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UCD IMPROVE Technical Information #251C

Filter Inventory and Acceptance

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

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Prepared By: DocuSigned by: Anthony Kawamoto 3A49A57FF666452... Date: 10/4/2022

Reviewed By: DocuSigned by: Jason Giacomo B62B01F81613421... Date: 10/4/2022

Approved By: DocuSigned by: Marcus Langston 0A10CFCF79B0452... Date: 10/4/2022

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DOCUMENT HISTORY

Date Modified	Initials	Section/s Modified	Brief Description of Modifications
05/04/2020	GRM	All	Updated wording & formatting.
03/04/2021	TAK	All	Updated balance QC and general procedures to include weighing in the MTL AH500 Autohandler. Updated wording for filter acceptance.
04/12/2021	GRM	All	Updated wording to accommodate for secondary AH500 unit & move to Drew Ave.
01/31/2022	SRS	All	Previous anthologized version separated into individual TIs.
3/17/2022	GRM	ALL	Updated wording to accommodate new procedures.
4/18/2022	GRM	Section 7 & 8	Added Data and Records Management & Quality Assurance and Quality Controls sections

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1. PURPOSE AND APPLICABILITY

The purpose of this TI is to describe the process of acceptance testing and inventorying for the PTFE, nylon, and quartz filters. The procedures described apply to all filters used for IMPROVE sampling network.

2. SUMMARY OF THE METHOD

PTFE and nylon filters undergo preliminary testing before lots are delivered. When lots are delivered, acceptance testing is performed before the filters are cleared to be loaded and sent out into the field. Quartz testing is done by the quartz contractor before being sent to the sample handling group. All filter types have inventory sheets that are used to track usage and to estimate when a new lot must be ordered.

3. CAUTIONS

Be sure to track filter inventory carefully and to order filter shipments well in advance (six months or more) to accommodate any delays in the delivery process.

Be very careful when performing acceptance testing and interpreting results. The quality of the filters is important to sampling and analysis.

4. PERSONNEL QUALIFICATIONS

Lead laboratory technicians, laboratory managers, or principal investigators (PI) can carry out filter acceptance and inventory procedures. Lead lab assistants must be trained by the lab manager or another lab assistant familiar with the procedures before performing these tasks.

5. EQUIPMENT AND SUPPLIES

See individual sections for detailed equipment lists for the tasks involved in filter acceptance and inventory.

6. PROCEDURAL STEPS

6.1 PTFE Filters

6.1.1 Receiving a PTFE Filter Lot

Shipments of PTFE filters are sent with an invoice and a packing slip and that can range from several boxes of filters to as many as 1100 boxes (enough for a year). Test lot shipments will usually contain a small number of filters, while approved lot shipments will usually contain the full number of filters used for the year. Sometimes lot shipments are split and sent within a day or two of each

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other. When filters are received, count the number of boxes and/or filters present to verify the packing slip. Sign and date the packing slip and give it to the AQRC employee in charge of accounting.

The received PTFE filter boxes are placed in a large container (e.g., Bankers box) and stored by the MTL Autohandler Chambers if space allows.

6.1.2 PTFE Filter Inventory

The PTFE filter inventory files are located in: "U:\IMPROVE_Lab\Lab Gravimetric\Filter Inventory and Acceptance. There is a separate folder for each year. Within each yearly folder are separate Excel files for nylon, quartz, and PTFE filters.

Each Excel file contains numerous spreadsheets for logging in sets of boxes of filters.

These sheets are created when a shipment of filters arrives and are completed as filters are used. The lab staff updates the excel sheet with entries as the filters are used.

There is also a “RATE LOG” sheet that keeps track of filter usage and provides an estimated depletion date for the filters on hand. The PTFE files also include “LABELS” sheets that are used to create and print labels to be affixed to each box of filters if applicable.

PTFE filters come in large shipments, typically around a year’s supply. A new set of log sheets and labels to affix to each box of filters need to be created for each new shipment.

Copy the most recent Excel file for the PTFE filters and rename it with the date of receipt of the shipment. Some cutting and pasting is needed to create the new file, and enough sheets must be created within the file to accommodate the size of the new shipment.

1) Highlight all sheets of interest (sheets beginning with “SHEET”) holding **Shift** and selecting the first and then last sheet. Viewing any of the selected sheets, select all fields from (J8) to (K32) and press **Delete**. This same change should be reflected on all sheets, deleting any pre-filled “INITIALS” and “DATE” entries.
2) Note the Part Number on a box of filters, following “P/N.” The filter diameter, 25 mm, should not change.
3) Note the Lot Number on a box of filters. The lot number is typically the same for every box in the shipment.
4) Note the day these filters were received.
5) Select the **INPUT DATA** sheet and fill in the Part Number, Lot #, and Received Date(s).
6) Confirm on the box that the REMOVAL is 3.0 µm and the Size is 25 mm.

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The Box # is determined by the box numbers assigned by MTL. The last three numbers on the labels become IMPROVE's internal pack (or box) numbers. List the box numbers consecutively in the Box # column of the spreadsheet, 25 to a page. The Box # for PALL shipments starts at 1 and follows through chronologically. The next column to the left, "Quantity," lists the number of filters in a box. This number is typically 100 for PTFE filters. However, some filters are removed from a few boxes for acceptance testing or other tests, so modify the numbers in those cells to reflect the actual number of filters in each box. Note this by inserting a comment (right-click **Insert Comment**) for that field. The PTFE spreadsheet has a "SHIPMENT" column, which is usually "1" unless the order is split or delivered in separate shipments.

A few filters selected from each new lot will need to undergo acceptance testing. Work with the laboratory manager to select these filters and to arrange for laboratory analysis.

The PTFE Excel file contains a "RATE LOG" sheet. This sheet keeps track of the filter usage versus the inventory available and, based on the average rate of usage, predicts when the current lot will run out. Edit the "RATE LOG" sheet as needed to contain the same number of rows as the number of spreadsheets in the shipment. Note that columns C ("PACKAGES") through G ("COMPLETED") are populated by links to the individual spreadsheets. When a new "RATE LOG" sheet is created, review it carefully to make sure the links are pointing to the proper sheets based on "SHIPMENT" and "SET" listed in columns A and B. Referring to the summary formulas at the bottom of the spreadsheet, the "TOTAL" summation should include all the rows of the table, as it shows the total beginning inventory. The "FIL USED" and "AVG" formulas include only the rows associated with the filters used to date, as will be explained further below. Ignore columns to the right of column H.

The laboratory staff will complete an entry on the excel sheet each time a box of filters is used. Enter the initials and date into each cell on the appropriate sheet.

Once an entire log sheet has been populated proceed to the "RATE LOG" sheet. In cell H3, enter the date on which the log sheet was completed. Check the last completed row in the "RATE LOG" sheet to verify that it corresponds to the log sheet being entered (that row will have been completed by its links to the log sheet). Then go to the formulas at the bottom of the spreadsheet. In both "FIL USED" and "AVG," change the second cell within the formula parentheses to indicate the row of the log sheet being added. If a single log sheet is being added, this will involve augmenting the formula by one row (for example, changing (D6:D17) to (D6:D18)).

Now that all of the data is entered, check the depletion date shown in yellow at the bottom of column H. This date is the estimate of when the inventory will run out based on average usage.

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6.1.3 PTFE Filter Acceptance Testing

Consistency in flow rate and composition (i.e., no contamination) are primary requirements for PTFE filters being used in the IMPROVE network.

Generally, a small number of filters are received for pre-delivery testing. Approximately 10% of the filters are analyzed by XRF for composition. This number will vary depending on the availability of the XRF instruments and the Laboratory Manager. Another eleven filters from each box are tested for flow changes. When certified, the entire lot is authorized for use in network operations. Acceptance testing is performed again when the filter lot is delivered before they are cleared to go out into the field. The following sections apply to the preparation and analysis of both new test lots of filters and filters that have been pre-approved. Items that apply specifically to only one or the other are noted.

6.1.3.1 PTFE Analysis

Approximately 10% of the pre-delivery filters are analyzed by X-ray fluorescence (XRF) to verify that there are no abnormal artifacts. This number will vary depending on the availability of the XRF instruments and the Laboratory Manager. Once the filters have been analyzed, the average net intensities (cps/mA) and standard deviations are determined for each species. The results of these filters are compared with both the results from the testing of the lot currently in use. If the measured net intensities (cps/mA) for the two lots are within the set acceptance limit—which is the average bilateral +/- 3 standard deviations of measured net intensities—then the filters are accepted for full delivery. If an outlier or irregularity is observed from visual inspection of the filters and/or the results of the XRF, the laboratory manager is informed.

Once the shipment of the new lot has been received, 0.3% to 0.4% of the filters (randomly chosen) are analyzed by XRF for final check. This number will vary depending on the availability of the XRF instruments and the Laboratory Manager. The results of these filters should meet the same acceptance limits set for the pre-delivery box. All results and comparisons should then be forwarded to the laboratory manager for a final decision about acceptance or rejection of the specific lot of filters.

6.1.3.2 Special Tests for New PTFE Test Lots

Once a test lot is shown to have no significant contamination, a test to examine flow change must be performed.

6.1.3.3 Flow Change Test

A flow change test is done to simulate the change in flow rate that should be expected when the new filter lot is installed in samplers that were calibrated using filters from the current filter lot. A significant change in the flow rate must

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be avoided as it may result in invalid data.

1) Supplies needed:
   - Three IMPROVE $PM_{2.5}$ cartridges
   - Twenty-two PTFE filters from the test lot (11 per box for preliminary testing)
   - Twelve PTFE filters from the current lot
   - Forceps with ceramic tips
   - DryCal® device
   - Worksheet and pen
   - Arbor press
   - Tygon® tubing with DryCal® fitting on one end and T-plug on other
   - Top plug from audit kit
   - One sampling unit, complete with one controller and one $PM_{2.5}$ module in the IMPROVE shop
2) Carefully load a current-lot filter into each cassette in all three cartridges, being sure all parts are assembled properly.
3) Copy last year's filter acceptance worksheet. It should be located in: U:\IMPROVE_Lab\Lab Gravimetric\Filter Inventory and Acceptance\Filter Acceptance. Rename the file to indicate the current year (and set, if applicable). Delete the entries and save the file. Print out the now blank worksheet.
4) Bring the Tygon® tubing with fittings and probe attached, plug from an audit kit, worksheet, and cartridges to the IMPROVE shop.
5) Confirm that the controller in the IMPROVE shop delivers stable data.
6) Attach the Tygon® tubing to the DryCal® using the DryCal® fitting. Tighten the fitting by hand first, and then use a wrench for ¼ of a turn to make sure the fitting is tight. Use the plug from an audit kit to block the top of the T-plug in the module. Insert the probe (attached to the Tygon® tubing) into the bottom of the T-plug in the module.
7) Put the first cartridge into the module. Plug in the controller and enter calibration mode. Go to position 1 of the module being used.
8) Turn the DryCal® on. Write down the pressure value displayed on the DryCal® onto the worksheet. Select **Measure** and then press **Enter**.
9) Calibrate using the first position cassette of the first cartridge. Do this by selecting **Continuous** mode on the DryCal® and press **Enter**. The DryCal® will take continuous measurements and will display a running average for the measurements up until the 10th consecutive measurement. Then, the running average resets.
10) While the continuous measurements are taken by the DryCal®, turn the

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black knob on the valve behind the cyclone until the values on the DryCal® read approximately 23 lpm. Once it reads about 23 lpm, press **Enter** to pause. Then, select **Burst**. The DryCal® will take 10 measurements. If the average value is within ± 0.01 from 23 lpm, write down the value. Make sure to also record the temperature. If the average value is outside the acceptable range, repeat this step.

11) Run through the rest of the positions in the cartridge using the **Burst** option. Record the readings for each filter, making sure to also note the time and temperature for each reading.

12) After all filters have been measured, choose the filter with the median reading. This filter will be used in position 1 of cartridge 1 when testing the new lot filters.

13) Unload the current lot filters into labeled Petri dishes. Place one of the median filters into position 1 of the first cartridge, and then fill the rest of the positions in the three cartridges with new lot filters. Repeat step six for the new lot filters.

14) Unload the cassettes (except for the median filter in position 1 of cartridge 1) and reload the cassettes with another 11 new lot filters. Repeat step six again.

For preliminary testing, if the PTFE filters are within the acceptable range for the flow change test, then the test lot is approved. After being approved, a purchase order for the approved lot should be submitted to MTL by the appropriate employee.

6.1.4 Switching PTFE Filter Lots

The exact date on which the new PTFE lot will begin to be used can be predicted using the “RATE LOG” tab described earlier in Section 6.1.2. The first filter information for the new PTFE lot should be listed on the Week 1 log sheet of any given bin. The lot will change at the start of any day, preferably at the beginning of a new cycle (2-3-2 or 3-2-2). When planning for the transition, keep in mind that it is ideal to have approximately two PTFE filter boxes from the old lot remaining at the end of a transition, so that there are enough for archiving but not too many that go unused.

Once the date for the lot change is chosen, the lab can begin preparation. The new PTFE lot needs to be swapped with the old PTFE lot in the sample handling lab when the correct bins are ready for load with the new lot. Also, remove the problem filters (dropped, specks, holes) from the lab that are from the old lot. Make new empty boxes for the defective filters. Navigate to the Web Application, and under the Home tab select the **Lots** tab. Select the lot that will be retired and add an EndDate. Once an EndDate is added to a lot the lot will be marked as inactive. Select **New Lot**. Enter the Lot Number, Manufacturer, select Default Module Configurations, and the given Start Date. Enter any comments, if

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applicable and select **Create**. Once the new lot is added, the new cycle of bins can be loaded.

6.2 Nylon Filters

6.2.1 Receiving a Nylon Filter Lot

Shipments of nylon filters are sent with an invoice and a packing slip. Shipments can range from two boxes of filters to as many as three hundred boxes; each box contains one hundred nylon filters. Test lot shipments will usually contain around two boxes, while approved lot shipments will usually contain the full number of boxes used for the year (~ 300). Sometimes lot shipments are split and sent within a day or two of each other. When filters are received, count the number of boxes present in the order to verify the packing slip. Sign and date the packing slip and give it to the AQRC employee in charge of accounting.

After nylon boxes are stickered, they are sorted into re-sealable bags in groups of 4 boxes. Make sure boxes are sorted in such a way that their box numbers remain sequential. Nylon filters are then stored in the refrigerator in the general Sample Handling Lab area.

6.2.2 Nylon Filter Inventory

The nylon inventory files are located at U:\IMPROVE_Lab\Lab Gravimetric\Filter Inventory and Acceptance. There is a separate folder for each year. Within each yearly folder are separate Excel files for nylon, quartz, and PTFE filters.

Each Excel file contains numerous spreadsheets for logging in sets of boxes of filters.

These sheets are created when a shipment of filters arrives and are completed as filters are used.

There is also a “RATE LOG” sheet that keeps track of filter usage and provides an estimated depletion date for the filters on hand. The nylon files also include “LABELS” sheets that are used to create and print labels to be affixed to each box of filters.

Nylon filters come in large shipments, typically around a year’s supply. A new set of log sheets and a new set of labels to affix to each box of filters are created for each shipment.

Copy the most recent Excel file for nylons and rename it with the date of receipt of the shipment. Some cutting and pasting is required to create the new file, and enough sheets must be created within the file to accommodate the size of the new shipment.

Working from right to left in each sheet, delete the entries in the “DATE” and

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"INITIALS" columns, as these are completed as the filters are used. Enter the date of receipt of the shipment in the "INPUT" tab and it should update all the log and label sheets.

For the Box # column, list pack numbers consecutively starting at 1. There will be twenty pack numbers per page for nylon filters. Boxes are assigned pack numbers after labels are generated and affixed to each box, as described below. If a lot is split into two shipments, the pack number resets and the first box of shipment 2 is set as 1.

The next column to the left, "Quantity," lists the number of filters in a box. This number is typically 100 for nylons. However, several filters are removed from a few boxes for acceptance testing or other tests, so modify the numbers in the appropriate cells as necessary to reflect the actual number of filters in that box.

The spreadsheet has a **SHIPMENT** column, which is usually "1" unless the order is split and delivered in separate shipments. Find the lot number on a sticker on the filter boxes and enter it into the "Lot #" cell in the "**INPUT**" tab and all sheets should be updated. The entries in the **"REMOVAL**," "**SIZE**," and "**PART #**" column do not typically change and can usually be left untouched; however, if the "**PART #**" changes, enter the new number into the "**PART #**" cell in the "**INPUT**" tab.

A set of labels to be affixed to each box of filters is created for each shipment. Go to the "**LABELS**" sheet to do this. There may be multiple "**LABELS**" sheets to accommodate the size of the shipment. In most cases, the label sheets will already be updated with the date received and the new lot number. Cells B3 and E3 may need to be modified if it is not shipment #1. All of the other cells in the sheet are linked to these upper-left cells and populate themselves automatically. Print the label sheets onto label stock and affix a label to each box of filters.

A few selected filters from each new lot of nylon filters will need to undergo acceptance testing. Work with the laboratory manager to select these filters and to arrange for laboratory analysis.

Each Excel file contains a "**RATE LOG**" sheet. This sheet keeps track of the filter usage versus the inventory available and, based on the average rate of usage, predicts when the current lot will run out. Edit the "**RATE LOG**" sheet as needed to contain the same number of rows as the number of spreadsheets in the shipment. For multiple shipments within a spreadsheet, set the appropriate number of rows for each shipment as it comes in. Note that columns C ("**PACKAGES**") through G ("**COMPLETED**") are populated by links to individual spreadsheets. When a new "**RATE LOG**" sheet is created, review it carefully to make sure the links are pointing to the proper sheets based on the "**SHIPMENT**" and "**SET**" listed in columns A and B. Referring to the summary formulas at the bottom of the spreadsheet, the "**TOTAL**" summation should include all the rows of the table, as it shows the total beginning inventory. The "**FIL USED**" and "AVG" formulas include only the rows associated with the

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filters used to date, as will be explained further below. Ignore columns to the right of column H.

The laboratory staff will complete an entry on the excel sheet each time a box of filters is checked out for use.

Once an entire log sheet has been populated proceed to the "**RATE LOG**" sheet. In cell H3, enter the date on which the log sheet was completed. Check the last completed row in the "**RATE LOG**" sheet to verify that it corresponds to the log sheet being entered (that row should have been completed by its links to the log sheet).

Then go to the formulas at the bottom of the spreadsheet. In both "**FIL USED**" and "**AVG,**" change the second cell within the formula parentheses to indicate the row of the log sheet that is being added. If just one log sheet is added, this will involve augmenting the formula by one row (for example, changing (D6:D17) to (D6:D18)).

When all of the data is entered, check the depletion date shown in yellow at the bottom of column H. This date is the estimate of when the inventory will run out based on average usage.

6.2.3 Nylon Filter Preliminary/Acceptance Testing

Consistency in flow and composition are the primary requirements for nylon filters being used in the IMPROVE network.

Precut nylon filters from Pall Corporation are purchased by UC Davis in boxes of 100 filters. Approximately 2 boxes are sent for preliminary testing. Eleven filters from each box (or a total of 22 filters) are tested for flow changes, and around five from each box (or totaling 10 filters) are sent to the ion contractors for analysis to verify that there are no abnormal artifacts. When certified, the entire lot is authorized for purchase. Acceptance testing is performed again when the filter lot is delivered before they are cleared to go out into the field. The following sections apply to the preparation and analysis of both new test lots of filters and filters that have been pre-approved. Items that apply specifically to only one or the other are noted.

6.2.3.1 Nylon Analysis

Ten nylon filters from each nylon shipment (including test lot filters for preliminary testing) are sent for analysis to the ion contractor to verify that there are no abnormal artifacts. Steps for analysis follow below.

1) Randomly select 10 or more filters apart from the ones used for the pressure tests described below.
2) Place each selected filter in a Petri dish and label the dishes "TEST0"-"TEST9."

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3) Package the filters in a Petri dish box and ship them overnight to the ion contractor.
4) Receive the data and determine the average concentrations and standard deviations for each species.
5) Compare the results for the lot being tested with the results from the testing of the lot currently in use.
6) Forward the results and comparisons to the laboratory manager. If the measured concentrations for the 2 lots are within 5%, the tested blanks are lower than the analyzed lab blanks, and the standard deviation is low, then the filters are accepted for use.
7) Set aside 1 or 2 boxes from the new lot (after final acceptance testing) for archiving and for maintenance technicians' future audits.

6.2.3.2 Flow Change Test

The flow change test for nylon filters is essentially the same as the flow change test for PTFE filters, which is described in section 6.1.3.3. The only difference is that the audit cartridge is a B cartridge.

Calculate the average flow rate for the lot being tested. If flow rate shows great variability within the same lot and it is not due to a leaky cassette, the filter counts may be increased to see if the trend continues.

