A Guide to Conducting Noise Sampling

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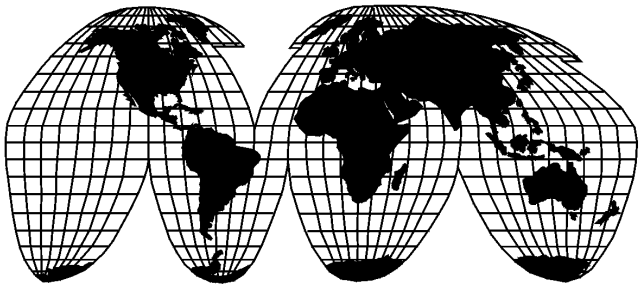

A Guide to Conducting Noise Sampling

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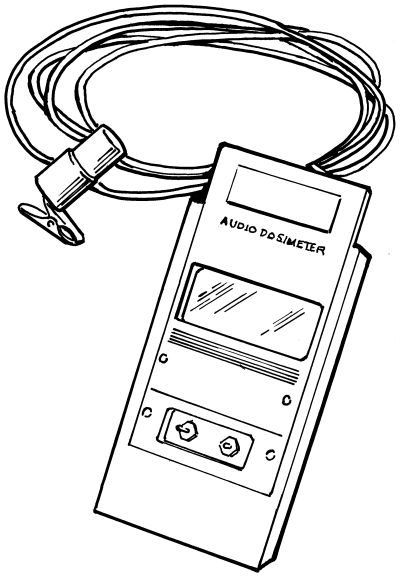
Table of Contents

NOISE SAMPLING

Under MSHA's "Health Standard for Occupational Noise Exposure," a mine operator must establish a monitoring system that evaluates each miner's noise exposure. The purpose of the monitoring is to determine compliance with the noise standard.[1] The easiest way to determine compliance is to establish a sampling program. This booklet explains the basic steps in conducting noise sampling.



SAMPLING EQUIPMENT

There are two basic instruments commonly used to sample continuous noise. The first instrument, a noise dosimeter, measures personal exposure to noise and is the instrument MSHA usually uses to determine compliance. It consists of a microphone (placed in the miner's hearing zone) and a case containing the microprocessor-controlled monitor. The dosimeter continuously monitors, integrates, and records the sound energy a miner is exposed to during the shift. It uses this information to calculate the daily noise dose.

Most dosimeters also keep track of the highest sound level recorded at any time, and indicate if there has been exposure above 115 dBA (the maximum allowable sound level under MSHA regulations). Most dosimeters can also function as a sound level meter.

There are numerous dosimeters on the market and while their general functions are similar, they each have specific requirements for battery checks, operation, reading the display, etc. The manufacturer's instruction book will explain the requirements.

The second instrument, a sound level meter (SLM), contains a microphone, an amplifier, frequency response networks, and some type of indicating meter. The SLM indicates the sound level pressure in decibels (dB) by measuring sound pressure, then amplifying and scaling it.

Instruments used to determine compliance with MSHA regulations use the slow response and the "A" scale which most closely approaches the way our ears receive and perceive sound pressures. Sound level meter readings can be used to help identify the source of a miner's noise exposure and for noise surveys in the workplace.

MSHA's new noise standard requires mine operators to integrate all sound levels over the appropriate range in determining a miner's noise dose. Personal

Instruments used in underground coal mines that will be used inby on a mining section, or in a return air course, must have MSHA 2G approval.

[1] 30 CFR § 62.110

noise dosimeters perform this integration automatically, but an operator who uses an SLM will have to do it manually. (See Step 6 – Computing the Miner's Noise Dose.) The new regulation has an **action level** that requires integration of sound pressure levels from 80 to at least 130 dBA and a **permissible exposure level** and **dual hearing protection level** which require integration from 90 to at least 140 dBA. So an operator needs to use a dosimeter that can be set to integrate sound levels for both ranges or use two dosimeters. When more than one dosimeter is used, the instruments must be set to:

- Use one setting or instrument to measure a sound level range from 80 to at least 130 dBA.
- Use one setting or instrument to measure a sound level range from 90 to at least 140 dBA.

