and roof talk could go unheard.

MSHA separately conducted an elementary analysis of the data, using the definition of material impairment of hearing used throughout the analyses in this preamble: an average 25 dB hearing level at 1000, 2000 and 3000 Hz. For MSHA's analysis, all audiograms were considered to be valid (e.g., no contamination from temporary threshold shifts, sinus conditions, etc.). Information on years of mining experience, noise exposure, use of hearing protectors, and job function was not provided.

In order to reflect current trends, the percentage of current coal miners with a material impairment of hearing was compared to historical data (NIOSH's study on coal miners published in 1976). The audiometric data were placed into a compatible format, e.g., age and hearing loss criteria. Only those coal miners (2,861) whose latest audiogram was taken between 1990 and 1994 were included in the analysis. The results are shown in Chart R1 along with NIOSH's 1976 results for both the noise exposed miners and the non-noise exposed controls.

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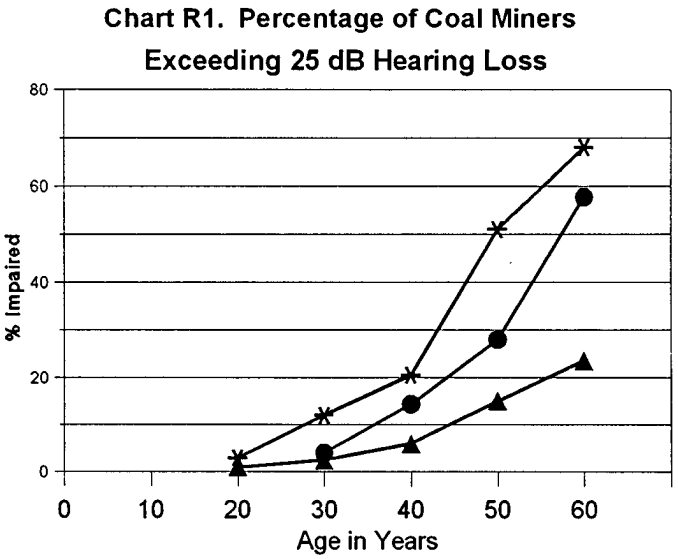

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The data points for chart R1 are the mean of both ears at 1000, 2000 and 3000 Hz. The top line connects data points from the 1976 group, and the middle line connects points from the 1990–1994 group; the bottom line represents the non-noise exposed group.

As shown in Chart R1, it is obvious that many coal miners who had audiograms taken from 1990 through 1994 have a material impairment of hearing. These miners were still losing more of their hearing acuity than non-noise exposed workers. This remains true even if the analysis is limited to miners less than 40 years of age (i.e., those who have worked only under the current coal noise regulations). The fact that the loss is at a slower rate than shown in the 1976 data may indicate some progress under the existing regulations compared with no regulation.

Furthermore, MSHA analyzed the data for the number of standard threshold shifts (STS's) and reportable hearing loss cases in order to estimate the number of such events that may occur if the proposal is adopted. In the proposal, MSHA defines an ''STS'' 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 importance of an STS is that it reveals that a permanent loss in hearing acuity has occurred relative to that miner's baseline. This is the type of loss that is deserving of mine operator intervention. When the change from the baseline averages 25 dB or more at the same frequencies, the hearing loss must be reported to MSHA so that the Agency can intervene if necessary. (MSHA discusses the definition of STS and reportable hearing loss in detail in the sections of this preamble dealing with proposed §§ 62.160 and 62.190.) In both cases, the data differ from that in Chart R1, which is looking at the hearing loss relative to audiometric zero—not the individual miner's baseline.

For a second analysis, the first audiogram was assumed to be the baseline. The last audiogram was compared to the baseline. Neither audiogram was corrected for presbycusis. Also, because of the lack of supporting data, no provision for excluding an STS as being non-occupational was possible. A total of 3,102 coal miners had a baseline and at least a second audiogram. However, only those miners whose latest audiogram was conducted between 1990 and 1994 were considered. The results are presented in Chart R2.

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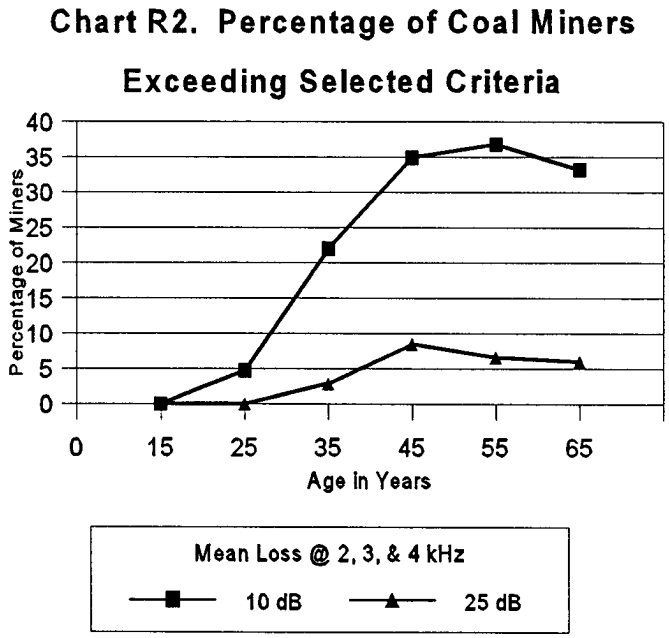

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Chart R2 clearly shows that many of the coal miners from 1990 through 1994 were found to have an STS. The likelihood of acquiring an STS generally increases with advancing age. The MSHA analysis was conducted in a conservative fashion. Because the intervening audiograms were excluded from this analysis, the number of STSs is probably low since only a single STS was recorded. There could be several explanations for the drop in the percentage of STS's for the 65 year old age group in chart R2, including, for example, changed work assignments.

In addition to this privately maintained audiological data, there have been two special NIOSH studies of the hearing acuity of coal miners. These studies were reviewed in detail in the Risk of Impairment section, above. The first study was published in 1976. Even though the majority of noise exposures were found to be less than 90 dBA, approximately 70% of the 60-year-old coal miners had a material impairment of hearing using the OSHA/NIOSH definition. Another NIOSH study, conducted by Hopkinson (1981), corroborated the results of the earlier NIOSH study on the hearing acuity of coal miners.

Commenter Data

In its ANPRM, MSHA solicited comments on the number of current miners with a hearing loss based on suggested criteria. Two commenters provided information on the hearing acuity of miners. The first commenter estimated that 45 to 50% of the employed miners have an STS and at least 25% have an STS if corrected for presbycusis. 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. However, when corrected for presbycusis, the percentage of miners with this level of hearing loss decreased to about 15%.

The second commenter referenced a paper presented by Smith et al. at the 1989 Alabama Governor's Safety and Health Conference. 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. Smith et al. had found that 15% of these workers would have some degree of hearing impairment using AAO–HNS 1979 impairment criteria. Smith et al. also reported that at least 26% of the mining population would have some degree of hearing impairment using the same criteria. Smith (1994) confirmed the prevalence of material impairment among miners in a letter to MSHA.

MSHA also requested information on hearing loss to individual miners in its ANPRM. Specific information was requested on each miner who had incurred a hearing loss, including the related noise exposure, state workers' compensation award, cost of the award, miner's age, occupation and degree of hearing loss. The Agency received few comments pertaining to the information requested. The Agency requests additional comment on these issues.

Reported Hearing Loss Data

Another potential body of information about hearing loss among miners comes from reports mine operators are required to submit to MSHA of such losses. At present, however, there is not a definition of ''reportable hearing loss'' linking what is reported to some particular measurement. Rather, under 30 CFR part 50, mine operators are only required to report cases of NIHL to MSHA when it is diagnosed by a physician or when the miner receives an award of compensation.

Nevertheless, between 1985 and 1995 mine operators reported a total of 2,402 cases of NIHL—and among these cases were a substantial number of miners who began working at a mine after the implementation of the current noise regulations.

Coal mine operators reported 608 cases among surface miners, 1,077 cases among underground miners, and 14 cases among miners whose work positions were not identified. According to coal mine operators, 662 of the 1,699 cases began working at a mine after the implementation of noise regulations for coal mines (1972 for underground and 1973 for surface). Workers with no reported mining experience were excluded from this analysis, because their noise exposure history in mining was unknown.

For the same period, metal and nonmetal mine operators reported 555 cases among surface miners and 148 cases among underground miners. According to mine operators, 142 of the 703 cases began working at a mine after the implementation of noise regulations for metal and nonmetal mines (1975). As with the coal data, workers with no reported mining experience were excluded.

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 to workers who began working after the implementation of the current standards. This is despite the fact that, at the present time, there are more metal and nonmetal miners than coal miners employed in the U.S. A possible explanation of the differences between reported cases of NIHL among coal, metal and nonmetal miners may be the more frequent use of engineering noise controls in metal and nonmetal mining.

MSHA reviewed the narrative associated with each NIHL case to determine the degree of hearing loss. Although many narratives contained information as to the reason for reporting the NIHL case, others only listed the illness as ''hearing loss.'' Approximately half the cases had no information on the severity of the hearing loss. Some narratives contained information on the severity of the hearing loss, such as an STS, OSHA reportable case, or percent disability. Based upon the information in the narratives it is not possible to determine an average severity for the NIHL cases.

However, at least 40% of the cases in coal mining were reported to MSHA as the result of the miner being compensated for NIHL. Another 7% of the cases filed a workers' compensation claim for NIHL. In metal and nonmetal, at least 19% of the cases were the result of the miner being compensated for NIHL. Nearly another 3% of the cases filed a workers' compensation claim for NIHL.

MSHA contends that the number of cases reported to the Agency are low because of the following factors: the lack of a specific definition of a NIHL in MSHA's part 50 regulations which may result in confusion on the part of mine operators about which cases to report; the lack of consistency among the states' requirements for awarding compensation for an NIHL and among physicians in diagnosing what constitutes a hearing loss caused by noise; and the lack of periodic audiometric testing in the mining industry.

In summary, current hearing loss reported to MSHA under part 50 cannot be used to accurately characterize the incidence, prevalence or the severity of hearing loss in the mining industry. However, the part 50 data clearly show that miners are incurring NIHL.

Workers' Compensation Data

Another source of information about hearing loss among miners is state workers' compensation agencies and insurance carriers. Many states do not keep detailed workers' compensation data themselves; categorization of data are inconsistent across the states; and there are privacy concerns in obtaining the detailed information needed for studies. MSHA would welcome information about studies of hearing loss that have been performed by the insurance industry or others based on this data.

Valoski (1994) studied 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 data bases, he was unable to obtain data for all states. In fact, data were not available from a number of key mining states.

From the data that were available for study, 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 dollars excluding rehabilitation or medical costs.

In Niemeier's letter to MSHA, Chan et al. of NIOSH (1995) investigated the incidence of NIHL among miners using information from the Bureau of Labor Statistics' (BLS) Supplementary Data System. Like Valoski, he found the national data to be incomplete. Only 15 states participated in the BLS program between 1984 and 1988. In these 15 states, a total of 217 miners (93 coal miners and 124 metal and nonmetal miners) were awarded workers' compensation for NIHL. Chan et al. stated that because of differing state workers' compensation requirements, it is not possible to directly compare NIHL among the states. These factors limit the usefulness of the obtained data.

MSHA also reviewed reports on workers' compensation in Canada and Australia. The noise regulations and mining equipment used in these countries are similar to those in the U.S. A recent report on workers' compensation awards to miners in Ontario, Canada (1991) revealed that between 1985 and 1989, NIHL was the second leading compensable occupational disease. Approximately 250 claims for NIHL involving miners were awarded annually during that time.

Lescouflair et al. (1980) studied 278 metal and asbestos miners in Quebec, Canada, who claimed compensation for hearing loss. Of the 278 cases, 28.7% (80) were excluded as cases of non-mining NIHL. Approximately 50% (99) of those remaining cases diagnosed as having NIHL were shown to have a hearing impairment based upon the AAOO 1959 criteria and an estimated 63% (125) showed an impairment based upon AAO–HNS 1979 criteria. 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 NIHL among the miners for those subjects exposed to a mixture of intermittent-continuous noise versus 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 NIHL comprised 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 NIHL. 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.

In conclusion, like reported cases of NIHL, the compensation data are too incomplete to be used for quantitative estimates of the prevalence of NIHL in the mining industry. But like the reported case data, the compensation data that are available do show that numerous cases are still being filed each year at considerable cost. Further, according to the data reported by mine operators, many miners who developed NIHL only worked in mining after the implementation of the current noise regulations. While limited, this evidence of continued risk supplements and supports the data previously presented from scientific studies.

The Agency would welcome the submission of additional data to supplement that which it has been able to gather to date.

Exposures in the U.S. Mining Industry

In this section MSHA presents information on noise exposure in the U.S. mining industry, so as to develop a picture of the mining population at a significant risk of incurring material impairment as a result of that exposure. The exposure levels are particularly high in the coal industry, where hearing protectors, rather than engineering or administrative controls, remain the primary means of miner protection against NIHL. But the data indicate that exposure levels remain high in all sectors of the mining industry even

though noise regulations have been implemented for some time.

Inspection Data

The first presentation, Tables II–9 and II–10, reviews noise exposure data collected by MSHA inspectors from thousands of samples gathered over many years to check compliance with the current permitted levels. Because the proposed rule would alter the way a miner's noise dose is calculated in one respect, MSHA conducted a special survey to obtain data that would reflect this change. The data are presented in Tables II–11 and II–12. The survey data are also presented by occupation in Tables II–13 and II–14. All the readings are in time-weighted 8-hour averages.

Tables II–9 and II–10 display samples which present readings exceeding the permissible exposure limit, a TWA_8 of 90 dBA.

Table II–9 shows noise dose trends in metal and nonmetal mines based on over 232,500 full-shift samples collected by MSHA from 1974 through 1995 using personal noise dosimeters.

TABLE II–9.—METAL AND NONMETAL NOISE DOSE TRENDS 1974 TO 1995 [a]

Year	Number of samples	Number of samples > 90 dBA	Percent of samples > 90 dBA
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

[a] Data from USBOM' MIDAS data base.

Table II–10 below presents noise dose trends in coal mines based on 75,691 full-shift samples collected by MSHA from 1986 through 1995 using personal noise dosimeters. MSHA actually began routine sampling in coal mines in 1978; however, its data base did not begin until 1986.

TABLE II–10.—COAL MINE NOISE DOSE TRENDS, FISCAL YEARS 1986 TO 1995

Fiscal year	Number of samples	Number of samples >90 dBA	Percent of samples >90 dBA
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

The inspection data for the two sectors have also been graphed in charts II–9 and II–10 for years in which MSHA collected data for both sectors.

As illustrated by the charts, the metal and nonmetal sector shows a gradual, but consistent, downward trend in the percent of samples exceeding the current PEL. However, there was no such clear trend for coal mines during the same time period. (It should be noted that while the data points on these 3–D graphs come from the last column of the tables, the shading may make them seem somewhat lower than they are in fact.)

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Chart II-9. U.S. M/NM Industry Noise Dose Trend

Inspector Samples — 1986-1995

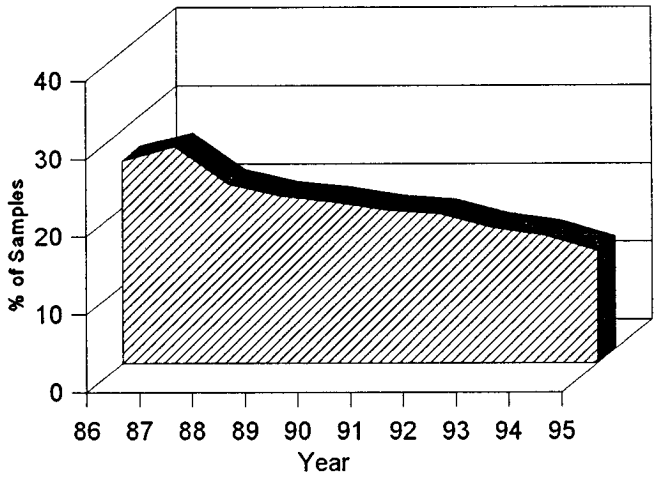
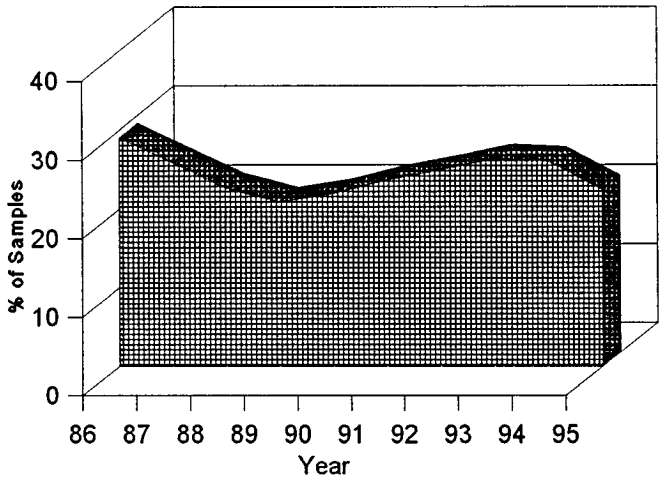


Chart II-10. U.S. Coal Industry Noise Dose Trend

Inspector Samples — 1986-1995



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There are several factors which must be considered when drawing any conclusions from the data. MSHA sampling may be biased towards noisier mines and occupations. Additionally, when an overexposure is found during an initial survey, the data base includes both the initial overexposure and the results of any resampling to determine compliance after the mine operator has utilized engineering and/or administrative controls. While these biases may tend to offset each other, their specific impact cannot be quantified. These factors should, however, impact both sectors roughly equally.

Dual Survey Data

MSHA has concluded that the information contained in Tables II–9 and II–10 understates the actual noise exposures in the industry because the information was collected using a 90 dBA threshold level, i.e. sound levels of less than 90 dBA are not integrated into the results. As discussed later in part III of the preamble, in connection with proposed § 62.120(a), MSHA is proposing to change the threshold level to integrate sound levels of between 80 dBA and 130 dBA because MSHA has concluded that this is warranted by the weight of scientific evidence. Integrating the sound levels between 80 dBA and 90 dBA into the noise exposure will generally increase the measured noise dose. The greater the amount of noise between 80 dBA and 90 dBA the greater the impact on the measured noise dose.

Accordingly, MSHA conducted a special survey to compare noise exposures at different threshold levels. The survey, referred to hereinafter as the ''dual-threshold'' survey, involved the collection of personal noise dosimeter data by MSHA inspectors in coal mines and metal and nonmetal mines. Each sample was collected using a personal noise dosimeter with the capability of simultaneously collecting data at both a 90 dBA threshold and an 80 dBA threshold. All other dosimeter settings were the same as those used during normal compliance inspections (the 90 dB criterion level, 5-dB exchange rate, and A-weighting system which are not now being proposed by MSHA for change). The noise doses were mathematically converted to the appropriate TWA_8 using different criterion levels and threshold values.

Tables II–11 and II–12 display the dual-threshold data: respectively in metal and nonmetal mines, and in coal mines. Table II–11 specifically 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 II–11.—M/NM DUAL THRESHOLD SAMPLES AT OR EXCEEDING SPECIFIED TWA_8 SOUND LEVELS FROM MARCH 1991 THROUGH DECEMBER 1994

TWA_8 Sound Level (in dBA)	90 dBA thresholds		80 dBA threshold	
	Number of samples	Percent of samples	Number of samples	Percent of samples
90	7,360	17.4	11,150	26.5
85	.....	.....	28,250	66.9

Note: Two of the boxes in the table do not contain entries. This is to avoid the potential for making an inappropriate comparison of values. Direct comparison of TWA_8 values determined with different thresholds is not appropriate if the TWA_8 is less than one of the thresholds. An example may help to illustrate the point. A miner exposed to a constant sound field of 85 dBA for 8 hours would be determined to have a noise dose of 0%, or a TWA_8 of 0 dBA, if a 90 dBA threshold is used: none of the sound would be counted in the computation. If the exposure was measured using an 80 dBA threshold, the dose would be 50%, or a TWA_8 of 85 dBA. Contrasting the measures taken with the two thresholds would be inappropriate in such a case.

As indicated in Table II–11, 17.4% of all samples collected by MSHA in metal and nonmetal mines during the specified time period equaled or exceeded a TWA_8 of 90 dBA using a 90 dBA threshold—slightly less than the results of inspector sampling in Table II–9. In these instances, engineering and/or administrative controls were required to be implemented in the metal or nonmetal mines to reduce sound levels to the PEL: a requirement that would be retained under the proposed rule. When sound levels between 80 dBA and 90 dBA are taken into account, however, 26.4% of the readings indicated non-compliance. Thus, changing the threshold to properly reflect harmful sound levels indicates harmful noise exposures in this industry are more significant than revealed by the inspection data in Table II–9. Furthermore, 67% of the samples in metal and nonmetal mines exceeded a TWA_8 of 85 dBA using an 80 dBA threshold.

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

TABLE II–12.—MSHA COAL DUAL THRESHOLD SAMPLES AT OR EXCEEDING SPECIFIED TWA_8 SOUND LEVELS FROM 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	1,075	25.3	1,510	35.6
85	.....	.....	3,268	76.9

As indicated in Table II–12, 25.3% of all samples collected by MSHA in coal mines during the specified time period equaled or exceeded a TWA_8 of 90 dBA using a 90 dBA threshold. This percentage increases to 35.6% when an 80 dBA threshold is used. Furthermore, using an 80 dBA threshold, almost 77% of the survey samples from the coal

industry showed noise exposures equaling or exceeding 85 dBA.

Tables II–13 and II–14 present some of the MSHA dual-threshold sampling data by occupation for the most frequently sampled occupations in metal and nonmetal mines and coal mines, respectively. A note of caution: the only data presented in these tables is 90 threshold data at a TWA_8 of 90, and 80 threshold data at a TWA_8 of 85. Accordingly, the columns should not be compared. Perhaps the best way to think of this presentation is as two independent analyses at how the exposure levels of various job categories compare with each other.

TABLE II–13.—PERCENTAGE OF MSHA M/NM SAMPLES[a] BY SELECTED OCCUPATION, EXCEEDING SPECIFIED TWA_8 Sound Levels

Occupation	Number of samples	90 dBA threshold	80 dBA Threshold
		Percent of samples > 90 dBA	Percent of samples > 85 dba
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

[a] These occupations comprise about 87 percent of the 42,206 MSHA dual-threshold samples collected in metal and nonmetal mines from March 1991 through December 1994. All samples were collected using a personal noise dosimeter over a miner's full-shift.

TABLE II–14.—PERCENTAGE OF MSHA COAL SAMPLES BY OCCUPATION, EXCEEDING SPECIFIED TWA_8 SOUND LEVELS[a]

Occupation	Number of samples	90 dBA threshold	80 dBA threshold
		Percent of samples > 90 dBA	Percent of samples > 85 dBA
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

[a] Above sampled occupations comprise about 71.0% of the 4,247 MSHA dual threshold samples collected in coal mines from March 1991 to December 1995. All samples were collected using a personal noise dosimeter over a miner's fullshift.

As shown in these tables, the percentage of miners exceeding the specified sound levels varied greatly according to occupation. For example, Table II–13 shows that only 8.4% of the backhoe operators in metal and nonmetal mines had noise exposures exceeding a TWA_8 of 90 dBA using a 90 dBA threshold, while 64.4% of the pneumatic rotary drill operators had similar exposures. When reviewing the same two occupations, 52.6% of the backhoe operators and 89.0% of the pneumatic rotary drill operators would have noise exposures exceeding a TWA_8 of 85 dBA using an 80 dBA threshold.

Conclusion; Miners at Significant Risk of Material Impairment

MSHA has prepared an exposure profile of miners based on the data presented in this part; the methodology is summarized in the following paragraphs and described in detail in the Agency's preliminary RIA. Based on this profile, 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 that 15% of coal miners will incur a material impairment of hearing under present exposure conditions, or 18,947 coal miners. The figures are 13% of metal and non-metal miners (26,977 metal and nonmetal miners) and 14% of miners as a group (45,924 miners). (The figures include contract miners but exclude certain office workers.)

To derive this information, MSHA began with the 80 dBA exposure data discussed in the prior section. The sampling data were sorted by exposure range: e.g., samples with a TWA_8 of between 80–84.9 dBA, those between 85–89.9 dBA, those between 90–94.9 dBA, and so on.

The sampling data were then adjusted by subtracting 5 dBA from the exposure readings for all samples that had a TWA_8 of 90 dBA at the 90 threshold. These are the samples that would be above the current PEL. MSHA assumed that mine operators currently issue personal HPDs to miners exposed at or above the PEL, that miners are using the HPDs, and that such protection reduces the miner's equivalent TWA_8 noise exposure by about 5 dBA. (There is an extended discussion in part III of this preamble about hearing protector effectiveness, and appropriate references, that shed further light on these assumptions.)

Then the percentage of adjusted samples within each range was multiplied by MSHA's estimates of the total number of mine employees. Those estimates are based on information gathered by the former USBOM (and are presented in part IV of this preamble as part of the Agency's industry profile).

Finally, to establish the number of miners expected to incur a material impairment of hearing, the Agency multiplied the number of miners in each exposure range by the risk of impairment of exposure at that range for a lifetime. For this purpose, the Agency used the 1972 NIOSH risk estimates discussed earlier in this part. (The Agency is aware that NIOSH is currently working on revising its estimates using a different model and taking hearing loss at an additional frequency into account; but until such an approach is peer reviewed, MSHA has concluded it should rely upon the 1972 estimates.)

Based on these assumptions, Table II–15 presents MSHA's profile of the projected number of miners currently at significant risk of developing a material impairment of NIHL under existing exposure conditions.

TABLE II–15.—PROJECTED NUMBER OF MINERS LIKELY TO INCUR NIHL IMPAIRMENT UNDER EXISTING STANDARDS AND EXPOSURE CONDITIONS

	<80	80–84.9	85–89.9	90–94.9	95–99.9	100–104.99	≧105	Total*
Coal	0	599	11,956	5,622	643	111	16	18,947
M/NM	0	1,225	16,910	7,580	1,190	62	10	26,977
Total*	0	1,825	28,866	13,201	1,833	173	26	45,924

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

When MSHA promulgated noise standards in 1971 for underground coal mines, in 1972 for surface coal mines, and in 1974 for metal and nonmetal mines, compliance with the requirements was thought to be adequate to prevent the occurrence of NIHL in the mining industry. Since that time, however, there have been numerous awards of compensation for hearing loss among miners.

Moreover, MSHA's requirements are dated in light of the Agency's experience, that of other domestic and foreign regulatory agencies, and the recommendations of experts on what it takes to have an effective prevention program. NIOSH, for example, currently recommends a comprehensive program which includes the institution of an HCP to prevent NIHL; MSHA's current standards do not include such protection.

In light of current scientific evidence demonstrating that NIHL constitutes a serious hazard, the evidence of continuing harm to miners, and the fact that MSHA standards no longer reflect experience and expert advice, MSHA has concluded that there is a need to replace its existing noise standards with new standards that would provide additional protection to miners. Section 101(a)(6)(A) of the Federal Mine Safety and Health Act of 1977 (Mine Act), 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.

Significant NIHL clearly is the type of material impairment of health, which Congress has directed the Secretary of Labor (Secretary) to prevent. MSHA has concluded that the new requirements in this proposal are necessary to prevent large numbers of miners from suffering material impairment of health resulting from exposure to noise. Compliance will reduce NIHL among miners and the costs associated therewith.

Based on these studies and MSHA's own calculations and analysis presented above, the Agency has concluded that regulatory action is necessary to address the continued excess risk of NIHL resulting from mining employment.

III. Discussion of Proposed Rule

Summary

This part of the Supplementary Information reviews the provisions of the proposed rule, along with the information, comments and alternatives considered by MSHA in developing each feature of the proposal.

While the Agency is seeking to present a complete picture of the basis for its preliminary decisions, so as to facilitate comment, space considerations preclude a full presentation of all of the sources reviewed by the Agency. Part V is a complete reference list of those sources. Among other things, part V contains a list of publications by the former USBOM that were reviewed by the Agency. Many of these describe methods for controlling noise for particular types of mining equipment or facilities, and thus supplement the discussion in this part about feasible engineering controls. All constitute part of the Agency's rulemaking record.

In addition to the materials cited in part V, the Agency researched the noise regulatory codes of a number of other jurisdictions—including those of the military and of other countries. While these codes are noted in this part in a few summary tables, and discussed in connection with certain key requirements being proposed by the Agency, the Agency has determined there is no need to elucidate their requirements in each and every section of this part. Nevertheless, these codes also constitute part of the Agency's rulemaking record.

Section 62.100 Purpose and Scope; Effective Date

Purpose

The purpose of the standards in proposed part 62 is the prevention of occupational noise-induced hearing loss among miners. It is important to clearly state the purpose of the regulations: to clarify it to the regulated public and Agency personnel, and so that the effectiveness of the regulations over time can be measured consistent with principles under the Government Performance Results Act.

Scope

Part 62 would set forth health standards for all coal, metal and nonmetal mines, both surface and underground, subject to the Federal Mine Safety and Health Act of 1977. MSHA currently has 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). In fact, however, there are really two groups of standards: those applicable to coal mines and those applicable to metal and nonmetal mines. This is because the surface and underground standards for noise in metal and nonmetal mines are identical; the same is true of the surface and underground standards for noise in coal mines. The differences between the standards applicable in the coal industry and in other mining industries are discussed in detail in the following pages.

Part 62 would establish a single, uniform noise standard applicable to all mines. This approach is favored by many. Those who responded to MSHA's ANPRM generally agreed that consolidation and simplification of multiple standards into one may help to facilitate understanding of, and thus compliance with, regulatory requirements. Such an approach is also traditional with noise: OSHA's standards apply uniformly to hundreds of industries.

The proposed standard is not identical to the existing coal standard nor to the existing metal and nonmetal standard. Nor is the proposal identical to the noise standard which has been applicable to most other industries since 1983 pursuant to the Occupational Safety and Health Act (29 CFR 1910.95). Conditions in the mining industry, experience with the current standards, MSHA's review of the latest scientific information, the comments submitted in response to the ANPRM, and the requirements of the Mine Safety and Health Act have led the Agency to propose a standard that is unique in some respects. Nevertheless, many key features in the proposal are identical to features in one or more of the existing noise standards.

Several charts comparing the features of the proposed standard to the features of existing MSHA and OSHA noise standards are included in the ''Question and Answers'' in part I of the Supplementary Information accompanying this notice.

Effective Date

MSHA recognizes that successful implementation of these new and uniform health rules will require new training of MSHA personnel and guidance to employees and mine operators, particularly small mine operators. Accordingly the Agency is proposing that the new standards take effect one year after the date of publication of the final rule. An alternative would be to phase in the new requirements. The Agency believes some could be phased in quickly, but wants to avoid confusion. The Agency requests comment on whether a phased-in approach is appropriate and how it might most effectively be designed.

Section 62.110 Definitions

The proposal would include some definitions to facilitate understanding.

The definitions include some technical terms universally used in noise measurement, e.g., criterion level.

The definitions also include some terms used in the mining industry in a way that differs from usage in other contexts, e.g., usage under the OSHA standard. One example is the term ''hearing conservation program'' or ''HCP.'' Under the proposal, requirements for hearing protectors and training are not always linked to audiometric testing results as they are under the OSHA standard. To avoid confusion, the proposal defines a hearing conservation program as a generic reference to those sections of the proposal that set forth the requirements for an audiometric testing program. Another example is the definition of ''qualified technician''.

The definitions also include some terms which are non-standard. In particular, the Agency is proposing to use the term ''supplemental baseline audiogram'' instead of the more commonly used ''revised audiogram''; MSHA believes its terminology will make it easier for the mining industry to understand the requirements of the proposal.

The discussion which immediately follows summarizes the salient features of the definitions. A more detailed discussion of the definitions is contained in those sections of the preamble which review the context in which each definition is to be used.

Access

Access is the right to examine and copy records. This is consistent with the use of this term in several of MSHA's and OSHA's existing health standards.

Audiologist

A professional, specializing in the study and rehabilitation of hearing, who is certified by the American Speech-Language-Hearing Association or licensed by a state board of examiners. MSHA has included this definition primarily to indicate which organizations certify or license audiologists. MSHA has decided that all practicing audiologists should be either licensed or certified by one or both of the above organizations. This term is considered in the section of this preamble that discusses proposed § 62.140 *Audiometric testing program*.

Baseline Audiogram

The audiogram against which future audiograms are usually compared. By comparing an annual audiogram to the baseline audiogram the progression of noise-induced hearing loss can be determined. This term is considered in the section of this preamble that discusses proposed § 62.140, *Audiometric testing program*.

Criterion Level

This refers to the sound level which if applied for 8 hours results in a dose of 100% of that permitted by the standard. Under proposed § 62.120(a), the criterion level would be a sound level of 90 dBA. If applied for 8 hours, this sound level would result in a dose of 100% of the permissible exposure limit (PEL), established by proposed § 62.120(c) as an 8-hour-time-weighted average of 90 dBA. The PEL and the

criterion level are not the same thing. While the PEL is a sound level of 90 dBA for 8 hours, it is also a sound level of 95 dBA for 4 hours; the criterion level is always a constant, derived from what the PEL is at 8 hours of exposure.

Decibel (dB)

Unit of measurement of sound. Decibel is used to describe environmental/occupational sounds and hearing acuity.

Decibel, A-weighted (dBA)

Sound levels measured using the A-weighting network. There are several frequency response networks which have been developed, as noted in the section of the preamble discussing proposed § 62.120(a). A-weighting refers to the frequency response network closely corresponding to the frequency response of the human ear. This network attenuates sound energy in the upper and lower frequencies (<1000 and >5000 Hz) and slightly amplifies those frequencies between 1000 and 5000 Hz. The characteristics of the A-weighting network are found in ANSI S1.25–1991, ''Specification for Personal Noise Dosimeters''.

Designated Representative

A designated representative is an individual or organization to whom a miner gives written authorization to exercise a right of access to records, pursuant to proposed § 62.200.

Exchange Rate

The amount of increase or decrease in sound level which would require halving or doubling the allowable exposure time to maintain the same noise dose. In this proposal, a 5-dBA increase in the sound level would correspond to a halving of the allowable exposure time. Exchange rate is discussed in detail in the section of this preamble discussing proposed § 62.120 *Noise exposure levels.*

Hearing Conservation Program (HCP)

An HCP is designed to detect early changes in a miner's hearing acuity so that corrective action can be instituted to minimize future hearing loss. In general parlance, an HCP is a system of audiological examinations that provide guidance for the use of hearing protectors, other controls, and training. In the proposed rule, however, hearing protector use and training linked to audiological examinations are only a limited subset of the hearing protector and training requirements. Accordingly, to avoid confusion, the term ''hearing conservation program'' in the proposed rule is defined as a generic reference to the requirements of §§ 62.140 through 62.190 of part 62, the requirements dealing with audiological examinations and the corrective actions linked thereto.

Hearing Protector

The purpose of this definition is to clarify that not all devices or materials inserted in or that cover the ear to reduce the noise exposure can qualify as a hearing protector. For example, MSHA does not consider a hearing aid as a hearing protector.

A hearing protector must meet two requirements. First, to be a hearing protector a device must be sold wholly or in part on the basis of its ability to reduce the level of sound entering the ear. Thus, cotton would not be an acceptable hearing protector. Second, the device must have a scientifically accepted indicator of noise reduction value.

MSHA's definition encompasses that used in the Environmental Protection Agency's (EPA) labeling standards for hearing protectors (40 CFR § 211.203(m)). The EPA defines a hearing protector 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.

EPA requires that all hearing protector manufacturers include labeling information with their products that indicate their Noise Reduction Rating (NRR). Thus, if a hearing protector has such a label, the mine operator can be confident that it meets MSHA's definition of a hearing protector. As noted in the discussions of proposed § 62.120(a), MSHA does not believe the NRR ratings are meaningful in workplace situations; moreover, other organizations have recommended that the EPA reconsider the rating system it uses. MSHA is therefore not proposing to delimit the range of hearing protectors that may be offered to only those with an NRR as such; rather, any scientifically accepted indicator of noise reduction value will be acceptable evidence of the product's purpose.

The Agency is interested in comments on this definition.

Hertz (Hz)

A unit of measurement of frequency, numerically equal to cycles per second. The range of audible frequencies is 20 to 20,000 Hz.

Medical Pathology

A condition or disease affecting the ear. The term is used in the proposed rule in contexts which do not require actual diagnosis and treatment; see specifically the discussion of proposed §§ 62.125 and 62.170. Medical conditions of this type should ultimately be diagnosed and treated by a physician specialist, e.g., an otolaryngologist.

Qualified Technician

A technician who has been certified by the Council for Accreditation in Occupational Hearing Conservation (CAOHC) or by another recognized organization offering similar certification. MSHA has decided that requiring a technician to be certified would ensure that audiometric tests are administered by a competent person. The definition of ''qualified technician'' is discussed in connection with proposed § 62.140 *Audiometric testing program.*

Reportable Hearing Loss

This defines the extent of hearing loss which must be reported to MSHA so the Agency can intervene to prevent further hearing loss. Such reporting is already required pursuant to 30 CFR part 50. This definition clarifies how the requirements of 30 CFR part 50 apply in the case of noise.

The definition in the proposed rule would require that hearing loss be calculated by subtracting the current hearing levels from those on the baseline audiogram at 2000, 3000, and 4000 Hz; when the permanent hearing losses at each frequency are averaged (added up and divided by three), the hearing loss must be reported if the average loss in either ear has increased by 25 dB. In making this calculation, a supplemental baseline audiogram would be used in lieu of the baseline audiogram in those cases in which the supplemental audiogram was created because of a significant improvement in hearing acuity, in accordance with the provisions of proposed § 62.140(d)(2).

The definition of reportable hearing loss is discussed in connection with proposed § 62.190, *Notification of results; reporting requirements.* As discussed therein, the Agency is specifically seeking comment on two points: (a) an appropriate definition of reportable hearing loss in those cases in which operators lack an audiometric test record; and (b) the nature of the hearing loss that MSHA should capture through its part 50 reporting system.

Sound Level (in dBA)

The sound pressure level measured in decibels using the A-weighting network and exponential time averaging. Pursuant to proposed § 62.120(a)(3)(iv), sound pressure levels would be measured using the A-weighting network and the slow-response time constant. 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 magnitude of these pressure changes and is generally perceived as loudness.

Standard Threshold Shift (STS)

This defines the extent of hearing loss which requires intervention by a mine operator pursuant to proposed § 62.180.

An STS is a measure of permanent change for the worse—relative to a miner's baseline audiogram, or relative to the most recent supplemental audiogram where one has been established pursuant to proposed § 62.140(d). The definition in the proposed rule would require that hearing loss be calculated by subtracting the current hearing levels from those measured by the baseline (or supplemental) audiogram at 2000, 3000, and 4000 Hz; when the hearing losses at each frequency are averaged (added up and divided by three), the hearing loss would be considered an STS if the average loss in either ear has reached 10 dB.

MSHA discusses this definition in detail in connection with proposed § 62.160, *Evaluation of audiogram*.

By contrast with an STS, a temporary threshold shift (TTS) is a temporary change in hearing acuity, which corrects itself after sound levels are decreased and does not permanently impair hearing. The latter term is used frequently in the preamble, but is not needed in the proposed rule.

Supplemental Baseline Audiogram

This is an annual audiogram used in certain specific cases in lieu of the baseline audiogram to measure reportable hearing loss or standard threshold shift. Some professionals prefer the term ''revised'' baseline audiogram; in this proposal, ''supplemental'' is used to ensure mine operators are clear that the integrity of the original ''baseline'' audiogram must be preserved.

A supplemental baseline audiogram is established under the circumstances set forth in proposed § 62.140(d)(1) or 62.140(d)(2). See the discussion of those sections in this preamble, as well as the related discussions of ''reportable hearing loss'' and ''standard threshold shift.''

Time-Weighted Average-8 Hour (TWA_8).

That sound level, which if constant over an 8-hour time period, would result in the same noise dose as is measured. This yardstick measurement is used in the rule in connection with various limitations; for example, the proposed PEL would be a TWA_8 of 90 dBA.

Not all noise measurement instruments give readouts in terms of time-weighted 8-hour averages. Many personal noise dosimeters, for example, measure noise as a percentage of permitted dosage, with the PEL equated to 100%. Mine operators therefore need to convert noise dose to an equivalent TWA_8 to determine if the action level or the PEL has been exceeded, and to evaluate the impact of engineering controls. Accordingly, MSHA has provided a list of TWA_8 conversion values in Table 62–2, included in proposed § 62.120. The table has been compiled by equating a dose of 100% to the proposed PEL. For example, a dose of 50% equals a TWA_8 of 85 dBA—the level at which some protective action must be taken under the proposal.

The TWA_8 and the dose are to be used interchangeably. Since the noise exposure will be measured for the entire shift, compliance with the noise standard will be based upon the measured dose. If the measured dose exceeds 100%, regardless of the length of the workshift, the miner will be considered to be overexposed to noise. It would thus be improper to adjust a TWA_8 reading for an extended work shift.

Care should be taken not to assume that those models of personal noise dosimeters which give readouts in both the noise dose and the ''average sound level'' in dBA are giving a TWA_8 readout. The ''L_{avg}'', or average sound level, is the constant sound level which equals the dose over the measurement period. The value of the TWA_8 is the same as the L_{avg} if the measurement period is 8 hours.

It should be noted that the TWA_8 is a term used in the context of a 5-dB exchange rate. In the context of a 3-dB exchange rate, the equivalent term is the ''$L_{eq,8}$''. The latter term is used occasionally in the preamble—in discussing the possible use of a 3-dB exchange rate, and in those studies performed with data from countries using a 3-dB exchange rate.

Section 62.120 Limitations on Noise Exposure

Introduction

The provisions of this section of the proposed regulation deal with some critical subjects: how to compute a miner's noise dose; the hierarchy of controls at different noise exposure doses; and the monitoring of noise exposure.

Specifically, paragraph (a) of proposed § 62.120 provides the parameters for computing the amount of noise to which a miner is exposed—a miner's noise dose. Paragraphs (b) through (d) establish a series of noise exposure limitations, and the specific mine operator actions required if noise exceeds that level. Paragraph (e) establishes a ceiling on sound levels to which a miner may be exposed. Paragraph (f) establishes a mine operator's obligation to evaluate each miner's noise exposure to determine if it exceeds any of the limitations established by this section, and to notify miners at risk.

A short summary of each subsection follows. Thereafter, a more detailed presentation is provided.

§ 62.120(a)

Proposed paragraph (a) sets forth a formula for dose computation which corresponds to the measurements made by most current personal noise dosimeters. It further specifies that: all sound levels from 80 dBA to at least 130 dBA be integrated into the dose measurement, including impact/impulse noise in that range; noise be measured over a full shift; a 5-dB exchange rate be used; and that measurements be made using the A-weighting network and slow response instrument settings. This paragraph also clarifies that measurement of noise dosage is to be made without regard for the effect of a hearing protector.

The exchange rate is the measure that reflects how much of a decrease in exposure time is required when the sound level increases. The proposed 5-dB exchange rate is the same as under current standards. Using that rate, the exposure permitted at a sound level of 90 dBA is half that permitted at a sound level of 85 dBA—a miner gets the same noise dose in 4 hours at 90 dBA as at 8 hours at 85 dBA.

The Agency currently uses a 5-dB exchange rate. There appears to be a consensus in the recent literature for an exchange rate of 3-dB. Moreover, the current 5-dB exhange rates incorporates an assumption that there is significant time for hearing to recover from high sound levels. MSHA has concluded that

noise exposure under mining conditions does not warrant such an assumption. A 3-dB exchange rate does not incorporate this assumption.

Nevertheless, the Agency is proposing to retain the existing 5-dB exchange rate because of feasibility considerations. Changing to a 3-dB rate from a 5-dB rate would significantly reduce the amount of time that miners could be exposed to higher sound levels without exceeding the permissible exposure limit. For example, MSHA estimates that the percentage of miners whose exposure would be in violation of a PEL set at a $L_{eq,8}$ of 90 dBA would be just about double that of a PEL set at a TWA_8 of 90 dBA. This means mine operators would have to utilize controls to reduce exposures to the PEL more frequently—and the controls required to reduce exposures that much would be more expensive. Furthermore, it is extremely difficult to reduce the noise exposures to below a $L_{eq,8}$ of 90 dBA using currently available engineering or administrative noise controls or a combination thereof. Accordingly, moving the industry to a 3-dB exchange rate may be infeasible at this time. (Part IV contains a further discussion of feasibility issues.)

Two features proposed with respect to noise measurement of particular significance are: lowering the threshold at which sound levels are integrated into a miner's noise dose, and prohibiting the adjustment of noise measurements to provide credit for hearing protector attenuation.

MSHA is proposed that the threshold for integrating noise into dose measurements be expanded to cover sounds as low as 80 dBA. This decision is based on strong evidence that such exposures do contribute to hearing impairment. While more protective than the present threshold of 90 dBA, this change will generally result in higher dose readings in both the coal and metal and nonmetal sectors than at present. For example, MSHA's dual-threshold survey indicated that in the metal and nonmetal industry, the percentage of samples above the PEL increased from 17.4% at a 90 dBA threshold to 26.4% at an 80 dBA threshold; in coal the figures increased from 25.3% to 35.6%.

Moreover, the proposed regulation would not allow dose measurements to be adjusted in those cases in which miners are wearing hearing protectors. This is consistent with the thrust of the proposal to establish for all mining sectors a hierarchy of controls for noise in which primary reliance will be upon engineering and administrative controls.

§ 62.120(b)

Proposed paragraph (b) establishes an ''action level'' at a TWA_8 of 85 dBA.

The need for an action level reflects two facts: (1) There is a significant risk of material impairment to miners from a lifetime of exposure to noise at this level; and (2) the Agency believes it may not be feasible at this time to lower the PEL to this level, since that would require that mine operators use all feasible engineering and administrative controls to reduce noise exposures to this level.

The proposal would require that all miners exposed above the action level be provided special instruction in the hazards of noise and protective methods. The training is to be provided annually for as long as exposure exceeds the action level. (The nature of this instruction, how it is to be provided, and how it can be coordinated with other required miner training are subjects discussed in connection with proposed § 62.130.)

If a miner's exposure exceeds the action level but is below the PEL, an operator will also be required to enroll a miner whose exposure exceeds the action level in a hearing conservation program (HCP). While enrollment in the HCP would require the operator to make annual audiometric testing available to the miner, miners exposed to noise below the PEL would have the right to decline taking any annual audiometric testing. The requirements for such testing are discussed in connection with proposed § 62.140, audiometric test procedures. MSHA is seeking comments on how to minimize the burden on mine operators of providing audiometric examinations for those miners with only a temporary attachment to the mining work force (e.g., summer employees), while recognizing the importance of detecting and tracking hearing loss among those who switch jobs.

In addition, the operator must provide properly fitted hearing protection—before the initial hearing examination, if a significant threshold shift in hearing acuity is detected, and at any other time upon miner request. Should it take more than 6 months to provide the initial hearing examination because of the need to wait for a mobile test van, or should a significant threshold shift in hearing acuity be detected, the operator would also be required to ensure that the miner wear the hearing protection—even if the miner's noise exposure remains under the PEL. (A discussion of the timeframes for audiometric tests, and the use of mobile test vans, is included in the discussion of proposed § 62.140, audiometric test program. The definition of a significant threshold shift is discussed in connection with proposed § 62.160, evaluation of audiogram).

An action level currently exists under OSHA but would be new to the mining industry. As discussed herein, MSHA proposes to build upon the requirements which have been used by OSHA while giving due regard to implementation approaches appropriate to the circumstances of the mining community.

§ 62.120(c)

Proposed paragraph (c) would establish the permissible exposure limit (PEL) to noise for a miner as a TWA_8 of 90 dBA during any workshift. (This is also referred to as a dose measurement of 100%; the action level TWA_8 of 85 dBA is half this dose of noise.) The proposal further provides that if the PEL is exceeded, in addition to the controls required at the action level, the mine operator shall use all feasible engineering and administrative controls to reduce the miner's noise exposure to the PEL. The mine operator has a choice of whether to use engineering controls, administrative controls, or both; but if administrative controls are utilized, a copy of the procedures involved must be posted, and copies given to the affected miners.

If reducing the dose to this level with such controls is not feasible, the proposal requires the mine operator to use such controls to lower the noise exposure as much as is feasible.

In addition, in such cases, the proposal requires that the operator take extra steps to protect miner hearing. The operator must ensure all miners so exposed take the annual hearing examinations, must provide properly fitted hearing protection to all miners so exposed, and must ensure the hearing protection is used by all miners so exposed.

Under the proposal, a consistent hierarchy of controls is established for all mines. Mine operators must first utilize all feasible engineering and administrative controls to reduce sound levels to the PEL before relying on other controls to protect against hearing loss. This approach is consistent with that currently in place for metal and nonmetal mines, but would be a change for coal mines. As discussed herein (in connection with proposed § 62.125, hearing protectors), MSHA has considerable evidence that primary reliance upon hearing protectors, as is the current case in the coal industry, is misplaced.

As under the present standards, the proposal would require a mine operator

to use only such engineering controls as are technologically feasible, and to use only such engineering and administrative controls as are economically feasible for that mine operator.

As noted, the proposed rule provides for supplemental controls in those cases in which the Agency concurs with a mine operator that the use of all feasible engineering and administrative controls cannot reduce noise to the PEL. MSHA believes that when a miner is exposed to such high levels of noise, these supplemental obligations are necessary to protect miner hearing. Hearing protectors are not without their discomforts; but the risk of hearing loss at such exposure levels ought to be the controlling factor. While audiometric testing is not an invasive procedure, the Agency is concerned that there may be economic pressures and personal reasons that may lead miners to decline to take hearing examinations. The information generated by these tests is necessary, however, to trigger investigation of potentially serious flaws in the layers of noise controls required at these high exposure levels. In addition, the Agency believes that miners operating under such high noise conditions should be aware of the severity of any hearing loss; in a mining environment, this knowledge could have implications for the safety of the miner and the safety of others. Comments on this provision are specifically solicited.

§ 62.120(d)

Proposed paragraph (d) provides that should a miner's noise exposure exceed a TWA_8 of 105 dBA during any workshift, a dose of 800% of the PEL, the mine operator shall, in addition to taking all of the actions required when exceeding the PEL, require the miner to use dual hearing protection—i.e. both a plug type and a muff type hearing protector. In this context, the Agency presents information about the mining jobs at which the exposures of this level are occurring; and requests comment on whether there should be an absolute dose ceiling, regardless of the feasibility of control by an individual mine operator.

§ 62.120(e)

Proposed paragraph (e) would provide that at no time shall a miner be exposed to sound levels exceeding 115 dBA.

§ 62.120(f)

Proposed paragraph (f) consists of two parts. First, it would require mine operators to establish a system of monitoring which effectively evaluates each miner's noise exposure. This will ensure that mine operators have the means to determine whether a miner's exposure exceeds any of the limitations established by this section, as well as to assess the effectiveness of noise controls. The proposed rule is performance oriented in that the regularity and methodology used to make this evaluation are not specified. Specific requirements for periodic monitoring now applicable to the coal sector would be revoked.

Proposed paragraph (f) would also require that miners be notified in writing should their exposure exceed any of the levels specified by this section—whether based on operator or MSHA evaluations of noise. Notice would be required within 15 calendar days.

