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Post-Sample Weigh In
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UCD IMPROVE Technical Information #251H

Post-Sample Weigh In

*Interagency Monitoring of Protected Visual Environments
Air Quality Research Center
University of California, Davis*

*February 9, 2024
Version 3.1*

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DOCUMENT HISTORY

Revision	Date Modified	Initials	Section/s Modified	Brief Description of Modifications
	02/16/2022	SRS	All	Previously anthologized version separated into individual TIs.
	4/20/2022	GRM	All	Updated wording to accommodate new procedures & appended to Section 5.4.
3.1	02/09/2024	TAK	All	Minor corrections. Updated balance prevision. Updated to include additional analysis paths. Updated terminology for terminal-status filters.

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1. PURPOSE AND APPLICABILITY

The purpose of this TI is to describe the procedures used to process sampled PTFE filters and prepare them either for further analysis or for storage. Procedures listed are applicable to all routine IMPROVE filters.

2. SUMMARY OF THE METHOD

Once all PTFE filters have been placed in carriers and weighed, they are ready to process at the Post-sample Weigh In station. Sampled PTFE filters and all terminal-status filters are weighed on a microbalance and their post-weights are recorded using a custom application: Improve Filter Processing (lab app). A-module filters are prepared for further analysis, and D-module filters are prepared for permanent storage. Beginning November 13, 2023, the reported balance precision was increased to 0.0001mg.

3. CAUTIONS

Many site names are similar. It is important to ensure that the site being loaded in the “POST” program matches the site name on the Petri dishes.

Make sure to handle only one cassette at a time. Interacting with more than one cassette while processing filters increases the risk of filter swaps.

Sometimes the loose screens stick to the filters. Try gently holding the filter and screen with one pair of forceps while trying to separate them with another pair of forceps. Ask a lead lab tech to separate them if there is concern about tearing the filter.

Sometimes filters are accidentally loaded upside-down, so the sample is on the wrong side of the filter. Make sure to weigh the filter barcode-side up, even if the sample is on the incorrect side. Also, make sure to place the filter in the Petri sample-side up. If a filter has a sample on the wrong side, note this in the lab app and notify a lead lab tech.

Sometimes a filter is damaged or misplaced. Notify the lead lab tech immediately for both scenarios.

4. EQUIPMENT AND SUPPLIES

- Mettler Toledo XPR6UD Microbalances
- MTL Autohandler Chambers
- Mettler Toledo XP6 Microbalance
- Computer with Improve Filter Processing balance application
- Antistatic unit
- Forceps with ceramic tips

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- Polonium strips (small and large)
- Container for used loose 1A and 4D screens
- Clean Petri dishes
- Clean slides
- Arbor Press
- Designated 1A Petri trays and 4D slide trays
- Block for stabilizing 4D slides

5. PROCEDURAL STEPS

5.1 Manually Weighing

Manual weighing for routine operations is only performed when the automated weighing systems are both inoperable.

- 1) There is one microbalance, located at the Mettler 1 station. Make sure to enter the correct username and password when logging in to the “Post-sample Weigh In” computer. At post-weigh chamber prep there are grid disks; they will be used as workspace for the filters before weighing. Notify the lead lab tech that the Mettler 1 balance will be used to ensure balance calibrations and proper reference weights have been weighed.
- 2) From the desktop, open *Improve Filter Processing* application. Select **Post-Sampling**, then click on **Post-sample Weigh In**.
- 3) Enter three-letter initials into the program. A pop-up window will list the sites in the queue on the left column. Review the queue, and then select a site bin from the shelf in the “Post-weigh Chamber Prep” rack. Ensure the cursor is blinking on the right column of the pop-up window, and then scan the barcode associated with the site or type in the site name if there is no barcode. Always select a bin from the queue unless directed otherwise by a lead lab tech.
- 4) Each bin has three re-sealable bags labeled Week 1, Week 2, and Week 3. Each bag should contain four cartridges. 1A and 4D cartridges should be the only cartridges with cassette labels. Ensure that the dates on the 1A and 4D labels fall within the week listed on the bags and that the site codes on the bag and cassette labels correspond. EXCEPTIONS: 5X module boxes and C-only sites will differ from this. 5X module boxes will have an additional cartridge in each week’s bag. If the 5th module is an A or a D, check the dates and site code on the labels. Single-C sites (DETR1) will only have one cartridge in each bag and all filters and associated cassette labels should already be removed.

