

**California Environmental Protection Agency**



# **Air Resources Board**

## **STANDARD OPERATING PROCEDURE PARTICULATE MATTER (PM) SAMPLE COLLECTION**

**SOP MV-AEROSOL-158**  
Version 3

Revision Date: October, 2014

Chemical Analysis and Emissions Research Branch  
Emission Compliance, Automotive Regulations and Science Division  
State of California  
Haagen-Smit Laboratory  
9528 Telstar Avenue  
El Monte, CA 91731

This procedure has been reviewed by the staff of the Air Resources Board and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Air Resources Board, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

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| <b>California Air Resources Board</b><br>ECARS<br>Author: H. Toutounjian<br>Document ID: SOP158 | <b>Standard Operating Procedure</b><br><b>PM Sample Collection</b> | Effective Date: 10/1/14<br>Version: 3<br>Approved By: Wayne McMahon<br>Page 2 of 28 |
|---|--|---|

## Purpose

The purpose of this procedure is to specify Particulate Matter (PM) filter handling procedures throughout the Haagen-Smit Laboratory (HSL) from the time of pick up from Chemical Analysis and Emissions Research Branch (CAERB) to the time of return to CAERB. PM filter weighing and other requirements are found in related Standard Operating Procedures (SOPs).

### I. Regulatory Requirements

Not applicable.

### II. Related Documents

- A. Horiba Heated Filter Unit HF-47 Operation Manual (Quad Sampler)
- B. AVL PM Sampling Operation Manual
- C. AVL GEM 140 Application Guide
- D. AVL GEM 140 Maintenance & Troubleshooting Guide
- E. CAERB Chain-of-Custody form (PM & EC/OC)
- F. Test Cell Log Book
- G. CAERB Filter Handling and Weighing SOP
- H. PM Sampling Standard Operating Procedure (Vehicle Testing SOP)
- I. VTS Dyno Sheet

### III. Additional Requirements

- A. Testing is not valid until the procedure is successfully performed. Any invalid or aborted test must be reported in the Test Cell Log Book including reason(s) that cause the test to be invalid or aborted, and any remedial action(s) taken. Appendix 4 shows a sample Test cell Log Book.

### IV. Equipment and Materials

- A. Vehicle Testing System (VTS) Computer
- B. Horiba Quad PM Sampler
- C. AVL GEM SPC PM Sampler
- D. Powder-free nitrile gloves (anti-static)
- E. Plastic Zip-Lock bags
- F. Petri dishes and petri dish covers
- G. Teflon filter ring holders (cassettes)
- H. Filter holder rack
- I. Avery labels
- J. CAERB filter labels
- K. CAERB Chain-of-Custody forms (PM and EC/OC)

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|---|--|---|
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|---|--|---|

V. Safety Requirements

- A. Review and become familiar with the manufacturer equipment manuals mentioned in this procedure regarding safety precautions. ARB staff must observe and follow all the safety requirements and precautions applicable to this test cell. If there are any questions or concerns contact your section supervisor immediately or notify appropriate personnel.

VI. Designated Staff Allowed to Perform this Procedure

- A. This procedure may be performed by: an Automotive Emission Test Specialist (AETS) III, AET Supervisor, Air Pollution Specialist, or an Air Resources Engineer.
- B. Each staff must have previously demonstrated ability in performing this procedure and be approved by the section supervisor. One person is normally required to perform the procedure.

VII. Procedure

A. Preliminary Checks and Set-Up

- 1. Two weeks prior to actual testing, test engineer is responsible for sending an email to (CAERB) with the information in the table below to request PM filters. A sample table is shown below.

|                     |        |
|---------------------|--------|
|                     | Dyno 3 |
| Project             | 2S11C1 |
| Teflon              | 18     |
| Quartz              | 0      |
| Trace Element (XRF) | 8      |
| PUF(Filter + XAD):  | 12     |
| GC bags             | 4      |

- 2. One week prior to actual testing, test engineer is responsible for confirming the above request and informs CAERB of any changes to original request.

3. Test engineer is responsible for picking up PM filters from SLB (CAERB) prior to the week's testing. An example is shown in Figure 1.



Figure 1. Quartz Filters Arrive in Zip-Lock Plastic Bag, Individual Petri Dishes and Labels from CAERB

4. The filters are picked up in individual filter ring cassettes in Petri dishes with covers, each with unique ID No. barcode labels affixed to their Petri dish covers, along with a Chain-of-Custody form. A sample is shown in Appendix 2 and 3.
5. Test engineer (Dyno personnel) and CAERB staff each signs on the Chain-of-Custody form at the time of pick up. The lines for "Filter Received by Dyno/Date and Filters Delivered by CAERB /Date" should be completed by CAERB and dyno staff.

