BSR/ASHRAE Standard 199-2016 RA202X

Public Review Draft

Method of Testing the Performance of Industrial Pulse Cleaned Dust Collectors

First Public Review (September 2025)

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CONTENTS

BSRASHRAE Standard 199-2016, Method of Testing the Performance of Industrial Pulse Cleaned Dust Collectors

NOTE

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(This foreword is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

FOREWORD

ASHRAE Standard 199 provides a method of testing pulse cleaned dust collectors. The approach uses the "black box" concept, by which the dust collector and test system to be evaluated are operated per the instructions of the dust collector manufacturer without modification. This test procedure is not concerned with the internal operation of the dust collector. The performance assessment elements of the test system (inlet challenge hardware, outlet emissions quantification instrumentation, and means to provide regulated airflow through the system) are physically separated and designed so that they can be arranged and independently fastened to the black box to be evaluated.

Other methods of testing fabric and pulse cleaned filter elements (fabric filters) have been used extensively. Although useful, these methods do not adequately address performance. They do not accurately portray the dynamics of pulsed operations of multiple, full-filter arrangements. Moreover, prior to Standard 199, no standardized test was available to test the full system. Standard 199 addresses this need by requiring sequential cleaning consisting of six distinct stages run continuously.

The approach is to introduce a metered dust challenge using a specified test dust and then measure the concentration of the dust by two methods: gravimetric and photometric. Test stages include the following:

a. *Conditioning*
   Stage 1: Initial dust loading
   Stage 2: Initial dust loading with on-demand cleaning
   Stage 3: Dust loading with continuous cleaning
b. *Performance Test*
   Stage 4: Final dust loading with on-demand cleaning
c. *Recovery Test*
   Stage 5: Up-set condition
   Stage 6: Post-up-set condition

The standard describes the collection of total mass emissions and photometric emissions where no more than 25% of the filter elements are pulsed at one time.

a. *Gravimetric Efficiency*
   1. *The standard includes a gravimetric measurement of total mass.*
   2. *Performance is measured by isokinetic sampling at the centerline onto a downstream membrane. The weight change of the membrane is used to calculate mass penetration as a decimal fraction of the upstream mass concentration.*
   3. *The gravimetric efficiency uses a calculated upstream concentration based on measured feed rate.*
b. *Photometric emissions*
   1. *The standard includes downstream airborne concentration of particulate as defined by PM_1, $PM_{2.5}$, and PM_{10}.*

Before beginning the test, the requestor must provide several operating parameters. These include the following:

a. *Specified airflow (the nominal volumetric flow rate for the test)*
b. *Pulse cleaning system high and low tubesheet differential setpoints*
c. *Pulse duration (the time the electronic signal indicates the solenoid valve is open)*
d. *Pulse intervals (the time between initiation of the successive pulses)*
e. *Pulse cleaning pressure*
f. *Pulse cleaning system volume*
g. *Up-set pressure condition limit (minimum of 10 in. of water [2488.4 Pa])*

This method of test does not prescribe performance; rather it provides a way to state the performance of a pulse cleaned dust collector. It characterizes performance of a pulse cleaned dust collector system under specified laboratory conditions and under specified operating parameters using a standard test dust. Test results should not be used to predict absolute performance in actual industrial applications of similar equipment; however, these results will be useful in the comparative performance of different systems.

INSERT FOREWORD AS SHOWN ON NEXT PAGE.

1. PURPOSE

The purpose of this standard is to provide a quantitative laboratory test method for determining the performance of industrial pulse cleaned dust collectors using a test dust.

2. SCOPE

This method of test applies to bag, cartridge, or envelope industrial dust collectors that recondition the filter media by using a pulse of compressed air to discharge the dust cake from the filter media while the air cleaning device remains online.

3. DEFINITIONS AND ACRONYMS

3.1 Definitions

airflow, specified: airflow rate in acfm (m^3/s) at the lab conditions by which the device is tested. In this standard it is specified by the requestor.

black box: device, system, or object that can be viewed in terms of its input, output, and transfer characteristics without any knowledge of its internal workings.

Informative Note: For the purpose of this test procedure, the industrial pulse cleaned dust collector is treated as a black box. The inputs are airflow, test dust, compressed air, pulsing mode, and electricity. The outputs are cleaned air and dust. The transfer functions are the measurements detailed in Section 11, such as pressure differential, compressed-air con-

(This foreword is not a part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard.)

This is a reaffirmation of Standard 199-2016. This standard was prepared under the auspices of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). It may be used, in whole or in part, by an association or government agency with due credit to ASHRAE. Adherence is strictly on a voluntary basis and merely in the interests of obtaining uniform guidelines throughout the industry. This version of the reaffirmation has no changes.

sumption, gravimetric efficiency, and photometric emissions. This test procedure is not concerned with the internal operation of the dust collector.

cleaning, continuous: process of cleaning filter elements based on a predetermined time interval as opposed to tubesheet differential pressure initiated cleaning.

cleaning, cycle: period in which all pulse cleaning valves are activated once, in sequential order, until immediately before the sequence starts again.

cleaning, on-demand: process of cleaning filter elements based on tubesheet differential pressure as opposed to predetermined time interval.

coefficient of variation: standard deviation of a group of measurements divided by the mean.

concentration, mass: amount of contamination material in the air expressed as a unit of mass per actual unit volume of air, for example, grains per cubic foot (gr/ft^3) or milligrams per cubic metre (mg/m^3).

efficiency, gravimetric: 100% minus the percentage of mass that passes through the filter from a known upstream concentration.

emissions, photometric: downstream concentration measured by a photometer at the given upstream conditions.

header: component of the pulse cleaning system that stores the compressed air supply for the pulse valves.

penetration, gravimetric: percentage of mass that passes through the filter from a known upstream concentration.

PM_1: particulate mass less than 1 μm as determined by photometric measurement in accordance with USEPA 40 CFR Part 50.

$PM_{2.5}$: particulate mass less than 2.5 μm as determined by photometric measurement in accordance with USEPA 40 CFR Part 50.

PM_{10}: particulate mass less than 10 μm as determined by photometric measurement in accordance with USEPA 40 CFR Part 50.

pressure, differential: difference of static pressure measurements between two points in a system.

Informative Note: Standard 199 includes two differential pressure measurements in this standard: across the tubesheet and inlet piezometer to outlet piezometer.

pulse cleaning system (PCS): term for the components used to momentarily and locally reverse the airflow through a filtration system with the objective of removing collected particulate from the system's filtration elements. These systems include all parts from the compressed air connection to the point of compressed air discharge into the filter element, and any associated equipment.

pulse duration: amount of time that each individual pulse cleaning solenoid is energized, typically expressed in milliseconds (ms).

pulse interval: time between the initiation of two successive pulses when the pulsing algorithm has not been satisfied, typically measured in seconds (s).

Stairmand disk: plate occupying the central half of the area of a duct, oriented so it is perpendicular to the direction of airflow. It is used to induce turbulence and mixing.

3.2 Acronyms and Abbreviations

acfm	quantity airflow in actual cubic feet per minute
CV	coefficient of variation
USEPA	U.S. Environmental Protection Agency
ISO	International Organization for Standardization
NIST	National Institute of Standards and Technology
PCS	pulse cleaning system
in. of water	inches of water

4. TEST METHODOLOGY

4.1 Sequence of Test Events. The objective of Standard 199 is to quantify the performance of a dust collection system as defined Section 2. To achieve this, the black box concept has been employed. The test consists of six distinct stages run continuously without stopping the airflow, as shown in Figure 4-1 and briefly defined in the following subsections. Gravimetric efficiency sampling and photometric emissions measurements are performed throughout the test as required. Refer to Section 9 for a detailed procedure.

4.1.1 Stage 1: Initial Dust Loading. This stage loads dust to the collector to a predetermined differential pressure with no pulse cleaning. Once differential pressure has been reached, the test proceeds to the next stage.

4.1.2 Stage 2: Initial Dust Loading with On-Demand Cleaning. Once the initial dust loading stage is complete, on-demand pulse cleaning is initiated while maintaining airflow and dust feed. Cleaning interval is determined by requestor-specified high and low differential pressure setpoints.

4.1.3 Stage 3: Dust Loading with Continuous Cleaning. This stage follows the initial on-demand cleaning with continuous pulse cleaning while maintaining airflow and dust feed. This stage lasts for 24 hours or until the predetermined maximum differential pressure has been reached, whichever occurs first.

4.1.4 Stage 4: Final Dust Loading with On-Demand Cleaning. This second, longer on-demand stage follows the continuous cleaning stage while maintaining airflow and dust feed. Cleaning is determined by requestor-specified high and low differential pressure setpoints.

4.1.5 Stage 5: Up-Set Condition. Dust feed is maintained and pulse cleaning stopped. This stage continues until differential pressure reaches the predefined maximum. At this point, dust feed is stopped.