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- 5) If the bin is not a single-C site, continue to step 6. If the box is a single-C site, then a list of all dates processed in the previous station will appear on the screen. Read the instruction on the screen. Then press **SUBMIT** located at the bottom of the screen. Must process the bin through the station even though no filters will be weighed.
- 6) Visually check the bubble level on top of the Mettler balance and be certain that the inner bubble is centered within the outer black circle. If the bubble level is not centered, immediately inform a lead lab tech so that they can perform an adjustment.
- 7) Make sure there is 1-inch a polonium strip inside the balance. Make sure the polonium strip is not too close to the weighing pan; if the strip is too close a filter may rest on it and report faulty measurements. Make sure that there is a whole polonium strip attached to the glass top of the weighing chamber.
- 8) Check that the reading on the balance display is 0.000 mg. Unstable weights have blue numbers as well as the loading circle on the terminal display. Stable weights are indicated by black numbers without any displayed loading circle. If the reading is stable and is not 0.000 mg, immediately inform a lead lab tech and do not proceed with any weighing until instructed to do so.
- 9) Make sure that the antistatic unit is turned on and the wristlet is attached to a grounded source.
- 10) The lab app will display all the sampling dates within a bin; however only remove the 1A from the Week 1 bag. Remove the red caps from the 1A cartridges and place them in the Week 1 bag. All red caps removed during the post-sample weighing should go into the Week 1 bag to simplify the processing of clean filters in cartridge preparation and pre-sample weigh-in stations.
- 11) Remove the label from the first sampled cassette in the 1A cartridge and place it on a clean Petri dish. The first sampled position will be the first position in the cartridge. All filters must be weighed regardless of status.
- 12) Open the first sampled cassette with the arbor press. Overturn the cassette bottom over the polonium strips. There should be a loose screen and a filter on each cassette bottom. Remove the loose screen and place it in the labeled container for used screens. If the screen sticks to the filter, try holding the filter with one set of forceps while trying to separate the two with another pair of forceps. If there is concern about ripping the filter, ask a lead lab tech to separate them. Note: only open one sampled cassette at a time.

Make sure to orient the filter so that it rests on the grid disk sample-side up. The filter will be sample-side up when it comes out of the cassette bottom. Note that typically the sample is on the side of the filter with a legible alphanumeric code

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on the outer ring. This is the proper orientation. Sometimes a filter is loaded upside-down. It is important to note this in the lab app and to weigh and store the filter sample-side up.

- 13) Closely inspect the filter. Filters can have a variety of problems, all of which must be reported in the lab app. The standard procedure for reporting filter problems involves reporting the problem in the lab app. Click on the “!” button for the correct module and sample date. Refer to UCD TI: #251G’s Section 5.1, “Unloading and Processing PTFE filters” for further details.
 - a. Filters can have problems with their weights that need to be noted. The lab app will automatically perform a validation. If the weight is a negative value, zero, or higher than 150.000 mg then a popup message will appear. The only exceptions to this are field blanks; field blanks can be in a range of ± 0.005 mg, if the weight difference is greater than that a popup message will appear. Also, if an A filter has a greater or equal to mass difference than a D filter, a pop-up message will appear. If any measurement is outside of the expected range, an automated analysis comment is added to that IMPROVE filter measurement.
- 14) Open the draft shield of the balance by pressing the right arrow button on the balance terminal. Slowly pass the filter through the ionizing zone of the antistatic unit and gently place the filter onto the balance pan. Close the balance door by pressing the same arrow key.
- 15) Once the filter is on the balance, follow the screen prompts given by the lab app and wait for a stable weight (black numbers without any displayed loading circle will appear on the balance display). The lab app will automatically query the balance and take a weight, press **A** to accept it. If the weight is incorrect, press **R** on the keyboard to refresh the value and the lab app will pick up a new weight.
- 16) After the proper weight is recorded, remove the filter from the balance with forceps. Place the 1A filter sample-side up into the labeled Petri dish and put it into the A filter Petri tray. Re-attach the cassette bottom and top.
 - a. A-filter inventory is generated as filters are processed through the Post Weigh station. Filters are inventoried according to the sampling month, then separated into valid-status or terminal-status. Valid-status filters are further separated into different analysis paths. After each filter is processed at Post Weigh, the lab app interface will display the filter’s correct inventory tray and tray position.
- 17) Repeat steps 11-17 for all 1A filters in the week, then click on “4D” along the left side of the screen.