The proposal has been designed to ensure that miners are made aware of the hazards they currently face. Miners exposed above the action level should be notified of that fact so, for example, they can consider the importance of using provided, properly fitted and maintained hearing protectors. On the other hand, the proposal does not require notification of a particular miner if an exposure measurement indicates that the miner's exposure has not changed and the miner has within the last year been apprised of the same information.

The proposal has no provision for requiring the posting of warning signs.

Dose Computation

Proposed § 62.120(a) sets forth important technical specifications on computing noise dose. These specifications were utilized in the establishment of the limitations set forth in this section; they therefore must be utilized in dose measurements taken to determine compliance.

Using a Personal Dosimeter

The dose itself is usually read directly from a personal noise dosimeter. The dosimeter is set to the specifications required by the proposed standard (e.g. 80 dB threshold), attached to the miner, and the total dose read out at the end of the full work shift.

Using a Sound Level Meter

Some operators may prefer to take a series of individual readings with sound level meters, and derive the dose from these readings. Accordingly, the proposal also sets forth the formula for determining the dose in this fashion.

Proposed § 62.120(a)(1) would specify that noise dose is to be computed by combining the sound levels during various periods of time during the miner's measurement period, in accordance with the formula:

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

where:

D=the percent of permissible exposure,
C_n=the total time of exposure at a specified sound level, and
T_n=the reference duration of exposure at that level, as listed in Table 62–1.

Table 62–1 contains reference durations for sound levels from 85 to 115 dBA. The sound levels to be integrated into the dose measurement pursuant to this proposal actually range from 80 to 130 dBA. Reference durations for sound levels not in the table can be calculated pursuant to the formula in the table note. (For a detailed discussion of this topic see the section of this preamble entitled *Threshold and range of integration*.)

As noted, current personal noise dosimeters automatically compute a miner's noise exposure essentially using the above formula. In fact, noise dose is relatively simple to compute when the sound level is constant throughout the work shift. For example, a miner is exposed to 95 dBA for 2 hours and has no additional noise exposure. The reference duration, from Table 62–1, for 95 dBA is 4 hours. Substituting the values into the above formula yields:

$$D=100\ (2/4)$$ or equivalently 50%.

When a miner is exposed to fluctuating sound levels, the total noise dose can be computed using the same formula. For example, a miner is exposed to 90 dBA for 1 hour, 95 dBA for 2 hours and 100 dBA for 1 hour. The reference durations from Table 62–1 are 8 hours, 4 hours, and 2 hours, respectively. Substituting the values into the above formula yields:

$$D=100\ (1/8+2/4+1/2)$$ or 100 (0.125+0.50+0.50) or equivalently 112.5%.

Conversion of Dose to TWA_8

Table 62–2, included in proposed § 62.120(a)(2), has been constructed to permit dosage measurements to be converted readily into time-weighted average 8-hour (TWA_8) measurements.

The TWA_8 is the sound level which if constant over an 8-hour time period, would result in the same noise dose as is measured. This yardstick measurement is the one used to establish the action level, PEL, and double-hearing protection supplemental control level in the proposed regulation. Since personal noise dosimeters measure noise as a percentage of permitted dosage, with the permissible exposure limit (PEL) equated to 100%, this table allows for ready conversion of

those measurements into a form that measures compliance.

As stated previously, the TWA_8 and the dose are to be used interchangeably. It is intended that the TWA_8 not be adjusted for extended work shifts. Since the noise exposure will be measured for the entire shift, compliance with the noise standard will be based upon the measured dose. If the measured dose exceeds 100%, regardless of the length of the workshift, the miner will be considered to be overexposed to noise. MSHA requests commenters to review the proposed rule and offer suggestions to help the Agency ensure that this intention is clearly conveyed in the rulemaking language.

The table has been constructed by equating the proposed PEL to a dose of 100%. More specifically, the TWA_8 conversion values in Table 62–2 are based on the use of a 90 dBA PEL, 80 dBA threshold, and a 5-dB exchange rate. Interpolation for values not found in this table can be determined from the following formula: $TWA_8=16.61 \log_{10}(D/100)+90$, where D is the percent dose.

It is important to understand that the exposure is interpreted as if averaged over 8 hours. Thus, if a miner only works for 5 or 6 hours, the sound levels can be higher during those hours than if the miner works for 8 hours. Conversely, if a miner works an extended shift (greater than eight hours), the sound levels would need to be lower. Some current models of personal noise dosimeters will provide readings in both dose and the average sound level (L_{avg}) over the sampling period. Although the L_{avg} is useful in some circumstances, it is only equal to the TWA_8 when the period sampled is 8 hours.

Consideration of Hearing Protector Attenuation

Proposed § 62.120(a)(3)(i) would require that when determining a miner's noise dose, the attenuation of hearing protectors not be considered. This provision would supplement the intent of proposed § 62.120(c) to preclude the current practice in the coal industry of not issuing a citation based upon a noise exposure that exceeds the PEL when the miners are wearing hearing protection.

Several commenters recommended that no credit be given for hearing protector attenuation in determining the miner's noise dose. These commenters believed that engineering or administrative controls should be given primacy over hearing protectors.

Other commenters, however, supported an allowance for hearing protector attenuation. Their recommendations varied from allowing the full NRR value, to allowing only a 5 decibel attenuation for all makes and models of hearing protectors.

Field studies in mining by Giardino and Durkt (1996), Kogut and Goff (1994), Giardino and Durkt (1994), Durkt (1993), Goff, et. al. (1986), Durkt and Marraccini (1986), and Goff and Blank (1984) have shown that the measured hearing protector attenuation at mines is far less than the attenuation measured in the laboratory and is in some cases minimal. Furthermore, the measured attenuations were highly variable. These two factors make it virtually impossible to accurately predict the in-mine effectiveness of hearing protectors in reducing noise exposures. A more detailed discussion of hearing protector performance and attenuation rating methods is presented in the *Hearing protector effectiveness* section of this preamble.

Table III–1 presents three types of information from various jurisdictions. These items are—

(1) the consideration of hearing protector attenuation when determining the occupational noise exposure;

(2) the weighting network used for measuring occupational noise exposure; and

(3) the instrument response time for measuring non-impulse/impact occupational noise.

TABLE III–1.—FEATURES OF SELECTED LEGISLATION OR GUIDELINES FOR EVALUATING NON-IMPULSE/IMPACT NOISE TABULATED FOR VARIOUS ENTITIES

Entity	Credit for hearing protector attenuation	Weighting network	Response times
U.S. Army	No	A-weighting	Slow.
U.S. Navy	Implied	A-weighting	Slow.
U.S. Air Force	No	A-weighting	Slow.
Canada (consensus)	Not addressed	A-weighting	Slow (SLM only).
EEC	No	A-weighting	Slow or fast.
Australia (consensus)	No	A-weighting	Fast (integrating SLM) or slow (SLM)
Australia (national)	No	A-weighting	Fast (integrating SLM) or slow (SLM).
Western Australia	No	A-weighting	Fast (integrating SLM) or slow (SLM).
South Africa	Implied no	A-weighting	Slow.
ISO (consensus)	Implied no	A-weighting	Fast (SLM).
ACGIH (consensus)	Implied no	A-weighting	Slow.

In reviewing the procedures for exposure measurement in regulations and codes of practice (mandatory or recommended) from the selected branches of the U.S. armed services, international communities, the ISO, and the ACGIH, MSHA found that some diversity exists among the methods used (See Table III–1). Nearly all of the entities either specify or imply that attenuation provided by hearing protectors should not be considered in determining a worker's noise exposure.

Based on this information, MSHA has concluded that it would be inappropriate to consider the attenuation of hearing protectors in determining a miner's noise dose. As computed, the noise dose provides a measurable foundation upon which can be built a noise control program: including, as discussed herein, the use of hearing protectors to attenuate that noise dose.

This provision would supplement the intent of proposed § 62.120(c) to preclude MSHA's current practice in the coal industry of not issuing a citation based upon a noise exposure that exceeds the PEL when the miners are wearing hearing protection. This is consistent with the thrust of the proposal to establish for all mining sectors a hierarchy of controls for noise in which primary reliance will be upon engineering and administrative controls. These issues are discussed at length in connection with proposed § 62.120(c) under *Hierarchy of controls* and *Hearing protector effectiveness.*

Threshold and Range of Integration

Proposed § 62.120(a)(3)(ii) would require that all sound levels from 80 dBA to 130 dBA be integrated into the

miner's noise dose for determining compliance with the PEL. Sound levels less than 80 dBA would not be included in the noise exposure computation. By not excluding any particular types of sound from the requirement, MSHA intends that the term ''all sound levels'' include, but is not limited to, continuous, intermittent, fluctuating, impulse, and impact noise.

MSHA currently uses a threshold of 90 dBA for all purposes. OSHA, however, uses a dual threshold: a 90 dBA threshold for measuring whether a dose exceeds its PEL (TWA_8 of 90 dBA), and an 80 dBA threshold for determining whether a dose exceeds its action level (TWA_8 of 85 dBA).

Many of the commenters to MSHA's ANPRM supported a threshold of 80 dBA. Some specifically supported a single threshold. One of these commenters stated the following:

> It was an undue burden on employers when OSHA adopted a dual threshold level (90 dBA when sampling for PEL and 80 dBA when sampling for a Hearing Conservation Program). Few employers in our practice understand the difference, and in fact, very few service providers in our area understand the dramatic differences these two threshold levels can create. MSHA has the opportunity to correct this [oversight] by OSHA, and would be wise to adopt the 80-dBA threshold.

Another commenter stated:

> MSHA should use an 80-dBA threshold for integrating noise on dosimeters for both compliance with the PEL and the action level. The exposure characterization of levels between 80 dBA and 130 dBA would be more accurate using an 80-dBA threshold dosimeter versus a 90-dBA integrating dosimeter.

A third commenter recommended the following:

> One threshold level should be used for all measurements—80 dBA. A single threshold level of 80 dBA, as compared to separate thresholds of say, 90 dBA and 80 dBA, would greatly simplify and reduce the costs of measuring noise exposure levels and would provide an additional margin of safety.

Several commenters recommended that the current threshold of 90 dBA be retained. One of these commenters stated the following:

> * * * multiple thresholds would be extremely burdensome and costly and would require companies to purchase and use meters that integrate at different levels. * * * the requirement that more than one threshold be used is unsupported by reliable and widely accepted scientific data and is unnecessary for protection of the health of miners.

Two commenters supported the use of a dual threshold consistent with OSHA's current standard, while another commenter recommended a threshold of 75 dBA, because EPA had said that 75 dBA equates to no risk.

One mining association commented that a member company had collected about 4,500 samples between 1985 and 1988 using personal noise dosimeters set at an 80 dBA threshold and found that about 20% of the measurements equalled or exceeded the PEL. MSHA notes these results are comparable to the results of the dual-threshold survey conducted by the Agency and reviewed in part II.

According to ACGIH (1994) all sound levels exceeding 80 dBA should be integrated into the daily noise exposure. Because permissible durations are presented for sound levels up to 139 dBA, the range of integration can be inferred to be 80 to 139 dBA.

ANSI S1.25–1991, ''Specification for Personal Noise Dosimeters'', recommends that the threshold level be set at least 5 dB below the criterion level. Although ANSI S1.25–1991 specifies personal noise dosimeters to have an operating range of at least 50 dB, most currently manufactured personal noise dosimeters have an operating range greater than 50 dB. In addition, these personal noise dosimeters will integrate sound levels up to 140 dBA to include impulse/impact noise at pre-selected thresholds of 80 dBA, 85 dBA, and 90 dBA.

There is general agreement among the EEC, the ISO, the international community, and selected branches of the U.S. armed services that all types of noise be integrated in the worker's noise dose; however, a threshold is not always specified.

Moreover, based on its review of the available evidence, MSHA has determined that the use of a single 80 dBA threshold for determining a miner's noise exposure is necessary for miner protection. Its many advantages include:

(1) it would address the risk of hearing impairment from prolonged exposure (greater than 8 hours) above 80 dBA;

(2) it would improve the accuracy of exposure measurements, ensuring that at-risk miners would be accurately identified;

(3) it is consistent with OSHA's 80 dBA threshold for HCP requirements, allowing for comparison data;

(4) it would be less burdensome than using dual thresholds, allowing the use of a single, less complex personal noise dosimeter to collect the required information rather than a more expensive instrument or two separate instruments; and

(5) a single threshold is appropriate in as much as MSHA's proposed approach to hearing conservation is linked closely to other parts of its proposal.

Several consequences should be noted of switching to a threshold of 80 dBA from the present threshold of 90 dBA. As noted in part II of this preamble, MSHA inspectors conducted comparative sampling for several years, simultaneously collecting readings at both the 90 dBA and 80 dBA thresholds. Tables II–11 and II–12, located in part II of the Preamble, show the effect of using an 80 dBA threshold versus a 90 dBA threshold with a criterion level of 90 dBA. Of the more than 42,000 samples collected in metal/non-metal mines, for example, 7,360 (17.4%) exceeded a criterion of 90 dBA using a 90 dBA threshold; whereas, 11,150 (26.4%) exceeded the 90 dBA criterion using an 80 dBA threshold. Hence, the use of an 80 dBA threshold will result in a higher proportion of samples exceeding the PEL. Also, an 80 dBA threshold means that in the case of an extended workshift of more than 8 hours, sound levels that average below 90 dBA can result in a dose that exceeds the PEL. For example, the PEL for a 16-hour workshift is 85 dBA, which equates to a TWA_8 of 90 dBA.

Further, based upon research conducted by MSHA, the Agency has determined that the effect of switching to a lower threshold is not linear. Sound levels just under 90 dBA will have a much greater impact on the dose computation than those nearer 80 dBA.

Full-Shift Sample

Proposed § 62.120(a)(3)(ii) would also require that compliance with the PEL or action level be based on the determination of a miner's full-shift noise exposure. Typically, a full-shift measurement would be taken with a personal noise dosimeter. This procedure would be consistent with MSHA's existing noise standards and sampling procedures.

OSHA's noise standard does not specify a sampling duration, other than to require personal monitoring where circumstances such as high worker mobility, significant variation in sound level, or a significant component of impulse noise make area monitoring generally inappropriate. OSHA does require that the sample be representative of the worker's exposure.

In response to MSHA's ANPRM, numerous commenters addressed sampling duration, including the question of novel work shifts (work shifts differing from 8 hours). Many commenters stated that the noise measurement should encompass the entire work shift regardless of duration. For those shifts which exceed 8 hours,

a number of commenters suggested that the PEL be adjusted to account for the longer work shift. Others suggested that the noise exposure be adjusted.

Several commenters advocated the use of a 40-hour noise exposure instead of a daily 8-hour noise exposure because of the widely varying noise exposure of miners. These commenters believed that the 40-hour exposure would present a better representation of the noise exposure.

A few commenters addressed partial shift sampling. At many small mines, miners may be involved with several different jobs with different noise exposures. Because of this, one commenter believed that partial-shift sampling was more representative of a miner's noise exposure. The commenter did not want the highest partial-shift noise exposure projected to a full-shift and reported as the typical exposure for that shift. Another commenter suggested that the survey duration encompass at least two-thirds of the shift in order to represent a full-shift sample.

Lancaster (1986), in a study of noise exposure of British coal miners, reported that the variation in the day-to-day occupational noise exposure of compressed air drillers and electricians had a range that exceeded 30 dBA. The smallest range for any of the fifteen occupations was 8 dBA. Lancaster reported that five-shift samples greatly reduced the chance of getting an unrepresentative high or low result. Further, Lancaster concluded that a five-shift sample was not a reliable routine method for determining the long-term noise exposure. In order to determine the long-term average noise exposure to within an accuracy of 2 dBA, Lancaster stated that 4 to 57 samples are needed depending upon the occupation.

MSHA concurs with the majority of commenters that full-shift sampling is more representative of the noise exposure than partial-shift sampling. Therefore, MSHA has determined that a full-shift measurement is necessary because partial-shift noise surveys do not account for such factors as: variable work tasks, worker mobility, and no set production pattern for many mining situations. These occurrences are commonplace in the mining industry.

The Agency did not include a long-term sampling requirement in the proposal. Such a requirement would be burdensome to the mining industry and is not relevant to compliance with the proposed standard, which will be based upon a single full-shift sample by the Agency. (For further consideration of MSHA compliance policy in this regard, see the last of the Questions and Answers in part I.)

Impulse/Impact Noise

MSHA's proposal does not include a specific limit on impulse or impact noise. Rather, it provides that all noise in the range from 80 dBA to 130 dBA be integrated into a miner's noise dose, including any impulse/impact noises measured in those ranges. Most personal noise dosimeters cover this range of sound levels. MSHA has concluded that, currently, there is not a sufficient scientific consensus to support a separate impulse/impact noise standard. Further, existing procedures, for identifying and measuring such sound, lack the practicality to enable its effective enforcement: for example, many personal noise dosimeters do not permit use of the fast response settings needed to isolate sounds of this type. Since industrial impulses are almost always superimposed on a background of moderate-to-high levels of continuous noise, and since both may be harmful, MSHA has determined that it is only reasonable to consider their effect together, rather than to treat each separately. As indicated below, there is ample justification for this approach in the studies reviewed by MSHA and comments submitted to the record.

MSHA's existing noise standards for coal mines do not include a limit for impulse/impact noise. Both OSHA's and MSHA's Metal and Nonmetal existing noise standards limit impulse/impact noise to a peak level of 140 dB. Neither standard, however, specifically defines impulse/impact noise nor procedures to measure it.

OSHA, in its Hearing Conservation Amendment, determined that impulse noise should be combined with continuous noise to calculate employee noise exposure for purposes of the HCP. OSHA's standard, however, retains the 140 dB peak limit on impulse and impact noise. The OSHA preamble to its Hearing Conservation Amendment (46 FR 4099) stated:

> Since industrial impulses are almost always superimposed on a background of moderate to high levels of continuous noise * * * and since both may be harmful, it is only reasonable to consider their effects together rather than to treat each separately * * *. The decision to measure all noise exposures for purposes of the hearing conservation program is a pragmatic approach to the whole problem of impulse noise. For, while there is some dispute as to the precise definition and effect of impulse noise, there is general agreement that impulse noise is damaging.

Impulse/impact noise is typically characterized by a rapid rise time, high peak value of short duration, and rapid decay.

In 1974, OSHA proposed the following definition for impulse noise (39 FR 37775):

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

At that time, OSHA proposed to limit exposure to impulses at 140 dB to 100 per day, and to permit a tenfold increase in the number of impulses for each 10-dB decrease in the peak pressure of the impulse. OSHA stated that this proposal was in accordance with the criterion proposed by McRobert and Ward (1973). OSHA's proposal on impulse noise exposure limits was identical to that recommended by the ACGIH (1986).

Currently, there is no uniformly accepted definition of impulse or impact noise. ANSI S12.7–1986, ''Methods for Measurement of Impulse Noise'', defines impulse noise as ''a single short burst or a series of short bursts of sound pressure. The pressure-time history of a single burst includes a rise to a peak pressure, followed by a decay of the pressure envelope.''

The ACGIH (1986) states that:

> Impulsive or impact noise is considered to be those variations in noise levels [sound levels] that involve maxima at [time] intervals of greater than one per second. Where the intervals are less than one second, it should be considered continuous.

Integrating impulse/impact noise into the miner's noise dose is broadly supported by many of the commenters. One commenter stated that currently there is not enough scientific information to promulgate a separate standard on impulse/impact noise. Several commenters advocated retaining the current MSHA Metal and Nonmetal 140 dB peak limit. However, two commenters indicated that exposure to this peak be limited to 100 occurrences per work shift. One commenter on this issue recommended that MSHA adopt the measurement methods described in ANSI S12.7–1986, ''Methods for Measurement of Impulse Noise''. This ANSI document, however, does not specify a criterion level for such noise. Another commenter stated that 156 dB is most likely the critical point at which the sensory components of the human ear disintegrate.

Defining impulse/impact noise, and setting an appropriate limit, has proven to be an arduous task mainly because of the difficulty in measuring such sound and differentiating it from non-impulse/impact noise that may occur simultaneously. Impulse/impact noise

seldom occurs alone in the mining environment. Several commenters on this issue indicated that current instrumentation, including in particular the personal noise dosimeter, cannot distinguish between impulse/impact and continuous noise occurring simultaneously. Some commenters stated that although personal noise dosimeters cannot distinguish between impulse/impact noise and continuous noise, newer models of personal noise dosimeters are capable of accurately integrating the two types of noise into a single combined dose.

The studies reviewed by MSHA and discussed below indicate that even though there is no consensus as to a definition of impulse/impact noise, all researchers and regulators agree that this type of noise is damaging to hearing.

Ward (1990) stated that both impulse and impact noises involve high sound pressure levels and short durations, so in a sense, they jointly represent an extreme type of intermittent noise. He believed, however, that there is considerable evidence that a distinction should be made between impulse noise and impact noise, and that they should be treated separately. Ward characterized impulse noise as ''A-duration,'' such as that from gunfire. Whereas he characterized impact noise as ''B-duration,'' having multiple, nearly equal peaks and a sustained reverberation that may endure for a second or even longer.

Ward believed that recent research tends to support the conclusion that impact noise can reasonably be expected to behave in a manner similar to that of intermittent exposure to short bursts of otherwise continuous but high-intensity noise. He stated that any predictive scheme that accurately estimates the hazard of intermittent noise in the range of time-weighted averages (TWA_8) or $L_{eq,8}$ of 110 dBA to 130 dBA also would be successful in predicting the hazard from impact noise, and no ''correction for impulsiveness'' should be necessary. He further stated, the same is true of impulse noise as long as the level of the pulse does not exceed some ''critical'' value. If the impulse exceeds this critical level, however, Ward believed that the hazard increases rapidly with further increases in level or in the number of impulses.

Ward stated that the most hazardous impulse would be one that has its maximum energy in the most sensitive region of the human auditory system: namely 2000 to 3000 Hz. This occurs when the A-duration is around 0.2 milliseconds (ms). For pulses whose A-duration is in this vicinity, he believed the critical level to be around 150 dB for the average individual and around 140 dB for the most susceptible ears. He believes, however, that his limit results in overprotection against pulses whose A-duration is short (as in the case of cap guns) or long (as with cannons or sonic booms).

Ward concluded that impulse noise may be the most important cause of NIHL in the general population, not by a gradual erosion of auditory sensitivity through repeated daily exposure, but rather by a single event causing acoustic trauma. He emphasized, however, that the determination of valid exposure limits for specific impulses is still a major problem.

In the American Industrial Hygiene Association (AIHA) *Noise & Hearing Conservation Manual,* Ward (1986) also expressed concern regarding an impulse/impact noise limit. He stated:

> Just where, if anywhere, this type of limit should be placed is still undecided. Although the present OSHA regulations state: ''Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure'' (Anon., 1971), this number was little more than a guess when it was first proposed in the CHABA document (Kryter et. al., 1966), and no convincing supportive evidence has since appeared. While 140 dB may be a realistic ceiling for impact noises, it is inappropriate for impulses, so exposure limits in which the permitted peak level increases as the duration of the pulses becomes shorter should continue to be used (Anon., 1968).

Volume II of the Ohio State University Research Foundation report (Melnick et al., 1980) discussed the effects of single, high-level impulses and stated:

> There are insufficient data to develop distributions of hearing loss as the function of the parameters of single, high-intensity impulses. The very nature of the stimulus makes these effects on man difficult to quantify.

This report, however, stated the following regarding single impulse levels that could cause damage:

> * * * In experiments with laboratory animals, impulses having peak levels in the range of 150 to 160 dB were capable not only of producing damage to the inner ear but also showed evidence of trauma to the structures of the middle ear, including perforation of the tympanic membrane (Eames et al., 1973). Pfander (1975) reports that, in humans, perforations of the tympanic membrane were observed when the peak level for an explosive impulse was in the range of 180 dB. In his experiments with the effects of sonic booms on mice using peak levels that range from 126 to 146 dB, with durations in excess of 100 msec, Reinis (1976) reported that five such booms delivered at the rate of 1 every 10 seconds are capable of producing bleeding in the cochlea of the experimental animals.

The Committee on Hygiene Standards of the British Occupational Hygiene Society (1976) developed standards for impulse noise. Their recommendation referenced a study by Kryter and Garinther which ''showed that temporary hearing loss after exposure to 100 impulses increased rapidly at sound pressure levels exceeding 170 dB.'' Kryter and Garinther, however, recommended limiting instantaneous sound pressure levels to 150 dBA, because special measurement techniques and instruments would be needed to measure levels in excess of 150 dBA.

Shaw (1985) recommended, in the interest of simplicity and in keeping with ISO/DIS 1999–1984, that the use of hearing protectors be mandatory where there is exposure to noise at the work place with instantaneous peak sound pressures exceeding 200 pascals (140 dB relative to 20 micropascal). Shaw stated, however, that exposure to many simple non-reverberant impulses (''clicks'') at that level would be required to produce significant temporary threshold shift even in the most sensitive ears. Shaw further discussed the concept of ''critical level'' and stresses that ''the relationship between peak sound pressure level and mechanical or physiological stress * * * is exceedingly complex.'' Shaw quoted McRobert and Ward (1973) who urged that ''* * * damage risk criteria incorporate a more complicated criterion for impulse and impact noise than a simple ceiling or peak level * * *.''

ISO/DIS 1999–1990 (1990) also supported combining continuous noise with impulse/impact noise in conjunction with the use of a 3-dB exchange rate.

In discussing the combined effects of continuous and impulse/impact noise, the ACGIH (1986) stated that:

> Some studies have shown that the effects of combined impulse and continuous noise are additive [Okada et al., *Int. z Angew. Physiol.,* 30:105–111 (1972)]. Other studies have shown that rapidly repeated impulses [Coles and Rice, *Occupational Hearing Loss,* pp. 71–77 (1971)] and simultaneously continuous noise [Cohen et al., *J. Acoust. Soc. Am.,* 40:1371–1379 (1966)] in some cases provide up to 10 dB of protection.

Evans and Ming (1982) and Sulkowski and Lipowczan (1982), however, supported the theory that impulse noise superimposed on steady-state noise is more hazardous than the same levels of either separately. Cluff (1982), professor of audiology at Arizona State University, believed that the combined

continuous/impulse noise dose procedure should be approached with a degree of caution. He stated that:

> The procedure involves some knotty issues; not the least of which is the issue of equal energy (3-dB doubling rule) vs equinocivity (the principle embodied in the 5-dB doubling rule). One other issue deserves mention also. What is impact/impulse noise? It is a simple matter to describe impact/impulse noise in terms of its source when the source is obvious and individual events are spaced far apart temporally. It is quite another matter to describe it differentially from continuous noise when the source is not obvious and when individual events are repeated rapidly (as with the case of gear trains, pneumatic chisels, conveyor belts, grinders, internal combustion engines, etc.). Indeed, this difficulty may be central to the heretofore tendency to class it as continuous noise when the repetition rate exceeds one or two events per second. Were it not that the weight of evidence appears to argue against this approach, the simple thing would be to call it continuous noise and treat it as such.

As shown in Tables III–4 and III–5 (in the section entitled *Permissible exposure level (PEL),* discussing proposed § 62.120(c)), the majority of international communities and selected branches of the U.S. armed services have adopted 140 dB peak as the upper limit for sound levels in their respective regulations. However, there is no consensus among these regulators as to a definition of impulse/impact noise.

In reviewing the literature on impulse/impact noise, MSHA found that such noise frequently is divided into two general categories: ''A-duration'' impulses are short duration (measured in microseconds) and non-reverberant in that they usually occur outside or in a sound deadening environment; and ''B-duration'' impacts are of longer duration (measured in milliseconds) and are reverberant mainly because they occur inside where the sound is augmented by reflections from hard surfaces. MSHA's experience indicates that there is seldom impulse noise of A-duration in mills and underground mines, because of the reverberant field. Scheduled blasting at surface mines would not be impulse noise of A-duration because of the multiple detonations several milliseconds apart in a semi-reverberant field when considering the rock walls and floor.

MSHA is concerned about the practicality of enforcing an impulse/impact noise limit in mining. Distinguishing impact/impulse noise from continuous noise, according to most of the definitions discussed above, would require sophisticated, delicate laboratory instrumentation. This equipment is: cumbersome, not intrinsically safe, not readily available, and not capable of withstanding the harsh mining environment.

As pointed out by some commenters, there have been many technological advances in the capabilities of noise measuring instruments, and equipment now exists that can integrate impulse/impact noise into the dose. The ability of personal noise dosimeters to accurately integrate sound levels above 130 dBA into the noise dose, however, may be questionable. ANSI S1.25–1991, ''Specification for Personal Noise Dosimeters'', specifies that personal noise dosimeters must have an operating range of 50 dB. ''Operating range'' is defined by ANSI as the range between threshold and an upper sound level within which a personal noise dosimeter operates within stated tolerances. Accordingly, if an 80 dBA threshold is used, current personal noise dosimeters would be required to meet ANSI tolerances up to 130 dBA.

As stated previously, MSHA has determined that there is little noise in mining that could be characterized as impact or impulse given their prevailing definitions. One source of impact noise that may exceed the existing 140 dB criteria is that caused by blasting in underground mines. MSHA has determined that noise from blasting in underground mines would be considered impact noise rather than impulse noise because of the highly reverberant environment.

In Volume II of the Ohio State University Research Foundation report (Melnick et al., 1980), Melnick et al. states the following with regard to measuring impulse/impact noise, such as that produced by blasting:

> Under conditions sufficient to produce measurable hearing loss, it would be extremely fortuitous if measuring instruments were in place to permit the assessment of the actual exposure of the single impulsive event. Generally, these exposures are accidental in nature.

Because blasting occurs at irregular intervals, with most miners removed from the blast site prior to its initiation, it would be difficult for MSHA to measure such exposures and to enforce a limit designed to protect against such exposures.

MSHA considered many factors in determining the merit of proposing an impulse/impact noise limit for the mining industry. Although there is much evidence in the literature on the harmful effects of impulse/impact noise, MSHA concluded that, currently, there is not a sufficient scientific consensus to support a separate impulse/impact noise standard. Further, existing procedures for identifying and measuring such sound lack the practicality to enable its effective enforcement. This is due, in part, to the complexity of the phenomena, where consideration must be given to such factors as: the peak sound pressure level; the wave form and crest factor; the rise and decay time; whether it is A-duration or B-duration; the number of impulses per day; the presence or absence of steady-state sound; the frequency spectrum of the sound; and the protective effect of the middle ear acoustic reflex.

In conclusion, studies discussed above indicate that when impulse/impact noise is combined with continuous noise, hearing loss is exacerbated. Therefore, MSHA has determined that, for purposes of this proposal, impulse/impact noise should be combined with continuous noise for purposes of calculating a miner's noise exposure. Since industrial impulses are almost always superimposed on a background of moderate-to-high levels of continuous noise, and since both may be harmful, it is only reasonable to consider their effect together, rather than to treat each separately. There is ample justification for this approach in the studies reviewed by MSHA and comments submitted to the record.

MSHA, however, requests further comment on this issue, particularly on impulse/impact noise sources in mining which may not be integrated adequately into the miner's noise dose. Additionally, MSHA requests data addressing a critical level to prevent traumatic hearing loss; what this critical level should be; whether it should be based on a single event; and a practical scientifically validated method for its discrete measurement.

Exchange Rate

The exchange rate is another factor which is involved in the determination of noise dose. 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 be determined to have accumulated the same dose as a result of only a 4-hour exposure at 95 dBA. If the exchange rate were reduced to 3-dB, the same dose would be received with a 4-hour exposure at only 93 dBA. Other terms for exchange rate include ''doubling rate,'' ''trading ratio,'' and ''time-intensity tradeoff.''

The Agency currently uses a 5-dB exchange rate. There appears to be a concensus in the recent literature for an exchange rate of 3-dB, although the Agency is seeking additional

information on this point. Moreover, the current 5-dB exchange rates incorporates an assumption that there is significant time for hearing to recover from high sound levels. MSHA has concluded that noise exposure under mining conditions does not warrant such an assumption. A 3-dB exchange rate does not incorporate this assumption.

Nevertheless, the Agency is proposing to retain the existing 5-dB exchange rate because of feasibility considerations. Changing to a 3-dB rate from a 5-dB rate would significantly reduce the amount of time that miners could be exposed to higher sound levels without exceeding the permissible exposure limit. For example, MSHA estimates that the percentage of miners whose exposure would be in violation of a PEL set at a $L_{eq,8}$ of 90 dBA would be just about double that of a PEL set at a TWA_8 of 90 dBA. This means mine operators would have to utilize controls to reduce exposures to the PEL more frequently—and the controls required to reduce exposures that much would be more expensive. Furthermore, it is extremely difficult to reduce the noise exposures to below a $L_{eq,8}$ of 90 dBA using currently available engineering or administrative noise controls or a combination thereof. Accordingly, moving the industry to a 3-dB exchange rate may be infeasible at this time. (Part IV contains a further discussion of feasibility issues.)

OSHA, in its 1974 proposed noise standard (39 FR 37774), stated the following regarding its decision to use a 5-dB exchange rate:

> EPA recommended [in response to OSHA's proposal] a doubling rate [exchange rate] of 3 dB. While the 3-dB doubling rate is hypothetically correct for uninterrupted noise exposure, noise exposure in industry is normally interrupted since there are several breaks in the day's work. OSHA agrees with the Advisory Committee [Standards Advisory Committee on Noise, appointed by the Assistant Secretary for OSHA] that the doubling rate should be adjusted to take into account the various breaks which occur in a workday. Therefore, OSHA believes that a doubling rate of 5 dB is more appropriate than the 3 dB.

MSHA received numerous comments regarding this particular issue. Many refer to scientific studies showing the ability of the ear to recover from temporary shifts (temporary threshold shifts, or TTS) incurred during noise exposure. TTS should not be confused with PTS, which refers to permanent theshold shifts—i.e., loss of hearing acuity. Whether TTS and PTS are inexorably linked is a subject of debate, as noted below.

Many commenters advocated retaining the existing 5-dB exchange rate. Two of these commenters believed that there is sufficient support in the scientific literature for a 3-dB exchange rate, but recommended that MSHA retain using the 5-dB exchange rate so as to maintain consistency between MSHA and OSHA.

A number of commenters, however, recommended a 3-dB exchange rate. Several stated that it has greater scientific and technical validity. Others supported the 3-dB exchange rate because it would be in agreement with regulations in many countries outside the United States and with the recently issued international standards [International Standards Organization, ISO 1999.2] which the U.S. endorsed. One commenter asserted that the ''use of the 3-dB, rather than a 5-dB, exchange rate facilitates the calibration/characterization and the interpretation of the performance of such [noise measuring] instruments.'' Another commenter criticized the theory that the 3-dB exchange rate only applies to steady state noise, stating the following:

> First, steady and intermittent noise merely identifies the extremes of episodes of noise and quiet that most workers experience in the course of a day. It is the rare exception to find workers who experience either continuous or steady state noise. Recovery from noise-induced damage, therefore, is unpredictable in the real world. Second, the hypothesis of recovery during intermittent noise exposure has not been empirically verified.

Other commenters stated that the use of the 3-dB exchange rate is not appropriate in mining because exposures in the mining industry are intermittent and, therefore, miner recovery from temporary threshold shifts occurs during the working day. Finally, two commenters stated that if the exchange rate were lowered, many of the personal noise dosimeters currently in use would become obsolete and would have to be replaced.

MSHA reviewed several recent studies relating to the selection of an exchange rate. Kryter (1984) in his discussion of interruptions in and durations of daily noise exposures, asserts that even short periods of reduced noise exposure during the workday facilitate recovery, and that a 5-dB exchange rate is thus appropriate to take this into account. He states:

> * * * it does not matter whether the off time is continuous or interrupted during the 8-hour day. In either case, the recovery process continues and is equally effective. For example, the level of a noise of 8 hours duration per workday could be increased by 6 dB and cause no additional PTS provided its duration is decreased to 4 hours, either by reducing the total work period by 4 hours or by introducing ''off'' periods (longer than 10 sec each) which total 4 hours. This, of course, is in reasonably close agreement with the ''5 dB exchange'' that would be allowed in some noise assessment procedures, such as the U.S. Department of Labor Occupational Safety and Health Administration (OSHA) regulations.

Dear (1987) supported retaining the 5-dB exchange rate based upon the studies of Sulkowski (1980), Gosztonyi (1975), Scheiblechner (1974), Schneider (1970) and Pell (1973). Further, Dear believed that the studies of Passchier-Vermeer (1973) and Burns and Robinson (1970), which formed the basis for Shaw's recommendation to adopt a 3-dB exchange rate (discussed below), were critically flawed and furthermore the findings of Passchier-Vermeer did not agree with those of Burns and Robinson. Dear asserted that Shaw discounted other studies which showed that the 5-dB exchange rate correlated well with hearing loss. Dear claimed that for every study which supports the 3-dB exchange rate, another supports the 5-dB exchange rate. Dear further contended that a 3-dB exchange rate was valid only for workplaces with no intermittent noise exposure, which is a condition that rarely exists in American workplaces.

Sataloff et al. (1984) studied the effect of intermittent noise exposure on the hearing acuity of workers. This study corroborates an earlier report, done by Sataloff et al. (1969) on the hearing acuity of rock-drilling miners, that intermittent noise is not as hazardous as continuous noise of the same intensity. In the more recent study, 295 industrial workers who did not use hearing protectors were exposed to non-impact sound levels from 99 dBA to 118 dBA with quiet periods less than 90 dBA. Most of the workers were exposed to the higher sound levels. The researchers concluded that intermittent noise exposure produced little hearing loss at frequencies below 3000 Hz; however, it produced substantial damage at the higher frequencies. The pattern of damage, exhibited by workers exposed to continuous noise, was also realized at the lower audiometric frequencies. The researchers attributed the difference in patterns of damage to the recovery of the hair cells in the cochlea during quiet periods in the workers exposure to intermittent noise.

Sataloff et al. (1984) also compared the hearing loss of a population of 295 workers exposed to intermittent noise to other studies on workers exposed to continuous noise conducted by Royster et al., Botsford, and Johnson and Harris'

review of Baughn's findings. Sataloff et al. asserted that the comparison indicated that workers exhibited more hearing loss when exposed to continuous noise than from exposures to intermittent noise. Although research showed that the loss caused by intermittent noise differs substantially from the effects of continuous noise of the same intensity, Sataloff et al. did not state an opinion as to which exchange rate is most appropriate.

Hodge and Price (1978), in their review of damage risk criteria, summarized that the 3-dB exchange rate was proposed to account for variations in exposure time to both intermittent and continuous noise and that the 5-dB exchange rate was proposed to account for the ''beneficial effect of recovery'' during quiet periods between such exposures. They stated, however, that the sound level would need to fall below 60 dBA to effect recovery. They concluded that neither the 3-dB nor 5-dB exchange rate fits the hearing loss at all frequencies or under all conditions and there will be controversy in this area for many years to come.

Cluff (1982), professor of audiology at Arizona State University, states that:

> * * * while equinocivity (the principle embodied in the 5-dB doubling rate) may be an applicable basis for determining noise dose for lower levels of noise, its credibility suffers as the level of the noise increases above 90 dBA. * * * The only justification for equinocivity, in lieu of equal energy [3-dB exchange rate], is that on-the-job exposure to noise will probably be intermittent. * * * Applying the above logic to very high noise levels [sound levels], intermittent exposure may be claimed for noise levels of 115 dBA, for instance, only if the duration of each individual exposure is substantially shorter than the approximately two minute maximum that would be allowed under equal energy.

Bies and Hansen (1990) developed an equation fitting a 6-dB exchange rate to the ISO 1999: 1990(E) data, instead of the 3-dB exchange rate as presented by ISO. Essentially, they showed that the mathematical solution fitting an equation to the hearing loss data contained in ISO 1999: 1990(E) is not unique.

Macrae (1991) published an article which refutes Bies and Hansen's findings. Macrae studied people with a sensorineural hearing loss at 4000 Hz to determine the progression of the loss in relation to presbycusis. Macrae's data supported ISO 1999 which uses a 3-dB exchange rate. Macrae believed that Bies and Hansen erred by assuming that hearing loss, due to presbycusis and noise exposure, was additive on an antilogarithmic basis at 4000 Hz. Because the progression of hearing loss at other frequencies was not studied, Macrae could not reach any definite conclusions as to the progression of hearing loss at frequencies other than 4000 Hz.

According to the Committee on Hearing, Bioacoustics, and Biomechanics of the National Research Council (CHABA) (1993), the data for specifying an exchange rate were not conclusive.

Compared to steady-state noise data, little data exist on the effect of intermittent or time varying noise exposure. Depending upon the length of time of the exposure, an exchange rate of between 0-dB and 8-dB is appropriate. Each of these single number exchange rates is valid for a limited set of exposure conditions. Therefore, CHABA did not recommend an exchange rate. Additionally, CHABA concluded that the maximum sound level for effective quiet is approximately 80 dBA at most frequencies.

NIOSH (1995) recommends a 3-dB exchange rate based upon the latest scientific data. This recommendation represents a change in NIOSH's position on exchange rate from that included in the 1972 *Criteria for Recommended Standard * * * Occupational Exposure to Noise.*

NIOSH presents many reasons for this change in position. In their 1972 criteria document, NIOSH based the recommendation for a 5-dB exchange rate on earlier recommendations of CHABA (Kryter et al., 1966). CHABA's 1966 recommendations were predicated on three postulates, which included—

(1) TTS_2 (temporary threshold shift measured two minutes after cessation of the noise exposure) is a valid predictor of permanent threshold shift (PTS);

(2) equivalent TTS_2's obtained from exposures were equally hazardous; and

(3) TTS_2 is a consistent measure of the effects of a single day's exposure to noise.

Since that time, NIOSH believes that more recent scientific studies have proven these postulates to be erroneous. Another assumption that NIOSH found for justifying the 5-dB exchange rate was that interruptions will be of ''equal length and spacing so that a number of identical exposure cycles are distributed uniformly throughout the day.''

Although NIOSH found that intermittent noise exposure is less harmful than continuous noise exposure, NIOSH has determined that the beneficial effects of intermittency which allow for recovery from TTS are not found in industry today. The quiet periods are too loud and too short to permit recovery of TTS before the next exposure to harmful noise.

NIOSH cites field studies by Sataloff et al. (1969), Holmgren et al. (1971), Johansson et al. (1973), and Institut National de Recherche et de Securite (1978), to show the beneficial effect of intermittency of noise exposure in mining and forestry. Studies by NIOSH (1976), NIOSH (1982), Passchier-Vermeer (1973) and Shaw (1985), not supporting this finding were also cited. NIOSH, however, concludes that ''the ameliorative effect of intermittency does not support the use of the 5-dB exchange rate.''

The Shaw study (1985) supports the 3-dB exchange rate based on the premise that a 3-dB exchange rate better fits the epidemiological data on the relationship between noise exposure and hearing loss. Shaw also criticizes the use of the 5-dB exchange rate because it was based upon the assumption that a permanent threshold shift (PTS) is related directly to temporary threshold shift (TTS). Shaw believes that no researcher has adequately demonstrated a relationship between PTS and TTS. Furthermore, he states that the 5-dB exchange rate does not take into account variations in the temporal pattern of exposure.

Suter (1983) conducted a comprehensive review of the literature on exchange rate. She concluded that the 5-dB exchange rate is under-protective in many situations and that the 3-dB exchange rate is more firmly supported by the scientific evidence for assessing hearing impairment as a function of sound level and duration. Suter, however, stated that:

> The situation becomes more complex when noise becomes truly intermittent, in other words, when there are large differences between high and low levels, and levels in between occur rarely. The studies of forestry workers and miners [Sataloff et al. 1969; Holmgren 1971; Johansson 1973; and Institute National de Recherche et de Securite 1978] indicate that the frequent periods of quiet between noise bursts *can* in *some* circumstances, ameliorate the effects of noise exposure.

Regarding the literature review, Suter explained that the researchers' findings have been refuted by two NIOSH studies of intermittently exposed coal miners (NIOSH, 1976) and firefighters (NIOSH, 1982). In addition, the researchers' studies suffer from various methodological problems such as inadequate characterization of exposure, sporadic wearing of hearing protectors, small sample size, etc. Nevertheless, Suter believed that these studies show a valid trend, in that the intermittency of exposure can offset the effects of noise exposure, especially in view of

some of the animal studies (Ward and Turner, 1982). Suter further stated that:

> The logical consequence of such a trend [intermittent noise exposure being less hazardous than continuous noise exposure] would be to allow an adjustment to the maximum permissible exposure limit for outdoor, intermittent noise exposure. This is by contrast to a 5-dB exchange rate, for which there is virtually no scientific justification * * *.

Suter suggested using a 3-dB exchange rate along with an adjustment of 2 dB to the PEL for outdoor noise. She stated that ''The exact amount of such an adjustment should await clarification by further scientific evidence.''

According to Sliney (1993), chair of the ACGIH Physical Agents TLV Committee, (ACGIH) revised its exchange rate from 5-dB to 3-dB, on the basis that the use of a 5-dB exchange rate is not wise for short exposure periods. The ACGIH stated that allowable durations for high sound levels which are permitted with a 5-dB exchange rate are excessive. In addition, ACGIH believed that, with a 3-dB exchange rate, an upper limit for the TLV was capped by a 140 dBC impulse peak sound pressure level. Both the 1971 and 1990 versions of the ISO 1999 standard employ the 3-dB exchange rate.

Evans and Ming (1982) studied five groups of employees in noisy occupations using personal noise dosimeters which integrated sound levels based on a 3-dB exchange rate. The noise exposures ranged from 80 dBA to 102 dBA. They used a mathematical model developed by Robinson and Shipton based upon a 3-dB exchange rate for predicting hearing loss among exposed workers. Evans and Ming stated that the observed noise-induced hearing loss (NIHL) of workers in the spinning, weaving, and bottling industries agreed with those predicted by Robinson and Shipton's model. The hearing loss of workers in the metal-work industry, however, tended to be greater than those predicted. The authors believed that the significant amount of impulse noise contributing to the noise exposures in this industry explained the difference. Evans and Ming concluded that the use of Robinson and Shipton's prediction method is valid for predicting the hearing loss risk for various noise exposures.

As will be displayed later in Tables III–4 and III–5, the 3-dB exchange rate is also used by many international communities and selected branches of the U.S. armed services.

Although occupations in the mining industry are typically exposed to varying sound levels, most miners are continuously exposed to noise above 80 dBA. Because the majority of exposures are continuously above 80 dBA, little or no time is available to permit ''recovery time'' from TTS. Thus, miners experience little recovery from the effects of these noise exposures. ''Recovery time'' is a basic tenet of the current 5-dB exchange rate; thus, the Agency has concluded the continuous nature of noise exposure in the mining industry is more realistically characterized by the 3-dB exchange rate.

Although the Agency has reached this conclusion, and although there appears to be a growing consensus supporting the use of a 3-dB exchange rate among the scientific community, international regulators, and the U.S. armed services, MSHA has chosen to retain a 5-dB exchange rate for its proposal because there are significant feasibility implications of adopting a 3-dB rate—both economic and technological.

With respect to economic feasibility, MSHA conducted a study of the effect of a 3-dB exchange rate on the measured noise exposure of U.S. metal and nonmetal miners. The mine inspectors collected measurements during the course of their regular inspections using personal noise dosimeters which collected data using 5-dB and 3-dB exchange rates simultaneously. These data are presented in Table III–2.

TABLE III–2.—M/NM SAMPLES[a] EXCEEDING SPECIFIED SOUND LEVELS COLLECTED BY MSHA FROM MAY 1995 TO OCTOBER 1995

Sound level (in dBA)	5-dB exchange rate		3-dB exchange rate	
	Number of samples	Percent of samples	Number of samples	Percent of samples
90	491	16.5	1483	49.9
85	.....	.....	2543	85.5

[a] Total of 2974 samples. Two of the boxes in the table do not contain entries. This is to avoid the potential for making an inappropriate comparison of values. Direct comparison of TWA_8 values determined with different thresholds is not appropriate if the TWA_8 is less than one of the thresholds. An example may help to illustrate the point. A miner exposed to a constant sound field of 85 dBA for 8 hours would be determined to have a noise dose of 0%, or a TWA_8 of 0 dBA, if a 90 dBA threshold is used: none of the sound would be counted in the computation. If the exposure was measured using an 80 dBA threshold, the dose would be 50%, or a TWA_8 of 85 dBA. Contrasting the measures taken with the two thresholds would be inappropriate in such a case.

The measurements in Table III–2 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. To get a better picture of the impact of moving from a 5-dB exchange rate to a 3-dB exchange rate if, as proposed, the Agency adopts an 80-dBA threshold, Table III–3 has been constructed. The data for the 5-dB exchange rate comes from the Agency's dual-threshold survey for metal and nonmetal mines, presented in Table II–11. This also allows for the analysis of data at values below a TWA_8 of 90 dBA, something which is not possible with a 90 dBA threshold. The data for the 3-dB exchange rate come from Table III–2—switching to an 80 dB threshold does not significantly change the 3-dB readings in Table III–2.

TABLE III–3.—METAL/NONMETAL SAMPLES EXCEEDING SPECIFIED SOUND LEVELS AT DIFFERENT EXCHANGE RATES

Sound level (in dBA)	5-dB Percent	3-dB percent
90	26.9	49.9
85	67.6	85.5

As indicated in Table III–3 the selection of an exchange rate substantially affects the measured noise

exposure. The percentage of miners whose noise exposure would exceed a PEL set at a TWA_8 of 90 dBA (or an $L_{Eq,8}$ of 90 dBA in the case of a 3-dB exchange rate) increases from 26.9% to 49.9% when the exchange rate changes from 5-dB to 3-dB. Looking at the numbers another way, as compared with using a 5-dB exchange rate, using a 3-dB exchange rate would result in the need to utilize engineering or administrative controls to limit the exposure of twice as many miners. Moreover, the engineering controls required would be more expensive since it would take a more stringent control to bring down, to the PEL, exposures that double every 3-dB. The table also reveals that to switch to a 3-dB exchange rate and setting the PEL at an $L_{eq,8}$ of 85 dBA would increase the percentage of miners whose exposure is out of compliance with the PEL from 67.6% to 85.5%.

MSHA has not compiled similar data for coal mining, although the consequences would be similar. Accordingly, MSHA believes that using a 3–dB exchange rate would have significant implications for the U.S. mining industry.

With respect to technological feasibility, it is extremely difficult to reduce the noise exposures to a $L_{eq,8}$ of 90 dBA using currently available engineering or administrative noise controls or a combination thereof. For many pieces of existing equipment it is not practical to apply engineering controls without seriously compromising the equipment's operational capacity.

Accordingly, as discussed in part IV of this preamble, moving the industry to a 3-dB exchange rate may be infeasible at this time.

MSHA believes that the determination of an appropriate exchange rate is one of the more noteworthy issues in the proposed rule. Accordingly, MSHA requests further comment and data on this issue. In particular, MSHA notes that the studies supportive of a 5-dB rate are generally dated, and requests information about any more current study supporting that exchange rate.

A-weighting, slow-response

Proposed § 62.120(a)(3)(iv) requires that the instruments used for measuring noise exposures be set for the A-weighting network and slow-response (exponential time averaging). This is identical to the existing MSHA regulations for exposures to non-impulse/impact noise. OSHA also uses the A-weighting network and the slow-response time for evaluating exposure to noise.

Weighting networks were designed to approximate the response of the human ear to tones of equal loudness. The human ear does not respond to all levels of tones in the same way. At low sound pressure levels (e.g., 50 dB) the ear discriminates against low-frequency and high-frequency tones. At higher sound pressure levels (e.g., 90 dB), the ear no longer discriminates against low- and high-frequency tones. Although the human ear does not discriminate against low-frequency tones at high sound levels, the low-frequency tones are less damaging to hearing than mid-frequency tones.