4.1.6 Stage 6: Post Up-Set Condition. After up-set condition has been reached, airflow is reduced to 25% of specified value. Continuous pulse cleaning is initiated and continues for 10 complete cycles. The system is then returned to speci-

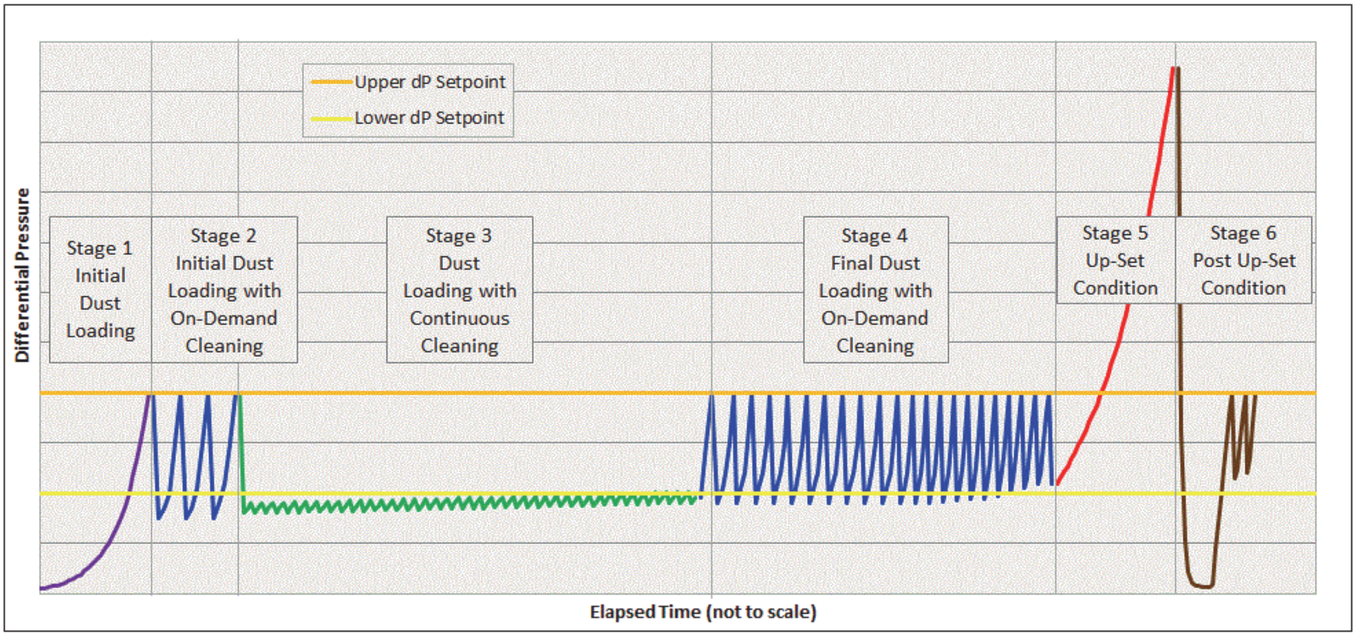

FIGURE 4-1 Schematic showing sequence of test stages.

fied airflow, and differential pressure is measured. Dust feed is then restarted and final measurements are performed.

5. TEST APPARATUS

5.1 Dust Feeder/Dispersion System. The dust feeder shall be capable of continuously feeding the test dust at 1 gr/ft^3 (2.28 g/m^3) at the specified airflow. The dust feeder shall incorporate a scale with active feedback control, such that the dust feed rate is automatically controlled within the stated tolerance. Aspiration of the fed dust shall be accomplished by an ISO 5011 [2] heavy-duty dust injector at a pressure between 20 and 50 psig (1.38 and 3.45 bar). Ensure that all items that come into contact with the dust feed system are grounded.

5.2 Test Duct. The test duct shall consist of round duct sections sufficient to maintain an inlet carrying velocity between 3500 to 5000 ft/min (17.78 to 25.4 m/s). The upstream and downstream duct diameters shall be the same from the inlet to 1 duct diameter downstream of the gravimetric sampling port. The duct material shall be electrically conductive and electrically grounded, have a smooth interior finish, and be sufficiently rigid to maintain its shape at the operating pressure. A Stairmand disk shall be used upstream of the downstream sampling devices to ensure aerosol uniformity.

Flow measurement shall be made by standardized flow measuring device in accordance with ASHRAE Standard 41.2 [1].

The test duct and the necessary hardware are schematically shown in Figure 5-1, and locations are specified in Table 5-1. Required details are specified in Figures 5-2 and 5-3. Performance requirements are detailed in the qualification of test setup (Section 8).

5.3 Pulse Cleaned Dust Collector. The requestor shall supply all items, including pulse cleaning system with control, filter housing, filters, and continuous dust removal system. The system shall be set up to clean a maximum of 25% of the filter media at any one time. The system shall not contain an integral blower. See Section 7 for requestor-defined parameters.

5.4 Blower and Associated Control System. The blower and associated control system shall have sufficient capacity to consistently maintain specified airflow throughout the test.

5.5 Instrumentation

5.5.1 Aerosol Photometer. Downstream concentration shall be measured by a 90 degree light scattering aerosol photometer. The instrument shall be calibrated to the test dust and capable of the mass and flow requirements of the specified test parameters. It shall be capable of detecting 0.001% of the upstream concentration in the size range of 0.1 to 10 µm. The instrument shall be set to a time constant of 60 s and capable of simultaneously measuring and recording size-segregated mass fraction concentrations corresponding to PM_1, $PM_{2.5}$, and PM_{10}.

5.5.2 Gravimetric Sampling. A sample train capable of conducting isokinetic sampling and recording total gas flow shall be used.

5.5.3 Sensors. Sensors shall meet the minimum requirements as listed in Table 5-2. A calibration system shall be employed to track accuracy and traceability to appropriate NIST primary standards.

5.6 Lab Conditions. Temperature shall be kept between 60°F and 100°F (16°C and 38°C). Relative humidity shall be kept between 45% ±10% rh. These conditions apply to the lab and the inlet airstream.

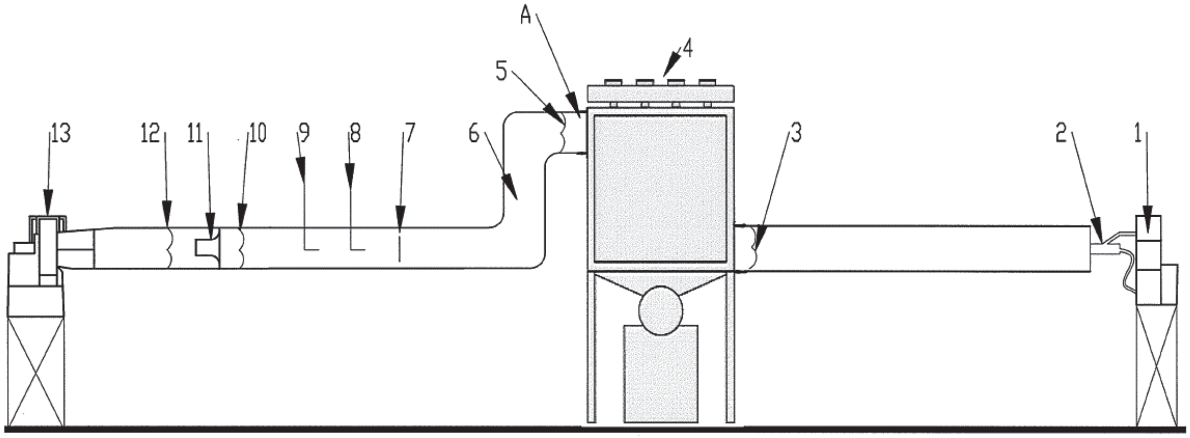

FIGURE 5-1 Schematic showing test setup.

1. Dust feed system
2. Heavy-duty dust injector
3. Collector inlet fitting and inlet piezometer ring
4. Pulse cleaned dust collector (including pulse controls, airlock, and dust bin)
5. Outlet piezometer ring
6. Collector outlet fitting

A. Leak checkpoint (See Section 8.4)

7. Stairmand disk
8. Photometer sampling port
9. Gravimetric sampling port
10. Upstream airflow nozzle piezometer pressure tap (including upstream static pressure)
11. Airflow nozzle
12. Downstream airflow nozzle piezometer pressure tap
13. Blower and associated control system (with optional exit filter)

TABLE 5-1 Required Device Placement Minimums, Stated in Straight Duct Diameters (*D*) [a] where Necessary

Device	Location	Comment
Inlet duct	6*D* upstream of inlet fitting	
Inlet and outlet fittings	Immediately connected to pulse cleaned dust collector	Fittings from duct to device are allowed.
Inlet and outlet piezometer rings	Immediately connected to pulse cleaned dust collector	Constructed per Figure 5-2
Stairmand disk	2*D* downstream of the outlet fitting and 6*D* upstream of the photometric sampling port	If airflow uniformity at the photometric sampling port can be demonstrated without this device, it may be omitted.
Photometric sampling port ***Informative Note:*** No part of the photometric sampling system shall have a cross-stream dimension perpendicular to the photometer sample flow greater than 1% of the square root of the duct cross-sectional area. The inlet area of the isokinetic sampling probe shall be less than 1% of the duct cross-sectional area.	6*D* downstream of the exit of the Stairmand disk and 3*D* upstream of any change in duct cross-section or direction	
Gravimetric sampling port ***Informative Note:*** The gravimetric sampling system shall not block more than 10% of the cross-sectional area of the duct.	2*D* downstream of the photometric sampling port and 1*D* upstream of any change in duct cross-section or direction	
Airflow nozzle	The duct upstream and downstream of the flowmeter shall conform to the requirements in Section 8.1.	Change in duct diameters are allowed to accommodate airflow nozzle.

a. There shall be a minimum of one diameter (1*D*) between any two sampling or measurement devices.