A less commonly used instrument is the octave band analyzer which measures the intensity of a noise at different frequencies. This information is useful and necessary in planning noise control measures because different noise frequencies require different approaches to noise reduction.

Step 1: Setting up a monitoring system

Rather than sampling each individual worker, an operator may take noise samples in certain areas of the mine or sample a sufficient number of miners who are performing representative tasks. Based on the information from those noise samples, the operator may be able to determine whether sampling in other areas, or of miners on other pieces of equipment, may be necessary.

Another mine operator may use the results of sampling conducted by an insurance carrier, or information provided by manufacturers on sound levels generated by their equipment, to determine compliance.

Step 2: Informing the miners

Mine operators must provide affected miners and their representatives with an opportunity to observe noise exposure monitoring. This includes giving them prior notice of the date and time of the exposure monitoring. The purpose of this requirement is to ensure that the miner is operating equipment or performing his or her assigned task under normal working conditions, and that the

noise-measuring instruments are being used properly. A mine operator is not required to pay a miner or representative when they observe the monitoring.

The operator must also inform miners:

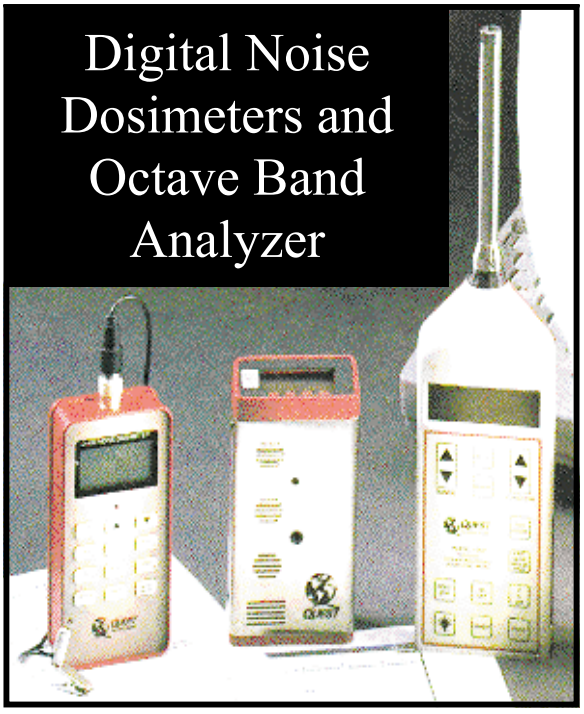
- if their exposures reach the action level, or if they exceed the permissible exposure level or the dual hearing protection level; and
- of corrective action taken if their exposures exceed the permissible exposure limit or the dual hearing protection level.

Step 3: Calibrating the equipment

Before and after each noise sample, you must check the sampling device's calibration with an acoustical calibrator. Dosimeters can be purchased with a calibrator specifically intended for use with those dosimeters.

Check the calibration by placing the microphone into the opening of the calibrator (with supplied coupler) which produces a pure tone at a given sound level (often 114 dBA). The dosimeter is set on Sound Level Meter (SLM) function. Both the SLM and dosimeter should read at the sound level intensity ± 1 dB. If they do not, the instrument must be recalibrated according to the manufacturer's recommendations before you use them. Do not use the instrument to take the noise survey until it is recalibrated.

Note: In addition to checking the calibration of your instruments before and after each noise sample, you should have SLMs and dosimeters serviced and calibrated annually by the manufacturer.



Step 4: Taking noise samples with a dosimeter

(See Step 5 if you are using a Sound Level Meter)

By now, you have already evaluated the mine site, determined which miners need to be sampled for noise exposure, and notified the affected miners and their representative. You should explain the purpose and procedures for sampling to the miner who will be wearing the dosimeter.