The information collected from this test must be sent to the laboratory manager.

If the test lot passes the flow change test and all the prior tests, then it is approved, and a purchase order can be placed for next year. If the new lot passes the flow change test and all prior tests, it is cleared for use in field operations.

6.2.4 Switching Nylon Lots

The monitoring of remaining filters from a given lot and the transition between filters is very similar to the procedures for the PTFE filters. Differences and distinctions are outlined below.

6.2.4.1 Monitoring the Depletion of Nylon Filters

Nylon filters do not have the same manufacturing problems as PTFE filters; therefore, there is no need to keep track of the percentage of rejects. Check the "RATE LOG" about once a month (more often when approaching the lot change date) to see what the estimated end date is for the current lot. The "RATE LOG" can be found in U:\IMPROVE_Lab\Lab Gravimetric\Filter Inventory and Acceptance\YYYY\YYYY_MM_DD_NYLON FIL Log.xls

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6.2.4.2 Transitioning Between Lots

The procedure for the transition between nylon lots is the same as the transition between PTFE lots, as described in Section 6.1.4.

6.3 Quartz Filters

Quartz filters are sent from PALL Corporation to the carbon contractor, where they are pre-fired and labeled. Quartz shipments are much smaller than nylon and PTFE shipments, typically around a month's supply of filters. The packet(s) of filters should be stored in the freezer in the Sample Handling Lab.

6.3.1 Quartz Filter Inventory

The quartz filter inventory files are located at U:\IMPROVE_Lab\Lab Gravimetric\Filter Inventory and Acceptance. There is a separate folder for each year. Within each yearly folder are separate Excel files for nylon, quartz, and PTFE filters. Quartz Excel files contain spreadsheets for logging in sets of boxes of filters as well as a "RATE LOG" sheet that keeps track of filter usage.

Because of smaller shipment sizes, a single Excel file can accommodate a year's worth of quartz shipments, with the "SHIP" number designated in each spreadsheet tab. The carbon contractor ships the boxes in vacuum-sealed packets, with around a half-dozen boxes in each packet. It is most convenient to list one or two packets on a sheet, so the number of records in each sheet will vary depending on how the carbon contractor filled the packets. If fewer than the maximum 12 rows in a sheet are used, delete the formulas in column M for the unused rows, as they will not calculate correctly if left in.

Open the most recent Excel file for quartz and rename it with the date of receipt of this shipment. Working from right to left in each sheet, delete the entries in the "DATE" and "INITIALS" columns as these are completed as the filters are used. Enter the date of the receipt of the shipment in the "RECEIVED" column. Information for the next six columns ("QUANTITY" through "PRE-FIRED") is provided on a data sheet that the carbon contractor ships with the filters. In addition, the carbon contractor emails an electronic excel document. Enter this information into the spreadsheets. The entries in the "SIZE" and "FIL TYPE" columns typically do not change, so they can be left untouched.

Each Excel file contains a "RATE LOG" sheet. This sheet keeps track of the filter usage versus the inventory available and based on the average rate of usage, predicts when the current shipment will run out. Edit the "RATE LOG" sheet, as needed, to contain the same number of rows as the number of spreadsheets (common for quartz), set the appropriate number of rows for each shipment as it comes in. Note that columns C ("PACKAGES") through G ("COMPLETED") are populated by links to individual spreadsheets. When a new "RATE LOG" sheet is created, review it carefully to make sure the links are pointing to the proper sheets based on the "SHIPMENT" and "SET" listed in columns A and B.

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Referring to the summary formulas at the bottom of the spreadsheet, the "TOTAL" summation should include all the rows of the table, as it shows the total beginning inventory. The "FIL USED" and "AVG" formulas include only the rows associated with the filters used to date, as will be explained further below. Ignore columns to the right of column H.

The laboratory staff will complete an entry on the excel log sheet each time a box of filters is checked out for use. Enter the *initials* and *date* into each cell on the appropriate sheet.

Once an entire log sheet has been populated proceed to the "RATE LOG" sheet. In cell H3, enter the date on which the log sheet was completed. Check the last completed row in the "RATE LOG" sheet to verify that it corresponds to the log sheet being entered (that row should have been completed by its links to the log sheet).

Next, address the formulas at the bottom of the spreadsheet. In both "FIL USED" and "AVG," change the second cell within the formula parentheses to indicate the row of the log sheet that is being added. If just 1 log sheet is added, this will involve augmenting the formula by 1 row (for example, changing (D6:D17) to (D6:D18)).

Once the data are entered, check the depletion date shown in yellow at the bottom of column H. This date is the estimate of when the inventory will run out based on average usage.

6.3.2 Switching Quartz Lots

Each box of quartz filters has a different lot number written on the top of the box. Laboratory technicians and undergraduate students must use sequential box numbers. Sometimes the carbon contractor will skip several box numbers in their numbering scheme. New entries for quartz filters are generated at Cartridge Preparation station. When a new box is opened the user updates the new **Lot** on the Cartridge Preparation screen. Do so by highlighting the lot of the first sample that will receive a filter from the new box. In **Lot #** enter the new lot. The new lot number can be found at the top of the box starting with a letter and followed by four numbers (i.e. Q9120). Ensure that the entry is correct. The **Start Date** should be prefilled with the current date and time. Select **Save**, the sequential lot numbers will be updated with the new lot number. A lead laboratory technician should be notified if any errors occurred while entering the new lot number.

7. DATA AND RECORDS MANAGEMENT

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Detailed information regarding each lot is located in the IMPROVE database and can be accessed through the Web Application: https://improve.aqrc.ucdavis.edu/Lots. Refer to UCD IMPROVE TI #251T, Section 2.1: Databases for more detailed information.

Inventory and tracking for each lot are located in the central U-Drive. All records are stored in their corresponding receiving year within the directory: U:\IMPROVE_Lab\Lab Gravimetric\Filter Inventory and Acceptance.

8. QUALITY ASSURANCE AND QUALITY CONTROL

Filter depletion rate is closely monitored by lab staff to ensure there are plenty of filters on hand, and to determine when a new order needs to be placed. Lot numbers are monitored closely and updated by the lab staff to ensure FilterIDs have the correct **Lot#** assigned before deployment for sampling.

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UCD IMPROVE Technical Information #251D

Box Receiving

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

July 15, 2022
Version 3.0

Prepared By: DocuSigned by: Anthony Kawamoto 3A49A57FF666452... Date: 10/4/2022

Reviewed By: DocuSigned by: Jason Giacomo B62B01F81613421... Date: 10/4/2022

Approved By: DocuSigned by: Marcus Langston 0A10CFCF79B0452... Date: 10/4/2022

UCDAVIS
AIR QUALITY RESEARCH CENTER

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05/04/2021	GRM	All	Updated wording & formatting.
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1. PURPOSE AND APPLICABILITY

This TI describes the proper procedures for opening IMPROVE blue boxes and transferring the contents to bins. Its purpose is to establish uniform guidelines for how to perform these tasks.

2. SUMMARY OF THE METHOD

IMPROVE blue boxes are not permitted in the sample handling laboratory to reduce the chance of contamination. Contents of these boxes must be removed and placed into matching site bins in the shipping/receiving area for the sample handling lab before getting transferred to the lab. Bins are brought back into the shipping/receiving area after new filters have been loaded. The contents are put back into the blue boxes and shipped out into the field.

3. CAUTIONS

Some site codes are very similar. Because of this, it is very important to make sure that filters are placed into the correct bins and that clean filters are shipped out in the proper box.

4. EQUIPMENT AND SUPPLIES

- Computer with IMPROVE Filter Processing application (lab app)
- Blue boxes containing sampled filters
- Velcro Labels with site names
- Barcode scanner
- Sticky Notes
- Colored pens (other than red)
- Box Cutter

5. PROCEDURAL STEPS

Prior to beginning work, open the Improve Filter Processing laboratory application (lab app). Open Post-sampling then select Box Receiving.

5.1 Remove Labels/Tape

When boxes arrive at Drew Avenue, they are stacked on the floor in the side delivery entrance, right outside of the IMPROVE shop. Bring the boxes into the shipping/receiving area for the sample handling lab and place them on the floor in front of the shelves of shipping boxes. IMPROVE bins for all sites are stacked adjacent to the desk.

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When opening a box, remove any tape that the operator may have put on the box to secure it for shipping. A box cutter may be used to cut the tape, but do not damage the box in the process. Remove as much of the tape as possible. Do not remove the box-top label located on top of the box in the far-left corner. It should have the site name and three installation dates. Do not remove the shipping label as this must be scanned.

5.2 Check In Boxes

1) Select a blue box to open, and then locate the associated bin. The Velcro labels have the site code four letters followed by a number (1-9). Site bins are also color-coded. Yellow bins are for the (2-3-2') boxes, and blue bins are for the (3-2-2') boxes. The Velcro label will also have an associated barcode. Attach the designated Velcro label to the corresponding colored bin. Be sure to use a bin of the appropriate color.
2) Log in to the computer, the login information can be requested from the laboratory staff in the sample handling lab. Open the Improve Filter Processing application (lab app). Select "Post Sampling" then select "Box Receiving".
3) Using the barcode scanner, scan the barcode associated with the site. Do not type in or click the site code, unless using an unlabeled bin.
4) Verify the correct box is open by checking the "Box Weeks" with the three bag labels for main site.
5) Scan the return label into the "Inbound Tracking Number". The tracking number is validated, if incorrect numbers then verify the correct box was received and write a note in the comments section.
6) Remove the bags and place into the correct bin.
7) Remove log sheets and flashcard. See section 5.3 for more information. If log sheets and flashcard are the correct ones, then click "correct dates" and "flashcard." If the flashcard number is incorrect then write a comment. If dates are incorrect then inform lead lab tech immediately.
8) Remove box top labels and return labels.
9) Place the empty box on one of the shelves, grouped alphabetically. If it is a replacement box, place it on the top shelf on top of the desk.
10) Go to Section 5.4 for flagging problems.

5.3 Locate the Flashcard

Every box should contain at least one flashcard (Compact Flash card or SD card), which is labeled with an eight-digit number on one side and the site code and UC code on the other. Typically, the flashcard is found in the Week 3 bag because the operator removes the flashcard at the end of the week. However, if a flashcard is not there, thoroughly check the other two bags as well as inside of the box. Sometimes it is best to empty the contents of each week to find a flashcard, as it can get stuck in the log sheet or hidden

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under cartridges. If a flashcard is not found in the box; in the lab app, do not select the box for the flashcard and type “No Flashcard” in the comment section.

Sometimes a flashcard will have a label that reads “IMPROVE Replacement” instead of a site name.

After pulling out the flashcard, remove the log sheets from each week bag. Place the flashcards to the side. Stack flashcards in the order the boxes were opened.

5.4 Flagging a Problem

Stack all log sheets together by site with week 1 on top and week 3 on bottom. When finished opening boxes, give the pile of log sheets to a lead lab tech along with the flashcards.

If a “NOTIFICATION MESSAGES FOR SELECTED SAMPLER BOX” comes up notify lead lab tech.

If any questions arise while opening boxes or something is unclear, ask a lead lab tech.

5.5 Deliver Bins to the Sample Handling Lab

Loaded bins are carried to the sample handling lab and placed on the holding rack next to the post-processing station. Bins of higher priority are placed on higher racks, while bins of lower priority are placed on lower racks. Bin priority is assigned based of the IMPROVE calendar and site status (Figure 1).

Figure 1. Bins.

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UCD IMPROVE Technical Information #251E

Entering Log Sheets and Simple Problem Diagnosis

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

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Reviewed By: DocuSigned by: Jason Giacomo B62B01F81613421... Date: 10/4/2022

Approved By: DocuSigned by: Marcus Langston 0A10CFCF79B0452... Date: 10/4/2022

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1. PURPOSE AND APPLICABILITY

This TI describes the procedures used to review flow rates, download flashcard information, diagnose simple sampling problems, and review log sheet data. These procedures are applicable to all routine IMPROVE sites.

2. SUMMARY OF THE METHOD

Potential issues are detected by reviewing and examining flow rates and log sheets. Any significant problems are directed toward the field maintenance team through JIRA and Microsoft Teams. Log sheet data is then reviewed and automatically updated to an application called Improve Filter Processing, which writes the information to the SQL database.

3. CAUTIONS

Examine log sheet values and flow data carefully. Missing a substantial problem could lead to losing a site for the year. If unsure about whether or not something is a problem, err on the side of caution and contact the field supervisor group.

Report equipment problems to the field maintenance team immediately. Not doing so could result in further sample loss.

Pay careful attention to the name of the site when reviewing log sheets. Some site names are very similar, and the correct site name must be typed in when entering the log sheets. Typing in the wrong site name could result in significant confusion later in the process.

4. PERSONNEL QUALIFICATIONS

Only trained lead laboratory technicians and members of the field maintenance team can perform the operations described in this TI.

5. EQUIPMENT AND SUPPLIES

- Flashcard reader
- Desktop computer (PC—for reading flashcards) with lab application
- Computer with network access
- Log sheets from sites
- Access to Flow Rates page (https://shiny.aqrc.ucdavis.edu/FlowRates/)

6. PROCEDURAL STEPS

6.1 Using Improve Data Management Web Application Flow Graphs

The Improve Data Management Web Application Flow Graphs are used to fully review

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and evaluate the flow data received on flashcards. If there are any problems with the web app see the software data management group for help.

To use, go to https://shiny.aqrc.ucdavis.edu/FlowRates/. Adjust the date range to be viewed, usually encompassing the three weeks of the box cycle plus one or two weeks prior, then select the site from the drop-down menu. After selecting the site, the page will automatically refresh.

The first view will be a zoomed-out view of all modules, to zoom in select a portion of the graph and double click. This zoomed-in view will stay until the graph is double-clicked again, however the date range function may not work properly when zoomed in. Simply zoom out to change the date, then zoom in again. When **All** is selected in the Plot drop-down, multiple modules and their CYC and/or ORI / Pressure values can be viewed at once. To view individual modules select them from the Plot drop-down menu.

Each graph shows the transducer values recorded on the flashcard in the form of a graph. The graphs provide a guide for appropriate values by placing range lines showing ± 5% of the nominal values rate, determined at calibration. If Flow Rate is selected the ± 5% range applies to nominal flow, which should be 23.0 lpm for modules 1A-3C and 16.9 lpm for 4D. Use these indicator lines to help determine transducer or flow value shifts due to equipment replacement or problems, swapped cartridges, double/single filters loaded for the C MOD, etc. Absence of transducer values indicates that there is no flashcard data for that time period.

6.2 Reading the Improve Data Management Web Application Filter Readings

In addition to the Flow Graphs, the electronic flow data is displayed in a table format in the Improve Data Management Web Application. The Filter Readings page is located under the primary tab “Operations” followed by the secondary tab “Filter Readings”. The search options are built to categorize by sampler and installment date. The table displays the Sampler, Date Recorded, Check Type, Module Title, Filter Date, Cyclone Reading, Orifice Reading, Max Vacuum, ET (minutes), Op Initials, and Filter. The “Date Recorded” is the date the operator ran the controller to collect either initial or final readings. The “Check Type” refers to the readings when the cartridge was installed, initial, or when the cartridge was removed ‘final’. The “Filter Date” refers to the sampling date. Note that Max Vacuum is only taken at initial readings. The moveable o-ring position will have two readings, one for each week it was installed in. The Filter Readings page can be a user-friendly alternative to the flashcard files. The Filter Readings are only uploaded when there is active network connection to the site. If the connection fails the alternative options would be the flashcard files and physical log sheets.

6.3 Reviewing the Log Sheets

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Log sheets are reviewed to spot issues that need to be examined more closely using flashcard data. There are several things in particular to look out for:

6.3.1 Elapsed Time (ET)

A run day typically consists of 1425 to 1440 minutes. The exception to this is the moveable position filter. This filter is running if the operator performs the sample change on the day designated on the log sheet. The operator must interrupt the sample to change out the cartridges and to transfer moveable position cassettes to the next week's cartridge. Thus, the ET will typically be somewhat shorter on this day. A value of ET ≥ 1410 is accepted; anything less than that should be reviewed for equipment issues, bad installation power interrupts, or other problems.

NOTE: Occasionally one of the ETs for the moveable position may read 0. The ET for the moveable position is recorded twice: once before it is moved over to a new cartridge and again when that "new" cartridge is uninstalled the next week. If one ET reads zero, check the other. Typically when this occurs, the operator performed the sample change before or after the moveable position run day. In this case, the other ET listed should be 1440.

If ETs are scrambled, very high, or very low, it may be easier to confirm real ETs by examining flashcard data through the web app or through the flashcard file. ETs are usually not over 1440 unless the controller has scrambled ETs due to a lightning strike. However, a rare and special case with version 7.0N is if a sample change is missed for a moveable position day and the next sample change is not performed until 3 weeks later on another moveable position day. In this case, the controller will log the full run time of the first sample and append the time for the later sample, thus possibly exceeding 1440 minutes.

6.3.2 Sample Change Dates

Sample changes should be performed on Tuesdays. If a sample change is not performed on a Tuesday, it is important to note when it was performed and if it affected any sample ETs. Each log sheet shows the sample days for its corresponding week. In order to have valid samples for the entire week, the sample change must not be performed later than 6.0 hours after the start of the sample day (with the exception of the moveable position). If any sample has an ET < 1080 due to a late sample change, that sample needs to be assigned a status of NS (no sample). This status can be confirmed by reviewing flashcard data or flow graph data. This will be discussed further in the "Simple Problems" section.

If a log sheet is blank, the filters may not have sampled. Check the install dates on the other log sheets and look for notes from the operator indicating a missed sample change. As described above, filters that do not sample due to a late sample

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change receive a status of NS. Confirm a missed sample change by using flashcard data or flow graph data.

6.3.3 Max ORI / VAC Values

V2 Controller: There are four MxORI values on each log sheet, one for each module. For Controller version 70.N, the highest value is 40. Acceptable ranges are from 35-40. If one or more of these values is significantly below this, contact the field maintenance team. An exception to this is if the site is a high elevation site, which can cause MxORI values to run 30-35. In this case, report anything that is under 30. If unsure about whether the site is high elevation or not, ask a maintenance team member.

6.3.4 ORI / Pressure and CYC / Flow Values

V4 Controller: On the V4 Controller, these values are called Vac values. Acceptable ranges are from 0-5, with stronger vacuum readings reading closer to zero. If a Vac value reads 5-15 on the V4 Controller, this can indicate that the pump is malfunctioning and/or is not turning on. Check the flashcard data to confirm whether the pump was running. See the below sections on flashcard data reviewing and simple problems for more information.

The ORI / Pressure and CYC / Flow values listed on log sheets are a real-time snapshot of what the transducer / flow rate values were when the operator was at the site for the sample change. These values are taken both when cartridges are installed and when they are uninstalled.

6.4 Reading Flashcards

Note that a flashcard only needs to be read if the flow data is not available or reliable in the Improve Data Management web application flow graphs. To read flashcards, use flashcard reader. Plugin the flashcard reader if it is not already prepared.

Insert a flashcard into the reader.

The number of files will vary depending on the program version running the controller at the site. There are two different Controller versions currently out in the field. Note all sites except for one have the V4 Controller version.

6.4.1 Controller Version 7.0N

There will typically be two to four files for sites running on 7.0N. There will be a file already labeled with UCID and the month and day of the first install date. Note that initial readings taken for week 1 of the next box may be in a separate, smaller .TXT file labeled with the month and date of the first install date for the next box. There should also be two log files. The log files will be named “logMMDD.TXT,” with MMDD being the month and date of first install for the current box cycle under review.

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NOTE: If a flashcard is blank or corrupt, run the recovery command located in U:\IMPROVE\FlashTXT. If nothing can be recovered, write "CFLSH blank/corrupt" at the bottom of the first log sheet.

If there is no flashcard for a box, write no flashcard at bottom of first log sheet.

6.4.2 V4 Controller

V4 Controller data should sync with the AQRC on-site servers every morning at 1 a.m. Do not clear data from any flashcard until after log sheet review and entry.

6.5 Ingesting the Flashcard

1) Open the lab app and select **Admin**.
2) Select the **Flashcard Upload** button.
3) Under file selection change the path to "This PC" then the flashcard reader.
4) Confirm that both the Archive Files and Archive All files in folder checkboxes are selected as needed.
5) Click **Load File(s)**
6) Use the arrow buttons to review data and make changes as necessary from this page.
7) If the data is valid click **Save Data**, this will save the files to the site's flashtxt folder. When the data is saved, a text box pops up that must be confirmed before moving on.
8) To check a new card, insert the new card and click refresh under file selection.
9) Do not clear data from any flash card until after log sheet review and entry.

6.6 Reading Flashcard Files

Check the ORI/Pressure and CYC/Flow values for each module across weeks. These values should be fairly stable across the three weeks.