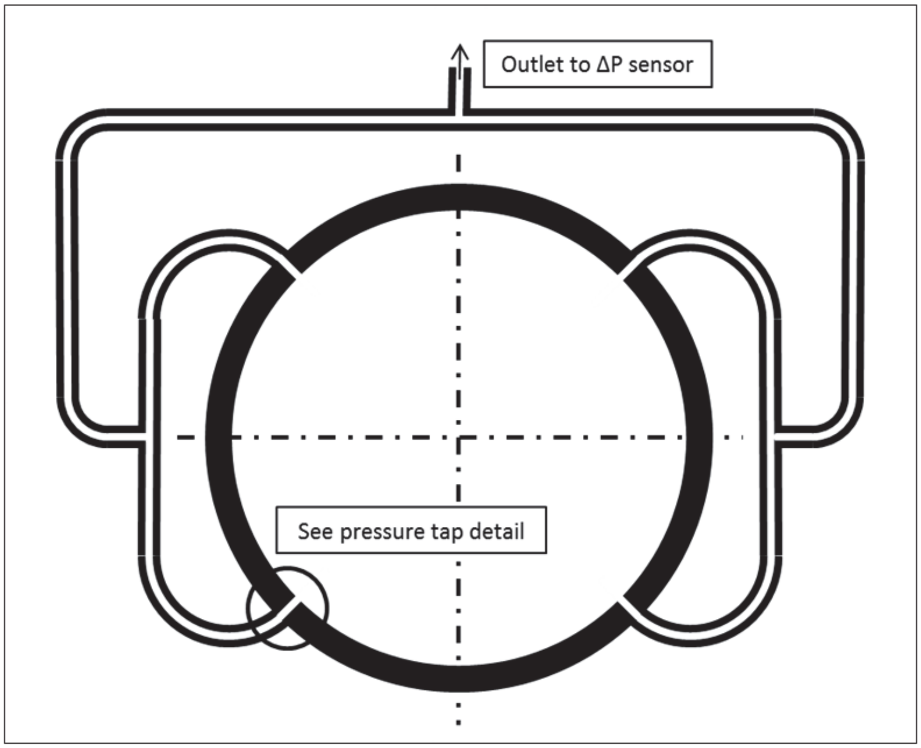

FIGURE 5-2 Typical piezometer ring (see Figure 5-3 for pressure tap requirements).

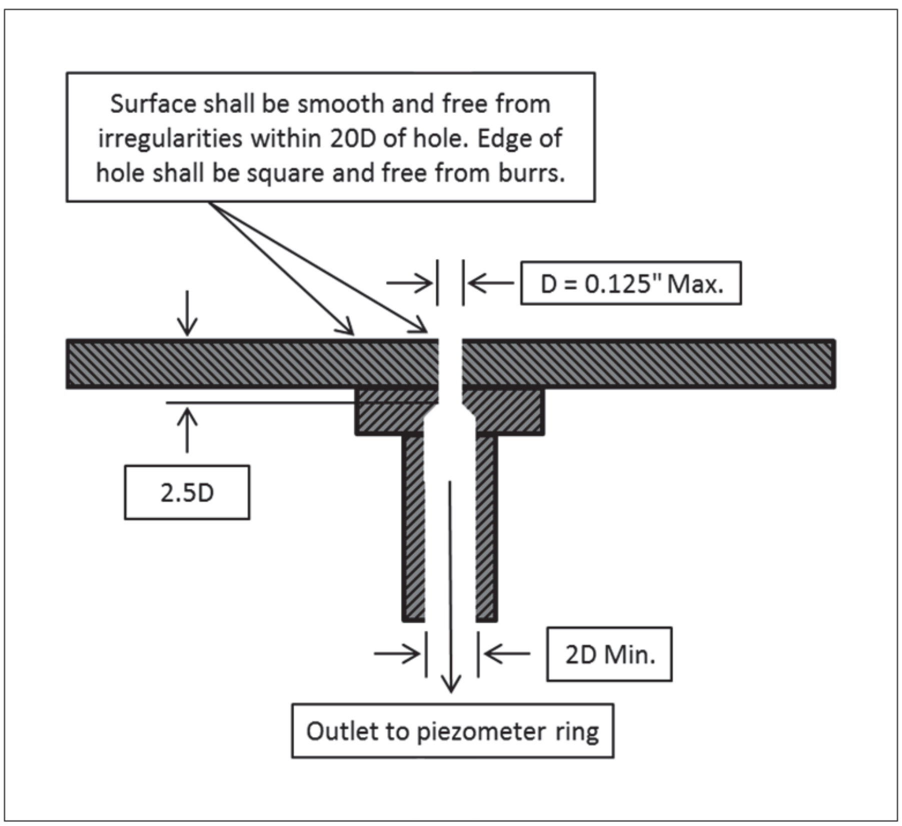

FIGURE 5-3 Piezometer pressure tap detail.

TABLE 5-2 Required Sensors and Minimum Requirements

Sensor	Range	Accuracy	Mechanical Accuracy	Resolution
Pressure (exit filter ΔP)*	0 to 4 in. of water (0 to 10 hPa)	±0.5% FS	±2%	0.1 in. of water (0.25 hPa)
Pressure (filter ΔP)	0 to 20 in. of water (0 to 49.8 hPa)	±0.5% FS	±2%	0.1 in. of water (0.25 hPa)
Pressure (inlet/outlet ΔP)	0 to 20 in. of water (0 to 49.8 hPa)	±0.5% FS	±2%	0.1 in. of water (0.25 hPa)
Pressure (airflow nozzle ΔP)	0 to 20 in. of water (0 to 49.8 hPa)	±0.5% FS	±2%	0.1 in. of water (0.25 hPa)
Pressure (airflow nozzle upstream static)	0 to 20 in. of water (0 to 49.8 hPa)	±0.5% FS	±2%	0.1 in. of water (0.25 hPa)
Pressure (pulse cleaning system)	0 to 150 psi (0 to 10.3 bar)	±0.5% FS	±2% FS	5 psi (0.3 bar)
Temperature	32°F to 212°F (0°C to 100°C)	±1°F (0.56°C)	N/A	0.1°F (0.06°C)
Relative humidity	3 to 95% rh	±2% rh	N/A	0.1% rh
Pressure (barometric)	26 to 32 in. Hg (3.5 to 4.3 kPa)	±0.05% FS	N/A	0.01 in. Hg (0.0013 kPa)
Scale (dust feed)	As needed	1 g	N/A	1 g
Scale (dust feed check)	0 to 2000 g	0.1 g	N/A	0.1 g
Scale (gravimetric)	As needed	0.02 mg	N/A	0.01 mg

* If optional exit filter is used.

6. TEST MATERIALS

6.1 Test Dust. Test dust shall be fine ground calcium carbonate (wet ground marble) with the following typical properties:

$CaCO_3$: 95%
Hegman gage: 6
Moisture: 0.12%
Plus 325 mesh: 0.003%
Particle size: 0.3 to 10 µm range, 3.0 µm median
Specific Gravity: 2.7
Bulk Density: 40lb/ft^3 (641 kg/m^3) loose, 65lb/ft^3 (1041 kg/m^3) packed

Test dust shall be stored in original unopened packaging in the conditions stated in Section 5.6.

6.2 Membrane. The gravimetric sampling shall be conducted on a commercially available ePTFE membrane with maximum 0.45 µm pore size.

6.3 Compressed Air. Compressed air shall be provided by an oil-free compressor with clean plumbing that meets ISO 8573-1 [3] for particulate, humidity, and oil. The air supply to the pulse cleaning system should have sufficient capacity to maintain the specified pulse cleaning system pressure at required pulse frequencies.

7. REQUESTOR DEFINED PARAMETERS

The requestor shall supply the following operating parameters, which shall be recorded on the report:

Specified airflow, acfm (m^3/h)
Pulse cleaning system low/high tubesheet differential pressure setpoints, in. of water (hPa)
Pulse interval, s
Pulse duration, ms
Pulse cleaning system pressure, psi (bar)
Pulse cleaning system volume, ft^3 (L)
Up-set condition limit (if greater than 10 in. of water [24.9 hPa])

8. QUALIFICATION/MAINTENANCE OF TEST SETUP

Table 8-1 contains the system qualification measurement requirements.

TABLE 8-1 System Qualifications

Parameter	Requirement	Interval	Section
Airflow	Meets ASHRAE Standard 41.2 [1]	Annually	8.1
Airflow rate stability	CV < 5%	Annually	8.2
Upstream airflow uniformity	CV < 10%	Each black box change	8.3
Duct leakage	≤1.0%	Each black box change	8.4
System cleanliness	Clean and inspect	Each test	8.4
Compressed air particulate purity	Meets ISO 8573-1 [3], Class 2	Annually	8.8
Compressed air humidity	Meets ISO 8573-1 [3], Class 4	Annually	8.9
Compressed air oil purity	Meets ISO 8573-1 [3], Class 0	Annually	8.10
Dust feed rate	Mean ±5% CV <5%	Each test	8.13
Aerosol photometer	Calibrate to test dust	Annually	8.15
Background check	See Section 8.16	Each test	8.16

8.1 Airflow Rate. Airflow rate shall be measured in accordance with ASHRAE Standard 41.2 [1].

8.2 Airflow Rate Stability. Measure the airflow according to 8.1 at the minimum and maximum airflow rate. Calculate a coefficient of variation (CV) based on 30 samples collected uniformly over 30 min.

8.3 Upstream Airflow Uniformity. The uniformity of the air velocity across the duct cross section shall be determined by a multipoint velocity traverse per ASHRAE Standard 41.2 [1].

A one-minute average velocity shall be recorded at each grid point. The traverse shall be repeated two more times to provide triplicate one-minute averages at each point. The average of the triplicate readings at each point shall be computed. The CV of the multipoint air velocity values shall be less than 10%.

8.4 Duct Leakage. The leak rate of the downstream test duct shall be evaluated in the following manner.

The downstream test duct shall be sealed immediately downstream of the pulse cleaned dust collector outlet (See Figure 5-1, item A) and downstream of the airflow measuring device by bolting a gasketed solid plate to the duct opening or other appropriate means. Carefully exhaust air from the test duct until a minimum of –10 in. of water (–24.9 hPa) is achieved. The airflow rate required to maintain the pressure constant shall be measured and recorded as the leak rate. The measured leak rates shall not exceed 1.0% of the corresponding specified airflow rate.

