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Standard Test Method for ~~Respirable Dust in Workplace Atmospheres~~Respirable Dust in Workplace Atmospheres Using Cyclone Samplers[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

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

1.1 This test method provides details for the determination of respirable dust concentration defined in terms of international convention in a range from 0.5 to 10 mg/m^3 ~~in workplace atmospheres.~~

~~1.2~~*in workplace atmospheres. Specifics are given for sampling and analysis using any one of a number of commercially available cyclone samplers.*

1.2 The limitations on the test method are a minimum weight of 0.1 mg of dust on the filter, and a maximum loading of 0.3 mg/m^2 on the filter. The test method may be used at higher loadings if the flow rate can be maintained constant.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 This test method contains notes that are explanatory and are not part of the mandatory requirements of the method.

1.5 *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

D~~6062M~~6062 Guide for Personal Samplers of Health-Related Aerosol Fractions

D6552 Practice for Controlling and Characterizing Errors in Weighing Collected Aerosols

D7440 Practice for Characterizing Uncertainty in Air Quality Measurements

E1 ~~Specification for ASTM Liquid-in-Glass Thermometers~~ Specification for ASTM Liquid-in-Glass Thermometers

E2251 Specification for Liquid-in-Glass ASTM Thermometers with Low-Hazard Precision Liquids

2.2 *Other International Standards:*[3]

ISO GUM Guide to the Expression of Uncertainty in Measurement, ISO Guide 98

ISO 7708 Air Quality—Particle Size Fraction Definitions for Health-Related Sampling

ISO 15767 Workplace Atmospheres—Controlling and Characterizing Errors in Weighing Collected Aerosol

EN 481 Workplace Atmospheres—Size Fraction Definitions for the Measurement of Airborne Particles in the Workplace

EN 13205 Workplace Atmospheres—Assessment of Performance of Instruments for Measurement of Airborne Particle Concentrations

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:* Definitions of Terms Specific to This Standard (otherwise, consult D1356):

3.1.1 ~~*respirable fraction of the dust*—that mass which passes through a cyclone at the stated conditions~~ **respirable dust**

[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.~~ Air Quality.

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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.~~

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

fraction—fraction of airborne material (see Fig. 1) that would be collected by an idealized sampler following the internationally-harmonized sampling conventions of ISO 7708, EN 481, Guide D6062, and Ref. **(1, 2).**).[4]

NOTE 1—The definition of the respirable dust fraction is a compromise between previous definitions, available samplers, and the fraction of dust that penetrates to (rather than deposits in) the alveolar region of the lung. Local legal definitions may differ from the definition adopted in this test method.

3.2 For the terms and definitions related to characterizing uncertainty, see ISO GUM and Practice D7440.

4. Summary of Test Method

4.1Air 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.

4.1 Air is drawn through a cyclone or equivalent sampler followed by a tared filter, which is then re-weighed to determine the mass of respirable dust. The air flow rate and time of sampling provide the volume from which the dust mass was sampled. A time-weighted average respirable dust concentration is calculated by dividing the mass by the total air volume.

NOTE 2—Samplers alternative to a cyclone (for example, foam-based or personal cascade impactors) may be used if they have desirable properties (for example, ease of use or uncertainty control) for intended application. Nevertheless, this test method is limited to cyclone samplers.

5. Significance and Use

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

5.2The 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.

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

5.2 Variations of the test method are in world-wide use for determining compliance relative to occupational exposure levels.

5.3 The test method may be used to verify dust control measures.

5.4 The test method may also be applied in research into health effects of dust in an occupational setting.

6. Apparatus

6.1 *Sampling Unit*—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 Evaluated Respirable Dust Cyclone—For a list of commercially-available samplers and characteristics, see Research Report RR:D22-1033.

NOTE 3—Bias relative to the international respirable dust criterion and the dust size distribution being sampled (**2-10**) must be controlled sufficiently (see 13.2.4) for the application of intended use.

6.1.2 *Filter Cassette Assembly*—Filter, filter-support pad, and filter cassette holder with suitable caps. The filter shall be non-hygroscopic and a collection efficiency greater than 95 % for the dust of interest.

[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.

