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a means of bypassing any PM sample media so the preclassifier flow may be stabilized before starting a test. Locate PM sample media within 75 cm downstream of the preclassifier's exit. You may not use this preclassifier if you use a PM probe that already has a preclassifier. For example, if you use a hat-shaped preclassifier that is located immediately upstream of the probe in such a way that it forces the sample flow to change direction before entering the probe, you may not use any other preclassifier in your PM sampling system.

(2) *Other components.* You may request to use other PM conditioning components upstream of a PM preclassifier, such as components that condition humidity or remove gaseous-phase hydrocarbons from the diluted exhaust stream. You may use such components only if we approve them under § 1065.10.

§ 1065.150 Continuous sampling.

You may use continuous sampling techniques for measurements that involve raw or dilute sampling. Make sure continuous sampling systems meet the specifications in § 1065.145. Make sure continuous analyzers meet the specifications in subparts C and D of this part.

§ 1065.170 Batch sampling for gaseous and PM constituents.

Batch sampling involves collecting and storing emissions for later analysis. Examples of batch sampling include collecting and storing gaseous emissions in a bag and collecting and storing PM on a filter. You may use batch sampling to store emissions that have been diluted at least once in some way, such as with CVS, PFD, or BMD. You may use batch-sampling to store undiluted emissions only if we approve

it as an alternate procedure under § 1065.10.

(a) *Sampling methods.* For batch sampling, extract the sample at a rate proportional to the exhaust flow. If you extract from a constant-volume flow rate, sample at a constant-volume flow rate. If you extract from a varying flow rate, vary the sample rate in proportion to the varying flow rate. Validate proportional sampling after an emission test as described in § 1065.545. Use storage media that do not change measured emission levels (either up or down). For example, do not use sample bags for storing emissions if the bags are permeable with respect to emissions or if they off-gas emissions. As another example, do not use PM filters that irreversibly absorb or adsorb gases.

(b) *Gaseous sample storage media.* Store gas volumes in sufficiently clean containers that minimally off-gas or allow permeation of gases. Use good engineering judgment to determine acceptable thresholds of storage media cleanliness and permeation. To clean a container, you may repeatedly purge and evacuate a container and you may heat it. Use a flexible container (such as a bag) within a temperature-controlled environment, or use a temperature controlled rigid container that is initially evacuated or has a volume that can be displaced, such as a piston and cylinder arrangement. Use containers meeting the specifications in the following table, noting that you may request to use other container materials under § 1065.10:

TABLE 1 OF § 1065.170—GASEOUS BATCH SAMPLING CONTAINER MATERIALS

| Emissions   | Engines   |   |
|---|---|---|
|   | Compression-ignition, two-stroke spark ignition, 4-stroke spark-ignition <19 kW   | All other engines   |
| CO, CO <sub>2</sub> , O <sub>2</sub> , CH <sub>4</sub> , C <sub>2</sub> H <sub>6</sub> , C <sub>3</sub> H <sub>8</sub> , NO, NO <sub>2</sub> <sup>1</sup> . | Tedlar <sup>TM, 2</sup> , Kynar <sup>TM, 2</sup> , Teflon <sup>TM, 3</sup> or 300 series stainless steel <sup>3</sup> . | Tedlar <sup>TM, 2</sup> , Kynar <sup>TM, 2</sup> , Teflon <sup>TM, 3</sup> or 300 series stainless steel <sup>3</sup> |
| THC, NMHC .....   | Teflon <sup>TM, 4</sup> or 300 series stainless steel <sup>4</sup> .....  | Tedlar <sup>TM, 2</sup> , Kynar <sup>TM, 2</sup> , Teflon <sup>TM, 3</sup> or 300 series stainless steel <sup>3</sup> |

<sup>1</sup> As long as you prevent aqueous condensation in storage container.

<sup>2</sup> Up to 40 °C.

<sup>3</sup> Up to 202 °C.