On the V2 Controller's software version 7.0N, each reading shows UCID, start time of the interval, end time of the interval (interval is typically fifteen minutes), GMT offset, whether the controller is sampling or not (OFF or ON), transducer values for all MODs, temperature (in mV), running ET of the sample if it is a sample day, operator initials, and version type. Readings are taken in intervals of fifteen minutes. V4 Controllers contain individual files for each day, with data logs for each piece of equipment.

Version 7.0N also contains a log file. Log files show the UCID, controller ID, and details of time/date/GMT offset changes, sample changes, etc. The log files are used for advanced troubleshooting.

6.7 Input Log Sheets

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If all values appear to be in range and appropriate for the site, it is time to enter the log sheets.

A shortcut for the current version of Improve Filter Processing application should be available on the desktop. If a shortcut is not available then check the start menu, create a shortcut from the following directory: U:\Improve_Software_Production\FilterProcessingProduction, or talk to IT.

Click on the shortcut to open the application, select **Admin** then click on **Input Log Sheets**. Enter user initials. Type in the full site code for the log sheets being entered or click on the correct site in the queue. The program will display all three weeks of the box. Operator initials, start and end dates, start and end times, ETs, sample dates, and some other columns are all already filled in. If all values are in range, next to "Controller Initial Readings" and "Controller Final Readings" click **LOAD.** If multiple filter readings were taken, the date time stamp will be displayed in green.

From the drop-down menu select the valid date and time recording. If both readings are valid select the most recent one. The readings are taken directly from the imported data that occurs daily for each site with connection at 1 a.m. If any values are not updated, manually update the values presented in the log sheets.

Note the LabApp does not support any non-alphanumeric values. If there are any dashes uploaded, remove them prior to continuing.

If values are not within appropriate range or flashcard data was not received, then log sheet values must be entered manually. Sample dates are set, but other pre-filled fields can be modified if necessary. Use the **Tab** or **Enter** key to move forward to the next field, and **Shift + Tab** to move back to the previous field. Enter the initials of the operator who performed finals for week 1. If the field on the log sheet is blank, find the information in the flow table of IMPROVE flow or the flashcard .TXT file. Enter in the times that initials and finals were taken. Make sure to use 24-hour time format, as "am" and "pm" options are not available. Make sure the sample change dates are correct; the lab app automatically fills in the Tuesday installation date. If the operator performed the sample change on an alternate date, modify the date.

The rest of the fields are entered by going down the columns, instead of going across rows. Fill in the MxORI / Vac values for all of the modules, from 1A through 4D, if there is a 5th module it will immediately follow the 4D on the log sheets. If two or more values in a row are the same, type in the first value to start with and then press the "+" key on the number pad to copy the same value. This is the preferred method for entering repeating values, as it reduces the chance of typing errors. V4 Controller values are given with another decimal place. The lab app does not support this, so the decimals must be truncated when inputting log sheets.

Next, enter in the initial ORI / Pressure values for each sample date and module, followed by the initial CYC / Flow values. Then, enter the final ORI / Pressure and CYC / Flow values. For 3-2'-2 boxes, there will be 3 entries for week 1 initials and only 2 for finals. The final value for the third position, or moveable, will be added in the second week. 2-3-2' will have this set-up in weeks 2 and 3.

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The next column is for ETs. It is already populated with 1440 ETs; if this is correct, go ahead and Tab through to the status column. If any of the ETs are not 1440, modify them as necessary.

Next, enter in the status code for each sample. The default status is "SO", if the samples are normal, the code to use is "NM." Other codes are described in section 6.8. Fill in the status boxes. Note the status code has to be manually updated for all sites.

The next column is called "FlwSrc". If flashcard information is available for the dates being entered, leave this column as default, which is prefilled with "MC." If there is no flashcard data or flow graph data, change the MCs to "LC, LO or NF". More on this can be found in section 6.8.5.

The following column is "TmpSrc". Temperature is listed on the log sheet above the "Finals" values. Type it in the first box. Press + to add the values to the addition cell(s). The final column should be left as default (M) unless there are no flashcard data or unreliable temperature values. In that case, change the value to "L" or "N".

If a comment needs to be entered, there are filter specific comment buttons, and sample day comment buttons. If an issue applies to only one sample, make sure to note it only in the box with the appropriate date and filter. If an issue applies to the whole week, leave a comment for each sample date. Most comments that can be used are found in the comments drop-down boxes on the lab app, special or newer comments can be found in the comments database can be located in U:\IMPROVE\Logs\StatusFlags\2018 Comment Database.xls.

Repeat these steps for the remaining weeks.

6.8 Simple Problems

6.8.1 Power Interrupt/Power Outage

Some IMPROVE sites are in remote locations or have frequent severe weather, leading to power interrupts or outages. When the power is off, all equipment shuts down including the controller unless the controller has backup power. However, if a site has a backup UPS, only the controller will remain functional and the sampling will halt if it is a sample day.

If there is a short ET on the log sheet and flashcard data indicate a data gap (complete absence of any data lines on the chart, several hours or days between readings in the .TXT file), then it is likely a power issue. Look for comments from the operator on the log sheets regarding loss of power at the site.

If loss of power causes a sample to have an ET of less than 1440 but more than 1080, it is considered to be a "power interrupt." There is a comment for this in the comment database that should be entered for the appropriate sample date(s) while entering the log sheet. As long as there are no other issues with the sample(s), the status (s) should remain NM.

If loss of power causes a sample ET to be less than 1080, the sample is terminal and is considered a "power outage." Add the appropriate comment found in the

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comments database or drop-down box for the appropriate day(s), and status the sample(s) as PO (for Power Outage).

6.8.2 Simple Pump Malfunctions

There are several things on the log sheets and in the flashcard data that can indicate a pump issue. MxORI / Vac is listed for each module on every log sheet. The typical acceptable range for MxORI is from 35-40, while Vac values range from 0-5. Sometimes MxORI values are lower, or VAC values are higher depending on elevation. However, if any pump's MxORI is below 30 or Vac greater than 5, contact the field maintenance team and let them know, as they may want to replace the pump.

A dead pump will not turn on at all, and the MxORI will read 10 or the Vac will read ambient pressure readings, which is the resting value when the pump is not functioning. Initial and/or Final ORI / Pressure readings for that module may also be at resting transducer values. Use flashcard data to determine when the pump failed and how many samples were affected. If the pump failed for less than six hours in a run day, use the appropriate comment but keep the status as NM. If the pump failed for more than six hours on a run day (valid ET<1080), the sample will receive a status of EP (Equipment Problem) and the appropriate pump failure comment should be used. Make sure for either situation to indicate in the comment which module had the failure. Review the Flow Rate data if available, if the pump died the flow rate and pressure readings will be similar to a non-sampling date.

Note that as long as the controller is on and functioning, the controller will think that the pump is on and provide an ET for a full run day as long as there are no other issues. To calculate the real ET, examine the flashcard or flow rate values and find the length in time that the pump was down, and then subtract it from the 1440 ET.

Notify the field maintenance team immediately so that they can troubleshoot the issue with the operators, especially if two or more pumps fail simultaneously. If there is already a notice in the metadata, the field group will have already created a JIRA issue and is working on troubleshooting the issue. State the JIRA issue within the comments section of the filter if the filter is impacted with an invalid filter status. While this situation is likely merely a dead pump, other factors could be at play to cause similar symptoms and must be evaluated as soon as possible.

6.8.3 Late Sample Change

As mentioned previously, operators install filters every week on a designated day (usually Tuesday). If an operator is late performing this change, sample loss is possible. The log sheet should have the dates of sample changes written on them.

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Any samples that occurred between the appropriate installation date and the date the operator did the sample change will likely have an ET of zero unless it was a late sample change on a sample day. Confirm this by examining the flow rate values, filter readings table, or flashcard data through the .TXT / Excel file or through the web app; the controller should have locked out after the designated day and the transducer readings for sample days after that day should read resting values. The final readings' ET should also read "0". These samples should be designated with a status of "NS". If a late sample change occurs during a sample day (not the 3rd position), the sample is only valid if the final ET is above 1080 minutes. Anything less is an "NS". If a week is missed completely (usually indicated by a blank log sheet), all of the samples for that week are "NS". Make sure to use the appropriate comment for each scenario using the comments database.

Occasionally, a late sample change is due to late shipment of a blue box. In this case, missed samples are still considered an "NS", but receive the comment that indicates the late sample change was due to the blue box and not the operator. An alternate reason for a late sample change may be inaccessibility due to weather. If the operator notes on the log sheets they were unable to access the site due to weather, the missed samples are still considered 'NS' but receive the comment that indicates the late sample change was due to severe weather.

6.8.4 C MOD Filter Issues

IMPROVE no longer has double-C FIL sites, in the past two C filters were loaded instead of one for each sampling position. Double-C FIL positions have higher ORI values than single C FIL modules due to the increase in resistance because of the two filters.

Sometimes a mistake occurs during the filter processing and a single C cassette is loaded as a double-C (quartz filters sometimes stick together, and it can be difficult to tell that two are sandwiched together). When double-C filters are loaded instead of a single C, the ORI / Vac values will deviate further from resting values, and the CYC / Flow value drops points due to the increase in resistance. If a double-C filter is suspected, physically check the cassette to determine for sure that two filters were loaded. If so, assign the sample a status of "QD" and enter the appropriate comment in the lab app. The extra 3C filter should be placed in a Petri, labeled with the site, date and 'double C not in DB', then handoff to a Lead Lab Tech to review.

6.8.5 Flashcard Issues

Sometimes operators forget to return flashcards. The laboratory technician or student assistant who opens the box at the Box Receiving Station should add a comment stating that the flashcard is missing. Do a quick check of the week

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bags to be sure that there is no flashcard. If the flashcard is indeed missing and flow rates data is unavailable or unreliable, assign a status of "NM" to all of the filters and change the "FlwSrc" and "TmpSrc" flags from "MC/MO" to "LC/LO or NF." For every week that is missing flashcard data set flags, click on "Use Log Sheet Data" located above "Final Readings" to change the flags from "MC/MO" to "LC/LO". Also add the appropriate comment from the database. Explanations for source codes are at the end of this section.

Email the operator to track down the flashcard and have it sent back. When it arrives, check the data. If the data are complete, change the "FlwSrc" and "TmpSrc" flags back to "MC/MO" and assign statuses as needed. Comment "CFLSH recovered".

Sometimes flashcards fail during a box. If there is only partial flashcard data (not the full three weeks), follow the steps above for any samples that do not have corresponding flashcard data

Flow Source Codes:

- MC: The Memory Cyclone
  - Used for A, B, C modules when there is a flashcard or flow graph data.
- MO: The Memory Orifice
  - Used for D modules when there is flashcard or flow graph data.
- LC: Cyclone values from log sheet
  - For A, B, C modules when there is no flashcard or flow graph data.
- LO: Orifice values from log sheet
  - For D module when there is no flashcard or flow graph data.
- NF/N: Nominal Flow/Nominal Temp
  - For A, B, C, D modules and Temperature when the flashcard, flow graph, and log sheet values are unusable.

6.8.6 4D Cartridge Upside Down

The 4D cartridge is the only cartridge that is installed with the cassettes pointing towards the bottom of the module. Because of this, operators sometimes install it the same way as the 1A-3C cartridges, which for the 4D cartridge is incorrect. If the 4D cartridge samples in the wrong orientation, the first position ORI / Pressure values (and possibly the second if it is a 3-filter cartridge) will be very close to MxVac / Vac values and the CYC will be close to resting values because the first (and second if applicable) will run on a paper position. The filters also may be blown out. Any deposit on the filters will be on the incorrect side. When this occurs, the filters in that cartridge should be assigned a status of BI (for Bad Install) and the appropriate comment should be used.

Sometimes an operator will catch the mistake during filter readings. If the initial readings look abnormal but the final readings are correct, the operator may have

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fixed the issue. Inspect the cartridges to confirm that the filters are intact, and the sample is on the correct side. Also check flashcard data to confirm good run day values. Rule out any other equipment issue (like a "sticky" solenoid) by talking to the field maintenance supervisor. If everything checks out, assign the filters a status of "NM" and note in the comments field that the D MOD ran fine, as the initial values will look incorrect.

6.8.7 Missing Screens

The 1A, 3C, and 4D cartridges are loaded with loose screens. While extremely rare, a cartridge may be sent out without loaded loose screens. The danger in this is that the filters will tear, and the loose material may cause the valve to clog. If there are cassettes with missing loose screens but no filter tears, the ORI values should be low and the CYC values should be high due to reduced resistance. Examine the physical cartridges to confirm that a missing loose screen is the cause for the reduced resistance. Samples that do not have loose screens but are not torn are given a status of "QD" until all further analyses have been completed. If both ORI / Pressure readings are close to resting values and CYC / Flow values for samples of a module are lower than normal (which would occur if flow is reduced due to a clogged valve), check the physical cartridges to see if loose screens were loaded for all samples and that all filters are intact.

If there is a filter that is torn and a screen that is missing in any cassette, contact the field maintenance team immediately. Samples that are torn due to missing loose screens are given the status "XX" (which implies that the lab was at fault for the terminal issue). If a clog in the valve exists due to a torn filter, discuss the situation with the field maintenance supervisor to determine whether or not the reduced flow is low enough for subsequent samples to be given terminal statuses.

6.8.8 Bad Temperature

A temperature probe is located in the 3C module and its values are recorded on the same interval as transducer values. When temperature probes malfunction for the V2 Controller, the values typically read around "4095". V4 Controllers will show Celsius temperatures that are out of range and unreasonable. If a trend like this is noticed, notify field maintenance. Also, if temperatures seem abnormally low or high for a site, talk to the field maintenance team to determine whether the temperature offset may have been set incorrectly (version 6.02 controllers) or whether some other issue is occurring.

6.8.9 Other Issues

Many other problems may occur with IMPROVE equipment; this TI is only meant to discuss the simpler problems that may occur. If values do not look correct and the problems listed above are not applicable, contact the field

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maintenance supervisor or an experienced lab or development technician to help determine the source of the problem.

7. DATA AND RECORDS MANAGEMENT

Field Controller Readings are ingested into the SQL database Filter Readings table. Log sheet data is then uploaded through the lab application from the Filter Readings table.

The corresponding flashcard data are uploaded to a SQL database through the use of the lab app, under the Admin section. A data connection to the SQL database through the web app is used to graph the flow data to help the diagnosis of log sheets. Finally, an Excel file called the Comments Database is used to store standardized comments for use in entering log sheets, if the comment needed is not already found in the lab app.

The flow plotter can be found at: http https://shiny.aqrc.ucdavis.edu/FlowRates/, or it can be navigated to through the web app: http://improve.aqrc.ucdavis.edu/Flows, by going to the Samplers button then clicking the Flows tab.

7.1 Input Log Sheets

The Improve Filter Processing application (lab app) is used to record data from the field log sheets for exposed filters into the various tables in SQL database. Through this program, temperature, pump vacuum readings, orifice / pressure and cyclone / flow values, elapsed sampling time, and filter status are recorded for each filter. A shortcut for the application will be located on the desktop. The software developers and IT department coordinate application updates and will automatically set up a shortcut on the desktop. Contact IT or developers if any issues.

7.2 Flow Rates

Flow Rates is an application (located at https://shiny.aqrc.ucdavis.edu/FlowRates/) used by the lab and other IMPROVE personnel to graph flow data for any site in the network. Users have the ability to view each module separately with the acceptable range of values displayed on the screen, providing users with a quick and easy way to determine if flow values are too high or too low. Users may also view all modules' flow data in the same graph. Finally, temperature values are also graphed for the user's convenience.

7.3 Comment Database

The Comment Database is an Excel file located in U:\IMPROVE\Logs\StatusFlags\2018 Comment Database.xls. It contains standardized comments to use in Input Log Sheets, the comments have been uploaded to the Improve Filter Processing Application. The comments are grouped according to common issues/problems. Each comment also indicates what status code to use for the samples the comment applies to; the lab app does not include the associated status code with the comments.

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UCD IMPROVE Technical Information #251F

Post Sample Processing

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

July 15, 2022
Version 3.0

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Reviewed By: DocuSigned by: Jason Giacomo B62B01F81613421... Date: 10/4/2022

Approved By: DocuSigned by: Marcus Langston 0A10CFCF79B0452... Date: 10/4/2022

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02/11/2022	SRS	All	Previously anthologized version separated into individual TIs
3/21/2022	GRM	All	Updated wording to accommodate adjusted procedure
6/29/2022	TAK	5.4, 5.5	Updated order for field blank processing

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1. PURPOSE AND APPLICABILITY

The purpose of this TI is to describe in detail the procedures used at the Post-sample Processing station. It is applicable to all routine filters in the IMPROVE network.

2. SUMMARY OF THE METHOD

Once all items have been unloaded at box receiving for a bin, the bin is ready for the first station of the Post-Sampling. A custom designed application IMPROVE Filter Processing (lab app) is used to process nylon and quartz filters. At the Post-sample Processing station, sampled nylon and quartz filters and associated field blanks are placed into Petri dishes and put away in a specific order generated by the web app, this order is inventoried by the lead lab tech before they are sent out for analysis. For problem status filters, only nylon, quartz and associated field blanks are removed at this station. These filters are also ordered according to a generated list and stored permanently.

3. CAUTIONS

Many site codes look similar. It is important to make sure that the correct bin is being processed by scanning the barcode associated with the specific bin.

Be careful to make sure that the correct forceps are used for each filter medium. Quartz filters flake very easily and can contaminate other filter types; therefore, it is important to use the appropriate forceps when processing these filters.

Do not clean nylon cassette bottoms with a lab wipe that has been used to clean quartz cassette bottoms. Instead, discard each lab wipe after cleaning all quartz cassette bottoms and use new lab wipes for the next bin.

Be careful to place the correct sampling date cassette label on the corresponding Petri dish. There is no other form to confirm which filter sampled on which date. Be sure to stack the filters in ascending order. If the filters are not found in the correct order during inventory the associated filters have to be given a Questionable Data (QD) status.

4. EQUIPMENT AND SUPPLIES

- Forceps for nylon filters
- Forceps for quartz filters
- Forceps for removing stickers
- Computer with “IMPROVE Filter Processing” application
- Three empty Petri trays (one for nylons, one for quartz, and one for problem filters)
- Brush for quartz
- Ethanol in appropriate container
- Nitrile gloves, lab coat, safety glasses (must be worn when using ethanol)

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- Laboratory wipes
- Container for loose C screens
- Arbor press
- Clean Petri dishes

5. PROCEDURAL STEPS

5.1 Petri Dish and Tray Setup

The counter includes trays full of Petri dishes with already processed 2B and 3C filters. The top of the Petri dishes (the sides without the Pall logo) should have a sticker placed on them and be facing forward when placed in the tray. The Petri dishes are placed in the tray starting from the back left and moving forward in the order processed. Within each site, the oldest dates go in first. Problem filters should be placed in a separate tray labeled "Problems" with the oldest date first as well. If problem filters share a date, place them in the order of their cartridge letters, with 2B (first) to 3C (second) and 5B or 5C (last if applicable). Field blank (FB) problems follow the associated filter type.

All trays are labeled with the name of the type of filter that belongs in them. Trays labeled "B Filters" are for the nylon filters, and the trays labeled "C filters" are for the quartz filters. Problem trays are labeled as "Problems." It is important to make sure that the processed filters are placed into their proper tray.

Prior to beginning work, open the IMPROVE Filter Processing lab app. Open Post-sampling, then select Post-sample Processing and check if there are any sites in the queue. Do not start processing a box if there are no sites in the queue.

If sites are available, then select a bin that appears in the queue and use the scanner to scan the barcode associated with the site. If there are site bins ready to be processed that do not show up on the queue, ask a lead lab tech for help. . If there are multiple bins to choose from, select the higher priority bin based off the IMPROVE calendar. The Post-sample Processing screen will include site name (top of screen), below the site name are two or three tables; one for 2B module (nylon filters) one for 3C module (quartz filters) and one for 5B or 5C module if applicable (Figure 1). Each table contains the following columns "STAT" for filter status, "SAMDAT" for sampling date, "QTR" for calendar quarter, "POS" for position number and "!" for problems.

A field blank will appear in its module's column based on cartridge position (Figure 1).

The "!" button will open a pop-up window to report sample problems (Figure 2). Filter status can be normal or terminal. Normal statuses include NM, SW, SP, SO and QD. The terminal statuses are also called "problems" and will be highlighted in red: PO, EP, NS, BI, OL, and XX (Table 1).

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Figure 1. Post-sample processing with 5C Module.