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

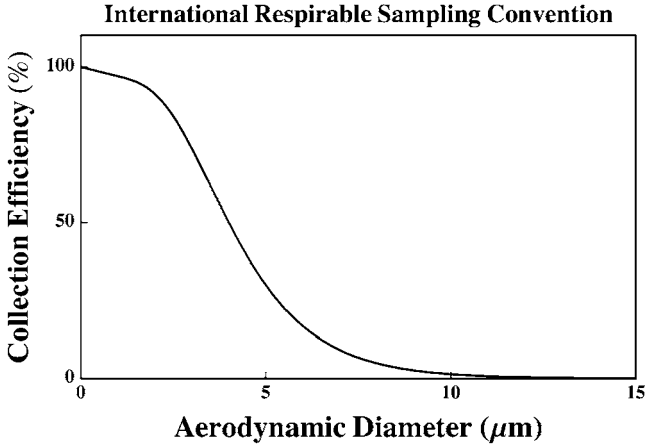

FIG. 1 Collection Efficiency of an Ideal Sampler Following the International Sampling Conventions

NOTE 4—As an example, most glass fiber and membrane filters with nominal pore size of 5 µm will fulfill this requirement (**11**). PVC is recommended for gravimetric analysis. The equilibrated filter is preweighed by the user.

NOTE 5—It is preferable to use a conductive cassette because electrostatic charge on the dust and a non-conductive cassette can result in a significant bias (**12-16**). For controlling dust which may become attracted to the interior cassette walls, several filter holders equipped with a shielded respirable dust filter and cassette are commercially available, which may be weighed together with the filter.

6.1.3 *Personal Sampling Pump*—With a flow rate uncertainty (see 13.2.1) less than 5 %. The pump pulsation amplitude may not exceed ±20 % of the mean flow. The sampling pump is calibrated 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).~~

~~6.1.2.1The cyclone 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).**~~

~~6.1.2.2Cyclone 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).**~~

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

~~6.1.3The 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.~~

~~NOTE1—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 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.~~

~~6.1.5Suitable means is provided for separately attaching the pump and the sampling head to the appropriate person.~~ 6—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 (**17**).

6.2 ~~*Buret*, capacity of 1 L, used as a soap bubble meter for calibration of the sampling unit.~~ Charger—Pump batteries shall be completely charged with an appropriate charger following the manufacturer's instructions or disposable batteries may be used.

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~~*—With temperature (20 ± 2°C) and humidity (50 ± 5 % Relative Humidity (RH)) control to allow weighing with an analytical balance to accuracy required. See ISO 15767 and Practice D6552 for controlling and characterizing errors in weighing collected aerosols.*

NOTE 7—If a weighing room is not available, a filter equilibration chamber can be used to equilibrate the filters in a temperature (20 ± 2°C) and humidity (50 ± 5 % RH) controlled chamber.

6.4 *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~~*—Capable of weighing to 0.01 mg or better, depending on application. Particular care must be given to the proper zeroing of the balance.*

6.5 *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~~*—To eliminate static charge in the balance case and on the filters during weighing. Po-210 neutralizers if used must be replaced within nine months of their production date.*

6.6 *Plane-Parallel Press*~~, capable~~ —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~~6.7 ~~*Tapered Tube-Flow Meter*, with~~ —With precision ~~±2%~~equal to 2 % or better within the range of the flow rate used. Calibrate the meter using Practice D3195.

~~6.10~~

6.8 *Thermometer*~~, dry bulb, 0 to 50°C with divisions every 0.1°C. (ASTM thermometers number 90C and 91C.) (See Specification~~ —Capable of covering the temperature range of interest with divisions every 0.1°C (see Specifications E1 ~~.)~~ and E2251).

NOTE 8—It is encouraged to use a non-mercury thermometer to minimize environmental hazards.

6.9 *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.

6.10 *Forceps*—Preferably nylon.

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

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).~~ Petri Dishes—With diameter slightly greater than the filter.

7. ~~Sampling~~

~~7.1Clean 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.~~

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

~~7.3Place 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.~~

~~7.4Assemble sampling apparatus as shown in Fig. 1~~Preparation of Samplers Prior to Sampling

7.1 Inspect the interior of the cyclone and clean it to keep away from reentrainment of large particles. If the inside surfaces are visibly scored, replace the cyclone since the dust separation characteristics of the sampler might be altered.

7.2 Equilibrate all the filters in an environmentally controlled weighing room or equilibration chamber for at least two hours.

7.3 Weigh the filters in the weighing room.

7.3.1 Internally calibrate the balance (zero balance) before use.

7.3.2 Grasp the filter with forceps and pass the filter several times through a charge neutralizer to eliminate static charge, if necessary.

7.3.3 Record the weight of filters.

7.4 Place the tared filter and filter support in the filter cassette holder, close firmly, and tape the circumference of the filter holder. If necessary, use the press described in 6.6.