8.5 System Cleanliness. The pulse cleaned dust collector downstream of the filters and downstream test duct shall be vacuumed, wiped down with wet wipes, and towel dried between tests to eliminate potential dust shedding from the system itself.

8.6 Ambient Air Temperature. Measure the air temperature to within ±1°F (0.56°C) of the actual value using a NIST traceable sensor.

8.7 Ambient Air Relative Humidity. Measure the relative humidity to within ±2% rh of the actual value using a NIST traceable sensor.

8.8 Compressed Air Particulate Purity. Compressed air particulate purity shall be measured in accordance with ISO 8573-4.

8.9 Compressed Air Humidity. Compressed air humidity shall be measured in accordance with ISO 8573-3.

8.10 Compressed Air Oil Purity. Compressed air oil purity shall be measured in accordance with ISO 8573-2.

8.11 Pulse Cleaning System Pressure. Pressure sensor calibration shall be NIST traceable per the manufacturer's recommendations.

8.12 Pressure Transducers. Pressure sensor calibration shall be NIST traceable per the manufacturer's recommendations.

8.13 Dust Feed Rate. The dust feed system shall be validated as follows.

8.13.1 Charge the dust feeder with test dust.

8.13.2 Set specified feed rate.

8.13.3 Start the dust feed system.

8.13.4 Collect dust dispensed for 3 min.

8.13.5 Determine the mass of dust fed using a calibrated scale.

8.13.6 Manually determine feed rate by dividing the mass of dust fed by the elapsed time.

8.13.7 Repeat steps 8.12.4 to 8.12.6 at 5-minute increments for 30 min.

8.13.8 Calculate mean, standard deviation, and CV.

8.14 Dust Dispersion System. Pressure sensor calibration shall be NIST traceable per the manufacturer's recommendations. Visually inspect the nozzle and replace if worn.

8.15 Aerosol Photometer. Photometer shall be calibrated to the test dust per the manufacturer's instructions and set to a time constant of 60 s.

8.16 Background Check. Operate the system for 15 min at specified flow. Then with no filters installed and the system operating at specified flow, take readings from the photometer once per minute for 5 min. Calculate the average PM_{10} readings. Install clean filters and operate the system for 15 min at specified flow. Take readings from the photometer once per minute for 5 min. Calculate the average PM_{10} readings. This average background PM_{10} reading with filters installed shall be a minimum of 3 orders of magnitude less than the average PM_{10} reading without filters installed; otherwise, investigate and resolve the source of the high reading and repeat the background check.

9. TEST PROCEDURE

9.1 Initial Baseline Measurements

9.1.1 Measure the Pulse Duration

9.1.1.1 Measure the pulse duration electrical signal using an oscilloscope for each output from the pulse cleaning system.

9.1.1.2 Report requestor-stated pulse duration and actual measured pulse duration.

9.1.2 With the pulse cleaning system in continuous cleaning mode, measure the pulse interval.

9.1.2.1 Measure one complete cleaning cycle using a stopwatch.

9.1.2.2 Divide the total elapsed time by the number of valves pulsed to obtain pulse interval.

9.1.2.3 Report the requestor-stated interval and actual interval.

9.1.3 Measure the compressed air consumption resulting from activating a single pulse valve.

9.1.3.1 Compressed air supply to the requestor's pulse cleaning system shall be connected by a leak-free shut-off valve and pressure sensor of appropriate scale to match the requestor's pressure and flow requirements. This sensor shall be located between the shut-off valve and the compressed air supply connection of the pulse cleaning system.

9.1.3.1.1 The volume of all components of the pulse cleaning system, such as piping connecting the header tank to each pulse valve and all pilot valve air lines, must be included in the pulse cleaning system volume value. If additional volume is added to the pulse cleaning system due to laboratory installation needs (plumbing, etc.), this extra volume shall be added to the cleaning system volume supplied by the requestor.

9.1.3.2 After the pulse cleaning system is pressurized, the shut-off valve shall be closed and the pressure recorded 30 s after pressurization.

Informative Note: The 30 s dwell time allows for temperature equilibration, thereby stabilizing the pressure reading. If the pressure does not stabilize, a leak may be present.

9.1.3.3 With the shut-off valve closed, pulse one valve of the collector once using the controls of the dust collector. The resulting cleaning system pressure shall be recorded 30 s after the pulse occurs.

9.1.3.4 The volume of air used shall be calculated by multiplying the total pulse cleaning system volume (V_T), calculated in the step 9.1.3.1.1, by the difference in the pressure as measured in Sections 9.1.3.2 and 9.1.3.3 and dividing by 14.7 psi (1 bar). For this standard, the pulse volume will be calculated from the following:

$$Q = \frac{\text{Volume}}{\text{Pulse}} = V_T \times (P_I - P_F)/14.7 \qquad (9\text{-}1)$$

where V is in ft^3 and P is in psi.

If actual compressed air temperature is outside the lab condition temperature range (60°F to 100°F [15.6°C to 37.8°C]), the calculated volume shall be corrected to 70°F (21.1°C) by multiplying the result obtained by the ratios of absolute temperatures. For example, if the temperature of the pulse cleaning system compressed air is 115°F (46.1°C):

$$Q_{Corrected} = Q\frac{(460°\text{F} + 70°\text{F})}{460°\text{F} + 115°\text{F}} = 0.92Q \qquad (9\text{-}2)$$

$$Q_{Corrected} = Q\frac{(237.8°\text{C} + 21.1°\text{C})}{(237.8°\text{C} + 46.1°\text{C})} = 0.92Q$$

9.1.3.5 Steps 9.1.3.2 through 9.1.3.4 shall be repeated for each valve on the pulse cleaning system.

The average air volume shall be calculated from all values collected in step 9.1.3.5 and recorded as standard cubic feet per pulse. This value shall be used to determine compressed air usage on continuous cleaning and on-demand cleaning.

9.1.4 Measure differential pressures versus airflow.

9.1.4.1 With elements installed, measure system differential pressure from inlet piezometer to outlet piezometer and tubesheet differential pressure across the tubesheet, with lab-supplied pressure transducers, in the following manner: 25%, 50%, 75%, 100%, 125%, 100%, 75%, 50%, and 25% of specified airflow.

9.1.5 At specified airflow, measure the downstream photometer values as a baseline.

9.1.5.1 Take readings from the photometer once per minute for 5 min.

9.1.5.2 Calculate the average PM1, PM2.5, and PM10 values to be used in Section 10.6.

9.2 Stage 1: Initial Dust Loading

9.2.1 Set the pulse cleaning system to requestor's low and high tubesheet differential pressure setpoints, and start pulse cleaning system on-demand.

9.2.2 Start airflow.

9.2.3 Measure and record operating parameters a minimum of once every 10 s (elapsed time, airflow rate, tubesheet differential pressure, temperature, relative humidity, barometric pressure, and dust fed) for Sections 9.2 through 9.7.

9.2.4 Once specified airflow is established, it shall be maintained through Section 9.7.

9.2.5 Begin gravimetric and photometric sampling. Continue through the initial dust loading with on-demand cleaning.

9.2.6 Begin dust loading at a concentration of 1.0 gr/ft^3 (2.28 g/m^3).

9.2.7 Begin recording total dust fed from this point forward.

9.2.8 Continue dust loading until differential pressure reaches requestor's specified tubesheet high differential pressure setpoint.

9.2.9 Record total dust fed during initial dust loading.

9.3 Stage 2: Initial Dust Loading with On-Demand Cleaning

9.3.1 Maintain airflow and dust feed rate from initial dust loading.

9.3.2 Continue the test until one of the first of the following conditions occur.

9.3.2.1 The initial dust loading with on-demand cleaning time reaches 4 h.

9.3.2.2 The pulse system cannot satisfy the preset low tubesheet differential pressure across the media (if this condition exists, continue pulsing until the low differential pressure does not drop below halfway between the low and high setpoints).

9.3.3 Maintain airflow and pause dust feed and pulse cleaning systems.

9.3.4 Remove gravimetric sampling membrane and replace with clean membrane for the step in Section 9.4.3.

9.3.5 Record photometer time-weighted average, and reset photometer for the step in Section 9.4.3.

9.3.6 Record the total dust fed and time of each pulse during initial dust loading with on-demand cleaning.

9.4 Stage 3: Dust Loading with Continuous Cleaning

9.4.1 Set the pulse cleaning system to operate continuously at the preset pulse interval.

9.4.2 Maintaining airflow from the initial dust loading with on-demand cleaning, restart dust feed and pulse cleaning systems.

9.4.3 Begin gravimetric and photometric sampling; continue throughout the dust loading with continuous cleaning.

9.4.4 Continue the test until one of the first of the following conditions occur.

9.4.4.1 The dust loading with continuous cleaning time reaches 24 h.

9.4.4.2 The tubesheet differential pressure reaches the maximum as specified by the requestor.

9.4.5 Maintain airflow and pause dust feed and pulse cleaning systems.

9.4.6 Remove gravimetric sampling membrane and replace with the clean membrane from step 9.5.3.

9.4.7 Record photometer time-weighted average and reset photometer for step 9.5.3.

9.4.8 Record the total dust fed and time of each pulse during dust loading with continuous cleaning.

9.5 Stage 4: Final Dust Loading with On-Demand Cleaning

9.5.1 Set the pulse cleaning system to requestor's low and high tubesheet differential pressure across the tubesheet, and start the pulse cleaning system on-demand.

9.5.2 Maintaining airflow from dust loading with continuous cleaning, restart the dust feed and pulse cleaning systems.

9.5.3 Begin gravimetric and photometric sampling; continue throughout the final dust loading with on-demand cleaning.

9.5.4 Continue the test until one of the first of the following conditions occur.

9.5.4.1 The final dust loading with on-demand cleaning time reaches 20 h.

9.5.4.2 The pulse cleaning system cannot satisfy the preset low tubesheet differential pressure across the media. If this condition exists, continue pulsing until the low differential pressure does not drop below halfway between the low and high setpoints.