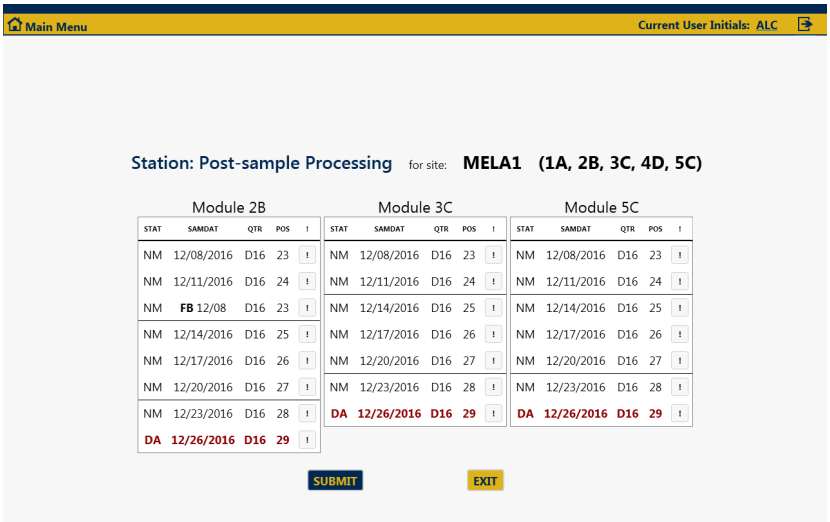

Figure 2. Post-sample processing reporting problems.

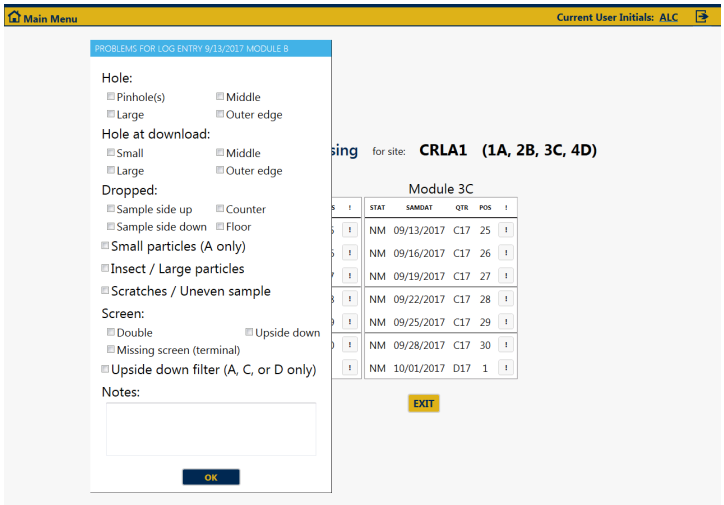

Table 1. Filter statuses.

NM	Normal
QD	Questionable Data, process as Normal
PO	Power Outage
EP	Equipment Problem
NS	No Sample
BI	Bad Install
OL	Offline
XX	Destroyed/No filter
SW	Swapped Sample Dates, process as Normal
SP	Field Blank/ Sample Swap, process as Normal
SO	Still Out

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5.2 Organization

1) Confirm that the bags are in numerical order in the bin, with week 1 in front to week 3 in back. Take the cartridges out of the week 1 bag and place them on the counter in order (1A, 2B, 3C, 4D, 5X; or, red, yellow, green, blue, orange). Make sure that the cartridges are oriented correctly so that the stickered side faces up and position 1 is the bottom right cassette for each cartridge. Do the same for week 2, placing the cartridges behind week 1, then again for week 3.
2) Verify site name and that the dates and position number from the lab app match the cassette labels. This is to confirm that all cartridges were placed in the correct bag. If there is any concern that the dates are not in order, let a lead lab tech know. Also confirm that the cartridge configurations are correct for the cycle that the bin is on. Notify lead lab tech if cartridge configurations are incorrect.

5.3 Rearranging the Cassettes

Yellow bins: Look at the cartridges in week 2. There should be a missing cassette in position 3 for each cartridge, 1A, 2B, 3C, 4D, and 5X. Now look at the cartridges in week 3. The third position cassette from week 3 is removable. It will be the only cassette attached with a black O-ring instead of a white C-clip. Pop the third position out of each cartridge of week 3 and insert them into the appropriate week 2 cartridge (1A to 1A, 2B to 2B, etc.) in the open hole.

Blue bins: Look at the cartridges in week 1. There should be a missing cassette in position 3 for each 1A, 2B, 3C 4D, and 5X. Now look at the cartridges in week 2. The third position cassette from week 2 is removable. The third position cassette from week 2 is removable. It will be the only cassette attached with a black O-ring instead of a white plastic C-clip. Pop the third position out of each week 2 cartridge and insert them into the appropriate week 1 cartridge (1A to 1A, 2B to 2B, etc.).

Immediately notify a lead lab tech if the configuration of the cassettes is incorrect

5.4 Processing of Normal Nylon and Quartz Filters

1) If there are any red highlighted statuses, refer to the instructions below on how to handle problem statuses. If the lab app indicates that all filter statuses are normal, set the 1A and 4D cartridges aside. Remove all the red caps from the 2B 3C, and 5B/C cassettes and place the caps in the week 1 bag. Do not remove the red caps for A and D cassettes.
2) From this point forward, handle only one cartridge at a time. Start with the 2B cartridges and then move on to the 3C then 5B/C cartridges. If any field blanks are present, treat them in the same manner as other cassettes. Field blanks will have handwritten labels and should be put in either the B or C trays when processed, depending on filter type. NOTE: A field blank should be processed and stacked in the order that the filters in the cartridge are unloaded – cartridge positions 1→3.
3) Remove the label from the first position B cassette from week 1 and place it on

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top of a clean Petri dish. Remove the bottom of the cassette using the arbor press and place the filter that lies in between the bottom of the cassette and the screen into the Petri dish. Close the Petri dish. If necessary, use the labeled forceps for the B filters. As the filters are processed, stack the Petri dishes from the earliest date (on the bottom) to the latest (on top). Proceed to process all the B filters in this fashion for all three weeks. Then, place the Petri dishes into the tray marked for B filters (nylons). The proper order of placement in trays is left side first from top to bottom with the oldest date placed in first. Again, field blanks should be placed in front of their counterpart sampled filter. If the tray is filled, continue with the Inventory instructions below.

4) Clean all the cassette bottoms and fixed screens using ethanol and laboratory wipes. Also make sure to clean the cartridge plate.
5) Process the quartz filters in the same order as the nylons. Note that the quartz cassettes have loose screens, so when the cassette bottom is inverted, both the filter and the loose screen will come out. Place the loose screens in the used quartz screen container, which is on the counter at the Post-sample Processing station. Ensure that the filters end up in the correct Petri dish.
6) Clean the 3C cassette bottoms and cartridge plates with laboratory wipes and ethanol. If there is a lot of quartz residue on the cassette bottom, take the quartz brush and brush the cassette bottom while holding it over a garbage can. This ensures that no quartz residue gets on the counter. Then wipe the cassette bottom with ethanol and a lab wipe. As mentioned previously, discard laboratory wipes after the 3C cartridges have been cleaned. Stack the Petri dishes with processed filters in the same fashion as the 2B filters and place them in the tray marked for 3C filters (quartz). If the tray is full, follow the instructions below for Inventory.
7) If there are 5B or 5C cartridges, process and clean these cassettes in the same manner as the 2B or 3C filters. They will go in the B or C inventory directly after the whole set of 2B or 3C Petri dishes.
8) Stack cartridges from each of the three weeks in pairs: 1A+4D and 2B+3C. Place them back in their corresponding bags. 2B and 3C cartridges should be in the bottom of the bag and the 1A and 4D cartridges on the top. This makes it easier for the person at the Post-weigh Chamber-prep station.
9) If a filter is dropped or punctured in any way, then report the problem by selecting the correct problem(s). Make sure to the correct sample date, and medium of the filter was selected. If it was dropped, select sample-side up or sample-side down and counter or floor.
10) If a quartz filter has no screen or double screen report it on the “Problems for Log Entry screen”.

5.5 Handling of Problem Cassettes

1) If any statuses within a bin are highlighted in red, take a red pen and write the problem status abbreviation (e.g., PO) directly on the label(s) belonging to the

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problem cassette(s). Make sure the proper cassette is identified by double-checking the sample date and the cartridge letter with the lab app. If there is a field blank that shares a date with a regular filter that has a problem status, the field blank may have a different status from the regular filter (usually it will remain NM), and should be treated accordingly.

2) Once all problem cassettes are labeled, proceed with processing the problem filters. To begin processing the problem cassettes, handle only one cartridge and cassette at a time. Start with the oldest date and the earliest letter.
3) Move the label from the first cassette to the top of a clean Petri.
4) Remove the bottom of the cassette using the arbor press. For the 2Bs, place the filter into the Petri dish and close. For 3Cs, invert the cassette bottom to remove the filter and the loose screen. Place the loose screens in the appropriate container. Loose screens for Cs go in a container at the Post-sample Processing station. The 1A and 4D problems are weighed at the Post-sample Weigh-In station.
5) Clean the cassette bottom with ethanol and a lab wipe. If it is a 2B cassette, make sure to clean the fixed screen as well. Remember not to use laboratory wipes that were used on a quartz cassette on a cassette of any other filter type.
6) Repeat steps 3-5 for every problem 2B or 3C cassettes in the bin.
7) Once all problem filters have been processed, then place Petri dishes in the Problems tray. Make sure to fill the left side of the tray first, from back to front. Oldest filters should be placed in first, going from 2B, 3C, 5B/C. NOTE: A field blank should be processed and stacked in the order that the filters in the cartridge are unloaded – cartridge positions 1→3.
8) If either tray is full, refer to the appropriate inventory instructions below.
9) Continue with the Post-sample Processing procedure for normal 2B and 3C cassettes in the manner described in the previous section.

5.6 Preparing Trays for Inventory

If any tray is filled, start inventory preparations by finding an empty Petri tray. Empty trays are typically found between the Post-sample Processing station and the Cartridge preparation station. Find six small round stickers to use to label the tray. For nylon (B) filters, the stickers should be yellow. For quartz (C) filters they should be green. Problems and FB problems are labeled with pink stinkers. Four stickers will be used on top of the tray (Figure 3) and two will be placed on the end (Figure 4). The top left sticker should be labeled with the number 1 and the top right sticker with the number 26. Both of these 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 four-digit year and the bottom right needs to be labeled with the identification number(s). These last sticker labels are repeated and placed on the side of the carton, directly under their corresponding stickers.

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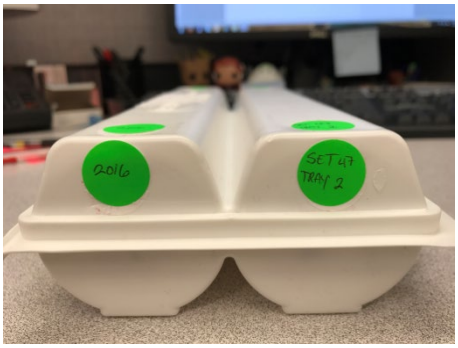
5.7 Identification Numbers for Bs and Cs

The identification numbers for B and C trays are the set number and tray number. To find out what set and tray number to label the tray with, check the inventory list. The last tray inventoried should be marked off. If the tray number on the previous carton is seven or less, copy the set number and add the next sequential tray number to the stickers, then place them on the carton. If the previous carton is labeled as tray 8, the current carton is the start of a new set.

Label the carton's stickers with the next sequential set number and the tray number will be 1 (one).

Figure 3. Top view of labeled inventory tray.

Figure 4. End view of labeled inventory tray.



5.8 Identification Numbers for Problems Trays

The identification numbers for Problems are done in the same way as the B and C trays; 8 Trays per Set.

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5.9 Tray Checking – Inventory

Tray checking, or Inventory, will be performed by the lead lab technician using the Web App Inventory tab. After labeling the trays they are stored at the lead lab tech's desk. The lead lab tech will inventory the filters when a full set is ready to inventoried and deployed to analysis labs.

5.9.1 B and C Inventory Boxes

From http://improve.aqrc.ucdavis.edu/Storage Boxes, select **View** on the most recent set number, click **Generate Tray** to start a 9th tray and copy down the first filter information. This will be the first filter of the new box. Do not complete creating the 9th tray. Instead, click back to box, then back to list to exit out to the Inventory Boxes page. Click the **Add Box** button, fill in the set year and info for the first filter. Click **Find filters**, then select the correct filter. Change the **Set Number** from 0 to the correct number, then select **Save Box** at the bottom of the page. From here, generate trays 7 through 8. The process for doing a thorough check and shipping filters is found later in this document, in *UCD IMPROVE TI #251M: BC Filter Shipments*.

5.9.2 Problem Filters

Find the 1st filter of a box in the same way as stated above for B and C filters. Use the list to check all of the filters rather than doing a quick check. The B and C problems are kept in a storage tray at the Post Processing Station, the A problems are kept in a storage tray at the Post Sample Weigh-In Station.

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Post-Weigh Chamber Prep

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

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Reviewed By: DocuSigned by: Jason Giacomo B62B01F81613421... Date: 10/4/2022

Approved By: DocuSigned by: Marcus Langston 0A10CFCF79B0452... Date: 10/4/2022

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1. PURPOSE AND APPLICABILITY

The purpose of this TI is to describe in detail the procedures used at the Post-Weigh Chamber Prep station. It is applicable to all routine PTFE filters in the IMPROVE network that have been pre-weighed through the MTL AH500 chambers.

2. SUMMARY OF THE METHOD

Once all nylon, quartz, and their associated problem filters have been removed from a bin, it is ready to go to Post-Weigh Chamber Prep. Sampled PTFE filters and all problem filters are transferred from petri-dishes to carriers to be weighed through the MTL AH500 chambers. Filters are loaded into the MTL AH500 chambers and stored until they can be processed through Post-sample weigh-in station.

3. CAUTIONS

Many site codes look similar. It is important to make sure that the correct bin is being processed by scanning the barcode associated with the specific bin.

Be careful of the orientation in which the cassettes are stacked. All A filters should be stacked first, followed by D filters. Field blanks are stacked at the end of their corresponding week and corresponding module. For 2-3-2' boxes the field blanks are stacked at the end of week 1, and for 3-2'-2 boxes the field blanks are stacked at the end of week 3.

Be careful to place the correct sampling date cassette label on the corresponding Petri dish. Be sure to stack the filters in ascending order for feasible access to the operator unloading the carriers from the AH500 chambers and conducting post-sample weigh-in.

Make sure to handle only one cassette at a time. Having two or more cassettes open while processing filters increases the risk of filter swaps. Make sure that the filter barcode being unloaded matches that of the Lab Application. At times operators conduct incorrect filter installments.

Sometimes the loose screens stick to the filters. Try gently holding the filter and screen with one pair of forceps while separating 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, with the sample 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. If a filter has sample on the wrong side, note this in the lab app and notify a lead lab tech.

4. EQUIPMENT AND SUPPLIES

- Automated Handler Chambers
- Computer with Improve Filter Processing balance application
- Forceps with ceramic tips

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- Grid disks for workspace Container for used loose 1A and 4D screens
- Clean Petri dishes
- Arbor press
- Clean MTL carriers
- Ethanol
- Nitrile gloves
- Safety glass or goggles
- Laboratory coat

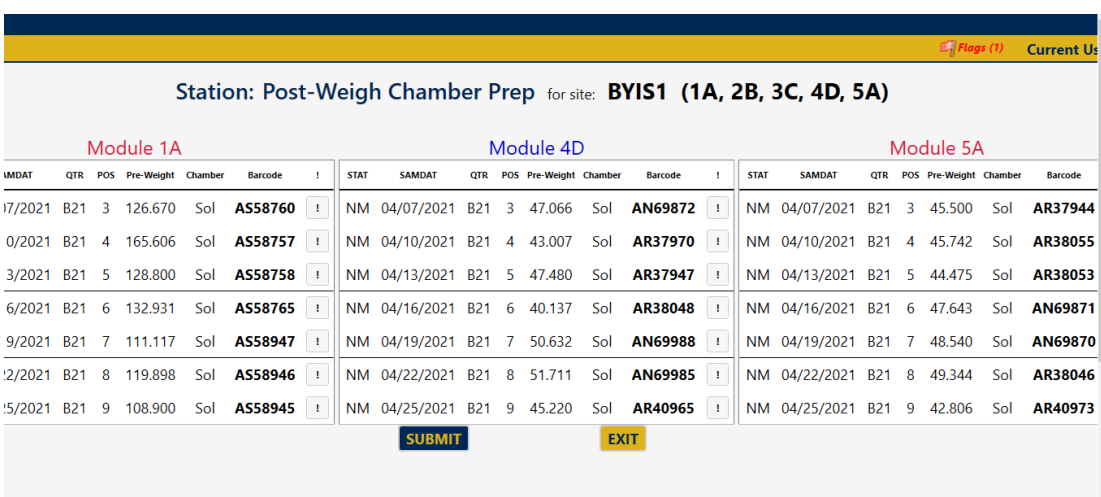
5. PROCEDURAL STEPS

Open Filter Processing lab app. Open Post-sampling select Post-weigh Chamber Prep, scan-in the bin or enter the three-letter name. The Post-weigh Chamber Prep will include site name (top of the screen), below the sites name are two or three tables; one is for 1A module ($PM_{2.5}$ PTFE filters), one for 4D module (PM_{10} PTFE filters), and one for 5A /5D module if applicable (Figure 1). Each table contains the following columns, "STAT" for filter status, "SAMDAT" for sampling date, "QTR" for calendar quarter, "POS" for position number, "Chamber" for identification of which chamber unit the filter was pre-weighed through, "Barcode" that identifies the unique filter barcode, and "!" for flagging purposes.

A field blank will appear in its module column based on the cartridge position (Figure 1).

The "!" button will open a pop-up window to report sample problems (Figure 2). Filter status can be normal or terminal. Normal statuses include NM, SW, SP, SO and QD. The terminal statuses are also called "problems" and will be highlighted in red: PO, EP, NS, BI, OL, and XX (Table 1).

Figure 1. Post-Weigh Chamber Prep processing with 5A module.



Module 1A							Module 4D								Module 5A						
AMDAT	QTR	POS	Pre-Weight	Chamber	Barcode	!	STAT	SAMDAT	QTR	POS	Pre-Weight	Chamber	Barcode	!	STAT	SAMDAT	QTR	POS	Pre-Weight	Chamber	Barcode
07/2021	B21	3	126.670	Sol	AS58760	!	NM	04/07/2021	B21	3	47.066	Sol	AN69872	!	NM	04/07/2021	B21	3	45.500	Sol	AR37944
0/2021	B21	4	165.606	Sol	AS58757	!	NM	04/10/2021	B21	4	43.007	Sol	AR37970	!	NM	04/10/2021	B21	4	45.742	Sol	AR38055
3/2021	B21	5	128.800	Sol	AS58758	!	NM	04/13/2021	B21	5	47.480	Sol	AR37947	!	NM	04/13/2021	B21	5	44.475	Sol	AR38053
6/2021	B21	6	132.931	Sol	AS58765	!	NM	04/16/2021	B21	6	40.137	Sol	AR38048	!	NM	04/16/2021	B21	6	47.643	Sol	AN69871
9/2021	B21	7	111.117	Sol	AS58947	!	NM	04/19/2021	B21	7	50.632	Sol	AN69988	!	NM	04/19/2021	B21	7	48.540	Sol	AN69870
2/2021	B21	8	119.898	Sol	AS58946	!	NM	04/22/2021	B21	8	51.711	Sol	AN69985	!	NM	04/22/2021	B21	8	49.344	Sol	AR38046
5/2021	B21	9	108.900	Sol	AS58945	!	NM	04/25/2021	B21	9	45.220	Sol	AR40965	!	NM	04/25/2021	B21	9	42.806	Sol	AR40973

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Figure 2. Post-Weigh Chamber Prep processing reporting problems.

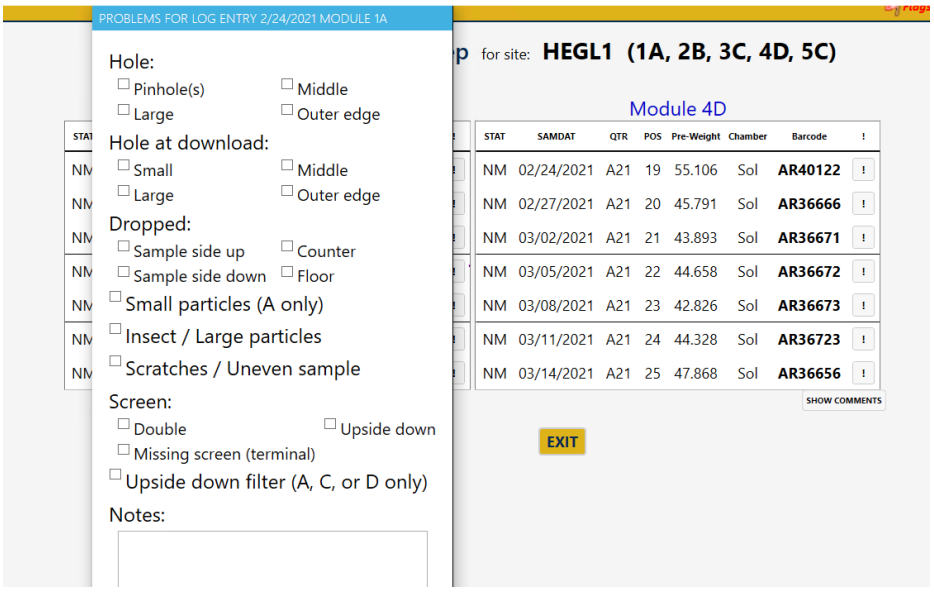

Table 1. Filter statuses.

