

## **DETERMINING MINERS' EXPOSURES TO DPM**

To validate a determination of a miner's exposure to the 160 TC PEL based on a personal TC sample, MSHA will analyze a non-citable area sample taken from an area of the mine without organic carbon (OC) interferences. To check for non-diesel OC interferences on the personal sample, MSHA will multiply the elemental carbon (EC) component of the personal TC sample by the ratio of TC to EC obtained from the area sample. MSHA will use this procedure when EC on the miner's personal sample is less than 160 micrograms per cubic meter of air times the error factor (EF) for EC, and TC on the miner's personal sample is greater than 160 micrograms per cubic meter of air times the EF for TC. MSHA will obtain both personal and area samples using the same type of sampling cassette used previously for its compliance sampling. This cassette incorporates an integral submicron impactor and tandem quartz fiber filters. MSHA will use NIOSH Analytical Method 5040 to determine TC and EC on both personal and area samples. Beginning May 20, 2008, MSHA will sample and analyze a miner's exposure to DPM as follows:

- MSHA will determine a miner's exposure to DPM based on the TC content of a single personal sample taken over the miner's full shift as specified in existing 30 C.F.R. § 57.5061 of the DPM standard.
- MSHA will collect area samples for the miner's full shift on the same shift during which the Agency takes the corresponding personal samples.
- MSHA will take the area sample in the main exhaust air course downstream from the miner's work location, where OC contributions from non-diesel sources are likely to be negligible. At a minimum, MSHA will locate the area sampler at least 25 feet downstream from smoking miners and at least 500 feet downstream from oil mist sources.
- If more than one miner is working upstream from the area sampler, MSHA will apply the TC to EC ratio from the area sample to each miner's personal sample.
- If the ventilation passing through the miner's work area or multiple work areas is coursed to more than one main exhaust, MSHA will locate an area sampler in each of these main exhausts.
- When it is necessary for MSHA to check a miner's personal sample for OC interferences based on multiple area samples, MSHA will average the TC to EC ratios of the area samples to determine the composite TC to EC ratio to apply to the personal sample.
- The miner is overexposed when:  
EC on the personal sample exceeds  $160 \times \text{EF}$ ; or  
EC on the personal sample is less than  $160 \times \text{EF}$ , TC on the personal sample exceeds  $160 \times \text{EF}$ , and EC on the personal sample times the ratio of TC to EC from the area sample exceeds  $160 \times \text{EF}$ .

## Use of Error Factors in Determining a Miner's Overexposure to DPM

The DPM permissible exposure limit (PEL) is 160 micrograms of total carbon (TC) per cubic meter of air ( $160_{TC} \mu\text{g}/\text{m}^3$ ).

1. TC from a personal sample **must exceed**  $160 \mu\text{g}/\text{m}^3$  times the error factor (EF) for TC to result in a miner's overexposure to DPM. The EF for TC is 1.192. Thus, it follows that the miner **is not overexposed** to DPM when TC from the miner's personal sample **is less than or equal to**  $160 \mu\text{g}/\text{m}^3$  times the EF for TC as demonstrated below:

$$\begin{aligned} \text{TC} &\leq 160 \times [\text{EF for TC}] \\ \text{TC} &\leq 160 \times 1.192 \\ \text{TC} &\leq 190.72 \end{aligned}$$

Per MSHA's practice to round up to the next higher integer, 190.72 is rounded to 191. Therefore, a miner **is not overexposed** to DPM when  $\text{TC} < 191$  ( $\leq$  changed to  $<$  because 191 is greater than 190.72)

2. When TC from a full-shift personal sample **is equal to or greater than**  $191 \mu\text{g}/\text{m}^3$ , MSHA will evaluate the EC content of the personal sample as follows to confirm that the TC exposure is not the result of organic carbon interferences:

The miner **is overexposed** to DPM when EC on the miner's personal sample for TC is greater than 160 times the EF for EC. The EF for EC is 1.095. This relationship may be expressed mathematically as:

$$\begin{aligned} \text{EC} &> 160 \times [\text{EF for EC}] \\ \text{EC} &> 160 \times 1.095 \\ \text{EC} &> 175.2 \\ 175.2 &\text{ is rounded up to next higher integer} = 176 \\ \text{EC} &\geq 176 \quad (> \text{ changed to } \geq \text{ because } 176 \text{ is already higher than } 175.2) \end{aligned}$$

Therefore, a miner is overexposed to DPM when EC on the personal sample equals or is greater than  $176 \mu\text{g}/\text{m}^3$ .

In addition, when the miner's full-shift exposure to EC on the personal sample is less than  $176 \mu\text{g}/\text{m}^3$ , **an overexposure may still exist** if the full-shift exposure to EC on the personal sample times the average TC to EC ratio of one or more area samples is greater than  $160 \times \text{EF for TC}_{\text{adj}}$ . This may be expressed mathematically as:

$$\text{TC}_{\text{adj}} > 160 \times [\text{EF for TC}_{\text{adj}}]$$

Note: Multiplying EC on the personal sample by the average TC to EC ratio of one or more area samples obtained where non-diesel OC interferences are likely to be negligible results in the TC concentration of the personal sample without OC interferences. This "adjusted" TC value is designated as  $\text{TC}_{\text{adj}}$  to differentiate it from TC, which refers to total carbon determined by the ordinary method of  $\text{EC} + \text{OC}$ .

The value of the EF for  $TC_{adj}$  depends on the number of area samples used for determining  $TC_{adj}$ . This EF ranges from 1.259 when 1 area sample is used to 1.121 when 10 area samples are used (unlikely a situation would be encountered where more than 10 area samples would be required - 1 to 3 area samples would be adequate in the vast majority of cases). In the following table, the column labeled "citation threshold" shows the values of 160 times the EF for  $TC_{adj}$  for each case from 1 up to 10 area samples (result rounded to the next higher integer).

Number of Area Samples Included in Average TC:EC Ratio	Citation Threshold for $TC_{adj}$
1	202
2	192
3	187
4	185
5	183
6	182
7	182
8	181
9	180
10	180

In summary, the miner is overexposed to DPM when  $EC < 176$  **and**  $TC_{adj}$  is equal to or greater than the corresponding value from the table depending on the number of area samples used. For example, if one area sample is used, a miner **is overexposed** when:

$$EC < 176$$

**and**

$$TC_{adj} \geq 202$$

If three area samples are used, a miner **is overexposed** when:

$$EC < 176$$

**and**

$$TC_{adj} \geq 187$$