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

~~7.6Remove 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.~~

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

~~7.8Sample 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:~~

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

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

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

~~7.9Attach 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 from falling into it and to avoid restricting the inlet. The pump can be attached to the worker's belt.~~

~~7.10Initiate sampling by turning the pump on and setting the flow rate determined in 8.5 and according to the manufacturer's instructions. Record the flow rate and the time. If the flow rate changes during sampling by more than ±5%, record the change and the time. Reset the flow rate. If unable to reset the flow rate to the original setting, terminate sampling and note the reason for termination. Follow Guide D6062M for personal samplers.~~

~~7.11At the end of the sampling period, turn the pump off and record the final flow rate and time.~~

~~7.12Replace the filter holder caps. Remove the sampling unit from the worker.~~

~~7.13For each set of 10 or fewer samples, submit a blank sample. The filters and filter holders to be used as blanks are prepared and transported in the same manner as the samples except that no air is drawn through them. Label these as blanks.~~

~~7.14The filter assembly should be returned to the laboratory in a suitable container designed to prevent sample damage in transit.~~

7.5 Place caps to the filter holder and suitably cover the assembly to avoid contamination if it is held for any time prior to use.

8. ~~Calibration and Standardization~~

~~8.1Air flow calibration of the sampling unit should be completed before and after each sampling session. (See Fig. 3.) Maintenance and repairs, according to the manufacturer's instructions, should be performed on a regular schedule and records kept for documentation.~~

~~8.2The choice of calibration instrument will depend largely on where the calibration is to be performed. A soap bubble meter or spirometer is recommended. Instructions for calibration of the sampling unit with the soap bubble meter are provided in 8.3-8.9 and Fig. 3. If a spirometer is selected, an appropriate procedure shall be used. Since the flow rate given by a pump is dependent on the pressure drop across the sampling device, for instance the filter and cyclone, the pump must be calibrated while operating with a representative sampling head in line. Calibration of the sampling unit should be performed at approximately the same~~

~~temperature and pressure that the sample will be collected.~~

~~8.3Place the sampling head, with the same type of filter to be used to collect the sample, in the jar. Connect the sampling head to the outlet of the jar and connect the outlet of the jar to the pump to be calibrated.~~

~~8.4Turn on the pump and moisten the inside of the bubble meter by drawing bubbles up the meter until the bubbles are able to travel the entire length of the buret without bursting.~~

~~8.5Adjust the pump to provide the desired flow rate.~~

~~8.6Start a soap bubble up the buret and measure with a stopwatch the time it takes the bubble to pass from the zero line to the 1.0 L mark.~~

~~8.7Repeat the procedure in 8.5 at least three times. Calculate the flow rate by dividing the volume of air between the preselected marks of the buret by the time required for the soap bubble to traverse the distance and average the results. If the measured flow rate is outside the specification, readjust as in 8.5 and repeat 8.6 and 8.7.~~

~~8.8Record the date of the calibration and the temperature and pressure at the time of the calibration.~~

~~8.9Alternatively, the calibrated flow meter (6.9) may be used to field check flow rate at the beginning and end of sampling. Connect the outlet side of the flow meter to the inlet (vacuum side) of the pump. Connect the inlet side of the flow meter to the outlet of the jar, which contains the sampling head. Turn on the pump and determine flow rate from a calibration chart prepared for the flow meter by comparison with a soap bubble flow meter or spirometer.~~ Sampling

8.1 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 calibrated pump's inlet with a piece of flexible tubing. Make sure all connections are free of leaks by closing off the filter inlet.

8.2 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 30-cm 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 from falling into it and to avoid restricting the inlet. The pump can be attached to the worker's belt.

8.3 Initiate sampling by turning the pump on and record the flow rate and the time. For long-term sampling, periodically check the pump whether the pump functions properly. If a noticeable change of the flow rate is visually observed due to bending or blockage of tubing, turn off the pump and reset the flow rate. If unable to reset the flow rate to the original setting, terminate sampling and note the reason for termination.

NOTE 9—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 eight hours. Sampling times shorter than a full shift are permitted if the following occurs:

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

Specific working operations of shorter duration are to be investigated.

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

8.4 At the end of the sampling period, turn the pump off and record the final flow rate and time.

8.5 Remove the sampling unit from the worker and carefully take the sampling equipment to a clean, dust-free area.

8.6 Measure the pump flow rate using the calibrated flow meter. If the flow rates before and after sampling differ by more than 5 %, consider the sample to be invalid.

8.7 Remove the filter holder from the sampling head and replace the filter holder caps.

8.8 For each set of ten or fewer samples, submit a field blank sample. The filters and filter holders to be used as blanks are prepared and transported in the same manner as the samples except that no air is drawn through them. Label these as blanks.

8.9 The filter assembly should be returned to the laboratory in a suitable container designed to prevent sample damage in transit.

NOTE 10—The sampler must not be inverted at any time or else re-deposition of particles from the cyclone body onto the filter may occur.

NOTE 11—The preferred procedure is to personally transport samples back to the laboratory such as by car or carry-on aircraft baggage. If collected samples need to be shipped by a shipping service, place sample packages inside larger boxes and cushion with packing materials.