#### B. In-Cell PM Filter Management

1. Enter the Test Information in VTS and retrieve the Test ID Number. (Refer to the appropriate Vehicle Emission Testing standard operation procedure, TP005 or TP006, for VTS operations). A sample is shown in Appendix 1.
2. The PM filters will be kept in the original Ziploc bag as they were picked up from CAERB. Only number of filters that is needed for a test will be removed from the Ziploc bag during a test preparation.
3. Filters used shall be recorded in chronological order down the list on the Chain-of-Custody. A sample is shown in Appendix 2 and Appendix 3.
4. Generate Avery Test ID Labels.
  - a) From a desk-top work station, open a new Microsoft Office Word blank document.

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|---|--|---|
| <b>California Air Resources Board</b><br>ECARS<br>Author: H. Toutounjian<br>Document ID: SOP158 | <b>Standard Operating Procedure</b><br><b>PM Sample Collection</b> | Effective Date: 10/1/14<br>Version: 3<br>Approved By: Wayne McMahon<br>Page 5 of 28 |
|---|--|---|

- b) From the navigation bar select “Mailings”.
- c) Click on “Labels” in the upper left hand side of the menu tool bar.
- d) The “Envelope and Labels” window opens.
- e) Select “Full page of the same labels from the “Print” pull-down menu.
- f) Select “Avery” from the “Vendor” pull-down menu.
- g) Select “Auto-select feed tray” from the “Page Printer” pull-down menu.
- h) Make sure to load the number of Avery label pages into the proper printer tray face down prior to printing. Scroll through the “Product Number” menu and select the appropriate Avery label size (1"x 2-<sup>5</sup>/<sub>8</sub>").
- i) Enter the following information fields in the upper left hand side of the page:
  - (i) Project Number
  - (ii) Test Type
  - (iii) Test ID Number
  - (iv) Date
  - (v) Vehicle Number
  - (vi) Equipment Used (AVL SPC or Horiba (Quad))
  - (vii) Filter Test Phase Number
  - (viii) Filter Location Number in the Instrument
- j) Once the data fields are created using Times New Roman Font size 9 (such that all the fields fit on the label), click on “Update Labels” located in the center of the “Mailings” tool bar.
- k) A preview of the mailing labels will appear in the document window.
- l) Select “Print Preview” from the navigation bar and ensure that a complete page with the fields appears on the screen prior to printing.
- m) Click “Print” to print the labels.

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|---|--|---|
| <b>California Air Resources Board</b><br>ECARS<br>Author: H. Toutounjian<br>Document ID: SOP158 | <b>Standard Operating Procedure</b><br><b>PM Sample Collection</b> | Effective Date: 10/1/14<br>Version: 3<br>Approved By: Wayne McMahon<br>Page 6 of 28 |
|---|--|---|

5. Complete and affix one Avery Test ID label to the Chain-of-Custody form in the vehicle Test Information column for each and every filters used in a test.
6. If the Test Engineer has specified a Trip Blank to be used, ensure the Trip Blank petri dish cover is not removed at any time and that the Trip Blank remains in the control room and never taken into the testing area.
7. If the Test Engineer has specified a Field Blank for the test, handle and label as any of the other PM filters and use the filter exactly the same way as for a real test which includes loading and unloading. Field blank sampling generally varies with different projects. Hence, field blank should be sampled as per the procedure mentioned in the test plan for a particular project. The loading and unloading procedure is discussed in the latter sections.
8. Assigned PM Unit and filter holder are documented on the filter label on top of petri dish (See Figure 2).



Figure 2. Petri Dish

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|---|--|---|
| <b>California Air Resources Board</b><br>ECARS<br>Author: H. Toutounjian<br>Document ID: SOP158 | <b>Standard Operating Procedure</b><br><b>PM Sample Collection</b> | Effective Date: 10/1/14<br>Version: 3<br>Approved By: Wayne McMahon<br>Page 7 of 28 |
|---|--|---|

C. Loading PM Test Filters.

For each test, load a test filter as specified by the Test Engineer in the appropriate filter holder for the measurement system indicated (either the Horiba (Quad) or AVL SPC particulate measurement instrument).

1. Horiba Quad PM Sampler

- a) Use powder-free nitrile gloves to handle the filters and make sure that the filter surface is never contacted by handling the cassette only.
- b) Ensure that gloved hands are used throughout the loading and unloading procedure.
- c) Only handle the filter cassette, contacting the filter surface invalidates the filter.
- d) Get a filter holder rack. The holder rack will be needed for loading and unloading of filters. Label position numbers on the rack which will be needed during loading and unloading of filters.



**Figure 3. Filter Holder Rack**

- e) Using gloved hands, carefully uncover the petri dish containing each filter to be used in the test and load each of the filter cassettes in a filter holder.