1. Insert the battery in the dosimeter.

2. Turn on dosimeter and look for some type of "battery OK" indication.

3. Ensure that the instrument is set on the "A" scale, slow response, and that the exchange rate is 5 dB.

4. Check the calibration of the dosimeter and clear the dosimeter of any previous readings before taking a sample. Record the dosimeter number and results of the calibration in writing.

5. Emphasize to the miner the importance of working in a routine manner; note that wearing the dosimeter should not interfere with normal duties.

6. Discourage whistling, shouting, or tapping the microphone.

7. Instruct the miner:
   not to remove the dosimeter unless absolutely necessary;
   not to bump, drop, or otherwise abuse the dosimeter; and
   to keep the microphone uncovered, but to leave the windscreen on.

8. Tell the miner that you will be coming around periodically to take sound level meter readings and to check the microphone, and inform the miner when and where the dosimeter will be removed.

9. Place the microphone at the top of the shoulder, midway between the neck and the end of the shoulder, pointing upward. (For situations where the miner is positioned so that the entire exposure is primarily from one direction, the microphone should be located on the shoulder closest to the sound source.)

10. Turn on the dosimeter and record time on.

11. Check the microphone's position periodically during the shift.

12. To the extent practical, position the dosimeter case and microphone cable underneath exterior clothing.

13. MSHA recommends full shift sampling. During the sampling period, record all pertinent data in writing.

14. At the end of the sampling period take and record your final readings.

15. Turn off the dosimeter, record time off, and remove from the miner.

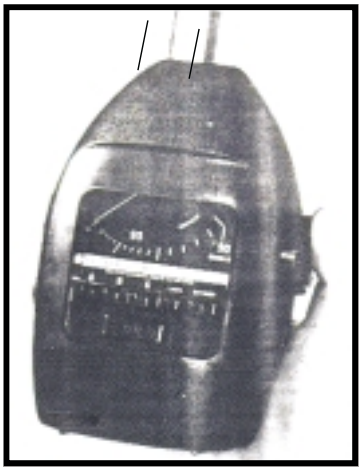
16. Explain results to the miner and distribute cards, fact sheets, or handouts on noise, noise sampling, and noise controls.

17. Recheck the dosimeter's calibration. If the dosimeter does not recalibrate, then the survey would be considered invalid.

Step 5: Taking noise samples with a sound level meter (SLM)

As mentioned earlier, most dosimeters can be adapted for use as a sound level meter. In addition, there are many instruments that work only as an SLM. Check the manufacturer's instruction book for more information. When a dosimeter is used as an SLM, select the SLM function, then follow the general instructions below.

1. Set the SLM on the "A" weighting network, slow meter response, for all measurements.
2. Check the calibration according to manufacturer's instructions and note the results in writing.
3. In general, hold the SLM or dosimeter microphone at arm's length, keeping your body out of the path of the noise. Hold the microphone within one foot of the miner's most exposed ear whenever possible. As specified by the manufacturer, either hold the microphone perpendicular to the noise source or pointed toward the source.
4. Because SLM readings may fluctuate, observe the readings for about 30 seconds. Ignore any momentary high or low levels that may occur.
5. Take several readings for each activity the miner performs during the work shift. Your goal is to find the highest sound levels at each work site.
6. Record the sound level reading or range of sound levels. Also, record the time, location, specific activity of the miner, ID number of any equipment the miner is operating, whether doors/windows are open, and any other pertinent information. The duration that the miner is exposed to each sound level must also be recorded. This information is needed to calculate the dose.
7. Make a sketch showing where the various readings were taken if it would aid future identification.
8. Explain results to the miner and distribute cards, fact sheets or handouts on noise, noise sampling, and noise controls.
9. Recheck the calibration. If the SLM does not recalibrate, the survey would be considered invalid.