9. ~~Procedure~~

~~9.1Carefully swab the outer surface of the filter assembly with a lintless paper towel moistened with water before opening the filter holder to minimize sample contamination.~~

~~9.2Open the filter holder and carefully remove the filter from the holder with the aid of a rod inserted into the outlet hole of the filter holder and a filter tweezer. Handle the filters very gently by the edge to avoid loss of dust. Transfer the filter to a petri dish. Brush out the filter holder and add to the filter any dust adhering to the inside of the filter holder. Place the filter in the weighing room. Handle the equilibrated filter as stated in 7.2.~~

~~9.3Weigh the filter on the same analytical balance that was used to determine the tare weight (6.6).~~ Calibration and Standardization

9.1 Air flow calibration of the sampling unit should be completed before and after each sampling session. Maintenance and repairs, according to the manufacturer's instructions, should be performed on a regular schedule and records kept for documentation. See Practice D5337 for guidance on flow rate calibration.

NOTE 12—Make sure that the pump is connected to an appropriate sampling train, in the order of pump, tubing, inlet of sample media holder, and the cyclone connected to the sample media holder.

NOTE 13—Some samplers are accompanied with their own calibration chamber and thus, do not need a jar to calibrate the pump; refer to the manufacturer's manual. Alternatively, a calibrated flow meter (see 6.7) may be used to check the field flow rate at the beginning and end of sampling.

NOTE 14—It is critical that the flow rate required for the sampler be set at the time and location of sampling. If the temperature and pressure in the sampling environment differ from where the pump flow rate was set, the volumetric flow rate needs to be readjusted prior to sampling.

10. Procedure

10.1 Carefully swab the outer surface of the filter assembly with a lintless paper towel moistened with water before opening the filter holder to minimize sample contamination.

10.2 Remove the caps of the filter holder and equilibrate in an environmentally controlled room or equilibration chamber for at least two hours.

10.3 Open the filter holder and carefully remove the filter with forceps from the holder with the aid of a rod or filter lifter inserted into the outlet hole of the filter holder. Handle the filters very gently by the edge to avoid loss of dust. Transfer the filter to a petri dish. Place the filter in the weighing room.

10.4 Weigh the filter preferably on the same analytical balance that was used to determine the tare weight. If the original balance is not available or is inoperative, then an alternative analytical balance can be used for the second reading, capable of weighing to the nearest 0.01 mg or better as needed. Record anything notable about the filter such as overloading, leakage, torn and so on.

NOTE 15—The balance shall be regularly calibrated using ASTM Class I weights or equivalent NIST-traceable certified weights. An alternative balance that would be used in the procedure shall be calibrated as the same level as the original balance.

10.5 After weighing the filter, make sure to re-zero the balance prior to weighing next filter.

11. Calculation

~~10.1Mass of dust found on the sample filter:~~

11.1 The mass M_s(mg) of dust found on the sample filter is calculated as:

~~(1) $Ms = (m2 - m1) - \delta mb$~~

~~(1) $Ms = (m2 - m1) - \delta mb$~~

δm_b

where:

m_1 = ~~tare weight, in mg, of the clean filter before sampling,~~ tare weight (mg) of the filter before sampling,

m_2 = ~~the weight, in mg, of the sample-containing filter,~~ mass (mg) of the filter plus aerosol sample, and

~~m_3~~ δm_b = ~~the mean value of mass, in mg, found on the blank filter, and~~

~~M_s~~ = ~~mass found on the sample filter.~~average mass increase or decrease (mg) of the blank filter.

~~10.2The sampled volume is:~~

11.2 The sampled volume V_s(m^3) is:

~~Vs (2)~~

~~Vs~~ (2)

$= (Q\ t) / (1000\ L/m3)$

t

where:

Q = ~~the mean indicated flow rate, in L/min of air sampled,~~ mean flow rate (L/min) of air sampled, and

t = ~~the sampling time, in min,~~

~~Vs = the volume, in m^3, of the air sampled, and~~

~~1000 = conversion from L to m^3.~~sampling time (min).

~~Note2—There are no temperature or pressure corrections for changes in sampled volume since it is critical that the flow rate required for the cyclone be set at the time and location of sampling.~~

~~10.3The concentration of the respirable dust in the sampled air is expressed in mg/m~~ ^{3}

11.3 The concentration C (mg/m^3) of the respirable dust in the sampled air is:

~~(3) $C = Ms / Vs$~~

~~(3) $C = Ms / Vs$~~

where:

~~C = mass concentration of respirable dust,~~

~~K = a correction factor for the cyclone to convert to respirable mass fraction (supplied by the manufacturer),~~

M_s = ~~mass, in mg found on the sample filter, see 10.1, and~~ mass (mg) found on the sample filter (see 11.1), and