Figure 4. Using Gloved Hands Uncover Filter Petri Dish and Handle Filter Cassette only

- f) Using gloved hands, pick up each filter cassette from its petri dish by handling it carefully by its edges, making sure never to contact the filter surface, and place it in the appropriate filter holder.



Figure 5. Using Gloved Hands Carefully Place Unused Filter In Horiba Sampler Filter Holder

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|---|--|---|
| <b>California Air Resources Board</b><br>ECARS<br>Author: H. Toutounjian<br>Document ID: SOP158 | <b>Standard Operating Procedure</b><br><b>PM Sample Collection</b> | Effective Date: 10/1/14<br>Version: 3<br>Approved By: Wayne McMahon<br>Page 9 of 28 |
|---|--|---|

- g) Ensure that the filter cassette sits firmly in the filter holder.



**Figure 6. Ensure Filter Cassette Sits Firmly In Filter Holder**

- h) Close the filter holder using the fastening clasp, ensuring an even seal around the flange.



**Figure 7. Return the Sealed Filter Holder to the Filter Holder Rack until all the Cassettes Are Loaded**

- i) Return the loaded filter holder to the filter holder rack.
- j) Load the remaining filter cassettes in the same manner as Steps VIII C 1. (a-i) as required by the test procedure.
- k) Once all the filter cassettes are loaded into each filter holder, carefully pick up each filter with the filter holder from the rack to load into the instrument.

- l) Ensure that the filter holders are always kept in an upright vertical position when handling.



Figure 8. Ensure Filters Are Kept Upright When Loading into PM Sampler

- m) Load each filter holder containing the filters into the Horiba (Quad) PM Sampler sequentially according to its position label.



Figure 9. Load Each Filter Holder Sequentially into the Horiba PM Sampler.

## 2. AVL GEM SPC PM Sampler

Filter cassettes are loaded directly onto stages containing the filter holder rings inside the AVL SPC PM Sampler unit.



Figure 10. AVL PM SPC Sampler

- a) Load each filter sequentially as required by the test procedure.
- b) Open the door of the PM SPC Sampler, starting with the first filter chamber on the far left-hand-side of the AVL SPC PM Sampler unit, load the filters in sequential order as required by the test.
- c) In Test Cell 7, only the first chamber needs to be manually opened by depressing each of the 2 red levers to release the seal and raise the filter chamber.



Figure 1 The Manually Operated AVL SPC PM Sampler Chamber is Opened by Depressing Each of the 2 Red Levers.

|   |  |  |
|---|--|--|
| <b>California Air Resources Board</b><br>ECARS<br>Author: H. Toutounjian<br>Document ID: SOP158 | <b>Standard Operating Procedure</b><br><b>PM Sample Collection</b> | Effective Date: 10/1/14<br>Version: 3<br>Approved By: Wayne McMahon<br>Page 12 of 28 |
|---|--|--|

- d) With both levers up, the chamber opens and is ready for loading the filter cassette onto the chuck inside the chamber.



**Figure 12. With Both Red Levers Up the Manual AVL SPC PM Sampler Chamber Lifts Open**

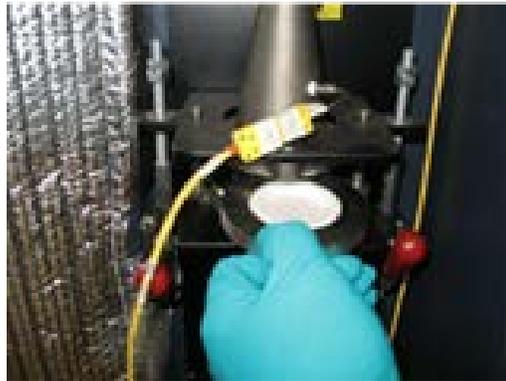
- e) Using gloved hands, simply slide the metal filter holder ring out from the open chamber.
- f) Load an unused filter cassette by simply inserting it into the metal filter holder ring.



**Figure 13. Using Gloved Hands Carefully Place an Unused Filter Cassette into the AVL SPC PM Sampler Metal Filter Ring**

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|---|--|--|
| <b>California Air Resources Board</b><br>ECARS<br>Author: H. Toutounjian<br>Document ID: SOP158 | <b>Standard Operating Procedure</b><br><b>PM Sample Collection</b> | Effective Date: 10/1/14<br>Version: 3<br>Approved By: Wayne McMahon<br>Page 13 of 28 |
|---|--|--|

- g) Replace the loaded filter holder ring into the AVL SPC PM Sampler chamber, ensuring that the filter surface is never contacted.



**Figure 14. Replace the Loaded Test Filter Holder Ring into the AVL SPC PM Sampler Chamber**

- h) Close the chamber and lock into position by pushing down the 2 red levers on either side of the chamber.