<sup>4</sup> At (191 ±11) °C.

(c) *PM sample media.* Apply the following methods for sampling particulate emissions:

(1) If you use filter-based sampling media to extract and store PM for measurement, your procedure must meet the following specifications:

(i) If you expect that a filter's total surface concentration of PM will exceed  $0.473 \text{ mm/mm}^2$  for a given test interval, you may use filter media with a minimum initial collection efficiency of 98%; otherwise you must use a filter media with a minimum initial collection efficiency of 99.7%. Collection efficiency must be measured as described in ASTM D 2986-95a (incorporated by reference in §1065.1010), though you may rely on the sample-media manufacturer's measurements reflected in their product ratings to show that you meet applicable requirements.

(ii) The filter must be circular, with an overall diameter of  $46.50 \pm 0.6 \text{ mm}$  and an exposed diameter of at least 38 mm. See the cassette specifications in paragraph (c)(1)(vi) of this section.

(iii) We highly recommend that you use a pure PTFE filter material that does not have any flow-through support bonded to the back and has an overall thickness of  $40 \pm 20 \mu\text{m}$ . An inert polymer ring may be bonded to the periphery of the filter material for support and for sealing between the filter cassette parts. We consider Polymethylpentene (PMP) and PTFE inert materials for a support ring, but other inert materials may be used. See the cassette specifications in paragraph (c)(1)(v) of this section. We allow the use of PTFE-coated glass fiber filter material, as long as this filter media selection does not affect your ability to demonstrate compliance with the applicable standards, which we base on a pure PTFE filter material. Note that we will use pure PTFE filter material for compliance testing, and we may require you to use pure

PTFE filter material for any compliance testing we require, such as for selective enforcement audits.

(iv) You may request to use other filter materials or sizes under the provisions of §1065.10.

(v) To minimize turbulent deposition and to deposit PM evenly on a filter, use a  $12.5^\circ$  (from center) divergent cone angle to transition from the transfer-line inside diameter to the exposed diameter of the filter face. Use 300 series stainless steel for this transition.

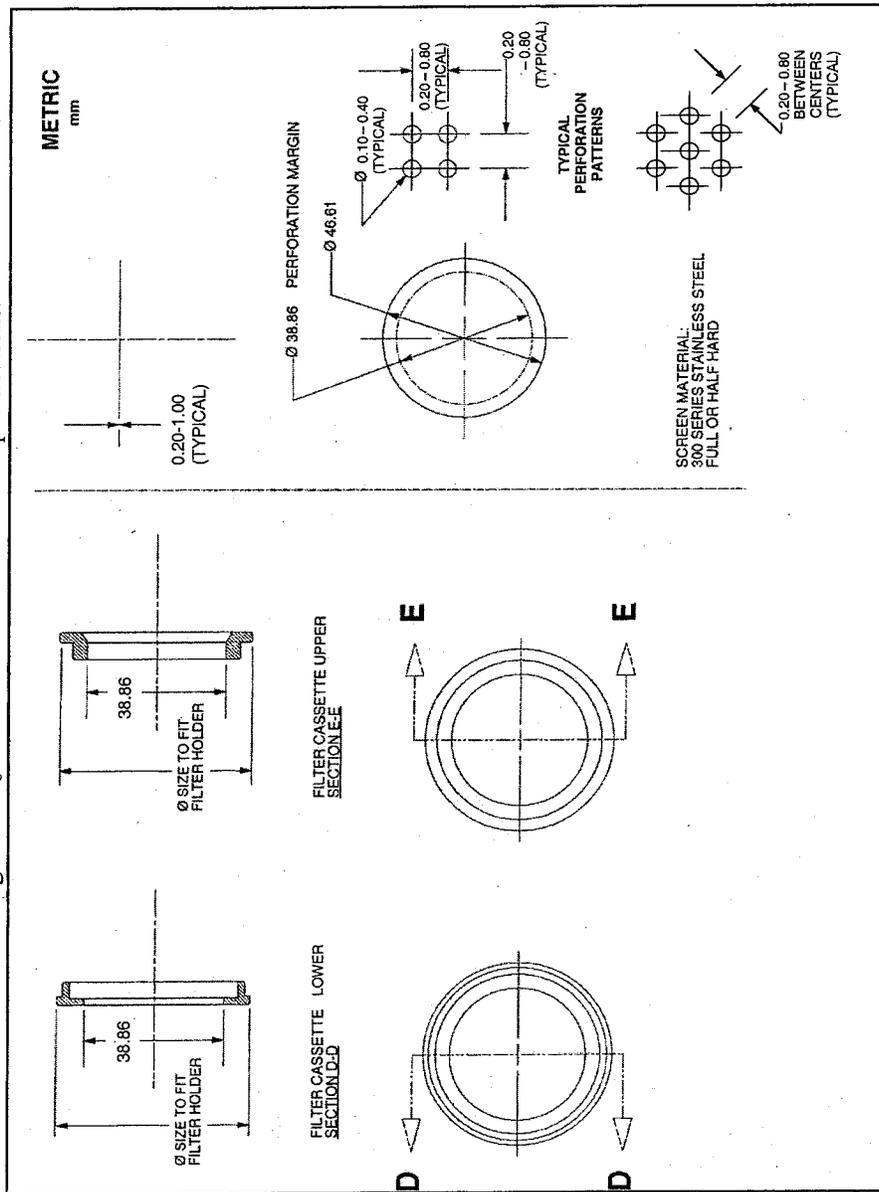
(vi) Maintain sample velocity at the filter face at or below 100 cm/s, where filter face velocity is the measured volumetric flow rate of the sample at the pressure and temperature upstream of the filter face, divided by the filter's exposed area.