9.5.5 Maintain airflow and pause dust feed and pulse cleaning systems.

9.5.6 Remove gravimetric sampling membrane.

9.5.7 Record the photometer time-weighted average, and reset the photometer for step 9.6.2.

9.5.8 Record the total dust fed and time of each pulse during final dust loading with on-demand cleaning.

9.6 Stage 5: Up-Set Condition

9.6.1 Maintaining airflow from final dust loading with on-demand cleaning, restart dust feed and pulse cleaning systems.

9.6.2 Begin photometric sampling; continue throughout the up-set condition.

Informative Note: These photometric data are solely for monitoring integrity of filters or to detect filter failure.

9.6.3 Shut off pulse cleaning system.

9.6.4 Continue dust feed until tubesheet differential pressure reaches 10 in. of water (24.9 hPa) or as specified by requestor (whichever is greater).

9.6.5 Turn off the dust feeder.

9.6.6 Record the total dust fed during up-set condition.

9.7 Stage 6: Post Up-Set Condition

9.7.1 Reduce to 25% of specified airflow.

9.7.2 Turn on pulse cleaning system to continuous pulsing and continue until each filter element has been pulse cleaned 10 times.

9.7.3 Return airflow to 100% of specified airflow.

9.7.4 Record tubesheet differential pressure upon return from up-set condition.

9.7.5 Record photometer time-weighted average and reset photometer for step 9.7.7.

9.7.6 Turn on dust feed and start the pulse cleaning system on-demand.

9.7.7 Begin photometric sampling; continue throughout the post up-set condition.

9.7.8 Continue for a minimum of one complete cleaning cycle.

9.7.9 Record the photometer time-weighted average.

10. DATA REDUCTION AND CALCULATIONS

10.1 Differential Pressure Versus Airflow

10.1.1 Correct resulting value for barometric pressure and temperature per Normative Annex A.

10.2 Differential Pressure

10.2.1 Performance Summary Differential Pressure Average

10.2.1.1 Calculate the average tubesheet differential pressure measured during the last four hours of Stage 4:

$$\Delta P_{4a} = \frac{\sum_1^n \Delta P}{n} \tag{10-1}$$

where ΔP is the tubesheet differential pressure measured during one measurement interval and n is the total number of measurements taken during the last four hours of Stage 4 (4*a*).

10.3 Dust Fed

10.3.1 Dust Fed per Stage

10.3.1.1 Subtract the ending weight from the beginning weight for each stage.

10.3.1.2 Divide the dust fed by the total time to obtain the average dust feed rate.

10.3.2 Total Dust Fed

10.3.2.1 Sum dust fed per each stage.

10.4 Compressed Air Consumption

10.4.1 Compressed Air Consumption per Stage

10.4.1.1 Multiply number of pulses per stage by compressed air volume per pulse and divide by the total time per stage to obtain the compressed air flow rate.

10.4.2 Performance Summary Compressed Air Consumption

10.4.2.1 Calculate the compressed air consumption during the last four hours of Stage 4 (Q_{4a}, expressed as a ratio of cubic feet [litres] of compressed air used over cubic feet [litres] of cleaned air)

$$Q_{4a} = \frac{(n \times Q)}{(\mathrm{AF} \times 60\ \mathrm{min}) \times (1\ \mathrm{h} \times 4\ \mathrm{h})} \tag{10-2}$$

were n is the total number of pulses during the last four hours of Stage 4, Q is the average compressed air consumption per pulse (in ft^3) calculated in Section 9.1.3, and AF is the actual airflow of the unit during the last four hours of Stage 4.

10.4.3 Stage 4 Compressed Air Consumption

10.4.3.1 Calculate the cumulative compressed air consumption of Stage 4 by multiplying the cumulative number of pulses by the compressed air volume per pulse as a function of time.

10.4.3.2 Graph cumulative compressed air consumption versus time.

10.5 Gravimetric Efficiency

10.5.1 Calculate the average upstream concentration in initial dust loading with on-demand cleaning stage:

$$C_{Upstream} = \frac{M_{DustFed}}{Q_{System} T_{Stage}} \tag{10-3}$$

where $M_{DustFed}$ is the total dust fed for the stage, Q_{System} is average airflow rate, and T_{Stage} is elapsed time for the stage.

10.5.2 Calculate the downstream concentration:

$$C_{Downstream} = \frac{M_{Sample}}{Q_{Sample} T_{Sample}} \tag{10-4}$$

where M_{Sample} is the mass increase of the gravimetric sample, Q_{Sample} is the isokinetic sample flow rate, and T_{Sample} is the elapsed time for the gravimetric sample.

10.5.3 Calculate the penetration by dividing the value from Section 10.5.2 by the value from Section 10.5.1:

$$P = \frac{C_{Downsream}}{C_{Upstream}} \times 100 \tag{10-5}$$

10.5.4 Calculate the gravimetric efficiency by subtracting one minus the penetration.

$$E = 100\% - P \tag{10-6}$$

10.5.4.1 If the mass increase is nondetectable, or if the calculated efficiency is greater than 99.99%, then you shall report ">99.99%".

10.5.5 Repeat steps 10.5.1 to 10.5.4 for dust loading with continuous cleaning and final dust loading with on-demand cleaning.

10.6 Photometric Data

10.6.1 For each required photometric time-weighted average report PM_1, $PM_{2.5}$, and PM_{10}.

10.6.2 Graph PM_1, $PM_{2.5}$, and PM_{10} as a function of time for the duration of the test.

10.6.3 Performance Summary Emissions

10.6.3.1 Calculate the average PM_{10} emissions during the last four hours of Stage 4 (4*a*):

$$E_{4a} = \frac{\sum_1^n e}{n} \tag{10-7}$$

where e is the emission measurement taken during one measurement interval and n is the total number of emission measurements taken during the last four hours of Stage 4.

11. REPORTING SPECIFICS

11.1 Report Template

11.1.1 The report shall use the attached data template with all fields completed. Figure 11-1 shows the required reporting format.

11.2 Deviations

11.2.1 If testing deviates in any way from this protocol, the report header shall be marked as modified with a supporting description of the deviation.

11.2.2 Any data field reporting nonstandard information shall be highlighted in red and marked with an asterisk (*).

12. NORMATIVE REFERENCES

1. ANSI/ASHRAE Standard 41.2-1987 (RA 1992), *Standard Methods for Laboratory Measurement*. ASHRAE, Atlanta, GA.

ISO 5011, *Inlet air cleaning equipment for internal combustion engines and compressors - Performance testing*

ISO 8573-1:2010, *Compressed air – Part 1: Contaminants and purity classes*

ISO 8573-2, *Compressed air – Part 2: Test methods for oil aerosol content*

ISO 8573-3, *Compressed air – Part 3: Test methods for measurement of humidity*

ISO 8573-4, *Compressed air – Part 4: Test methods for solid particle content*

National Primary and Secondary Ambient Air Quality Standards, Code of Federal Regulations, Title 40 Part 50 (40 CFR 50), as amended July 30, 2004 and Oct. 17, 2006. U.S. Environmental Protection Agency. www.epa.gov/air/criteria.html, accessed June 20, 2008.

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Requestor Information	
Requestor	

Device Under Test - Test Conditions			
Pulse Cleaned Dust Collector Information		**Filter Information**	
Manufacturer		Manufacturer	
Product Name		Product Name	
Tested Airflow (CFM)		Part Number	

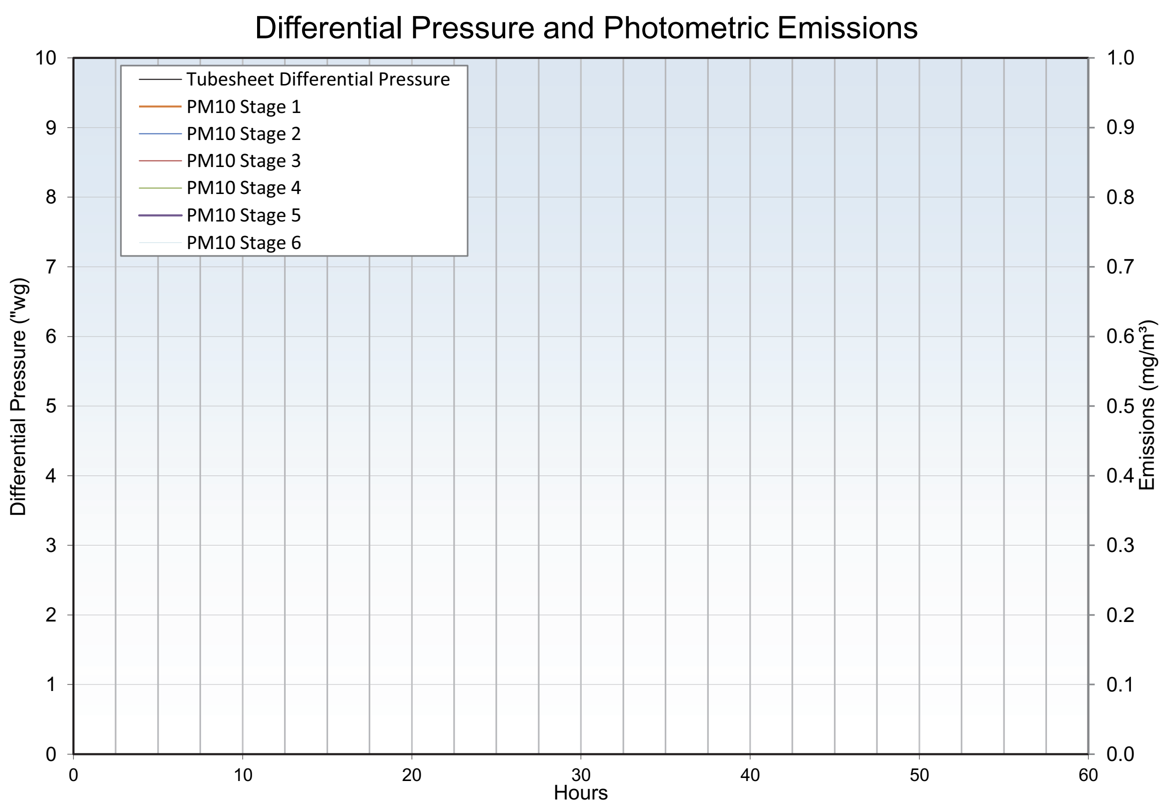
Performance Summary (Last 4 hours of Stage 4)		
Emissions[1] (mg/m³)	**Differential Pressure Average[2] ("wg)**	**Air Consumption[3] (ft³/1000ft³)**

[1]Average PM_{10} emissions

[2]Average of tubesheet differential pressure

[3]Compressed air usage rate (cubic feet of compressed air per 1000 cubic feet of cleaned air)

Full Test Summary



Disclaimer: Actual dust collector performance may vary depending upon multiple factors. See page three for full details.