**Figure 15. Close the Manually Operated AVL PM SPC Sampler by Pressing down the 2 Red Levers**

- i) The automated AVL SPC PM Sampler filter stage slide out automatically once the chamber door is opened and the dark metal plate over the filter holder stage is lifted.

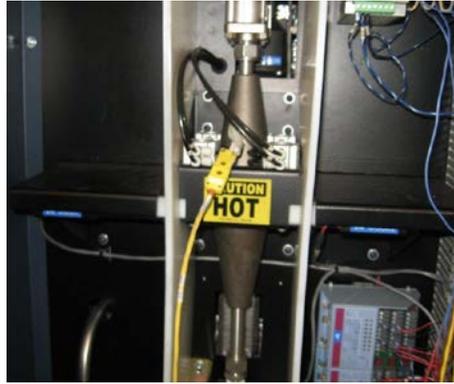


Figure 16. The Automated AVL SPC PM Sampler Filter Loading Stage Slides Out Once the Chamber Door Is Open

- j) To load filter cassettes into the AVL SPC Sampler lift the dark metal cover of the loading tray and the silver metal stage cover to allow access to the filter holder ring.

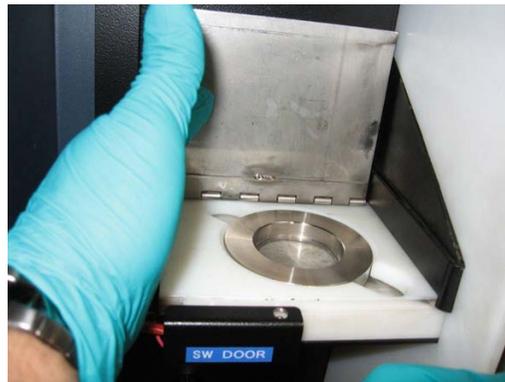


Figure 17. Lift the Dark Metal and the Silver Metal Covers to Access the AVL SPC PM Sampler Test Filter Ring

- k) Remove the metal filter holder ring from the stage.

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|---|--|--|
| <b>California Air Resources Board</b><br>ECARS<br>Author: H. Toutounjian<br>Document ID: SOP158 | <b>Standard Operating Procedure</b><br><b>PM Sample Collection</b> | Effective Date: 10/1/14<br>Version: 3<br>Approved By: Wayne McMahon<br>Page 15 of 28 |
|---|--|--|

- l) Insert an unused filter cassette into the holder ring by placing it in the metal filter holder ring.



**Figure 18. Using Gloved Hands Insert an Unused Filter Cassette into the AVL Sampler Filter Holder Ring**

- m) Ensure that the filter assembly is in an upright vertical position at all times when loading and unloading the stage.



**Figure 19. Ensure the Cassette and Holder are Kept Upright at All Times**

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|---|--|--|
| <b>California Air Resources Board</b><br>ECARS<br>Author: H. Toutounjian<br>Document ID: SOP158 | <b>Standard Operating Procedure</b><br><b>PM Sample Collection</b> | Effective Date: 10/1/14<br>Version: 3<br>Approved By: Wayne McMahon<br>Page 16 of 28 |
|---|--|--|

- n) Return the loaded test filter ring to its stage.



Figure 20. Return the Loaded Filter Holder Ring to its Stage

- o) The filter holder stage slides back into position and the chamber door closes automatically once the silver and dark metal covers is closed.

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|---|--|--|
| <b>California Air Resources Board</b><br>ECARS<br>Author: H. Toutounjian<br>Document ID: SOP158 | <b>Standard Operating Procedure</b><br><b>PM Sample Collection</b> | Effective Date: 10/1/14<br>Version: 3<br>Approved By: Wayne McMahon<br>Page 17 of 28 |
|---|--|--|

### 3. AVL SPC Smart Sampler System 472

For each of steps below, use clean powder-free nitrile gloves and do not touch the filter surface. If the filter surface is contacted, the filter is invalid.