Several weighting networks have been developed to take these differences into account: known as A, B, and C. Early researchers suggested using them all in combination: 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, concensus has developed on the use of the A-weighting network.

Response time, also known as a time constant, refers to the speed at which the instrument responds to a fluctuating noise.

There are five responses defined in ANSI S1.4–1983, ''Specification for Sound Level Meters''. They are 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. This response was used since it was easier to read the needle deflections on a meter in rapidly fluctuating noise. For this type of noise the needle deflections using the fast response (125 milliseconds) were too difficult for the human eye to follow. ANSI S1.25–1991, ''Specification for Personal Noise Dosimeters'', prescribes only the slow and the fast responses for personal noise dosimeters. Many of the older, but not obsolete, personal noise dosimeters only have the slow response. Furthermore, the slow response was used for characterizing the noise exposure when most damage risk criteria were developed.

Many commenters suggested that MSHA adopt OSHA's instrumentation requirements. This would imply that noise is to be measured on the A-weighting network and the slow response. However, one commenter suggested that MSHA use the fast response for evaluating noise exposure, because ''Use of fast response will result in a more accurate assessment of employee exposure.''

Prior to the adoption of the A-weighting network to evaluate noise exposure, the scientific community used more complex methods (e.g., octave bands and speech interference levels).

ACGIH (1986) reports that:

> * * * Botsford demonstrated that A-weighted levels are as reliable as octave band levels in the prediction of effects on hearing in 80% of the occupational noises considered, and slightly more conservative in 16% of the cases. Passchier-Vermeer and Cohen et al. similarly demonstrated that A-weighted levels provide a reasonable estimate of the hazard to hearing in most industrial environments.

The National Safety Council's Book, *Fundamentals of Industrial Hygiene*, Fourth Edition (Plog et al., 1995) states that:

> The A-weighted sound level measurement has become popular in the assessment of overall noise hazard because it is thought to provide a rating of industrial broadband noises that indicates the injurious effects such noise has on the human ear.

NIOSH (1972) recommended the continued use of the A-weighted sound level measurement in its criteria document for a recommended standard on occupational noise exposure. In this criteria document they state:

> As a result of its simplicity and accuracy in rating hazard to hearing, the A-weighted sound level was adopted as the measure for assessing noise exposure by the American Conference of Governmental Industrial Hygienist (ACGIH) and by Intersociety Committee consisting of representatives from the American Academy of Occupational Medicine, American Academy of Ophthalmology and Otolaryngology, ACGIH, Industrial Hygiene Association, and the Industrial Medical Association. A-weighted sound level measurement was adopted by the U.S. Department of Labor as part of the *Occupational Safety and Health Standards* and by the British Occupational Hygiene Society in its *Hygiene Standards for Wide-Band Noise.*

In reviewing the procedures for exposure measurement in regulations and codes of practice (mandatory or recommended) from the EEC, the ISO, the international community, and selected branches of the U.S. armed services (see Tables III–4 and III–5), MSHA found that there is general agreement among these groups that measurements be taken using the A-weighting network and most agree to use the slow-response instrument settings. ISO 1999 (1990) recommends that if sound level meters are used to measure noise exposure, then the instrument should be set on A-weighted, fast-response. In Australia, integrating sound level meters should be

set to fast-response while other sound level meters should be set to slow-response.

The scientific community and most regulatory entities around the world accept the A-weighting network and slow-response time as appropriate measurement parameters for characterizing noise exposures. These parameters have been used by the U.S. Department of Labor, since the adoption of the Walsh-Healey Public Contracts Act noise regulations of 1969.

Based upon comments and the good correlation between hearing loss and A-weighted noise exposures, MSHA proposes to continue using A-weighting and slow-response when determining a miner's noise exposure.

Action Level

Proposed § 62.120(b) establishes an ''action level'' at a TWA_8 of 85 dBA.

The need for an action level reflects two facts: 1) there is a significant risk of material impairment to miners from a lifetime of exposure to noise at this level; and 2) the Agency believes it may not be feasible at this time to lower the PEL to this level, since that would require that mine operators use all feasible engineering and administrative controls to reduce noise exposures to this level.

The proposal would require that all miners exposed above the action level be provided special instruction in the hazards of noise and protective methods. The training is to be provided annually for as long as exposure exceeds the action level. (The nature of this instruction, how it is to be provided, and how it can be coordinated with other required miner training are subjects discussed in connection with proposed § 62.130.)

If a miner's exposure exceeds the action level but is below the PEL, an operator will also be required to enroll a miner whose exposure exceeds the action level in a hearing conservation program (HCP). While enrollment in the HCP would require the operator to make annual audiometric testing available to the miner, miners exposed to noise below the PEL would have the right to decline taking any annual audiometric testing. MSHA's proposed testing requirements related to the action level are consistent with those of the OSHA HCP. The requirements for such testing are discussed in connection with proposed § 62.140, audiometric testing program.

MSHA is seeking comments on how to minimize the burden on mine operators of providing audiometric examinations for those miners with only a temporary attachment to the mining work force (e.g. summer employees), while recognizing the importance of detecting and tracking hearing loss among those who switch jobs.

In addition, the operator must provide properly fitted hearing protection—before the initial hearing examination, if a significant threshold shift in hearing acuity is detected, and at any other time upon miner request. Should it take more than 6 months to provide the initial hearing examination because of the need to wait for a mobile test van, or should a significant threshold shift in hearing acuity be detected, the operator would also be required to ensure that the miner wears the hearing protection—even if the miner's noise exposure remains under the PEL. (A discussion of the time frames for audiometric tests, and the use of mobile test vans, is included in the discussion of proposed § 62.140, audiometric testing program. The definition of a significant threshold shift is discussed in connection with proposed § 62.160, evaluation of audiogram.)

An action level currently exists under OSHA but would be new to the mining industry. As discussed herein, MSHA proposes to build upon the requirements which have been used by OSHA while giving due regard to implementation approaches appropriate to the circumstances of the mining community.

Comments on Action Level

Several commenters recommended an action level of 85 dBA for triggering the requirements of an HCP.

Many of those who commented in response to MSHA's ANPRM discussed hearing protection and audiometric testing. Some of these comments shed light on the relationship and comparative benefits of these approaches.

Some commenters supported the use of hearing protectors as an integral part of an HCP, while other commenters recommended that hearing protectors be supplied even when not required so as to afford greater protection. Other commenters expressed three common concerns over the use of hearing protectors—

(1) difficulty with speech communication and the masking of warning signals (roof talk, backup alarms, etc.), especially for those miners with a pre-existing hearing loss;

(2) miner acceptance, including comfort; and

(3) personal hygiene.

The latter two issues of miner acceptance and personal hygiene are discussed in detail in the sections of the preamble entitled *Selection of hearing protectors* and *Maintenance of hearing protectors*, respectively (in connection with proposed § 62.125).

Several commenters suggested alternatives for dealing with communication problems associated with the use of hearing protectors by those with a hearing loss or in the presence of background noise. These alternatives included use of a ''buddy'' system, visual warnings, communication headsets, vitro-tactile warning systems, flat-frequency response hearing protectors, and notch-amplification earmuffs.

Many commenters specifically mentioned the problem of miner acceptance of hearing protectors. One of these commenters stated: ''* * * there is anecdotal reporting to suggest that miners resist wearing hearing protective devices.''

One commenter stated: ''Another [usage] problem may be the use of muffs with additional safety equipment, e.g. hard hats and safety glasses, that may be required for use by the miners.'' Other commenters either had no problems with hearing protectors or felt that any problems could be overcome with the proper training.

In addition to the comments received in response to MSHA's ANPRM on this issue, several researchers and organizations have taken a position in regard to the use of hearing protectors.

Shaw (1985) reviewed much of the same literature as OSHA when the 1983 Hearing Conservation Amendment was prepared. Shaw's study supports requiring both hearing protectors and an HCP for exposures exceeding 85 dBA.

In *Communication in Noisy Environments* (Coleman et al., 1984), the authors state that:

> * * * excessive attenuation needs to be minimized and the frequency response of the protector is of particular importance in this respect. * * * (S)everal authors * * * suggest that a protector which passed relatively more low frequencies could increase remote masking and produce potential communication difficulties for some members of the population. This effect has been demonstrated to be of practical significance for coal mining conditions * * * A flat frequency response for a protector is necessary to counter the effect.

Michael (1991) recommends that the hearing protector attenuate the noise with an adequate margin of safety; however, the hearing protector should not unnecessarily reduce important aural communications. To accomplish this goal, the hearing protector's attenuation characteristics should be matched to the noise exposure spectra as close as possible. This way the hearing protector will minimally change

the worker's perception of the noise. Michael also points out that overall noise reduction achieved by a hearing protector can be substantially influenced by the spectra of the noise.

Chiusano et al. (1995) reported that a communication headset, without gain limiters, can expose communication workers to hazardous sound levels. The noise exposures ranged from 79.9 dBA to 103.8 dBA, with the average exposure being 87.0 dBA. Furthermore, the peak sound pressure levels ranged from 119.2 dB to 148.8 dB, with the average being 140.8 dB. Some recommendations presented by the authors to control the noise exposure were to include peak clipping, bandwidth limitations, signal compression, computerized gain control, and improving the signal to noise ratio.

In the *CAOHC Manual*, Miller (1985) states that many authorities consider OSHA's requirement on who must wear hearing protectors to be ''unwieldy.'' This manual states further that ''A more practical and workable approach is to require all workers exposed to levels of 85-dBA or higher to use PHPD's [personal hearing protection devices] regardless of whether the audiograms show an STS.''

According to Suter (1986): ''Because hearing loss may occur in people chronically exposed to levels of 85-dBA and above, it is wise to use protectors that attenuate to 85-dBA in all cases.''

The U.S. Armed Services, as well as the European Economic Community and other foreign countries, require the use of hearing protection when sound levels exceed 85 dBA.

General Discussion of Action Level and Requirements

The Agency has concluded that there is a significant risk of material impairment to miners from a lifetime of exposure to noise at a TWA_8 of 85 dBA. In mining, the first line of defense against risks has always been training. Accordingly, the proposal provides for annual instruction—to enhance awareness of noise risks, operator requirements, and available controls. This training would be required for any miner whose exposure is above the action level.

MSHA's requirements for this training, and a discussion of how it can be coordinated with existing training requirements, are in proposed § 62.130. As discussed below in connection with that section, MSHA received many comments in response to its Advance Notice of Proposed Rulemaking that supported the value of an annual training requirement. Studies have shown that the effectiveness of a hearing protection program is highly dependent on the proper use of hearing protectors and the commitment of both management and employees, and annual training is critical to reinforce both the knowledge and commitment.

The Agency believes it may not be feasible at this time to require mine operators to reduce noise exposures to a TWA_8 of 85 dBA. A detailed discussion on this point can be found in Part IV of this preamble. Thus, for exposures between a TWA_8 of 85 dBA (the action level), and a TWA_8 of 90 dBA (the PEL), the available tools to supplement training are limited to hearing protectors and annual audiometric examinations.

Hearing protectors offer only limited noise protection. As discussed in detail in connection with proposed § 62.125, studies indicate that hearing protectors may provide significantly less than their rated protection under actual mining conditions. Nevertheless, MSHA believes that if hearing protection is properly utilized—that is, if the requirements under proposed § 62.125 are implemented—they generally can be relied on to provide at least 5 dBA attenuation, and thus could realistically protect the majority of miners whose noise exposure falls between the action level and the PEL.

The comments that MSHA received in response to its ANPRM, however, suggest that ensuring the protectors are properly fitted, maintained and utilized may continue to prove difficult—even once the proposed new standards in this regard (see the discussion of proposed § 62.125) are taken into account. For example:

(1) The mining environment presents hazards which require a miner to be aware of his/her surroundings. Many underground miners claim that the use of hearing protectors interferes with their ability to hear warning signals or roof talk. This interference may be particularly pronounced among miners who already have a significant degree of hearing loss, and such miners may justifiably be reluctant to use hearing protectors;

(2) Hearing protectors (earmuffs and earplugs) are difficult to keep clean in the mining environment which can lead to irritation or infection of the ear(s);

(3) Earmuffs are often uncomfortable when worn in hot environments (e.g., surface mines during periods of extreme heat or some deep underground mines);

(4) Hearing protectors experience a degradation of attenuation when moved from their original position. This condition can occur often when hearing protectors are worn by a miner operating vibrating equipment (e.g., pneumatic drills, continuous mining machines, mobile equipment), wearing certain types of personal protective gear (e.g., safety glasses, hardhats, respirators, welder's hood, etc.), or sweating;

(5) The effectiveness of hearing protectors is highly dependent upon proper fit and use by the miner. While the amount of protection afforded by engineering controls can be easily measured, the attenuation of hearing protectors under actual working conditions can only be estimated; and

(6) Generally, hearing protectors are not effective in reducing low frequency noise. As most mining machinery emits predominantly low frequency noise, the use of hearing protectors may have a negligible effect in reducing the overall sound level.

To alleviate these problems, both operators and miners must be committed to working through individual concerns about hearing protection. MSHA believes that the best way to facilitate this process—at exposure levels between the action level and the PEL, and with a few exceptions—is to have operators provide instruction and make suitable hearing protectors available to miners upon request. If protectors are requested, they would have to be provided in accordance with the requirements of § 62.125—i.e. a choice of plug or muff type, properly fitted, maintained, and replaced under certain conditions. An operator would generally not, at such exposure levels, have an obligation to enforce the use of hearing protection. MSHA believes that the combination of knowledge, availability, and properly selected, fit and maintained equipment may be the best way to encourage hearing protector use.

MSHA would require an operator to provide a miner with a hearing protector while awaiting a baseline audiometric examination; but with the exception noted below, the operator would not have to enforce the use of the protector as long as the miner's exposure does not exceed the PEL.

In two cases, however, MSHA proposes to require operators to enforce hearing protector use at exposures below the PEL. The first case would be in the event a miner exposed above the action level has to wait more than 6 months for a baseline audiometric examination. As noted in proposed § 62.140, the baseline examination is normally to take place within 6 months of a determination that a miner is at risk because his or her exposure exceeds the action level; however, the time frame can be extended for an additional 6 months if the operator has to wait for a

mobile test van. In such cases, the miner is exposed to harm for an extended period of time without the benefit of audiometric test data, and MSHA believes it would be appropriate to require protection to be worn. This is the approach taken under OSHA's noise requirements.

In addition, an operator would be obligated to ensure the miner uses provided hearing protection when audiometric examinations indicate a significant threshold shift (STS) in hearing acuity has occurred and the miner's exposure exceeds the action level. (The evaluation of audiograms, and the determination of whether or not there is an STS, is the subject of proposed § 62.160.) MSHA believes that once there is evidence from the tests that the miner is incurring hearing loss, it is appropriate to require that hearing protectors be worn as long as exposure exceeds the action level.

Annual audiometric examinations cost more than providing hearing protection—but as already recognized by many in the mining industry, and all the industries which operate under OSHA's requirements, such examinations provide important information, especially in an environment in which hearing protector use has the problems noted previously. The act of enrolling miners in a ''hearing conservation program'' (HCP) can help emphasize to those individuals that they should pay more attention to the training and available controls. It also helps miner representatives, operators, and MSHA focus available resources on those miners who have actually suffered an STS at lower noise exposures. While MSHA is not proposing to require operators to compel miners to take the annual examinations at exposure levels below the PEL, and expects that many miners may be reluctant to take examinations out of concern about how the information would be used, MSHA anticipates that over time the required training would lead to growing use of such examinations within the mining industry. (MSHA's preliminary RIA assumes only limited participation at such exposure levels during the initial years of the rule's implementation.)

Participation in an HCP

MSHA has no standards addressing hearing conservation plans or programs in its existing metal and nonmetal regulations. However, an indeterminate number of mines have voluntarily established HCP's. MSHA estimates that 5% of small mines, and 20% of large mines, have such programs.

Existing MSHA coal noise standards require mine operators to submit ''* * * a plan for the administration of a continuing, effective hearing conservation program,'' within 60 days following the issuance of a notice of violation [citation] for subjecting a miner to a noise exposure exceeding the PEL. This plan must include provisions for pre-employment and periodic audiograms. The regulation, however, does not specify the procedures nor the time frame for obtaining these audiograms. Additionally, due to coal's policy of considering hearing protector attenuation in determining compliance with the PEL, few miners are found overexposed.

OSHA's noise standard requires that all employees exposed above the action level (TWA_8 of 85 dBA) be enrolled in an HCP. OSHA's HCP requirements include provisions addressing exposure assessment, training, audiometric testing, hearing protectors, notification, and recordkeeping.

Several commenters recommended requiring an HCP whenever a miner's exposure exceeds a TWA_8 of 85 dBA, or equivalently a noise dose of 50%.

Under MSHA's proposal, participation in an HCP would be provided by the mine operator at no cost to the miner. OSHA also specifies that audiometric testing and hearing protectors be provided at no cost to the employees. MSHA intends that the audiometric testing be given during normal working hours (on-site or off-site) and that miners participating in these activities receive wages for the time spent in their involvement. If the audiometric testing is provided off-site, MSHA intends the mine operator to compensate the miners for the additional costs, such as mileage, meals, and lodging, that they may incur.

Elements of an HCP

Some of the elements often considered to be part of an HCP are handled through separate, free-standing requirements under MSHA's proposal. These include hearing protection and training, and an employer's obligation to evaluate the noise to which miners are exposed to determine if specified levels are exceeded. Accordingly, the proposal uses the term HCP to refer essentially to annual audiometric testing and required follow up examinations and actions.

Under OSHA's noise standard, the elements of an HCP include:

(1) monitoring employee noise exposure;

(2) wearing hearing protectors;

(3) education and training; and

(4) audiometric testing and medical evaluation.

In its ANPRM, MSHA requested information concerning the elements which would be appropriate for inclusion in an HCP for mining. MSHA received numerous comments concerning this issue. Of these, many supported MSHA's adoption of HCP requirements similar to OSHA's, including:

> * * * Assessment, monitoring, engineering and/or administrative controls, hearing protective devices, employee education, audiometric testing, interpretation of audiometric tests and follow-up, and appropriate record keeping.

Although there was a consensus among commenters on the elements of an HCP, there was considerable variation in the substantive aspects of these elements. Commenters ranged from wanting more performance oriented requirements to wanting more specific requirements with fewer exceptions than in the existing OSHA rule.

One commenter wanted ''* * * a more stringent program than the present OSHA HCP * * *''. Another felt that no program should be implemented until ''* * * sufficient evidence and testing demonstrates a need for the program to protect the hearing of miners.'' Another commenter believed that audiograms were a needless expense, but that hearing protectors should be required for all miners exposed to hazardous sound levels. Several commenters believed that HCP's were of no value, stating ''Our experience with HCP's indicates they are wasted bureaucratic red tape and present no benefit to the employees.''

''Guidelines for the Conduct of an Occupational Hearing Conservation Program'' (1987) developed by the American Occupational Medical Association's Noise and Hearing Conservation Committee of the Council on Scientific Affairs presents the basic elements of an HCP. They recommend that each program include: (1) measurement of exposure; (2) engineering controls; (3) use of hearing protectors; (4) audiometric testing and medical evaluation; (5) education and training; (6) assessment of program effectiveness; and (7) management support.

MSHA agrees with the majority of the commenters to the ANPRM. However, as noted, MSHA proposes to require some of these elements through free-standing requirements. Accordingly, the proposal uses the term HCP to refer essentially to annual audiometric testing and required follow up examinations and actions. Overall, the requirements of MSHA's proposal are generally

consistent with OSHA's current HCP requirements and with the requirements of the U.S. armed services and the international community.

MSHA reviewed HCPs in effect at a variety of organizations. The HCPs consist mainly of monitoring employee noise exposure, controlling the noise, training employees, and conducting audiometric testing. The Agency believes that when engineering and administrative controls are not able to reduce a miner's exposure to within the PEL, annual audiometric testing and medical evaluation would enable mine operators and miners to take proper precautions to identify early hearing loss and thereby prevent further deterioration of hearing. This is discussed in more detail in those sections of the preamble reviewing the proposed HCP requirements (proposed § 62.140 et. seq.).

Effectiveness of HCP's

Although many commenters to MSHA's ANPRM stated that an HCP is needed, only a few commenters specifically addressed the effectiveness of an HCP.

One commenter referenced a study (ANSI, 1990; Royster and Royster, 1988) which indicated that the HCP at five out of 17 companies, or less than 30%, could be considered effective/adequate. This inadequacy, however, could be attributed to a lack of commitment by the companies in carrying out all of the necessary components of the HCP. This study found that, for the HCP to be successful, it is critical that a single individual have control over the program and its implementation. Furthermore, management must make a commitment to ensure that the program is fully implemented.

Another commenter, representing nonmetal mining companies, indicated that its members have not experienced large numbers of claims for hearing loss and this may be a reflection of program effectiveness.

In addition to the above comments, MSHA reviewed several studies regarding the effectiveness of HCP's. Villeneuve and Caza (1986) reported on the HCP for a Canadian mining company. Under this HCP, miners undergo audiometric evaluations, receive training, and wear hearing protectors. After ten years, the incidence of workers' compensation claims for hearing loss has diminished.

After obtaining audiometric data from three Ontario employers who had HCP's, Abel and Haythornthwaite (1984) investigated the progression of NIHL. Workers for the first employer (public utility) had their maximum hearing loss between 2000 and 6000 Hz. Further, 78% of the workers who reported never wearing their hearing protectors experienced 25 dB of hearing loss at 4000 Hz. For those workers who wore their hearing protectors at least half of the time, 38% had the same degree of hearing loss.

At the second employer (mining company) about half the drillers incurred a hearing loss of 1 dB per year or more at 4000 Hz. Motorman chute blasters incurred an average change of hearing of a little over 1 dB per year. This compares to a hearing loss of 0.5 dB per year for the control group. Further, in subjects who were over 50 years of age, 100%, 88% and 38% of the drillers, the motorman chute blasters, and the controls respectively had a hearing loss that exceeded 25 dB at 4000 Hz.

Finally, workers at a foundry and steel mill showed a 0.13 dB per year hearing loss at 1000 Hz and 1.3 dB per year at 4000 Hz. Their hearing loss was similar to the miners.

Abel (1986) reported on the progression of NIHL among three groups of workers, including miners. All noise-exposed workers had exposures exceeding 85 dBA and were enrolled in an HCP. One requirement of the HCP was mandatory use of hearing protectors. At 4000 Hz, the noise-exposed workers lost their hearing acuity at 1.5 dB per year compared to 0.5 dB per year for the control group, who were office workers.

Despite mandatory use of hearing protectors, most workers in the Abel 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 had a deleterious effect on the attenuation.

Gosztonyi (1975) reported on his evaluation of an HCP at a large manufacturing plant. The study covered a 5-year period (1969–1974) shortly after the passage of the Walsh-Healey Public Contracts Act noise regulations. The study covered 213 employees with a median age of 43 years. The workers were divided into three groups based on their noise exposure. These were: (1) 71 office workers exposed to sound levels of 50 to 70 dBA; (2) 71 workers in the machine shop exposed to sound levels of 80 to 85 dBA; and (3) 71 workers (wearing hearing protectors) in the chipping and grinding areas of the iron and steel foundry exposed to sound levels of 100 to 110 dBA. Gosztonyi found that, over a 5-year period, the hearing loss incurred by workers in group (3) were no greater than the losses exhibited by the other groups at each frequency, regardless of the baseline hearing thresholds. He concluded that an HCP (consisting of periodic noise exposure assessments, annual audiometric testing, and the mandatory use of hearing protectors) instituted when noise exposures exceed a hearing conservation criterion of approximately 90 dBA adequately protects the hearing of noise-exposed workers.

Pell and Dear (1989) reported the following:

> Two longitudinal studies of changes in hearing threshold levels and one study of the prevalence of hearing impairment in noise exposed and non-exposed workers have clearly indicated that DuPont's hearing conservation program has been effective in preventing occupationally noise-induced hearing loss [NIHL].

Several reports on the effectiveness of DuPont's HCP have been published. DuPont's HCP requires the wearing of hearing protectors in high noise areas, audiometric testing, and monitoring of noise exposure. In the first study Pell (1972) showed, via a retrospective study, that the hearing of workers was being protected. The hearing levels of workers in high noise areas were compared to the hearing levels of workers in quieter areas (below approximately 90 dBA). Both groups of workers had comparable hearing levels at frequencies between 500 and 2000 Hz. At higher frequencies the median hearing level of quieter area workers was slightly better than the median hearing level of high noise area workers. Although the differences were statistically significant, the author believed that the small differences lacked practical importance. Moreover, the difference was much less than the hearing loss which occurred due to presbycusis and other non-occupational factors. Comparing the results to a study published by Nixon and Glorig (1961) on unprotected workers, Pell concluded that the DuPont workers experienced much less hearing loss.

Later, Pell (1973) published the initial results of a 5-year longitudinal study on the same workers. The sound level to which workers were exposed in the quiet areas could approach 90 dBA, but most exposures were between 50 and 70 dBA. The workers in the highest noise areas were required to wear hearing protectors and most of the workers in the moderate noise areas chose to wear hearing protectors. A comparison of workers' hearing levels at 3000, 4000, and 6000 Hz revealed that there was no increased hearing loss among workers who wore hearing protectors in high noise areas versus the workers in the quiet areas. The researcher concluded that:

The analysis of changes in hearing threshold levels over a 5-year period has clearly indicated that persons who work in areas where noise levels (sound levels) exceeded 90 dBA showed hearing losses that were no greater than those experienced by persons who worked in areas where the noise levels (sound levels) were less than 90 dBA. It is evident, therefore, that a hearing conservation program in which the hearing conservation criterion is approximately 90 dBA can successfully protect the hearing of noise-exposed workers.

Pell believed that his study confirmed the earlier conclusion that DuPont's HCP was effective in preventing occupational hearing loss. Pell emphasized, however, that this study cannot reveal the effects of these sound levels on hearing acuity but is intended only to evaluate the effectiveness of the HCP. The third study is a continuation of the second study. In this study, Pell and Dear (1988) evaluated the effectiveness of DuPont's HCP over 20 years. However, the study did not involve the same workers over the entire time frame for many reasons. Furthermore, the researchers divided the workers into three categories: workers exposed to noise under 85 dBA; between 85 to 94 dBA; and 95 dBA or higher. The mean differences, over a 3-year period between workers in noisy (over 85 dBA and wearing hearing protectors) and quiet areas, were small. Evaluating the prevalence of hearing impairment using the AAO–HNS 1979 definition showed that the high noise areas had slightly higher prevalence rates of hearing impairment. After adjusting for presbycusis, only 7.1% of the workers in the high noise areas developed a hearing impairment. Pell and Dear concluded that presbycusis was by far the major factor in developing a hearing impairment. Furthermore, independent clinical evaluations of the non-presbycusis cases revealed that socioeconomic factors, (e.g., differences in off-the-job noise exposures and otological disease), may account for much of the excess hearing impairment of the noise-exposed workers. Pell and Dear attributed the effectiveness of DuPont's HCP to educating the workers to the hazards of noise, hearing protector fitting, and supervision. Because of these components, DuPont workers received greater noise reduction from foam earplugs than did workers in other industries. Pell and Dear believe that effective use of hearing protectors is the overwhelming factor in approaching avoidance of problem hearing loss. In addition, Pell and Dear believe that employees exposed above 90 dBA are better protected by using appropriate hearing protectors rather than implementing engineering controls to reduce the noise to 89 dBA or even 84 dBA.

Savell and Toothman (1987) studied the HCP at a factory. The workers whose time-weighted average noise exposures ranged from 86 to 103 dBA were required to wear hearing protectors as a condition of employment which was strictly enforced. These workers were employed between 8 and 12 years. Only the employees with more than 25 months off the job during the course of the study were excluded in order to obtain a large sample (265 workers). The group mean hearing levels from the latest audiograms were compared to the initial audiograms. Savell and Toothman did not find any significant change in hearing acuity over the course of the study. Therefore, they concluded that mandatory use of hearing protectors in an HCP can protect the hearing acuity of workers.

Bruhl and Ivarsson (1994) conducted a longitudinal study of the HCP at an automobile stamping plant over a 15-year period. The researchers evaluated workers' hearing levels over the frequency range of 2000 to 8000 Hz. Workers' hearing levels were compared to the hearing levels of a ''highly screened'' non-noise exposed male population. For sheet metal workers, the HCP reduced the noise-induced permanent threshold shift. Bruhl and Ivarsson concluded that the HCP, which included effective use of hearing protectors and reduction of sound levels, can eliminate occupational NIHL.

Franks et al. (1989) examined the hearing conservation records of a large printing company with multiple facilities. They examined the records for factors associated with the development of an STS. Franks et al. indicated that ''* * * statistically significant factors associated with Standard Threshold Shift [STS] were from medical and non-occupational noise exposure histories, and not occupational noise exposure.'' In other words, the HCP was effective since the hearing loss developed by the workers was from non-occupational exposures.

Moretz (1990), reporting on the work of the ANSI S12.12 working group, stated that ''A pilot analysis of industry's audiometric data found that fewer than 20 percent of the programs [HCP's] are effective.'' Moretz further reported that Alice Suter, a member of this ANSI working group, had stated that ''the actual percentage of companies with effective programs is probably even lower * * *,'' because the ANSI working group had looked at data from relatively large companies. Suter thought that smaller companies are less likely to have the resources necessary to operate an effective HCP.

The National Institutes of Health (NIH), in its Consensus Statement on Noise and Hearing Loss (1990), states that ''many existing hearing conservation programs remain ineffective due to poor organization and inadequately trained program staff.''

Although evidence indicates that a properly supervised and operated HCP can provide effective protection, in many instances, HCP's have failed due to the lack of necessary supervision and adherence to proper procedures and principles. Furthermore, the studies which showed HCP's to be effective were mainly of short term durations (five years or less). There is a lack of evidence that long term HCP's protect the hearing acuity of workers. Pell and Dear's 20 year study (1988) was in actuality two shorter longitudinal studies covering a five-year period at the beginning of the study and a three-year period at the end. In both of these shorter studies the hearing level of the participants did not change at a rate different from the non-noise exposed controls.

The two other long-term studies, Bruhl and Ivarsson (1994) and Bruhl et al. (1994) demonstrated that HCP's were effective in reducing noise-induced permanent threshold shift. At the plant both engineering noise control and hearing protectors were utilized to reduce worker's exposure to noise. Therefore, these studies indicate engineering noise control is a necessary component of an effective long-term HCP.

Rink (1996) studied the hearing loss of workers enrolled in HCPs. Between 1991 and 1995 nearly 590,000 audiograms were given. During the years the percentage of STSs decreased each year—from 4.69% to 1.22%. Further, Rink reported that about 50% of the STS consistent with noise exposure were persistent (confirmed STSs). The remainder were not permanent. Rink concluded that aggressively adhering to and enforcing the hearing conservation policies proposed by OSHA in 1983 can reduce and effectively control NIHL.

Many of the above studies indicate that an HCP can be effective in preventing hearing loss, but only if management and workers strictly adhere to its requirements. Several of these studies also concluded that engineering controls were a necessary part of an effective HCP. This is not inconsistent with MSHA's conclusions about the

importance of commitment by both operators and miners.

Evaluation of HCP Effectiveness

MSHA has not included a methodology or a requirement for mine operators to test the effectiveness of their HCP's. Currently, both MSHA's Coal and OSHA's noise standards require an effective HCP, but do not specify a procedure for evaluating the effectiveness of the program. Further, Metal and Nonmetal's noise standard has no requirement for an HCP.

In its ANPRM, MSHA also requested information concerning appropriate methods or requirements for evaluating the effectiveness of HCP's. One commenter felt that evaluation criteria are unnecessary and that the HCP is effective if exposures are reduced. Another commenter stated that uniform evaluation criteria have not been adopted. Another suggested that NIOSH be given the task of evaluating the effectiveness of HCP's for the mining industry.

A number of commenters believed that it was essential for MSHA to address procedures for evaluating the effectiveness of HCP's. Several of these commenters suggested that MSHA monitor the activities of the ANSI S12.12 Working Group for Evaluation of HCP's and consider using the guidelines established by this group, once they were finalized. ANSI has published a draft standard, ANSI S12.13–1991 Audiometric Database Analysis (ADBA), which describes techniques for evaluating the effectiveness of the HCP's.

Adera et al. (1993) studied the effect of using ADBA to determine the effectiveness of a utility company's HCP which had 2,317 participants. The hearing acuity of the utility workers was compared to the hearing acuity of tobacco company employees (control population). The tobacco company employees were one of the control populations used in developing the draft ANSI standard S12.13–1991. The control population's noise exposure was approximately 87 dBA and they wore hearing protectors consistently. While the ADBA method deemed the HCP acceptable, epidemiological techniques showed the workers to be at risk of developing a hearing loss. The age-adjusted risk of developing a hearing loss was 2.3 times that of the control population.

Simpson, Stewart, and Hecksel (1992) studied HCP's at 28 small companies representing 2,183 employees of which 865 qualified for ANSI analysis. The researchers concluded that companies with less than 100 employees may have difficulty in meeting ANSI S12.13–1991 data requirements for more than two consecutive years of data analyses due to employee turnover and absenteeism. Sample sizes smaller than 30 employees are likely to be more sensitive to outlier scores. Smaller sample sizes were also more likely to be rated marginal or unacceptable due to biasing effects of sample size. For 1990, the percent of STS's ranged from 0% to 3.8% at the individual plants. The rate of STS's across all 28 plants was 1.5%.

Simpson, Stewart and Kaltenbach (1994) investigated early indicators of HCP performance. A total of 27,047 employees (3,245 controls and 23,802 subjects) in 21 HCP's were included in the study. The rate of STS in the control groups ranged from 2.5 to 5.7% while the exposed groups had a rate between 4.6 and 28%. Comparing the incidence of STS's with ANSI S12.13–1991 indicators, the researchers concluded that the incidence of STS's was as good as the ANSI test criteria as an early indicator of the effectiveness of an HCP from the first two audiograms.

NIOSH (1995) recommended a simple method of determining the effectiveness of an HCP. According to NIOSH, if less than 5% (1 out of 20) of the noise-exposed workers enrolled in an HCP incur an occupationally-induced STS, the HCP is deemed effective. According to NIOSH, this method should be used to continually monitor the results of audiometric testing to indicate the effectiveness of the HCP before many individuals incur permanent shifts in hearing acuity.

While MSHA recognizes that the ADBA technique may be promising, the Agency is concerned that it may not be practical for the majority of mine operators. The ADBA technique may not be applied reliably to populations of fewer than 30 individuals and about 90% of the 15,000 mines under MSHA's jurisdiction employ less than 30 miners. Even if every miner was placed in an HCP, regardless of noise exposure, less than 10% of the mines could consider using the ANSI draft ADBA procedures to evaluate their HCP. ADBA analysis also may not be appropriate if the workforce being analyzed is not stable, exhibiting a high turnover rate. MSHA has determined that this may be the case for many small mines which operate seasonally, are portable, or change geographic locations. Currently, the annual turnover rate in mining ranges from 2% in large coal mines to 11% in small metal and nonmetal mines.

In addition, ADBA requires several years of data before the analysis can be conducted. Consequently, ADBA cannot be used to immediately determine the effectiveness of an HCP unless audiograms were collected prior to the effective date of the rule.

Finally, existing procedures for conducting ADBA call for the use of audiograms taken without observing a quiet period. Both OSHA's existing standard and this proposal require a 14-hour quiet period before conducting a baseline audiogram. These standards, however, do not address a quiet period for annual audiograms, leaving the choice to the employer or the mine operator. Consequently, where a quiet period is used, those audiograms could not be used in conducting ADBA.

MSHA also is concerned that the statistical methods employed by ADBA require the use of a computer, which many small mine operators may not have. Consequently, many mine operators may need to employ outside consultants to conduct this analysis. Because the ADBA techniques are relatively new, a sufficient number of consultants, who fully understand and can utilize this analytical technique, may not be available. Despite the problems with ADBA analysis for the mining industry, MSHA recognizes that it may be a valuable tool for identifying and correcting problems in an HCP before an STS occurs. MSHA does not wish to discourage mine operators from using this technique.

The analysis of an HCP's effectiveness can be as simple as comparing a current audiogram with prior audiograms. This simple approach, however, can be extremely time consuming and may not identify trends among miners.

Further, international communities and selected branches of the U.S. armed services require the effectiveness of the HCP's to be evaluated even though they do not include specific methods for the evaluation.

MSHA, however, is not specifying a methodology to determine the effectiveness of an HCP for several reasons. First, there is not a consensus among researchers and commenters as to a method even though a draft ANSI standard (ADBA) has been published on this issue. Secondly, the techniques for evaluating the effectiveness of an HCP that have been developed are not appropriate to an HCP with few participants. MSHA estimates that most HCP's in the mining industry would not have a sufficient number of participants to be tested. Further, MSHA contends that there are few consultants and fewer mine operators with the expertise to evaluate the effectiveness of an HCP.

MSHA requests specific suggestions on practical methods which could be used in the mining industry, particularly among small mine

operators, to evaluate the effectiveness of HCP's. MSHA also requests comments on NIOSH's above stated recommendations.

Temporary or Seasonal Miners

The proposal would not provide any exemption from the requirements to provide audiometric examinations for temporary or seasonal miners.

OSHA has no such explicit requirement. Moreover to create such an exemption would mean that workers who change jobs—within a single industry, or between industries—might end up never having a check on hearing loss even if working in very noisy conditions.

The proposal does include certain provisions that might in practice exclude some miners from examinations otherwise required. A mine operator has up to 6 months to conduct a baseline audiogram—up to 12 months if a mobile van is used. Thus in practice, the operator's obligation to provide examinations does not extend to those miners who leave employment before this time and who do not subsequently return to work for the same operator. Many summer employees might fall into this category.

MSHA solicits further comment on this issue.

Permissible Exposure Level (PEL)

Proposed § 62.120(c) provides as follows:

No miner shall be exposed to noise in excess of a TWA_8 of 90 dBA (PEL) during any workshift, or equivalently a dose of 100%.

(1) If a miner's noise exposure exceeds the PEL, the operator shall, in addition to taking the actions required under paragraph (b) of this section, use all feasible engineering and administrative controls to reduce the miner's noise exposure to the PEL. When administrative controls are used to reduce a miner's exposure, the operator shall post these procedures on the mine bulletin board and provide a copy to affected miners.

(2) If a miner's noise exposure exceeds the PEL despite the use of the controls required by paragraph (c)(1) of this section, the operator shall take the actions required by this paragraph for that miner.

(i) The operator shall use the controls required by paragraph (c)(1) of this section to reduce the miner's noise exposure to as low a level as is feasible.

(ii) The operator shall ensure that a miner whose exposure exceeds the PEL takes the hearing examinations offered through enrollment in the hearing conservation program.

(iii) The operator shall provide hearing protection to a miner whose exposure exceeds the PEL and shall ensure the use thereof. The hearing protection shall be provided and used in accordance with the requirements of § 62.125.

This paragraph would establish the permissible exposure limit (PEL) to noise for a miner as a TWA_8 of 90 dBA during any workshift. (This is also referred to as a dose measurement of 100%; the action level TWA_8 of 85 dBA is half this dose of noise.)

The PEL is a time-weighted average sound level to which a miner may be exposed that establishes the maximum dose of noise permitted. Under the proposal, this is established as a TWA_8 of 90 dBA—the same as at present. TWA_8 refers to a time-weighted-8-hour average, a term defined in proposed § 62.110. The exposure needed to reach the PEL varies by sound level and time. For example, the PEL would be reached as a result of exposure to a sound level of 90 dBA for 8 hours, but also reached by exposure to a sound level of 95 dBA for only 4 hours or 92 dBA for 6.1 hours.

The Agency considered proposing a different PEL. As noted in part II of the preamble, MSHA has concluded that there is a significant risk of material impairment from noise exposures at or above a TWA_8 of 85 dBA. MSHA considered setting the PEL at this level, but as discussed in part IV of this preamble believes that this may not be feasible at this time for the mining industry. Accordingly, the Agency is proposing to keep the PEL at a TWA_8 of 90 dBA—the level in effect for the mining industry and under OSHA. The PEL is a dose twice that which would be received at the level at which there is a significant risk of material impairment.

While the PEL would not change, the actions required if noise exposure exceeds the PEL would in many cases be different from those currently required.

Under the proposal, a hierarchy of controls is established for all mines. Mine operators must first utilize all feasible engineering and administrative controls to reduce sound levels to the PEL. This approach is more consistent with MSHA's existing noise standards for metal and nonmetal mines than for coal mines. Under the current metal and nonmetal regulations, mine operators have to utilize either engineering or administrative controls to reduce noise to the PEL or as close thereto as feasible. In the coal industry, MSHA inspectors do not cite for noise without first deducting the attenuating value of hearing protectors being worn by the miners subjected to excessive exposures of noise. In practice, this means personal protective equipment is in most cases accepted as a substitute for engineering and administrative controls.

As under the present standards, the proposal would require a mine operator to use only such engineering controls as are technologically feasible, and to use only such engineering and administrative controls as are economically feasible for that mine operator.

Moreover, the proposed rule spells out explicit requirements that will supplement these controls in those cases in which the Agency concurs with a mine operator that the use of all feasible engineering and administrative controls cannot reduce noise to the PEL. All sectors of the mining industry will, in such cases, have to provide all miners exposed above the PEL with a properly fitting hearing protector, ensure the miners use those protectors, and ensure that miners take their annual hearing examinations.

Existing Standards

MSHA's existing metal and nonmetal noise standards require the use of feasible engineering and administrative controls when a miner's noise exposure exceeds the PEL. Hearing protectors are also required if the exposure cannot be reduced to within the PEL. The existing metal and nonmetal standards do not, however, 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 noise practices for coal mines are significantly different from those for metal and nonmetal mines. The difference stems from 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—when MSHA measures an exposure at a TWA_8 of 90 dBA. But in coal mines, a citation is not issued in such a case if the miners are wearing hearing protection judged to be appropriate. The appropriateness is based on the EPA noise reduction rating minus 7 dB; in practice, most hearing protectors have ratings which meet this official test for many coal mine exposures. Accordingly, citations are seldom issued.

When coal mine operators do receive a citation for a miner's noise exposure exceeding the PEL, they are required to promptly institute administrative and/or engineering controls to assure compliance. Additionally, within 60 days of receiving a citation, coal mine operators are required to submit to MSHA a plan for the administration of a continuing, effective hearing conservation program, including provisions for—

(1) Reducing environmental noise levels;

(2) Making personal ear protective devices available to miners;

(3) Conducting pre-placement and periodic audiograms; and,

(4) Instituting engineering and administrative controls to ensure compliance with the standard (underground only).

With regard to MSHA's existing noise standard, the Federal Mine Safety and Health Review Commission (Commission) has addressed the issue of what MSHA must consider, when determining what is a feasible noise control for enforcement purposes, at a particular mine. According to the Commission, a control is considered feasible when: (1) the control reduces exposure, (2) the control is economically achievable, and (3) the control is technologically achievable. See *Secretary of Labor* v. *Callanan Industries, Inc.*, 5 FMSHRC 1900 (1983), and *Secretary of Labor* v. *A. H. Smith,* 6 FMSHRC 199 (1984).

In determining technological feasibility of a regulation, 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 economic feasibility, 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. 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. *Todilto Exploration and Development Corporation* v. *Secretary of Labor,* 5 FMSHRC 1894 (1983). No guidance has been provided by the Commission as to what level of reduction is considered significant. However, the Commission has 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.

Consistent with the case law, MSHA considers three factors in determining whether engineering controls are feasible at a particular mine: first, the nature and extent of the overexposure; second, the demonstrated effectiveness of available technology; and third, whether the committed resources are wholly out of proportion to the expected results. Before a violation of these requirements of the standard could be found, MSHA would have to determine that a worker has been overexposed; that administrative or engineering controls are feasible; and that the mine operator failed to install or maintain such controls. (See also the discussion of enforcement policy in the last of the Questions and Answers in part I.)

OSHA's PEL is a TWA_8 of 90 dBA, computed using a 90 dBA threshold. The standard requires the use of feasible engineering or administrative controls when a citation for exceeding the PEL is issued. Under OSHA policy (CPL 2.45A CH–12), however, if an effective HCP is in place, no STS has been detected, and adequate hearing protectors are utilized, no citation will be issued for noise exposures up to a TWA_8 of 100 dBA if the costs to implement the HCP are less than those of engineering or administrative controls. In determining the appropriateness of hearing protection for this purpose, OSHA reduces the EPA rating by 7; but it then further reduces effectiveness by halving the result of that calculation. (A more detailed discussion of hearing protector derating approaches can be found in the section on *Hearing Protector Effectiveness,* part of the discussion of proposed § 62.125.)

Comments and Studies on PEL

Several commenters to MSHA's ANPRM recommended a PEL of 85 dBA. One of these stated the following:

> The current PEL provides inadequate protection for miner's hearing. The 90 dB(A) PEL is excessive and permits noise exposure that will result in significant hearing loss among exposed miners. Specifically, 21 to 29% of workers exposed to 90 dBA for 40 years will suffer material impairment of hearing. Material impairment of hearing, defined by OSHA in this case, is 25 dBA or more loss for the frequencies 1, 2, and 3 kHz. Based on this risk of damage, OSHA adopted a hearing conservation program that is required when noise exposure reaches 85 dBA TWA.

Another of these commenters recommended a PEL of 85 dBA with an 80 dBA action level. This commenter stated that:

> Both OSHA and the National Institute for Occupational Safety and Health (NIOSH) have recommended a PEL of 85 dBA. This level seems to be an appropriate PEL for mining as well, since the numbers of miners with hearing loss continues to be a problem. Obviously a more conservative approach would be to utilize 80 dBA as the action level to trigger the implementation provisions of an HCP. Although more costly, the benefits for prevention of NIHL would certainly be substantial.

Many commenters on this issue, however, believe that MSHA's current PEL of 90 dBA should be retained and that it is adequate to protect miners. One commenter referenced Bartsch (see *Related Studies* in the III. Nature of the Hazard section of this preamble) as supporting evidence for retaining the PEL of 90 dBA. Three commenters cited lack of compensable noise-induced hearing loss (NIHL) cases among miners in their geographical area as a positive indication that the current PEL is adequate and they questioned the benefit of reducing the PEL to 85 dBA. These commenters also stated that about 20% of the miners in their area were exposed to average sound levels above 85 dBA, but under 90 dBA.

In addition to the comments received in response to its ANPRM, MSHA also reviewed numerous studies and standards relating to the establishment of a PEL.

The Physical Agents Threshold Limit Value Committee of American Conference of Governmental Industrial Hygienists (ACGIH) (1993) has adopted a Threshold Limit Value (TLV) of 85 dBA $L_{eq,8}$. The committee believed that there was a clear consensus that an 85 dBA TLV was valid and needed to protect the hearing acuity of workers at the higher audiometric frequencies of 3000 and 4000 Hz.

Stekelenburg (1982) suggests that 80 dBA be the acceptable level for noise exposure over a 40 year work history. Moreover, the researcher suggests that extra precautions are necessary for sensitive individuals and that these people need to be identified during the first five years of exposure to noise.

Embleton (1994) summarized the occupational noise regulations (pertaining to: PEL, exchange rate, and the upper limit for noise exposure) from 17 countries and selected branches of the U.S. armed services. His summary table (absent the recommendations in his report) is reproduced below as Table III–4.

TABLE III–4.—SOME FEATURES OF LEGISLATION TABULATED FOR VARIOUS COUNTRIES*

Country (jurisdiction)	L_{Aeq} 8-hour exposure rate	Exchange rate	Limit for engineering or administrative controls	Limit for monitoring hearing	Upper limit for sound level
Australia (varies by state)	85 dB	3 dB	85 dBA	85 dBA	140 dB lin, peak.
Brazil	85 dB	5 dB	90 dBA, no exposure >115 dBA if no protection.	85 dBA	130 dB peak.
Canada:					
(Federal)	87 dB	3 dB	87 dB	84 dBA	140 dB peak.
(ON, QU, NB)	90 dB	5 dB	90 dBA	85 dBA (a).	
(AB, NS, NF)	85 dB	5 dB	85 dBA		
(BC)	90 dB	3 dB	90 dBA		
China	70–90	3 dB			115 dBA.
Finland	85 dB	3 dB	85 dB		
France (b)	85 dB	3 dB	90 dBA or 140 dB peak	85 dBA	135 dB peak.
Germany (b), (c)	85 dB	3 dB	90 dBA	85 dBA	140 dB peak.
Hungary	85 dB	3 dB	90 dBA		125 dBA or 140 dB peak.
Israel	85 dB 5 dB			115 dBA or 140 dB peak..	
Italy	85 dB	3 dB	90 dB	85 dB	140 dB peak.
Netherlands	80 dB	3 dB	85 dB	140 dB peak..	
New Zealand	85 dB	3 dB	85 dBA +3 dB exchange rate.	115 dBA slow or 140 dB peak..	
Norway	85 dB	3 dB		80 dBA	110 dBA.
Spain	85 dB	3 dB	90 dBA	80 dBA	140 dB peak.
Sweden	85 dB	3 dB	90 dBA	80 dBA	115 dBA or 140 dBC.
United Kingdom	85 dB	3 dB	90 dBA	85 dBA	140 dB peak.
USA (d)	90 dB (TWA_8)	5 dB	90 dBA but no exposure >115 dBA.	85 dBA	115 dBA or 140 dB peak.
USA Army and Air Force)	84 dB	3 dB		85 dBA	140 dB peak.

*Embleton (1994).
Information for countries not represented by Member Societies participating in the Working Party is taken from Ref. 15.
(a) A more complex situation is simplified to fit this tabulation.
(b) These countries require the noise declaration of machinery, the use of the quietest machinery where reasonably possible, and reduced reflection of noise in the building, regardless of sound or exposure levels.
(c) The noise exposure consists of L_{Aeq} and adjustments for tonal character and impulsiveness.
(d) TWA is Time Weighted Average. The regulations in the U.S. are unusually complex because different thresholds are used to compute levels to initiate hearing programs (85 dBA), noise exposure monitoring (80 dBA), and noise reduction measures (90 dBA), each using a 5-dB exchange rate.

Embleton included recommendations based upon current practice taken from the various jurisdictions:

L_{Aeq} 8-hour exposure rate	Exchange rate	Limit for engineering or administrative controls	Limit for monitoring hearing	Upper limit for sound level
85 dBA	3 dBA	Use quietest machines and room absorption in workplaces.	On hiring and at intervals thereafter	140 dB peak.

He stated that:

The primary goal of this report and its recommendations is to reduce the risk of long term hearing damage and expose people to a practical minimum. . . . Each feature recommended had been considered to be practicable by at least one national jurisdiction and there may be some experience of its usefulness. Much current legislation was enacted several years ago, before the more recent scientific evidence was available and before it was integrated into current understanding of this complex scientific topic.

The U.S. armed services and possibly some international communities do not go through a public rulemaking process in establishing their respective noise regulations. Nevertheless, MSHA has included these sources to show that a consensus exists on noise legislation. Table III–5 lists information similar to that included in Table III–4 for several additional entities. Furthermore, there was a discrepancy found in Table III–4 as per the information provided for the U.S. armed services. The corrected information is included in Table III–5 (compiled by MSHA).

TABLE III–5.—FEATURES OF NOISE EXPOSURE CRITERIA FOR ADDITIONAL ENTITIES

Country or jurisdiction	L_{Aeq} 8-hour exposure rate	Exchange rate	Limit for engineering or administrative controls	Limit for monitoring hearing	Upper limit for sound level
American Conference of Governmental Industrial Hygienists (ACGIH).	85 dBA	3–dB		85 dBA	140 dBC peak.

