Designation: D4532 – 97 (Reapproved 2003)

Standard Test Method for Respirable Dust in Workplace Atmospheres[1]

This standard is issued under the fixed designation D4532; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method is useful for the determination of respirable dust (see Terminology D1356) in a range from 0.5 to 10 mg/m^3 in workplace atmospheres.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1356 Terminology Relating to Sampling and Analysis of Atmospheres

D3195 Practice for Rotameter Calibration

D5337 Practice for Flow Rate Calibration of Personal Sampling Pumps

D6062M **DESIG ATTRIBUTE D6062M DIDN'T MATCH, MATCHED WITH D6062** Guide for Personal Samplers of Health-Related Aerosol Fractions

E1 Specification for ASTM Liquid-in-Glass Thermometers

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *respirable fraction of the dust*—that mass which passes through a cyclone at the stated conditions **(1, 2).**[3]

4. Summary of Test Method

4.1 Air is accurately drawn for a measured period of time through a 10-mm cyclone followed by a tared filter. The respirable dust concentration is calculated from the weight gain of the filter and the total volume of air sampled.

5. Significance and Use

5.1 This test method covers the determination of respirable dust in workplace atmospheres.

5.2 The limitations on the test method are a minimum weight of 0.2 mg of dust on the filter, and a maximum loading of 0.3 mg/cm^2 on the filter. The test method may be used at higher loadings if the flow rate can be maintained constant.

6. Apparatus

6.1 The sampling unit consists of a pump and a sampling head. The sampling head consists of a 10-mm cyclone and a filter assembly.

6.1.1 *Pump*—A personal sampling pump with a flow rate accurate to ±5 %. Pump pulsation not to exceed ±20 % of the mean flow. The pump must be capable of maintaining the mean flow constant to within ±5 % during the sampling period. Calibrate the sampling pump using Practice D5337.

6.1.2 *Sampling Head*—The sampling head consists of a 10-mm cyclone, a filter, a filter-support pad, and a filter holder with suitable caps (see Fig. 1).

6.1.2.1 The cyclone[4] must be shown to be unbiased relative to the appropriate respirable dust criterion and the dust size distribution being sampled **(3, 4, 5, 6).** Based on the cyclone penetration curve for non-pulsating flow measured with a monodisperse aerosol, the bias in the test method is shown in Fig. 2 for sampling rates appropriate for individual cyclones. **(7).**

6.1.2.2 Cyclone samples collected with pulsating flow have been shown to yield a negative bias as large as 22 % compared to samples collected under steady flow **(8).**

6.1.2.3 Electrostatic charge on the dust and a non-conductive sampler can cause bias as large as 50 %. **(9).**

6.1.3 The filter shall be non-hygroscopic and a collection efficiency greater than 95 % for the dust cloud of interest. The filter and its filter support shall be 37 mm in diameter.

NOTE 1—As an example, most glass fiber and membrane filters with nominal pore size of 5 µm will nearly always fulfill this requirement **(10).** PVC is recommended for gravimetric analysis. The equilibrated filter is

[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 Atmospheres.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The boldface numbers in parentheses refer to the list of references at the end of this test method.

[4] The sole source of the 10-mm cyclones known to the committee at this time is Dorr-Oliver, Inc., Milford, CT 06460. If you are aware of alternative suppliers, please provide this information to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.