(vii) Use a clean cassette designed to the specifications of Figure 1 of §1065.170 and made of any of the following materials: Delrin<sup>TM</sup>, 300 series stainless steel, polycarbonate, acrylonitrile-butadiene-styrene (ABS) resin, or conductive polypropylene. We recommend that you keep filter cassettes clean by periodically washing or wiping them with a compatible solvent applied using a lint-free cloth. Depending upon your cassette material, ethanol ( $\text{C}_2\text{H}_5\text{OH}$ ) might be an acceptable solvent. Your cleaning frequency will depend on your engine's PM and HC emissions.

(viii) If you store filters in cassettes in an automatic PM sampler, cover or seal individual filter cassettes after sampling to prevent communication of semi-volatile matter from one filter to another.

(2) You may use other PM sample media that we approve under §1065.10, including non-filtering techniques. For example, you might deposit PM on an inert substrate that collects PM using electrostatic, thermophoresis, inertia, diffusion, or some other deposition mechanism, as approved.

Figure 1 of §1065.170—PM filter cassette specifications.



EFFECTIVE DATE NOTE: At 73 FR 37298, June 30, 2008, §1065.170 was amended by revising the introductory text and paragraphs (a) and (c)(1), effective July 7, 2008. For the convenience of the user, the revised text is set forth as follows:

**§ 1065.170 Batch sampling for gaseous and PM constituents.**

Batch sampling involves collecting and storing emissions for later analysis. Examples of batch sampling include collecting and

storing gaseous emissions in a bag or collecting and storing PM on a filter. You may use batch sampling to store emissions that have been diluted at least once in some way, such as with CVS, PFD, or BMD. You may use batch-sampling to store undiluted emissions.

(a) *Sampling methods.* If you extract from a constant-volume flow rate, sample at a constant-volume flow rate as follows:

(1) Validate proportional sampling after an emission test as described in §1065.545. Use good engineering judgment to select storage media that will not significantly change measured emission levels (either up or down). For example, do not use sample bags for storing emissions if the bags are permeable with respect to emissions or if they offgas emissions to the extent that it affects your ability to demonstrate compliance with the applicable gaseous emission standards. As another example, do not use PM filters that irreversibly absorb or adsorb gases to the extent that it affects your ability to demonstrate compliance with the applicable PM emission standard.