NM	Normal
QD	Questionable Data, process as Normal
PO	Power Outage
EP	Equipment Problem
NS	No Sample
BI	Bad Install
OL	Offline
XX	Destroyed/No filter
SW	Swapped Sample Dates, process as Normal
SP	Field Blank/ Sample Swap, process as Normal
SO	Still Out

5.1 Unloading and Processing PTFE Filters

1. 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.
2. Remove the label from the first sampled cassette in the 1A cartridge and place it on a clean Petri dish. The first sampled position is position one located on the bottom right-hand of the cartridge. All filters must be unloaded and weighed regardless of status.
3. Open the first sampled cassette with the arbor press. Overturn the cassette bottom over the grid disks. There should be a loose screen and a filter in each cassette

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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.

a. 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 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 the filter to where the alphanumeric code is legible and matrix code is visible.

4. Remove the first 1A Filter from its cassette and load it into a clean Carrier with the sample side faced up. Make sure that the filter barcode matches the corresponding filter in the LabApp. If the barcode does not match immediately contact a lead lab tech. The alphanumeric code and Filter Barcode should be legible and right-side up. Transfer the corresponding Cassette Sticker to the top of a clean unused Petri dish. Place the Petri dish with the sticker-side faced down.

5. Closely inspect each 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 see a-l below for further details. Click on the **"!"** button for the correct module and sample date.

   a. Hole: refers to existing rips or holes (filter was damaged prior to current station), then select a hole size, pinholes are the size of a needle or smaller. Large holes are anything bigger than a pinhole. Next select hole location, middle of the filter or the outer edge. Notify a lead lab tech if there is a large hole and the filter status is valid.

   b. Hole at download: the filter was damaged at the current station. Select, a hole size. Small is the size of the tip of a pinhole. Next select a location. Notify a lead lab tech if was damaged by a large hole.

   c. Dropped: If a filter is dropped on the counter or on the floor, it should be reported on the lab app. Indicate whether it fell sample side down or sample side up. Make sure to select both where the sample fell and the sampled side.

   d. Small particles (A filter only): select if visible particles on the filters.

   e. Insect/Large particles: select if bugs or large particles are visible. If present on A filter notify lead lab tech immediately. If present on D filter, then remove the bug or large particle without damaging filter prior to weighing, ask lead lab tech for help if necessary.

   f. Scratches/Uneven sample: select if specks, nonhomogeneous, or a patterned sample (on A's only): The color of any speck on a filter should also be noted

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(usually white or black). Note if there are multiple specks.

g. Screen: select **Double** if more than one screen present, select **Missing** if no screen present, and select **Upside Down** if screen was loaded on the wrong side.

h. Upside down filter: select if the sample is on the side without the alphanumeric code. If weighed through the chamber, ensure that the alphanumeric code is facing upwards when placed on the carrier.

i. Anodized Dust (D filters only): Anodized dust looks like wispy dark specks on the filter.

j. Peeling/Flaking: if sample is uneven due to sample peeling or flaking, notify lead lab tech. Peeling will typically occur at the edge of a filter. Sample loss due to flaking occurs when sample is dry.

k. Water spots: notify lead lab tech if water spots are present and enter a note into the LabApp.

l. Finally, if there is anything not listed above that is found on the filter and is abnormal, make sure to enter a detailed note.

6. Continue unloading and stacking all 1A filters for the box.
7. Remove the first 4D Filter from its cassette and load it into a clean Carrier with the sample side faced up. The Filter Barcode should be legible and right-side up. The corresponding Cassette Sticker can be discarded.
8. Continue for all 4D Filters for the box.
9. If the site contains a fifth 5A or 5D module treat it exactly as its counterpart. The order of stacking will follow the 4D filters.
10. Clean all cassette bottoms and tops using ethanol and laboratory wipes. Also make sure to clean the cartridge plate. Place all cassette bottoms in Week 1 bag.

5.2 Loading of PTFE Filters into MTL AH500 Chambers

1. In the end, there should be a stack of Filters in Carriers (one filter per carrier). Be vigilant that the field blank is placed at the end of the corresponding week and module type (Week 1 for 2-3-2', Week 3 for 3-2'-2). There should also be a stack of Petri dishes with the 1A Filter Cassettes stickers on them. All of these should be Cassette-sticker side faced down, with the oldest Sampling Date at the bottom and the most recent Sampling Date at the top. When complete with the box select submit and load the carriers into the corresponding chamber or holding bin.
2. Load the occupied Carriers into an empty Silo, loading Post-Weigh filters in Silos towards the right.
3. The stack of upside-down 1A Filter Petri dishes can be reverted to right side up and placed towards the front of a bin.

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4. This procedure can be repeated for the subsequent sites. 1A Filter Petri dish stacks are placed front-to-back in the same order that the Sites are processed. Note this order and the number of filters for each site on the "Post-Weigh Loading Sheet" form. Ensure that the "Post-Weigh Loading Sheet" is for the correct chamber by referring to the pseudonym 'Luna' and 'Sol'.
5. Continue to stack up Post-Weigh Carriers. Each Silo fits up to 100 Carriers. Do not stack the filters all the way to the top of the Silo as they can become difficult to remove. Stack each silo up to 80 carriers. Do not split the Filters / Carriers for a Site between Silos. If a complete Site will not fit, use the Silo to the left.
6. After all A and D filters have been unloaded, place the bin the Cartridge Preparation rack.

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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

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Version 3.0

Prepared By: DocuSigned by: Anthony Kawamoto 3A49A57FF666452... Date: 10/4/2022

Reviewed By: DocuSigned by: Jason Giacomo B62B01F81613421... Date: 10/4/2022

Approved By: DocuSigned by: Marcus Langston 0A10CECF79B0452... Date: 10/4/2022

UCDAVIS
AIR QUALITY RESEARCH CENTER

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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.

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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, the site it is ready to go to Post-sample Weigh In. Sampled PTFE filters and all problem filters are weighed on a microbalance and their post-weights are recorded using a custom designed application Improve Filter Processing (lab app). A module filters are prepared for further analysis, and D module filters are prepared for permanent storage.

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 two or cassettes 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 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 lead lab tech immediately for both scenarios.

4. EQUIPMENT AND SUPPLIES

- Mettler Toledo XPR6UD Microbalance
- Automated Handler Chambers
- Mettler Toledo XP6 Microbalance
- Computer with Improve Filter Processing balance application
- Antistatic unit
- Forceps with ceramic tips
- Polonium strips (small and large)
- Container for used loose 1A and 4D screens
- Clean Petri dishes

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- Clean slides
- Arbor Press
- Designated 1A Petri trays and 4D slide trays
- Block for stabilizing 4D slides

5. PROCEDURAL STEPS

5.1 Manually Weighing

1) There is one microbalance, 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 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.

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 ½ 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

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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 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 TI 251G *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, leave a detailed note for a lead lab tech. 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, leave a detailed note for a lead lab tech. Also, if an A filter

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has a greater or equal to mass difference than a D filter, a pop-up message will appear, leave a detailed note for a lead lab tech.

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. Make sure that the petri is placed into its correct corresponding month.

17) Repeat steps 11-17 for all 1A filters in the week.

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 5A filters the process is identical to the 1A process. The process for 5D filters is identical to 4D except the 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. If this value has a difference greater than or less than ± 0.005 from its pre-weight, write detailed note for lead lab tech.

21) The lab app will automatically move to week 2 of the A filters. 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.

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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.

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.

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If the scanner for the selected login credentials shows up on that list, higlight 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 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.

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.

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 Problem PTFE Filters

1) If any statuses within a bin are highlighted in red, take a red pen and write the problem status abbreviation (e.g., PO) directly on the label(s) belonging to the problem filter(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 problem 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 a separate 'Problems' tray. Ensure that the order in the tray starts with the oldest 'problem' 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 problem 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).

    c. Rotate the filter 30º - 45º at a time and press the **Trigger** button each time. Try to keep both barcodes within view and away from the Carrier's three

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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 filer 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:

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

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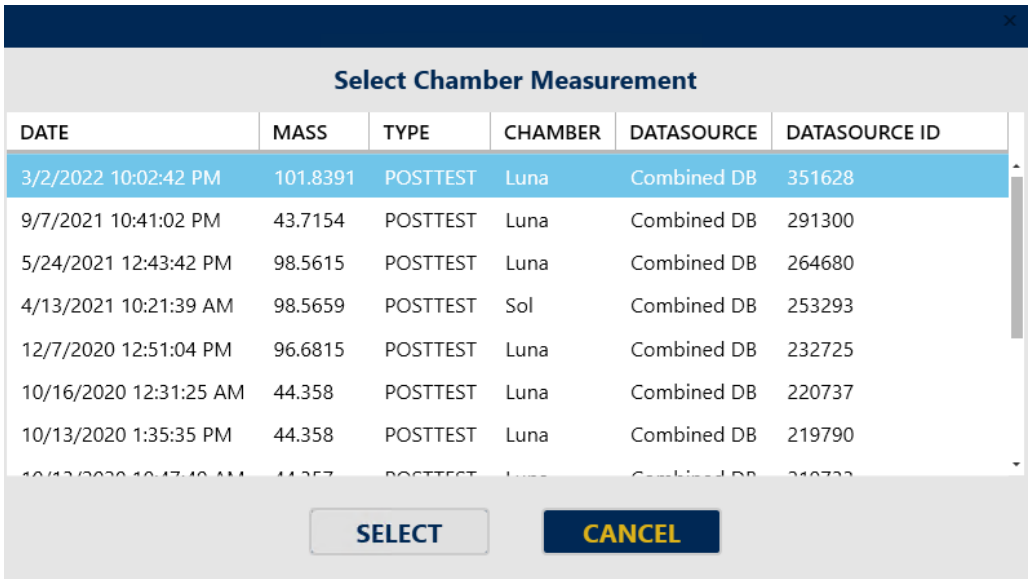
- Missing filter

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

SELECT CANCEL

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 work station 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 problem filters. For problem 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 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.

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UCD IMPROVE Technical Information #251I

Cartridge Preparation Station

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

July 15, 2022
Version 3.0

Prepared By: DocuSigned by: Anthony Kawamoto 3A49A57FF666452... Date: 10/4/2022

Reviewed By: DocuSigned by: Jason Giacomo B62B01F81613421... Date: 10/4/2022

Approved By: DocuSigned by: Marcus Langston 0A10CECF79B0452... Date: 10/4/2022

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02/17/2022	SRS	All	Previously anthologized version separated into individual TIs.
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Figure 2. Cartridge prep with 5A Module. 9

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1. PURPOSE AND APPLICABILITY

This TI details the procedures used for the Cartridge Preparation station in the sample handling laboratory and establishes uniform guidelines for how to perform these tasks. These instructions are applicable for any IMPROVE network site box.

2. SUMMARY OF THE METHOD

The Cartridge Preparation station is the first in the process of loading filters to be sent back out into the field. Cartridges are checked for proper orientation. All cartridges are labeled with fresh stickers for the new cycle. 2B and 3C filters are loaded, a flashcard is assigned, and field blanks are designated if necessary.

3. DEFINITIONS

- Dummy: a placeholder used for cassette positions that are not sampling positions and do not contain filters

4. CAUTIONS

When loading quartz filters, it is important to load a single screen and filter in each cassette. Failure to load a screen at all or loading two screens instead of one can severely affect sampling out in the field.

Some sites have very similar names. It is important to use the correct stickers when labeling cartridges and week bags so that no confusion occurs at later stations or in the field.

5. EQUIPMENT AND SUPPLIES

- Labeled Compact Flashcard or SD Card
- Bins with empty cartridges
- Computer with lab application
- Barcode scanner
- Week stickers (with site name and installation date)
- Cassette stickers (with site name and sample date)
- Sharpies/highlighters (red, yellow, green, blue, black)
- Necktie stickers (A, B, C, D, X)
- Dot stickers (red, yellow, green, blue, orange)
- Blank cassette stickers
- Black pen
- Clean 6 mil re-closable bags
- Pre-labeled 6 mil re-closable Week bags

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- Container of clean quartz screens
- Designated quartz forceps
- Stainless steel forceps for nylons
- Stainless steel forceps for quartz
- Clean quartz filters
- Clean nylon filters

6. QUALITY CHECK PROCEDURE

6.1 General Information

Bins ready to go through the Cartridge Preparation station are free of any sampled filters and placed near the Cartridge Preparation station.

Bins go through the Cartridge Preparation station according to priority. Priority is determined by the IMPROVE Calendar Cycle. Bins with pink or white labels will have three or more boxes in circulation and are higher priority depending on the IMPROVE calendar.

6.2 Quality Check of the Cartridges

The first step at the cartridge prep station is to remove the stickers from the week bags and then dispose of them. Remove all cartridges from the three-week bags and line them up by week. Perform a quick integrity inspection of all cartridges to make sure no portions of the cartridge are damaged and they have been cleaned thoroughly. Wipe down any cartridges that need to be and replace any parts. Parts that may need replacing include: dot-colored stickers, rubber o-rings, c-clips, cassette bottoms or tops.

Be able to recognize which cartridges (1A-5X) should be in which bag. Make any necessary corrections. Lists of how cartridges should be configured for each cycle type are below:

6.2.1 2-3-2 Yellow-bin Boxes

- Week 1: All 4 C-clip positions, with neckties on positions 1 and 2.
- Week 2: C-clip positions in positions 1 and 2, with an O-ring cassette in position 3. The 3 positions should have neckties. Position 4 should have a C-clip position with no necktie.
- Week 3: C-clip positions with neckties for positions 1 and 2. There should be an open hole in position 3 (no cassette). Position 4 should be a C-clip position without a necktie.

6.2.2 3-2-2 Blue-bin Boxes

- Week 1: C-clip positions for positions 1 and 2, with an O-ring cassette in

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position 3. These three positions should have neckties. Position 4 should have a C-clip and no necktie.

- Week 2: C-clip positions with neckties for positions 1 and 2. There should be an open hole in position 3 (no cassette). Position 4 should be a C-clip position without a necktie.
- Week 3: All 4 C-clip positions, with neckties on positions 1 and 2.

6.3 Week Bag Check

1) Check that week bags are presentable. They should be clean and without holes.
2) If unsure about a week bag, it is safer to replace it.
3) Pre-labeled week bags are located on a shelf at the Cartridge Preparation station. If there are none, make more using fresh 6 mil resealable bags and a black Sharpie.

6.4 Necktie Check

1) Check that there are clean neckties on all sampling positions (not on field blanks). Replacements for all A, B, C, D, and X neckties can be found on a shelf at the cartridge prep station.
2) If any necktie is fading or falling off, replace it. Clean the cassette neck with ethanol and a lab wipe before applying the sticker.

6.5 Access the Lab Application

1) Open the lab application. Navigate to Pre-Sampling, and then Cartridge Preparation, entering three-letter initials if necessary.
2) Scan the bin barcode (begin typing in the 5-character site code if the bin is unlabeled; select the site from the list).
3) Select up to four Field Blanks (FB) if the quota is not met. Otherwise select **None**.
4) In a tray at the Cartridge Preparation station, find the flashcard associated with the site. If the 8-digit serial number is listed on the left column, select it. Otherwise confirm with a lead lab tech before entering a new card number.

6.6 Stickering Bags and Cartridges

1) Bag and cassette stickers for all sites can be found in the filing cabinet. If any stickers are missing, ask a lab tech to print new ones.
2) Verify that the Cartridge and Bag stickers match the dates listed by the lab application. If they do not, contact an authorized lab tech. A line divides each week. SAMDAT (Sampling Dates) appear in the correct order of oldest at the top, to more-recent at the bottom, and module type should match, for each filter type. If there is a FB it will be noted in a separate table next to the flashcard info.

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3) Place the appropriate bag label on each week's bag. They are site and week specific.
4) Sticker all cartridges. Sticker Wk1→Wk3, POS 1→POS2, etc. for the appropriate filter type. Only sticker cartridges one week at a time to avoid mix-ups and confusion.
5) Determine whether or not field blanks need to be loaded.
    a. If no field blanks need to be loaded, continue to 6.
    b. Make the appropriate FB labels. Blank FB stickers are located at the Cartridge Preparation station. Label the sticker with the information reflected by the lab application (with the appropriate site, ordinal position, FB filter type, and sample date (the same sample date as the filter in position 1 of the appropriate week)).
    c. All field blanks are always in position 3. Field blanks are located in week 1 for yellow-bin (2-3-2') boxes and should have the same sampling date as the first position for that week. Blue-bin (3-2'-2) field blanks are located in week 3 and should match the sampling date of position 1 for that week.
6) After bag and cassette stickers are used, leave them in the appropriate desk tray on the shelf at Cartridge Preparation station. These will need to be returned to the filing cabinet at a later time.

6.7 Dummy Check

1) All positions without a necktie should have a correctly colored dummy set and screen. The dummy for the 1A cartridge is a thin, clear plastic disc and a circular red piece of construction paper. The clear plastic disc is placed in the cassette bottom, followed by the circular piece of construction paper. The dummy for the 3C, 4D, and 5X cartridge follows the same procedure except that the construction paper circle is green, blue, or orange instead of red. The 2B or 5B dummy consists of two white circular papers with blue type spelling "PALL" written on one side. The papers are placed type-side down into the cassette bottom.
2) If field blanks were designated and a field blank sticker was placed on the cartridge, remove the dummy set from that position. Clean the cassette bottom to prepare it for loading.
3) If a field blank was loaded previously but is not being loaded in the current box, fill that position with the appropriate dummy set. If it is a 1A, 3C, or 4D cassette, also make sure to put a correctly-oriented loose screen on top of the dummy set.

7. PROCEDURE FOR LOADING NYLON AND QUARTZ FILTERS

The second part of the Cartridge Preparation station is loading 2B and 3C filters.

1) Find the two sets of forceps needed for B/C filter loading. Each is used exclusively for one filter type and marked with a corresponding necktie

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around the end of the handle. If the forceps are not marked alert the lead lab tech.

2) There should be a box of nylon filters and a box of quartz filters at the station. If there are not any, notify a lead lab tech so that they can check out a new box. These filters are both stored in the IMPROVE SHLfridge; the nylon filters are in a fridge and the quartz filters are in a freezer.

3) Remove all red caps from the Week 1 bag. Stack the 1A on top of the 4D cartridges, keeping them together by week. These will not be loaded until the next station. Line up the 2B and 3C cartridges according to week.

4) Loading 2B filters: Separate the top and bottom pieces of the cassettes for all the sampling positions. Use a pair of 2B forceps to remove the 2B filters from their container. The filters are white and there are pieces of paper with the PALL logo on them to separate the filters. Throw away the papers. The 2B filters do not have any orientation. Simply place one in each cassette bottom. After loading a filter, close the cassette by putting the cassette bottom and top into the arbor press and then pushing down on the lever to close them together. When all filters have been loaded, put red caps on all cassette bottoms.

5) Loading 3C filters: Separate the top and bottom pieces of the cassettes for all sampling positions. Use a pair of 3C forceps to remove the quartz filters from their container. These filters do not have any paper to separate them. Be sure to take only one at a time. The 3C filters have a proper orientation: the roughest side must be facing up in the cassette bottom. Once a filter has been loaded into a cassette bottom, use forceps to pick up a loose 3C screen from the container at the station and place it on top of the filter. Make sure the screen is oriented so that the side with the engraved "UP" is facing up out of the cassette. After loading a filter, close the cassette by putting the cassette bottom and top into the arbor press and then pushing up on the lever to close them together. When all filters have been loaded, put red caps on all cassette bottoms.

6) When all 2B and 3C filters have been loaded and capped, return them to their appropriate week bags, along with the 1A and 4D cartridges. Place 2B and 3C cartridges at the bottom of each bag and 1A and 4D cartridges at the top. Place all remaining red caps in the Week 1 bag and move the bin to the "Pre-sample Weigh-in" cabinet.

7) Specialty Cases:

   a. 5X module sites: Some sites have a 5th module. This means that a site will have three bags with five cartridges in each. The 5th module can be any filter type. If it is a 1A or a 4D, no further work needs to be done. If it is a 2B or a 3C module, make sure to load the cassettes with the appropriate filter type. Note: 1A, 2B, 3C, or 4D cartridges in 5th module site bins are all labeled with an orange dot sticker and X neckties. To identify the appropriate filter type, refer to the lab application and confirm with the 5X module cassette and bag labels (Figure 1 and Figure 2).