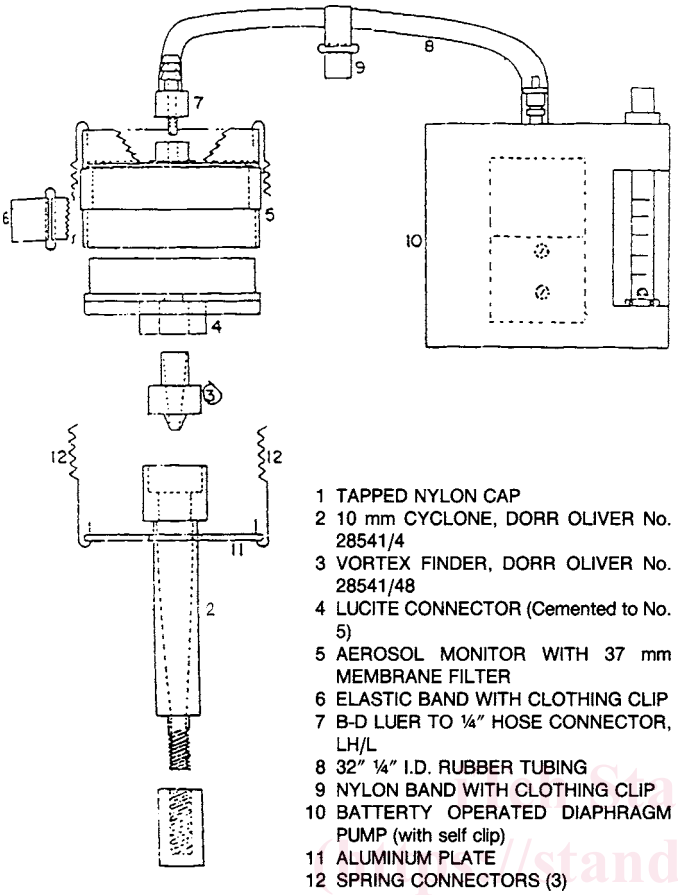

FIG. 1 Example of Personal Sampler for Respirable Dust

preweighed by the user. The weight of the filter holder is not used in any determination of weight gain in this test method. The filter holder material must not contribute to any weight change of the filter.

6.1.4 *Charger*—Pump batteries shall be completely charged with appropriate charger following the manufacturer's instructions or disposable batteries may be used.

6.1.5 Suitable means is provided for separately attaching the pump and the sampling head to the appropriate person.

6.2 *Buret*, capacity of 1 L, used as a soap bubble meter for calibration of the sampling unit.

6.3 *Barometer*, capable of measuring atmospheric pressure to ±0.1 kPa.

6.4 *Stopwatch*, capable of measuring to ±0.1 s.

6.5 *Weighing Room*, with temperature and humidity control to allow weighing with an analytical balance to ±0.01 mg.

6.6 *Analytical Balance*, capable of weighing ±0.01 mg or better. Particular care must be given to the proper zeroing of the balance. The same analytical balance and weights must be used for weighing filters before and after sample collection.

6.7 *Charge Neutralizer*, to eliminate static charge in the balance case and on the filters during weighing. Replace Po-210 neutralizers 9 months after production date.

6.8 *Plane-Parallel Press*, capable of giving a force of at least 1000 N (may be required if plastic filter holders are used that must be pressed together after insertion of the filter).

6.9 *Tapered Tube Flow Meter*, with precision ±2 % or better within the range of the flow rate used. Calibrate the meter using Practice D3195.

6.10 *Thermometer*, dry bulb, 0 to 50°C with divisions every 0.1°C. (ASTM thermometers number 90C and 91C.) (See Specification E1.)

6.11 *Manometer*, 0 to 250 mm of water (0 to 0.25 kPa) for measuring the pressure drop across the sampling head.

6.12 *Flexible Tube with Two Clips*, one near the sampling head, if the sampling head does not have a clip, and the other midway between the sampling head and the pump. The length of the tube is dependent on how the sampling unit is worn. A length of 0.7 to 0.9 m is suitable if the pump is attached to the worker's belt.

6.13 *Jar*, leakproof, of suitable size to contain the sampling head during calibration of sampling system. (See and Fig. 3).[5]

7. Sampling

7.1 Clean and inspect the interior of the cyclone. If the inside surfaces are visibly scored, replace the cyclone since the dust separation characteristics might be altered.

7.2 Condition all filters to a constant weight. Record the filter weight.

7.3 Place the tared filter and filter support in the filter holder, close firmly, and tape the circumference of the filter holder. If necessary, use the press described in 6.8. Suitably cover the assembly to avoid contamination if it is held for any time prior to use.

7.4 Assemble sampling apparatus as shown in Fig. 1.

7.5 Run the pump for 5 min to stabilize the flow rate.

7.6 Remove the filter holder caps and connect the filter holder to the cyclone as required by the manufacturer. Connect the outlet of the sampling head to the pump's inlet with a piece of flexible tubing. Check to be sure all connections are free of leaks by closing off the filter inlet. Flow should stop in 10 to 15 s.

7.7 Check the sampling unit for proper operation, check for leaks, and measure the flow rate.

7.8 Sample at 1.7 L/min for the Dorr-Oliver 10-mm cyclone, or as directed by manufacturer of specific cyclones. Depending on sample load, consecutive samples over the shift may be required. However, the sampling time should not exceed the operating life of the batteries or the prevailing "full shift." The nominal sampling period is 8 h. Sampling times shorter than a full shift are permitted if the following occurs:

7.8.1 The pressure drop across the filter exceeds the pump's capabilities; that is, the filter becomes clogged.

7.8.2 Specific working operations of shorter duration are to be investigated.

7.8.3 Determinations of variations of the exposure during a shift are made.

7.9 Attach the sampling head to the worker so that it is located in the breathing zone. The worker's breathing zone consists of a hemisphere 300-mm radius extending in front of the face, and measured from a line bisecting the ears. The sampling head shall be placed in such a manner to prevent dust

[5] The sole source for the 10-mm nylon cyclone calibrating jar known to the committee at this time is Fischer Scientific, 711 Forbes Ave. If you are aware of alternative suppliers, please provide this information to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee[1] which you may attend.