TABLE III–5.—FEATURES OF NOISE EXPOSURE CRITERIA FOR ADDITIONAL ENTITIES—Continued

Country or jurisdiction	L_{Aeq} 8-hour exposure rate	Exchange rate	Limit for exgineering or administrative controls	Limit for monitoring hearing	Upper limit for sound level
European Economic Community (EEC)	85 dBA	3–dB	90 dBA	85 dBA	140 dB peak.
South Africa	85 dBA	3–dB	85 dBA	85 dBA	115 dBA or 150 dB.
U.S. Air Force	85 dBA	3–dB	85 dBA	85 dBA	115 dBA or 140 dB.
U.S. Army	85 dBA	3–dB	85 dBA	85 dBA	140 dB.
U.S. Navy	84 dBA	4–dB	84 dBA	84 dBA	140 dB.
State of Western Australia	90 dBA	3–dB	90 dBA		140 dB.

Because the information contained in Tables III–4 and III–5 does not include every jurisdiction, MSHA solicits additional information on features of noise legislation for comparison purposes.

Hierarchy of Controls

The proposal would require mine operators to use all feasible engineering or administrative controls or a combination of these controls to reduce a miner's daily noise exposure to the PEL. If these controls do not reduce the exposure to the PEL, then they shall be used to reduce the exposure as low as feasible. The proposal does not place preference on the use of engineering controls over administrative controls; but all feasible controls of both types must be implemented to reduce noise exposure to the PEL or as close thereto as is possible when all feasible controls are utilized.

MSHA's proposed requirements for either feasible engineering or administrative controls or a combination of these controls are closer to MSHA's existing noise standards for metal and nonmetal mines than to the standards for coal mines.

In metal and nonmetal mines, engineering or administrative controls are required to the extent feasible when exposures exceed a TWA_8 of 90 dBA. Current metal and nonmetal enforcement requirements equate engineering and administrative controls and do not accept hearing protectors in lieu of such controls. Mine operators in these industries, which have a significant percentage of small employers, generally opt to use engineering controls over administrative controls, citing practical difficulties with the implementation of the latter. 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 having lower sound levels, rescheduling of tasks, and modifying work activities.

The hierarchy of noise control for coal mines is significantly different. In determining whether the mine operator is in violation of the PEL, MSHA deducts from noise exposure measurements the corrected attenuation of hearing protectors being worn by the miners. Given normal conditions in these mines, when hearing protectors are being worn, no citation is issued.

OSHA's standard requires the use of feasible engineering or administrative controls. As discussed above, however, current OSHA policy allows employers to rely on a combination of other controls—enrollment in an HCP, no STS, and adequate hearing protectors (measured in accordance with specifications adjusted for the purpose of the policy)—up to a noise exposure of 100 dBA, provided that the cost is less than that of the engineering and/or administrative controls.

A number of commenters responding to MSHA's ANPRM, specifically supported the primacy of engineering controls. One commenter supported the primacy of engineering controls citing anecdotal evidence that miners resist wearing hearing protectors. Another commenter stated that engineering controls for mining are far more available than commonly thought.

Several commenters stated that administrative controls can be effective but are often impractical. One commenter stated that administrative controls are effective but are of limited use at small operations because there are not enough people to rotate through the various jobs. Another commenter stated that although the use of administrative controls may lower the exposure of an individual miner such controls have the disadvantage of increasing overall exposure to a larger population. A third commenter stated that administrative controls should be the least preferred control method.

A significant number of commenters specifically requested that MSHA allow the use of hearing protectors in lieu of engineering or administrative controls, as long as the hearing protector provided adequate attenuation. These commenters believed that hearing protectors were equally as effective as engineering and administrative controls.

Many commenters recommended that MSHA allow the mine operator a choice or combination of controls, including the use of an HCP. Several commenters stated the following:

> There is no logical reason to handcuff operators by limiting flexibility and freedom of choice in selecting the most appropriate method of noise protection for the particular application; providing, of course, the method is effective.
>
> For some reason HPD's (hearing protection devices) have been regulated to be a third class behind administrative, and engineering controls. It is our experience the HPD's provide more effective, less costly, and more reliable protection than engineering or administrative controls in many circumstances. The employee acceptance is also good to excellent. Therefore the discrimination against HPD's should be removed in any future regulations.

Dear (1987) contends that employers can manage the risk of hearing impairment by encouraging all employees to participate in the HCP and that an HCP can be as effective, in many cases, as the use of other, more costly controls. He believes that some workers are better served by wearing hearing protectors than reducing the noise via engineering controls to the PEL. He contends that removing the hearing protectors when the sound levels are reduced to 90 dBA [by engineering controls] would expose workers to at least 90 dBA; whereas, use of hearing protectors would reduce exposures much lower. Dear cites studies conducted by DuPont on their employees to show the effectiveness of hearing protectors. Employees in the DuPont HCP, which includes hearing protectors and begins at approximately 90 dBA, had not developed hearing impairment during the study period.

Pell and Dear (1988) believe that employees exposed above 90 dBA are better protected by using appropriate hearing protectors, rather than implementing engineering controls to

reduce the noise to 89 dBA or even 84 dBA.

Berger (1983) states the following regarding engineering controls versus hearing protectors:

> When one compares engineering noise controls to HPDs [hearing protectors], it must be remembered that the same types of problems which afflict HPD performance in the RW [real world], will tend to reduce the effectiveness of noise control measures as well. For example, one of the most commonly used treatments is an enclosure. If it is not well fitted, or left partially ajar, or circumvented by an inconvenienced employee, or its gaskets and seals age, deteriorate, or break in any way, then its performance will be degraded in a manner similar to that which has been observed for poorly fitted and misused HPDs. When noise control is achieved by improved adjustments and lubrication, there must be a trained and dedicated employee to monitor the maintenance schedule, just as employees must care for and maintain their HPDs. In fact most engineering noise control procedures, except for some source noise control accomplished through equipment redesign, require maintenance and periodic adjustment or replacement to continue functioning properly. And except for enclosures, noise reductions of 10 dB or more are often difficult to achieve and maintain. Thus HPDs remain one of the most important protective methods for a hearing conservationist to consider, and can provide an effective adjunct to engineering noise controls in the majority of industrial noise environments.

Nilsson et al. (1977) studied hearing loss in shipbuilding workers. The workers were divided into two groups. In the first group, the workers were exposed to 94 dBA with 95% of the workers using hearing protectors. In the second group, the workers were exposed to 88 dBA and 90% of them wore 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 (NIHL) were common. The mean pure tone audiograms showed the typical noise dip at 4000 Hz. For increased exposure durations, the amount of NIHL increased. Workers exposed to 94 dBA exhibited more hearing loss than those exposed to 88 dBA. Nilsson concluded that 58.1% of all of the workers had some degree of hearing impairment, and only 1.8% was caused by factors other than noise after excluding hearing loss due to heredity, skull injury, or ear disease. According to Nilsson et al., the hearing protectors should have attenuated the noise by at least 13 dBA. This study concluded that reliance on hearing protectors alone is not sufficient to protect the hearing acuity of the workers.

NIOSH's position regarding the hierarchy of controls is stated in their December 16, 1994 comments to MSHA (NIOSH 1994). According to NIOSH there are three elements of an effective hierarchy of controls. They are—

1. Prevent or contain hazardous workplace emissions at their source;
2. Remove the emissions from the pathway between the source and the worker; and
3. Control the exposure of the worker with barriers between the worker and the hazardous work environment.

NIOSH further states that the essential characteristics of specific control solutions are—

1. The levels of protection afforded workers must be reliable, consistent, and adequate;
2. The efficacy of the protection for each individual worker must be determinable during use throughout the lifespan of the system;
3. The solution must minimize dependence on human intervention for its efficacy so as to increase its reliability; and
4. The solution must consider all routes of entry into worker's bodies and should not exacerbate existing health or safety problems or create additional problems of its own.

NIOSH (1988), in its publication entitled ''Proposed National Strategy for the Prevention of Noise-Induced Hearing Loss'' (Publication No. 89–135), encouraged OSHA to rescind its policy of accepting HCP's in lieu of either feasible engineering and/or administrative controls and states:

> It is extremely foolhardy to regard hearing protection as a preferred way to limit noise exposures because most employees obtain only half the sound attenuation possible from hearing protectors. Even with training, some workers fail to obtain maximum benefit from these protectors because they have difficulty adjusting them properly, or they refuse to wear them because they fear such devices will impair their ability to perform their jobs properly or hear warning signals. If, however, noise is reduced by engineering and/or administrative controls, the limitations of hearing protectors are of less concern.

In the report, ''Preventing Illness and Injury in the Workplace,'' the Office of Technology Assessment (1985) 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.

The National Hearing Conservation Association (NHCA) in a letter from their President, Susan Cooper Megerson (1994), to Joseph Dear, Assistant Secretary of Labor for Occupational Safety and Health, urged OSHA to rescind its policy of accepting an HCP in lieu of engineering noise controls for exposures up to 100 dBA. NHCA contends that feasible engineering controls should be the preferred method of controlling the noise. Further, NHCA states that ''Most hearing protectors, as they are worn in the field, do not provide sufficient attenuation to bring workers' exposures from 100 dB(A) to safe noise levels.''

Suter (1994) in a letter to Sue Andrei of OSHA's Policy Directorate urged OSHA to rescind its policy of accepting an HCP in lieu of engineering and/or administrative controls for exposures up to 100 dBA. Suter contends that most HCPs are ineffective due to hearing protectors providing only a fraction of their laboratory attenuation. Further, Suter urges OSHA to re-emphasize engineering noise controls.

MSHA understands that the two letters to OSHA were sent in response to an OSHA request for comment on how to design a priority scheme for OSHA standards. No responses were issued, and the priority scheme is still pending. MSHA has also reviewed a recent letter to the EPA from the American Industrial Hygiene Association questioning the rating system used to label hearing protectors with attenuation values; this is discussed above in the section on *Hearing protector effectiveness* (in connection with proposed 62.125).

In summary, commenters and researchers on this issue were divided as to whether engineering/administrative controls should have primacy over the use of hearing protectors or an HCP. Most of the international community, U.S. armed services, and NIOSH, however, discourage the use of hearing protectors and an HCP as the primary means of control and accept their use only when engineering and administrative controls failed to achieve a significant reduction in the worker's exposure.

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 having lower sound levels, rescheduling of tasks, and modifying work activities. Many mine operators have demonstrated that administrative controls can be as effective and less costly than the installation of engineering controls. However, the use of administrative controls may be limited by labor/management agreements, limitations on the number of qualified miners capable of handling a specific task, or difficulty in ensuring that miners adhere to the

administrative controls. Additionally, administrative controls have the potential draw back of exposing multiple workers to high sound levels for designated time periods. Because the effectiveness of administrative controls is based on adherence to these strict time periods, mine operators may find it difficult to verify compliance with the administrative procedures.

Although there are some disadvantages to using administrative controls, the Agency has determined that in certain circumstances they can be as effective as engineering controls. MSHA, therefore, believes that the mine operator should have the option to choose which method of control to use—provided that all feasible controls must be utilized if needed to reduce sound levels to or below the PEL. This would give mine operators maximum flexibility when considering the intricacies of their operation in complying with the regulation. Administrative controls, utilized properly, spread the risk over a larger population although at a lower risk to each individual.

A related type of control would be the transfer of miners to other assignments. The Mine Safety and Health Act provides for the Agency to prescribe such an approach in certain cases. MSHA considered proposals to do so in cases in which an STS is detected. Discussion of this topic is covered by the section of the preamble that reviews proposed § 62.180.

Based upon its review of the available evidence, MSHA concludes that a reduction of a miner's risk of material impairment due to occupational NIHL noise can best be achieved through the use of all feasible engineering or administrative controls or a combination thereof. The use of engineering controls inherently provides the most consistent and reliable protection because such controls do not depend upon individual human performance or intervention to function. MSHA's proposal would, however, allow mine operators to use either engineering or administrative controls. This would provide the mine operator with the flexibility to select the most appropriate control for the situation. These methods would be given clear primacy over personal protective controls. While MSHA is aware that NIOSH is seeking to develop an approach that would more accurately derate hearing protectors in actual workplace use, the prospects for this remain uncertain; moreover, the issues associated with the consistency and reliability of personal protective equipment use would remain.

Engineering Noise Controls for Mining Equipment

Engineering noise controls reduce exposure by modifying the noise source, noise path or the receiver's environment thereby decreasing the miner's exposure to harmful sound levels. Examples of these three types of engineering controls are exhaust mufflers, barriers, and environmental cabs, respectively. Exposures may also be controlled by substituting quieter mining equipment. For example, a diamond wire saw can be substituted for a conventional hand-held channel burner in the dimension stone industry.

MSHA has listed feasible engineering controls for the major classifications of equipment used in metal and nonmetal mines in its Program Policy Manual, Volume IV. The engineering controls referenced in this manual have been evaluated by MSHA Technical Support and proven feasible and effective in the mining industry. This document is currently used by MSHA inspectors and others to assist in determining if engineering controls are feasible. Following are some examples of the feasible controls covered in that manual.

1. *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, from the original equipment manufacturer and the manufacturers of retrofit cabs, for machines manufactured within the past 20 years. The noise reduction of factory installed acoustically treated cabs is generally more effective than that of retrofit cabs. According to some manufacturers, sound levels at the mine operator's position inside factory cabs are often below 90 dBA and in some cases below 85 dBA.

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. Additionally, some manufacturers offer cabs for lower profile underground mining equipment such as scoop-trams, shuttle cars, and haul trucks. The use of cabs on such underground mobile haulage equipment generally is feasible provided it does not create a safety hazard due to impaired visibility.

The former USBOM has published two how-to manuals entitled ''Bulldozer Noise Controls'' (1980), and ''Front-End Loader Noise Controls'' (1981) that describe in great detail how to install a retrofit cab and install acoustical materials.

2. *Barrier shields.* For some equipment, generally over 20 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 generally be installed at nominal cost to block the noise reaching the equipment operator. These techniques are also demonstrated in ''Bulldozer Noise Controls'' (1980).

Barrier shields and partial enclosures can also be used on track drills where full cabs are not feasible. Such shields and enclosures can be either free standing 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 within MSHA's current 90 dBA PEL. This barrier can be constructed at minimal cost from used conveyor belting.

3. *Exhaust mufflers.* In addition to an environmental cab or barrier shield, diesel powered equipment can be equipped with an effective exhaust muffler. The end of the muffler's exhaust pipe should be located as far away from the equipment operator as possible, and the exhaust directed away from the operator. For underground mining equipment, exhaust mufflers are generally not needed where water scrubbers are used. A water scrubber offers some noise reduction and the addition of an exhaust muffler may create excessive back pressure or interfere with the proper functioning of the scrubber. However, exhaust mufflers can 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 factory, they can be easily constructed by the mine operator. MSHA has a videotape available 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.

4. *Acoustical materials.* Various types of acoustical materials can be strategically used to block, absorb, and/or dampen sound. Generally such materials are installed on the inside walls of equipment cabs or operator compartments and in control rooms and booths. For example: barrier and

absorptive materials can be used to reduce noise emanating from the engine and transmission compartments; and acoustic 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.

5. *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 typically are successful in reducing exposures of employees working in them to below 85 dBA.

6. *Substitution of equipment.* In a 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 quieter type. For example, hand-held channel burners had been used for many years to cut granite in dimension stone quarries. These were basically small jet engines on a pole, fueled by diesel fuel and compressed air. The pole was held by the channel burner operator and the flame was directed against the granite. The intense heat caused the granite to spall and by moving the flame back and forth a channel could be created. Sound levels typically exceeded 120 dBA at the operator's ear.

Several years ago, alternative and quieter methods of cutting the granite were developed. These included replacing the channel burner with either a diamond wire saw, hydraulic or pneumatic slot drill, or water jet. 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 alternatives. MSHA also has a videotape describing these various alternatives.

7. *New equipment design.* Using the channel burners as an example, a new design of channel burner was engineered which automated the process. The hand-held channel burners can be replaced with automated channel burners using liquid oxygen. The automated design does not require the operator to be near the channel burner, thereby using distance to attenuate the noise.

In addition to the noise controls described in MSHA's Program Policy Manual, Volume IV, a number of other documents are available describing effective noise controls for coal, metal and nonmetal mines—controls for underground equipment and controls for surface equipment.

The MSHA document entitled, ''Summary of Noise Controls for Mining Machinery,'' (Maraccini 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. MSHA believes that the controls utilized in these specific cases can be extended to other pieces of mining equipment.

Furthermore, the former USBOM, which has been responsible for conducting research leading to improved equipment and methods for controlling safety and health hazards in mining, published a handbook entitled, ''Mining Machinery Noise Control Guidelines, 1983.'' (Bartholomae and Parker, 1983) This handbook describes engineering noise controls for coal, metal and nonmetal mining equipment. The former USBOM also published numerous documents describing noise controls for mining machinery. Many of these research reports are listed in the USBOM publication IC9004, ''The Bureau of Mines Noise-Control Research Program—A 10-Year Review.'' (Aljoe et al., 1985) Part V of this preamble contains a list of USBOM publications dealing with particular types of equipment.

In particular, these include 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 cutting machines such as continuous miners and longwall shears, the use of remote control is the single most significant noise control. The installation of noise dampening 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 use 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.

Finally, while MSHA is not making any assumptions about the development of new technologies, it would be interested to learn of any processes under development that could further assist mine operators in controlling noise. For example, the former USBOM (Burks and Bartholomae, 1992) has developed a variable speed chain conveyor which can be used to reduce the noise exposure of continuous miner operators and loading machine operators in particular. An empty conveyor is noisier than a full one because the coal covering the conveyor inhibits the radiation of noise. The variable speed chain conveyor only operates when necessary to convey coal. To date the manufacturers of mining machines have apparently not adopted this technology, despite the fact that it has the added benefits of reduced dust emissions, reduced power consumption, and reduced maintenance costs.

Although most of the USBOM noise control documents are not specifically discussed in this section, MSHA has reviewed them. The reviewed documents are listed in the references and are available to the mining community. For additional information on USBOM noise control projects contact: Mr. Edward D. Thimons, U.S. Department of Energy, Pittsburgh Research Center, P.O. 18070, Pittsburgh, PA 15236, (412) 892–6683, Fax (412) 892–4259.

Posting of Administrative Control Procedures

The proposal would require that the mine operator post a copy of any administrative controls in effect on the mine bulletin board, and provide affected miners with a copy. As required by Section 109 of the Mine Act, a mine operator must have a bulletin board. Documents containing pertinent mine information are required to be posted by various mandatory standards (e.g., training plan, emergency communication numbers, MSHA citations, etc.). This is an ideal place to require the administrative procedures to be posted, since most miners are familiar with its location and the importance of documents placed on it.

The existing MSHA coal noise regulations do not require written administrative controls, unless these controls are part of a hearing conservation plan. Further, if written, the administrative controls are not required to be posted. However, the affected miner would be informed of the administrative procedures as part of his/her required part 48 training. Neither MSHA's current metal and nonmetal nor OSHA's noise regulations require that administrative controls, if used, be in writing and posted.

MSHA did not receive any comments on this issue.

MSHA has concluded that it is important that administrative controls be posted, since miners must actively comply for the controls to be effective. Posting would facilitate informing miners of work practices necessary for

reducing their noise exposures, especially when temporarily assigned to a different job. Since the administrative controls must be in writing to be posted on the mine bulletin board, MSHA believes that providing the affected miners with copies would not be a significant burden as compared to other possible methods of notification and is likely to be more much more effective in ensuring miners are on notice of their obligation to comply.

Supplementary Controls

Under proposed § 62.120(b), any miner exposed above the action level will receive special training in noise protection, and be enrolled in a hearing conservation program in which annual audiometric tests are offered. Any miner exposed above that level is to receive hearing protection upon request, as is any miner who incurs an STS or who is waiting for a baseline audiogram. The operator must ensure hearing protection is worn, however, in only two cases: if there is an STS, and if it will take more than 6 months to get the baseline audiogram because of the need to wait for a mobile test van.

Under proposed § 62.120(c), if exposures exceed the PEL, and cannot be feasibly reduced to the PEL through the use of all feasible engineering and administrative controls, a few additional requirements would be applicable. All miners so exposed must be provided hearing protection, and required to use the hearing protection. In addition, the operator would be required to ensure that miners take the scheduled audiometric examinations.

The circumstances under which hearing protection must be worn are discussed more fully in connection with proposed § 62.125.

MSHA is proposing that mine operators require miners enrolled in an HCP to participate in audiometric testing once exposures exceed the PEL. This is not the case under OSHA; however, MSHA believes this approach is warranted in the mining industry.

The information generated by these tests can serve as triggers for both the mine operator and the Agency to investigate more thoroughly the implementation of noise controls. If an employee incurs a standard threshold shift, at the very least a hearing protector needs to be provided or changed. The audiological information can provide useful clues to the noise causing the problem, and point to an undetected failure of various controls: engineering controls, administrative controls, or the failure to properly fit, maintain or utilize hearing protectors. If an employee incurs a reportable hearing loss, it is an indication that despite regular MSHA inspections, some serious problem has not been detected or resolved and a more thorough analysis is probably required. If the required audiological examinations are not taken, standard threshold shifts and cases of reportable hearing loss will go unreported.

In addition, the Agency wants to ensure that miners are aware of the severity of any hearing loss; in a mining environment, this knowledge could have implications for the safety of the miner and the safety of others. Miners who do not recognize that they have a hearing problem—and hearing loss occurs gradually and is often hard for individuals to accept—may be less willing than those who have been advised they have a problem to pay attention to the problem. The proposed regulation provides for annual training, but a notification of a detectable change in hearing acuity would certainly help to focus attention.

The Agency is concerned that unless such participation is mandatory, the cost of the examinations, however limited, might create an incentive for mine operators to encourage miners to waive the examinations. Concern about the implications of health examinations on their job security may likewise discourage miners from taking examinations. The voluntary X-ray surveillance program currently offered to coal miners has a poor record of participation. This is not an unusual situation in the mining industry, where retention of good, well-paying jobs is a priority for most workers.

Finally, it should be noted that audiometric testing is not an invasive procedure. No damaging radiation is involved, nor is there any penetration with a needle or other device.

Comments on this provision are specifically solicited. In particular, experience from companies in which such examinations are mandated would be welcome. The Agency recognizes there may be concern on the part of some miners that if mine operators are provided with audiometric information, it could lead to the discharge of miners who are developing hearing loss problems so as to minimize potential workers' compensation claims.

Dual Hearing Protection

Proposed § 62.120(d) would require that, in addition to the controls required for noise exposure that exceed the PEL, a mine operator provide dual hearing protectors to a miner whose noise exposure exceeds a TWA_8 of 105 dBA during any workshift, a dose of 800% of the PEL. The mine operator must also ensure that they are worn. An earplug type protector would be worn under an earmuff type protector.

Currently, neither MSHA nor OSHA specifically mandate the use of dual hearing protection. In practice, however, existing rules require dual hearing protection under some circumstances.

Under current Coal and Metal and Nonmetal noise policy, dual hearing protection would be required whenever the attenuation of a single hearing protector does not reduce the miner's noise exposure to within the PEL.

Also, due to MSHA's current procedures for determining the attenuation of hearing protectors (discussed under *Hearing protector effectiveness* of this preamble), dual hearing protection would almost always be required when miners are exposed to sound levels above 112 dBA. As discussed below, the attenuation provided by dual hearing protectors is less than the sum of their individual attenuations. MSHA policy currently specifies that 6 dB be added to the attenuation of the hearing protector having the higher attenuation.

OSHA requires that ''adequate'' hearing protection be provided to and worn by workers. Employers would thus have to utilize dual hearing protection in some cases to get the needed attenuation. However, no specific dose level triggering dual hearing protection level has been established by OSHA.

No commenter addressed the exposure above which dual hearing protection would be required. One commenter suggested that MSHA consider dual hearing protection to provide 5 dB more attenuation than the hearing protector with the higher attenuation. Another commenter, disagreed with current MSHA Metal and Nonmetal policy and believed that more than 6 dBA credit should be given above the attenuation of the higher component (earplug or earmuff) when dual hearing protectors are worn. This commenter did not, however, specify how much credit should be given.

Research has demonstrated that dual hearing protection affords the wearer greater attenuation than either earplugs or earmuffs alone. Berger in EARLOG 13 (1984) has shown that the use of dual hearing protectors provides greater attenuation. The attenuation of the dual hearing protection is at least 5 dB greater than the attenuation of either hearing protector alone. This attenuation, however, is much less than the sum of the individual Noise Reduction Rating (NRR) values and is dependent on the frequency. Dual hearing protectors are especially important for noise which is dominated

by low to middle frequency sounds. The performance of dual hearing protectors is not influenced greatly by the selection of the earmuff; however, the selection of the earplug has a strong influence on the attenuation below 2000 Hz. For noises which are dominated by sounds above 2000 Hz, the attenuation of dual hearing protectors is limited by flanking bone conduction paths to the inner ear. Berger recommends dual hearing protectors whenever the TWA_8 exceeds 105 dBA.

Michael (1991) believes that, because of complex coupling factors, the attenuation from wearing both earplugs and earmuffs cannot be predicted accurately. If the attenuation of the earplug and earmuff is about the same at a given frequency, then the resultant attenuation should be 3 to 6 dB greater than the higher of the two individual attenuations. However, if one attenuation is much greater than the other, then the resultant attenuation will be slightly more than the higher attenuation.

Nixon and Berger (1991) report that earplugs, worn in combination with earmuffs or helmets, typically provided more attenuation than either hearing protector alone. The gain, in attenuation at individual frequencies, varies between 0 to 15 dB. At or above 2000 Hz, the attenuation of the combination is limited by bone conduction to approximately 40 to 50 dB. Below 2000 Hz, the selection of the earplug is critical for increasing the attenuation. There is little change in the attenuation of different types of earmuffs at frequencies below 2000 Hz.

Bertrand and Zeiden (1993) determined that miners exposed to sound levels of 118 dBA were afforded protection consistent with a sound level of 98 dBA by the use of earmuffs. The earmuff had an NRR of 24 dB. Consequently, the earmuff alone could not provide attenuation sufficient to protect the miner's hearing acuity.

Research has clearly demonstrated that dual hearing protection provides greater attenuation than either hearing protector alone. Further, the U.S. armed services require dual hearing protection for workers exposed to high sound levels. MSHA concurs that the additional attenuation afforded by the use of dual hearing protection is necessary to protect miners who are exposed to high sound levels. Furthermore, MSHA has concluded that a TWA_8 of 105 dBA (800%) is a prudent level above which dual hearing protection should be required. This level of noise exposure can quickly damage the hearing acuity of the exposed miner.

Dose Ceiling

Although the statement of the PEL in § 62.120(c) is absolute that no miner shall be exposed to noise above a TWA_8 of 90 dBA, the remainder of that paragraph and paragraph (d) deal with situations where in fact miners are going to be exposed to noise in excess of the PEL for some period of time—due to the economic feasibility of administrative and engineering controls for a particular mine operator, or due to the technological feasibility of engineering controls as to a particular operation. The seriousness of this situation for miners is indicated by the fact that MSHA is proposing that dual hearing protectors be required at a TWA_8 of 105 dBA: a noise dose of 800%.

The Agency is interested in comments on whether there is some noise dose which should be established as an absolute dose ceiling by the regulation, regardless of the implications for a particular mine operator or operation. The circumstances in which this might pose a problem for the mining industry appear to be very limited. While coal inspection data over the years have indicated some exposures over 800%, MSHA believes these are anomolies for which well-known controls are available. If there are problems, they are likely to be in the metal and nonmetal sector.

On the one hand, the dual-survey data indicate that using the 80 dBA threshold level, only about one-quarter of one percent (0.28%) of metal and non-metal exposures exceed a noise dose of 800%. The data indicate, however, that there remain a few specific job categories in the metal and nonmetal sector which experience a significant problem with noise exposures of this dimension, as indicated in Table III–6. The sample size is provided to illustrate that in some cases, the percentages are based on limited data.

TABLE III–6: METAL/NONMETAL JOB CATEGORIES IN WHICH MORE THAN 1% OF RECORDED EXPOSURES ARE OVER A TWA_8 of 105 dBA (800% of PEL)

Code	Job category	No. > 105	No. of sample	Percent > 105
134	Jet-piercing channel operator	5	9	56
234	Jet-piercing drill operator	1	3	33
058	Drift miner	15	55	27
057	Stope miner	9	39	23
534	Jackleg or stopper drill operator	7	31	23
434	Churn drill operator	1	7	14
334	Wagon drill operator	3	30	10
034	Diamond drill operator	3	46	7
046	Rock or roof bolter	2	38	5
734	Rotary (pneumatic) drill operator	20	478	4
634	Rotary (electric or hydraulic) drill operator	11	544	2
934	Jumbo percussion drill operator	2	111	2
399	Dimension stone cutter and polisher; rock sawer	3	301	1

Notes: Miscellaneous job categories where less than 1% of recorded exposures exceeded TWA_8 of 105 dBA are not displayed. Numbers are for four year period, 1991–1994.

The job descriptions do not necessarily indicate the equipment in use; for example, the stope miners and drift miners may well have been using the same equipment as the jackleg drill operators. Based on the Agency's experience, there are only a few pieces of equipment used in mining for which no control other than multiple hearing protectors is currently available.

The data illustrate that many exposures at this level are preventable. Even with the jackleg drills more than 75% of the exposures were controlled to less than a TWA_8 of 105 dBA. The data base from which the above information was drawn found nine bulldozer operators and three truck drivers

exposed to noise above 800% of the PEL; and while these constituted only a small fraction of the samples of those job categories, 0.7% and 0.05% respectively, the Agency is disturbed to find any such samples at all given that the metal and nonmetal industry has for some years been operating under a requirement to use engineering and administrative controls to bring sound levels down to the PEL or as close thereto as is feasible.

Accordingly, MSHA requests comment on whether there should be an absolute dose ceiling, regardless of the economic feasibility of control by an individual mine operator, and what that should be. MSHA also requests comment on whether such a dose ceiling should be technology forcing—i.e. apply regardless of the technological feasibility of currently available controls.

Ceiling Level

Proposed § 62.120(e) would retain MSHA's current 115 dBA ceiling level for continuous and intermittent noise. The 115 dBA ceiling level is intended to protect individuals from high sound levels which last longer than those typically characterized by impulse/impact noise.

The 115 dBA ceiling level originated out of the Walsh-Healey Public Contracts Act which formed the basis of current Department of Labor noise regulations. OSHA, in its 1974 proposed noise standard (39 FR 37775), specified that the 115 dBA limit was a maximum steady state sound level which was not to be exceeded regardless of the time-weighted average dose computation.

In its ANPRM, MSHA did not specifically request comments on the 115 dBA ceiling limit. One commenter, however, presented a view on the 115 dBA level. This commenter stated that ''Few professionals would allow a worker to remain unprotected while exposed to 115 dBA for 15 minutes.''

MSHA's review of available literature found a diversity of opinions on the choice of a ceiling level for exposures to continuous and intermittent noise.

At the 93rd Meeting of the Acoustical Society of America, Johnson and Schori (1977) reported that 115 dBA for 15 minutes may be grossly under protective, while an upper limit of 115 dBA, regardless of the time of the exposure, is unduly restrictive. For example, they found significant temporary threshold shift from exposure to 115 dBA for only 2.7 minutes. On the other hand, they found virtually no such shift from exposure to 130 dBA for 10 seconds and minimal shift (median of 2 dB) when exposed to 120 dBA for 40 seconds—although MSHA would point out it knows of no mining tasks taking such a limited time. In any event, this shows that the ceiling limit is dependent upon both time and intensity.

Cluff (1984) stated that ''The selection of 115 dBA for 15 minutes is arbitrary and represents several contradictions.'' He agreed with Johnson, however, that exposures to 115 dBA for 15 minutes is dangerous. Cluff stated that ''this danger is magnified by extending the 5 dB rule to 130 dBA'' and suggested that a 3–dB or 4–dB exchange rate may have merit as a solution.

Others discussed different ceiling limits to prevent temporary threshold shift which may lead to a permanent NIHL. The U.S. Army's Technical Memorandum 13–67, ''Criteria for Assessing Hearing Damage Risk from Impulse-Noise Exposure'' (Coles, 1967) stated that:

> It has been customary in steady-state noise DRC [damage risk criteria] * * * to include an upper limit of about 135 dB for unprotected noise exposure *for any duration, however short*. In most cases it is understood by implication only, rather than by direct statement, that this restriction is not intended to apply to impulse noise * * *

The technical memorandum, however, stated further that:

> The relationship between TTS [temporary threshold shift] resulting from a single noise exposure and permanent threshold shift (PTS) to be expected from habitual exposure is not known with certainty even for steady-state noise.

In *Acoustic Parameters of Hazardous Noise Exposures*, however, Henderson (1990) discussed a critical level above which damage by acoustic trauma begins. He stated that:

> At levels above 120 dB SPL [sound pressure level] the cochlea begins to be damaged by direct mechanical destruction, i.e., the organ of Corti can be lifted off the basilar membrane, tight-cell junctions can be ripped apart, and the tympanic membrane can be ruptured. The level at which mechanical damage occurs has been called the ''critical level,'' but it is important to recognize that there is not a critical level but rather a transition point that is related to the spectrum and temporal pattern of the exposure.

CHABA (1993) believed that single exposure to sound levels above 140 dBA can permanently damage hearing. Furthermore, the threshold for pain is dependent upon the frequency of the noise. This threshold lies between 135 and 140 dB.

Ward (1990) stated that:

> * * * a ''critical exposure'' for production of immediate severe loss, presumably associated with structural failure in the cochlea rather than with metabolic fatigue, is dependent not on the energy in the exposure (p^2t) but on a different quantity given by integrating the fourth power of the pressure over time. * * * The best estimate for the critical exposure in man is around 10^{11} Pa^4-sec for a median value, although individual differences in susceptibility and vulnerability mean that the range will be very great.

NIOSH (1995) recommends that the 115 dBA ceiling limit be retained. Citing recent medical research, NIOSH believes that the critical level is between 115 and 120 dBA. Above the critical level, immediate structural damage to the ear occurs. This structural damage causes a loss of hearing acuity.

ACGIH (1994) recommended that exposures to occupational noise should not be permitted above 139 dBA. Further, for sound levels equal to or exceeding 103 dBA, ACGIH believes that the exposure be ''limited by the noise source—not by administrative control.''

As illustrated by the above discussed studies, there is no consensus among the scientific community as to a sound level above which permanent damage occurs (regardless of the duration of exposure). However, many researchers believe the critical level is slightly above 115 dBA and is time dependent with an allowable duration of less than 15 minutes.

International communities and selected branches of the U.S. armed services specify a ceiling level; however, there is no agreement among these groups either.

There are relatively few noise sources in the mining industry that produce sound levels exceeding 115 dBA (e.g., unmuffled pneumatic rock drills and hand-held channel burners). However, these sources often operate during most of the work shift with resulting full-shift noise exposure considerably over the PEL. Currently, MSHA surveys these noise sources by taking spot readings with Type 2 sound level meters rather than conducting full-shift sampling with a personal noise dosimeter. The requirements for Type 2 sound level meters are in ANSI S1.4–1983, ''Specification for Sound Level Meters.'' MSHA intends to continue sampling these sources using a sound level meter.

Even though this proposal has retained the 115 dBA ceiling level for noise exposure, sound levels above 115 dBA are to be included in the determination of the noise dose. The Agency has determined that it is important to include sound levels above 115 dBA in the noise dose so that the miner's noise exposure is accurately assessed. By having an accurate assessment, the mine operator will be

able to provide hearing protectors with maximum attenuation and take steps to ensure that the hearing protectors are effectively fitted and properly worn.

MSHA believes that exposure to sound levels exceeding 115 dBA, regardless of duration, may potentially result in acute hearing loss among susceptible individuals. Although there is a lack of scientific consensus on the exact time of safe exposure, the majority believe that 15 minutes is hazardous. Accordingly, MSHA believes retention of the current ceiling is warranted. The Agency, however, welcomes additional comment on this issue.

Exposure Determination by Operators

Proposed § 62.120(f)(1) would require mine operators to establish a system of monitoring which effectively evaluates each miner's noise exposure. This will ensure that mine operators have the means to determine whether a miner's exposure exceeds any of the limitations established by this section, as well as to assess the effectiveness of noise controls. The proposed rule is performance oriented in that the regularity and methodology used to make this evaluation are not specified. Specific requirements for periodic monitoring by qualified persons now applicable to the coal sector would be revoked.

Under the approach proposed, mine operators may design a monitoring program suitable for each specific mine site. Mine operators would be expected to utilize survey methods and instrumentation which are scientifically valid and based on sound industrial hygiene practice.

Although calibration requirements are not specifically mandated in the proposal, good industrial hygiene practice dictates that any instrumentation used for determining a worker's occupational exposure to a contaminant, in this case noise, be calibrated. The calibration program should be composed of three phases—type testing of instruments, laboratory calibration of the instruments, and field calibration. Seiler and Giardino (1996) discussed the importance of each of these classes of calibrations.

Briefly, type testing is an exhaustive testing of a model of instrument to ascertain that it complies with a standard, such as the ANSI standard for personal noise dosimeters. Laboratory calibration is an extensive calibration that ascertains that an individual instrument meets factory specifications. Finally, field calibration is a brief procedure conducted before and after a survey to ascertain that an instrument is operating properly.

The mine operator has the responsibility of accurately determining a miner's noise exposure. In order to do this properly the type of instrumentation needs to be considered. In the cramped quarters of an underground mine and on mobile mining equipment, it may not be possible to accurately evaluate a miner's noise exposure without endangering the technician if a sound level meter is used. Other occupations cannot be sampled with a sound level meter because the most exposed ear is not accessible to the technician. For the above occupations, a personal noise dosimeter would need to be used. An analysis of noise exposures collected from 1986 through 1992 by the MSHA coal inspectorate revealed that 21.8% of the occupations could only be sampled using personal noise dosimeters. These occupations comprised nearly 60% of the surveys conducted by the inspectors.

A program would be expected to evaluate noise exposure in adequate detail to enable the mine operator to reasonably determine which miners work in areas requiring the institution of the controls that may be required. Sufficient evidence of a noise monitoring program must be available during mine inspections to permit the evaluation by MSHA of the program's effectiveness. The Agency will also take its own surveys of noise exposure during inspections to ascertain miner exposure and to evaluate the effectiveness of the mine operator's monitoring program.

MSHA believes that this proposal affirms a mine operator's obligation to take the action needed to determine whether or not a miner is in compliance with the exposure limitation requirements of the proposed regulation. At the same time, it allows mine operators maximum flexibility for determining a miner's noise exposure.

MSHA believes that mine operators have a number of incentives to monitor sound levels on a regular basis to ensure they can:

(1) Avoid the costs associated with needlessly including or retaining a miner in an HCP or providing special noise training;

(2) Assess the effectiveness or need for either engineering or administrative controls or a combination of these controls to meet the TWA_8 of 90 dBA;

(3) Document the miner's exposure for workers' compensation purposes;

(4) Provide information to health professionals evaluating miners' health and audiograms; and

(5) Avoid citations and penalties during the regular Agency inspections in the mining industry for failure to comply with the standard's requirements.

The results of operator monitoring will not be sent to MSHA, nor will monitoring results be used to determine compliance with the applicable noise standard. Mine operators are, however, under an obligation to take certain actions based upon any noise measurements they conduct. Proposed § 62.120 requires mine operators to take specific corrective action when a miner's noise exposure exceeds the various limitations set forth in the section. It also requires that miners be notified whenever a mine operator determines that their noise exposure exceeds the action level.

The requirements of proposed § 62.120(a), as to how noise is to be measured for the purposes of this proposal, would need to be followed by mine operators in their monitoring. These requirements include: disregarding the attenuation of any hearing protector worn by the miner, integrating all sound levels from 80 dBA to at least 130 dBA during a miner's full workshift, using a 90 dBA criterion level and a 5-dB exchange rate, and using an A-weighting and slow-response instrument setting. Mine operators would, of course, be free to take any additional measurements that they deem appropriate: for example, taking peak-response readings to measure any impact/impulse noise.

MSHA current coal noise standards (30 CFR §§ 70.500/71.800) require mine operators to monitor each miner's noise exposure twice a year and certify the results to MSHA. These standards also specify when and how to sample, who is qualified to sample, and reporting requirements.

MSHA's noise standards (30 CFR §§ 56/57.5050) for metal and nonmetal mines do not contain any operator sampling requirements, although they do require that mine operators maintain exposures in compliance with the PEL. In order to do this effectively, many metal and nonmetal mine operators conduct their own monitoring.

OSHA's noise standard requires employers to implement a monitoring program when information indicates that any employee's noise exposure may equal or exceed the action level (TWA_8 of 85 dBA). OSHA allows employers to use representative personal or area sampling; however, in areas with significant variations in sound level or high worker mobility, the employer would have to show that area sampling produces results equivalent to personal sampling. OSHA also requires the

employer to repeat the monitoring in specific situations.

MSHA's ANPRM solicited comments on the frequency of monitoring, the sampling strategy, and the use of the information obtained. The ANPRM also asked whether specification-oriented or performance-oriented requirements would be more appropriate. At that time, the Agency solicited comments based on the premise that the proposed rule would include a detailed monitoring requirement and the commenters responded accordingly. However, since MSHA has decided not to propose detailed monitoring requirements, the Agency has not addressed specific issues regarding area versus personal monitoring, instrumentation specifications, calibration requirements, or other related monitoring issues.

Many commenters preferred performance-oriented standards, similar to OSHA's, that would allow mine operator discretion in when and how to sample. One of these commenters stated:

> The goal of the monitoring effort should not be simply to collect noise exposure data, but rather to accomplish the goal of eliminating job-related noise induced hearing loss. With this goal in mind, the operator would need to have collected noise exposure information on the jobs that he had reason to believe were above the 85 dBA action level. This information would be necessary to identify those workers that should be included in the HCP as well as areas and equipment where noise controls are needed.
>
> If the operator does not choose to monitor for noise, he should have an alternate plan that accomplished the same goal: i.e., includes all non-office workers in the HCP regardless of noise exposure, perform a sound level survey to identify mandatory hearing protection areas and equipment, etc. It is recommended that MSHA adopt the logic outlined in the OSHA noise standard, 29 CFR 1910.95(d) (1), (2) and (3).

Conversely, two commenters recommended a specification-oriented rule. One of these recommended personal monitoring on an annual basis and the other simply recommended personal or area monitoring.

Finally, two commenters had a different view on monitoring. They recommended that MSHA, rather than the mine operator, conduct all monitoring for the purpose of this proposed standard. In response to these commenters, the Agency would point out that it is the responsibility of mine operators to ensure the safety and health of their miners. MSHA sampling programs are to audit the mine operators to ensure the protection of miners. Moreover, MSHA does not have the resources to sample every miner annually. Metal and Nonmetal has specific health sampling guidelines which require periodic sampling of selected mining occupations. MSHA currently conducts over 20,000 full-shift noise exposure surveys in the mining industry annually. Although MSHA intends to continue measuring the noise exposure of miners in order to determine compliance, it can only sample a small percentage of the exposed mining population annually. Mine operators are responsible for knowing at all times when their employees exceed applicable limits so that appropriate action can be taken.

The Agency, however, is willing to share its sampling results and analyses of these results with the mining industry. Mine operators who do not conduct their own monitoring could use the MSHA data along with information from equipment manufacturers to estimate a miner's noise exposure. This could be beneficial to all mine operators, particularly small mine operators with limited resources. If, however, as a result of this proposal, MSHA changes the threshold, prior sampling conducted by the Agency may not provide an accurate indication of whether a miner's noise exposure exceeds the new standard.

Although a mine operator could use prior MSHA sampling results, and information from equipment manufacturers, such use would not relieve the mine operator of responsibility to appropriately determine a miner's noise exposure. Therefore, it would behoove mine operators to determine a miner's noise exposure by methods comparable to those which would be used by MSHA, as outlined in § 62.120(a).

Although numerous commenters and organizations supported the need for monitoring, most favored a performance-oriented approach and did not specify a procedure to be followed. MSHA agrees. The Agency believes that the focus of the noise standard should be on preventing NIHL and reducing miners' noise exposures and that it would be counterproductive to specify detailed monitoring requirements or procedures. Also, the Agency does not want to stifle improvements in monitoring technology or methodology.

Moreover, the Agency believes that the current specification-oriented coal operator monitoring produces results that in fact are not representative of miners' noise exposure. For example, in FY 1994, coal mine operators conducted approximately 180,000 noise surveys (two per miner) and found 36 miners to be overexposed (their exposures exceeded 132%). However, MSHA does not know the extent to which mine operators may be including credit for the wearing of hearing protection in the determination of the miner's exposure. Conversely, MSHA conducted 6,339 surveys in coal mines and found 857 exposures exceeding the 132%. However, only 62 of these surveys resulted in a violation due to credit being given for use of hearing protection. This indicates that despite having specification-oriented monitoring requirements, current operator sampling in coal mines may not be providing results consistent with those found by MSHA.

For monitoring compliance with this proposal, the Agency intends to use validated scientific methodology. Current MSHA sampling procedures and policies are listed in MSHA's Program Policy Manual and its Coal, and Metal and Nonmetal, Health Inspection Procedures Handbooks. Copies of these documents are available for review and copying in MSHA offices. MSHA's sampling procedures, however, would be modified to be consistent with § 62.120(a) of this proposal once the rule is finalized.

Currently, MSHA bases its noise exposure compliance determinations on personal full-shift sampling with a personal noise dosimeter. The calibration of the personal noise dosimeters is checked before and after each survey. Additionally, annual laboratory calibration is conducted to assure measurement accuracy. The personal noise dosimeter's microphone is positioned on the top of the miner's shoulder, midway between the neck and the end of the shoulder, with the microphone diaphragm pointing in a vertical upward direction. The microphone is placed on the shoulder that is normally between the principal noise source and the miner's ear. Sampling is conducted while the miner performs his/her normal duties.

In the development of this proposal, MSHA also reviewed the noise monitoring programs of the U.S. Armed Services and other jurisdictions.

Although MSHA has described its current noise sampling procedures, the Agency may decide to modify or change these procedures based upon new or improved sampling methods, instrumentation, or technology.

Employee Notification

Proposed § 62.120(f)(2) would require that within 15 calendar days of determining that a miner's exposure exceeds the action level, the permissible exposure level, the dual hearing protection level, or the ceiling level established by this section, the mine

operator notify the miner in writing of the overexposure and the corrective action being taken. If the miner's exposure has not changed from one of these levels to another, and the miner has been notified of his exposure at that level within the past year, no notification needs to be provided; if the level has changed, or there has been no notification in the past year, notification is to be provided. The proposal specifically states that these notifications are triggered by exposure evaluations conducted either by the operator or by an MSHA inspector.

At the present time, MSHA does not require notification, though it is implied in those cases in which a coal miner is enrolled in an HCP for having exceeded the PEL. OSHA's standard requires that employees be notified in writing of monitoring results that exceed the action level within 21 days of the monitoring.

The proposed requirement is consistent with Section 103(c) of the Mine Act. Section 103(c) of the Mine Act states in pertinent part that:

> 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.

Many commenters supported miner notification of all sampling results and stated that such is current company policy. Several of these commenters recommended that the specific method of notification be left to the discretion of the mine operator. One commenter specifically stated that through notification, ''the employee could help facilitate a solution to the problem and be more committed to following safety procedures.'' This commenter also stated that ''requiring written notification is not effective when dealing with persons who cannot read or do not have the background to understand the meaning of the notification's contents.''

A mining association commented ''* * * that miners should be made aware when their exposure exceeds allowable limits * * *'' and that ''* * * employees should have knowledge of their exposure and any subsequent hearing loss. * * *'' This association suggested, however, that notification ''* * * be in the form of entry into the HCP. * * *'' Several other commenters recommended that MSHA's requirements be the same as OSHA's.

After reviewing the comments and the regulations from the U.S. Armed Forces and international organizations, MSHA concludes that notification should be provided for exposure at any level defined in the proposed regulation. At the action level, there is a significant risk of material impairment (as discussed in part II of this preamble). Notification will be needed at this level because under the proposal, if the noise exceeds that level, the mine operator would be required to take protective action (hearing protectors and enrollment in an HCP). Notification at this level would explain to the miners the reason why it is necessary for them to wear their hearing protectors. Moreover, since the harm occurs at this level, notification is required under § 103(c) of the 1977 Mine Act. Notification at the permissible exposure level and dual hearing protection level—exposures respectively 2 and 16 times the dose at the action level—is necessary to ensure the miner understands the rationale for added protection and the actions being taken by the mine operator to lower noise exposures. The same is true for any exposures exceeding the ceiling level.

MSHA believes there is no need to notify a miner of every exposure determination, as long as the miner is cognizant of the general level of his or her exposure—so that the miner pays attention to noise exposure and noise abatement efforts (including the use of properly fitted and maintained hearing protectors). If an exposure measurement for a miner demonstrates a change in that miner's situation—e.g., from below the PEL to over the PEL, or from over the PEL to above the dual-hearing protector level—the miners should be made aware of this fact.

Moreover, even if the miner's situation has not changed, the miner should be reminded of his or her overexposure when it is measured if notification has not been made recently. MSHA welcomes comment on the proper balance to strike between the need for notification and nonproductive paperwork.

MSHA has concluded that the notification should be in writing. This would ensure that the miner does not misconstrue the measured level nor the actions being taken.

Warning Signs

The proposed rule has no provision for requiring the posting of warning signs. While MSHA acknowledges the value of posting warning signs, the process is inherently complicated in the ever changing mining environment, and MSHA believes the training requirements it is proposing should ensure miners are apprised of noise hazards to which they may be exposed.

Section 101(a)(7) of the Mine Act requires that health or safety standards promulgated by MSHA:

> * * * prescribe the use of labels or other appropriate forms of warning as are necessary to insure that miners are apprised of all hazards to which they are exposed, * * *

Existing MSHA noise standards do not exercise this authority with respect to noise, and do not require the posting of warning signs.

When OSHA promulgated its Hearing Conservation Amendment, it did not include a requirement for warning signs. OSHA stated in the preamble to the final rule, that the use of warning signs to warn employees about noise hazards in high noise areas should be left to the discretion of the employer. In so doing, OSHA stated that noise is more readily discernible than other harmful physical agents and therefore a specific warning sign requirement may not be necessary to protect employees, and that in certain circumstances such signs might confuse rather than serve a useful educational purpose. OSHA also recognized that the employer is more familiar with the workplace environment and will be in a better position to determine if the posting of signs in a given situation will aid in the success of the company's HCP. Further, OSHA stated that other methods, such as training, may be more appropriate for apprising employees of the hazards of noise.

In its ANPRM, MSHA asked whether it should require warning signs in areas exceeding a specified sound level, and what this sound level should be. Numerous commenters specifically addressed the issue of warning signs and were about equally divided over whether such a requirement is necessary. Those commenters supporting the use of warning signs varied considerably on criteria for their use. For example, one commenter indicated that warning signs should only be posted in areas where an immediate threat of injury exists, such as areas with impact noise above 140 dB or constant noise above 115 dBA. Other commenters said that warning signs should only be required on non-mobile equipment, or in areas where the use of hearing protectors is mandatory.

Among those commenters that did not support the use of warning signs, several stated that MSHA's standard should be performance-oriented and allow the mine operator to decide how to warn its employees, such as through training, safety meetings, notification of exposure results, etc. One commenter

stated that in the mining environment it would be difficult to illuminate signs to the point they could be read and understood, and that they would be difficult to maintain in most mining situations. This commenter also believed that the nature of certain mining operations does not lend itself to the use of signs because the work area is constantly changing. Another commenter agreed, stating that warning signs would be difficult to keep current in mobile operations.