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- 18) For 4D filters, the process is identical except that the filters are placed in the D filter slide tray for that site. Locate the 4D/5D tray associated for the site and sampling date found at the Post-Sample Weigh-In station. Ensure that the tray is for the correct quarter and year. Locate the associated slide within the tray for the first 4D filter. The slide sticker will have the sampler, sampling date, module, ordinal position, and quarter position. Check that the quarter position matches the tray number found along the right-hand side.
 - a. Place the corresponding slide face down on the desk. Place weighed filter on the slide with the sample facing up. Place blank unlabeled slide over the filter and compress both slides together to where the filter is centered.
- 19) For 5th-module filters, the process is identical to the 1A or 4D process. Click on **5A** or **5D** along the left side of the screen. 5D filters are placed in the 5D filter slide tray for that site.
- 20) Occasionally, there will be a field blank in one of the cartridges. After measuring the routine A and D filter weights, the computer will display a prompt to weigh the field blank.
- 21) Place the 1A week 1 cartridge back into week 1 and remove the A cartridges from week 2. Repeat steps listed above until all modules and three weeks have been processed.
- 22) Review the weights at the end of box. If any changes need to be made, move the cursor to highlight the weight to be modified. Ensure the correct sample date was selected and reweigh the filter. Repeat as necessary, notify lead lab tech if any issues.
- 23) Select **Submit** when finished.
- 24) After site has been processed through Post-sample Weigh-In, then move the bin to the “Cartridge Preparation” rack.

5.2 Weighing in the MTL Autohandler Chambers

When loading filters into the Silos, always keep Silo A empty. After a complete weighing procedure, the Carriers will shift one silo to the left (F→E→D→C→B→A) and have their order inverted (so the Carrier that was at the top will end up at the bottom). Never mix Pre-Weigh and Post-Weigh filters in any one Silo. The suggested equilibration time is four hours. This time may need to be shortened when weighing time sensitive filters. Each filter takes approximately 2.5 minutes to weigh. It is best to have weighing completed before or soon after 8:00 a.m. so there is enough time to process the filters for that day. It is critical that work is done carefully. If there are Post Weighing filters that need to be unloaded, those should be removed and processed as soon as possible. If there are Pre-Weighing filters that need to be unloaded, they can be set aside and stored in the “Clean weighed filters” box for their corresponding chamber, Luna or Sol.

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Note that the lab app's Post-Weigh Station's barcode-scanning view only works when using credentials that are connected to a Cognex scanner. Otherwise, it will go to the default manual-weighing view. These instructions only cover the new and or different parts of the Post-Weigh station and will not delve into every step. Prior experience with the manual Post-Weighing station is required and the same procedural considerations must be observed.

- 1) Refer to the previously filled "Post Weigh Loading Sheet" form and confirm which Silos now contain Post Weigh filters (after they have been shifted one Silo to the left after weighing).
- 2) Start unloading Post-Weigh filters from the Silo furthest to the right, lowest in the alphabet. Identify the corresponding Load Silo / Destination Silo Bin. Find the 1A Filter Petri Dish stack closest to the front of that Bin and note the Site and Date range. This will be the first Site to process.
- 3) Remove the stack of 1A Filter Petri Dishes and grab the site's 4D Filter Slides.
- 4) Navigate to the lab app Post-Weighing Station and enter 3-letter initials.
- 5) Select the Site and Date from the table on the left. It will take a few seconds to advance to the next screen. If an error message appears before the next screen pops up, it might be because the lab app cannot recognize the external barcode scanner. Confirm that the external barcode scanner is securely connected (power and Ethernet).
- 6) In the upper right corner, there is a barcode status section. Confirm that the Default Device for the selected credentials is selected. If not, click anywhere inside the rectangular box that shows the device name to bring up another popup. If the scanner for the selected login credentials shows up on that list, highlight it, press **OK**, and confirm that the same device name shows up on the previous window. Note that the COM9 device is the barcode scanner in the MTL chamber.
- 7) It is not necessary, but the barcode reader's alignment can be confirmed by placing a filter (still in its Carrier) under the barcode scanner and checking the Live Display box on the middle of the screen. The Carrier must be oriented with the Carrier barcode in the upper left corner, the MTL logo on the upper right corner, and the alphanumeric barcode legible from the front. If the barcode scanner beeps soon after checking the Live Display box, it signals that the scanner was able to read a valid barcode. The scanner will stop trying to read a barcode after a few seconds even if a filter is placed within view. Uncheck the Live Display box before proceeding, the last captured image will remain in that view until the Live Display box is activated again or the lab app successfully scans a filter in the following steps. Note that while that Live Display box is checked, the scanner cannot be used to scan in filters to the lab app. The section on the bottom

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right will show the Scanner Status. Once the station is prepared, press the **Trigger** button or select **T**. If the scanner successfully scans the barcode, the barcode scanner should beep, the Live Display should refresh with a screenshot of the correct filter, and a green rectangle should appear somewhere near the barcode that was scanned. The text field should show the correct 6-digit alphanumeric filter barcode.

