

where t = sampling time in minutes and airflow rate = $0.002 \text{ m}^3/\text{min}$). The product of t and the airflow rate is the total volume of air from which dust is accumulated on the filter.

The following example is meant to illustrate the effect of the second step in the conversion, multiplication by $t/480$, which adjusts for the full length of the sampled shift. Suppose a DO sample is collected over a 9-hour shift and that the amount of dust accumulated during the shift is 1.5 mg. If the concentration were not adjusted to an 8-hour equivalent concentration, the MRE-equivalent concentration would be calculated as $1.92 \text{ mg}/\text{m}^3$. Under the proposed definition of "equivalent concentration," this quantity is then multiplied by $540/480$, yielding an equivalent concentration measurement of $2.16 \text{ mg}/\text{m}^3$. Let us suppose now that this concentration measurement was for a longwall occupation under a PAPR protection program with an applicable protection factor of 2. Therefore, the

concentration measurement of $2.16 \text{ mg}/\text{m}^3$ is divided by 2, which yields $1.08 \text{ mg}/\text{m}^3$, the equivalent concentration to which the wearer of the PAPR is exposed.

This adjustment does not change the daily limit on the accumulated dose of respirable coal mine dust as intended by the existing exposure limit for coal mine dust. Since the current limit was based on the assumption that exposure occurs over an 8-hour shift, it corresponds to a daily cumulative dose of respirable coal mine dust of $8 \times 2.0 = 16 \text{ mg-hr}/\text{m}^3$ as measured by the MRE instrument. The proposed definition of equivalent concentration will maintain this same MRE-equivalent $16 \text{ mg-hr}/\text{m}^3$ daily limit, regardless of the length of the working shift being sampled.

To continue the example, the exposure accumulated during the sampled working shift is the same, whether over 8 hours at an average of $2.16 \text{ mg}/\text{m}^3$ or over 9 hours at an average of $1.92 \text{ mg}/\text{m}^3$. In either case,

the MRE-equivalent exposure accumulated during the sampled shift is $17.3 \text{ mg-hr}/\text{m}^3$, which exceeds the intended limit of $16 \text{ mg-hr}/\text{m}^3$. Under the definition of "equivalent concentration" provided here, this will be reflected by the fact that, when more than $16 \text{ mg-hr}/\text{m}^3$ (MRE-equivalent exposure) is accumulated over the course of the particular shift sampled, the equivalent concentration will exceed $2.0 \text{ mg}/\text{m}^3$, regardless of the shift's length.

Similarly, using a currently approved sampler, the plan verification limit for respirable quartz dust (*i.e.*, $0.1 \text{ mg}/\text{m}^3$) will be exceeded when the total amount of quartz dust amassed on a filter during the full production shift exceeds 0.07 mg , regardless of the shift's length. For example, if 0.08 mg of quartz dust were accumulated over the course of a 12-hour shift, then the equivalent concentration of respirable quartz dust would be calculated as:

$$1.38 \times \frac{0.08 \text{ mg}}{720 \text{ min} \times 0.002 \text{ m}^3/\text{min}} \times \frac{720 \text{ min}}{480 \text{ min}} = 0.115 \text{ mg}/\text{m}^3,$$

This is exactly the same value of the equivalent concentration that would be obtained if 0.08 mg of quartz dust were accumulated on an 8-hour shift.

MSHA originally proposed a different but mathematically equivalent method of adjusting concentrations to an 8-hour equivalent and solicited comments on the proposed method. The proposed method would have defined "concentration" to mean what is here defined as "equivalent concentration." Instead of making an explicit adjustment to the concentration, using the factor of $t/480$ as in the present definition, the proposed rule would have substituted 480 for the actual sampling time in the definition of respirable dust concentration. The proposed definition of "equivalent concentration" is meant to both preserve the ordinary definition of "concentration" and to clarify the adjustment to an 8-hour equivalent.

MSHA believes that the proposed adjustment to an "8-hour equivalent concentration" is necessary to protect miners, who normally work nontraditional or extended shifts, from excessive exposures. A miner working for ten hours at an average concentration of $2.0 \text{ mg}/\text{m}^3$ will inhale and retain more respirable coal mine dust as a result of that specific shift than a miner working for eight hours at the same average concentration. By

comparing the adjusted concentration to the concentration limit originally intended for miners working an 8-hour shift, the same cumulative exposure limit is applied on individual shifts for all miners.

It should be noted that the American Conference of Governmental Industrial Hygienist (ACGIH) approach of reducing the permissible concentration to compensate for the extension of a shift beyond eight hours is similar in its effect to the approach taken here of adjusting the equivalent concentration upwards and comparing it to a fixed limit. MSHA makes similar adjustments for extended work shifts in the enforcement of exposure limits in metal and nonmetal mines under 30 CFR 56.5001 and 57.5001. Taking into account the reduced recovery time that results from an extended work shift would have led to a numerically greater and more protective adjustment, but this would also have introduced additional complexities in the calculation of equivalent concentration measurements. The Secretary believes that the method proposed strikes a reasonable balance between no adjustment at all, and a far more complex adjustment that would attempt to model clearance, deposition, and retention mechanisms.

Material Produced

"Material produced" would mean the amount of coal and/or any other substance(s) extracted by a mechanized mining unit during a production shift. In order to properly assess the effectiveness of the ventilation plan requirements for respirable dust control and for subsequent monitoring purposes, MSHA proposes to require that the operator record and make available records of the amount of material produced by each mechanized mining unit each shift under a new paragraph (h) of § 75.370.

Mechanized Mining Unit (MMU)

The existing definition would be modified by deleting the reference to § 70.207(e) (Bimonthly sampling; mechanized mining units), and replacing it with proposed § 70.206(d); and by transferring the requirements for identifying each MMU specified in existing §§ 70.207(f)(1) and (f)(2), to revised § 70.2.

MRE

"MRE" would mean Mining Research Establishment of the National Coal Board, London, England.

Personal Continuous Dust Monitor (PCDM)

"Personal continuous dust monitor" would mean a type of approved