Warning signs could provide an indication to miners that they are entering an area where the wearing of hearing protectors is required. Some mine operators have voluntarily placed warning signs in high noise areas such as preparation facilities and on surface mobile equipment.

MSHA believes, due to the dynamic nature of mining (advancing underground faces, changing quarry perimeters, a mobile workforce, etc.), that a requirement for the installation of fixed warning signs may be difficult to implement. Warning signs may also be inappropriate where miners do not work a fixed period of time in the area covered by the sign. For example, a miner in an area with a 90 dBA sound level for less than four hours, with no significant noise exposure for the rest of the day, would not be required to wear hearing protectors under MSHA's proposal, whereas a miner who spends more than four hours in that area would.

After careful analysis of the literature and review of regulatory requirements from international communities and the U.S. Armed Services, MSHA believes that training may be a more appropriate vehicle to inform workers of the hazards of noise to their hearing. Further, the Agency believes that the posting of warning signs for noise should be optional and left to the discretion of the mine operator. The proposed rule would require initial and annual training for all miners exposed above the action level as discussed under § 62.130 *Training* of this preamble.

Though MSHA is not proposing to require warning signs for noise, it expects that many mine operators will voluntarily post such signs to indicate to miners locations where hearing protectors must be worn. If, however, mine operators choose to use administrative controls to reduce a miner's noise exposure, the proposal would require that the affected miner be informed of the administrative procedures and that such controls be posted on the mine bulletin board. Such procedures may provide notification of sound levels in specific work locations.

Section 62.125 Hearing Protectors.

Whenever hearing protectors are required to be provided by the proposed regulations, they must be provided in accordance with the requirements of this section.

The miner is to have a choice from at least one earplug type and muff type protector; and, in the event dual hearing protection is required, a choice of one of each. The mine operator is to ensure that in those cases when hearing protection is required to be worn, it is worn by miners exposed to sound levels required to be integrated into the miner's dose measurement: i.e., sound levels above 80 dBA. The hearing protector is to be fitted and maintained in accordance with the manufacturer's instructions. Hearing protectors and necessary replacements are to be provided by the mine operator at no cost to the miner. Finally, should the hearing protector cause or aggravate a medical pathology of the ear, the miner is to be allowed to select a different hearing protector from among those offered by the mine operator.

Selection of Hearing Protector

The proposal requires that if hearing protectors are required to be provided to miners for any reasons, the mine operator shall provide a choice of one earplug type and one muff type, and ensure proper fit. Earmuffs include both active and passive; earplugs include disposable earplugs, pre-molded earplugs, custom-molded earplugs, and canal caps. The proposal also requires that the training in hearing protection specified in proposed § 62.130(a) be received at least once before the miner has to make a choice: to ensure the miner understands the choices available.

While these requirements are limited, they will help to significantly encourage hearing protector use and effectiveness. The proposal does not seek to constrain mine operator selection of protectors. As noted herein, hearing protectors come in a wide variety, for different purposes, and with different attenuation values. MSHA believes that mine operators have an incentive to provide a wide variety of types to encourage safe and effective use.

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 given the opportunity to select from a variety of suitable hearing protectors provided by the employer; however, the variety is not defined. OSHA states in the 1981 preamble to its Hearing Conservation Amendment (46 FR 4152) that ''The 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.''

In its ANPRM, MSHA asked whether mine operators should be required to make available a selection of hearing protectors. Almost all of the commenters on this issue were in favor of this provision. Some specifically recommended that the mine operator provide a choice of at least three different models, including at least one earmuff and one earplug. One commenter suggested that the selection should include at least six models. Most commenters indicated that the need to provide a variety of hearing protectors is more related to fitting and comfort than on the labeled attenuation per se.

One commenter recommended against providing a variety of hearing protectors, stating that ''It is the responsibility of the mine operator to evaluate the various noise exposures, and to select the appropriate HPDs [hearing protectors].'' The commenter maintained that the mine operator should only have to provide an alternative hearing protector when the individual has a specific condition which precludes the use of the selected hearing protector.

Several commenters addressed the need to allow the miner to choose a hearing protector that is comfortable. One commenter stated that:

> The most effective hearing protector is one that is worn and worn properly. If the hearing protector is not comfortable or the employee cannot wear a certain type of plug or muff, then the hearing protector will not be worn and the HCP will not be effective.

Another commenter maintained that ''* * * the principal usage problem with HPD's is that because of discomfort, interference with necessary communication, and interference with normal work routines, many HPD's are not worn.'' While another commenter stated:

> The performance of hearing protectors in the field (including the manners in which they are used, not used, or misused by workers in situations in which HPDs are needed, but are uncomfortable, unsafe, or otherwise inconvenient) is frequently inferior to their performance when tested in idealized laboratory conditions and there are substantial variations among individual susceptibilities to noise-induced hearing loss [NIHL].

The National Hearing Conservation Association's Task Force on Hearing Protector Effectiveness (Royster, 1995)

recommends that the employer consider many criteria when selecting the variety of hearing protectors from which workers are to choose. 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 hearing protector's noise reduction, wearer's daily noise exposure, variations in sound level during a work shift, user preference, communication needs, hearing acuity of the wearer, compatibility with other safety equipment, wearer's physical limitations, and climate and working conditions. Physical limitations (missing fingers, arthritis, limited hand strength) may restrict users from properly inserting compressible foam earplugs in their ears.

Berger (1986) stated that comfort must be considered when selecting hearing protectors. If the laboratory attenuation of a hearing protector is very high, but it is uncomfortable to wear, the actual in-use attenuation may be reduced or even nonexistent. Conversely, a comfortable hearing protector with less attenuation may be worn consistently, thereby providing greater effective protection.

In EARLOG 8, Berger (1981) asserted 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.

In the report, *Communication in Noisy Environments* (Coleman et al., 1984), the authors stated that:

> Although acceptability is in part governed by the comfort of the devices, there are other factors such as concern with hygiene, belief in (real or presumed) communication difficulties, and social constraints which 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.

The authors further stated that:

> In general, ear inserts [earplugs] appear less attractive than circumaural protectors [earmuffs] for mining conditions. A helmet mounted circumaural protector is to be preferred on grounds of comfort, ease of fitting and removal, reliability of attenuation, and acceptability in terms of hygiene; whereas ear inserts of the compressible foam type may produce marginally less interference with communication and they will impair localization less, they are likely to be more comfortable in hot and humid conditions.

Pfeiffer (1992) suggested that greater care be exercised when selecting hearing protectors for workers experiencing hearing loss. Pfeiffer stated that it is important not to overprotect the worker which can cause difficulty in communicating. If this happens, the worker will be reluctant to wear the hearing protector.

MSHA recognizes that local mine conditions such as dust, temperature, and humidity can cause one type of hearing protector to be more suitable than another. For example, under normal mining conditions, some miners may experience problems with earmuffs because of a buildup of perspiration under the seals.

Based on such factors and on comments received in response to the ANPRM, MSHA concluded that the minimum selection appropriate to offer miners with normal hearing consists of at least one type of earmuff and one type of earplug. MSHA expects that each hearing protector in the selection would provide adequate attenuation. Further, a consensus of the U.S. armed services and international communities agrees that workers should choose from a selection of several hearing protectors.

If miners are allowed to choose from a selection of hearing protectors, particularly if given appropriate training as is required under this proposal, they will be more apt to wear and care for them in such a manner as to obtain the maximum amount of protection. Providing miners with a choice from a selection of hearing protectors will foster greater acceptance and use. Further, MSHA recognizes that a trial period may be necessary for the miner to determine if using the selected hearing protector for a prolonged period causes significant discomfort. If significant discomfort occurs, MSHA encourages the mine operator to allow the miner an opportunity to select an alternate hearing protector. Selection of an alternative hearing protector is mandatory under the proposal if required by a medical condition.

There are several factors which the affected miner needs to consider before choosing a hearing protector from the selection offered, and which miners will learn about through the training specified under proposed § 62.130(a). These factors include—

(1) Hearing protectors must fit properly to provide the estimated amount of protection;

(2) People have all shapes and sizes of ear canals, and fitting commonly used earplugs to an unusually shaped ear canal may be uncomfortable or harmful to the individual. For those earplugs which need to be fitted to the size of the ear canal, all available sizes of that earplug should be available for fitting and use. Some employees may need a different size for each ear when their ear canals are of a different size or configuration; and

(3) Hearing impaired miners may need special hearing protectors which provide adequate attenuation, yet permit auditory reception.

With regard to the latter, MSHA is not at this time proposing that any special type of hearing protector be provided, nor any type of protector be excluded, for those miners who are already hearing impaired. However, MSHA will endeavor to ensure operators understand that special care should be taken in providing a hearing protector for the safety of a miner with a significant hearing loss. Most earplugs and earmuffs attenuate sound unequally across all frequencies and are most effective at attenuating high frequency sounds. Hearing loss due to noise and aging reaches its peak at the higher audiometric frequencies. Because of these factors, a miner wearing a hearing protector, without specific accommodation for any significant hearing loss, would hear distorted auditory signals which would significantly hamper communication. A miner, with a significant hearing loss and wearing hearing protectors, could be placed in a hazardous situation because he/she could not hear or comprehend an audible warning.

Although some commenters have recommended the use of communication type hearing protectors for hearing impaired miners, MSHA will caution mine operators against their use in very high noise areas because the sound level produced under the cup may be hazardous. Some manufacturers of communication type hearing protectors, however, have placed limiters in the electronics to protect against the speaker in the cup producing hazardous sound levels.

Even though some researchers have indicated that using a hearing protector may cause communication problems for an impaired miner, commenters have presented many practical ways of resolving this problem. Consequently, MSHA chose not to propose specific requirements regarding hearing protectors for impaired miners to allow the mine operators maximum flexibility.

MSHA solicits comments on whether mine operators should be required to provide an additional type of hearing protector, such as flat response, level dependent or active noise control earmuff, for miners with a hearing impairment, or whether any type of protector should be explicitly excluded for such miners.

Hearing Protector Effectiveness

MSHA received many comments on the attenuation, or effectiveness, of hearing protectors. The issue arises in a number of contexts, including what role a hearing protector's attenuating characteristics should play in the selection of the most appropriate hearing protector in those cases requiring hearing protection.

While MSHA recognizes the importance of proper selection, MSHA has decided not to incorporate specific procedures into its proposal on rating the effectiveness of hearing protectors. Based on the information presented herein, MSHA has concluded there is not presently a generally acceptable method of predicting hearing protector attenuation in the field. Moreover, MSHA has determined that there are other factors which are equally or more important than a hearing protector's attenuation for ensuring that a miner is protected from NIHL. These factors include: (1) comfort, (2) training, (3) fit, (4) maintenance, and (5) consistent use.

Nevertheless, MSHA realizes the merits of having a valid methodology for determining the attenuation of hearing protectors—for a variety of reasons, including facilitation of the selection of the most appropriate hearing protector when selection and use is required. The Agency, therefore, solicits comments on a scientifically based, yet practical, method for determining the effectiveness of hearing protectors as used under mining conditions. In addition, comments on field estimates of hearing protector attenuation, especially the NIOSH (1995) derating scheme, are encouraged.

Current MSHA regulations do not explicitly address this issue. MSHA policy, however, specifies a procedure for calculating a hearing protector's effective attenuation based upon the Noise Reduction Rating (NRR) provided by the manufacturer. Manufacturers currently determine an NRR for each hearing protector from laboratory testing in accordance with EPA regulations (40 CFR § 211.206 and § 211.207). The NRR is intended to provide an estimate of the noise reduction achievable under optimal conditions and was designed to be used with C-weighted sound levels. Because MSHA measures noise exposure with A-weighting instead of C-weighting, it adjusts the NRR by subtracting 7 dB. As reported by Maraccini (1987), this 7-dB adjustment accounts for the average difference between the C-weighted and A-weighted sound levels in mining.

OSHA's standard does specify the hearing protector attenuation required. Under OSHA's standard, attenuation must be sufficient to reduce an employee's noise exposure to a TWA_8 of 90 dBA; except that if the worker is experiencing an STS, then the hearing protector must reduce the noise exposure to a TWA_8 of 85 dBA. Employers are required to use one of four methods to determine the noise exposure beneath the hearing protector. These methods are NRR and NIOSH methods 1, 2, or 3 as described in the ''List of Personal Hearing Protectors and Attenuation Data,'' HEW Publication No. 76–120, NIOSH 1975, pp. 21–37. The NRR is the most convenient method to use and is a simplification of NIOSH method 2. In addition, when the NRR is to be used with A-weighted sound levels, OSHA requires that 7 dB be subtracted from the NRR.

As noted in connection with the discussion of proposed § 62.120(c), where an employer wishes to take advantage of OSHA's policy of not citing overexposures when, among other factors, adequate hearing protection is being used, a more stringent method of determining the effectiveness of hearing protectors is used by OSHA. In evaluating hearing protector effectiveness in this context, OSHA also subtracts 7 dB from the hearing protector's stated NRR to adjust for the difference in weighting systems, but further derates the NRR by 50%. All types of hearing protectors are treated the same way. The derating is done to account for the significant reductions, which various researchers have found, in hearing protector attenuation under industrial conditions when compared to laboratory conditions.

One commenter to MSHA's ANPRM indicated that laboratory protocols have been developed and are being tested which may be more representative of the actual field performance of hearing protectors, but noted that validated and agreed upon standardized procedures are still some years away. This commenter stated:

> The real-world attenuation data which form the basis for our criteria are taken from Berger's summary (1983) of 10 field studies, utilizing 1551 employees, wearing seven different types of earplugs and greater than nine different types of earmuffs, in over 50 different industries, and his more recent paper (Berger, 1988) which discusses additional current studies. Although the data can be separated by plugs and muffs, the variability within the plug category is such that some of the better attenuating earplugs overlap with the earmuffs. Therefore, for a general regulatory guideline, the data averaged across all HPDs and employee subjects is taken from the two papers. This results in an NRR_{84} of approximately 10 dB (i.e., the NRR computed with a one-standard deviation correction which estimates the protection at the 84th percentile).
>
> Since the NRR is meant to be subtracted from the C-weighted sound level, and the regulation is formulated in terms of A-weighted levels, an indicator of representative C–A values for the mining industry is then required. The 100 NIOSH noises (NIOSH, 1975) which have often been taken to be representative of general industry have median C–A of about 2 dB, and 90% have C–As of <6.5 dB. However, mining noises may exhibit greater low-frequency energy. For example the data in Kogut (1990) which represent 17 different types of equipment in the metal/nonmetal mining industry (coal excluded), show a mean C–A of 6.7 dB, but the Kogut values are not a statistically representative sample of the mining industry. For our purposes we will average the two estimates and presume a median C–A for mining of 5 dB.
>
> With an NRR for 84% of the users of 10 dB, and C–A value for typical mining noises of 5 dB, the credit for HPD attenuation for most of the users in the typical mining noises is 10 − 5=5 dB. Adding this value of 5 dB to the PEL of 90 dBA sets the second cutoff level of 95 dBA.

This commenter also stated that NRR's do not provide a good indication of either relative or absolute field performance; thus, ''there is no good way to accurately derate existing lab data to predict field performance.''

In The NIOSH Compendium of Hearing Protection Devices (1994) several sets of laboratory measured attenuations, besides the NRR, are listed. These data were obtained using different standardized methods. NIOSH presents examples of using each method to estimate the sound level beneath the hearing protector. In addition, NIOSH presents physical features (i.e., number of flanges, composition, compatibility with other personal safety equipment, etc.) of the hearing protectors.

NIOSH (1995) recommends a derating scheme based upon the type of hearing protector. NIOSH acknowledges that hearing protector wearers do not attain the laboratory attenuation in industrial situations. Accordingly, they recommend that to ascertain the effectiveness of a hearing protector in workplace use, the NRR for an earmuff, formable earplugs, and all other earplugs would be derated by 25%, 50%, and 70%, respectively.

The National Hearing Conservation Association's Task Force on Hearing Protector Effectiveness (Royster, 1995) recommends that the EPA's NRR for hearing protector attenuation be replaced with a new NRR(SF), which the researchers felt more realistically reflects the field performance of hearing protectors. The NRR(SF)'s are determined by laboratory testing for hearing protector attenuation after the

subject fits the hearing protector to his/her head. This differs from the EPA's NRR value which is determined after the researcher fits the hearing protector to the subject. Regardless of the method used, the amount of attenuation provided by a hearing protector will vary among the individual subjects resulting in a range of attenuation values. The Task Force stresses that it is not possible to predict the field attenuation of a given hearing protector for an individual; it concluded, however, that the NRR(SF) would be a more realistic estimate. In addition, small differences (less than 3 dB) in the NRR or NRR(SF) are not believed to be of practical consequence. The Task Force recommends continued audiometric testing whenever hearing protectors are used.

MSHA notes that the American Industrial Hygiene Association (AIHA, 1995) recently sent the EPA a letter requesting that the EPA revise its rule on noise labeling requirements for hearing protectors. The reasons cited for requesting a revision of EPA's NRR rating system included—(1) the current method of rating hearing protectors overestimates the actual workplace protection from 140 to almost 2000 percent; (2) the inability to predict absolute levels of protection from labeled values; (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; and (5) there is no requirement for quality assessment or accreditation of the test laboratory.

Michael (1991) believed that the simplification needed to obtain a single number rating (NRR) caused it to be inaccurate. Instead of the NRR, the researcher recommended using the spectra of the noise in conjunction with the attenuation characteristics to select the most appropriate hearing protector. This is even more important when the wearer has sensorineural hearing loss.

Many field studies on the attenuation of hearing protectors have been conducted in the mining industry by Giardino and Durkt (1996), Kogut and Goff (1994), Giardino and Durkt (1994), Bertrand and Zeiden (1993), Durkt (1993), Goff et. al. (1986), Durkt and Marraccini (1986), Goff and Blank (1984), and Savich (1979). With the exception of Bertrand and Zeiden (1993), these researchers reported that hearing protectors provided much less attenuation than that measured in the laboratory. Some researchers tested new earmuffs while others tested old earmuffs. In many instances attenuation was minimal and highly variable. These studies indicate that hearing protector attenuation cannot be reliably predicted under actual use conditions and is substantially less than that indicated by the NRR from the manufacturer.

Bertrand and Zeiden (1993) determined the effectiveness of hearing protectors by measuring the hearing level of miners exposed to sound levels exceeding 115 dBA. These researchers found that although the hearing protectors provided less attenuation, the difference was not significant. For example, miners exposed to 118 dBA had hearing levels consistent with exposure to 98 dBA. Therefore, the hearing protector whose NRR was 24 provided 20 dBA of attenuation.

Durkt (1993) studied the effectiveness of 11 models of new earmuffs using miniature microphones inside and outside the cups. At surface mines, 107 tests were conducted on operators of equipment, including bulldozers, front-end-loaders, and overburden drills. Durkt concluded that the effectiveness of the earmuff was related to the noise spectrum. Moreover, the measured noise reduction was much less than the NRR when the noise spectrum contained significant amounts of low frequency noise. Most diesel-powered equipment generate noise which is primarily in the low frequency range.

Kogut and Goff (1994) studied the effectiveness of earmuffs being used in both surface and underground mines. A total of 540 tests were conducted on miners 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 afforded 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.'' Furthermore, a simple method of reliably predicting the effectiveness of earmuffs eluded the researchers. A complex method was developed for predicting the effectiveness of earmuffs; however, it lacks practicality.

Giardino and Durkt (1996) and Giardino and Durkt (1994) expanded on the previous two discussed studies. A total of 1,265 tests were performed on 545 different machines (20 different machine types). According to the researchers, earmuffs provided minimal noise reduction for the operators of equipment powered by internal combustion engines. The researchers concluded that the NRR was a poor predictor of earmuff performance under actual mining conditions. Furthermore, they reported that the NRR is not a good indicator for comparing different models of earmuffs.

Numerous 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) indicate that hearing protector effectiveness is substantially less than the NRR value indicated by the manufacturer.

Furthermore, Regan (1975) found that earmuff type protectors yield the most attenuation and custom molded earplugs the least. Behar (1985) found that the measured NRR, in industrial situations, averaged 14.9 dB lower and reached 25 dB lower than the manufacturer's nominal value. Green et al. (1989) reported workers, who were using earplugs, were receiving one-third to one-half of the laboratory based NRR value and workers enrolled in an effective HCP obtain greater attenuation from their hearing protectors. Crawford and Nozza (1981) reported that the average attenuations of the earplugs were typically 50% of the manufacturer's values, except for user-molded earplugs whose field attenuation was near the laboratory values.

Lempert and Edwards (1983) reported, ''In the majority of cases, workers received less than one-half of the potential attenuation of the earplugs'' and concluded, ''Regardless of the type of earplug used by a particular plant, a large portion of the workers received little or no attenuation.''

Hempstock and Hill (1990) reported that the workplace performance of earmuffs more closely approximated the laboratory performance than earplugs. For both earmuffs and earplugs, the measured workplace attenuations were lower and the standard deviations higher than those measured in the laboratory. The researchers attributed these results to the ease of fitting an earmuff compared to fitting an earplug. Their study revealed that the degradation was dependent upon the model of hearing protector and even differed between sites. Another result was that safety glasses substantially degraded the performance of earmuffs. Workers wearing safety glasses received approximately one-half of the laboratory attenuation. However, the researchers did not find that headband tension was a factor in the attenuation of earmuffs.

Royster et al. (1996) found that the wearing of safety glasses reduced the attenuation of earmuffs by about 5 dB at all frequencies.

Pfeiffer (1992) reported on studies of hearing protector effectiveness in

German industry. According to Pfeiffer earplugs provided between 10 and 15 dB less attenuation and earmuffs about 6 dB less in industry than in the laboratory. As part of the study, used muffs, which were not obviously defective (e.g., missing liners, headbands stretched out of shape, cushions missing or broken), were tested against new ones. The older earmuffs provided significantly less attenuation than new ones. The degradation of attenuation was dependent upon the model and frequency tested and exceeded 7 dB for some frequencies.

Abel and Rokas (1986) reported that the attenuation of earplugs decreases as a function of wearing time and that head and jaw movement hastened the decrease. At Noise-Con 81, Berger (1981) also concluded that the performance of hearing protectors decreased as a function of wearing time. Kasden and D'Aniello (1976, 1978) found that the custom molded earplugs retained their attenuation after three hours of use during normal activity; however, typical earplug performance degraded over the three hours of use. Krutt and Mazor (1980) reported that the attenuation of mineral down earplugs decreased over a three-hour wearing period. These researchers did not observe any degradation of the attenuation of expandable foam earplugs. Cluff (1989) investigated the effect of jaw movement on the attenuation provided by earplugs and, determined the change in attenuation was dependent on type of earplug. The self-expanding viscose foam earplugs retained more of their attenuation than multi-flanged or glass-fiber earplugs. Casali and Grenell (1989) tested the effect of activity on the attenuation provided by an earmuff and found that only at 125 Hz was there a significant degradation in attenuation. Furthermore, the attenuation of an earmuff was highly dependent upon the fit.

Royster and Royster (1990) report that the noise reduction rating (NRR) cannot be used to determine, or rank order, the real world attenuation of hearing protectors. Two individuals, using the same model of hearing protector, can obtain vastly different levels of attenuation. Royster and Royster stated that ''Products that are more goof-proof (earmuffs and foam earplugs) provided higher real-world attenuation than other HPDs.''

Casali and Park (1992) reported that the noise attenuation at 500 or 1000 Hz showed a high correlation with the total noise attenuation of hearing protectors. Therefore, the researchers believe that models can be developed to predict the total attenuation of hearing protectors based upon the measured attenuation at a single frequency. This would eliminate the need to derate the NRR so that it accurately reflects the field attenuation. The prediction method, they believe, will provide information on the adequacy of the worn hearing protector and can be used in objectively fitting the hearing protector.

Berger (1992) reported on the progress of the ANSI Working Group S12/WG11, ''Field Effectiveness and Physical Characteristics of Hearing Protectors'', on developing or identifying laboratory and/or field procedure(s) which yield useful estimates of field performance of hearing protectors. The Working Group was established to address the clearly demonstrable divergence between laboratory and field attenuations of hearing protectors.

Berger also summarized the results of 16 studies involving over 2,600 subjects on the field attenuation of hearing protectors. Earplug attenuation averaged about 25% of the published U.S. laboratory attenuations (range 6 to 52%) and earmuff attenuations averaged about 60% of the laboratory attenuations (range 33 to 74%).

Royster et al (1996) reported on the progress of the American National Standards Institute Working Group (S12/WG11) charged with developing a laboratory methodology of rating hearing protectors which reflects the attenuation obtained by workers. Hearing protector attenuation measured using this methodology reflects the attenuation achieved by workers in a well managed hearing conservation program. The Working Group has developed a methodology and is in the process of drafting an ANSI standard around it. However, it will be some time before the standard is adopted. Even if the standard is adopted, there will be some legal ramifications, as the EPA would have to append their regulations to adopt this standard as the method for rating hearing protectors. As part of the testing of the methodology, the researchers found that the instructions which manufacturers include with their hearing protectors may be inadequate. Some of the test subjects could not properly don the earplug, from simply reading the manufacturer's instructions.

As demonstrated above, many researchers have developed standardized methods of measuring the attenuation of hearing protectors in a laboratory setting. In addition, many researchers have compared the results of laboratory attenuations to estimated or measured field attenuations. However, based on a review of the major studies, MSHA notes that researchers have yet to develop standardized tests for measuring the field attenuation of hearing protectors.

MSHA is cognizant of the potential for increased use of diesel equipment in mines in coming years. Diesel engine noise, a common mining noise control problem, is predominantly low frequency noise. In this regard, the Agency notes that hearing protectors are generally more effective in reducing high frequency noise than low frequency noise. Thus, noise from diesel engines contains the frequencies where hearing protectors are least able to attenuate the noise. The consequence is that hearing protectors poorly protect workers from excessive noise exposure when the source of the noise is a diesel engine.

Some special hearing protectors, notably flat response hearing protectors, attenuate the sound across all frequencies the same. In developing a flat response hearing protector, the manufacturer degraded the attenuation at the high frequency instead of enhancing the low frequency attenuation.

MSHA has concluded that at this time there is not a consensus among the scientific community as to a reliable method of predicting the actual attenuation received from hearing protectors in the mining environment. Additionally, experience indicates that miners do not receive the full attenuation measured in the laboratory (NRR). Research data indicate that many workers receive only a small fraction of the NRR. Therefore, the Agency has determined that one cannot rely solely on the EPA's NRR value.

Because of the lack of an acceptable method of predicting hearing protector attenuation in the field, MSHA chose not to include a method for determining the adequacy of hearing protectors in the proposed noise regulations.

It should be noted that in order to ensure hearing protection devices have undergone testing to ensure quality, MSHA is proposing that the definition of ''hearing protector'' permit only devices having a ''scientifically accepted indicator of noise reduction value.'' The Agency solicits comments as to alternatives to the NRR that could be used in this regard.

Wearing of Hearing Protectors

Proposed § 62.120 would require that hearing protectors must be worn in certain cases: if noise exceeds the action level and a baseline audiogram has not taken place within 6 months after the exposure is determined; if an STS has been detected; and whenever a miner is

exposed to noise levels above the PEL. In such cases, proposed § 62.125 would provide that the hearing protectors must be worn when the miner is ''exposed to sound levels which are required to be integrated into a miner's noise exposure measurement.'' This means that if a miner is required to wear hearing protectors, those protectors must be worn when that miner is exposed to sound levels above 80 dBA; sounds above that level have been demonstrated to be harmful, while such a demonstration has not been made for sound levels less than 80 dBA.

MSHA recognizes that mine operators may want to develop particular policies on exactly when hearing protectors can be removed, and sees no need to delimit how this might be done. This practical approach, when taken together with the proposed requirements for employee training about hearing protectors and ensuring selection and proper fit of hearing protectors should facilitate the appropriate use of hearing protectors.

Both MSHA's and OSHA's existing standards require that hearing protectors be worn when the employee's noise dose exceeds permissible levels. Neither standard, however, specifies a sound level below which workers could remove their hearing protectors. Although MSHA received general comments on levels above which hearing protectors should be worn, MSHA did not receive any specific comments addressing wearing practices or under what conditions it would be safe to remove a hearing protector.

As has been emphasized, hearing protectors are only effective if they are worn. Chart NR1 illustrates that the amount of attenuation provided is highly dependent upon the duration a hearing protector is worn.

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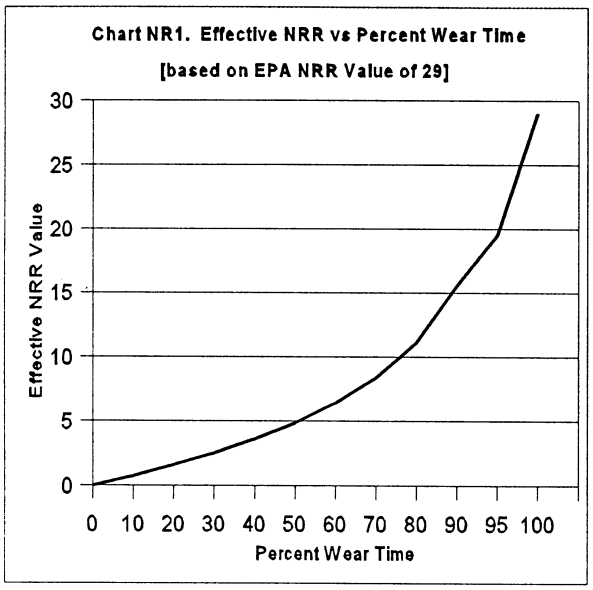

Chart NR1 demonstrates that if a hearing protector with an NRR of 29 dB is worn only half the time, the wearer will effectively obtain only about 5 dB of attenuation. Thus, it is critical for mine operators to ensure that the hearing protectors provided are worn. An NRR of 29 dB is among the highest NRR values reported by hearing protector manufacturers.

Although MSHA did not ask a specific question in its ANPRM on monitoring effective usage of hearing protectors, several commenters recommended that MSHA require mine operators to supervise the proper wearing of hearing protectors.

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 had a deleterious effect on the attenuation.

In EARLOG 8, Berger (1981) contends that persons, who are more prone to otitis externa (infections), would need to be monitored more closely for failure to wear their hearing protectors. Persons with a medical pathology of the ear are more likely to resist wearing a hearing protector because of pain or extreme discomfort associated with its use.

Based on the comments received and MSHA's experience, one critical factor impacting on miner use is their concern that wearing hearing protectors can, under some circumstances, create serious safety risks. Apart from the information previously noted in connection with the discussion of the proper selection of a hearing protector by miners already suffering hearing loss, there is the issue whether hearing protectors diminish the ability of even miners with good hearing to hear ''roof talk.'' Prout et al. (1973) stated that:

> Personal ear protectors do not generally prevent a miner from hearing and analyzing roof talk when the noise level [sound level] is sufficiently high as to require the use of ear protectors. However, the ability to interpret roof warning signals is degraded by the use of ear protectors in quiet. Consequently, ear protectors should be removed when the noisy machines are shut down.

MSHA is reviewing its own records for further information on the effect of hearing protectors on safety, and welcomes further information from commenters. Of course, MSHA recognizes that failure to wear hearing protectors may accomplish nothing in some cases. For example, if some surface haulage fatal accidents result because high sound levels from mining machinery mask the backup alarms, taking off hearing protectors is not going to make the working environment any safer. Indeed it is more likely that the miner would suffer a temporary threshold shift which would make it

even more likely the backup alarm was missed.

MSHA's review of the literature and codes revealed that the U.S. armed services and many international communities have specified sound levels above which hearing protectors must be worn.

MSHA believes proposing 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. A more practical approach would be for 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 permit miners to remove their hearing protectors in areas with low sound levels (below 80 dBA). This would minimize the miner's feeling of isolation and communication difficulties caused by the wearing of hearing protectors in such areas. As previously presented, most researchers have indicated that sound levels below 80 dBA are not hazardous.

The Agency, however, requests additional comment on this issue, and, as noted above, on the specific issue of whether hearing protection can be a safety hazard.

Fitting of Hearing Protectors

The proposal would require that mine operators ensure that hearing protectors be fitted in accordance with manufacturer's instructions.

MSHA's existing noise standards do not address requirements for fitting hearing protectors. OSHA's existing standards require that employers ensure proper initial fitting and supervise the correct use of all hearing protectors.

Many commenters on this issue recommended fitting.

Most of these specified use of the manufacturer's instructions for fitting. A few of these specifically recommended that miners be fitted by individuals trained in the fitting of hearing protectors. Other commenters did not recommend fitting per se, but recommended that mine operators provide a variety of types and sizes of hearing protectors to ensure proper fit.

Several commenters indicated that some types of hearing protectors do not require fitting. One commenter recommended use of Audiometric Data Base Analysis (ADBA) to determine hearing protector effectiveness. Other than ADBA, this commenter believed that there was insufficient data at this time to recommend a criterion for proper fitting.

In EARLOG 17, Berger (1985) recommends that ''Prior to issuing HPDs the fitter should visually examine the external ear to identify any medical or anatomical conditions which might interfere with or be aggravated by the use of the protector in question.''

In *Communication in Noisy Environments,* Coleman et al. (1984) stated:

> If a protector cannot be removed or fitted easily and quickly, it may be either left on when not needed, possibly impairing communication * * * or not fitted when needed, reducing the protection from noise exposure. Ease of fitting is therefore a desirable attribute for coal mining conditions.
>
> Sweetland (1981) found that circumaural protectors were removed and replaced more often than earplugs in mining conditions, which could be taken as an indication that the former devices were easier to fit and use. * * * Factors, such as the time required to hold a compressible foam plug in position for it to achieve its design performance, and the procedure required to fit inserts correctly, which involves reaching around the back of the head to grasp the earlobe, can reduce their acceptability for mining conditions.

At Noise-Con 81, Berger (1981) reported that the attenuation was greater when noise was used to help in the fitting of hearing protectors although the variability was not significantly greater.

Carter and Upfold (1993) investigated methods of determining the attenuation provided by foam earplugs. Both an earmuff with an earphone and a cushion with an earphone gave results comparable to the standard laboratory method and could be used to estimate the group attenuation of foam earplugs. However, the results of the measured attenuation for individuals were not as good as that for the group. The researchers, therefore, concluded that neither method with earmuffs or cushions could be used to determine the attenuation provided by a foam earplug to an individual, although the methods could be used to check the effectiveness of fitting and training of a group.

Merry et al. (1992) reported that subjects obtained greater attenuation from earplugs if an experimenter directs the fitting using the subject's response to noise when compared to subjects simply reading the manufacturer's instructions and inserting their own earplugs.

Chung et al. (1983) reported that the major factor affecting the earmuff performance was the fit which is dependent upon headband tension. Adequate tension is necessary for good attenuation. However, high headband tension generally caused discomfort. The same occurred when the earmuff seal was cracked. However, no effect of the age of the earmuffs was observed. Chung et al. concluded that training and proper fitting can increase the effectiveness of earmuffs, thus protecting workers from incurring noise-induced hearing loss (NIHL).

Phoon and Lee (1993) studied workers who developed NIHL in Singapore. For 103 of 156 earplug users (66%) who developed NIHL, there was a mismatch between the earplug and the size of both ear canals. In 13.5% of these workers, the mismatch occurred in one ear.

Royster et al. (1996) reported the manufacturer's instructions were not always adequate in describing the procedures for donning a hearing protector. Several subjects improperly inserted earplugs during a laboratory experiment of hearing protector attenuation. The inappropriately inserted earplugs would be considered improperly fitted hearing protectors.

ANSI S3.19–1974, ''Method for the Measurement of Real-Ear Protection of Hearing Protectors and Physical Attenuation of Earmuffs'', recommends that 60 to 70 dB white noise be used when the subject fits a hearing protector. White noise has essentially a random spectrum with equal energy per unit frequency bandwidth over a specified bandwidth.

As described above, researchers have identified several techniques for both subjectively and objectively evaluating the fit of hearing protectors. While many of the techniques show promise, there is no consensus as to which method is best. Most techniques are applicable to a specific type of hearing protector and are not practical for use by many mine operators. These techniques are discussed further under the *Hearing Protector Effectiveness* section of this preamble.

MSHA also considered the use of ADBA (Audiometric Data Base Analysis) to determine the effectiveness of hearing protectors in lieu of subjective fitting requirements. Since ADBA does not provide immediate feedback as to the fit of a hearing protector, MSHA has concluded that ADBA is inappropriate for determining the fit of a hearing protector. ADBA analysis requires multiple subjects, not an individual, before a conclusion of adequacy is determined. Besides ADBA determines the adequacy of the HCP (protecting the hearing acuity of a group of workers), not the adequacy of protecting an individual. Moreover, MSHA believes that ADBA is not practical for most mining operations as discussed under the *Evaluation of HCP effectiveness* section of this preamble. Furthermore, ADBA requires several audiograms which are conducted on an

annual basis. In the interim, the hearing acuity of a miner could be irreversibly damaged.

As supported by the researchers and many commenters, 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. Further, MSHA is concerned that some manufacturer's instructions are not adequate to ensure the proper fitting of a hearing protector. Although comfortable hearing protectors should be provided, MSHA is also concerned that some miners may choose hearing protectors that are too loose or otherwise improperly fit, and consequently not achieve adequate noise reduction.

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 concluded that the manufacturer's instructions are the best criteria for fitting. MSHA encourages commenters to provide information on any standardized methods of testing the fit of hearing protectors.

Maintenance of Hearing Protectors

MSHA's proposal would also require mine operators to ensure that hearing protectors are maintained in accordance with manufacturer's instructions. Neither MSHA's nor OSHA's existing noise standards address requirements for maintaining hearing protectors.

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, it is easier for microorganisms normally found in the ear to invade the skin. When hearing protectors are implicated as the cause of inflammation of the external ear canal (otitis externa), often the hearing protector is contaminated with an irritating or abrasive substance. This situation can be corrected with proper cleaning of the hearing protector before use.

MSHA's proposal is designed to ensure that miners not develop medical problems while they are attempting to protect themselves from the hazard of noise. If an earplug cannot be adequately cleaned, then the mine operator would have to replace it.

In addition to providing guidance on the fitting of hearing protectors, manufacturers also provide instructions on the proper care and cleaning of their hearing protectors. Many recommend soap, warm water, and careful rinsing. Solvents and disinfectants generally are discouraged 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 would just be a matter of applying common sense, i.e., cleaning the hands before rolling and/or inserting earplugs.

Several commenters addressed hygiene problems when the hearing protectors become dirty. One of these commenters stated that miners would need to clean their permanent hearing protector daily and that irritation due to sweating and skin contact with the hearing protector can be a problem associated with its use.

In EARLOG 5, Berger (1980) states that permanent [non-disposable] hearing protectors should be replaced between two and 12 times per year. The constant wearing of hearing protectors causes them 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, can shrink, or can lose their elasticity.

As referenced in EARLOG 17 (Berger, 1985), Forshaw and Cruchley studied the effects of washing the hearing protectors worn by long-range patrol aircraft crews. The crews were divided into three groups: one group wore pre-molded earplugs; the second group wore foam earplugs washed after each use; and the third group wore foam earplugs which were washed weekly. Examinations by medical officers revealed no fungal or clinically significant bacterial infections among the three groups.

MSHA also reviewed standards from the U.S. Armed Forces and the international community on the topic of hearing protector maintenance. The consensus of the standards was that damaged or deteriorated hearing protectors must be replaced.

Miners have also been known to alter the hearing protection provided to make them more comfortable. Such alterations have included cutting off the end of earplugs or stretching out the head-band on earmuffs. These alterations can significantly decrease the hearing protector's attenuation.

Hearing protectors can also be damaged from exposure to heat, cold, ozone, chemicals, or dirt. Such conditions are common in the mining industry, and mine operators must periodically check the hearing protectors provided and replace them when damage is found.

Hearing Protectors Provided at No Cost to Miner

The proposal would also require the mine operator to provide necessary replacements at no cost. This is intended to ensure that the mine operator repairs or replaces a miner's hearing protector when it becomes damaged or deteriorated to the point that the required protection is compromised.

MSHA believes that it is essential for mine operators to replace worn-out or damaged hearing protectors in order to maintain their effectiveness. This is in agreement with the international community and the U.S. armed services. Damaged or deteriorated hearing protectors do not provide their designed optimum amount of protection. Further, MSHA believes that the manufacturer's instructions are the best source of information as to the proper procedures for maintaining a particular protector.

MSHA's existing noise standards do not specifically address the replacement of hearing protectors. OSHA's noise standards simply require that hearing protectors be replaced as necessary.

MSHA received no direct comments to its ANPRM on the issue of mine operators supplying commercially available hearing protectors at no cost to the miner. However, several commenters supported adopting requirements similar to OSHA's which includes provisions for providing hearing protectors at no cost to the worker.

Replacement of hearing protectors would be based on the manufacturer's instructions, upon finding any deterioration that could adversely affect the hearing protectors attenuation, or upon a need for the miner to choose a different hearing protector due to a medical pathology caused or aggravated by the initial hearing protector provided (see following section which discusses medical pathology). For example, manufacturers of disposable earplugs may state in their instructions that they should be replaced after each use.

Replacement of Hearing Protector Due to Medical Pathology

MSHA's proposal would also require the mine operator to provide an individual miner with a different, more acceptable, type of hearing protector when presented with evidence of a medical pathology (e.g., otitis externa or contact dermatitis). The definition of ''medical pathology'' is intended to be broad enough to cover injuries. If, for example, a miner would suffer a burn in the ear canal which would preclude the wearing of earplugs, an employee who

elected earplugs should have the opportunity to now select a muff.

MSHA does not intend to require that the evidence of a medical pathology be a diagnosis by a physician specialist—nor to require mine operator action without any evidence whatsoever. The goal here is a practical one: exchange the hearing protector if there appears to be a medical problem. A preliminary diagnosis of medical pathology by a family physician or nurse should be accepted by an employer for the purposes of this requirement.

In EARLOG 17, Berger (1985) discusses some predisposing factors for otitis externa. These include allergy to chemicals or hair dyes and sprays; dermatitis; chronic draining middle ear infections; excessive cerumen (ear wax); and systemic conditions which lower the body resistance, such as anemia, vitamin deficiencies, diabetes, and endocrine disorders. Disposable hearing protectors may be warranted for those individuals prone to infections. The researcher reported that the prevalence of otitis externa is approximately 2% in both users and nonusers of hearing protectors. He stated that:

> Although hearing protection devices should not be worn in the presence of some preexisting ear canal pathologies, and care must be exercised regarding selection and use under certain environmental conditions, regular wearing of HPDs does not normally increase the likelihood of contracting otitis externa.

Furthermore, Royster and Royster in EARLOG 17 (Berger, 1985) reported on a situation in which underground miners in a warm and humid environment were experiencing otitis externa. Switching from a pre-molded vinyl earplug to a foam earplug decreased the incidence of this condition.

Although documented cases of hearing protectors causing infections in the ear canal or on the skin surrounding the ear are not prevalent, MSHA is aware of at least one reported case of an ear infection in the mining industry specifically attributed to the use of hearing protectors.

MSHA's existing noise standards do not specifically address the replacement of hearing protectors. OSHA's noise standards simply require 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 would also be at no cost to the miner.

Section 62.130 Training

Summary

Proposed § 62.130 would provide the specifications for instruction and certification of training required by the proposed rule. Proposed § 62.120 requires such training for all miners exposed above the action level, and annually thereafter if still exposed above that level. Proposed § 62.180 requires retraining for every miner who incurs an STS.

Miners would receive instruction in the value of hearing protectors, selection and fitting of protectors, and proper use of such protectors. Miners would also receive instruction as to the operation of an operator's hearing program and in the mine operator's noise control efforts. There are no special qualifications for instructors, nor any specifications on the hours of instruction. Training is required to be provided without cost to the miner. The mine operator would be required to certify the completion of any training required by this part, and maintain the most recent certification for a miner at the mine site for as long as the miner is required to use hearing protectors or be enrolled in an HCP, and at least 6 months thereafter.

MSHA considered whether the requirements of part 48, ''Training and Retraining of Miners,'' were adequate to ensure the training required under this part. The requirements of part 48 specify the initial and annual retraining of all miners in a list of subjects, many specified in the law itself (section 115 of the Mine Safety and Health Act). The importance of this training is emphasized by statutory requirements for the submittal of training plans, on the specification of the hours to be devoted to the training, and on the qualifications of instructors. Training is required on noise, but it is in general terms, covering the purpose of taking exposure measurements and on any health control plan in effect at the mine. Mine operators may provide additional training, but the topics that need to be covered often make this impracticable within the prescribed time limits.

After considering the available information about the importance and prevalence of training requirements, and based upon its experience in implementing the requirements of part 48, MSHA has determined that the requirements of part 48 do not provide adequate noise training for those miners for whom exposure is clearly a problem. Part 48 training is neither comprehensive enough to provide such miners with the level of education needed for the proper use of hearing protection devices, nor, in the case of noisy mines, detailed enough on methods to reduce sound levels.

Nevertheless, MSHA believes compliance with this proposal can in many cases be fulfilled at the same time as scheduled part 48 training. The Agency does not believe special language in proposed part 62 is required to permit this action under part 48, but welcomes comment in this regard. Mine operators who can do so are free to fulfill their training requirements under § 62.120 by covering the topics in initial and annual part 48 training, and so certify on the separate form required by this part. If incorporated into part 48, mine operators would, however, be required to submit a revised training plan to the local district office for approval. Some mine operators may not have room in their part 48 plans, however, to be able to incorporate these topics. Moreover, some training required under the proposal will clearly not fit within a regular schedule: e.g., the training required by § 62.180 whenever a standard threshold shift in hearing acuity is detected.

MSHA has endeavored to make the training requirements as simple as possible. If conducted separate from part 48, there are no specifications on trainer qualifications, no minimal training time, nor any training plans. If however the training is incorporated into part 48, then all applicable part 48 requirements will have to be met.

Background

Training requirements are a mainstay of mine safety and health. Although MSHA has no training requirements in its existing noise regulations, the general training requirements set forth in part 48 require basic training as to the purpose of taking noise measurements, and in any health (noise) control plans that are in effect at the mine.

Numerous commenters responding to MSHA's ANPRM, expressed considerable support for miner training on noise and its effects and believed that it is an essential element of any effective HCP. Many of these commenters specifically supported annual refresher training. Commenters differed, however, in their opinions as to how training could best be accomplished. Several commenters recommended that MSHA incorporate any training requirements related to this standard into MSHA's existing training requirements under 30 CFR part 48—Training and Retraining of Miners. A few commenters believed that the training requirements in MSHA's part 48 were adequate and that no additional instruction was needed.

One commenter suggests that the initial training class be limited to less than 10 individuals (Berger, 1988; Royster and Royster, 1985). Although training may best be accomplished in small groups, MSHA's proposal would not limit the size of any training classes.

There is considerable precedent for requiring training as part of noise control programs.

OSHA's noise standard has training requirements which are similar to those in MSHA's proposed noise standard with a few exceptions. These exceptions are discussed later in this section.

In OSHA's 1981 preamble (46 FR 4157), Morrill stresses the importance of worker education in overcoming workers objections to wearing hearing protectors. This document quotes a Dr. Maas as saying that, ''Supervisors must sell employees on the need and value of hearing protection devices. When employees understand what the protective measure is for, it will be accepted because the employee realizes it is for his own good.'' A number of comments to OSHA's Hearing Conservation Amendment (46 FR 4157) indicated that workers are reluctant to appear weak or ridiculous as a result of wearing hearing protectors. 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) and Royster et al., (1982)).

CAOHC (Miller, 1985) states the following regarding the need for training as part of an effective program (HCP):

> A critical component of the OHC [Occupational Hearing Conservation] program is the employee education program (EEP). In many respects, the EEP is the most important aspect of the OHC program since it is designed to increase the auditory consciousness of the employee regarding the hazardous effects of noise exposure and by so doing to get him to use effective forms of PHPD's [personal hearing protective devices] conscientiously and consistently. Such use of PHPD's will actually protect the worker's hearing, while the other aspects of the program, important as they are, will not do so. No amount of noise monitoring or audiometric testing, for example, will protect hearing.

MSHA also reviewed the training requirements set forth in international standards and those of the U.S. Armed Services. The consensus was that training was necessary; however, the training interval was not always specified.

Training About Hearing Protector Selection and Use

Section 62.130(a) specifically provides that the training is to include instruction in—

(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 care, fitting, and use of the hearing protector worn by the miner;

(5) the general requirements of the regulation;

(6) the 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.

OSHA requires annual training on the same elements except it does not require training on the requirements of its noise standard. It is MSHA's view, however, that some training on the requirements of the standard is necessary in order for employees to understand the role hearing protection plays in a broader protection scheme.

Purpose, Advantages, and Disadvantages of Hearing Protectors Offered

Instruction on this topic would help the miner make an informed choice as to which hearing protector to use. This basic instruction would be initially required when the mine operator first determines the miner's noise exposure exceeds the action level. Moreover, pursuant to proposed § 62.125, this instruction must be provided at least once before the miner must make a selection of a hearing protector. Furthermore, it would need to be repeated annually thereafter, because hearing protectors should be replaced periodically.

MSHA anticipates the training would address specific advantages and disadvantages of earmuffs, earplugs, and canal caps as they relate to the needs of the miner and the specific conditions at the mine. For example, an electrician who opts to use an earmuff must understand the need to use one with dielectric properties to minimize the chance of incurring an electrical shock when working around energized equipment. An over-the-head earmuff is unsuited for those miners required to wear hardhats: the earmuff would interfere with the wearing of the hardhat as the hardhat could not be placed over the headband. In addition, the mine operator should discuss the specific advantages and disadvantages of any special hearing protectors offered such as active noise reduction, level-dependent, flat-response, and notch-amplification hearing protectors, or a communication headset. For example, a miner with a sensorineural hearing loss in the higher frequencies may require a different type of hearing protector than a miner with a conductive hearing loss across all frequencies. Accommodating the hearing loss may require a level-dependent, active noise reduction, or notch-amplification hearing protector to improve the miner's ability to communicate and hear warning signals in a noisy environment. All miners need to understand the relative advantages and disadvantages of earmuffs and earplugs as they are not at all obvious: hence, the necessity for training.

Some advantages of earmuffs (circumaural hearing protectors) include: they are easily donned and removed by the miner when working in intermittent noise; they offer protection against dust in the ear canal; they are not easily misplaced or lost; they fit people with unusually shaped ear canals; and they can be worn over earplugs. Berger in EARLOG 3 (1980), and Coleman et al. (1984) reported that one major disadvantage of earmuffs is that they hinder a miner's ability to localize the direction of sounds. If the miner's safety depends on the ability to localize sounds, then this disadvantage would preclude the use of earmuffs. Other potential disadvantages of earmuffs include: discomfort; headache; a feeling of claustrophobia; excessive warmth and perspiration under the muff seal; and skin irritation. Earmuffs may present problems if the miner wears safety glasses or earrings. Eyeglass temples reduce the attenuation afforded by earmuffs.

In EARLOG 19, Berger (1988) states that the use of eyeglasses with an earmuff can break the seal of the earmuff and cause a loss of attenuation of up to 6 dB depending on the frequency of the noise.

Royster et al. (1996) tested the effect of wearing two different safety glasses on the attenuation of an earmuff. The researchers found that the attenuation was reduced by about 5 dB across all frequencies.