(2) You must follow the requirements in §1065.140(e)(2) related to PM dilution ratios. For each filter, if you expect the net PM mass on the filter to exceed 400 µg, assuming a 38 mm diameter filter stain area, you may take the following actions in sequence:

(i) First, reduce filter face velocity as needed to target a filter loading of 400 µg, down to 50 cm/s or less.

(ii) Then, for discrete-mode testing only, you may reduce sample time as needed to target a filter loading of 400 µg, but not below the minimum sample time specified in the standard-setting part.

(iii) Then, increase overall dilution ratio above the values specified in §1065.140(e)(2) to target a filter loading of 400 µg.

\* \* \* \* \*

(c) \* \* \*

(1) If you use filter-based sampling media to extract and store PM for measurement, your procedure must meet the following specifications:

(i) If you expect that a filter's total surface concentration of PM will exceed 400 µg, assuming a 38 mm diameter filter stain area, for a given test interval, you may use filter media with a minimum initial collection efficiency of 98%; otherwise you must use a filter media with a minimum initial collection efficiency of 99.7%. Collection efficiency must be measured as described in ASTM D2986-95a (incorporated by reference in §1065.1010), though you may rely on the sample-media manufacturer's measurements reflected in their product ratings to show that you meet this requirement.

(ii) The filter must be circular, with an overall diameter of  $46.50 \pm 0.6$  mm and an ex-

posed diameter of at least 38 mm. See the cassette specifications in paragraph (c)(1)(vii) of this section.

(iii) We highly recommend that you use a pure PTFE filter material that does not have any flow-through support bonded to the back and has an overall thickness of  $40 \pm 20$  µm. An inert polymer ring may be bonded to the periphery of the filter material for support and for sealing between the filter cassette parts. We consider Polymethylpentene (PMP) and PTFE inert materials for a support ring, but other inert materials may be used. See the cassette specifications in paragraph (c)(1)(vii) of this section. We allow the use of PTFE-coated glass fiber filter material, as long as this filter media selection does not affect your ability to demonstrate compliance with the applicable standards, which we base on a pure PTFE filter material. Note that we will use pure PTFE filter material for compliance testing, and we may require you to use pure PTFE filter material for any compliance testing we require, such as for selective enforcement audits.

(iv) You may request to use other filter materials or sizes under the provisions of §1065.10.

(v) To minimize turbulent deposition and to deposit PM evenly on a filter, use a 12.5° (from center) divergent cone angle to transition from the transfer-line inside diameter to the exposed diameter of the filter face. Use 300 series stainless steel for this transition.

(vi) Maintain a filter face velocity near 100 cm/s with less than 5% of the recorded flow values exceeding 100 cm/s, unless you expect either the net PM mass on the filter to exceed 400 µg, assuming a 38 mm diameter filter stain area. Measure face velocity as the volumetric flow rate of the sample at the pressure upstream of the filter and temperature of the filter face as measured in §1065.140(e), divided by the filter's exposed area. You may use the exhaust stack or CVS tunnel pressure for the upstream pressure if the pressure drop through the PM sampler up to the filter is less than 2 kPa.

(vii) Use a clean cassette designed to the specifications of Figure 1 of §1065.170 and made of any of the following materials: Delrin™, 300 series stainless steel, polycarbonate, acrylonitrile-butadiene-styrene (ABS) resin, or conductive polypropylene. We recommend that you keep filter cassettes clean by periodically washing or wiping them with a compatible solvent applied using a lint-free cloth. Depending upon your cassette material, ethanol (C<sub>2</sub>H<sub>5</sub>OH) might be an acceptable solvent. Your cleaning frequency will depend on your engine's PM and HC emissions.