FIGURE 11-1 Report template (page 1).

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Requestor Information	
Company	
Address	
Phone Number	
Contact & Email	

Device Under Test

Collector Information				Filter Information	
Manufacturer				Manufacturer	
Serial Number				Part Number	
Product Name				Product Name	
Pulse Clean System (PCS) Information				Media Type	
No. Pulse Valves		Valves Pulse/cycle		Media Area (ft²)	
PCS Volume (ft³)		Stated Interval (min)		No. of Filters	
Initial PCS Pressure (PSI)		Actual Interval (min)		Additional Info	
Post Pulse PCS Pressure (PSI)		Stated Duration (ms)			
Compressed Air/Pulse (ft³)		Actual Duration (ms)			
Compressed Air/cycle (ft³)					

Test Conditions

Ambient Lab Conditions				Requestor Variables - Set by Customer	
Temperature (min|max|avg) (°F)				Tested Airflow (CFM)	
Rel. Humidity (min|max|avg) (%RH)				High / Low Set Points ("wg)	
Baro. Pressure (min|max|avg) ("Hg)				Up-Set Max ΔP ("wg)	
Test Dust					
Calcium Carbonate				Concentration (grain/ft³)	1

Test Results

	Initial Dust Loading	Initial On-Demand Cleaning	Continuous Cleaning	Final On-Demand Cleaning	Up-Set Condition	Post Up-Set Condition
Stage	**1**	**2**	**3**	**4**	**5**	**6**
Duration (hrs)						
Dust Fed (lbs)						
No. of Pulses	-				-	
Total Air Usage (ft³)	-	0	0	0	-	0
Gravimetric Eff. (%)						-
PM_{10} Avg (mg/m³)						
$PM_{2.5}$ Avg (mg/m³)						
PM_1 Avg (mg/m³)						

Cumulative Data		Filter ΔP Data	
Total Test Duration (hrs)	0.0	Initial Filter ΔP ("wg)	
Total Dust Fed (lbs)	0.0	Avg. Pressure ("wg) Stage 3	
Total Number of Pulses	0		

FIGURE 11-1 (cont.) Report template (page 2).

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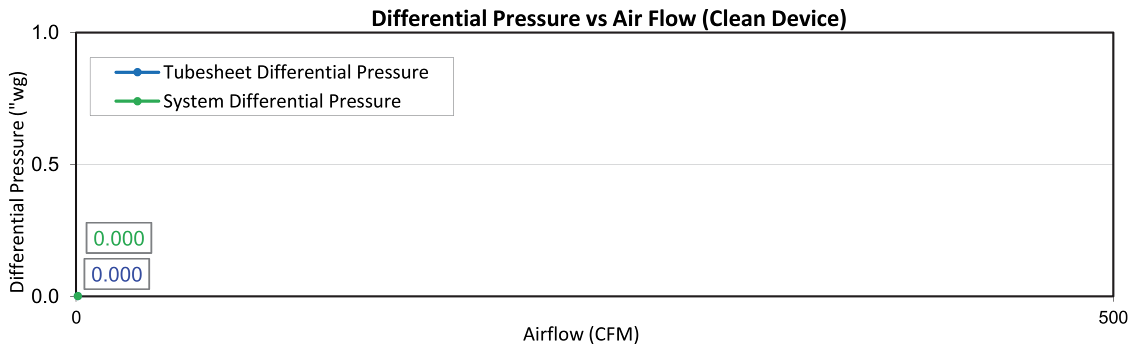

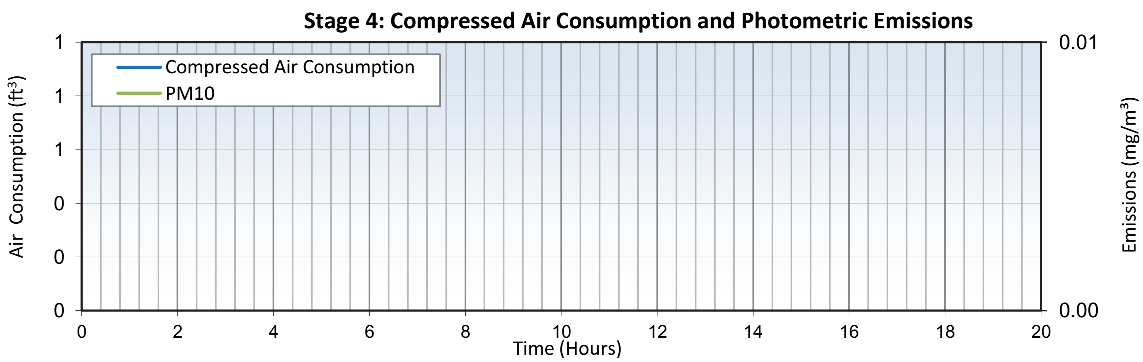

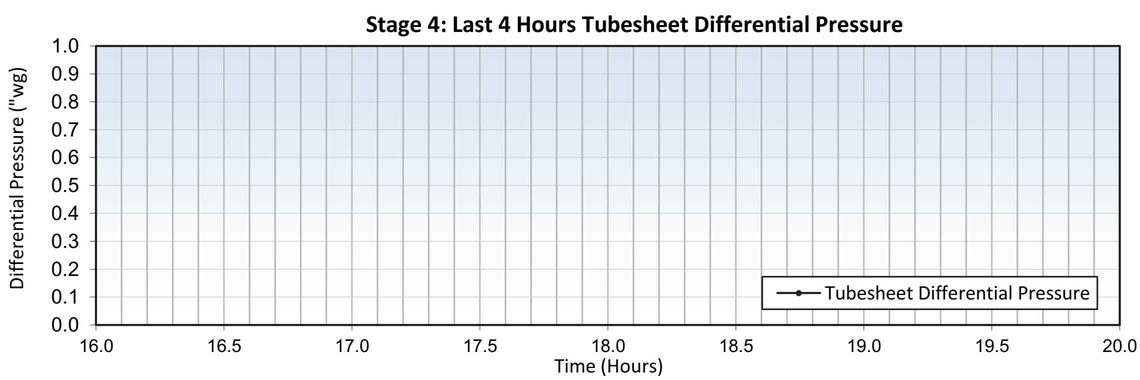

Comments

FIGURE 11-1 (cont.) Report template (page 3).

(This is a normative annex and is part of the standard.)

NORMATIVE ANNEX A
DIFFERENTIAL PRESSURE DATA CORRECTION

The differential pressure across the tubesheet shall not be corrected for ambient conditions.

The system differential pressure as measured in Section 9.1.4 shall be corrected for ambient conditions per the following procedure.

If the temperature and pressure at the inlet piezometer of the filter under test differ from the standard conditions of 70°F and 29.92 in. Hg (21°C and 1 bar), then the measured differential pressure shall be corrected to indicate the differential pressure that would be measured if the conditions were standard.

Informative Note: This correction to the differential pressure of the pulse cleaned dust collector is independent of the corrections required for the airflow rate measurement device that are required to establish the correct actual volume airflow rate at the inlet of a pulse cleaned dust collector under test.

Measure the dust collector differential pressure ΔP as a function of volume flow rate Q. Plot the measured differential pressure (ΔP_m) as a function of the measured flow rate (Q_m). Note that in this test method, Q_m is the actual volume airflow rate at the filter at the test conditions. Find K_1 and K_2 by performing a least-squares curve fit of Equation A-1 to the data.

$$\Delta P_m = K_1 \times \eta_m \times Q_m + K_2 \times \rho_m \times Q_m^2 \qquad \text{(A-1)}$$

where η_m and ρ_m are the dynamic viscosity and mass density of air in the unit at the test conditions, respectively. Subscript m refers to measured values or conditions at the device under test during the measurement.

Use Equation A-2 to calculate the standard filter differential pressure (P_s) at the specified airflow rate in the range of airflow rates measured. Extrapolation to airflow rates outside of the measured range is not permitted.

$$\Delta P_s = K_1 \times \eta_s \times Q_s + K_2 \times \rho_s \times Q_s^2 \qquad \text{(A-2)}$$

where η_s and ρ_s are the dynamic viscosity and mass density of air at standard conditions, respectively. Q_s is the airflow at standard conditions. Subscript s refers to standard conditions.