Step 6: Computing the miner's noise dose

If the operator uses a dosimeter, the exposure levels are integrated automatically and results are expressed in dose percent. When an SLM is used, the operator must calculate the dose using the formula:

Dose = $100(C_1/T_1+C_2/T_2....C_n/T_n)$, where

C= the time a miner is exposed to each level
T= the time allowed at the same corresponding level taken from Table 62-1

Example

The operator measures a miner's exposures as follows:

87 dBA for 4 hours
(12.1 hours are allowed at this level)

90 dBA for 2 hours
(8 hours are allowed at this level)

80 dBA for 2 hours
(32 hours are allowed at this level)

Under MSHA's "Health Standard for Occupational Noise Exposure," when you calculate a miner's noise exposure, you do not adjust the dose if the miner was wearing hearing protectors during the noise sampling. This information is not part of the dose calculation.

So, the calculations would be:

100 (4/12.1 + 2/8 + 2/32) = 64%

Since the action level is 50% dose, this miner would be above the action level and the operator would have to take the steps described in Step 7.

Since, for the purposes of compliance, only sound levels above a 90 dBA threshold are integrated into the dose, only the 2 hours of exposure at 90 dBA are counted and the miner's dose would be 25%. Thus, the operator is in compliance.

Table 62-1 Reference Duration

dBA	T(hours)	dBA	T(hours)
80	32.0	100	2.0
85	16.0	101	1.7
86	13.9	102	1.5
87	12.1	103	1.3
88	10.6	104	1.1
89	9.2	105	1.0
90	8.0	106	0.87
91	7.0	107	0.76
92	6.1	108	0.66
93	5.3	109	0.57
94	4.6	110	0.50
95	4.0	111	0.44
96	3.5	112	0.38
97	3.0	113	0.33
98	2.6	114	0.29
99	2.3	115	0.25

At no time shall any excursion exeed 115 dBA. For any value, the reference duration (T) in hours is computed by: $T=8/2^{(L-90)5}$ where L is the measured A-weighted, slow-response sound pressure level.

Table 62-2 "DOSE"/TWA_8 Equivalent

Dose (Percent)	TWA_8	Dose (Percent)	TWA_8
25	80	303	98
29	81	350	99
33	82	400	100
38	83	460	101
44	84	530	102
50	85	610	103
57	86	700	104
66	87	800	105
76	88	920	106
87	89	1056	107
100	90	1213	108
115	91	1393	109
132	92	1600	110
152	93	1838	111
174	94	2111	112
200	95	2425	113
230	96	2786	114
264	97	3200	115

Interpolate between the values found in this Table, or extend the Table, by using the formula: $TWA_8 = 16.61 \log_{10} (D/100) + 90$.

Step 7: Evaluating the results

On an instrument set to integrate noise levels from 80 to at least 130 dBA,

> . . . a reading of 50 percent or a TWA_8 of 85 dBA (or higher) would indicate that the "action level" referred to in 30 CFR Part 62 had been reached. *In this case, a mine operator is required to enroll the affected miner(s) in a hearing conservation program.*

[TWA_8 means an eight hour time-weighted average.]

On an instrument set to integrate noise levels from 90 to at least 140 dBA,

> . . . a reading exceeding 100 percent or a TWA_8 exceeding 90 dBA would indicate that the PEL had been exceeded. *In this case, a mine operator is required to implement all feasible engineering and administrative controls (Note: the rule requires both controls to be used if one type cannot reduce the exposure to the PEL) to reduce miners' noise exposure to the PEL, and enroll affected miners in a hearing conservation program.*

On an instrument set to integrate noise levels from 90 to at least 140 dBA,

> . . . a reading exceeding 800 percent or a TWA_8 of 105 dBA would indicate that a miner's exposure is above the Dual Hearing Protection Level referred to in 30 CFR Part 62. *In this case, a mine operator must* ***provide and ensure*** *that the affected miner(s) simultaneously wear(s) an earplug-type and an earmuff-type hearing protector.* In addition, all feasible engineering and administrative controls must be implemented and the miner must be enrolled in a hearing conservation program.

The maximum allowable noise level is 115 dBA. MSHA's rule prohibits exposure above 115 dBA for any duration, **not as a time-weighted average**.