Barham et al. (1989) investigated the effects of safety glasses and hair on the effectiveness of earmuffs. The wearing of safety glasses decreased the noise reduction up to 4 dB depending upon the frequency. The glasses had slender and flexible wire-reinforced side frames so that the side frames would fit close to the head. Not only did the safety glasses decrease the average noise reduction, they also reduced the variability (standard deviation) of the

noise reduction realized among the individuals. The type of hair and its length influenced the noise reduction provided by earmuffs. Individuals with short hair realized up to 5 dB more protection, depending upon the frequency, than individuals with long or curly hair and beards.

Michael (1991) asserts that glasses with plastic temples may cause a loss of attenuation from 1 to 8 dB, due to breaking the seal of the earmuff. In some cases, this loss can be substantially reduced if small, close fitting wire temples are employed.

Nixon and Berger (1991) report that temples of eyeglasses reduce the efficacy of earmuffs normally by 3 to 7 dB provided the cushions of the earmuffs are in good shape. This effect varies among earmuffs and it also depends upon the style and fit of the eyeglasses. To minimize the effect of wearing eyeglasses, the temples should be as thin as possible and fit close to the side of the head.

Savich (1979) measured the noise attenuation of earmuffs. Because of long hair and safety glasses, the earmuffs provided less attenuation than expected based upon laboratory tests. Furthermore, head size has a significant influence on the attenuation because of different clamping forces. Increased clamping force increases the attenuation.

Some advantages of earplugs include: they are cooler, if the miner has to work in a hot, humid environment; they are more easily worn with safety glasses, hardhats, and other personal safety equipment (e.g., air-purifying or welding helmets); and they fit miners who have extremely large external ears. One disadvantage of an earplug is that inserting it into the ear canal could present a personal hygiene problem if the miner removes and reinserts it several times during the day. A miner who is susceptible to ear infections or secretes significant amounts of ear wax may be better suited for using earmuffs.

As noted earlier in this section, training is critical to miner cooperation. MSHA has concluded, after reviewing the scientific literature, U.S. Armed Forces regulations, and standards from the international community, that requiring the mine operator to instruct each miner required to wear hearing protectors on the purpose, advantages, and disadvantages of the choices available will facilitate hearing protector use and effectiveness.

Care, Fitting, and Use of the Hearing Protector Selected

In response to MSHA's ANPRM, many commenters supported the need to train employees on the proper fitting, care, and use of hearing protectors.

Merry et al. (1992) studied the effect of fitting instructions on the resulting attenuations of earplugs. Novice subjects were given earplugs. The difference in their hearing thresholds between the unoccluded and occluded conditions was the attenuation of the earplug. The subjects obtained greater attenuation whenever the experimenter assisted the subject in fitting the earplug than when the subject merely read the manufacturer's instructions before donning the earplug. Furthermore, the researchers noted that the attenuations obtained by the subject when just the manufacturer's instructions were read is comparable to the attenuations measured under industrial conditions.

Casali and Lam (1986) reported that the proper design and presentation of user insertion/donning instructions are critical to the amount of attenuation afforded by hearing protectors. They found that in some cases, the magnitude of protection afforded by the use of earplugs exhibited greater than a twofold increase when training ranged from no instruction to detailed and model instruction. Their study also showed that the attenuations afforded by earmuffs and earcaps were not as influenced by the level of instruction as were earplugs. Casali and Lam concluded that any instruction technique provided an improvement in attenuation over no instruction at all. However, they found no statistically significant differences among the type of instruction used. They also stated that regardless of the insertion/application instruction type selected, it is imperative that workers be retrained periodically in hearing protector insertion practices, hearing protector sizing, and hearing protector care to maintain optimal hearing conservation.

Royster et al. (1996) had novice users of hearing protectors don the protectors after reading the manufacturer's instructions. Since some users failed to properly don the hearing protectors, the researchers concluded that the instructions provided by the manufacturer were not always adequate. Consequently, additional instruction should be provided to assure the proper donning of hearing protectors.

Barham et al. (1989) reported that the noise reduction achieved by an earmuff improved by approximately 4 dB for a group and up to 6 dB for an individual following instruction on its use. Not only did the attenuation increase but also the standard deviation (a measure of variability) decreased. Therefore, instruction significantly improved the noise reduction achieved by the wearer of an earmuff.

Park and Casali (1991) studied the effects of two levels (minimal and detailed) of instruction on the measured attenuation obtained by regular hearing protector users. The users were tested using different hearing protectors from the ones they normally wore. The amount of noise attenuation increased and the standard deviations decreased when the investigators presented the instructions and demonstrated the proper manner to don and doff hearing protectors as compared to the employees simply reading the instructions. The efficiency of earplugs was found to be highly sensitive to the degree of instruction while earmuffs and canal caps were not.

MSHA believes that training is critical to the effective use of hearing protectors, and that miners must be shown how to use, fit, and care for their hearing protectors if they are to be effective. Further, the instructions should be repeated at yearly intervals to maintain effectiveness. Simply instructing the miner to read manufacturer's directions on the hearing protector container would not be adequate. MSHA is concerned that some manufacturer's instructions are inadequate for the proper fitting of hearing protectors. The effectiveness of hearing protectors can be highly dependent on how they fit the individual wearer. Not all people will achieve the same degree of fit or effectiveness from the same hearing protector.

Training About Hearing Conservation Program and Operator Noise Controls

OSHA's noise standard has similar training requirements with the exception that they do not require training on the respective responsibilities of the employer and employee in maintaining controls.

MSHA has determined that training miners enrolled in an HCP on the respective responsibilities of mine operator and miner is necessary to obtain maximum effectiveness from an HCP. Miner cooperation and support is required, for example, to ensure:

(1) The hearing protector provided fits properly each time it is donned;

(2) The hearing protector is worn whenever the miner is exposed to hazardous sound levels;

(3) Exposure to high sound levels is avoided for at least 14 hours before taking the baseline audiogram;

(4) Participation in the audiometric testing;

(5) Cooperation with any administrative control(s) instituted by the mine operator; and

(6) Use and maintenance of the engineering noise controls provided by the mine operator.

MSHA believes that a miner's understanding and motivation would be enhanced by conducting initial and annual training in these areas. The rationale for retraining miners who suffer an STS is discussed in connection with § 62.180, *Follow-up corrective measures when STS detected.*

MSHA believes that a miner must also be trained to understand the audiometric tests. This will enable miners to understand their own results and determine the effect of wearing hearing protectors.

Effectiveness. MSHA has endeavored to make the training requirements as simple as possible. If conducted separate from part 48, there are no specifications on trainer qualifications, no minimal training time, nor any training plans. If however the training is incorporated into part 48, then all applicable part 48 requirements will have to be met.

While this approach reduces the burden on those mine operators who cannot incorporate part or all of the noise training into part 48 training, it also means that certain safeguards in effect for part 48 training will not be directly applicable to that noise training not provided during part 48 training. There would be no review of a noise training plan, for example, to ensure that the instruction is adequate or that the training is to be given in the language spoken by most of the miners. Comments on this point are solicited.

The Agency believes it can ensure the noise requirements have been fulfilled by checking with exposed miners to ensure that the required training elements have been covered and that the certifications are valid.

Certification. Section 62.130(b) of the proposal would require that, upon completion of any training required under this part, the mine operator certify the date and type of training (initial or annual) given each miner. The certification would be signed by the person conducting the training.

It is standard practice in the mining industry to require certification of training, as a way of facilitating compliance. Training received under part 48 must be certified. The certification form used for part 48 does not have a separate line on which to indicate that the training required under the proposed noise standard has been completed; moreover, this would not be suitable in any event for noise training given independently of part 48 training as may often be the case.

MSHA believes that it is important to record the type and date of any training conducted under its proposed noise regulations. A written record, together with miner interviews, provide the Agency necessary checks to ensure the training is provided as required with only a minimal burden.

An optional approach on which MSHA would welcome comment is to simply require that a mine operator must, upon request, give an MSHA inspector copies of all materials related to the employer's noise training program. This is the approach taken by OSHA.

Retention. Section 62.130(b) of MSHA's proposal would require the mine operator to retain the most recent certification at the mine site for as long as the miner is exposed to noise above the level which initiated the training and for at least six months thereafter.

MSHA has a retention requirement for part 48 training. Part 48 training records are to be retained for two years for currently employed miners or for 60 days after the termination of employment. OSHA has no retention requirement for training records.

The Agency believes it is important to retain training records in order to verify that the required training has been provided, as with the certification requirements. The retention requirement is short and not burdensome: only the most recent record must be retained, and then only until the miner's exposure drops beneath the level which initiated the training (or 6 months after cessation if employment should that come before the exposure level has dropped).

Section 62.140 Audiometric Testing Program

This section of the proposal would establish basic procedures for the audiometric testing program in which those miners enrolled in a hearing conservation program (HCP) will participate. It includes provisions for: qualifications of personnel performing the audiograms, baseline audiograms, annual audiograms, and supplemental baseline audiograms.

MSHA is seeking explicit comment on a number of points. What follows is a brief summary of some key features of this section of the proposal.

With respect to qualifications of personnel, MSHA would require that an ''audiologist'' be certified by the American Speech-Language-Hearing Association or licensed by a state board of examiners. ''Qualified technicians'' would be required to have been certified by the Council for Accreditation in Occupational Hearing Conservation (CAOHC) or another recognized organization offering equivalent certification. CAOHC or equivalent certification would assure that the technicians are qualified. MSHA is not proposing to require qualifications for physicians.

It is critical to obtain a baseline audiogram before exposure to hazardous noise. If this is not possible, then the baseline is to be obtained as soon as is reasonably possible. Due to remote locations and intermittent operations of many mines, MSHA determined that allowing six months (or 12 months if a mobile test van is used) for obtaining the baseline audiogram was reasonable. The 12 month period would allow mine operators to schedule many baseline and annual audiograms simultaneously, and thus, substantially reduce the cost when mobile test vans are used. Pursuant to proposed § 62.120(b), miners would be provided hearing protection until such time as the baseline audiogram is conducted; and in the event the miner has to wait for more than 6 months to get a baseline audiogram because a mobile test van is used, the operator would be required to ensure the use of hearing protection.

MSHA has also determined that a 14-hour quiet period should precede the baseline audiogram to ensure a valid result: hearing protectors will not be considered a substitute for a quiet period under the proposal, and miners are to be notified of the importance of compliance with the quiet period.

MSHA has concluded that audiograms need to be provided annually for miners enrolled in an HCP. MSHA is not proposing to require this quiet period for annual audiograms, though it may be in the mine operator's interest to do so.

Background

Under existing standards for coal mines, MSHA requires pre-employment and periodic audiograms at those mines under a hearing conservation plan, but includes no specific procedures or time frames for obtaining these audiograms. Moreover, at present, less than 1% of the coal miners are covered by a hearing conservation plan. MSHA currently does not have any requirements addressing audiometric testing for metal and nonmetal mines.

OSHA's noise standard also contains requirements for qualifications of personnel and for baseline, annual, and supplemental baseline audiograms. The limited number of differences between the OSHA standard and the MSHA proposal are noted in the discussion that follows.

Qualifications of Personnel

Section 62.140(a) of MSHA's proposal would require that audiometric tests be conducted by a physician, an audiologist, or a qualified technician who is under the direction or supervision of a physician or an audiologist.

MSHA would require that an ''audiologist'' be certified by the American Speech-Language-Hearing Association or licensed by a state board of examiners. ''Qualified technicians'' would be required to have been certified by the Council for Accreditation and Occupational Hearing Conservation (CAOHC) or another recognized organization offering equivalent certification.

OSHA's noise standard requires that—

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

MSHA received comments that specifically addressed the qualifications of persons conducting audiometric tests. Some commenters were concerned that physicians may not have the specific knowledge necessary to conduct audiometric testing. One of these commenters stated that:

> * * * many physicians are not well versed in problems of audition, especially occupational noise induced hearing loss [NIHL]. If physicians are to be included in the list of acceptable supervisors, they should be limited to ''qualified occupational physicians,'' or perhaps ''qualified occupational physicians with audiological experience.''

Other commenters recognized that technicians need specific training, but disagreed as to whether formal certification was necessary. Many commenters specifically stated that MSHA should require CAOHC certification as the minimum acceptable criteria for training of audiometric technicians.

Many commenters specifically recommended or implied that MSHA treat technicians who operate microprocessor audiometers the same as technicians who operate other types of audiometers. One stated that:

> The use of a microprocessor audiometer does not guarantee a valid, reliable audiogram, nor does it obviate the need for the technician to be familiar with the important interpersonal and procedural details of administering an audiogram and providing feedback to the employees.

Other commenters, however, stated that persons who operate microprocessors do not need to be certified, but it was unclear whether they thought that training and demonstration of competency would be necessary for such technicians. Finally one commenter wanted ''maximum flexibility in audiometric testing.''

One commenter on this issue stated that:

> * * * We do not believe that there are other qualified medical personnel [other than an audiologist or physician] who understand the principles of interpreting an audiogram appropriately.

The U.S. Army (1991), Air Force (1991), and Navy (1994) regulations require that a physician, audiologist or technician conduct the audiometric tests. The audiometric technician must be CAOHC certified or certified through military medical training and be under the supervision of a physician or audiologist.

MSHA believes that it is unnecessary to specify that physicians be ''licensed'' or ''qualified.'' All states require physicians to be licensed. MSHA is concerned, however, that licensing does not imply qualification to conduct audiometric testing, evaluate audiograms, and supervise technicians in these areas. The Agency expects physicians to exercise professional judgement when evaluating their own qualifications to conduct audiometric testing. In addition, the medical profession enforces a high degree of accountability and ethical standards. Nevertheless, further comment is requested on this issue.

MSHA believes that certification or licensing of audiologists is essential to an effective HCP. Properly trained and certified audiologists would be qualified to conduct audiometric testing, evaluate audiograms, and supervise technicians. Unlike physicians, MSHA believes that certification or licensing presupposes that the audiologist would be qualified to conduct audiometric testing.

With respect to qualified technicians, MSHA considered the comments on this topic filed in response to the ANPRM and concluded that qualified technicians need to be certified by CAOHC or by an organization offering equivalent training. CAOHC or equivalent certification would assure that the technicians are qualified. While MSHA recognizes that the OSHA standard allows physicians discretion to judge the qualifications of technicians, MSHA believes requiring certification is not restrictive and best ensures quality control. MSHA would also require CAOHC or equivalent certification for technicians who operate microprocessor audiometers. The Agency concludes that requiring CAOHC or equivalent certification would not be overly burdensome on the mining industry.

NIOSH commented on OSHA's proposed rule, and again on MSHA's ANPRM, that there may not be enough CAOHC courses offered in a given year, or in a wide enough geographical area, to require that all technicians be CAOHC certified. OSHA's preamble (46 FR 4128) in 1981 indicated that, at that time, there were about 6,700 CAOHC certified technicians and 700 course directors. Since 1981, however, the number of CAOHC course directors has decreased to about 400, but the number of certified technicians has increased to about 14,000. Although this number of certified technicians may be sufficient to conduct the required audiograms in the mining industry, MSHA believes that promulgation of this rule will result in even more individuals seeking certification. In addition to CAOHC certification for audiometric technicians, MSHA would also accept training by any other recognized organization offering equivalent certification. MSHA requests information on any other nationally recognized program for the certification of persons to conduct audiometric tests.

MSHA also considered the ''qualifications of personnel'' requirements from U.S. Armed Forces codes and international standards. The consensus was that the technician needed to be trained in conducting audiometric testing.

Although the proposal would not require that the audiologist or physician be present when the technician conducts the audiometric test, MSHA would require that they directly supervise the technician to ensure strict adherence to testing procedures and measurement parameters.

Baseline Audiogram

Section 62.140(b) of MSHA's proposal would require that, within six months of a miner's enrollment in an HCP, the miner shall be offered a valid baseline audiogram of the miner's hearing acuity against which subsequent annual audiograms can be compared. This would include miners with temporary layoffs, such as those miners employed at seasonal operations. However, the proposal would allow up to 12 months

to obtain a baseline audiogram when a mobile test van is used.

Under existing standards for coal mines, MSHA does not specifically address a time frame for offering a baseline audiogram for those miners under a hearing conservation plan. MSHA has no requirements for baseline audiograms in its current metal and nonmetal noise regulation. This proposal is consistent with OSHA's noise regulation.

The proposal would allow mine operators to use existing audiograms as the baseline, provided that they meet the testing requirements of this part. OSHA also accepts existing audiograms as a baseline because, in most cases, accepting old baseline audiograms is more protective for the employee. OSHA reasoned that:

> * * * old baselines will allow the true extent of the hearing loss over the years to be evaluated. Obtaining a new baseline audiogram after many years of noise exposure might be less protective since the new audiogram might show higher thresholds and the true extent of future losses would appear smaller than when compared with the original baseline.

All commenters, addressing the issue of audiograms recognized the need to establish a baseline. The commenters varied, however, on the time needed to establish this baseline, i.e., from 30 days up to one year from the first exposure to noise. One stated that ''* * * the first annual or periodic audiogram should be allowed to be considered as the baseline or pre-employment audiogram.'' Most of the commenters, who specified a time frame for completing the baseline audiogram, agreed with OSHA's position of allowing up to six months. Only one comment was received, on the 1-year time allowed, for audiometric testing with mobile test vans. This commenter was concerned that miners might be exposed to noise, in the interim period, until the test van was available and recommended ''that the employees utilize hearing protection from the time they are enrolled in an HCP.''

NIOSH (1995) recommended that the baseline audiogram be conducted within 30 days of enrollment in an HCP, even if a mobile test van is used. NIOSH believes it is unacceptable to wait up to six months for a baseline audiogram, because exposure to high sound levels for a relatively short period of time can adversely affect the hearing acuity of susceptible individuals.

MSHA has also taken into consideration requirements of the U.S. Armed Forces and the international community with respect to baseline audiograms. Many in the international community and the U.S. armed services agree that the baseline audiogram is of primary importance.

MSHA has determined that the baseline audiogram is essential, because it is the reference against which subsequent audiograms are to be compared. The comparison will be used to determine the extent of hearing loss. If the baseline audiometric test is not conducted properly, it will not reflect the miner's true hearing thresholds and any changes between baseline and subsequent tests may be masked. Further, existing audiograms may be used as the baseline, if they meet the testing requirements of this part. The use of pre-existing audiograms would be more protective for the affected miner and less burdensome on the mine operator.

Because of the baseline audiogram's importance, it is critical to obtain one before exposure to hazardous noise. If this is not possible, then the baseline is to be obtained as soon as is reasonably possible. Due to remote locations and intermittent operations of many mines, MSHA determined that allowing six months (or 12 months if a mobile test van is used) for obtaining the baseline audiogram was reasonable. The 12 month period would allow mine operators to schedule many baseline and annual audiograms simultaneously, and thus, substantially reduce the cost when mobile test vans are used.

It should be noted that the provisions of § 62.120 of MSHA's proposal would require mine operators to ensure that all miners enrolled in a hearing conservation program be provided hearing protectors until they receive a baseline audiogram; and require the operator to ensure the protection is used if the need to wait for a mobile test van delays the initial audiogram past 6 months.

MSHA solicits additional comments on the appropriate time frame for obtaining audiograms, especially in remote mining areas.

14-hour Quiet Period

Section 62.140(b)(2) of the proposal would require that the mine operator ensure that the affected miner is not exposed to workplace noise for at least a 14-hour period immediately prior to receiving the baseline audiogram.

MSHA has no existing requirement in this area. The proposal is similar to OSHA's noise standard except that, as discussed below, OSHA permits the use of hearing protectors in lieu of removal from workplace noise.

The 14-hour quiet period is intended to provide a miner's hearing with sufficient rest to allow recovery from any temporary threshold shift (TTS) caused by pre-test noise exposure. If the baseline audiogram is skewed by TTS, subsequent comparisons to annual audiograms would not provide accurate indications of the extent of damage incurred during the time span between the baseline and subsequent tests.

There were numerous comments concerning the time frame for a quiet period. Of these, most suggested that the 14 hours mandated in OSHA's noise standard was sufficient to minimize any TTS. Others recommended different time frames for the quiet period. One stated that ''* * * there are sufficient human data in the literature to establish that a 14-hour quiet period is too short.'' Several commented that:

> A suitable quiet period of 24 hours prior to the performance of audiometric testing would be preferred. However, a 16-hour quiet period would often meet the needs of most operations, being the amount of time normally between the end of one days work and starting time for the next.

One thought that eight hours was enough. Another commented that a quiet period should be allowed but not required for the initial test. Further, this commenter stated that 24 hours should be required for confirmation testing.

Fodor and Oleinick (1986) in their paper on workers' compensation reported that one researcher found full recovery from ''physiological fatigue'' in 16 hours, with recovery from ''pathological fatigue'' taking longer. This researcher reported that the initial recovery seems to be a logarithmic function of time and the longer recovery period is a linear function. Most researchers, however, report complete recovery from TTS taking no longer than 16 hours provided the TTS did not exceed 40 dB. On the other hand, some states require that a worker be away from noise exposure for six months before evaluating hearing loss for workers' compensation purposes.

MSHA concludes, after reviewing the scientific literature and the standards of various jurisdictions, that the length of time required to obtain full recovery from TTS depends upon the magnitude of the sound pressure level, the length of exposure, the frequencies affected, the person's age, and the person's susceptibility to hearing damage. Because the mine operator has no control over the non-occupational noise exposure of a miner, MSHA decided against limiting non-occupational noise to a specified sound level during the quiet period; however, as noted below, MSHA is requiring that the mine operator notify employees of the need to avoid high levels of noise during the 14-hour period preceding the test, which it

hopes will limit non-occupational noise exposure. With the exception of the EEC (15 minute quiet period), the consensus of the international community and the U.S. armed services is that there should be a quiet period of at least 14 hours. MSHA decided that a 14-hour quiet period would be the most appropriate alternative and is consistent with OSHA's requirements, comments to the ANPRM, and its review of available literature. A quiet period longer than 14 hours could place an undue burden on mine operators as the miner may have to stay away from work to comply with the quiet period if the miner works a slightly extended shift; many work shifts exceed 8 hours especially when a lunch period is taken into account.

Use of Hearing Protectors for 14-hour Quiet Periods

Section 62.140(b)(2) of the proposed standard would also prohibit the use of hearing protectors as a substitute for the 14-hour quiet period. As noted previously, OSHA currently does allow hearing protectors to be used during the required 14-hour quiet period.

When it first promulgated its Hearing Conservation Amendment in 1981, OSHA did not permit the substitution of hearing protectors for the 14-hour quiet period. This decision generated much discussion among commenters believing that it was unnecessarily restrictive. Even professional audiologists strongly disagreed on this issue. One commenter suggested that if the hearing protector reduced the level of sound energy reaching the ear to 80 dBA or less, this would effectively reduce the amount of baseline contamination to less than the usual amount of audiometric measurement error. Commenters also cited problems such as additional overtime wages, disruptions of work schedules, and non-occupational noise exposure.

In 1983, OSHA revised its Hearing Conservation Amendment to allow the use of hearing protectors as an alternative for the 14-hour quiet period prior to the baseline audiogram. OSHA concurred with the large number of commenters who testified that the use of hearing protectors may provide sufficient attenuation to prevent noise-induced TTS from contaminating baseline audiograms.

MSHA received many comments addressing this issue. Several of these stated that hearing protectors should not be substituted for the quiet period. Their general consensus can be summarized by one commenter who stated that:

> * * * the use of HPDs cannot be relied upon to reduce the noise in all cases to a level suitable to be considered quiet for the purpose of establishing baseline audiograms, especially if individual variations in susceptibility to noise induced hearing loss are considered.

Other commenters believed that the use of hearing protectors should be allowed because they prevent TTS. One such commenter wanted a qualification stating that:

> * * * in many instances it may simply not be practical or possible to test everyone for their baselines as they come to the workshift, and thus reliance on HPDs for the 14-hr. noise-free period is required. Thus MSHA should allow use of HPDs in lieu of the 14 hrs., but with the following stipulation:
>
> * * * no more than five days prior to the test, 1) the employees whose hearing is to be evaluated receive refresher training in the use of their protectors, and 2) the condition of the hearing protector(s) the employee is to wear is checked and found satisfactory. Any employee whose TWA exceeds 100 dBA shall be required to wear an earplug together with an earmuff * * *

Some 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 of TTS. Individuals with TTS recovered their normal hearing quicker when exposed to 75 dBA sound level rather than 85 dBA. The NIOSH Criteria Document (1972) 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 the level would have to fall below 60 dBA to be effective quiet and not contribute to the development of a TTS.

MSHA's proposal differs from OSHA's standard, in that it would not allow hearing protectors to be substituted for the 14-hour quiet period prior to the baseline audiogram. Although MSHA recognizes that its decision may pose some scheduling problems for mine operators, it should be emphasized that the quiet period is required only for the baseline audiogram. Mine operators, however, may choose to employ it for the annual audiograms.

MSHA has determined that the problems associated with the use of individual hearing protectors are too great to guarantee an accurate baseline measurement. Data indicate that in order to provide effective quiet, 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 attenuate noise to such low levels in order to prevent contamination of the baseline. Even at 80 dBA, some researchers concluded that this level may be inadequate for the most susceptible individuals. Moreover, the typical sound levels in mining are higher than those experienced in general industry; therefore, hearing protectors would need to attenuate the noise to a greater degree. Although MSHA contends that hearing protectors can provide some protection to miners whose exposures do not exceed the PEL, MSHA has concluded that engineering and administrative controls provide much more effective protection. MSHA's concerns with the ability of hearing protectors to provide adequate attenuation are addressed in connection with the requirements of proposed § 62.120(b), under the heading of *Hearing protector effectiveness*.

Notification to Avoid High Sound Levels

Section 62.140(b)(3) of the proposal would require mine operators to notify miners to avoid high levels of non-occupational noise during the 14-hour period before taking the baseline audiogram. This requirement is the same as OSHA's noise standard.

In the 1983 preamble to its Hearing Conservation Amendment (48 FR 9757), OSHA emphasizes that, even if workers received this information in training classes, such notification would aid memory and, thus, provide additional support to the goal of obtaining a valid baseline audiogram. OSHA concludes its discussion of this issue as follows:

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

Only a few commenters offered an opinion on this specific issue in response to MSHA's ANPRM. These commenters agreed that workers need to be advised to avoid non-occupational noise exposure prior to taking the baseline audiogram.

MSHA believes that it is appropriate for operators to notify miners of the importance of avoiding high noise areas in order to obtain valid baseline audiograms. The proposed requirement is consistent with OSHA's noise standard and the limited commenter responses.

Annual Audiogram

Section 62.140(c) of MSHA's proposal requires that, after establishing a baseline, the miner to be offered a new

audiogram once every 12 months as long as the miner remains in the HCP.

Existing MSHA standards require coal mine operators to submit a hearing conservation plan, which includes conducting periodic audiograms, for each miner exposed to noise in excess of the PEL. Because the use of hearing protectors is considered to provide compliance with the PEL in this industry, few receive audiograms. Moreover, there are no standards requiring audiograms for metal and nonmetal workers.

OSHA requires, after the baseline audiogram has been obtained, an annual audiogram for each employee exposed at or above its action level to identify changes in hearing acuity, so that the use of hearing protectors can be prescribed or other follow-up measures initiated before hearing loss progresses. The preamble to OSHA's hearing conservation amendment (46 FR 4143) states:

> OSHA has chosen to retain the annual audiometric test requirement because of the potential seriousness of the hearing damage that can occur within a 2-year period. For employees exposed to high levels of noise, a 2-year period between audiograms might allow too much hearing loss to occur before identifying the loss and taking remedial steps.

In response to its ANPRM, MSHA received numerous comments that specifically addressed periodic audiograms. Many of these supported annual testing and a few recommended a different time period. These latter commenters suggested the following alternative time periods: once or twice a year, depending on the intensity of the exposure; every other year; and based upon need.

MSHA concludes that the determination of an STS in the one-year period between required audiograms is meaningful for detecting the type of problems for which HCP enrollment is the purpose. Detection of an STS triggers several important actions under the proposal. Retraining of the miner would be required. If the miner is enrolled in the HCP as a result of noise exposure above the action level, but the miner's noise exposure is below the PEL, detection of an STS would require the provision of a hearing protector—which a miner at that exposure level would otherwise not be required to utilize. If the miner was already using a hearing protector, it would have to be replaced. Detection of an STS would also require reevaluation of the engineering and administrative controls being used. Waiting two years or more between periodic audiograms could allow excessive hearing damage to miners. MSHA also recognizes that some miners may be more susceptible to hearing damage from noise exposure, and a few may be exposed to high sound levels, such that annual audiometric testing may not be frequent enough to prevent an STS.

In light of the comments to MSHA's ANPRM, the Agency's review of the literature and pertinent governmental regulations, and OSHA's existing requirements, MSHA has tentatively concluded that annual audiometric testing is both necessary and appropriate. Annual audiometric testing is an integral part of a comprehensive HCP.

Supplemental Baseline

Section 62.140(d) of MSHA's proposal would require the mine operator to establish a ''supplemental audiogram'' when: (1) the STS 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 proposed requirements are similar to those in OSHA's noise standard except for the terminology.

In response to its ANPRM, MSHA received numerous comments on circumstances in which it was not appropriate to use the original baseline audiogram. Many commenters were in favor of revising the baseline if an STS was persistent. One stressed the need for clear guidelines for baseline revision to avoid the use of a variety of creative methods which could result in different STS totals. Other commenters were in favor of revising the baseline if the annual audiogram showed an improvement in hearing. Another recommended revising the baseline only if the improvement was consistent for at least two or three consecutive tests. A final commenter wanted the baseline revised only if there was a testing error.

MSHA believes, after reviewing these comments and standards of the U.S. Armed Forces, that revising the baseline after an STS has been identified would prevent this same STS from being identified repeatedly. The annual audiogram on which the STS is identified would then become the ''supplemental baseline audiogram.'' This supplemental baseline would be used for comparison with future annual audiograms to identify a second STS. The ''baseline audiogram'' would continue to be used to quantify the total hearing loss in determining whether the loss constitutes a ''reportable hearing loss''. To avoid confusion in the mining industry, MSHA is proposing the term ''supplemental baseline'' rather than the term ''revised baseline'' used under OSHA. Since all audiograms are to be retained as part of the audiometric test record (see § 62.150(c)), supplementation of the baseline audiogram would not permit the destruction of the original baseline audiogram.

MSHA would also require supplementation of the baseline if the annual audiogram shows significant improvement in hearing level because this would more closely resemble the miner's actual hearing acuity prior to being exposed to occupational noise. In this case, supplementation of the baseline would be more protective because it would allow more accurate evaluation of the true extent of future hearing loss. Therefore, when a baseline is revised due to an improvement of hearing acuity, this supplemental baseline would be considered as the original baseline for determining when an STS occurs and for quantifying the total hearing loss for reportablility under part 50. The latter is reflected in the definition of reportable hearing loss.

Section 62.150 Audiometric Test Procedures

MSHA proposes not to include specific procedural requirements for conducting audiometric tests, calibrating audiometers, and qualifying audiometric test rooms. Instead, MSHA proposes a performance-oriented requirement that audiometric testing be conducted in accordance with scientifically validated procedures. MSHA would specify the test frequencies, but would allow the physician or the audiologist to use professional judgment in choosing the appropriate testing procedure(s) and require certification of the scientific validity of the procedures.

While this approach may require somewhat more in the way of paperwork requirements, MSHA believes this is far preferable to the alternative of a detailed specification standard, which could stifle technology and impede improvements in methodology.

The proposal would also specify what records must be maintained, and for how long, at the mine site. The proposed items included in the audiometric test record—name, job classification, audiograms and certifications as to the procedures used to take them, any exposure determinations, and the results of any follow-up examinations—would provide information essential for evaluating a miner's audiogram, among other purposes.

The records are to be retained for at least six months beyond the duration of the miner's employment. The six month retention period at the mine site would assure that the audiometric test records of miners who have short periods of unemployment are not destroyed and are available for use by the mine operator to conduct further evaluations upon the miner's return. In practice, MSHA believes that many mine operators will keep miner's audiograms long after the miner's employment ceases, for use if the miner should file a subsequent workers' compensation claim for hearing loss.

Currently MSHA's metal and nonmetal noise standards do not contain audiometric testing provisions. While Coal's noise standard requires audiometric testing, it does not specify how it is to be conducted. MSHA's proposal differs from OSHA's noise standard which contains detailed procedures in 29 CFR § 1910.95(h) and the associated Appendices C, D, and E.

Several commenters generally supported MSHA's adoption of audiometric testing requirements that are the same as OSHA's. A number of commenters made specific recommendations regarding various aspects of conducting audiograms including audiometric test instruments, calibration procedures, and audiometric test rooms. Since MSHA has decided not to specify audiometric test requirements in the proposed rule, a discussion of the comments on specific procedures is not included (except in the section which follows, *Test procedures).*

ANSI has several standards which impact the audiometric test procedure. ANSI S3.21–1978 ''Methods for Manual Pure-Tone Threshold Audiometry'' provides detailed procedures for conducting audiometric tests. ANSI S3.1–1991 ''Criteria for Maximum Ambient Noise Levels for Audiometric Test Rooms'' provides a criteria for the maximum background sound pressure levels neccessary in order to obtain a valid audiogram. ANSI S3.6–1996 ''Specifications for Audiommeters'' provides design criteria for various classes of audiometers.

After reviewing comments, the scientific literature and several governmental standards, MSHA chose not to include detailed, highly technical procedures and criteria for conducting audiometric testing in the proposal. Instead MSHA chose a performance-oriented approach by proposing to require that audiometric testing procedures be governed by scientifically validated methods. Because the person responsible for conducting the tests is a physician, audiologist, or qualified technician, he/she should be familiar with scientifically validated procedures. MSHA would allow the physician or the audiologist to use professional judgement in choosing the appropriate testing procedure(s).

Moreover, audiometer manufacturers provide recommendations on audiometer use and calibration (both laboratory and field). Because the manufacturers are aware of the intricacies of their instruments, they would be the most qualified to issue recommendations on the use and calibration of their audiometers. By following manufacturer's recommendations accurate audiometric testing is assured without MSHA mandating detailed calibration specifications.

By not specifying a single test procedure, MSHA would permit the use of any scientifically validated procedure. If a new, possibly more accurate procedure would be validated, the medical professional could readily adopt its use. If, however, current procedures were adopted in the rule, an amendment would be needed to permit the use of any new procedure.

Even though MSHA found no single comprehensive criteria for audiometric testing, save OSHA's, there are criteria which deal with various aspects of testing. For example, ANSI has standards on background sound pressure levels for audiometric testing, methods for pure tone audiometry, and for specifications for audiometers. MSHA expects that most audiograms would be conducted using OSHA's requirements, since many physicians and audiologists are familiar with those regulations. Further, many texts and CAOHC training courses discuss OSHA's audiometric testing procedures and criteria. Although MSHA has not proposed detailed specifications in its standard, the Agency contemplates publication of nonmandatory guidelines describing what it believes to be the latest scientific procedures for conducting audiometric tests.

MSHA, realizing that performance-oriented standards for audiometric testing may be controversial, solicits comments on this approach, and continues to solicit comments on the audiometric test procedures, permissible background sound pressure levels, and calibration requirements for audiometers.

Test Frequencies

The proposal would require that audiometric tests be pure tone, air conduction, hearing threshold examinations, with test frequencies at 500, 1000, 2000, 3000, 4000, and 6000 Hz. The proposal also specifies that these examinations be taken separately for each ear at the given test frequencies. In response to MSHA's ANPRM, no commenters specifically addressed audiometric test frequencies. Several, however, generally supported MSHA's adoption of audiometric testing requirements that are the same as OSHA's. MSHA's proposal would be consistent with OSHA's requirements with respect to testing frequencies, as well as consistent with the NIOSH criteria document (1972).

Although none of the commenters directly addressed audiometric test procedures, several stated that MSHA should adopt or follow the OSHA Hearing Conservation Amendment.

As noted in part II of this preamble, noise-induced hearing loss is a permanent sensorineural condition that cannot be improved medically. It is characterized by a declining sensitivity to high frequency sounds. This loss usually appears first and is most severe at the 4000 Hz frequency. The ''4000 Hz notch'' in the audiogram is typical of NIHL. 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 STS, MSHA, like OSHA, believes that these test frequencies contribute to a more complete audiometric profile and are helpful in assessing the validity of the audiogram as a whole. Furthermore, the inclusion of 500 and 1000 Hz makes it easier for an audiologist or physician to differentiate conductive hearing loss from NIHL, and the inclusion of 6000 Hz would better differentiate between presbycusis and NIHL.

Certification

Section 62.150(b) of MSHA's proposal would require that mine operators obtain a certification, from whomever conducts audiometric tests under this part, that such tests were conducted according to a scientifically validated procedure.

OSHA's current noise standard does not require such certification. OSHA has specific audiological test procedures, allowable background sound pressure levels in audiometric test rooms, and audiometer calibration requirements. MSHA's metal and nonmetal noise standards do not contain audiometric testing provisions. While Coal's noise standard requires audiometric testing, it does not specify how it is to be conducted.

MSHA did not address this issue of certification in its ANPRM and, therefore, no comments were received.

MSHA's proposal would relieve the mine operator from specifying the audiological test procedure and criteria. The mine operator would rely on the professional judgement of the physician or audiologist to select the appropriate tests and criteria. Certification would not be accepted from a qualified technician; pursuant to the proposed provisions in § 62.140, qualified technicians are to perform their work under the supervision of a physician or audiologist. MSHA believes that it is necessary for the physician or audiologist to certify that the audiological tests were conducted in accordance with a scientifically validated procedure. In most cases, the mine operator does not have sufficient medical knowledge to determine if the tests were properly conducted and must rely on the judgement of a physician or audiologist. The certification will stand as evidence that the audiological tests were conducted in accordance with the requirements for a scientifically validated procedure.

Audiometric Test Recordkeeping and Retention

Section 62.150(c) of MSHA's proposal would require that mine operators maintain a record of each required audiometric test. This record would contain—

(1) the name and job classification of the miner tested

(2) a copy of the miner's audiogram(s) (original baseline, annual, and supplemental baseline);

(3) certification(s) that the tests were conducted using scientifically validated procedures;

(4) any exposure determination for the miner; and

(5) the results of any follow-up examination(s).

This information would not have to be written on the actual audiogram as long as it was kept with the audiogram. The audiometric test records would be required to be maintained at the mine site for the duration of the affected miner's employment plus at least six months.

Although not defined in this proposal, by the term ''duration of employment'' MSHA means 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 dies. There must be a lapse of at least six months beyond formal termination of employment before a mine operator could destroy the audiometric test records. Moreover, it is MSHA's intent that a layoff, strike, lockout, furlough, period of leave (both paid and unpaid), or other temporary break in service would not be considered as a formal termination of employment, even if it exceeds six months.

MSHA's existing standards have no requirements in this area. OSHA's noise standard requires that employers maintain a record of the audiometric test results and maintain these records for the duration of employment.

Since the publication of the noise standard, OSHA promulgated 29 CFR 1910.20 Access to employee medical records. This standard applies to all medical records required to be kept pursuant to OSHA standards—noise records are treated in the same way as carcinogen records. Under 1910.20, OSHA requires that medical records for each employee be maintained for at least the duration of employment plus (30) years, with the exception of employees who have worked for less than (1) year for the employer. The medical records for these employees need not be retained beyond the term of employment if they are provided to the employee upon termination. Further this standard requires that exposure records be maintained for at least 30 years.

Additionally, OSHA's noise standard requires that the audiometric test record include—

(1) name and job classification of the employees;

(2) date of the audiogram;

(3) examiner's name;

(4) date of the last acoustic or exhaustive calibration of the audiometer; and

(5) employee's most recent noise exposure assessment.

Additionally, employers are required to maintain an accurate record of background sound pressure levels in audiometric test rooms. OSHA's noise standard has no requirement to maintain these records at the employer's work site.

MSHA received a number of comments specifically addressing time frames for maintaining audiometric test records. One commenter recommended that they be maintained for 30 years. Two commenters recommended that such records be retained for the duration of the miner's employment plus 30 years. Most of the commenters on this issue recommended that MSHA require that audiometric test results be kept for the duration of employment.

MSHA also reviewed the audiometric test recordkeeping and retention requirements from the U.S. Armed Forces and various other countries. Generally, the audiometric test record is to be maintained for at least the duration of employment.

MSHA considered allowing mine operators to keep the audiometric test record at a location other than the mine site. The Agency concluded, however, that this alternative was impractical because it could delay MSHA's access to such records. Furthermore, it would be burdensome for mine operators to copy and mail the records or send a fax of these records to the Agency.

MSHA believes that this record should be retained for at least six months beyond the duration of the miner's employment. The risk of harm stops with the cessation of employment; keeping the records an additional 6 months would assure that a miner's audiometric test records are not destroyed and are available for use by the mine operator to conduct further evaluations should a miner return within that time period. In practice, MSHA believes that many mine operators will keep miner's audiograms long after the miner's employment ceases, for use if the miner should file a subsequent workers' compensation claim for hearing loss. In some states, the worker has many years following employment to file such a claim.

The proposed items included in the audiometric test record would provide essential information to MSHA and to the health professional for evaluating a miner's audiogram. The information is also necessary for identifying the audiograms, evaluating whether the audiometric tests have been conducted properly, and for determining whether the results are valid. Further, the information is critical for the evaluator in determining whether an identified hearing loss was not work related or aggravated by occupational noise exposure.

Section 62.160 Evaluation of Audiograms

MSHA's proposal would require that the mine operator inform the person evaluating the audiogram of the requirements of this part and provide them with copies of the miner's audiometric test records. The mine operator would be responsible for having a physician, audiologist, or qualified technician determine if an audiogram is valid and if a standard threshold shift (STS) or reportable hearing loss has occurred—in which case certain actions are required pursuant to § 62.180 and § 62.190. Time frames and privacy protection are part of the proposal, as is a requirement for a prompt retest if an audiogram is invalid.

STS is defined in this proposal, as in OSHA's standard, as a change in a worker's hearing acuity for the worse,

relative to that worker's baseline audiogram, of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear. If the STS is determined to be permanent, a supplemental baseline is established pursuant to § 62.140 and this becomes the baseline for determining any future STS. This definition is sufficiently restrictive to locate meaningful shifts in hearing, yet not so stringent as to create unnecessary follow-up procedures; the averaging of hearing levels at adjacent frequencies will reduce the effect of testing errors at single frequencies.

The proposal would permit but not require mine operators to adjust audiometric test results by applying a correction for presbycusis before determining whether an STS or reportable hearing loss has occurred, and it includes tables for this purpose. Presbycusis is the progressive loss of hearing acuity associated with the aging process. The proposed adjustment for presbycusis is optional; however, if a mine operator uses this approach, it must be applied uniformly to both the baseline and annual audiograms in accordance with the procedures and values listed in the proposed standard. Although this is the position taken in the proposal, MSHA notes that the latest NIOSH advice on this topic has advised against the use of presbycusis correction factors. Moreover, the Agency is concerned about locking-in specific presbycusis adjustment tables. MSHA, therefore, requests additional comments on whether to use presbycusis corrections for audiograms and, if so, how to provide for such adjustment in a regulatory context.

MSHA's existing noise standards do not address the evaluation of audiograms. MSHA's proposed requirements would be similar to those in OSHA's noise standard; the few differences are noted below.

Information Provided to Reviewer

Section 62.160(a)(1) of MSHA's proposal would require 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. OSHA requires employers to provide the persons evaluating audiograms with a copy of the requirements of its standard, copies of the employee's baseline and most recent audiometric test records, background sound pressure levels in the audiometric test room, and a record of audiometer calibration.

In its ANPRM, MSHA did not address what information the mine operator should provide to the person evaluating audiograms. The commenters, therefore, did not address this issue specifically. In discussing related topics, some commenters recommended that MSHA adopt OSHA's requirements on this issue.

Recently, research has implicated exposure to chemicals as aggravating hearing loss, Fetcher (1995), Morata (1989, 1993, 1995). MSHA requests comments as to how to address various aspects of this possible relationship. For example, could exposure to chemicals cause an invalid audiogram? What information should reviewers have about chemical exposure? Any research results on this topic would be welcome.

MSHA believes that providing certain information is necessary for physicians and audiologists to evaluate the accuracy and validity of miners' audiograms. For example, the evaluator would need to know the procedure for determining an STS, the criteria for retest or medical follow-up, presbycusis correction procedures, and recordkeeping requirements.

Review of audiogram. Under § 62.160(a)(2) of this proposal, the mine operator would be responsible for having a physician, audiologist, or qualified technician determine if an audiogram is valid and if an STS or reportable hearing loss has occurred. MSHA's proposal is consistent with the present OSHA noise standard.

Of the many commenters on this specific issue, most believed that professional review was necessary. One of these said that ''MSHA should require an audiologist or physician to evaluate audiograms that show standard threshold shifts [STS] or other unusual changes''.

A few commenters felt that professional review was unnecessary. These commenters indicated that the person conducting the audiogram could inform the employee of the results, and explain the significance of these results, so that the employee could make any decisions regarding further testing or evaluation.

The U.S. Armed Services and the international community vary on the medical expertise required to review audiograms.

MSHA believes that audiograms need to be reviewed for validity; as noted below, if audiograms are not valid, the proposal would require a retest. Examples of questionable audiograms are audiograms that show: large unilateral differences in hearing thresholds between the two ears; unusual frequency patterns that are not typical of NIHL; thresholds that are not repeatable; or an unusually large hearing loss over a yearly period. MSHA maintains that the review of audiograms is an integral part of an audiometric testing program.

Qualifications for Audiogram Reviewers

Under § 62.160(a)(2) of this proposal, a mine operator would be required to have a physician, audiologist or a qualified technician who would be under the supervision of a physician or audiologist evaluate audiograms to determine their validity and whether an STS or reportable hearing loss has occurred. The qualifications of these individuals to conduct this evaluation are discussed under § 62.140 *Qualifications of personnel* along with the comments received on this issue.

Standard Threshold Shift (STS)

This proposal would require the evaluator to determine whether a miner has incurred an STS in his/her hearing. STS is defined in this proposal as a change in a worker's hearing threshold relative to that worker's baseline audiogram of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear. This requires that hearing loss be calculated by subtracting the current hearing levels from those on the baseline audiogram at 2000, 3000, and 4000 Hz; when the hearing losses at each frequency are averaged (added up and divided by three); if the average loss in either ear has reached 10 dB, it constitutes an STS. If the STS is determined to be permanent, a supplemental baseline is established pursuant to § 62.140 and this becomes the baseline for determining any future STS. The definitions of ''baseline audiogram'', ''supplemental baseline audiogram'', and ''standard threshold shift'' are discussed in detail in connection with proposed § 62.110.

OSHA defines an STS in essentially the same way, requiring that employees' annual audiograms be compared to their baseline audiogram to determine if the annual audiogram is valid and if an STS has developed.

Of the numerous comments addressing the issue of STS in response to MSHA's ANPRM, many endorsed OSHA's definition of STS. One commenter stated that:

> The Standard Threshold Shift (STS) concept is the basic foundation of a hearing conservation program and is the best indicator of early noise-induced hearing loss [NIHL]. It enables those conducting the audiometric examinations to have the needed ''red flag'' to indicate when additional testing or evaluation is needed. It also enables the effectiveness of the employer's hearing conservation program to be evaluated and monitored. The criteria must be sensitive enough to identify meaningful changes in hearing but must not be so sensitive as to

pick up spurious shifts or ''false-positives.'' * * * Identifying a standard threshold shift therefore means that the shift value must be outside the range of audiometric error (± 5 dB) and serious enough to warrant prompt attention.* * * The averaging of shifts over adjacent frequencies minimizes normal test error, and random errors will tend to cancel each other out. * * *

In considering the frequencies to be used, it is noted that 4000 Hz is generally considered to be affected by noise the earliest and most severely. The 2000 and 3000 Hz frequencies are very important in understanding speech and should also be included in the definition of STS.

For the above-mentioned reasons, as well as simplifying the process in facilities which have operations under both MSHA and OSHA jurisdiction, we recommend MSHA adopt an average shift of 10 dB or more at 2000, 3000, and 4000 Hz, relative to the baseline audiogram. * * *

Of those commenters who did not endorse OSHA's STS criteria, one stated that OSHA's STS definition was ''* * * not stringent enough and the worker hearing loss has progressed too far with this shift to be a reliable preventive measure.'' Another stated—

* * * the suggested criteria [OSHA's STS definition] provides no benefit but additional testing, specialist costs, reporting, administrative costs, and potential MSHA punitive fines. * * *

The STS concept is misguided. A significant percentage * * * of people will have changes take place in their hearing which would qualify as an STS without any exposure to occupational noise.

Royster (1992) proposes a definition of STS that is different from OSHA's. In her definition, 15 dB of hearing loss (relative to the baseline) must occur at any audiometric test frequency from 500 to 6000 Hz on two sequential audiograms, before the STS is established. The 15 dB of hearing loss which occurs on two sequential audiograms identifies the largest number of true positives (permanent threshold shifts) and the least number of false positives (temporary threshold shifts mistakenly identified as permanent threshold shifts).

NIOSH (1995) recommends that the criteria for an STS be a 15 dB decrease in hearing acuity at any one of the audiometric test frequencies from 500 to 6000 Hz on two sequential audiograms. The shift in hearing acuity must be in the same ear. The second audiogram would be administered as soon as reasonable. NIOSH believes this criteria is sufficiently stringent to detect beginning hearing loss, yet won't include workers whose hearing acuity is simply showing normal variability. If the 15 dB change is found, an immediate retest should be conducted and followed by a confirmation test within 30 days. The confirmation test should be preceded by 14 hours of quiet.

This draft criteria for STS differs from the criteria recommended by NIOSH in their 1972 criteria document. NIOSH's previous criteria defined STS 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.

There are some instances where large 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 large shifts are uncommon, they may occur in noise-sensitive individuals, especially in the early stages of NIHL. Correctly identifying significant threshold shifts is particularly important for workers who have already begun to lose their hearing. The proposed definition of STS would identify individuals suffering shifts as large as 30 dB at 4000 Hz with no shifts at the lower frequencies (30 plus 0 plus 0 divided by 3 equals 10, an STS). This permits the early identification of individuals at risk, so that corrective measures could be taken.

MSHA's proposed definition of STS is sufficiently restrictive to locate meaningful shifts in hearing, yet not so stringent as to create unnecessary follow-up procedures. The averaging of hearing levels at adjacent frequencies will reduce the effect of testing errors at single frequencies. The occurrence of an STS is serious enough to warrant prompt attention because it may be a precursor to material impairment of hearing. It is important to note that MSHA does not equate STS with material impairment caused by NIHL.

MSHA believes, after considering the relevant factors and reviewing current U.S. military and international standards, that the proposed definition of STS is the most appropriate and consistent with the purposes of its hearing conservation standard. The proposed definition of STS—

(1) is adequately supported in OSHA's record for its Hearing Conservation Amendment;

(2) is the criteria recommended or accepted by most commenters to MSHA's ANPRM;

(3) results in a high degree of accuracy in identifying workers for follow-up;

(4) concentrates on those frequencies that are the earliest or the most severely affected by noise; and

(5) is a recognized and relatively simple approach.

Because NIOSH revised its recommendation for the criteria of an STS, MSHA requests comments on NIOSH's new criteria. Furthermore, any data on the advisability of using either the MSHA proposed criteria of STS or NIOSH's criteria of STS would be welcomed.