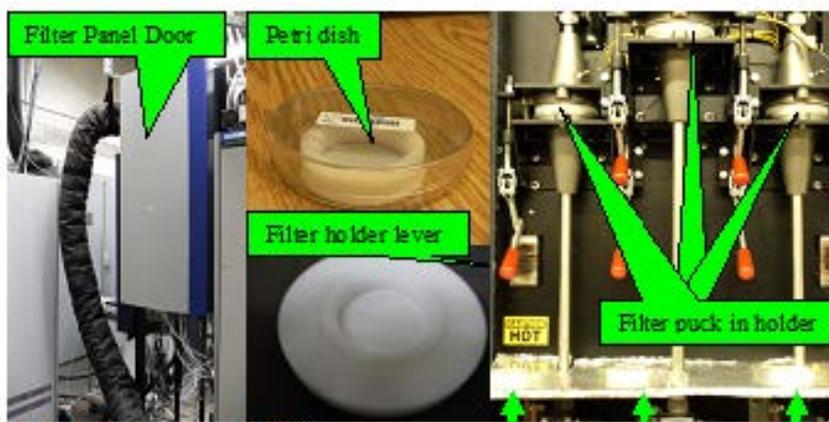


Figure 21. Loading sequences

- a) Open filter panel door and align each petri dish with filter cassette as it has assigned in the Chain-of-Custody to holders for each sampler
- b) Lift the red knob levers up to open each holder
- c) Remove puck from holder
- d) Open petri dish and remove filter cassette and place it onto puck (Precaution- Do not touch filter surface. If contacted, the filter is invalid)
- e) Insert filter cassette/puck into holder
- f) Pull the red knob holder levers down to securely close holder
- g) After loading each filter cassette, close petri dish
- h) Repeat steps b-g for each holder
- i) After loading all the filters cassette, close filter panel door

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|---|--|--|
| <b>California Air Resources Board</b><br>ECARS<br>Author: H. Toutounjian<br>Document ID: SOP158 | <b>Standard Operating Procedure</b><br><b>PM Sample Collection</b> | Effective Date: 10/1/14<br>Version: 3<br>Approved By: Wayne McMahon<br>Page 18 of 28 |
|---|--|--|

D. PM Sampling

1. Perform the test as specified in the test plan.

E. Unload Test Filters

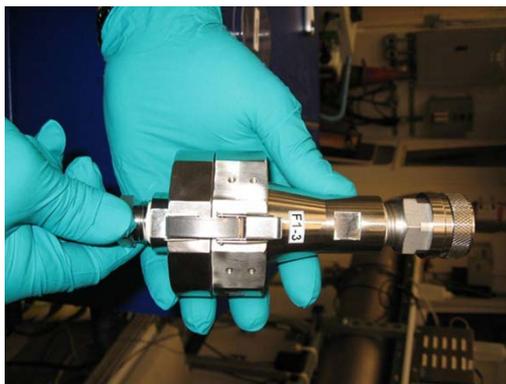
1. Horiba Quad PM Sampler
  - a) Use powder-free nitrile gloves to handle the test filters and make sure that the filter surface is never contacted and remains in an upright vertical position at all times.
  - b) Ensure that gloved hands are used throughout the unloading procedure.
  - c) Handle the test filters by the cassette edges only, contacting the filter surface invalidates the test.
  - d) Using gloved hands, unload each filter holder containing a test filter from Horiba (Quad) PM Sampler sequentially according to its position label.
  - e) Return each filter holder to its position in the filter holder rack.
  - f) Once the filter holder is securely seated in the rack release the fastening clasp and open the filter holder carefully to unload the test filters one at a time.
  - g) Open each filter holder and unload each test filter cassette individually, ensuring the test filter cassettes are kept in an upright vertical position at all times.



Figure 22. Return each test Filter holder to the Holder Rack

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|---|--|--|
| <b>California Air Resources Board</b><br>ECARS<br>Author: H. Toutounjian<br>Document ID: SOP158 | <b>Standard Operating Procedure</b><br><b>PM Sample Collection</b> | Effective Date: 10/1/14<br>Version: 3<br>Approved By: Wayne McMahon<br>Page 19 of 28 |
|---|--|--|

- h) Carefully remove the test filter while handling it by the cassette edges, ensuring that the surface is at no time contacted and place it in its original petri dish.
- i) Replace the Petri dish cover with the test filter's unique ID No. label.
- j) Close the clasp of the emptied cassette holder ensuring an even seal around the flange.



**Figure 23. Close the Horiba Cassette Holder Clasp and Ensure and Even Seal**

- k) Return each unloaded filter holder into its position in the Horiba instrument.
  - l) Repeat Steps VIII E 1 (a) – (k) for each test filter.
  - m) Once all the test filters are unloaded and returned to their uniquely labeled Petri dishes place the lot into a zip-lock plastic bag for returning to SLB for analysis.
  - n) The Chain-of-Custody sheet is to accompany the original lot but keep it out of the zip-lock bag for sign off.
2. AVL GEM SPC PM Sampler
- a) Test filters are unloaded from the stages containing the filter holder rings inside the AVL SPC PM Sampler unit.
  - b) Once the test is completed, open the chamber door of the PM SPC Sampler for unloading.