- 8) If the barcode scanner does not beep a few seconds after Triggering, a popup box will note that the scanner was unable to detect a barcode. The Live Display should still update with a screenshot, but the barcode text field should show #UNDEF. Refer to the Barcode scanner troubleshooting section at the end.
- 9) After a successful filter barcode scan, press **Accept** or **A** to continue. If the MTL database does not have records for the filter barcode, a popup box will appear. Refer to the “No Weigh Data Found” troubleshooting section at the end. The lab app will perform the same weigh validation as before. Select a different filter if the criteria are not met. To replace the filter barcode with a different one, replace the filter Carrier and press **Trigger** or **T** to refresh.
- 10) If the database has records for the filter barcode and it passes all validation, confirm that the filter barcode accepted (refer to the refreshed Live Trigger screenshot too) for the Sampling Date and Module match. All associated Post Weigh information will be filled in on the table to the right.
 - a. Filters can have problems with their weights that need to be noted. The lab app will automatically perform a validation. If the weight is a negative value, zero, or higher than 150.000 mg then a popup message will appear. The only exceptions to this are field blanks; field blanks can be in a range of ± 0.005 mg, if the weight difference is greater than that a popup message will appear. Also, if an A filter has a greater or equal to mass difference than a D filter, a pop-up message will appear. If any measurement is outside of the expected range, an automated analysis comment is added to that IMPROVE filter measurement.
- 11) Remove the filter from its Carrier and load it into the correct Petri dish or 4D Filter Slide as usual. It is paramount that all the associated Post-Weigh information appears before handling the filter. Not doing so can easily lead to errors.
 - a. A-filter inventory is generated as filters are processed through the Post Weigh station. Filters are inventoried according to the sampling month, then separated into valid-status or terminal-status. Valid-status filters are further separated into different analysis paths. After each filter is processed at Post Weigh, the lab app interface will display the filter’s correct inventory tray and tray position.
- 12) After accepting a barcode / weight, the Scanner Status will show “Ready to trigger” and the barcode text field should be blank. Once the filter is correctly

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loaded into Petri dish or D-slide, continue to assign barcodes / weights in the same order as manually weighing filters. Always confirm the Scanner Status and empty barcode text field before triggering another scan. If the Scanner Status says, “Accept or trigger to retry” and there is still text in the barcode text field, the barcode / weight has not been accepted and assigned.

- 13) Note additional Holes, Dropped, or other comments in the “!” section of each filter.
- 14) The empty carrier can be set aside in a pile for use for future weighing procedures.
- 15) Continue this procedure for the next Site. This will be the next Petri dish stack behind the first, or in the next bin.

5.3 Handling of Terminal-status PTFE Filters

- 1) If any statuses within a bin are highlighted in red, take a red pen and write the terminal-status abbreviation (e.g., PO) directly on the label(s) belonging to the terminal-status(s). Make sure the proper filter is identified by double-checking the sample date, filter barcode, and the module with the lab app. If there is a field blank that shares a date with a regular filter that has a terminal-status, the field blank may have a different status from the regular filter (usually it will remain NM) and should be treated accordingly.
- 2) After processing the weight of the filter through the Post-sample Weigh In station, place the 1A filter in its corresponding petri dish. Place the petri dish in the separate “Terminal-Status” tray. Ensure that the order in the tray starts with the oldest ‘terminal-status’ filter.
- 3) After processing the weight of the filter through the Post-sample Weigh In station, place the 4D filter in its’ corresponding slide. The slide will be inserted into its’ corresponding position within the tray as routine.
- 4) If the problem filter is found for a 5th ordinal position, follow step 2 or 3 depending on the module, either A or D.
- 5) Repeat steps 2-4 for every terminal-status 1A or 4D filter.

5.4 Troubleshooting

- 1) Barcode Scanner Troubleshooting:
 - a. Press **Ok** to get past the popup window.
 - b. Check that filter’s alphanumeric code is legible (not upside down when viewed on the screenshot).