Reportable Hearing Loss

The proposal would require the evaluator to determine if there has been a ''reportable hearing loss''. See the discussion of ''Reporting noise-induced hearing loss (NIHL)'' under § 62.190 *Notification of results.*

Instruction to Medical Professional

Section 62.160(a)(3) of the proposal would require the mine operator to 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. Currently, neither MSHA nor OSHA have such a provision in their noise standards; OSHA does have such provisions in air quality standards like benzene and lead.

The topic of instructions to medical professionals was not raised in the ANPRM. Therefore, no comments on this issue were received.

MSHA believes that this requirement is necessary to safeguard the privacy of individuals. The mine operator does not need to be informed of medical conditions unrelated to occupational noise exposure. MSHA's rationale is that if the mine operator had confidential medical information, the mine operator could use it to justify an adverse action against the miner.

30-Day Requirement

According to § 62.160(a)(4) of MSHA's proposal, the mine operator would have 30 days to obtain the audiometric results and the interpretation of the results from the person evaluating the audiogram. OSHA does not specify a time period for evaluating audiograms.

MSHA's ANPRM did not address the issue of time frame for evaluating audiograms. A few commenters, however, expressed concern with the length of time that some service providers take to report results to the employer. One stated that:

Service providers have taken undue advantage of a perceived 'grace period' in the OSHA Hearing Conservation Amendment to inform employees of a shift in hearing. * * * the lag time may total six to eight weeks. This is a disservice to the employee, and is certainly preventable.

Notification of STS, including the optional retest of STS-affected employees, should be completed within a 30-day period following testing. OSHA's time limit of 21 days following notification to the employer creates a loophole which makes the employee wait all too long for feedback regarding STS.

The other commenter stated that:

In reality, from the time the hearing test is sent to an audiologist or physician to review, it is reviewed, recommendations made, it is returned to the plant personnel and the plant has 21 days to notify the employee, the total process often stretches into a 45–60 day time frame.

MSHA believes that a 30-day limit to evaluate audiograms is reasonable and necessary to prevent undue delays in the evaluation of the audiogram and notification to the miner of the results. Under proposed § 62.190, a miner would have to be notified within 10 working days of audiogram results obtained by the mine operator, as discussed in connection with that section; accordingly, the net result of these provisions is a maximum delay of approximately 44 days from the date of audiometric testing to the notification of the miner. If a retest was conducted, which, as discussed below must be done within 30 days of receiving a determination that the original test was invalid, this delay in notification could be as long as 104 days. If the miner's employment ceases during this delay period, the mine operator would be required to provide the miner with a copy of the audiometric test records as required by § 62.200(c), including the results of all testing, as soon as the record is complete. MSHA welcomes comments on this issue.

Audiometric Retest

Section 62.160(b)(1) of the proposal would require a mine operator to conduct a retest, if the audiogram was judged to be invalid, within 30 calendar days of receiving this information—provided, however, that the 30-day time frame is stayed until any medical pathology resulting in the invalid audiogram has improved to the point that a valid audiogram may be obtained. In addition, § 62.160(b)(2) of the proposal would allow a mine operator to obtain one retest within 30 days after an STS or reportable hearing loss is found, and to substitute the retest audiogram for the annual audiogram. The latter retest is not mandatory.

OSHA also permits a retest within 30 days to confirm an STS, but does not specifically require a retest if the audiogram is judged to be invalid.

Many commenters supported OSHA's retest provision as written, while others supported it with qualifications. One commenter believed that a 60-day period was appropriate. Another believed that a 30-day limitation to both retest and notify was appropriate because:

Service providers have taken undue advantage of a perceived grace period in the OSHA Hearing Conservation Amendment to inform employees of a shift in hearing. By the time audiometric tests are administered, entered into a computer, returned to an employer, and then finally returned to the employee, the lag time may total six to eight weeks. This is a disservice to the employee, and is certainly preventable.

Other commenters stated different views. One commenter stated that:

* * * most programs involve the use of testing vans that cannot easily make a return trip in 30 days because of scheduling limits. It would also be extremely expensive to make a return trip to confirm a single STS. If an employee is found to have a significant hearing loss, he should be required to wear hearing protectors in all noise environments of 85 dBA or greater. If the next scheduled audiogram also shows the hearing loss, then the loss should be considered confirmed.

Another commenter stated that:

* * * an employee with a change in hearing could be immediately counseled, refitted [i.e., hearing protectors], educated, notified and return to his job. This would be more cost-effective than bringing him back prior to the shift to get a hearing test showing there is no STS.

MSHA believes, after considering comments and reviewing U.S. armed forces and international standards, that the retest provisions are necessary to assure that valid audiograms are provided in a timely fashion. The retest should be conducted within a reasonable time, and 30 days is believed to be adequate, with the caveat that this time frame does not begin to run until any medical pathology causing a validity problem has improved to the point that a valid audiogram can be obtained. MSHA recognizes that in such cases it will not be possible to wait for a mobile van; but MSHA believes that in the limited number of cases where a retest is required, it is appropriate and necessary to send the miner to the nearest available facility for such a test.

The provision to obtain an optional retest if an STS is detected is desirable. This would permit the mine operator to substantiate that an STS had occurred, thus confirming permanent hearing loss. By detecting only permanent hearing loss, the mine operator would have better information on which to base administrative, technical, and financial decisions relative to retraining the miner, permitting the miner to select a different or additional hearing protector, and reviewing the effectiveness of the noise controls.

Use of Age Correction (Presbycusis Factors)

Section 62.160(c) of the proposal would permit mine operators to adjust audiometric test results by applying a correction for presbycusis before determining whether an STS or reportable hearing loss has occurred. Presbycusis is the progressive loss of hearing acuity associated with the aging process. This adjustment for presbycusis is optional; however, if it is used, it must be applied uniformly to both the baseline and annual audiograms in accordance with the procedures and values listed in § 62.160(c) (1) through (4).

OSHA's noise standard also permits the use of presbycusis correction factors. MSHA's proposal would be essentially the same as OSHA's Appendix F: Calculations and Application of Age Corrections to Audiograms. Both MSHA's proposal and OSHA's Appendix F adopt the procedures and age correction tables used by NIOSH in its criteria document (1972).

Commenters to OSHA's Hearing Conservation Amendment (48 FR 9763) suggested that the use of such presbycusis factors also would account for those cases of NIHL that arise from causes other than occupational noise exposure. In the preamble to its Hearing Conservation Amendment (48 FR 9763), OSHA states that:

* * * these correction factors will aid in distinguishing between occupationally induced and age-induced hearing loss. This is particularly important because the pattern of hearing loss due to aging closely resembles that of noise-induced hearing loss [NIHL]. * * * Therefore, although * * * the use of a correction factor may complicate calculation procedures and cause some errors, * * * professional supervision of the hearing conservation program will ensure that audiometric technicians understand how to use the age correction chart * * *

Most commenters who addressed this issue in MSHA's ANPRM, contend that the use of presbycusis correction factors is appropriate. Many of these commenters supported MSHA's use of the same criteria as in OSHA's Appendix F. Other commenters recommended age corrections different than those used by OSHA. One commenter suggested that MSHA use the ISO 1999.2 (1989) standard. Another one suggested that, because the NIOSH criteria is almost 20 years old, ''The criteria used should be the most recent and [accepted] data.''

Several commenters believed that applying presbycusis factors would reduce unnecessary recordkeeping and follow-up procedures. One stated that:

Many audiometric computer programs used for processing data have this correction calculation built in the software. To change to some other criteria or to remove this factor will result in the modification of numerous systems and a need to switch back and forth,

depending on whether the operator is OSHA or MSHA regulated.

Another of these suggested that MSHA require the use of such correction factors, rather than allow their use to be optional, because such optional use could result in discrepancies in results among audiometric testing services.

A few commenters suggested that it would be better not to adjust audiometric test results for presbycusis. They maintained that the place to claim credit for presbycusis is in determining workers' compensation and not in the institution of an HCP. These commenters believed that not everyone who ages loses their hearing to the same degree, and that the use of presbycusis corrections might mask changes for older adults who have previously had good hearing.

Finally, one commenter recommended that MSHA seek medical advice from national sources to determine what the medical community recognizes as changes occurring from aging.

In contrast to NIOSH's presentation of one set of presbycusis data, the ISO Document ISO 1999:1990(E) (1990) gives a dual set of values for the non-industrial noise exposed population. These data are offered in two tables. One table represents a highly screened, otologically normal population, i.e., persons in a normal state of health, free from all signs and symptoms of ear disease and obstructing wax in the ear canals, and having no history of undue exposure to noise. The second table represents an unscreened population from an industrialized country. The ISO states that the choice of using the screened or unscreened data base depends on what question is to be answered. It states:

> For example, if the amount of compensation that could be due to a population of noise-exposed workers is to be estimated, and otological irregularities and non-occupational noise exposure are not considered in compensation cases, unscreened populations will form the more appropriate data bases.

The ISO further states, however, that its standard ''* * * is based on statistical data and therefore shall not be used to predict or assess the hearing impairment or hearing handicap of individual persons.'' The ISO data would be more difficult to use than NIOSH data because its interpretation would require a higher level of statistical and mathematical expertise.

NIOSH (1995) now recommends that audiograms not be corrected for presbycusis. NIOSH believes that it is inappropriate to apply presbycusis correction factors from a population to an individual. Furthermore, there are no data to confirm that a 50 year old in 1995 will incur the same hearing loss due to aging that a 50 year old did in 1970. If the worker's audiogram is to be corrected for presbycusis, then the hearing loss of a non-occupational noise exposed group with the same demographic characteristics as the worker should be used. However, these kinds of data are not complete nor are they readily available.

The following is an example of the use of presbycusis correction factors as proposed in MSHA's noise standard—

(a) Determine from Tables 62–3 or 62–4 the age correction values for the miner by—

(1) Finding the age at which the baseline audiogram (or supplementary baseline audiogram if appropriate) was taken and recording the corresponding values of age correction at 2000 Hz through 4000 Hz; and

(2) Finding the age at which the most recent audiogram was taken and recording the corresponding values of age correction at 2000 Hz through 4000 Hz.

(b) Subtract the value 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.

(c) Subtract the value found in step (b) from the hearing threshold level found in the annual audiogram to obtain the adjusted annual audiogram hearing threshold level.

(d) Subtract the hearing threshold in the baseline audiogram (or supplemental baseline audiogram as appropriate) from the adjusted annual audiogram hearing threshold level to obtain the age-corrected threshold shift.

Example: A miner is a 32-year-old male. The audiometric history in decibels is shown below for his right ear. A threshold shift of 10 dB at 2000 and 3000 Hz and 20 dB at 4000 Hz exists between the audiograms taken at ages 27 and 32. A retest audiogram has confirmed this shift.

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

An asterisk (*) has been used to identify the supplemental baseline audiogram and a plus (+) the most recent audiogram. The annual audiogram taken at age 27 becomes a supplemental baseline audiogram (and is used in calculating hearing loss) because it shows a significant improvement over the baseline audiogram taken at age 26.

Steps (a) and (b). Find the age correction values (in dB) at age 27 and age 32 in Table 62–3. The difference, shown below, 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.

	Frequency (Hz)		
	2000	3000	4000
Age 32	5	7	10
Age 27	4	6	7
Difference	1	1	3

Step (c). Subtract the difference determined in step (b) from the hearing levels in the most recent audiogram. In this example, the adjusted hearing threshold levels are as follows:

	Frequency (Hz)		
	2000	3000	4000
Age 32	10	10	25
Correction	1	1	3
Adjusted	9	9	22

Step (d). Subtract the hearing threshold level in the baseline audiogram from the adjusted annual audiogram hearing threshold to obtain the age-corrected threshold shift.

	Frequency (Hz)		
	2000	3000	4000
Adjusted	9	9	22
Baseline	0	0	5
Shift	9	9	17

The average threshold shift at 2000, 3000, and 4000 Hz *without* age correction is (10+10+20)/3=13.3 dB. The average age-corrected threshold shift at 2000, 3000, and 4000 Hz is (9+9+17)/3=11.7 dB. This shift is an STS because it exceeds 10 dB, but it is not, as yet, a reportable hearing loss (25 dB). Intervention at this point should prevent further loss and subsequent impairment.

MSHA agrees that not all individuals are affected by presbycusis to the same degree. Additionally, studies have

shown that individuals in environments free from noise exposure display little evidence of presbycusis. MSHA is concerned that the use of presbycusis corrections may allow some miners to incur excess work-related hearing loss. For example, some miners may not have off-the-job noise exposure and may not have a decrement in their hearing due to aging at the levels specified in the presbycusis correction table. Nevertheless, MSHA maintains that at this time, allowing the adjustment of audiometric test results for presbycusis is both reasonable and appropriate. In industrial audiometry, this correction is often used to determine occupational NIHL by adjusting the measured hearing level to compensate for the normal loss of hearing due to aging. This is particularly important because the pattern of hearing loss due to aging resembles that of NIHL. The use of age corrections will help the mine operator judge how well the HCP is working. Such adjustments are consistent with current scientific practice, OSHA's standard, and the recommendations of the majority of the commenters to MSHA's ANPRM.

MSHA selected the NIOSH presbycusis data so that all mine operators who correct audiograms for aging will be using the same data. Though there may be slight variations at individual frequencies, the NIOSH presbycusis values are similar to those of other well known presbycusis data bases, such as the U.S. Public Health Service data, those used by Robinson and Burns, and those of Passchier-Vermeer. The NIOSH data are for a highly screened population which excluded individuals with any significant noise exposure on-the-job, off-the-job, or during military service. Using a single set of presbycusis values will standardize the process of determining STS nationwide. If MSHA allowed mine operators to select their own presbycusis values, there could be major nonuniformity in determining STS's and reportable hearing losses. Nevertheless, the Agency is concerned about locking-in particular presbycusis adjustment tables, and requests additional comments on how to provide for a presbycusis adjustment in a regulatory context.

In conclusion, MSHA believes that, at this time, scientific data and the consensus of commenters support allowing the use of the presbycusis correction factors presented in Tables 62–3 and 62–4. Although this is the position taken in the proposal, MSHA notes that the latest NIOSH advice on this topic has advised against the use of presbycusis correction factors. MSHA, therefore, requests additional comments on whether to use presbycusis corrections for audiograms.

Section 62.170 Follow-up Evaluation When Audiogram Invalid

This section of the proposal provides that when 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 the wearing of hearing protectors, a miner must be referred for a clinical audiological or otological evaluation as appropriate at mine operator expense.

This section also provides that if the physician or audiologist concludes that the suspected medical pathology of the ear which prevents obtaining a valid audiogram is unrelated to the miner's exposure to noise or the wearing of hearing protectors, the miner be advised of the need for an otological evaluation; but in such cases, no financial obligation would be imposed on mine operators.

Finally, this section would require the mine operator to 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.

OSHA's noise standard has similar follow-up requirements, except for the nondisclosure provision. MSHA's current noise standards have no follow-up evaluation provisions.

In response to MSHA's ANPRM, many commenters supported OSHA's or similar requirements for referring employees to a physician for a medical follow-up. A few commenters, however, stated that ''MSHA need not include criteria for directing miners for further medical follow-up nor require a physician, audiologist, or other qualified medical personnel to evaluate the audiograms.''

Another commenter stated the following regarding who should pay for these follow-up evaluations:

> * * * I have a standard recommendation when working with companies that they pay for all initial medical evaluations in order to determine disposition. I think it is as important to them to have documentation that an employee has a medical problem just as [when] he has an occupational one.

The decision as to which type of evaluation, clinical audiological evaluation or otological, is appropriate will depend upon the circumstances. Standards from 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 for HCP purposes. For example, such testing may be warranted if 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 physician specialist (e.g., otolaryngologist) to identify a medical pathology of the ear. Audiometric testing can imply the existence of such a medical pathology. For example, a hearing loss in only one ear can indicate the existence of an acoustic neuroma (type of tumor) at an early stage. Such discovery could be potentially life saving. Another more common reason for an otological examination would be for the removal of impacted ear wax (cerumen) which reduces hearing acuity and can be aggravated by the use of insert-type hearing protectors.

Making the determinations under this section would not require a diagnosis by a physician specialist confirming a medical pathology. The proposal 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.

If the person evaluating the audiogram believes that the suspected medical pathology is related to occupational noise exposure or to the wearing of hearing protectors, the proposal would require the mine operator to pay for the miner's follow-up medical evaluations. MSHA believes that the mine operator has the primary responsibility for work-related medical problems. On the other hand, if the person evaluating the audiogram determines that the suspected medical pathology is not related to the wearing of hearing protectors, then the proposal would require the mine operator to instruct the medical professional to inform the miner of the need for medical follow-up, but would not require the mine operator to pay for it or to be informed of the findings. In such cases, therefore, the follow-up otological examination would be at the miner's expense. Although MSHA agrees that taking action to keep miners healthy would be beneficial to the mine operator, the Agency contends that it would be inappropriate to require mine

operators to pay for non-work-related medical problems.

MSHA also does not believe that it would be appropriate for mine operators to be informed of medical findings that are unrelated to the miner's occupational noise exposure or to the wearing of hearing protectors. If a mine operator would want this information, the proposal would permit the release of this information only upon the written consent of the miner. MSHA has included this provision out of concern for the privacy rights of the miner. A related provision is considered in somewhat more detail in the discussion of proposed § 62.160.

Section 62.180 Follow-Up Corrective Measures When STS Detected

MSHA's proposal would require that, unless a physician or audiologist determines that an STS is neither work-related nor aggravated by occupational noise exposure, mine operators would have 30 calendar days after the finding of an STS to—

(1) Retrain the miner in accordance with § 62.130;

(2) Provide the miner with the opportunity to select a hearing protector, or a different hearing protector if the miner has previously selected one, from the selection offered under § 62.125; and

(3) Review the effectiveness of any engineering and administrative controls to identify and correct any deficiencies. In addition, pursuant to proposed § 62.120(b), an operator would be required to ensure that a miner who has incurred an STS wears provided hearing protection.

A hearing loss of 10 dB from a miner's prior hearing level is of enough significance to warrant intervention by a mine operator, unless it is determined the loss is not work-related. If the controls in place are effective—including the training—this loss should not be occurring. It should be noted that the retraining required is to take place within 30 days after the finding of the STS, and thus it is unlikely mine operators can satisfy this requirement through their part 48 training programs.

MSHA's proposal does not include a provision for transferring a miner who incurs repeated STS's or a reportable hearing loss. A miner transfer program would be complex to administer, and would probably not be feasible in the metal and nonmetal sector. This sector consists largely of smaller mines which may be unable to rotate workers to other assignments on a long-term basis.

Most commenters on this issue suggested that MSHA adopt OSHA's requirements. One of these commenters, however, disagreed with OSHA's allowance for discontinued use of hearing protectors when an STS was found to be temporary. The remaining two commenters recommended that the mine operator only be required to retrain the miner in the use and fit of the hearing protector.

OSHA's noise standard requires that the work-relatedness of an STS be determined only by a physician. Employees, who have a work-related STS and are not using hearing protectors, must be fitted with hearing protectors, be trained in their use and care, and be required to use them. Employees who have an STS and are using hearing protectors must be refitted, be retrained, and be provided with hearing protectors offering greater attenuation when necessary. OSHA does not stipulate a time frame for conducting follow-up procedures.

MSHA believes that audiologists have sufficient training and medical expertise to determine the work-relatedness of an STS, and that it would be needlessly restrictive to limit this determination to a physician as in OSHA's standard.

MSHA, however, like OSHA would not permit technicians to make this determination. MSHA believes that while qualified to conduct and evaluate audiograms under the supervision of a physician or audiologist, technicians do not have the necessary training nor medical expertise to determine if an STS is work related. MSHA has determined that it is necessary to have a physician or audiologist determine the possible work relatedness of any STS. For example, the physician may determine that a miner's STS resulted from: a bad cold or sinus condition; taking certain medication, such as heavy doses of aspirin; or an acoustic neuroma (type of tumor). Careful diagnosis may, on the other hand, reveal that the STS is work related and caused by improper fit of the hearing protector.

MSHA, after reviewing comments and related regulations, believes that the proposed corrective measures are adequate and necessary to prevent further deterioration of the miner's hearing acuity after an STS has been determined. MSHA believes that the 30 day requirement for retraining, selection of a hearing protector or different hearing protector, and evaluation of noise controls is reasonable.

Retraining

If a miner has an STS, § 62.180(a) of this proposal would require that the miner be retrained in accordance with § 62.130, and a record kept of such training.

The specific training elements contained in § 62.130 are discussed in the provisions of this preamble describing those respective sections, including the required certification thereof. Such retraining could be conducted in conjunction with the annual refresher training, under 30 CFR part 48, but only if the latter is so approved and scheduled to be completed within 30 days of the finding of an STS. If the annual refresher training is not conducted within 30 days, the retraining for miners with an STS would have to be conducted separately. It would not be permissible to wait until the next annual refresher training.

Provide Opportunity To Select a Hearing Protector or Different Hearing Protector

In the mining industry, miners are typically exposed to high sound levels and some of the miners may be more susceptible to hearing loss from the noise exposures than others. Consequently, if a miner is diagnosed with an STS, then he or she must be given the opportunity to select a hearing protector or different hearing protector.

Section 62.180(b) of this proposal directs the mine operator to afford the miner the opportunity to select adequate hearing protection from those offered by the mine operator under § 62.125. While that section of the proposal only requires the mine operator to offer one type of ear plug and one type of ear muff, MSHA presumes that most mine operators will offer a range of each. Pursuant to § 62.120(b), the operator is required to ensure that a miner with an STS wears the hearing protector.

The choice of hearing protectors from this selection will be based on the miner's personal preference. The benefits of allowing the miner to select his/her hearing protector are discussed under § 62.125 *Selection of hearing protector.* MSHA believes that even though a miner may select a protector with a noise reduction rating lower than that which might be selected by a mine operator in such cases, factors such as comfort are more critical in ensuring that the miner will fully utilize this critical piece of personal protective equipment. Moreover, as discussed in the section on *Hearing protector effectiveness,* MSHA has concluded that there is no standardized objective method to determine whether an additional or different hearing protector would provide the miner with greater protection. MSHA requests further comment on this issue.

Review Effectiveness of Controls

Upon the finding of an STS, MSHA would require, under § 62.180(c) of the proposal, the mine operator to review the effectiveness of any engineering and administrative controls. The mine operator would need to correct any deficiencies. The implementation and maintenance of either engineering or administrative controls or a combination of such controls above the PEL is the primary method for reducing a miner's noise exposure and, thus, reducing the risk of hearing loss. OSHA's current noise regulation does not require a review of the effectiveness of engineering and administrative controls when an STS is found.

The inadequacy of engineering or administrative controls or a combination of such controls may well be the contributing factor in the development of a miner's STS. Thus, the proposal would require the mine operator to review the effectiveness of controls and update or modify them, as necessary and feasible, to reduce the miner's noise exposure.

Miner Transfer

The Federal Mine Safety and Health Act of 1977 (30 U.S.C. 811) requires health standards to include, as appropriate, provisions for removing a miner from hazardous exposure where that miner may suffer material impairment of health or functional capacity. MSHA has decided not to include such a provision in its proposal.

MSHA's current noise standards do not contain such a transfer provision. Nor does the OSHA noise standard have such a requirement.

In its ANPRM, MSHA requested comments regarding the need for a transfer provision in the proposed rule for a miner with a diagnosed occupational hearing loss. In response, many commenters stated that a miner transfer provision is not appropriate. Some of the concerns expressed by the commenters included: the negotiation of disability accommodation sections in labor contracts; problems with rate retention and seniority provisions in existing contracts; the contribution of non-occupational noise exposure to the hearing loss; uncertainty as to the etiology of the hearing loss; and the impracticality in small operations. However, several commenters disagreed, indicating that the transfer of a miner is appropriate when other efforts to halt the progression of the hearing loss have failed. They added that the safety of a miner with a hearing loss would be jeopardized, due to the inability to hear warning signals and/or understand verbal instructions in the noisy environment (a hazard to other miners as well).

Several of the U.S. Armed Forces, and some other countries, allow for removal or transfer of employees from noisy areas.

Although MSHA would encourage mine operators to transfer miners who have incurred a hearing impairment, MSHA believes that a miner transfer provision would not be feasible, at the vast majority of small mining operations, because of limited personnel and non-noise exposed occupations. At larger mines transfer may be feasible; however, MSHA believes that the obligation to utilize all feasible administrative (as well as engineering controls) would reduce miner exposure time to harmful noise in much the same way as a transfer provision but without unwarranted complexity.

Section 62.190 Notification of Results; Reporting Requirements

This section of the proposal would require that miners be notified of audiometric test findings, and that the Agency be notified of any instances of ''reportable hearing loss.''

The proposal would require the mine operator, within 10 working days of receiving the results of an audiogram, or the results of a follow-up evaluation pursuant to § 62.170(a)—those follow-ups on which the mine operator would receive results—to notify the miner in writing of the results and interpretations, including any finding that an STS or reportable hearing loss has occured. The notification would include an explanation of the need and reasons for any further testing or evaluation that may be required.

MSHA believes that informing miners of the results of their audiometric tests in a timely manner is critical to the success of an HCP. Immediate feedback upon completion of the testing provides the greatest benefit.

The proposal would require mine operators to inform MSHA of any reportable hearing loss, unless the physician or audiologist has determined the loss is neither work-related nor aggravated by occupational noise exposure. This essentially restates for noise the requirements of 30 CFR part 50, but with an explicit definition of reportable hearing loss for the first time. Having a uniform definition will ease reporting burdens on mine operators while promoting the development of an improved data base on hearing loss in the mining community.

The proposal would define a reportable hearing loss as a change in hearing acuity 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. Should an annual audiogram actually indicate an improvement in hearing at any time, this audiogram would, pursuant to § 62.140, become the baseline for purposes of determining whether a reportable hearing loss has occurred. As noted herein, MSHA is seeking comment on whether part 50 should collect information on harm on less dramatic shifts in hearing acuity, and how reporting should be accomplished in cases in which an operator lacks audiometric data.

Notification of the Miner

Section 62.190(a) of MSHA's proposal would require that within 10 working days of receiving the results of an audiogram or follow-up evaluation, the mine operator shall notify the miner in writing of—

(1) the results and interpretation of an audiometric test, including any finding of an STS or a reportable hearing loss; and

(2) if applicable, the need and reasons for any further testing or evaluation.

MSHA has no current requirements in this area. The proposed time frame is consistent with the time frame for notification to the Agency, under part 50, of cases of reportable hearing loss. MSHA's proposal would differ from OSHA's standard in this regard and in several other respects: the miner would be informed of the need and reason for further medical evaluations, and the miner would be informed of the finding of a reportable hearing loss. Moreover, OSHA's requirement does not specify how long, following the annual audiogram, an employer can take to make this determination.

All commenters on this issue favored notifying the employee of the results of audiometric testing and follow-up examinations. They differed, however, as to the time to be allotted for such notification and the requirements of such notification.

Many commenters endorsed OSHA's requirements. One commenter agreed that written notification be provided within 21 days, the same as OSHA, but recommended that such notice be provided for all audiometric test results. This commenter stated:

> It is our policy to notify all employees of the results of their audiometric tests in writing. An appropriate time frame would be 21 days from the time the employee's facility is made aware of the results. If the time frame for notification is 21 days from the time of the actual test, many problems may arise. If a mobile testing service is utilized, the results may not be sent in for analysis for at least

a week. Our audiological staff reviews all of our audiograms in-house rather than relying on outside services for analysis. Some of our testing services microfilm the tests or analyze them separately which means that a delay of a few weeks may occur. The purpose should be that the employee receive results in a timely enough fashion so that they are meaningful.

One commenter recommended that written notification be provided to the miner within 30 days of determining a confirmed STS. Another commenter recommended that miners be notified of an STS, including any optional retest, within 30 days of the testing. This commenter stated that:

Service providers have taken undue advantage of a perceived grace period in the OSHA Hearing Conservation Amendment to inform employees of a shift in hearing. By the time audiometric tests are administered, entered into a computer, returned to an employer, and then finally returned to the employee, the lag time may total six to eight weeks. This is a disservice to the employee, and is certainly preventable.

Notification of STS, including the optional retest of STS-affected employees, should be completed within a 30-day period following testing. OSHA's time limit of 21 days following notification to the employer creates a loophole which makes the employee wait all too long for feedback regarding STS.

Other commenters recommended notifying miners of the results of their audiometric tests, but did not specify a time frame.

The U.S. Armed Forces regulations, and standards of some members of the international community, vary on the time frame for notification.

The time frame in MSHA's proposal is shorter than the time frame for notification in OSHA's standard, but is consistent with MSHA's requirement that the Agency be notified of reportable hearing losses within 10 working days. MSHA's proposal would also differ from OSHA's standard in that the miner would be informed of the need and reason for further medical evaluations; and the miner would be informed of the finding of a reportable hearing loss. In addition, pursuant to § 62.170(b), MSHA's proposal would require the mine operator to instruct the physician to notify the miner of the need for an otological examination based upon a medical pathology of the ear that is unrelated to the affected miner's noise exposure or the wearing of hearing protectors. MSHA believes that miners have a right to know the results of any medical tests conducted on them.

MSHA believes that it is appropriate to require written notification. Under proposed § 62.200, the miner would in any event have access to all required records under this part upon written request. Providing the notices in writing would ensure there are no misunderstandings on the part of miners as to the severity of the problem.

MSHA believes that informing miners of the results of their audiometric tests in a timely manner is critical to the success of an HCP. Immediate feedback upon completion of the testing provides the greatest benefit. Generally, the employee shows the most interest and concern regarding the effects of noise on his/her hearing immediately following testing. Providing the results several weeks or months later may have less of an impact. In many cases, however, it may not be feasible or practical to inform miners immediately of the results of their audiometric tests. The proposal, consequently, would allow mine operators up to 10 working days to inform the miner (the same time period as provided under part 50 for notification of MSHA of cases of reportable hearing loss). Because the proposal would allow up to 30 calendar days to evaluate audiograms, it could be as long as 44 days following testing before the miner is informed of the results. In the case of an audiometric retest, it could be as long as 104 days before the miner is informed of the results of the retest. MSHA believes that it is necessary to specify a maximum time frame for informing miners of the audiometric test results in order to prevent undue delays.

Reporting Noise-Induced Hearing Loss (NIHL)

Section 62.190(b) of this proposal would require the mine operator to report hearing loss under 30 CFR part 50, if the results of an audiogram or follow-up evaluation indicate that a miner has incurred a ''reportable hearing loss.'' This section is designed to refine, in light of this proposal, MSHA's existing reporting requirements for injuries and illnesses in 30 CFR part 50, so as to ease reporting burdens on employers while promoting the development of an improved data base on hearing loss in the mining community.

The current reporting requirements provide that mine operators report a hearing loss whenever a physician determines that it is work related, or whenever an award of compensation is made. NIHL is specifically listed among the examples of occupational illnesses to be reported when it is work related. The proposal would establish the reporting definition for this purpose: but the report would only be required under part 50 if the hearing loss is suspected to be work related.

OSHA does not have reporting requirements: i.e., a level which triggers notification to the agency so that it can intervene. It does, however, have recording requirements for noise, so that information is gathered about NIHL and is available to employers, employees, and agency personnel. In June 1991, OSHA issued its current policy (1991) for reporting NIHL (on the OSHA Form 200). This policy requires employers to record a work-related shift in hearing of 25 dB or more in either ear from the original baseline audiogram averaged over 2000, 3000, and 4000 Hz. The recording criteria use identical evaluation frequencies as required for determining an STS. The policy allows a correction for presbycusis when determining reportability. In January 1996, OSHA published a proposal to revise agency recordkeeping standards. Under the proposal's mandatory Appendix B, the recording requirement would drop to a work-related shift in hearing of 15 dB or more in either ear. OSHA notes it is proposing this change to ensure the recording of any STS (a 10 dB shift under OSHA's standard), with some allowance made for instrumentation variance.

In its ANPRM, MSHA discussed the problems that the Agency is experiencing with its existing reporting requirements. Of the commenters addressing this issue, many recommended that MSHA require reporting of a 10-dB average loss in either ear at 2000, 3000, and 4000 Hz (the OSHA STS criteria). One commenter favored reporting any job-related loss and another stated that the criteria of reporting an STS was too high because ''* * * the worker['s] hearing loss has progressed too far with this shift to be a reliable preventative measure.'' Other commenters stated that the STS criteria represent a slight change in hearing and is not meaningful for reporting purposes. Two commenters recommended that the criteria for reporting be that used for defining impairment (the AAO–HNS 1979 criteria).

Some hearing conservation associations have opposed OSHA's current policy, arguing that employers should record the NIHL when the employee incurs an STS. Driscoll and Morrill (1987) presented the position of the American Industrial Hygiene Association (AIHA) in a paper entitled ''A Position Paper on a Recommended Criterion for Recording Occupational Hearing Loss on OSHA Form 200''. AIHA concluded that ''a confirmed STS which results from workplace noise exposure is considered an appropriate

measure for surveillance or recordkeeping purposes.''

The National Hearing Conservation Association (NHCA) in a letter from their President, Susan Cooper Megerson (1994), to Joseph Dear, Assistant Secretary of Labor for Occupational Safety and Health, urged OSHA to require the recording of an occupational hearing loss when an STS was confirmed. NHCA contends that recording hearing loss after it reaches an average of 25 dB or more at 2000, 3000, and 4000 Hz is ''dangerously underprotective and not technically well founded.''

Suter (1994) in a letter to Sue Andrei of OSHA's Policy Directorate urged OSHA to adopt a policy of recording persistent occupational hearing loss at an STS instead of at an average of 25 dB or more at 2000, 3000, and 4000 Hz.

MSHA's proposal would define a ''reportable hearing loss'' as a change in hearing threshold relative to the miner's original baseline audiogram of an average of 25 dB or more in either ear at 2000, 3000, and 4000 Hz. If a physician determines that the hearing loss is neither work-related nor aggravated by occupational noise exposure, then it would not be considered a reportable illness under part 50. As discussed in connection with proposed § 62.140, if an audiological exam showed a significant improvement in hearing acuity, the original baseline would be supplemented to reflect this: a correction which would then affect the reportability of hearing loss. Furthermore, as noted in the discussion of proposed § 62.160, the proposal would allow the correction of audiograms for presbycusis when determining the reportability of shifts in hearing threshold levels.

In selecting its reporting criteria, MSHA took into account that a loss of this magnitude is one that diminishes quality of life and the ability to understand speech in noisy environments. MSHA's reporting criteria, although not impairment per se, represent a substantial loss which would provide a reliable indication of the effectiveness of MSHA's rule and enforcement programs. Moreover, the calculation would be the same as that used to determine an STS and, thus, not an extra burden. The use of other criteria, such as the AAO–HNS 1979 criteria for impairment, would require an additional set of calculations at different frequencies.

MSHA is concerned, however, that reporting only losses of 25 dB may not provide MSHA a full picture of hearing loss in the mining industry. A loss of 25 dB is used by many states as a basis for making disability awards. Some have recommended that any STS (10 dB loss) should be captured in a hearing loss data base. OSHA, which currently requires any 25 dB loss to be captured in an employer's log, has proposed to capture any 15 dB loss. MSHA accordingly solicits comment on this point.

An important goal of the proposal is to clarify the level of hearing loss which is reportable. MSHA believes that its current reporting requirements are vague; consequently, cases of NIHL are inconsistently reported or not reported. Some mine operators have reported even a small loss, while others only reported when a miner received an award of compensation. In other cases, mine operators have not reported when an award of compensation was granted because the miners had retired. Inconsistent reporting also results because worker compensation regulations vary from state to state, i.e., the same hearing loss would be compensable and thus reportable in some states and not in others. For these reasons, current hearing loss data reported to MSHA under part 50 cannot be used to accurately characterize either the prevalence or the degree of hearing loss in the mining industry.

Reporting at a specified level, as required by the proposal, would eliminate reliance on workers' compensation awards as a criteria for defining NIHL to be reported. Nevertheless, part 50 would still require that awards of compensation be reported in those cases when the loss had not been previously reported. Two general examples of such cases are (1) if the miner had incurred the 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 had not been in an HCP or had not received an audiometric test while employed by the operator.

In this regard, MSHA would like comment on how to define ''reportable'' hearing loss for those operators who do not have audiometric test data. Not all mine operators will be required to obtain audiometric test data under the proposed rule; thus, such operators may not be able to use a definition of reportable hearing loss defined in this manner. MSHA also requests specific suggestions on how to capture data on work-related NIHL: (1) that is not discovered until after the miner's employment is terminated; and (2) that the miner had accumulated from work with several employers.

MSHA does not expect mine operators to report the same reportable hearing loss each year that a miner works at the mine. The next reportable hearing loss would not be reported until the miner incurs another 25 dB shift (50 dB shift from the original baseline). MSHA does intend for each ear to be treated independently in terms of a reportable event, unless the reportable loss occurs in both ears during a particular year. (For example, 28.7 dB, left ear, 25.9 dB, right ear, not corrected for presbycusis.) Although not specifically required in its proposal, MSHA anticipates that mine operators would indicate when reporting to MSHA—

(1) the actual average hearing loss;

(2) in which ear(s) the loss occurred; and

(3) whether the audiograms were corrected for presbycusis. (For example, 28.7 dB, left ear, corrected for presbycusis.)

Section 62.200 Access to Records

Authorized representatives of the Secretaries of Labor and Health and Human Services would have immediate access to all records required under this part.

Moreover under the proposal, a miner or former miner, or his/her designated representative with written consent, would have access to all the records that the mine operator is required to maintain under this part for that individual miner or former miner. Also, the miners' representative is in all cases to have access, for miners they represent, to noise training records and notices required under § 62.120(f) to be given to miners exposed to noise above various levels.

The mine operator would have 15 days from receipt of a written request to provide such access. The proposal would define ''access'' as the right to examine and copy records. The first copy of any record requested by a person is to be provided without cost to that person, and any additional copies requested by that person are to be provided at reasonable cost.

Upon termination of employment, mine operators would be required to provide a miner without cost an actual copy of all his/her own records (those required under this part).

MSHA has no uniform records access provision that address these issues—though the Agency and NIOSH do have statutory rights to access. The provisions proposed here are similar to those in other health standards proposed in recent years by the Agency.

Section 103(c) of the Mine Act states that:

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. Such regulations 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.

OSHA's requirements for access to records incorporate its standards for ''Access to Employee Exposure and Medical Records'' [29 CFR § 1910.20(a)–(e) and (g)–(i)]. OSHA's requirements and MSHA's proposal are essentially the same.

All of the commenters addressing this issue favored providing affected miners with reasonable access to required records. Most of these commenters also recommended that the request for access to records be in writing.

The Agency agrees, after reviewing comments and related regulations, that access to noise records by both employees and the government is essential, and does not believe the costs of providing such access will be significant. As noted by OSHA, in its preamble to its proposed Hearing Conservation Amendment (46 FR 4161)—

Such access will serve to educate employees as to the state of their hearing and the effectiveness of the program, and will encourage their conscientious participation in it. The information in the records will be invaluable to the Assistant Secretary in the enforcement of the amendment and will be useful in research into the effects of occupational noise exposure. The Director of NIOSH will also be primarily interested in the records for research purposes.

MSHA also agrees that requests from miners, miner's designated representatives, and miner's representatives be in writing. This requirement would benefit both the miners and mine operators by protecting them in matters of dispute regarding the date on which the request was submitted. MSHA's access to records requirements would not preclude the mine operators from requiring the requester to sign a receipt after receiving the records. In addition, the definition of miner's ''designated representative'' specifies that such person have written authorization to request records for each miner or former miner represented. Because requested records may contain personal, private information, MSHA intends that the miner's designated representative would present such authorization to the mine operator when requesting records on behalf of a miner or former miner.

According to the proposal the mine operator would have 15 days to provide the miner, former miner, or miner's designated representative access to the requested records. MSHA believes that it is reasonable to require the mine operator to provide access because the proposal would require the records to be maintained at the mine site.

The mine operator has some choice as to how to provide records requested by an employee or representative. The mine operator could provide a copy, make available mechanical copying facilities, or loan the record to the requester for a reasonable time to enable a copy to be made. The proposal provides that if a copy is requested, however, it shall be provided, and the first copy shall be at no cost. If a copy of the record had been provided previously without cost, the proposal would allow the mine operator to charge reasonable, non-discriminatory administrative costs for providing an additional copy of the record. The mine operator, however, could not charge for the first copy of new information which subsequently had been added to the record.

MSHA believes that its proposed requirements for access to records are both reasonable and necessary to meet its mandate under the Mine Act. MSHA would welcome comments on what actions are 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 proposed requirements.

Section 62.210 Transfer of Records

The proposed standard would require mine operators to transfer all records (or a copy thereof) required by this part to any successor mine operator. The successor mine operator would be required to receive these records and maintain them for the period required. Additionally, the successor mine operator would be required to use the baseline audiogram obtained from the original mine operator (or supplemental baseline audiogram as appropriate) for determining an STS and reportable hearing loss.

MSHA's existing noise standards do not address the transfer of records, nor does MSHA have general standards on this point. The provisions proposed here are similar to those in other health standards proposed in recent years by the Agency. OSHA's standard requires transfer of records and, in addition, incorporates by reference transfer provisions found in its ''Access to Employee Exposure and Medical Records'' standards (29 CFR 1910.20 (h)). MSHA's proposal regarding the transfer of records is essentially the same as in OSHA's regulations.

MSHA's ANPRM did not address the transfer of records and no comments were received on this subject. MSHA considered OSHA's requirements and believes that they are both reasonable and necessary to ensure that records are maintained for the required periods of time when a mine operator ceases to do business.

Requiring successor mine operators to use the prior baseline audiogram will provide the miners with a greater degree of protection by assuring that an STS or reportable hearing loss is based on the original or supplemental baseline taken under the original mine operator, instead of based on a new baseline. Generally if a new baseline would be established by a successor mine operator, the miner would need to lose additional hearing acuity before the corrective action triggered by the occurrence of an STS is implemented or a hearing loss is required to be reported.

IV. Feasibility

MSHA has tentatively concluded that it is feasible for the mining industry to take the actions specified in the proposed rule. MSHA has also tentatively concluded that at this time, it may not be feasible for the mining industry to comply with two changes that would otherwise be warranted to further reduce the risk of impairment from occupational NIHL—reducing the PEL to a TWA_8 of 85 dBA, and reducing the exchange rate from 5-dB to 3-dB.

As background, this part begins with a review of the pertinent legal requirements for setting health standards under the Mine Act and an economic profile of the mining industry.

Pertinent Legal Requirements

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 a consideration.

Feasibility in this context refers to both economic and technological feasibility. It also refers to what is feasible for an entire industry, not an individual mine operator; although for this purpose, MSHA has considered independently the situations of the coal mining sector and the metal and nonmetal mining sector.

In relation to feasibility, 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 court 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); (CA 3 1975) *Society of Plastics Industry* v. *OSHA,* 509 F.2d 1301 (CA 2), *cert. denied,* 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).

Thus, standards may be economically feasible even though industry considers them economically burdensome.

Though the Mine Act and its legislative history are not specific in defining feasibility, the courts have clarified the meaning of feasibility. The Supreme Court, in *American Textile Manufacturers' Institute* v. *Donovan* (OSHA Cotton Dust), 452 U.S. 490, 508–509 (1981), defined the word ''feasible'' as ''capable of being done, executed, or effected.'' The Court stated that a standard would not be considered economically feasible if an entire industry's competitive structure was threatened. According to the Court, the appropriate inquiry into a standard's economic feasibility is whether the standard is capable of being achieved.

Courts do not expect hard and precise predictions from agencies regarding feasibility. Under the ''arbitrary and capricious standard,'' used in judicial review of agency rulemaking under the Administrative Procedures Act, an agency need only base its predictions on reasonable inferences drawn from the existing facts. An agency is required to produce a reasonable assessment of the likely range of costs that a new standard will have on an industry. 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. *United Steelworkers of America* v. *Marshall,* 647 F.2d 1189 (D.C. Cir. 1980).

In developing a new health standard, an agency must also 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. *United Steelworkers of America* v. *Marshall,* supra at 1272. If only the most technologically advanced companies in an industry are capable of meeting the standard, then that would be sufficient demonstration of feasibility (this would be true even if only some of the operations met the standard for some of the time). *American Iron and Steel Institute* v. *OSHA,* 577 F. 2d 825 (3d Cir. 1978) at 832–835, see also *Industrial Union Dep't., AFL-CIO* v. *Hodgson,* 499 F. 2d 467 (D.C. Cir. 1974).

In evaluating the feasibility of particular requirements under these legal tests, MSHA took into account how it anticipates interpreting those requirements. For example, in the case of the requirement that mine operators use all feasible engineering and administrative controls, the Agency considered legal guidance from the Federal Mine Safety and Health Review Commission as to what MSHA must consider, for enforcement purposes, as a feasible noise control at a particular mine. This guidance is discussed in the ''Questions and Answers'' in part I (see Question 12). MSHA also used its expert knowledge of particular equipment or methods of noise control available in the industry, and considered exposure data indicating the extent to which the industry would be out of compliance should a particular proposal be adopted.

Industry Profile

Determining the feasibility of controls for the mining sector requires consideration of the composition and economics of that sector. The following information is reprinted from MSHA's preliminary Regulatory Impact Analysis (RIA), and was considered by the Agency in reaching preliminary conclusions.

Overall Structure of the Mining Industry

MSHA divides the mining industry into two major segments based on commodity, the coal mining industry and the metal and nonmetal mining industry. These major industry segments are further divided based on type of operation (underground mines, surface mines, and independent mills, plants, shops, and yards). MSHA maintains its own data on mine type, size, and employment. MSHA also collects data on the number of contractors and contractor employees by major industry segment.

MSHA categorizes mines as to size based on employment. For the purpose of analyzing this proposed rule, MSHA defines small mines to be those having fewer than 20 employees and large mines to be those having at least 20 employees. Table IV–1 presents the number of small and large mines and the corresponding number of miners, excluding contractors, by major industry segment and mine type. Although MSHA does not maintain a data base of the numbers of miners by job title, Table IV–2 presents an estimate of the numbers of miners by job title groups based in part on research conducted by the U.S. Department of the Interior, Bureau of Mines. The Agency does not maintain a data base which would allow determination of the types of services provided by independent contractors or the job titles of contractor employees. Table IV–3, however, presents MSHA data on the numbers of independent contractors and the corresponding numbers of employees by major industry segment and the size of the operation based on employment.

TABLE IV–1.—DISTRIBUTION OF OPERATIONS AND EMPLOYMENT (EXCLUDING CONTRACTORS) BY MINE TYPE, COMMODITY, AND SIZE

Mine type	Small (<20 EES)		Large (>20 EES)		Total	
	Number of mines	Number of miners	Number of Mines	Number of Miners	Number of Mines	Number of Miners
Coal:						
Underground	466	4,630	606	49,370	1,072	54,000
Surface	875	5,337	396	30,173	1,271	35,510
Shp/Yrd/Mll/Plnt	421	2,701	132	5,169	553	7,870
Office workers	.....	752	.....	5,030	.....	5,782
Coal Subtotal	1,762	13,420	1,134	89,742	2,896	103,162
Metal/nonmetal (M/NM):						
Underground	141	1,191	134	16,736	275	17,927
Surface	8,838	49,214	1,192	79,230	10,030	128,444
Shp/Yrd/Mll/Plnt	288	2,146	223	18,889	511	21,035
Office workers	.....	8,530	.....	18,644	.....	27,174
M/NM Subtotal	9,267	61,081	1,549	133,499	10,816	194,580
Total all mines	11,029	74,501	2,683	223,241	13,712	297,742

Source: U.S. Department of Labor, Mine Safety and Health Administration, Office of Standards, Regulations, and Variances, based on preliminary 1995 MIS data (quarter 1–quarter 4, 1995). MSHA estimates assume that operator office workers are distributed the same as non-office workers.

TABLE IV–2.—MINING WORKFORCE ESTIMATES BY JOB TITLE GROUPS (INCLUDING OFFICE WORKERS AND EXCLUDING CONTRACTOR EMPLOYEES)

Job title groups	Coal mining		M/NM mining		Total	
	Percent	Miners	Percent	Miners	Percent	Miners
Backhoe-crane-dragline-shovel operator	1.9	2,004	2.5	4,938	2.3	6,942
Beltman-belt cleaner (coal)-belt repairman	3.4	3,473	0.4	800	1.4	4,273
Blaster	0.8	810	0.3	605	0.5	1,415
Continuous miner & related machine operator	4.2	4,282	([1])	([1])	1.4	4,282
Deckhand-barge & dredge operator	0.2	156	0.6	1,103	0.4	1,259
Dozer-heavy & mobile equipment operator	6.8	7,038	2.7	5,289	4.1	12,326
Driller-auger operator (coal)-rock bolter (m/nm)	1.9	1,910	1.9	3,700	1.9	5,611
Electrician-wireman (coal)-lampman	4.0	4,127	1.9	3,780	2.7	7,908
Front-end loader-forklift (m/nm) operator	2.8	2,876	7.2	13,943	5.7	16,820
Grader-scraper operator	1.6	1,636	0.7	1,323	1.0	2,959
Laborer-miner-utility man	15.0	15,477	10.3	20,021	11.9	35,498
Longwall operator	0.7	689	([1])	([1])	0.2	689
Manager-foreman-supervisor	11.1	11,423	10.1	19,685	10.5	31,108
Mechanic-welder-oiler-machinist	15.0	15,457	14.7	28,546	14.8	44,003
Mine technical support	4.4	4,521	6.7	13,039	5.9	17,561
Office workers	5.6	5,782	14.0	27,174	11.1	32,956
Plant operator-warehouseman	3.8	3,921	14.0	27,315	10.5	31,236
Roof bolter-rock driller (coal)	5.3	5,459	0	0	1.8	5,459
Scoop tractor operator-motorman (coal)	3.4	3,510	0	0	1.2	3,510
Shuttle car-tram (m/nm) operator	3.6	3,756	0.8	1,607	1.8	5,363
Stone cutter-finisher	0	0	0.5	879	0.3	879
Truck driver	4.7	4,854	10.7	20,832	8.6	25,686
Total	100	103,162	100	194,580	100	297,742

[1] Continuous miner and longwall operators at metal/nonmetal mines are included in the job group ''laborer-miner-utility man.''

Extrapolated from U.S. Bureau of Mines, *Characterization of the 1986 Coal Mining Workforce* (IC 9192) and *Characterization of the 1986 Metal and Nonmetal Mining Workforce* (IC 9193), 1988.

TABLE IV–3.— DISTRIBUTION OF CONTRACTORS (CONTR) AND CONTRACTOR EMPLOYEES (MINERS) BY MAJOR INDUSTRY SEGMENT AND SIZE OF OPERATION

Contractors	Small (<20)		Large (≥20)		Total	
	Number of contr.	Number of miners	Number of contr.	Number of miners	Number of contr.	Number of miners
Coal:						
Other than office	3,580	14,310	291	12,863	3,871	27,173

TABLE IV–3.— DISTRIBUTION OF CONTRACTORS (CONTR) AND CONTRACTOR EMPLOYEES (MINERS) BY MAJOR INDUSTRY SEGMENT AND SIZE OF OPERATION—Continued

Contractors	Small (<20)		Large (≥20)		Total	
	Number of contr.	Number of miners	Number of contr.	Number of miners	Number of contr.	Number of miners
Office workers	.....	1,291	.....	1,160	.....	2,451
Coal Subtotal	3,580	15,601	291	14,023	3,871	29,624
Metal/nonmetal (M/NM):						
Other than office	2,656	12,921	352	20,975	3,008	33,896
Office workers	.....	734	.....	1,191	.....	1,925
M/NM Subtotal	2,656	13,655	352	22,166	3,008	35,821
Total	6,236	29,256	643	36,189	6,879	65,445

Source: U.S. Department of Labor, Mine Safety and Health Administration, Office of Standards, Regulations, and Variances, based on preliminary 1995 MIS data (quarter 1–quarter 4, 1995). MSHA estimates assume that contractor office workers are distributed the same as non-office workers.