(This annex is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

INFORMATIVE ANNEX B COMMENTARY

B1. OUTLET EXIT FILTER

While not required by the standard for performance evaluation, a good laboratory setup typically employs exit filtration in the overall test duct. Placed directly upstream of the fan, exit filtration prevents any unforeseen or unplanned failure from spreading beyond the test into the laboratory space. This helps keep the lab space from accumulating dust over time as naturally happens in this type of testing. This prevents the unexpected filter breach from contaminating the entire lab space as well. Due to the high volumetric airflow required for this test, multiple exit filters mounted in parallel may be necessary, with expansion and contraction transitions mounted directly upstream and downstream. Typical laboratory setups use a HEPA filter.

B2. REQUIREMENT OF 25% MAXIMUM OF FILTER MEDIA CLEANED

Following the protocol set by the initial research project for this standard (ASHRAE RP-1284), a maximum of 25% of filter media cleaned during any pulse cleaning event was specified. This parameter results from the understanding that the vast majority of products and applications use four element dust collectors (or larger). Certain products and applications do use systems that do not meet this criteria. If it is desired to test these systems, this method of testing can still be used, provided the reporting documentation stipulates that this is a modified ASHRAE Standard 199 test.

B3. PULSE CONTROL SYSTEM

Typical pulse control systems are set up to pulse on time or pressure, with no automatic adjustments. Pulse control systems that use feedback loops to adjust cleaning parameters are being introduced to the market. This standard does not address the use of these new technologies. Tests conducted with these control systems can still be used, provided the reporting documentation stipulates that this is a modified ASHRAE Standard 199 test.

B4. EMISSION MEASUREMENTS

Efficiency measurement by particle counter was originally part of ASHRAE RP-1284. The committee elected to use aerosol photometers as a more economical and practical measurement technology to capture emission data. This decision does not preclude the use of particle counters in addition to the specified instruments.

B4.1 Photometric Monitoring. Photometric sampling of the various stages, with specific reporting of PM_1, $PM_{2.5}$, and PM_{10} data is a requirement of this standard. It is also a good practice to monitor this equipment to provide advance (or real-time) information that could indicate a leak, filter failure, or some other issue with the test setup. Typically, this would manifest in a higher than expected downstream concentration. In the event that this is noticed, the test can then be shut down before a more catastrophic failure is realized, and the issue investigated. Please note, however, that stoppage of the test is not allowed per the standard, so any further data collected will fall under the category of a modified ASHRAE Standard 199 test. This requires that the report be marked as modified as per Section 11.2.

B5. USE OF OTHER TEST DUSTS

An official ASHRAE Standard 199 test shall use the test dust specified in Section 6.1. A requestor may wish to follow the ASHRAE Standard 199 method, substituting another test dust should that dust more closely resemble what is seen in the target market, be useful in the development process, or for some other reason. This modification requires that the report is marked as modified as per Section 11.2.

B6. COMPRESSED AIR CLEANLINESS

Industrial dust collectors with dust cakes are very efficient air filters. Laboratory gravimetric efficiencies in the range of 99.999% to 99.9999% or higher are possible. In this case, measuring the efficiency of dust collectors in this test procedure is much like measuring the efficiency of ULPA filters. Even small amounts of contamination in the airstream downstream of the dust collector will affect the measured efficiency.

The compressed air used to pulse clean the filters is introduced downstream of the filters. Contamination in the compressed air then affects the ability to measure the true efficiency of the dust collector. The compressed air cleanliness requirements in this standard were calculated to ensure that the contamination from compressed air is less than 10% of the material penetrating a dust collector operating at 99.9999% efficiency and relatively high compressed airflow.

B7. DUCT LEAKAGE

Contamination in the downstream plenum and downstream duct work due to leakage may contribute to the efficiency measurements. These sections of the test system must be sealed.

B8. SYSTEM CLEANLINESS

Contamination in the downstream plenum and downstream duct work may contribute to the efficiency measurements. These sections of the test system must be cleaned prior to the beginning of a test.

B9. SUMMARY OF TEST STAGES

Table B-1 shows the test stages and the parameters associated for easy reference.

TABLE B-1 Summary of Test Stages

Stage	Stage Name	Airflow	Dust Feed	Pulse Cleaning	Gravimetric Efficiency	Photometric Emission[a]
	Baseline measurements	Varies	No	Manual	No	No
1	Initial dust loading	Specified	Yes	No[b]	Yes, Sample 1	
2	Initial dust loading with on-demand cleaning	Specified	Yes	On demand	Yes, Sample 1	Yes, Sample 1
3	Dust loading with continuous cleaning	Specified	Yes	Continuous	Yes, Sample 2	Yes, Sample 2
4	Final dust loading with on-demand cleaning	Specified	Yes	On demand	Yes, Sample 3	Yes, Sample 3
5	Up-set condition	Specified	Yes	No	No	Monitor only
6	Post up-set condition (a)	25% of specified	No	Continuous for 10 cycles	No	Monitor only
	Post up-set condition (b)	Specified	No	No	No	Monitor only
	Post up-set condition (c)	Specified	Yes	Minimum of 1 cycle	No	Yes, Sample 4

a. Photometric concentration is measured throughout the test sequence with a one-minute time constant. The photometric time-weighted average concentrations are recorded for the specified portions of the test sequence.
b. On-demand cleaning may be actuated; this is simply the time before the first cleaning cycle is automatically initiated.

B10. MANDATORY REPORTING

B10.1 Report Template. Figures B-1, B-2, and B-3 show an example of a completed test report.

B10.2 Performance Summary. The performance summary gives a snapshot of the pulse cleaned dust collector once the device has reached a steady state of operation, allowing for comparisons between test results. Air consumption gives a value of the rate of compressed air use (cubic feet [litres] of compressed air per 1000 cubic feet [litres] of cleaned air) for the unit during the last four hours of Stage 4. The calculated compressed air used during the last four hours of Stage 4 is divided by the airflow and time (4 h), yielding a dimensionless value.

A future consideration for this standard may be the inclusion of a differential pressure stability number. While as yet undefined, it may be valuable to quantify the rate of change of differential pressure performance during Stage 4. In general, this would be the slope taken from a linear curve fit of the tubesheet differential pressure measured during the last four hours of Stage 4. This parameter would then represent the tendency of the differential pressure to remain stable over time. A perfectly stable unit would have a stability of 0, and a worst case performing unit would have a stability of infinity. A lower stability number would represent a system that would be expected to have a longer useful life.

B10.3 Modifications to the Test Method. Variations of this standard may be requested for a variety of different reasons, such as development work. Any variation from the full test standard shall be marked as modified as per Section 11.2.

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Requestor Information

Requestor	ASHRAE 199 Review Committee

Device Under Test - Test Conditions

Pulse Cleaned Dust Collector Information		Filter Information	
Manufacturer	Equipment Manufacturer	Manufacturer	Sample
Product Name	Equipment Product Name	Product Name	Canister
Tested Airflow (CFM)	1760	Part Number	Sample PN

Performance Summary (Last 4 hours of Stage 4)

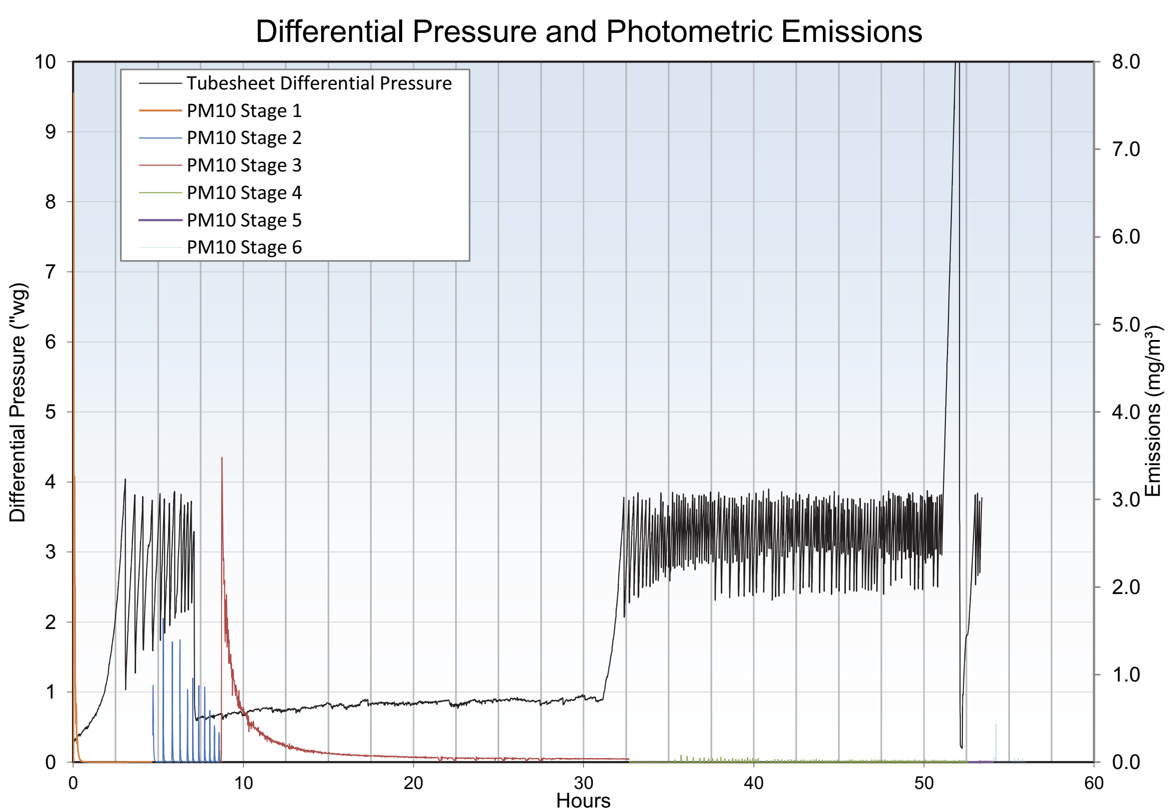
Emissions[1] (mg/m^3)	Differential Pressure Average[2] ("wg)	Air Consumption[3] ($ft^3/1000ft^3$)
Not Available	**3.14**	**0.078**

[1]Average PM_{10} emissions

[2]Average of tubesheet differential pressure

[3]Compressed air usage rate (cubic feet of compressed air per 1000 cubic feet of cleaned air)

Full Test Summary



Disclaimer: Actual dust collector performance may vary depending upon multiple factors. See page three for full details.