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8. SUBMIT RECORDS

Re-check all neckties, stickers, dummies, bags, and cassette organization, then submit the records through the lab app.

Figure 1. Cartridge prep with 5C Module.

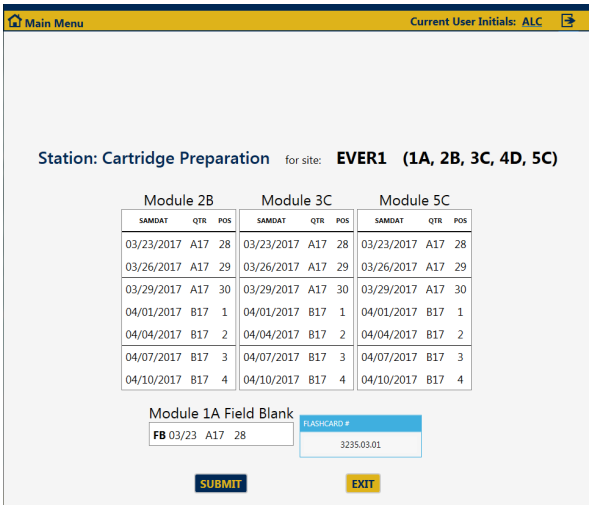
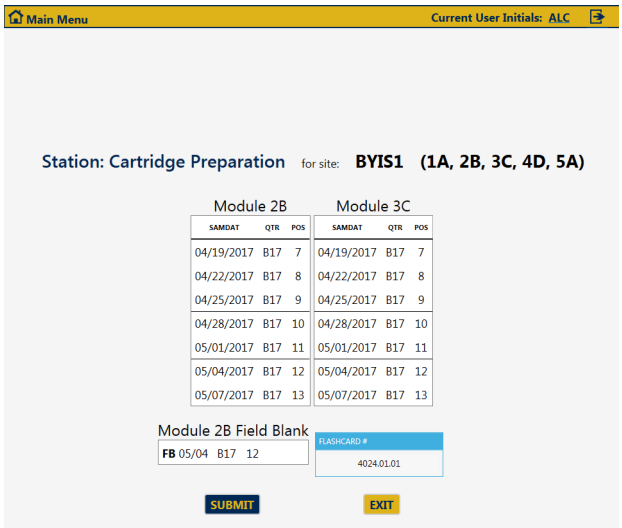


Figure 2. Cartridge prep with 5A Module.



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UCD IMPROVE Technical Information #251J

Pre-Sample Weigh In

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

July 15, 2022
Version 3.0

Prepared By: DocuSigned by: Anthony Kawamoto 3A49A57FF666452... Date: 10/4/2022

Reviewed By: DocuSigned by: Jason Giacomo B62B01F81613421... Date: 10/4/2022

Approved By: DocuSigned by: Marcus Langston 0A10CFCF79B0452... Date: 10/4/2022

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1. PURPOSE AND APPLICABILITY

The purpose of this TI is to describe the procedures used to weigh and install clean 1A and 4D PTFE filters to be sent back out into the field. These procedures are used for every site in the IMPROVE network, though many of them generally apply to special studies as well.

2. SUMMARY OF THE METHOD

Clean PTFE filters are weighed on a microbalance. The weights are recorded using the lab application. PTFE filters are loaded into labeled cassettes. Log sheets are generated, one for each week. Bins are then ready for the Quality Check station.

3. CAUTIONS

Many site names are similar. It is important to ensure that the site being loaded in the Pre-sample Weigh-in program matches the site name on the bin.

Make sure to handle only one cassette and one filter at a time. Having two or more cassettes open while loading filters increases the risk of filter swaps.

When loading PTFE filters, it is important to place a single screen in each cassette. Failure to load a screen at all or loading two screens instead of one can severely affect sampling out in the field. It is important to load the PTFE filter with the alphanumeric code facing down on the bottom portion of the cassette. Make sure to use the correct login information at the Pre-sample Weigh-in computer.

4. EQUIPMENT AND SUPPLIES

- Mettler Toledo XP6 Microbalance
- Computer with lab application
- Barcode scanner
- Antistatic unit
- Forceps with ceramic tips
- Container of clean 25 mm loose screens
- Polonium strips (small and large)
- Clean PTFE filters
- Printer
- Log sheet paper
- Extra red caps

5. PROCEDURAL STEPS

5.1 Manually Weighing

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1. Refer to section 5.1 of TI 251H: Post-Sample Weigh In for general precautions. These instructions only cover the new and or different parts of the Pre-Weigh station and will not delve into every step. There is one micro balance at the Mettler 1 station. There should be one set of forceps to be used for the PTFE filters. Make sure to use the correct login information at the station. The username and password are posted in the safety glasses cabinet.
2. Remove the PTFE filters from the box and line up as many as possible but safely (do not let the filters fall onto the counter) on the polonium strips. Use the forceps, making sure to grab the filters by the plastic edge. Throw away the clear plastic circles that are on the top and bottom of each stack of filters if applicable. If there are not PTFE filters readily available, notify a lab assistant to check-out more.
3. Open the Lab Application. Navigate to Pre-Sampling, and then Pre-sample Weigh-in, entering three-letter initials. Scan the bin barcode (type in the 5-character site code if the bin is unlabeled).
4. The cartridges should have already been stickered by the time the bin gets to this station. Remove the 1A and 4D cartridges from week 1. Verify that the Cartridge and Bag stickers match the dates listed by the Lab Application. If they do not, contact an authorized lead lab assistant. A line divides each week. SAMDAT (Sampling Dates) appear in the correct order of oldest at the top, to more-recent at the bottom, and module should match, for each filter type
5. Make sure that the balance reads 0.000 mg. If it does not, alert the lead lab tech. Check the level bubble at the top of the balance. If the bubble is outside of the circle, ask a lead lab tech to level it before continuing.
6. Make sure that there is ½ 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.
7. Wait for the lab application to accept the zero weight. Take the forceps and pick up a PTFE filter from the polonium strips. Look at the filter. Make sure that there are no holes. If a speck can be seen on the filter, try to flick it off by tapping the edge of the forceps. If the speck will not come off, place it in the box on the weight table that is labeled, “Specks.” If a hole is found, place it in the box labeled, “Holes.” If the filter is dropped or injured in any way due to handling, place it in the “Dropped” box.
8. Ensure that the filter is oriented correctly. The alphanumeric code on the outer rim of the filter is facing up. Pass the filter through the antistatic unit on the right side of the balance. Open the balance by pressing the right arrow button. With the wrist remaining within the ionizing strip’s effective zone, gently place the filter on the pan shiny side down and press the same button to shut the door.
9. The top row in the A module column with the first sample date row will appear

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highlighted. Therefore, the filter that is being weighed belongs to position 1 of the A module. There will be an area for text to the right of the weights box that will read "Waiting for stable weight." While waiting for the balance to stabilize, open the first position of the physical 1A cartridge. Do so by putting the cassette in the arbor press and pulling down on the lever. Take the cup from the bottom of the press and set it next to the polonium strips. When the filter weight is stable, the program will pick up the weight and display it in the green box.

10. After the filter's weight stabilizes and a weight is displayed, the text area will offer several options: **[A]** to accept and continue; **[R]** to discard and retry. Check to make sure that the weight the balance display reports matches the number on the computer monitor. If the two numbers differ, then press **[R]** to discard and retry. If the weights match, press **[A]**. The text area will be confirmed that the weight is saved. Remove the filter. Open the balance door and gently grab the filter (again by its outer edge) with the forceps. Set the filter down into the cassette bottom. Make sure that the filter is alphanumeric code faced down in the cassette bottom. The proper orientation is extremely important. Then, retrieve a clean loose screen from the container on the weight table and place it on top of the filter. Make sure the side with the engraved "UP" is facing up in the cassette cup. Make sure to load only one, as they can sometimes stick together.

11. The program will wait for a stable zero weight from the balance. Alert the lead lab tech if it fails to do so by itself. After, the program displays "Waiting for stable weight" in text area, place another filter on the balance. Now the space for the second position A filter will be highlighted. Pick up another filter and place it on the balance. Be sure to close the balance door. The computer will automatically start waiting for the balance to stabilize. Filters are weighed by week, with 1A filters weighed first in order of earliest to more recent sampling dates, the 4D filters in that same order. Proceed with the rest of the filters in the box.

12. Make sure while weighing that all weights in a week are ± 0.100 mg apart from each other. The program will perform this check and prompt for a replacement weight when necessary. If filters are too close in weight, select **NO** on the pop-up screen and select another filter to weigh.

13. When all three weeks are complete, the lab application will offer the chance to change a weight. Whenever replacing a weight at the end of a box, contact an authorized lead lab assistant. Next, submit records and retrieve the log sheets for the box from the printer. The site name is printed in the center at the top of each log sheet. Confirm that the log sheets match the site that was just loaded. Fold the log sheets in half lengthwise, then widthwise and place them in the correct weeks. Place all red caps on the bottom of the 1A and 4D cartridges. Place the completed bin in the cabinet at the "QC Check" station.

14. Special Case #1: 5X module-boxes. Some bins will have an additional cartridge in each week bag. If the 5th module is an A or a D, it will show up on the weigh

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in page with the 1A and 4D samples (Figure 1).

15. Special Case #2: C-only site. C-only site (DETR1) will not need to have any filters weighed at the load station. Simply submit records to print the log sheets (Figure 2).

5.2 Weighing in MTL Autohandler Chambers

Refer to section 5.2 of TI 251H: Post-Sample Weigh In for general precautions and for the weighing of the clean filters. These instructions only cover the new and or different parts of the Pre-Weigh station and will not delve into every step. Prior experience with the manual Pre-Weighing station is required, and the same procedural considerations must be observed.

1. Prepare a set of filters (~15) that have already been Pre-Weighed through either MTL chamber. Keep the filters in the same carrier that it was weighed in. Confirm that there are plenty of filters that have been Pre-Weighed in the MTL Chamber available before proceeding. If at any time two filters were accidentally loaded to one carrier, the registered Pre-Weigh would be very high 160 + mg. Split them into separate carriers and reuse both filters for the next round of Pre-Weigh loading (within 30 days).
2. Navigate to the lab app Pre-Weighing Station.
3. Scan in or type in the five-character code for the bin. It will take a few seconds to advance to the next screen. If an error message comes up 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).
4. In the upper right corner, there is a barcode status section. There are multiple scanners on the network so confirm that the scanner corresponding to the login is selected. If not, click anywhere inside the rectangular box that shows the device name to bring up another popup. If the desired scanner shows up on that list, highlight it, press **OK**, and confirm that the same device name shows up on the previous window. The COM9 device is the barcode scanner in the AH1 MTL chamber.
5. To check the barcode reader's alignment or to view a filter through the barcode scanner, place a filter (still in its Carrier) under the barcode scanner and check the Live Display box on upper center 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

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Display box is checked, the scanner cannot be used to scan in filters to the lab app.

6. The section on the upper right will show the Scanner Status. Once the station is prepared, press the Trigger button or 'T' to trigger. If the barcode successfully scans the barcode, the barcode scanner beeps, the Live Display refreshes with a screenshot of the correct filter, and a green rectangle appears somewhere near the barcode that was scanned. The text field shows the correct 6-digit alphanumeric filter barcode.

7. If the barcode scanner does not beep a few seconds after Triggering, a popup box appears. The Live Display should still update with a screenshot, but the barcode text field shows **#UNDEF**.

    a. Press Ok to get past the popup window. Check that filter's alphanumeric code is legible (not upside down when viewed on the screenshot). If it was Pre-Weighed by the MTL chamber while the barcode was upside down, it may be best to set that filter and Carrier aside; the filter orientation can be corrected and reloaded the next time the MTL chamber Pre-Weights filters
    b. Rotate the filter 30º - 45º 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.
    c. If the barcode does not scan and the alphanumeric code is not legible for a clean / unsampled filter, we will not use that one. It is very important that the barcodes are correctly assigned.

8. 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 of section 5.4of TI 251H: Post-Sample Weigh.

9. The lab app will perform the same weigh validation as before it may be necessary to select a different filter if the criteria is not met.
10. If a filter is dropped or torn before it is assigned to a site, set it in the dropped / holes box.
11. If the database has records for the filter barcode and it passes all validation, confirm that the filter barcode (refer to the refreshed Live Trigger screenshot) accepted for the Sampling Date and Module match. All associated Pre-Weigh information will be filled in on the table to the right.
12. Remove the filter from its Carrier and load it into the Cassette as usual (barcode side faced down).
13. It is paramount that all the associated Pre-Weigh information appears before handling the filter. Not doing so can easily lead to errors.
14. After accepting a barcode and weight, the Scanner Status shows "Ready to trigger" and the barcode text field is blank. Once the filter is correctly loaded into the cassette, continue to assign barcodes / weights in the same order as

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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. If a filter is dropped or damaged after it is accepted / assigned to a sampling date, the filter weigh replacement procedure is similar to manual weighing. The filter can be replaced after all weights for that site have been assigned.

15. Submit records and retrieve the log sheets for the box from the printer. The site name is printed in the center at the top of each log sheet. Confirm that the log sheets match the site that was just loaded. Place all red caps on the bottom of the 1A and 4D cartridges. Place the completed bin in the cabinet at the "QC Check" station.
16. The empty carrier can be set aside in a pile for use for future weighing procedures.
17. Repeat all steps for all A module filters, and followed by all D module filters. If the bin contains a 5A or 5D module, loading of clean filters will follow the D module.

6. DATABASE MANAGEMENT

The lab application is used to load filters that will be sent out into the field. The program checks the Logs and Weights databases to determine the sample date of the last filter weighed for each site. The lab app then determines the next seven sample dates required at each site.

Figure 1. Pre-sample weigh in with 5A Module.

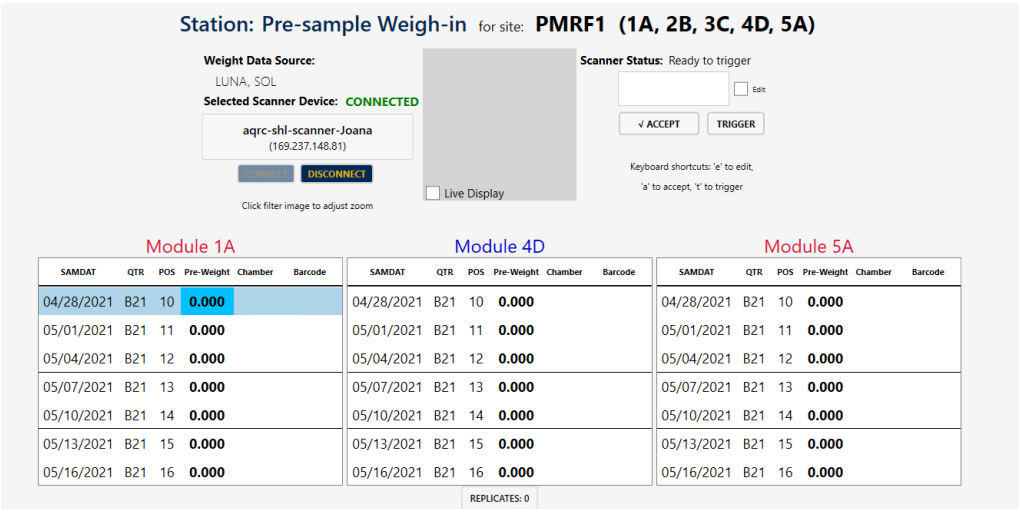

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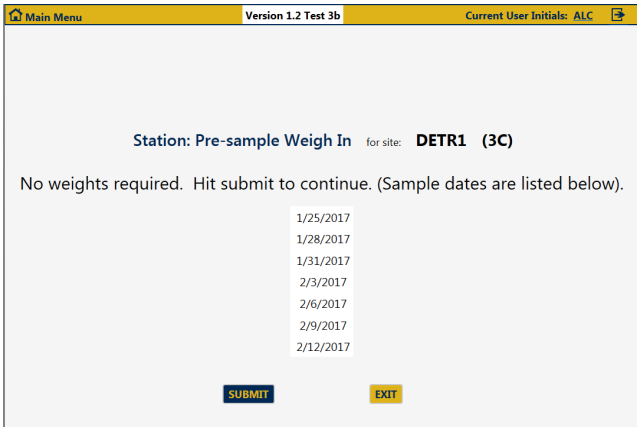
Figure 2. Pre-sample weigh in with 3C only.



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UCD IMPROVE Technical Information #251K

Quality Check Station

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

July 15, 2022
Version 3.0

Prepared By: DocuSigned by: Anthony Kawamoto 3A49A57FF666452... Date: 10/4/2022

Reviewed By: DocuSigned by: Jason Giacomo B62B01F81613421... Date: 10/4/2022

Approved By: DocuSigned by: Marcus Langston 0A10CFCF79B0452... Date: 10/4/2022

UCDAVIS
AIR QUALITY RESEARCH CENTER

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DOCUMENT HISTORY

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02/24/2022	SRS	All	Previously anthologized version separated into individual TIs.
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1. PURPOSE AND APPLICABILITY

The purpose of this TI is to describe in detail the procedures used at the Quality Check station in the sample handling laboratory. It is applicable to all routine filters in the IMPROVE network.

2. SUMMARY OF THE METHOD

Once all cartridges of a bin have been loaded with new filters, the bin goes through a final check to make sure that all filters and cartridges are suitable to be shipped out. Log sheets are examined for mistakes and the flashcard number is confirmed. Any issues are remedied. Shipping labels are printed out and placed in the bins. The bins are placed onto a rack and eventually transferred to the designated shipping/receiving area for the sample handling lab in the IMPROVE shop to be packed and shipped out.

3. CAUTIONS

Many site names look similar. It is important to make sure to print out the correct UPS label for each site so that they are sent to the correct place.

Remember that United States Postal Service (USPS) sites have a white site label on their bins.

Remember to staple the return label to the Week 3 log sheet and place the outgoing label in the bin. Sometimes these labels are accidentally swapped, and the box ultimately ends up back at the lab instead of its proper destination. This can cause loss of sample out in the field and is to be avoided.

Double-check each cassette in every 1A, 3C, and 4D cartridge to make sure that a single loose screen has been loaded in each cassette. Multiple screens or no screen can affect the flow rate of the sample out in the field.

4. EQUIPMENT AND SUPPLIES

- Computer with Internet access and lab application
- Barcode scanner
- Thermal printer
- UPS label rolls and pouches
- Highlighters
- Stapler
- IMPROVE Calendar
- UPS Outbound View Zones

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5. PROCEDURAL STEPS

The Quality Check station is located near the door closest to the shop. Bins ready to be checked are located in the cabinet near the QC station. Before starting this station, print out the UPS labels for the bin that is going to be checked.

5.1 Procedures for Regular UPS Shipping

1. Some sites cannot receive boxes via UPS for various reasons (remoteness, delivery issues, etc.). The bins for those sites have white site code labels. UPS labels will not be generated for those bins unless authorized by a lead lab tech. All other bins will need UPS labels.
2. Use the computer at the QC Check station to go to the UPS web site (http://www.ups.com).
3. Click the Log-in option at the top of the web page.

a. Ask the lead lab techs for the username and password.

4. When the shipping information page loads, choose a site code from the "Address Book" pull- down menu located at the top middle of the page (e.g., CABI1). The page will refresh with the address information for that site. If the site is one of the international destinations (BYIS1, VIIS1, EGBE1), continue to the International Shipping Procedures in Section F.
5. Leave the "Ship From" and "Return" addresses as default. It should be the Drew Avenue address.
6. For the question, "What are you shipping?" 5X module sites are referred to as X in the UPS website.
   a. Number of Packages: Leave as default (1)
   b. Packaging Type: Select appropriate box size — Regular (Standard), Larger (5X Module), Smaller (Single-Module)
   c. Weight: 4 lbs. for standard blue boxes, 6 lbs. for 5X module boxes, and 3 lbs. for single-module boxes (used for ATLA1, DETR1, PITT1).
   d. Package Dimensions:
      - Regular (Standard) boxes: 9" x 10" x 6"
      - Larger (5X Module) boxes: 13" x 10" x 7"
        - 2-3-2: EVER1, FRRE1, MACA1, MELA1, SWAN1, WICA1, SAGA1
        - 3-2-2: BYIS1, HEGL1, MEVE1, PMRF1, SAMA1, YOSE1
      - Smaller (Single-Module) boxes (DETR1): 9" x 8" x 6"
7. For "How Would You Like to Ship?" Click the "Compare Time and Cost" link. Choose the cheapest service that will get the box two business days before installation (the Friday before the first week installation date for the

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box). Keep in mind any holidays or weather delays when choosing a shipping option. When in doubt, it is always safer to choose 2nd Day Air.