Economic Characteristics

The U.S. mining industry's 1995 production is worth in excess of $58 billion in raw mineral resources. Coal mining contributed about $20 billion to the Gross Domestic Product in 1995 and metal and nonmetal mining contributed about $38 billion. Another $17 billion is reclaimed annually from recycled metal and mineral materials such as scrap iron, aluminum, and glass.

The Agency obtained financial information on the various mineral commodities primarily from the U.S. Department of the Interior, Bureau of Mines, and the U.S. Department of Energy, Energy Information Administration.

Structure of the Coal Mining Industry

MSHA separates the U.S. coal mining industry into two major commodity groups, bituminous and anthracite. The bituminous group includes the mining of subbituminous coal and lignite. Bituminous operations represent over 93% of the coal mining operations, employ over 98% of the coal miners, and account for over 99% of the coal production. About 60% of the bituminous operations are large; whereas about 90% of the anthracite operations are small.

Underground bituminous mines are more mechanized than anthracite mines in that most, if not all, underground anthracite mines still hand-load. Over 70% of the underground bituminous mines use continuous mining and longwall mining methods. The remaining use drills, cutters, and scoops. Although underground coal mines generally use electrical equipment, a growing number of underground coal mines use diesel haulage equipment.

Surface mining methods include drilling, blasting, and hauling and are similar for all commodity types. Most surface mines use front-end loaders, bulldozers, shovels, or trucks for coal haulage. A few still use rail haulage. Although some coal may be crushed to facilitate cleaning or mixing, coal processing usually involves cleaning, sizing, and grading.

Preliminary data for 1995 indicate that there are about 2900 active coal mines of which 1760 are small mines (about 61% of the total) and 1130 are large mines (about 39% of the total).

These data indicate employment at coal mines to be about 103,200 of which about 13,400 (13% of the total) worked at small mines and 89,700 (87% of the total) worked at large mines. MSHA estimates that the average employment is 8 miners at small coal mines and 79 miners at large coal mines.

Structure of the Metal/Nonmetal Mining Industry

The metal and nonmetal mining industry consists of about 70 different commodities including metals, industrial minerals, stone, and sand and gravel. Preliminary data for 1995 indicate that there are about 10,820 active metal and nonmetal mines of which 9270 are small mines (about 86% of the total) and 1550 are large mines (about 14% of the total).

These data indicate employment at metal and nonmetal mines to be about 194,600 of which about 61,100 (31% of the total) worked at small mines and 133,500 (69% of the total) worked at large mines. MSHA estimates that the average employment is 7 miners at small metal and nonmetal mines and 86 miners at large metal and nonmetal mines. Table II–4 presents the number of metal and nonmetal mines and miners by major commodity category, mine size, and employment. In addition, MSHA estimates that about 350 mines are owned by state, county, or city governments.

TABLE IV–4.—ESTIMATED DISTRIBUTION OF METAL/NONMETAL MINES AND MINERS [1]

Commodity	Small (<20 EES)		Large (>20 EES)		Total	
	Number of Mines	Number of Miners	Number of Mines	Number of Miners	Number of Mines	Number of Miners
Metal	176	1,199	193	46,296	369	47,495
Nonmetal	546	3,496	231	25,436	777	28,932
Stone	2,640	23,003	894	53,157	3,534	76,160
Sand and Gravel	5,905	33,383	231	8,610	6,136	41,993
Total	9,267	61,081	1,549	133,499	10,816	194,580

[1] Includes office workers. Excludes contractors.

Metal Mining

Metal mining in the U.S. consists of about 25 different commodities. Most metal commodities include only one or two mining operations. Metal mining operations represent about 3% of the metal and nonmetal mines, employ about 24% of the metal and nonmetal miners, and account for about 35% of the value of metal and nonmetal minerals produced in the U.S. About 48% of the metal mining operations are small.

Underground metal mining uses a few basic mining methods, such as stope, room and pillar, and block caving with primary noise sources being diesel haulage equipment, pneumatic drills, and mills. Larger underground metal mines use more hydraulic drills and track-mounted haulage; whereas, smaller underground metal mines use more hand-held pneumatic drills. Stope mining uses more hand-held equipment. Surface metal mines include some of the largest mines in the world. Surface mining methods (drill, blast, haul) use the largest equipment and are similar for all commodity types.

Nonmetal Mining

For enforcement and statistical purposes, MSHA separates stone and sand and gravel mining from other nonmetal mining. There are about 35 different nonmetal commodities, not including stone or sand and gravel. About half of the nonmetal commodities include less than 10 mining operations; some include only one or two mining operations. Nonmetal mining operations represent about 7% of the metal and nonmetal mines, employ about 15% of the metal and nonmetal miners, and account for about 34% of the value of metal and nonmetal minerals produced in the U.S. About 70% of the nonmetal mining operations are small.

Nonmetal mining uses a wide variety of underground mining methods. For example, potash mines use continuous miners similar to coal mining; oil shale uses in-situ retorting; and gilsonite uses hand-held pneumatic chippers. Some nonmetal commodities use kilns and dryers in ore processing. Others use crushers and mills similar to metal mining. Underground nonmetal mining operations generally use more block caving, room and pillar, and retreat mining methods; less hand-held equipment; and more electrical equipment than metal mining operations. As with underground mining, surface mining methods vary more than for other commodity groups. In addition to drilling, blasting, and hauling, surface nonmetal mining methods include other types of mining methods, such as evaporation beds and dredging.

Stone Mining

There are basically only eight different stone commodities of which seven are further classified as either dimension stone or crushed and broken stone. Stone mining operations represent about 33% of the metal and nonmetal mines, employ about 39% of the metal and nonmetal miners, and account for about 19% of the value of metal and nonmetal minerals produced in the U.S. About 75% of the stone mining operations are small.

Stone generally is mined from quarries using only a few different methods and diesel haulage to transfer the ore from the quarry to the mill. Crushed stone mines typically drill and blast; whereas, dimension stone mines typically use channel burners, drills, or wire saws. Milling typically includes jaw crushers, vibratory crushers, and vibratory sizing screens.

Sand and Gravel Mining

Based on the number of mines, sand and gravel mining represents the single largest commodity group in the U.S. mining industry. About 57% of the metal and nonmetal mines are sand and gravel operations. They employ about 22% of the metal and nonmetal miners and account for about 11% of the value of metal and nonmetal minerals produced in the U.S. Over 95% of the sand and gravel operations are small.

Construction sand and gravel is generally gathered from surface deposits using dredges or draglines and only washing and screening milling methods. As in other surface mining operations, sand and gravel uses diesel haulage equipment, such as front-end loaders, trucks, and bulldozers. In addition, industrial sand and silica flour operations mill the ore using crushers, ball mills, screens, and classifiers.

Economic Characteristics of the Coal Mining Industry

The U.S. Department of Energy, Energy Information Administration, reported that the U.S. coal industry produced a record 1.03 billion tons of coal in 1994 with a value of about $20 billion. Of the several different types of coal commodities, bituminous and subbituminous coal account for 91% of all coal production (940 million tons). The remainder of U.S. coal production is lignite (86 million tons) and anthracite (4 million tons). Although anthracite offers superior burning qualities, it contributes only a small and diminishing share of total coal production. Less than 0.4% of U.S. coal production in 1994 was anthracite.

Mines east of the Mississippi account for about 53% of the current U.S. coal production. For the period 1949 through 1995, coal production east of the Mississippi River fluctuated relatively little from a low of 395 million tons in 1954 to 630 million tons in 1990. (It was 568 million tons in 1994.) During this same period, however, coal production west of the Mississippi increased each year from a low of 20 million tons in 1959 to a record 490 million tons in 1995. The growth in western coal is due in part to environmental concerns that led to increased demand for low-sulfur coal, which is concentrated in the West. In addition, surface mining, with its higher average productivity, is much more prevalent in the West.

Preliminary MSHA data for 1995 indicate that small mines produced about 4% of the total coal mine production (about 44 million tons) and large mines produced about 96% of the total (983 million tons). MSHA calculations indicate that the average total production per miner for 1995 was about 3,500 tons at small mines and 11,400 tons at large mines. The average total coal production for 1995 was about 25,000 tons per small mine and 867,000 tons per large mine.

The 1994 estimate of the average value of coal at the point of production is about $19 per ton for bituminous coal and lignite, and $36 per ton for anthracite. MSHA chose to use $19 per ton as the value for all coal production because anthracite contributes such a small amount to total production that the higher value per ton of anthracite does not greatly impact the total value. The total value of coal production in 1995 was about $20 billion of which about $0.9 billion was produced by small mines and $19.1 billion was produced by large mines. On a per mine basis, the average coal production was valued at $0.5 million per small mine and $17 million per large mine.

Coal is used for several purposes including the production of electricity. The predominant consumer of coal is the U.S. electric utility industry which used 829 million tons of coal in 1995 or 80% of the coal produced. Other coal consumers include coke plants (33 million tons), residential and commercial consumption (6 million tons), and miscellaneous other industrial uses (73 million tons). This last category includes the use of coal products in the manufacturing of other products, such as plastics, dyes, drugs, explosives, solvents, refrigerants, and fertilizers.

The current rate of U.S. coal production exceeds U.S. consumption by roughly 90 million tons annually. In 1995, 89 million tons of this excess production was exported and the remainder was stockpiled. Japan (11.8 million tons), Canada (9.4 million tons), and Italy (9.1 million tons) were the top three importers of U.S. coal. Year-to-year fluctuations in exports of U.S. coal vary more than domestic consumption. During the 1990's, changes in exports from the previous year varied from a 24% increase to a 27% decrease; whereas, changes in domestic consumption only varied from a 4% increase to a 1% decrease.

The U.S. coal industry enjoys a fairly constant domestic demand. Its demand by electric utilities continues to increase annually. MSHA does not expect a substantial change in coal demand by utilities in the near future because of the high conversion costs of changing a fuel source in the electric utility industry. Energy experts predict that coal will continue to be the dominant fuel source of choice for power plants built in the future. Nuclear and hydropower currently comprise, and are anticipated in the future to comprise, a small fraction of fuel sources for utilities.

The international market for coal was marked by several notable events in the 1990's. The breakup of the Soviet Union (USSR), a new political regime in South Africa, and economic policy changes in the United Kingdom and Germany contributed to price and demand changes in coal's global marketplace; newly independent, former USSR republics provided competition to U.S. companies for a share of the European coal market; and the deep European recession of 1993–1994 caused exports of coal to decrease. Similarly, the cessation of the economic boycott of South Africa, and its new political leadership, has led to new interest in South African exports. South Africa ranks third after Australia and the U.S. in coal exports. Its coal exploration and mining have the nation poised to maintain its global position. The privatization of British power companies and the elimination of coal subsidies in Germany have led to an increased interest in U.S. coal. These international economic policy changes are predicted to create a substantial export opportunity for U.S. coal over the long term.

The net effect of these aforementioned international activities appears to be a continued demand for U.S. coal at or near current level. The U.S. can expect additional competition, however, from other current coal producing countries (e.g., Australia, South Africa, former USSR republics, Poland), as well as from new suppliers in Colombia, Venezuela, China, and Indonesia. The U.S. coal industry has vast reserves of unmined coal which is predicted to sustain coal's demand for another half millennium if mined at the current rate.

The economic health of the coal industry may be summarized as a fairly stable market which may be subject to periodic price and demand fluctuations. These fluctuations are largely functions of domestic supply disruptions and increased international competition. The 1993 average profit as a percent of revenue for the coal mining industry was about 3–4% after taxes.

Economic Characteristics of the Metal and Nonmetal Mining Industry: Summary

The 1995 value of all metal and nonmetal mining output is about $38 billion. Metal mining contributes $13.2 billion to this total and includes metals such as aluminum, copper, gold, and iron. Nonmetal mining is valued at $12.9 billion and includes commodities such as cement, clay, and salt. Stone mining contributes about $7.2 billion and sand and gravel contributes about $4.3 billion to this total.

The entire metal and nonmetal mining industry is markedly diverse not only in terms of the breadth of minerals, but also in terms of each commodity's usage. For example, metals such as iron and aluminum are used to produce vehicles and other heavy duty equipment, as well as consumer goods such as household equipment and soda pop cans. Other metals, such as uranium and titanium, have limited uses. Nonmetals like cement are used in construction while salt is used as a food additive and on roads in the winter. Soda ash, phosphate rock, and potash also have a wide variety of commercial uses. Stone and sand and gravel are used in numerous industries including the construction of roads and buildings.

A detailed economic picture of the metal and nonmetal mining industry is difficult to develop because most mines are either privately held corporations or sole proprietorships, or subsidiaries of publicly owned companies. Privately held corporations and sole proprietorships do not make their financial data available to the public. Further, parent companies are not required to separate financial data for subsidiaries in their reports to the Securities and Exchange Commission. As a result, financial data are available for only a few metal and nonmetal companies and these data are not representative of the entire industry. Each commodity has a unique market demand structure. The following discussion focuses on market forces on a few specific commodities of the metal and nonmetal industry.

Metal Mining

Historically, the value of metals production has exhibited considerable instability. In the early 1980's, excess capacity, large inventories, and weak demand depressed the international market for metals while the strong dollar placed U.S. producers at a competitive disadvantage with foreign producers. Reacting to this, many metal mining companies reduced work forces, eliminated marginal facilities, sold non-core businesses, and restructured. At the same time, new mining technologies were developed and wage increases were restrained. As a result, the metal mining firms now operating are more efficient and have lower break-even prices than those that operated in the 1970's.

For the purposes of this analysis, MSHA uses the Standard and Poor's methodology of dividing metal mining into two categories: iron ore and alloying metals, and copper and precious metals. Metal mine production is valued in excess of $13 billion. Copper, aluminum, gold, and iron are the highest revenue producers of the metal industry.

Variations in the prices for iron and alloying metals, such as nickel, aluminum, molybdenum, vanadium, platinum, and lead, coincide closely with fluctuations in the market for durable goods, such as vehicles and heavy duty equipment. As a result, the market for these metals is cyclical in nature and is impacted directly by changes in aggregate demand and the economy in general.

Both nickel and aluminum have experienced strong price fluctuations over the past few years; however, with the U.S. and world economies improving, demand for such alloys is improving and prices have begun to recover. It must be noted that primary production of aluminum will continue to be impacted by the push to recycle. Recycling of aluminum now accounts for 30% of the aluminum used and this percent is expected to rise in the coming years. Due to the increase in aluminum recycling, prices have been falling and inventories rising since the mid to late 1980's.

The market for copper and precious metals, such as gold and silver, is marked by great uncertainty and price volatility. Prices for gold and silver fluctuated by as much as 17 to 25%, respectively, during 1993. The copper market recovered substantially during

1994, posting a 3.7% growth in demand by 1995. The gold and silver markets, however, continue to be marred with speculative demand spurs; consistent recovery and growth have been difficult to achieve due to uncertainty of U.S. buyers and shifts in production in South Africa and Russia. In 1993, Russia began to cut back its gold production which had generated low prices in the global market since 1990.

Overall, the production from metal mining increased by about 5.5% from 1987 to 1995; 1995 estimates put capacity utilization at 84%. MSHA expects that the net result for the metal mining industry may be reduced demand but sustained prices. The 1993 average profit as a percent of revenue for the metal mining industry was about a 1.3% loss after taxes.

Nonmetal Mining, Including Stone and Sand and Gravel

Nonmetal mine production is valued at more than $24 billion. Included in this figure is the production of granite, limestone, marble, slate, and other forms of crushed and broken or dimension stone. Other prosperous commodities in the nonmetal category include salt, clay, phosphate rock, and soda ash. Market demand for these products tends not to vary greatly with fluctuations in aggregate demand. Stone is the leading revenue generator with 1994 production valued at $7.2 billion. Construction sand and gravel and industrial sand 1995 production is valued at about $4.3 billion.

Evaluating financial information for nonmetal mining operations is particularly difficult. Financial data are available only for relatively large mining operations and these often engage in a wide variety of activities of which mining is typically only a small part. Many large mining firms have financial interests in mines or mills of different commodities, thereby making it difficult to evaluate the financial aspects of any specific commodity. Publicly held firms are not required to separate financial data for their subsidiaries in their reports to the Securities and Exchange Commission and financial data are not available for most of the small mines because they are not publicly owned. (About 98% of the small metal and nonmetal mining operations are stone, sand and gravel, or other nonmetal operations.) This discussion of the economic characteristics of the nonmetal mining industry does not separately address sand and gravel, stone, and miscellaneous other nonmetal mining operations as was done in the discussion of the nonmetal mining industry's structure.

Sand and gravel and stone products, including cement, have a cyclical demand structure. As a recession intensifies, demand for these products sharply decreases. Some stability in the market was achieved during 1993 and early 1994. Demand for stone, particularly cement, is expected to grow by as much as 4.8% and demand for sand and gravel is expected to grow by as much as 2.3%.

The U.S. is the largest soda ash producer in the world with its 1994 production valued at about $650 million. Soda ash is used in the production of glass, soap and detergents, paper, and food. Both salt and soda ash have a fairly constant demand structure due to the products' uses and the lack of suitable substitutes. A 1994 industry analysis indicates shifts in the world demand for salt. European demand, impelled by the economic breakdown of Central and Eastern Europe, has declined; however, growth in demand has increased in Asia and the Far East.

Phosphate rock, which is used primarily to manufacture fertilizer, has an unusual market structure. U.S. production and exports of phosphate rock have declined in recent years and imports from Morocco increased by 180% from 1991 to 1992.

The remaining nonmetal commodities which include boron fluorspar, oil shale, and other minerals are produced typically by a small number of mining operations. Despite this fact, annual production of pumice, perlite, vermiculite, and some others is valued at the tens of millions of dollars for each product.

Overall, the production from nonmetal mining remained relatively stable from 1987 to 1995; 1995 estimates put capacity utilization for stone and earth minerals at about 97%. The net result for the nonmetal mining industry may be higher demand for stone and various other commodities and increased prices. The 1993 average profit as a percent of revenue was about 3–4% for nonmetal mine production, excluding stone and sand and gravel; about 8% for stone mining; and about 5% for sand and gravel.

Feasibility of Requiring the Use of Engineering and Administrative Controls at a TWA_8 of 90 dBA

In this proposal, MSHA has determined that the Mine Act's objective to protect miners from material impairment of health can be met by requiring mine operators to use all feasible engineering and administrative controls. This approach is close to that already required in the metal and nonmetal sector of the industry. In the coal sector, attenuation of hearing protectors have been considered in determining compliance with the PEL, and in practice this has meant that few mine operators have had to institute engineering or administrative controls.

The approach gives mine operators flexibility to choose those controls or combinations of controls which would be the most effective in reducing exposure to noise. If the institution of administrative controls does not adequately protect the miners in a given work situation, MSHA will require the implementation of feasible engineering controls. Under this approach, the Agency has to determine in the particular situation that the proposed engineering controls are feasible prior to requiring their implementation. Likewise, if the engineering controls prove inadequate, the Agency will require the implementation of feasible administrative controls.

In the metal and nonmetal industry where this approach is currently implemented, smaller operations predominate. As a result, administrative controls are seldom feasible, and engineering controls may not be economically feasible for some operations. Moreover, given the technology available in this sector, in a few cases complete engineering solutions may not be technologically feasible. However based on the information on available controls reviewed in part III, including methods developed by the former Bureau of Mines, MSHA believes there are few cases in which noise cannot be significantly reduced through some sort of engineering control (including miner isolation). The Agency has specifically solicited comments on the feasibility of controls for metal and nonmetal equipment and operations identified as generating sound levels above a TWA_8 of 105 dBA; as noted in part III, exposures exceeding this level constitute less than one-quarter of one percent of all exposures, and many mine operators do manage to control the exposures from such equipment. And the Agency welcomes comments on other specific feasibility concerns. Based on its review, MSHA believes most metal and nonmetal mine operators will find feasible engineering controls that meet their requirements.

In the coal industry, many mine operators are larger and the technology is different. Many coal mine operators are large enough to be able to use administrative controls where engineering controls are not economically feasible. Moreover, based

on the information reviewed in part III, MSHA is confident that engineering solutions are available that can significantly reduce noise in almost all situations in which coal mining noise exceeds the PEL. Moreover, the Agency notes that the available engineering solutions are constantly changing—for example, it may be easier today than it used to be to find retrofit cabs for older equipment. Even in problem areas like coal preparation plants and highwall areas there are available solutions. In coal preparation plants, motor enclosures, operator control booths, material dampening of chutes and transfer points, and process area enclosures can bring about significant reductions in exposure; for highwall areas, exhaust mufflers and compressor barriers can do the same. The Agency would be interested in comments on problems encountered in controlling noise in coal operations and on solutions that have proved effective.

In concluding that such requirements are feasible in the mining industry, MSHA takes into account that the proposed rule would require a mine operator to use all feasible engineering and administrative controls. On the one hand this means that MSHA will require mine operators to consider all possible controls so as to find a combination that will in fact reduce noise as much as possible. MSHA's enforcement policy in this regard has been noted earlier in this section (and in the Question and Answer section in part I). On the other hand, there may be situations where no combination of engineering and administrative controls to reduce exposures to the PEL is economically or technologically feasible. In such cases, the proposed standard specifies the other actions a mine operator must take to protect workers to the maximum extent possible—including the use of engineering and administrative controls to reduce exposures to the maximum extent that is feasible.

Following is further discussion of the feasibility of administrative controls and engineering controls, respectively.

Feasibility of Administrative Controls

Administrative controls refers to the practice of limiting the exposure of individual miners to a noise source. Administrative controls reduce exposure through such actions as rotation of miners to areas having lower sound levels, rescheduling of tasks, modifying work activities, or limiting the amount of time that a miner is exposed to noise.

The feasibility of administrative controls to solve particular noise problems in any mine may be limited by a number of factors: limitations on the number of qualified miners capable of handling a specific task, labor/management agreements affecting duty assignments, or difficulty in ensuring that miners adhere to the administrative controls. Further, because the effectiveness of administrative controls is based on adherence to these strict time periods, mine operators may find it difficult to verify compliance with the administrative procedures.

As explained in the discussion of proposed § 62.120(c), it is MSHA's experience that administrative controls are relatively more feasible for mines with many employees and relatively less feasible for mines with fewer employees. As demonstrated by the industry profile, the mines in the coal industry are generally larger mines. It is MSHA's experience that many coal mine operators may prefer administrative controls as the primary noise control. This is, in fact, the reasons proposed § 62.120(c) was designed to preserve mine operator choice. The use of such controls is much less feasible in the smaller mines that characterize the metal and nonmetal industry.

Feasibility of Engineering Controls

If administrative controls are not feasible, or cannot by themselves reduce noise to the PEL, mine operators are to use all feasible engineering controls. This discussion is divided into two parts: the technological feasibility of such controls, and the economic feasibility of such controls.

Technological Feasibility of Engineering Controls

MSHA is an active and knowledgeable partner 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 actively assists mine operators in developing noise controls. Based upon this knowledge, and MSHA's experience, the Agency has determined that feasible engineering controls exist for the majority of equipment used in mining.

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 reducing miners' 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. A more detailed discussion regarding the availability of these controls is contained in part III of this preamble (see *Engineering Noise Controls for Mining Equipment*, in the discussion of proposed § 62.120(c) in part III). Part V of this preamble contains a list of publications of the former USBOM evaluating noise controls for various types of mining equipment.

As noted previously, there are some instances where current noise control technology still cannot reduce sound levels to within a TWA_8 of 90 dBA and where quieter replacement equipment may not be feasible. An example of this is a pneumatic jackleg drill used in hardrock mining. MSHA's data on equipment producing high levels of noise are discussed in part III (see the discussion of a possible dose ceiling in proposed § 62.120(e)).

Economic Feasibility of Engineering Controls

The data from MSHA's dual-threshold survey, presented in Tables II–11 and II–12 in part II of this preamble, indicate that even with the proposed new threshold level (80 dBA), almost three-quarters of the metal and nonmetal samples, and almost two-thirds of the coal samples, already are below the PEL. No additional controls would be required in these cases.

The Agency has determined that the incremental costs of the requirements for engineering controls would be $3.5 million a year for ten years, of which $2.2 million is allocable to the coal sector and $1.3 million to the metal and nonmetal sector. (The additional costs to the metal and nonmetal sector reflect in part the proposed lowering of the threshold, which will result in the measurement of more overexposures than at present.)

As described in more detail in the Agency's preliminary RIA, to calculate the costs for engineering controls, 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 proposed rule, MSHA considered the engineering controls that are used under the current rule. MSHA believes that metal and nonmetal mine operators may generally have exhausted the least costly engineering controls to comply with the current rule for some job groups. Compliance with the proposed rule for these job groups would require

that the mine operator use more expensive controls—specifically, retrofitting equipment—or purchase new equipment. For other job groups, however, mine operators may have used only those controls necessary to comply with the PEL and the less costly controls may still be available. To determine the cost of engineering controls, MSHA looked at the average cost of such engineering controls.

For the coal industry, HPDs have generally been substituted for engineering and administrative controls, so the industry has not exhausted the use of relatively inexpensive controls which have been demonstrated to be capable of bringing about significant reductions of sound levels. Even though the average cost of such controls would be less than for the metal and nonmetal industry, the change in approach would require controls be used much more often than at present. This is why the industry would experience a relatively higher expense for engineering controls.

MSHA believes the requirements for engineering and administrative controls clearly meet the feasibility requirements of the law. Based on the comments received in response to its ANPRM and discussed below, MSHA believes some in the industry may misunderstand the nature of the engineering controls required. In many cases, inexpensive controls may effectively eliminate overexposures.

Comments on Feasibility of Engineering and Administrative Controls

MSHA received numerous comments indicating that engineering controls were not feasible to reduce a miner's noise exposure to within the PEL for many types of mining equipment. Several commenters stated that engineering controls are most effective when they are designed into equipment versus applied by retrofitting. Other commenters stated that retrofit noise controls are often not as durable or effective as controls installed by the equipment manufacturer. One commenter suggested that MSHA establish approval and certification procedures for equipment noise emissions, similar to those established in part 18 for permissible equipment used in gassy mines.

In response to the commenters who indicated that engineering controls were not feasible for many types of mining equipment, MSHA would point out that significant progress has been made in developing quieter mining equipment since the mid-1970's when MSHA's existing noise standards were promulgated. Currently, almost all pneumatic drill manufacturers offer exhaust mufflers where few were available in the early 1970's. Similarly, almost all manufacturers of mobile surface equipment offer environmental and/or acoustically treated cabs. Some manufacturers also offer acoustically treated cabs for underground mining equipment, such as jumbo drills and scoop trams. As noted, the availability of feasible engineering noise controls is discussed in greater detail in the section of the preamble on *Engineering Noise Controls for Mining Equipment.*

MSHA does not agree with the commenter who suggested that MSHA establish approval and certification for equipment noise emissions similar to part 18. Such a process could be more costly and limit a mine operator's flexibility in implementing noise control procedures.

The most cited disadvantage of engineering controls is cost. In particular, some commenters are concerned that they would be required to install controls that would not, by themselves, be adequate to attain compliance. If this occurs, the proposal would also require that administrative controls be used to reduce exposure to the PEL; moreover, if a combination of controls does not reduce exposures to the PEL, hearing protectors must be worn and the affected miners enrolled in an HCP. These commenters believe that in such cases, costs to install engineering controls are wasted since they still may have to resort to these additional controls. More significantly, mine operators are concerned that requiring engineering controls will usually require the purchase of new equipment.

The first concern is misplaced. Controlling noise requires the hierarchy of requirements proposed by § 62.120(c). A mine operator has a choice as to what mix of engineering and administrative controls to use as long as together they reduce noise exposures to the PEL or as close thereto as feasible. Hearing protectors and enrollment in a hearing conservation program are helpful when nothing more can feasibly be done to reduce noise exposure, but they are not a substitute.

MSHA generally agrees with the commenters who stated that engineering controls are most effective when factory installed. The Agency would encourage mine operators to purchase mining machinery equipped with appropriate noise controls offered by the original equipment manufacturer rather than retrofitting noise controls. Almost every piece of mining equipment currently manufactured has optional noise control packages. Based on comments and MSHA's experience in noise control, the Agency has concluded that engineering controls designed and installed by the manufacturer for a particular unit will generally be more effective and durable than a retrofit control of similar design. Additionally, the cost of such controls may in some cases be substantially higher if it is purchased from the equipment manufacturer on a retrofit basis, rather than at the time the unit was originally built.

At the same time, as discussed in part III, MSHA has determined that some retrofit controls may be as effective as controls offered by equipment manufacturers. Examples of engineering controls which are routinely retrofitted onto existing mining equipment include: environmental cabs; control booths; sound barriers and baffles; exhaust mufflers; and the application of acoustical materials to equipment firewalls and the inside walls of cabs and control booths. Moreover, many successful retrofit noise controls (e.g., cabs, barrier shields, and drill exhaust mufflers) were developed by operators using materials readily available. Often the miners who use the equipment offer valuable suggestions on improving the design and effectiveness of these controls. Some of the controls developed by the mine operators have been adopted by manufacturers for use on both existing and new equipment. MSHA has determined that allowing the mine operator to develop controls provides the mine operator with maximum flexibility in complying with the standard thereby eliminating the need in those cases to purchase manufacturer installed controls.

Infeasibility of PEL at TWA_8 of 85 dBA

MSHA seriously considered lowering the PEL to a TWA_8 of 85 dBA because of its conclusion that there is a significant risk of material impairment from noise exposures at or above this level. The Agency has tentatively concluded, however, that it may not be feasible at this time for the mining industry to reduce noise to that level.

Exposure data collected by MSHA indicate that with a PEL at a TWA_8 of 85 dBA and an 80 dBA threshold, over two-thirds of the mine operators in the metal and nonmetal industry, and over three-quarters of the mine operators in the coal industry, would need to use engineering and administrative controls to reduce current exposures. (See Tables II–11 and II–12 in part II.)

Moreover, the engineering controls needed to reduce those exposures would be more expensive, because they would have to reduce the exposures further than with a PEL set at a TWA_8 of 90 dBA. Accordingly, the Agency

does not believe it can demonstrate that a reasonable probability exists that the typical mine operator will currently be able to develop and install controls that will meet such a standard.

It is true that the proposed standard only requires that individual mine operators use those controls which are feasible for that mine operator. The feasibility requirement under the statute, however, is that the Agency make a reasonable prediction, based on the ''best available evidence,'' as to whether an industry can generally comply with a standard within an allotted period of time. The Agency must show that a reasonable probability exists that the typical mine operator will be able to develop and install controls that will meet the standard. Accordingly, MSHA believes that if most mine operators are unlikely to be able to use engineering and administrative controls to bring noise levels to a TWA_8 of 85 dBA, the standard is not feasible for the industry as a whole.

Infeasibility of Exchange Rate of 3-dB

The exchange rate is a measure of how quickly the dose of noise doubles. Accordingly, the measure is the rate determining how much a miner's exposure must be limited to compensate for increasing dose. For example, at a 5-dB exchange rate, the exposure permitted at a sound level of 90 dBA is half that permitted at a sound level of 85 dBA; a miner gets the same noise dose in 4 hours at 90 dBA as at 8 hours at 85 dBA.

The Agency gave serious consideration to changing the exchange rate from 5-dB to 3-dB, and is specifically seeking comment on this important matter. There is a consensus in the recent literature that noise dose actually doubles more quickly than measured by the 5-dB rate, and in particular consensus for an exchange rate of 3-dB. Moreover, MSHA has concluded that the type of noise exposure in the mining environment tends to warrant an exchange rate that does not assume significant time for hearing to recover from high sound levels—the current exchange rate incorporates such an assumption. A full discussion of the scientific merits of various exchange rates, and of the rates used by various regulatory authorities, can be found in part III of the Preamble (as part of the discussion of proposed § 62.120(a), dose determination).

Nevertheless, the Agency is proposing to retain the existing 5-dB exchange rate because of feasibility considerations. Changing to a 3-dB rate from a 5-dB rate would significantly reduce the amount of time that miners could be exposed to higher sound levels without exceeding the permissible exposure limit. For example, MSHA estimates that the percentage of miners whose exposure would be in violation of a PEL set at a TWA_8 of 90 dBA would about double if a 3-dB exchange rate is used. (See Table III–3 in the exchange rate discussion in part III. The table also indicates what would happen if the PEL were set at a TWA_8 of 85 dBA). This means mine operators would have to utilize controls to reduce exposures to the PEL more frequently. Moreover, more expensive controls would often be required, since the need to reduce exposures more to get them down to the PEL.

The feasibility requirement under the statute is that the Agency make a reasonable prediction, based on the ''best available evidence,'' as to whether an industry can generally comply with a standard within an allotted period of time. The Agency must show that a reasonable probability exists that the typical mine operator will be able to develop and install controls that will meet the standard. The exposure data noted indicate it may be difficult for MSHA to make such a showing.

Furthermore, if a 3-dB exchange rate is used, it is extremely difficult to reduce the noise exposures to below the PEL with currently available engineering or administrative noise controls or a combination thereof.

Accordingly, MSHA has tentatively concluded that moving the industry to a 3-dB exchange rate may not be feasible at this time.

Conclusion

Based on the information before it, the Agency has tentatively concluded that the proposed rule meets the statutory requirements for feasibility, and that it may not be feasible for the mining industry, as a whole, at this time, to require a more protective regimen.

The Agency is particularly interested in receiving additional data that would be relevant in making final determinations on the points discussed above.

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List of Subjects

30 CFR Parts 56 and 57

Metal and nonmetal, Mine safety and health, Noise.

30 CFR Part 62

Mine safety and health, Noise.

30 CFR Parts 70 and 71

Coal, Mine safety and health, Noise.

Dated: November 26, 1996.

J. Davitt McAteer,

Assistant Secretary for Mine Safety and Health.

It is proposed to amend Chapter I of Title 30 of the Code of Federal Regulations as follows:

PART 56—[AMENDED]

1. The authority citation for part 56 continues to read as follows:

Authority: 30 U.S.C. 811, 957, 961.

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, 957, 961.

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.

6. Subpart F (§§ 70.500–70.511) 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.

8. Subpart I (§§ 71.800–71.805) is removed.

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.
62.110 Definitions.
62.120 Limitations on noise exposure.
62.125 Hearing protectors.
62.130 Training.
62.140 Audiometric testing program.
62.150 Audiometric test procedures.
62.160 Evaluation of audiogram.
62.170 Follow-up evaluation when audiogram invalid.
62.180 Follow-up corrective measures when STS detected.
62.190 Notification of results; reporting requirements.
62.200 Access to records.
62.210 Transfer of records.

Authority: 30 U.S.C. 811, 857, 861.

§ 62.100 Purpose and scope; effective date.

The purpose of these standards is the prevention 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 shall take effect (one year from the date of publication of the final rule).

§ 62.110 Definitions.

The following definitions apply in this part:

Access. The right to examine and copy records.

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 pursuant to § 62.140 against which subsequent audiograms are compared to determine the extent of hearing loss, except in those specific situations in which this part requires the use of a supplemental baseline audiogram for such a purpose.

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 levels. MSHA defines decibel in two different 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 pressure of 20 micropascals (μPa), which is the threshold of normal hearing acuity at 1000 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.

Decibel, A-weighted (dBA). Sound levels measured using the A-weighting network. A-weighting refers to the frequency response network closely corresponding to the frequency response of the human ear. This network attenuates sound energy in the lower and upper frequencies (<1000 and >5000 Hz) and slightly amplifies those frequencies between 1000 and 5000 Hz to which the ear is more sensitive.

Designated representative. Any individual or organization to whom a miner gives written authorization to exercise a right of access to records.

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.

Hearing conservation program (HCP). The term is used in this part as a generic reference to the requirements of §§ 62.140 through 62.190, such as audiometric testing, evaluation and follow-up examinations.

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 that has a scientifically accepted indicator of noise reduction value.

Hertz (Hz). Unit of measurement of frequency numerically equal to cycles per second. The audible range of frequencies for humans with normal hearing is 20 to 20000 Hz.

Medical pathology. A condition or disease affecting the ear.

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.

Reportable hearing loss. A change in hearing acuity for the worse, relative to the miner's baseline audiogram or, in the case of a supplemental baseline audiogram established pursuant to § 62.140(d)(2), relative to such supplemental baseline audiogram, of an average of 25 dB or more at 2000, 3000, and 4000 Hz in either ear.

Sound level. The sound pressure level measured in decibels using a weighting network (e.g., A-weighted) and exponential time averaging (e.g., slow response). The A-weighting network and the slow response time are defined in ANSI S1.4–1983, ''American National Standard Specification for Sound Level Meters.''

Standard threshold shift (STS). A change in hearing acuity for the worse relative to the miner's baseline audiogram, or relative to the most recent supplemental baseline audiogram where one has been established, of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear.

Supplemental baseline audiogram. An annual audiogram designated, as a result of the circumstances set forth in § 62.140(d)(1) or those set forth in § 62.140(d)(2), to be utilized in lieu of a miner's original baseline audiogram in measuring changes in hearing acuity.

Time-weighted average-8 hour (TWA_8). That sound level, which if constant over 8 hours, would result in the same noise dose as is measured.

§ 62.120 Limitations on noise exposure.

(a) *Dose determination.*

(1) A miner's noise dose (D) is computed by the formula: $D = 100(C_1/T_1 + C_2/T_2 + * * * + C_n/T_n)$, where C_n is the total time of exposure at a specified sound level, and T_n is the reference duration of exposure at that sound level set forth in Table 62–1.

(2) Table 62–2 is to be utilized when converting noise measurements from dosage readings to equivalent TWA_8 readings.

TABLE 62–1.—REFERENCE DURATION

L (dBA, slow-response sound level)	Reference Duration, T (hour)
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

Note: 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 level.

TABLE 62–2.—CONVERSION FROM "DOSE" TO EQUIVALENT TWA_8

Dose (percent noise exposure)	TWA_8
25	80.0
29	81.0
33	82.0
38	83.0
44	84.0
50	85.0
57	86.0
66	87.0
76	88.0
87	89.0
100	90.0
115	91.0
132	92.0
152	93.0
174	94.0
200	95.0
230	96.0
264	97.0
303	98.0
350	99.0
400	100.0
460	101.0
530	102.0
610	103.0
700	104.0
800	105.0
920	106.0
1056	107.0
1213	108.0
1393	109.0
1600	110.0
1838	111.0
2111	112.0
2425	113.0
2786	114.0
3200	115.0
3676	116.0
4222	117.0
4850	118.0
5572	119.0
6400	120.0

Interpolate between the values found in this Table, or extend the table, by using the formula: $TWA_8 = 16.61 \log_{10} (D/100) + 90$.

(3) A miner's noise exposure measurement shall:

(i) Not be adjusted on account of the use of any hearing protector;

(ii) Integrate all sound levels from 80 dBA to at least 130 dBA during the miner's full workshift;

(iii) Use a 90 dBA criterion level and a 5-dB exchange rate; and

(iv) Use an A-weighting and a slow-response instrument setting.

(b) *Action level.* When a miner's noise exposure exceeds a TWA_8 of 85 dBA during any workshift, or equivalently a dose of 50%, the operator shall take the actions specified in paragraphs (b)(1) and (2) of this section and, at the request of the miner, also take the actions specified in paragraph (b)(3) of this section.

(1) An operator shall provide the miner training that includes the instruction required by § 62.130, at the time exposure exceeds the action level and every 12 months thereafter that exposure continues to exceed the action level.

(2) An operator shall enroll the miner in a hearing conservation program which shall meet the requirements of §§ 62.140 through 62.190. Moreover, the operator shall, with respect to any miner enrolled in such program, provide hearing protection in accordance with the requirements of § 62.125 until such time as a baseline audiogram has been obtained. If it takes more than 6 months to conduct the baseline audiogram, or if the miner is determined to have incurred an STS, the operator shall ensure that the hearing protection is provided to the miner and worn by the miner.

(3) At the request of any miner, the operator shall provide hearing protection to the miner in accordance with the requirements of § 62.125.

(c) *Permissible exposure level (PEL).* No miner shall be exposed to noise exceeding a TWA_8 of 90 dBA (PEL) during any workshift, or equivalently a dose of 100%.

(1) If a miner's noise exposure exceeds the PEL, the operator shall, in addition to taking the actions required under paragraph (b) of this section, use all feasible engineering and administrative controls to reduce the miner's noise exposure to the PEL. When administrative controls are used to reduce a miner's exposure, the operator shall post these procedures on the mine bulletin board and provide a copy to affected miners.

(2) If a miner's noise exposure exceeds the PEL despite the use of the controls required by paragraph (c)(1) of this section, the operator shall take the actions required by this paragraph for that miner.

(i) The operator shall use the controls required by paragraph (c)(1) of this section to reduce the miner's noise exposure to as low a level as is feasible.

(ii) The operator shall ensure that a miner whose exposure exceeds the PEL takes the hearing examinations offered through enrollment in the hearing conservation program.

(iii) The operator shall provide hearing protection to a miner whose exposure exceeds the PEL and shall ensure the use thereof. The hearing protection shall be provided and used in accordance with the requirements of § 62.125.

(d) *Dual hearing protection level.* Whenever a miner's noise exposure exceeds a TWA_8 of 105 dBA during any workshift, or equivalently a dose of 800%, the operator shall ensure that the miner is provided and uses both ear plug and ear muff type protectors pursuant to § 62.125.

(e) *Ceiling level.* At no time shall a miner be exposed to sound levels exceeding 115 dBA.

(f) *Operator exposure evaluation; employee notification.*

(1) Operators shall establish a system of monitoring which effectively evaluates each miner's noise exposure.

(2) Whenever a miner's exposure is determined to exceed the action level, the permissible exposure level, the dual hearing protection level, or the ceiling level established by this section, according to exposure evaluations conducted either by the operator or by representatives of the Secretary of Labor, and the miner has not received notification of exposure at such level within the prior 12 months, the operator shall, within 15 calendar days, notify the miner in writing of the exposure determination and the corrective action being taken. The operator shall maintain at the mine site 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 above the action level and for at least 6 months thereafter.

§ 62.125 Hearing protectors.

When hearing protection is required pursuant to this part, an operator shall:

(a) Allow the miner, after such miner has received the training specified by § 62.130 at least once, to choose a hearing protector from at least one muff type and one plug type, and in the event dual-hearing protection is required, to choose one of each type;

(b) In those cases in which the operator is required to ensure the use by a miner of hearing protection, ensure that the protector is worn by the miner when exposed to sound levels which are required to be integrated into a miner's noise exposure measurement;

(c) Ensure that the hearing protection is fitted and maintained in accordance with the manufacturer's instructions;

(d) Provide the hearing protectors and necessary replacements at no cost to the miner; and

(e) Allow the miner to choose a different hearing protector if wearing the selected protector is subsequently precluded due to medical pathology of the ear.

§ 62.130 Training.

(a) Miner training required by this part shall include the following instruction:

(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 care, fitting, and use of the hearing protector worn by the miner and the various types of hearing protectors offered by the operator;

(5) The general requirements of this part;

(6) The 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 training requirement under this part shall only be met if the operator certifies the date and type of training given each miner. The type of training may be initial noise training of a miner, annual retraining of a miner, or special retraining required for a miner as a result of the detection of an STS. The certification shall be signed by the person conducting the training. The operator shall maintain the miner's most recent certification at the mine site for as long as the miner is exposed to noise above the level which required the training and for at least 6 months thereafter.

§ 62.140 Audiometric testing program.

(a) Audiometric tests performed pursuant to this part shall be conducted by a physician, an audiologist, or a qualified technician under the direction or supervision of a physician or an audiologist, and pursuant to the procedures set forth in § 62.150.

(b) *Baseline audiogram.* A miner enrolled in a hearing conservation program shall be offered a valid baseline audiogram of the miner's hearing acuity against which subsequent annual audiograms can be compared.

(1) The valid baseline audiogram shall be offered within 6 months of enrolling the miner in an HCP, except that where mobile test vans are used to meet the audiometric test requirements of this section, the valid baseline audiogram shall be offered within 12 months of enrolling the miner in an HCP. An existing audiogram of the miner's hearing acuity may be used as the baseline audiogram if it meets the audiometric testing requirements of this part.

(2) The operator shall not expose the miner to workplace noise for at least 14 hours before conducting the baseline audiogram. Hearing protectors shall not be used as a substitute for this quiet period.

(3) The operator shall notify miners of the need to avoid high levels of noise during the 14-hour quiet period before taking the baseline audiogram.

(4) The operator shall not revise either a miner's baseline audiogram, or supplemental baseline audiogram where one has been established, due to changes in enrollment status in the HCP except for periods of unemployment exceeding 6 consecutive months.

(c) *Annual audiogram.* After establishing the baseline audiogram, the operator shall offer a subsequent valid audiogram at intervals not exceeding 12 months for as long as the miner remains in the HCP.

(d) *Supplemental baseline audiogram.* An annual audiogram shall be deemed to be a supplemental baseline audiogram when, in the judgment of the audiologist or physician:

(1) The standard threshold shift (STS) revealed by the audiogram is permanent; or

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

§ 62.150 Audiometric test procedures.

(a) The operator shall assure that all audiometric testing required under this part is conducted in accordance with scientifically validated procedures. Audiometric tests shall be pure tone, air conduction, hearing threshold examinations, with test frequencies including as a minimum 500, 1000, 2000, 3000, 4000, and 6000 Hz. Each ear shall be tested separately.

(b) The operator shall obtain from the physician, audiologist, or qualified technician who conducts an audiometric test required under this part, a certification that the testing was conducted in accordance with paragraph (a) of this section.

(c) The operator shall compile an audiometric test record for each miner tested. Such record shall include the following:

(1) Name and job classification of the miner who has undergone the audiometric test(s);

(2) A copy of all of the miner's audiograms required under this part;

(3) Certification(s) as required under paragraph (b) of this section;

(4) Any exposure determination for the miner; and

(5) The results of any follow-up examination(s).

(d) Audiometric test records shall be maintained at the mine site for the duration of the affected miner's employment plus at least 6 months.

§ 62.160 Evaluation of audiogram.

(a) The operator shall:

(1) Inform persons evaluating audiograms of the requirements of this part and provide them with a copy of the miner's audiometric test records;

(2) Have a physician, 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 an STS or a reportable hearing loss, as defined in this part, has occurred;

(3) Instruct the physician or audiologist not to reveal to the operator any specific findings or diagnoses unrelated to the miner's exposure to noise or wearing of hearing protectors without the written consent of the miner; and

(4) Obtain the results, and the interpretation of the results of any audiogram conducted under this part within 30 calendar days of conducting the audiogram.

(b)(1) The operator shall conduct an audiometric retest within 30 calendar days of receiving a determination that a required audiogram is invalid and that any medical pathology has improved to the point that a valid audiogram may be obtained.

(2) If the results of an annual audiogram demonstrate that the miner has incurred an STS or reportable hearing loss, the operator may conduct one retest within 30 calendar days of receiving the results of the audiogram and consider the results of the retest as the annual audiogram.

(c) In determining whether an STS or reportable hearing loss has occurred, allowance may be made for the contribution of aging (presbycusis) to the change in hearing level by adjusting the audiograms used in making those determinations according to the following procedures:

(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 supplemental baseline audiogram as appropriate, was taken, and recording the corresponding values of age corrections at 2000, 3000, and 4000 Hz; and

(ii) Finding the age at which the most recent audiogram was taken and recording the corresponding values of age corrections at 2000, 3000, and 4000 Hz.

(2) Subtract the value determined in paragraph (c)(1)(i) of this section from the value 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.

(3) Subtract the value determined in paragraph (c)(2) of this section from the hearing threshold level found in the annual audiogram to obtain the adjusted annual audiogram hearing threshold level.

(4) Subtract the hearing threshold in the baseline audiogram or supplemental baseline audiogram from the adjusted annual audiogram hearing threshold level determined in paragraph (c)(3) of this section to obtain the age-corrected threshold shift.

TABLE 62–3.—AGE CORRECTION VALUE IN DECIBELS FOR MALES

Years	Audiometric test frequencies (Hz)		
	2000	3000	4000
20 or younger	3	4	5
21	3	4	5
22	3	4	5
23	3	4	6
24	3	5	6
25	3	5	7
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 older	13	23	33

TABLE 62–4.—AGE CORRECTION VALUE IN DECIBELS FOR FEMALES

Years	Audiometric test frequencies (Hz)		
	2000	3000	4000
20 or younger	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

TABLE 62–4.—AGE CORRECTION VALUE IN DECIBELS FOR FEMALES—Continued

Years	Audiometric test frequencies (Hz)		
	2000	3000	4000
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	12	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 older	12	16	17

§ 62.170 Follow-up evaluation when audiogram invalid.

(a) If a valid audiogram cannot be obtained due to a suspected medical pathology of the ear which the physician or audiologist believes was caused or aggravated by the miner's exposure to noise or the wearing of hearing protectors, the operator shall refer the miner for a clinical audiological evaluation or an otological examination, as appropriate, at no cost to the miner.

(b) The operator shall instruct the physician or audiologist that if a valid audiogram cannot be obtained due to a suspected medical pathology of the ear which the physician or audiologist concludes is unrelated to the miner's exposure to noise or the wearing of hearing protectors, the physician or audiologist shall inform the miner of the need for an otological examination.

(c) The operator shall instruct the physician or audiologist not to reveal to the 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.

§ 62.180 Follow-up corrective measures when STS detected.

Unless a physician or audiologist determines that an STS is neither work-related nor aggravated by occupational noise exposure, the operator shall within 30 calendar days of receiving evidence of an STS or receiving the results of a retest confirming an STS:

(a) Retrain the miner, including the instruction required by § 62.130;

(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 operator pursuant to § 62.125; and

(c) Review the effectiveness of any engineering and administrative controls to identify and correct any deficiencies.

§ 62.190 Notification of results; reporting requirements.

(a) Within 10 working days of receiving the results of an audiogram, or receiving the results of a follow-up evaluation required under § 62.170(a), the operator shall notify the miner in writing of:

(1) The results and interpretation of the audiometric test, including any finding of an STS or reportable hearing loss; and

(2) If applicable, the need and reasons for any further testing or evaluation.

(b) If evaluation of the audiogram shows that a miner has incurred a reportable hearing loss as defined in this part, the operator shall 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.

§ 62.200 Access to records.

(a) The authorized representatives of the Secretaries of Labor and Health and Human Services shall have access to all records required under this part. Upon written request, the operator shall provide, within 15 calendar days of the request, access to records as indicated below:

(1) The miner, former miner, or, with the miner's written consent, the miner's designated representative shall have access to all records that the operator is required to maintain for that individual miner under this part; and

(2) The miners' representative shall in all cases have access to training records compiled pursuant to section § 62.130, and to copies of notices made pursuant to § 62.120(f)(2), for the miners whom they represent.

(b) Upon termination of a miner's employment, the operator shall provide the miner without cost with a copy of all records that the operator is required to maintain for that individual miner under this part.

(c) If a person who has access to certain records under this section requests a copy of a record, the operator shall provide the first copy of such record requested by a person at no cost to that person, and any additional copies requested by that person at reasonable cost.

§ 62.210 Transfer of records.

(a) Whenever an operator ceases to do business, that operator shall transfer all records required to be maintained by this part, or a copy thereof, to any successor operator who shall receive these records and maintain them for the required period.

(b) The successor operator shall use the baseline audiogram, or supplemental baseline audiogram as appropriate, obtained by the original operator for determining the existence of an STS or reportable hearing loss.

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