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|---|--|--|
| <b>California Air Resources Board</b><br>ECARS<br>Author: H. Toutounjian<br>Document ID: SOP158 | <b>Standard Operating Procedure</b><br><b>PM Sample Collection</b> | Effective Date: 10/1/14<br>Version: 3<br>Approved By: Wayne McMahon<br>Page 20 of 28 |
|---|--|--|

- c) To open the manually operated AVL SPC PM filter chamber, lift each of the 2 red levers on either side of the chamber to release and raise the filter chamber clamp.
- d) With both levers up, the chamber opens and is ready for unloading the test filter cassette from the filter holder ring inside the chamber.
- e) Using gloved hands, simply slide the filter holder out from the open chamber, ensuring that the test filter cassette is maintained in an upright vertical position at all times.
- f) Unload the test filter cassette by lifting it carefully from the metal ring by its edges, ensuring that at no time the surface of the test filter is contacted.
- g) Replace the unloaded filter holder ring back into the PM SPC Sample chamber.
- h) Close the chamber and lock into position by pushing down the 2 red levers on either side of the chamber.
- i) The automatic AVL SPC PM Sampler filter chambers are opened electronically once the chamber door is opened and the dark metal and silver covers over the filter stage are lifted up.
- j) Lift the dark metal cover of the loading tray and the silver metal stage cover to allow access to the filter cassette assembly.



Figure 24. Return the Loaded Filter Holder Ring to its Stage

- k) Using gloved hands, carefully remove the metal filter holder ring from the stage making sure to keep the test filter in an upright vertical position and that the filter surface is not contacted at any time.

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|---|--|--|
| <b>California Air Resources Board</b><br>ECARS<br>Author: H. Toutounjian<br>Document ID: SOP158 | <b>Standard Operating Procedure</b><br><b>PM Sample Collection</b> | Effective Date: 10/1/14<br>Version: 3<br>Approved By: Wayne McMahon<br>Page 21 of 28 |
|---|--|--|

- l) Unload a test filter cassette from the holder ring by carefully lifting it by its cassette edges.
- m) Ensure that at no time the surface of the test filter is contacted and that the test filter is in an upright vertical position at all times.
- n) Return the empty metal sample ring to the AVL SPC PM Sampler stage.

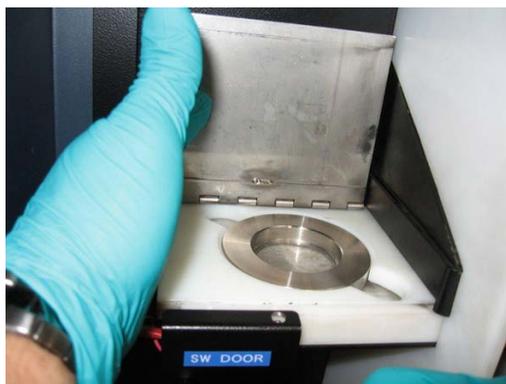


Figure 25. Return the Empty Filter Holder Ring to its Stage and Close the Dark Metal and Silver Metal Covers.

- o) The instrument filter holder stage slides back into position and the chamber door closes automatically once the silver metal cover and the dark metal covers are closed.
  - p) Place each of the sampled test filters back into their original Petri dish and replace with its uniquely labeled cover.
3. AVL SPC Smart Sampler System 472

For each step below, use clean powder-free nitrile gloves and do not touch the filter surface. If contacted, the filter is invalid.

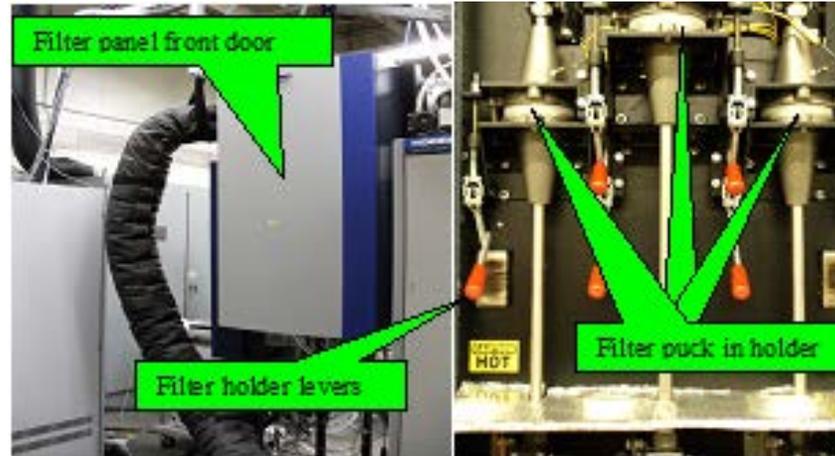


Figure 26. Filter panel and holder

- a) Open filter panel door
- b) Lift the red knob levers up to open each holder
- c) Open petri dish
- d) Remove filter cassette (puck) and place it in to its original petri dish. Precaution - do not touch filter surface and ensure to hold filter cassette (puck) in upright position at all time. If contacted filter surface, the filter is invalid.
- e) Close petri dish
- g) Place trial cassette (puck) back onto filter holder
- i) Pull the holder levers down to close holder