8. References: Fill in Reference #1 with the four letters of the site code (omit the # that follows the site code) and add the date of first install, which can be found on the week 1 bag sticker. Do not put any slashes, dashes, commas, etc. For example, SAPE1 with a start date of 11/03 would be SAPE1103. For Reference #2, enter user three letter initials.
9. For "How Would You Like to Pay?" make sure that the default option is selected: (XXXXXX) – Air Quality Research Center.
10. Leave "Would you Like to Schedule a Pickup?" blank then click the **Next** button.
11. The UPS label will then print from the thermal printer at the QC Check station. There will be a confirmation box when the web page refreshes. Scroll down the refreshed webpage and choose the "Create a Return Shipment" option.
12. The page should refresh, and the site code should have already been chosen from the drop- down Address Book menu. Confirm that it is the correct site code. Leave the second box as default — it should provide Drew Avenue's address.
13. For Box #3, "What are you returning?" leave the Packaging type as default. The proper weight should already be filled in, along with the package dimensions. There will be a new field in the box that asks for a "Merchandise Description." Type in "Air Filters."
14. For Box #4, "How would you like to return?" leave the service and delivery method as default. The service should always be 2nd Day Air, unless the site is within 2 days ground shipping (refer to UPS Outbound View Zones). The "Label Delivery Method" should be "Print Return Label." When in doubt, it is always safer to choose 2nd Day Air.
15. Box #5 should have fields already entered. Leave them as they are.
16. Box #6 should have "Bill Shipping Charges to (XXXXXX)-Air Quality Research Center." Make sure this is selected, and then click "Next."
17. Retrieve both labels from the thermal printer. Highlight the site name and place the outgoing label in the bin. Put the return label aside as it will be used during the Final Check.
18. If the bin is not immediately going through the QC Check station, highlight the site code on the outgoing label and place both labels in the bin. Do not make labels for a bin that will not be QC'd and sent out that same day.

5.2 Outgoing International Shipments

1. If BYIS1, VIIS1, or EGBE1 is selected from the "Address Book" drop-down menu, the international shipment page will come up. It is very similar to the

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normal page but with a few unique boxes.

2. Leave "Ship From" and "Return" addresses as default.
3. Differences that all three sites will ask for:
   a. BYIS1 and EGBE1 will have an extra field at the top asking for Customs Value. Type in "100."
   b. Description of Goods: Type in "Air Filters."
   c. Weight: 4 lbs. Regular (Standard) sites, and 5 lbs. for Larger (5X Module) sites.
4. Select Service: Select UPS Worldwide Saver (Express).
5. Reference Section:
   a. Reference #1: SITEMMDD (4 letter side code plus month and date of first Tuesday install).
   b. Reference #2: 3 letter user initials
6. Bill shipping charges and bill duties and taxes: Make sure both are set to (XXXXXX) — Air Quality Research Center.
7. Make sure that the box saying "Review shipping details" is checked. Click **Next**. Review shipping information and then click **Ship now**.
8. A new page will come up with different form options available. Make sure to select "Complete Selected Export Forms Online" — it should be default checked. Also, make sure that Commercial Invoice is checked. This should also be set as default. At the bottom, make sure the box saying "Preview Shipment before completing shipment" is checked.
9. On the next page, click **Add Product**. Add "Air Filters" from the Product List drop-down menu. The product description and Tariff Code should automatically fill in. Type "1" for Number of units. Price per unit should be defaulted to 100.00 and the currency should be "USD US Dollars." For Unit of Measure, choose "Pieces." Then click **Submit**, followed by **Next**.
10. Leave everything as it is on the next page. Click **Next**.
11. Leave the "Form Description" blank and click **Next**.
12. On this page, choose "Print All Online Forms." Then click **Open** if the browser asks to open or save the forms.
13. Go to **File** in Adobe and choose **Print**. Make sure the aqrc-lab-copier on aqrc-print is selected and press **Print**. Three copies of the invoice should print out. *Do not print to the thermal printer.*
14. Retrieve the commercial invoices from the printer. Sign and date each one in the appropriate fields at the bottom of the page.
15. Go back to the UPS webpage and click **Next**.

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16. Leave everything as default in the Select Export Forms and click **Next**.
17. Review all details (paying special attention to the payment information in Box 4) and choose **Ship Now**. Two labels should print. One will look like a regular outgoing label and the other will have a paragraph printed on it and a section for a signature. Sign and date the label. Retrieve a UPS pouch by QC Check station and place the commercial invoices in it. Make sure that the barcode on the first commercial invoice is visible through the pouch.

5.3 International Return Shipping

1. To create an International Return, choose **Create Import** from the list of options on the left-hand side of the screen.
2. Box #1: "Where is this shipment coming from?" Select site: BYIS1, EGBE1, or VIIS1
3. Box #2: Leave as default; it should be the Drew Avenue address.
4. Box #3: What Are You Returning?
   a. Description of Goods: "Used Air Filters for Testing"
   b. Number of packages: Default should be 1
   c. Weight: 4 lbs. for Regular (Standard) sites and 5 lbs. for Larger (5X Module) sites
   d. Merchandise description: Type in "Used Air Filters for Testing."
5. Box #4: "How Would You Like to Return?"
   a. Service: Select **UPS Express Saver**.
   b. Label Delivery Method: Select **Print Return Label**.
   c. Make sure "Send E-mail notifications" is checked.
6. Box #5: "Would you like to add reference numbers to this return shipment?"
   a. Reference #1: SITEMMDD (4 letter side code plus month and date of first Tuesday install).
   b. Reference #2: Enter user initials.
7. Box #6: "How Would You Like to Pay?"
   a. Bill shipping charges to: (XXXXXX)-Air Quality Research Center.
   b. Bill duties and taxes to: (XXXXXX)-Air Quality Research Center.
   c. Make sure "Review shipping details, including price, before completing the shipment" is checked.
8. Box #1 in "Enter Additional Import Control Information":
   a. If "electronic label" was selected, make sure "Send Electronic Label to:" is filled in with a lead lab assistant's email. (e.g.

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takawamoto@ucdavis.edu)

9. Review your return details and press **Next**.
10. Leave everything as default. "Complete selected export forms online" and "Commercial invoice" should be checked. Press "Add product."
11. "Enter Product Information":
    a. Choose Air Filter Return from the Product List drop-down menu. The Product Description will automatically fill in.
    b. Make sure that the Product Country of Origin is set to the default, "United States - US."
    c. Number of units: 1
    d. Price per unit: 100
    e. Unit of Measurement: Pieces
12. Press **Next**. Leave everything as default on the next page and click **Next** again.
13. Leave the "Forms Description" blank and press **Next**.
14. Review Export forms—leave everything default and do not print. The click **Next**.
15. Leave everything on this page as default.
16. Click **Ship now**. Put all of them into a UPS pouch after signing and dating all forms and place it in the bin. It will be shipped out in the blue box with the filters.
17. A hard copy of these instructions with pictures can be found at the QC station, and an electronic copy can be found here: U:\IMPROVE_Lab\Lab_Gravimetric\Sample Handling Laboratory SOP\Shipping Label Instructions

5.4 Quality Check Procedure

1. Highlight the site code present on the outgoing label and make sure to place it in front of the bin. Set the return label aside. Note that bins with white labels are USPS sites. Refer to the USPS Instructions at the QC Check station to print these labels. An electronic copy can be found here: U:\IMPROVE_Lab\Lab_Gravimetric\Sample Handling Laboratory SOP\Shipping Label Instructions\USPS\2020
2. Open the lab application. Navigate to Pre-Sampling, and then QC Check, entering three-letter initials.
3. Scan the bin barcode (type in the 5-character site code if the bin is unlabeled).
4. Check the week bag labels to make sure that they match the dates on the screen and have the correct installation dates on them.
5. Starting with Week 1, remove the log sheet and all the cartridges. Starting with

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the 1A cartridge, make sure that the dates and sequence numbers written on the labels are correct and in the right order. Then remove all the red caps on the cassette bottoms. Make sure that there is a filter in all of the sampling positions and dummy sets in the non-sampling positions. Also check for any specks, holes, etc. on the filter. Continue this process with the 2B, 3C, 4D and 5X cartridges. If any specks are found, try gently tapping the cartridge on the counter. If the speck comes off and it is an A or D filter, set the filter in the 'To be reweighed' bin at the Pre-Sample Weigh-in station. Select a new filter that has already been weighed from the corresponding chamber. Notify a lead lab tech so that the barcode and pre-mass can be updated. If there are any other filter integrity issues with an A or D filter follow the same procedure. If there is a filter integrity issue with a B or C filter, discard the current filter and place a new clean filter in the corresponding cassette.

6. Make sure all 1A, 3C, and 4D cartridges have loose screens in each cassette. Do this by looking through the hole in the cassette tops. Also, check carefully for double screens. Double screens will normally create a "honeycomb" pattern when viewed from the top of the cassette. If in doubt about whether a screen is a single or a double, it is best to check to make sure.

7. Pay special attention to the 3C filters. They have a smooth side and a rough side. The smooth side should be visible when the red cap is removed from the cassette bottom. Make sure all sides of the filter are completely inside the cup as well.

8. Now, look at the log sheet. Fold the log lengthwise and then widthwise and place it into its corresponding bag. The site and installation date are typed in the top center of the page. Make sure that the site on the log sheet corresponds to the site label on the bin and that the installation date matches the week bag's sticker and the date on the lab application. Highlight this information so that it draws the operator's attention. To the right of this information is the eight-digit flashcard number. This number corresponds to the flashcard that can be found in the Week 1 bag in its own small, plastic case. Retrieve the flashcard and check to see that the number matches what is written on the log sheet. Make sure that the flashcard goes back into the Week 1 bag.

9. The 1A and 4D filters are weighed before being installed and the weights are recorded at the bottom left hand corner of each log sheet. From top to bottom, the numbers on the left are for the weights of the 1A filters and the numbers on the right are the weights of the 4D filters. If there is a 5th module A or D, the weights will appear to the right of the 4D column.

10. Put the cartridges back in the bag, and then slide the log sheet and flashcard into the bag. Repeat this process for weeks 2 and 3. Make sure to highlight the site name and installation date for each log sheet. Ensure that the cartridges are in the bag neatly and flat so that the bags close and all three will fit into the shipping box.

11. For Week 3, staple the backing of the UPS return label (if applicable) to the front

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of the log sheet. Scan the UPS tracking number to the appropriate text box. If it is a USPS site, change the dropdown to USPS and scan the USPS tracking number. Replace the contents of the last week's bag. Check the boxes for "Screens," "Field blank" (if applicable), 5th module (if applicable), and "Flashcard Numbers", then hit **Submit**. Place the bin into the rack under the bench.

12. Occasionally, there will be an extra step at the Quality Check station. There will be notes or signs displayed next to the computer or on a specific bin with instructions. Some examples are putting a newsletter in the bin, changing an address label, or giving the bin to a lead lab tech before shipping out.

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UCD IMPROVE Technical Information #251L

Box Shipping

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

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Reviewed By: DocuSigned by: Jason Giacomo B62B01F81613421... Date: 10/4/2022

Approved By: DocuSigned by: Marcus Langston 0A10CECF79B0452... Date: 10/4/2022

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1. PURPOSE AND APPLICABILITY

The purpose of this TI is to describe the procedures used to pack and ship boxes for IMPROVE network sites.

2. SUMMARY OF THE METHOD

Boxes are packed and placed at designated locations for pickup.

3. CAUTIONS

Many site names are similar. It is important to pay close attention to the site code of the bin and to ensure that the proper label is printed for it.

Inbound and Outbound tracking labels look similar. It is important to pay close attention to the receiver address to ensure the box is delivered to the site on time.

4. EQUIPMENT AND SUPPLIES

- Computer with lab application
- Barcode scanner
- Packing tape and handheld tape dispenser
- Box top labels
- Outgoing UPS/USPS shipping labels

5. PROCEDURAL STEPS

1. Open the lab application. Navigate to Pre-Sampling, and then Box Shipping, entering three-letter initials if necessary.
2. Scan the bin barcode (type in the 5-character site code if the bin is unlabeled).
3. Check the week bag labels to make sure that they match the dates on the screen and have the correct installation dates on them.
4. Find the site-specific shipping box on the shelves.
5. Remove any old labels (both larger shipping labels, smaller tracking tags, and old box-top label) and extra pieces of tape.
6. After confirming that all bags are sealed, move the bags from the bin into the shipping box, orienting them from Week1 to Week3 from left to right.
7. In one of the folders located at the Box Shipping station, find the corresponding box-top label. The site, and three installation dates should match the lab application information, as well as the bag labels site, date, and color. Place it on the upper left of the top face of the box.
8. Place the outbound shipping label on the top face of the box, scanning the tracking

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number into the appropriate text box. Remember to change the drop-down to USPS if it is a USPS label.

9. Seal the shipping box with a small piece of packing tape, then press **Submit** on the lab application.
10. UPS boxes are ideally packed before 4 p.m. to assure pickup that day. These are placed in the hallway of the pickup/drop-off entrance.
11. USPS boxes are picked up on Tuesday and Thursday mornings. These are placed in the white corrugated plastic bins on the counter space next to the mailboxes near the front entrance. Place the boxes in the bins with the shipping label face up.

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UCD IMPROVE Technical Information #251M

B/C Filter Shipping

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

July 15, 2022
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1. PURPOSE AND APPLICABILITY

The purpose of this TI is to describe the procedures used to check and ship nylon and quartz IMPROVE filters for analysis. These instructions apply to all routine 2B and 3C IMPROVE filters.

2. SUMMARY OF THE METHOD

Final tray check lists are generated for 2B and 3C filters before they are prepared for shipping. Once a month, five lab blanks are added to each nylon filter shipment. Nylon filters are sent to the ion contractor, which as of January 2019 is RTI, and the quartz filters are shipped to the carbon contractor, which as of January 2019 is DRI.

3. CAUTIONS

Be careful when tray checking to make sure that every Petri dish has a filter in it. Pay particular attention to the Petri dishes that are loaded with lab blanks.

Be aware that working with files in the U:\ drive is extremely risky. Any errors that may occur can cause problems for lab equipment or analysis. Be extra careful when deleting or moving files.

Pay close attention when entering information into any macro. The information has to be in a designated format for the macro to work.

4. PERSONNEL QUALIFICATIONS

Only trained lead lab technicians can generate tray check lists and create Excel files for shipping.

5. EQUIPMENT AND SUPPLIES

The following supplies are necessary for 2B and 3C shipments:

- 1ft. cubed cardboard box for C filters, or 12” x 12” x 10” cardboard box for B filters, and packing material
- Re-sealable bags
- Packing tape
- Ice Packs (for C filters)
- ULINE Premium Laser Labels S-8039
- Envelopes
- UPS shipping labels
- Computer access to U:\ drive

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6. PROCEDURAL STEPS

6.1 Preparing Contractor Lists for 2B Filters

6.1.1 Acquiring First Filter for New Shipment

In the IMPROVE lab find the set number to be shipped by identifying the lowest set number for that year. Open the Inventory portion of the web app and click **View** for the set to be shipped out. Click the **Master List** button, and open in Excel. If all of the trays have not been generated yet follow the procedure laid out in *UCD IMPROVE TI #251F*, section 5.9.

6.1.2 Running the Macro

Open MACROS.xlsm, to access the macro, change back to the Master List file press **Alt+F8**. Select the "B_Filter_Inventory_ION" macro and click **Run**.

6.1.3 Entering Macro Information

The macro will ask for enough information to change the Master List into the desired format for the Contractor List. Follow the instructions in the input boxes. Be careful to enter the information in the exact format as the example. Following are the parameters of the input boxes:

1) **Year**. Enter the desired year in number format. Example: 2015.
2) **Set.** Enter the desired set in number format. Example: 1.

6.1.4 Printing the Pages

Print a copy of each B_Sheet_ [#] tab. The file will automatically be saved. If there was a previous version of the current set, that file will be overwritten by the new one.

6.1.5 Tray Checking

Confirm that each tray check list matches the inventory of filters in each tray. Print one copy of each sheet in the tray check list. Start with Tray 1. Open the first tray, with the filters on the right and the empty lid on the left. Note the site, sample date, and module of the first filter on the tray check list. Select the first filter in the upper left, position 1. Confirm a filter is present in the correct sample-side-up orientation, and that the filter information noted matches the tray check list. Perform the same checks for each filter on the tray check list/filter tray, correcting any discrepancies, as necessary. Continue to each subsequent tray until the set is done.

6.2 Monthly Ion Lab Blanks

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Near the end of every month, five clean lab blanks must be sent out. Add these lab blanks to an ion set being prepared for shipment. This should be done in the web app before creating the Master List.

6.2.1 Generating Labels

Open the “Lab BLNK stickers” file located in U:\IMPROVE_Lab\Lab Gravimetric\Applications and Macros\Ion_Carbon Outgoing\ION. Enter the date that the filters are being shipped into the yellow box in the upper left corner. This should update the cassette stickers near the middle of the page. On the bottom left of the page, update the ship date to record when each month’s lab blanks were shipped. Print out the cassette stickers to label five clean Petri dishes. Load one clean B filter (no paper dummies) into each of the five Petri dishes.

6.2.2 Appending the Inventory List

From the Improve Management Site web application home page, navigate to the "Inventory Boxes" page by clicking **Inventory** in the gray header. Find the appropriate filter set ID ("Set Number") in the box inventory and click **View**. On the "Inventory box details" page, find the last tray (highest number), and click **View**. Scroll to the bottom of the "Tray Details" page and remove the last five site filters from this tray (Tray Positions 46 to 50) by clicking the **Remove** button for each record. These removed filters will be added to the next set. Click the **Add blank button**, change the blank date to the current date, and then click **Update Inventory Box**. Repeat this action an additional four times for a total of five lab blanks. These five entries should all be identical except for the Filter ID, with nothing for the site (BLNK1 will show as the site on the Master List), and shipment day as the sample date. The status will be “NM” and the Purpose will be Lab Blank Ions.

Replace the last five network filters in Tray 8 with the five lab blanks, so that the tray check list matches the filters in the tray.

After adding the lab blanks follow the procedure laid out in 6.1 for preparing the contractor list and tray checking.

6.3 Preparing Contractor Lists for 3C Filters

6.3.1 Acquiring the Last Filter of Last Shipment

In the IMPROVE lab, find the set number to be shipped by identifying the lowest set number for that year. Open the Inventory portion of the Web App and click View for the set to be shipped out. Click the Master List button, and open in Excel. If all the trays have not been generated yet follow the procedure laid out in *UCD IMPROVE TI #251F*, section 5.9.

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6.3.2 Running the Macro

Open MACROS.xlsm. To access the macro, change back to the Master List file, press **Alt+F8**. Select the **C_Filter_Inventory_CARBON** macro and click **Run**.

6.3.3 Entering Macro Information

The macro will ask for enough information change the Master List into the desired format for the Contractor List. Be careful to enter the information in the exact format as the example. Following is the list of the parameters it will ask for:

1) **Year**. Enter the desired year in number format. Example: 2015.
2) **Set.** Enter the desired set in number format. Example: 1.

6.3.4 Printing the Pages

Print a copy of each C-Sheet_ [#] tab and the new file will be automatically saved. Any previous version of the set's tray sheets will be overwritten with the new one. Close the file and collect the new tray checking lists from the printer.

6.3.5 Tray Checking

See Section 6.1.5 for instructions on tray checking.

6.4 Shipping Instructions for B-Ion or C-Carbon

6.4.1 Generating Excel Files

Open the appropriate Contractors file for the current shipment. Print a second copy of all the tabs labeled B_Sheet_# or C_Sheet_#.

6.4.2 Creating a Cover Letter

Open "RTI & DRI Cover Letter.xls" file which is located U:\IMPROVE_Lab\Lab_Gravimetric\Applications and Macros. Press **Alt+F8**. Select the "RTI & DRI Cover Letter.xlsm'!SiteFetching.SiteFetching" macro and click **Run**. The macro will ask for enough information to update all records. Following is the list of the parameters it will ask for:

1) **Preparer's Name**. Enter desired name of person shipping outset.
2) **Date for Shipment**. Enter date shipment will be sent out. Example: 10/03/2022
3) **Shipment Year.** Example: 2022
4) **Shipment Set Number**. Example: 10
5) **Shipment Tray Count**. Enter the count of trays to be shipped out as part of the tray. Example: 8
6) **Shipment Filter Count**. Enter the number of filters to be sent as part of the set. Exampl: 400

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7) **Filter Type (B or C)**. Enter shipment type, B for Ions or C for Carbon.

. If anything is incorrect, make the appropriate changes. If there are any network link updates, the links may need to be updated. Any changes will automatically update relevant fields for the entire workbook.

For the B-ion cover letter, go to the "B Cover Letter" tab, and for C-carbon go to the "C Cover Letter" tab. The table in the upper left should reflect the same information as the "Site fetching" tab's table checked previously. Confirm everything on the page is correct then print one copy of the cover letter.