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- c. Rotate the filter 30° - 45° at a time and press the **Trigger** button each time. Try to keep both barcodes within view and away from the Carrier's three support tabs.
- d. If the scanner still cannot pick up the barcode, we have the option to manually type in the alphanumeric code as long as it is legible. Select the **Edit** check box or type in 'E', replace the text in the field to the left with the 6-digit alphanumeric code, and then click **Accept**.
- e. If the barcode does not scan *and* the alphanumeric code is not legible continue to step 2.

2) No Weigh Data Found Troubleshooting:

- a. If the MTL database does not have records for the filter barcode a popup box will appear. Press **Ok** to continue to the next step.
- b. If the popup box appears without having any problems scanning in the filter barcode (no repositioning or other troubleshooting was required), the filter barcode may not have been recorded by the MTL software. As long as it is confirmed that the filter is clean and unsampled, load it again the next time filters are Pre-Weighed in the MTL chamber (within 30 days).
- c. If the popup box appears after some troubleshooting, the filter barcode may not have been successfully scanned by the MTL chamber. If the MTL chamber barcode scanner cannot read the filter barcode, it will either assign the associated filter weight to the Carrier barcode, or a generic date and time stamp for when the filter was weighed (if the Carrier barcode was not recognized). Reposition the filter using some of the troubleshooting steps from the previous section and attempt to load it again the next time filters are Pre-Weighed in the MTL chamber (within 30 days).

3) Reassigning weight from carrier code to filter barcode:

- a. Enter the 7-digit carrier code into the Edit box A. Click **Accept**. A pop-up stating that "the scanned barcode doesn't match the current filter" will come up click ok.
- b. The 'Select Chamber Measurement' table will come up with all mass data associated to that carrier code. The table contains the weighing date, mass, type, chamber, data source, and data source ID. The table is organized in descending order. Locate a weighing date that is one or two days prior to the current date. Highlight the date as shown in Figure 1 below and click **Select**. The Post-Weight and Diff columns should be populated as routine.

4) Miscellaneous Troubleshooting:

Additional items that can cause problems include but are not limited to:

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- A large tear on the filter
- Double filter in a carrier
- Filter requires reweighing
- Missing filter

If any of the issues listed above occur, notify a lead lab tech immediately.

Figure 1. Select Chamber Measurement Table.

Select Chamber Measurement					
DATE	MASS	TYPE	CHAMBER	DATASOURCE	DATASOURCE ID
3/2/2022 10:02:42 PM	101.8391	POSTTEST	Luna	Combined DB	351628
9/7/2021 10:41:02 PM	43.7154	POSTTEST	Luna	Combined DB	291300
5/24/2021 12:43:42 PM	98.5615	POSTTEST	Luna	Combined DB	264680
4/13/2021 10:21:39 AM	98.5659	POSTTEST	Sol	Combined DB	253293
12/7/2020 12:51:04 PM	96.6815	POSTTEST	Luna	Combined DB	232725
10/16/2020 12:31:25 AM	44.358	POSTTEST	Luna	Combined DB	220737
10/13/2020 1:35:35 PM	44.358	POSTTEST	Luna	Combined DB	219790
10/13/2020 10:47:40 AM	44.357	POSTTEST	Luna	Combined DB	219733

5.5 A Filter Tray Inventory

If any 1A filter tray is filled, close the already-labeled tray and place it on the properly labeled shelf above the workstation adjacent to the weighing chamber (Sol). Then, find an empty Petri tray. Empty trays are typically found above the Post-sample Processing station. Begin inventory preparations for the next tray by finding six small round stickers to use to label the tray. For 1A filters, the stickers should be red. Four stickers will be used on top of the tray and two will be placed on the end. The top left sticker should be labeled with the number 1 and the top right sticker with the number 26. Both stickers should have a downward pointing arrow written after the number to indicate the order of the Petri dishes. The bottom left sticker needs to be labeled with the year and month and the bottom right needs to be labeled with the tray and set number. These last sticker labels are repeated and placed on the end of the carton, directly under their corresponding stickers. Repeat the process for terminal-status filters. For terminal-status filters, the stickers should be pink.

6. DATA AND RECORDS MANAGEMENT

The IMPROVE Filter Processing application (lab app) accesses the SQL database to develop a list of exposed filters to be processed from cassettes. Next, it queues the

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exposed filters for weighing, and records post weight values from the microbalance into the WEIGHTS table. Finally, after processing is finished, it notes that the record is “Finished” under the Current Lab Station in the web app.