FIGURE B-1 Example of completed test report (page 1).

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Company Address		

Requestor Information

Company	Your Company Name
Address	Your Address
Phone Number	Your Phone Number
Contact & Email	ASHRAE 199 Review Committee / Your e-mail

Device Under Test

Collector Information		Filter Information	
Manufacturer	Equipment Manufacturer	Manufacturer	Sample
Serial Number	146577-001-1	Part Number	Sample PN
Product Name	Equipment Product Name	Product Name	Canister
		Media Type	Synthetic

Pulse Clean System (PCS) Information

No. Pulse Valves	4	Valves Pulse/cycle	4	Media Area (ft²)	256
PCS Volume (ft³)	0.18	Stated Interval (min)	1	No. of Filters	4
Initial PCS Pressure (PSI)	100	Actual Interval (min)	1	Additional Info	ASHRAE 199 Test run #2
Post Pulse PCS Pressure (PSI)	40	Stated Duration (ms)	150		
Compressed Air/Pulse (ft³)	0.73	Actual Duration (ms)	100		
Compressed Air/cycle (ft³)	2.92				

Test Conditions

Ambient Lab Conditions				Requestor Variables - Set by Customer	
Temperature (min|max|avg) (°F)	70.0	90.0	86.9	Tested Airflow (CFM)	1760
Rel. Humidity (min|max|avg) (%RH)	39.0	52.0	42.5	High / Low Set Points ("wg)	2.5 / 3.75
Baro. Pressure (min|max|avg) ("Hg)	2.53	29.74	29.56	Up-Set Max ΔP ("wg)	10

Test Dust

Calcium Carbonate	Concentration (grain/ft³)	1

Test Results

	Initial Dust Loading	Initial On-Demand Cleaning	Continuous Cleaning	Final On-Demand Cleaning	Up-Set Condition	Post Up-Set Condition
Stage	**1**	**2**	**3**	**4**	**5**	**6**
Duration (hrs)	3.08	4.00	24.00	20.73	1.02	1.30
Dust Fed (lbs)	46.50	60.32	361.91	312.65	15.33	17.59
No. of Pulses	-	8	86400	149	-	41
Total Air Usage (ft³)	-	6	63032	109	-	30
Gravimetric Eff. (%)	88.27%		98.83%	99.41%	99.41%	-
PM_{10} Avg (mg/m³)	0.122	0.070	0.151	0.003	0.001	0.010
$PM_{2.5}$ Avg (mg/m³)	0.122	0.070	0.151	0.003	0.001	0.010
PM_1 Avg (mg/m³)	0.122	0.070	0.151	0.003	0.001	0.010

Cumulative Data		Filter ΔP Data	
Total Test Duration (hrs)	54.1	Initial Filter ΔP ("wg)	0.29
Total Dust Fed (lbs)	814.3	Avg. Pressure ("wg) Stage 3	0.91
Total Number of Pulses	86598		

FIGURE B-1 Example of completed test report (page 2).

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Company Address		Date:	Page:
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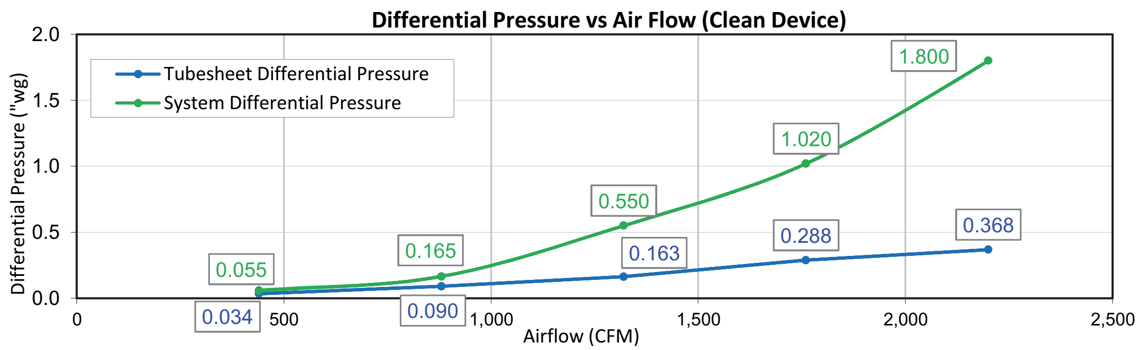

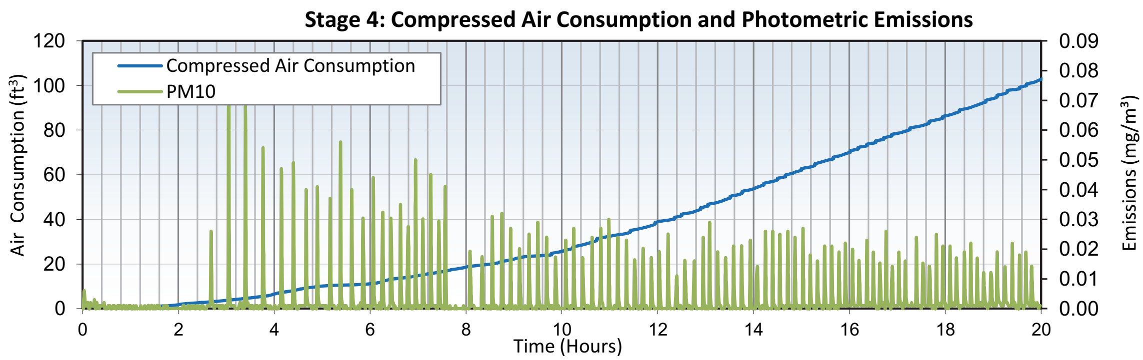

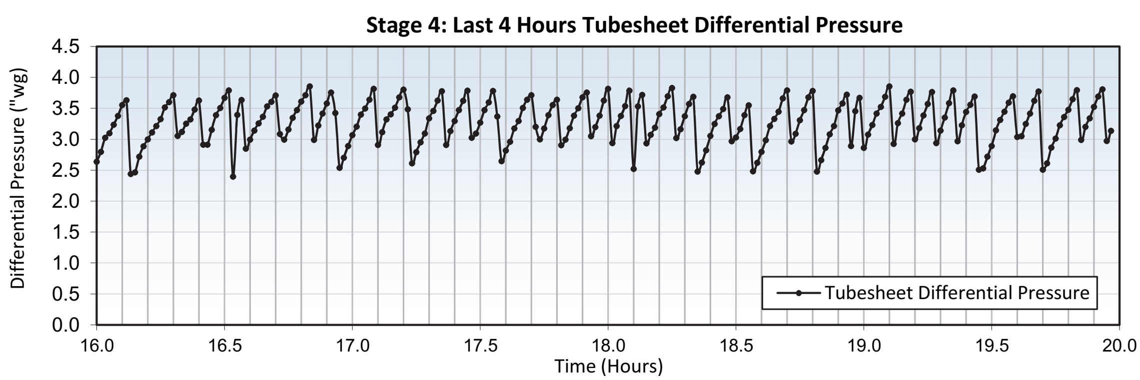

Comments

FIGURE B-1 Example of completed test report (page 3).

(This annex is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

INFORMATIVE ANNEX C
BIBLIOGRAPHY

ASHRAE. 2012. ASHRAE Standard 52.2, *Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size.* Atlanta: ASHRAE.

Burkhead, R., and C. Rose. 2010. Develop a Standard for Testing and Stating the Efficiency of Industrial Pulse Cleaned Dust Collectors. ASHRAE Research Project (RP) 1284 final report. Atlanta: ASHRAE.

POLICY STATEMENT DEFINING ASHRAE'S CONCERN FOR THE ENVIRONMENTAL IMPACT OF ITS ACTIVITIES

ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted Standards and the practical state of the art.

ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the Standards and Guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive Technical Committee structure, continue to generate up-to-date Standards and Guidelines where appropriate and adopt, recommend, and promote those new and revised Standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date Standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating Standards and Guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.

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About ASHRAE

ASHRAE, founded in 1894, is a global society advancing human well-being through sustainable technology for the built environment. The Society and its members focus on building systems, energy efficiency, indoor air quality, refrigeration, and sustainability. Through research, Standards writing, publishing, certification and continuing education, ASHRAE shapes tomorrow's built environment today.

For more information or to become a member of ASHRAE, visit www.ashrae.org.

To stay current with this and other ASHRAE Standards and Guidelines, visit www.ashrae.org/standards.

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ASHRAE offers its Standards and Guidelines in print, as immediately downloadable PDFs, on CD-ROM, and via ASHRAE Digital Collections, which provides online access with automatic updates as well as historical versions of publications. Selected Standards and Guidelines are also offered in redline versions that indicate the changes made between the active Standard or Guideline and its previous version. For more information, visit the Standards and Guidelines section of the ASHRAE Bookstore at www.ashrae.org/bookstore.

IMPORTANT NOTICES ABOUT THIS STANDARD

To ensure that you have all of the approved addenda, errata, and interpretations for this Standard, visit www.ashrae.org/standards to download them free of charge.

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