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|---|--|--|
| <b>California Air Resources Board</b><br>ECARS<br>Author: H. Toutounjian<br>Document ID: SOP158 | <b>Standard Operating Procedure</b><br><b>PM Sample Collection</b> | Effective Date: 10/1/14<br>Version: 3<br>Approved By: Wayne McMahon<br>Page 23 of 28 |
|---|--|--|

- F. Return the batch to CAERB at the end of the week's testing.
1. Place the test filter batch back into the zip-lock closure plastic bag that was used for filter delivery to return filters to CAERB for analysis.
  2. Be sure to include the Trip Blank(s) and/or Field Black(s) along with the batch if any were required for the test.
  3. The completed Chain-of-Custody form is to accompany the original batch but is not to be enclosed in the zip-lock plastic bag for sign off. Complete the following form fields:
    - (i) Client Name/Project
    - (ii) Test ID Number
    - (iii) Site Location/Dyno
    - (iv) Test Date
    - (v) Sample ID
    - (vi) Position
    - (vii) The name and signature of the individual returning the PM filters to CAERB for analysis.

**List of Appendixes and Flowchart:**

Appendix 1: VTS Screen with PM Schedule

Appendix 2: COC (Teflon)

Appendix 3: COC (EC/OC)

Appendix 4: Test cell log Book

Appendix 5: PM Filter Handling Flow Chart

Appendix 1

VTS Test Cell

Vehicle Test    ▶ Vehicle Prep    ▶ Cell Config    ▶ Dyno Coefficient    ▶ Test Definition    ▶ Small Engine

Run Test

Project 2R1305    Vehicle 13    Test Type EC1    Test Num 3    [Retrieve](#)

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Dyno Operator    Reason B-Baseline    Test Name ENHANCED COLD CVS II TEST  
 Driver ID    DR Sequence 3    Vehicle ID 1005005  
 Supervisor    Test Cell 7    Test ID 1036084  
 Canister On

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Model JETTA    Model Year 2010    Set Backpressure   
 License Num    VIN 3VWR9A7AJ1AM094003    Backpressure  
 Odometer    Miles    [More Vehicle Info](#)

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Select Dyno Coeff Set 1

|            |              |   |            |           |
|------------|--------------|---|------------|-----------|
| Dyno Coeff | Target Coeff | Test Weight (lb) 3025                           | Mil. Accum | Prep      |
| A 0.71     | A 20.55      | Road Load @50 mph (hp)                          | Prep Now   | Cold Soak |
| B 0.0419   | B 0.2055     | Run with EO Horsepower <input type="checkbox"/> | Temp (°F)  | Time (h)  |
| C 0.01738  | C 0.01677    | Highway Weight (lb)                             | Min        | Max       |
| D (%)      | D (%)        | EO Inertia Weight (lb) 3025                     |            |           |
| N          | N            |   |            |           |

Coeff Units English    Coeff Units English

EO Horsepower (hp)    Add 10% —

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PM Schedule

[New PM Schedule](#)

| PM System    | PM Schedule Code | Heated                              | Double Dilution          | PUF                      | Backup Filter            | PM Test Mode | Gtot | Dilution Ratio | Dilution Air Flow Rate |
|--------------|------------------|-------------------------------------|--------------------------|--------------------------|--------------------------|--------------|------|----------------|------------------------|
| Quad PM      | —                | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Fixed        |      |                |                        |
| PM System    | PM Schedule Code | Heated                              | Double Dilution          | PUF                      | Backup Filter            | PM Test Mode | Gtot | Dilution Ratio | Dilution Air Flow Rate |
| Quad PM      | —                | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Fixed        |      |                |                        |
| PM System    | PM Schedule Code | Heated                              | Double Dilution          | PUF                      | Backup Filter            | PM Test Mode | Gtot | Dilution Ratio | Dilution Air Flow Rate |
| Quad PM      | —                | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Fixed        |      |                |                        |
| PM System    | PM Schedule Code | Heated                              | Double Dilution          | PUF                      | Backup Filter            | PM Test Mode | Gtot | Dilution Ratio | Dilution Air Flow Rate |
| AVL GEM SPC  | PMSPC            | <input type="checkbox"/>            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | —            |      |                |                        |
| PM System    | PM Schedule Code | Heated                              | Double Dilution          | PUF                      | Backup Filter            | PM Test Mode | Gtot | Dilution Ratio | Dilution Air Flow Rate |
| Pierburg FFP | —                | <input type="checkbox"/>            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | —            |      |                |                        |

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Fuel Type EN09    Speciation Sample    PM Speciation   
 Batch 1    Alcohols     Particle Sizer   
 Sample 2    Carbonyls     N2O Sample   
 HC Speciation     Double HC Speciation   
 HFID     Power Meter

CVS Flow Rate 10.59 (374)

| Bag | Rate |
|-----|------|
| 1   | Auto |
| 2   | Auto |
| 3   | Auto |

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Shift none    Aux Digital Out none  
 Violation none    Aux Analog Out none  
 CVS and VVS none

Comments (Show Input Box)   
 Previous Comments  
 06/11/2013 07:44  
 332 CEP, Canister  
 LoadIng, PM Sample,  
 EERS ,CPC.