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(viii) If you store filters in cassettes in an automatic PM sampler, cover or seal individual filter cassettes after sampling to prevent communication of semi-volatile matter from one filter to another.

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**§ 1065.190 PM-stabilization and weighing environments for gravimetric analysis.**

(a) This section describes the two environments required to stabilize and weigh PM for gravimetric analysis: the PM stabilization environment, where filters are stored before weighing; and the weighing environment, where the balance is located. The two environments may share a common space. These volumes may be one or more rooms, or they may be much smaller, such as a glove box or an automated weighing system consisting of one or more countertop-sized environments.

(b) We recommend that you keep both the stabilization and the weighing environments free of ambient contaminants, such as dust, aerosols, or semi-volatile material that could contaminate PM samples. We recommend that these environments conform with an "as-built" Class Six clean room specification according to ISO 14644-1 (incorporated by reference in §1065.1010); however, we also recommend that you deviate from ISO 14644-1 as necessary to minimize air motion that might affect weighing. We recommend maximum air-supply and air-return velocities of 0.05 m/s in the weighing environment.

(c) Verify the cleanliness of the PM-stabilization environment using reference filters, as described in §1065.390(b).

(d) Maintain the following ambient conditions within the two environments during all stabilization and weighing:

(1) *Ambient temperature and tolerances.* Maintain the weighing environment at a tolerance of  $(22 \pm 1)$  °C. If the two environments share a common space, maintain both environments at a tolerance of  $(22 \pm 1)$  °C. If they are separate, maintain the stabilization environment at a tolerance of  $(22 \pm 3)$  °C.

(2) *Dewpoint.* Maintain a dewpoint of 9.5 °C in both environments. This dewpoint will control the amount of water

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associated with sulfuric acid (H<sub>2</sub>SO<sub>4</sub>) PM, such that 1.1368 grams of water will be associated with each gram of H<sub>2</sub>SO<sub>4</sub>.

(3) *Dewpoint tolerances.* If the expected fraction of sulfuric acid in PM is unknown, we recommend controlling dewpoint at within  $\pm 1$  °C tolerance. This would limit any dewpoint-related change in PM to less than  $\pm 2\%$ , even for PM that is 50% sulfuric acid. If you know your expected fraction of sulfuric acid in PM, we recommend that you select an appropriate dewpoint tolerance for showing compliance with emission standards using the following table as a guide:

TABLE 1 OF § 1065.190—DEWPOINT TOLERANCE AS A FUNCTION OF % PM CHANGE AND % SULFURIC ACID PM

| Expected sulfuric acid fraction of PM (percent) | $\pm 0.5\%$ PM mass change | $\pm 1.0\%$ PM mass change | $\pm 2.0\%$ PM mass change |
|---|----------------------------|----------------------------|----------------------------|
| 5 .....   | $\pm 3.0$ °C .....         | $\pm 6.0$ °C .....         | $\pm 12$ °C                |
| 50 .....  | $\pm 0.30$ °C .....        | $\pm 0.60$ °C .....        | $\pm 1.2$ °C               |
| 100 .....                                       | $\pm 0.15$ °C .....        | $\pm 0.30$ °C .....        | $\pm 0.60$ °C              |

(e) Verify the following ambient conditions using measurement instruments that meet the specifications in subpart C of this part:

(1) Continuously measure dewpoint and ambient temperature. Use these values to determine if the stabilization and weighing environments have remained within the tolerances specified in paragraph (d) of this section for at least the past 60 min. We recommend that you provide an interlock that automatically prevents the balance from reporting values if either of the environments have not been within the applicable tolerances for the past 60 min.

(2) Continuously measure atmospheric pressure within the weighing environment. You may use a shared atmospheric pressure meter as long as you can show that your equipment for handling the weighing environment air maintains ambient pressure at the balance within  $\pm 100$  Pa of the shared atmospheric pressure. Provide a means to record the most recent atmospheric pressure when you weigh each PM sample. Use this value to calculate the PM buoyancy correction in §1065.690.