



Standard Test Method for Monitoring Diesel Particulate Exhaust in the Workplace¹

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^{ε1} NOTE—Editorial changes were submitted after publication in October 2013.

1. Scope

1.1 This test method covers determination of organic and elemental carbon (*OC* and *EC*) in the particulate fraction of diesel engine exhaust, hereafter referred to as diesel particulate matter (*DPM*). Samples of workplace atmospheres are collected on quartz-fiber filters. The method also is suitable for other types of carbonaceous aerosols and has been widely applied to environmental monitoring. It is not appropriate for sampling volatile or semi-volatile components. These components require sorbents for efficient collection.

NOTE 1—Sample collection and handling procedures for environmental samples differ from occupational samples. This standard addresses occupational monitoring of *DPM* in workplaces where diesel-powered equipment is used.

1.2 The method is based on a thermal-optical technique (1, 2).² Speciation of *OC* and *EC* is achieved through temperature and atmosphere control, and an optical feature that corrects for sample charring (carbonization).

1.3 A portion of a 37-mm, quartz-fiber filter sample is analyzed. Results for the portion are used to calculate the total mass of *OC* and *EC* on the filter. The portion must be representative of the entire filter deposit. If the deposit is uneven, two or more representative portions should be analyzed for an average. Alternatively, the entire filter can be analyzed, in multiple portions, to determine the total mass. Open-faced cassettes give even deposits but may not be practical. At 2 L/min, closed-face cassettes generally give results equivalent to open-face cassettes if other dusts are absent. Higher flow rates may be employed, but closed-faced cassettes operated at higher flow rates (for example, 5 L/min) sometimes have uneven deposits due to particle impaction at

the center of the filter. Other samplers may be required, depending on the sampling environment (2-5).

1.4 The calculated limit of detection (*LOD*) depends on the level of contamination of the media blanks (5). A *LOD* of approximately 0.2 μg carbon per cm^2 of filter was estimated when analyzing a sucrose standard solution applied to filter portions cleaned immediately before analysis. *LODs* based on media blanks stored after cleaning are usually higher. *LODs* based on a set of media blanks analyzed over a six month period at a commercial laboratory were *OC* = 1.2 $\mu\text{g}/\text{cm}^2$, *EC* = 0.4 $\mu\text{g}/\text{cm}^2$, and *TC* = 1.3 $\mu\text{g}/\text{cm}^2$, where *TC* refers to total carbon (*TC* = *OC* + *EC*). In practice, the *LOD* estimate provided by a laboratory is based on results for a set of media blanks submitted with the samples. To reduce blank variability (due to lack of loading), a manual *OC-EC* split is assigned at the time when oxygen is introduced. With manual splits, the *SD* for media blanks is typically about 0.02-0.03 μg *EC*/ cm^2 , giving *LODs* ($3 \times \text{SD blank}$) from about 0.06-0.09 μg *EC*/ cm^2 . The corresponding air concentration depends on the deposit area (filter size) and air volume.

1.5 *OC-EC* methods are operational, which means the analytical procedure defines the analyte. The test method offers greater selectivity and precision than thermal techniques that do not correct for charring of organic components. The analysis method is simple and relatively quick (about 15 min). The analysis and data reduction are automated, and the instrument is programmable (different methods can be saved as methods for other applications).

1.6 A method (5040) for *DPM* based on thermal-optical analysis has been published by the National Institute for Occupational Safety and Health (NIOSH). Method updates (3, 4) have been published since its initial (1996) publication in the NIOSH Manual of Analytical Methods (*NMAM*). Both *OC* and *EC* are determined by *NMAM* 5040. An *EC* exposure marker (for *DPM*) was recommended because *EC* is a more selective measure of exposure. A comprehensive review of the method and rationale for selection of an *EC* marker are provided in a Chapter of *NMAM* (5).

¹ This test method is under the jurisdiction of ASTM Committee D22 on Air Quality and is the direct responsibility of Subcommittee D22.04 on Workplace Air Quality.

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² The boldface numbers in parentheses refer to references at the end of this test method.