[Use Robot Driver](#)    [Run Test & Save](#)

\*) Indicates Required

[Save](#)    [Copy](#)    [Reset](#)    [Delete](#)    [Previous Screen](#)    [Next Screen](#)

Appendix 2  
 (COC for Teflon Filters)

CAERB Chain of Custody for PM Mass

Reported on  
 10/12/14

Client/Project: 2P1305

Site/Location/Dyno: 7 WK of 9/8/14

| Sample ID (barcode) | Vehicle Test Information   | Comments                                    |
|---------------------|--|---|
| *180017999*         | 2R1305 45-EC1-03 09-09-2014<br>Test ID 1039674 FFP SPC<br>Quad A B C D           | Trip Blank                                  |
| *180018000*         | 2R1305 45-EC1-03 09-09-2014<br>Test ID 1039674 FFP SPC<br>Quad A <u>B1</u> C D   | noticed a really thin white line<br>- N ROD |
| *180018001*         | 2R1305 45-EC1-03 09-09-2014<br>Test ID 1039674 FFP SPC<br>Quad A <u>B2</u> C D   |   |
| *180018002*         | 2R1305 45-EC1-03 09-09-2014<br>Test ID 1039674 FFP SPC<br>Quad A <u>B3</u> C D   |   |
| *180018003*         | 2R1305 45-US1B-03 Sept 9 2014<br>Test ID 1039651 FFP SPC<br>Quad A <u>B1</u> C D |   |
| *180018004*         | 2R1305 EC1-1B Sept 09 2014<br>Test ID 708016 FFP SPC<br>Quad A B C <u>D</u>      | Tunnel Blank                                |

Used all

Filters Delivered By AAMES: NROD Date: 9/8/14

Unused 0

Filters Received By Dyno: H.T. ? Date: 9-8-14

General comments about test: 24 filters

Filters Returned By Dyno: 7 MC Date: 9-12-14

Filters Received By AAMES: NROD Date: 9/12/14

Filters Received By AAMES: NROD Date: 9/12/14



Appendix 4  
(Test Cell Log Book)

6-9-14      OC      F-AIR

2R1403 09-UC-1 June 09, 2014  
Test ID 1038691 FFP \_\_\_ SPC \_\_\_  
Quad A \_\_\_ B \_\_\_ C \_\_\_ D \_\_\_

2R1403 09-UC-1 June 9, 2014  
Test ID SC-1038891 Blank  
Phase 1 2 Begin END

2R1403 13-MAC4-1 June 09, 2014  
Test ID 1038903 FFP \_\_\_ SPC \_\_\_  
Quad A \_\_\_ B \_\_\_ C \_\_\_ D \_\_\_

2R1403 13-MAC4-1 June 09, 2014  
Test ID 1038903 FFP \_\_\_ SPC \_\_\_  
Quad A \_\_\_ B \_\_\_ C \_\_\_ D \_\_\_

40-MAC4-2      RAM 3500

2R1403 14-UC-1 June 10, 2014  
Test ID 1038901 FFP \_\_\_ SPC \_\_\_  
Quad A \_\_\_ B \_\_\_ C \_\_\_ D \_\_\_

2R1403 14-UC-1 June 10, 2014  
Test ID SC-1038901 Blank  
Phase 1 2 Begin END

2R1403 14-MAC4-1-June 10,2014  
Test ID 1038902 FFP \_\_\_ SPC \_\_\_  
Quad A \_\_\_ B \_\_\_ C \_\_\_ D \_\_\_

2R1403 14-MAC4-1-June 10,2014  
Test ID 1038902 FFP \_\_\_ SPC \_\_\_  
Quad A \_\_\_ B \_\_\_ C \_\_\_ D \_\_\_

9-UC-2 / 650 /

2R1403-37-UC-1 June 11, 2014  
Test ID 1038823 FFP \_\_\_ SPC \_\_\_  
Quad A \_\_\_ B \_\_\_ C \_\_\_ D \_\_\_

2R1403 37-UC-1 June 11, 2014  
Test ID SC-1038823 Blank  
Phase 1 2 Begin END

2R1403-37-MAC4 -1 June 11, 2014  
Test ID 1038916 FFP \_\_\_ SPC \_\_\_  
Quad A \_\_\_ B \_\_\_ C \_\_\_ D \_\_\_

2R1403 37 MAC4 -1 June 11, 2014  
Test ID SC-1038916 Blank  
Phase 1 2 Begin END

## Appendix 5

### Flow Chart for PM Filter Handling SOP