6.4.3 Generating Tray Labels

Go to the "Generate Tray Labels" tab and fill out the appropriate information in the upper left corner. Note the warnings. Make sure that there is only one "Y" filled out for either "B" or "C" labels, or the sheet will error. The other entry should be "N." Print the tray labels and apply them to the shipment's trays. The labels are generated Tray 1-7 on the left column, from top to bottom, with Tray 8 on the right column. Print the correct labels onto ULINE Premium Laser Labels S-8039. Apply the labels to the tops of the correct tray, "facing" the right.

6.5 Preparing the Shipment

6.5.1 Printing the Hard Copy and File Copy

Prepare one set of tray check lists with the attached cover letter. Staple the cover letter to the top of the tray check lists (stacked with Tray 1 at the top). Fold the copy into thirds, it will later go into an envelope and will accompany the shipment.

6.5.2 Boxing the Trays

Place all filter trays into a 1 ft. cube cardboard box for "C" filters and a 12" x 12" x 10" cardboard box for "B" filters, stacked Tray 1-4 from top to bottom on the left, Tray 5-8 from top to bottom on the right (if there are more than four trays). Include the enveloped hard copy in a watertight re-sealable bag and use bubble wrap to secure the trays. Quartz shipments must include an ice pack, covered in bubble wrap to prevent the cardboard from getting moist. Ice packs are located in the Quartz-freezer in the IMPROVE lab. Securely seal the cardboard box with packing tape.

6.5.3 Printing Shipping Labels

Go to the UPS website and log into CampusShip. Ask the lead lab techs for the username and password.

Ion shipments will go to Research Triangle Institute (RTI in the UPS address book).

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- Packaging: Other Packaging
- Weight: 10 lbs.
- Dimensions: 12 in. x 12 in. x 10 in.
- Service: UPS 2nd Day Air
- Declared Value: $5000 (This package has "high value" requiring UPS to provide special handling)
- Reference #1: [Year]SET [#]BIONS
- Reference #2: [user initials]

Carbon shipments will go to Desert Research Institute (DRI in the UPS address book).

- Packaging: Other Packaging
- Weight: 12 lbs.
- Dimensions: 12 in. x 12 in. x 12 in.
- Service: UPS Ground (this should arrive at the same time as the Next-Day Air service)
- Declared Value: $5000 (this package has "high value" requiring UPS to provide special handling)
- Reference #1: [Year]SET [#]CCARBON
- Reference #2: [user initials]

When the shipping label is printed, two copies of the shipping receipt must be printed as well (sending one print job onto letter-sized paper should print two identical copies).

Apply the shipping label to the outside of the box. One copy of the shipping receipt must be given to the UPS pickup driver. The other copy must be signed and dated by the same driver for tracking purposes.

For Ion shipments create a ground shipping return label and include it in the envelope with the hard copy of the tray check list as described in 6.5.1. When RTI is finished desorbing filters, they will send back each box of used Petri dishes.

6.6 E-mailing

For carbon shipments, open the "C email" tab in the "RTI & DRI cover letter" file, and for ion shipments, open the "B email" tab. Ions shipments will be addressed to Tracy Dombek (tdombek@rti.org) and all carbon shipments will be addressed to Matt Classen (eafcarbon@dri.edu). Make sure Miranda De Boskey (mdeboskey@rti.org) and Laurie Stella (lbs@rti.org) are copied in all Ion shipments.

Copy and paste (values only) the e-mail template to a new e-mail sheet. The "To" and "Subject line" guidelines can be found above the template.

Confirm the Year, Set Number, and Ship Date in the subject line, as well as in the e-mail template body, are correct. At the bottom, confirm each tray's first filter site and date.

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Attach the correct previously generated.xls file. Copy over the corresponding tracking information.

6.7 Electronic File Storage

After finishing all of the above steps the electronic files must be correctly stored.

1) Go into U:\IMPROVE_Lab\Lab Gravimetric\Applications and Macros\Ion_Carbon Outgoing\ION or U:\IMPROVE_Lab\Lab Gravimetric\Applications and Macros\Ion_Carbon Outgoing\CARBON, move the recently created set files for B and C to their correct Shipped Year folder.
2) Open the recently created Set file, and the current year's Masterlist excel file (found here: U:\IMPROVE_Lab\Lab Gravimetric\Applications and Macros\Ion_Carbon Outgoing\Masterlists). Copy the info on the Master List tab of the Set file, to the appropriate tab within the Master List file. Copy the tracking number from the UPS label and paste it in as well.
3) Update the Inventory box details of the shipped set to include the tracking number and the final inventory date.

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UCD IMPROVE Technical Information #251N

A Tray Checking

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

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1. PURPOSE AND APPLICABILITY

The purpose of this TI is to describe the procedure for preparing 1A filters for FT-IR. This procedure is applicable to 1A IMPROVE network filters that sampled from January 2011 and on.

2. SUMMARY OF THE METHOD

After 1A filters have been post-weighed, they are placed in Petri dishes and labeled with a sticker designating the site name and sample date of the filters. Through this process, they are separated by months. Then, they are put into labeled Petri trays. When the trays are full, they are placed on a designated shelf near the weighing area. Weekly checks for level zero mass validation are performed by a lead lab technician. The inventory is then ran for the appropriate filter type and a tray check list is generated.

Filters are checked and arranged to match the order of the list. Trays are labeled with stickers to indicate set, month, and tray number, and a hard copy of the tray list is printed and stored in the tray.

3. CAUTIONS

Pay close attention when entering information into any macro. The information must be in the exact format as the example shown in the input box. If an incorrect format is entered, the macro will not work correctly, and an error will occur. If an error does occur, close the files and start over.

Be sure to enter the correct set number, month, and the correct first filter information when generating tray check lists. A mistake in entering either one of these can cause significant confusion later in the process.

4. PERSONNEL QUALIFICATIONS

Only trained lead laboratory technicians generate tray check lists for the 1A filters.

5. PROCEDURAL STEPS

5.1 Inventory A

1. Go to the Inventory section of the Web App and create the tray files for the trays to be inventoried. The same method used to make the 2B and 3C inventory sheets will be followed, with the exception that the 1A trays may not be a full set of 8. In addition, the corresponding month will have to be selected. Look through each inventory page to make sure there are no filters from other months. Move, Remove, and Add filters as necessary.
2. Go to the ‘Inventory Box Details’ page and download the master list.

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5.2 Running the Macros

Located U:\IMPROVE_Lab\Lab_Gravimetric\Applications and Macros, open MACROS.xls. While on the set master list access the macros menu, press **ALT-F8**. Select the "A_Filter_Inventory" macro. Click "Run" after selecting the appropriate macro.

5.3 Entering the Macro Information

The macro will ask a series of questions to generate the appropriate tray check list. Follow the instructions in the input boxes. Be careful to enter the information in the exact format as the example. Following is a list and screenshots of the parameters that both macros will ask.

- **Year-Month**. Enter the desired year in number format. Example: 2021-OCT
- **Set.** Enter the desired set in number format. Example: 1.
- **Tray.** Enter the desired starting tray in number format. Example: 1.

5.4 Printing the Pages

Select all completed "A_Sheet_ [#]" tabs. Go to the File tab and choose "Print." The type of filter and the set, month, and tray number should already be printed at the top of the page(s).

5.5 Tray Checking

After the lists have been printed, confirm that the contents of each tray match its corresponding list. Check that the site name, Module, Status, and sample date is correct for each position in the tray. Initial and date the list and then fold it up and place it in the corresponding tray after the check is complete. Check that the tray is properly labeled. Place the trays in the designated location the holding rack or FT-IR shelf.

5.6 FT-IR Tray Files

1. After tray check is complete go to the Tray Details page of each tray that was checked and click the FT-IR button.
2. Save each file here: U:\FTIR Tray Files from Lab\IMPROVE

5.7 Managing Contractor Files

1. After tray check is complete, go to the "U:\IMPROVE_Lab\Lab_Gravimetric\Applications and Macros\XRF" directory. Move the corresponding Excel file for the set to the correct closed year folder (named "[YYYY] Closed") and correct month folder (named YYY-MM XXX). If this folder does not exist, create it. Moving files into these folders eliminates the risk of them being overwritten.
2. Go into the current closed year folder, open the 'YYY MasterList A filter

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Months' file and the tray file that was just made. Copy the master list for the trays inventoried to the master list.

5.8 Managing Inventory Sets

When a full set of 8 A trays is complete, go to the Inventory Box Details page, click **Edit** and update Final Inventory Date.

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UCD IMPROVE Technical Information #251O

Cleaning Loose Screens

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

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1. PURPOSE AND APPLICABILITY

The purpose of this TI is to describe the equipment, supplies, and details needed to clean 25 mm loose screens.

2. SUMMARY OF THE METHOD

25 mm loose screens are cleaned using ethanol to remove any residue that may have accumulated during sampling. Loose screens used for quartz (3C) filters are kept separate from those used for PTFE (1A and 4D) filters to avoid any cross contamination.

3. CAUTIONS

Make sure to use the appropriate forceps, cleaning jars, and containers for the screens being cleaned. Since the 3C screens are separated from the 1A and 4D screens, there are two sets of equipment to use so that no cross contamination can occur.

4. HEALTH AND SAFETY WARNINGS

Ethyl alcohol can be absorbed through the skin and is irritating to the eyes. Nitrile gloves, lab coat, and safety glasses must be worn while performing this task. To reduce the dispersion of fumes, this procedure is completed in a fume hood located in the chemistry laboratory.

5. EQUIPMENT AND SUPPLIES

- Fume hood
- 2 Glass Jars with cover (1 for C screens, 1 for A+D screens)
- Drying rack with spill tray
- 2 forceps (1 for C screens, 1 for A+D screens)
- Ethanol (at least 97%)
- Funnel
- Nitrile gloves, Lab coat, safety glasses (must be worn when using ethanol)
- EH&S plastic container for ethanol waste
- 2 containers for cleaned screens (1 for Cs, 1 for A+D screens)

6. PROCEDURAL STEPS

1. Pour the used screens into the appropriate glass jar; if cleaning quartz screens, use the designated quartz jar. If cleaning screens used with PTFE filters, use the designated 1A and 4D jar. Fill the jar with the screens about ¾ full.
2. Put on gloves, lab coat, and safety glasses before beginning the procedure. Bring the used loose screens from the sample handling laboratory into the chemistry

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laboratory in room 116.

3. Fill the glass jar with ethanol to approximately 1” above the level of the screens.
4. Cover the jar and swirl it in a clockwise manner for approximately one minute.
5. Dispose of used ethanol into the approved container marked for waste.
6. Prepare the drying rack and clean it with ethanol and lab wipes.
7. Pour out screens onto the drying rack, spacing them apart with gloves or the designated forceps appropriate for the screen type.
8. Leave the screens on the rack until they are dry.
9. Transfer the screens into the designated container for clean screens and then seal it. Bring the clean screens back into the sample handling laboratory.
10. Waste disposal: Once the waste level has been reached, contact ethanol laboratory ethanol custodian to schedule EH&S for pickup.

7. REFERENCES

For more information on waste disposal, visit the EH&S Hazardous Waste Management website: https://safetyservices.ucdavis.edu/units/ehs/hazardous-materials-management.

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UCD IMPROVE Technical Information #251P

Labeling and Organizing D-Slides

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

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Version 3.0

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Reviewed By: DocuSigned by: Jason Giacomo B62B01F81613421... Date: 10/4/2022

Approved By: DocuSigned by: Marcus Langston 0A10CECF79B0452... Date: 10/4/2022

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1. PURPOSE AND APPLICABILITY

The purpose of this TI is to describe the process of labeling D-slides and organizing slides into Sears' slide trays in the Sampling Handling Lab. These instructions are applicable to all routine 4D IMPROVE filters.

2. SUMMARY OF THE METHOD

Labeling D-slides is routinely performed prior to the beginning of a new quarter. Proper sets of stickers are generated, separated, and organized into slide trays.

3. CAUTIONS

Close attention to detail is required when color coding, cutting, and placing stickers on slides, in addition to maintaining documents in order to prevent incorrect placement of stickers and or slides. It is also necessary to ensure close attention to sections that need be completed by a Lead Laboratory Technician. Ensure that documents in the U-drive used throughout this TI are not modified beyond instructions.

4. PERSONNEL QUALIFICATIONS

Trained undergraduate students and laboratory technicians are the only personnel who perform labeling and organizing of D-slides.

5. EQUIPMENT AND SUPPLIES

- Scissors or Paper Trimmer
- Blue Sharpie or Blue Highlighter
- Ruler
- Paper Clips/Stapler
- Approximately 162 Slot Sears' tray
- 25 mm slides
- D-Slide Stickers Set 1-3
- Labels for D-slide trays
- Small circular orange and blue stickers
- ULINE Premium Laser Labels S-8039

6. PROCEDURAL STEPS

6.1 File Folder Content

Set 1 pages contain 10 columns, each column contains stickers 1-20 for one site. Set 2 pages contain 10 columns, each column contains stickers 21-30 for two sites. Set 3 pages contain sticker 31, if applicable. Each set is separated by a blank sheet of paper.

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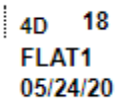
6.2 Sticker Content

1. Lead laboratory technician: update MACROS.xslm workbook located in U:\IMPROVE_Lab\Lab_Gravimetric\Applications and Macros. In the Site List tab update the Start Date to the first sampling date of the quarter based off the IMPROVE calendar. Print out tabs 1-20 new, and 21-30 new. If the quarter contains a 31st sampling date, print out tab 31 new. Manually change the 4D to 5D for the 5D sites. Place all stickers in a file folder, keeping the three sets separate.
2. Each page will hold stickers of IMPROVE sites organized alphabetically. Every sticker can be distinguished by several features:
    a. The left-hand corner has the ordinal position and module type.
    b. The right-hand corner has the position number 1- 30 (31). Corresponding to the position within the quarter and the placement in the D-slide tray.
    c. The center has the IMPROVE five digit site code (e.g., FLAT1) and directly under is the sampling date (Figure 1).

Figure 1. Example of D-Slide Sticker.



6.3 Marking Stickers

1. Take Set 1 (stickers 1-20) out of the folder, while keeping Set 2 inside the folder.
2. Take the blue sharpie/highlighter and ruler. In the center of each column mark a vertical line. Ensure that each line is in the center.
3. Repeat the process ten times on each page and repeat until Set 1 is complete.
4. Open the folder and retrieve Set 2 (stickers 21-30). Place the completed marked Set 1 back in the folder.
5. Complete Step 2 and Step 3 for the unmarked Set 2 and Set 3 if applicable.
6. Remove Set 1 from the folder, whilst keeping it separate from Set 2 and Set 3.

6.4 Separating Stickers

1. Starting with Set 2 cut horizontally to separate the two sites within each column. Cut between sticker 30 of the first site and sticker 21 of the second site. It is important to cut horizontally first in order to keep sites separated and organized.
2. Cut vertically where the page is marked by a small dotted line. Only cut along dotted lines. Once each strip is released from the whole page, place the strip on

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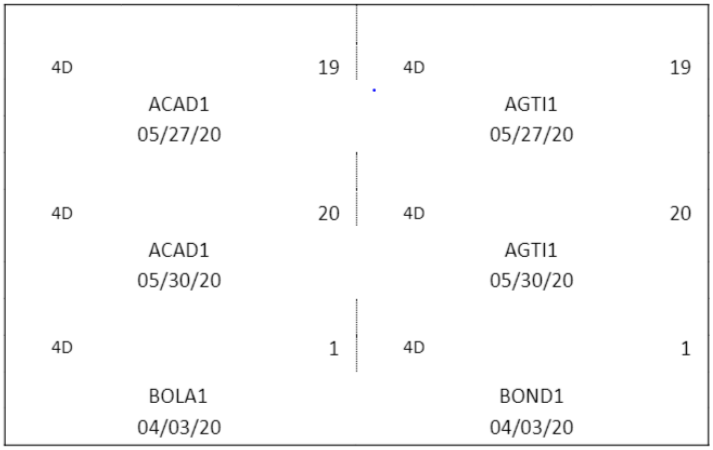
the counter. Keep strips organized in rows, repeat until five separate piles are created (Figure 2).

3. Once one row of five organized piles is completed, lay the next strip from the next half page on the first pile of the row of five. Continue until all halved pages are cut vertically. Repeat until complete with Set 2.

Figure 2. Demonstration of D-Slide Sticker Cutting Orientation.



6.5 Organizing Stickers 1-30 (31)

Each site is considered complete once Set 1, Set 2, and if applicable Set 3 have been combined.

1. Pick up one strip from Set 1 and one strip from Set 2 working left to right and top to bottom. Staple Set 1 and Set 2 together avoiding the face of the sticker. The result is two strips with corresponding sites numbered 1-30 in numerical order, as well in order of ascending date.
2. Leave Set 3 as is.

6.6 Placing D-Slides in Trays

1. Attain the Sear's trays and D-slides from corresponding storage locations. All sites will have one tray. Sites that have a 5D module will have two trays. There will also be several separate trays for Field Blanks.
2. Take out a pile of unlabeled slides with the smooth front side facing up. Pickup first stapled set, starting alphabetically. Place sticker on the front side of the slide, so that the edge of the sticker does not run over the top of the slide or into the hole in the middle of the slide. Repeat until the first set of stickers for the site is complete.
3. Inside each tray are slots numbered 1-40 on the right-hand side. Starting at the back of the tray at position 1, place the labeled slide into the corresponding slot. Be sure to position all stickered slides up, so that sticker is visible when looking down the tray from the front. Once all labeled slides are placed in tray slots,

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recheck that each position number and sticker match the number on the right-hand side of the slide tray. Continue until all trays are full of labeled slides.

6.7 Labeling D-Slide Trays

Each site is allotted its own tray. The face of the tray is marked with a four-letter site code and number 1-9, three-digit identification code, ordinal position, and module type. Refer to section *3.5 The Quarter Naming System in TI 251 S: Box Cycles and Cartridge Orientation* for further explanation.

1. Lead Laboratory Technician: Edit Slide Box - Front D and FB- D.xslm workbook. Navigate to U:\IMPROVE_Lab\Lab_Gravvimetric\Stickers. Navigate to the Slide Box Stickers tab. Under Slide Quarter update the quarter with the three-digit identification code. Print out all labels alphabetically onto ULINE Premium Laser Labels S-8039.
2. If additional FB stickers are needed navigate to the FB-D tab and update Slide Quarter and Slide Channel.
3. Apply D-slide tray label to the corresponding tray.
4. Once all sites have been completed, store all trays in a storage location or place them in the rack located above the Post-Sample Weigh-In station.

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UCD IMPROVE Technical Information #251Q

Cleaning Petri Dishes

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

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1. PURPOSE AND APPLICABILITY

The purpose of this TI is to describe how the Petri dishes in the sample handling laboratory are cleaned.

2. SUMMARY OF THE METHOD

Petri dish bottoms and lids are cleaned using ethanol and laboratory wipes. The bottoms and lids are placed faced up and set to air dry. The remaining particles are then blown out with a rubber bulb pump to ensure that no cross-contamination occurs. All laboratory wipes are disposed of.

3. CAUTIONS

Be cautious when using ethanol, follow proper personal protective equipment (PPE) guidelines via the ethanol MSDS. When examining Petri dishes ensure that each dish is empty. If a Petri dish has a filter alert a lead laboratory technician.

4. PERSONNEL QUALIFICATIONS

Trained undergraduate students and laboratory technicians are the only personnel who perform Petri dish cleaning.

5. EQUIPMENT AND SUPPLIES

- Ethanol in appropriate container
- Nitrile gloves
- Lab coat
- Safety glasses/goggles
- Laboratory wipes
- Forceps for sticker removal
- Rubber bulb pump

6. PROCEDURAL STEPS

1. Retrieve and put on PPE.
2. Clean the working bench using ethanol and laboratory wipes.
3. Remove label from the inventory tray using forceps labeled “Sticker”.
4. Remove Petri dishes and clean the inventory tray.
5. Remove the sticker from all lids.
6. Wet a laboratory wipe with ethanol, wipe down the inside of the bottom and lid. Ensure to get all areas. Place the lid and bottom faced up to allow the ethanol to evaporate. Repeat with all 50 Petri dishes.

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7. Blow out any remaining particles with the rubber bulb pump.
8. Place the lid onto the bottom of the Petri dish. Stack all 50 Petri dishes in the inventory tray.
9. Dispose of all laboratory wipes.

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UCD IMPROVE Technical Information #251R

General Laboratory Procedures

Interagency Monitoring of Protected Visual Environments
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4/15/2022	GRM	All	Updating wording to accommodate new procedures. Removed section 5.11. Added new section 5.11.
6/30/2022	TAK	5.12, 5.13	Added SOPs to “Recertifying Metal Test Weights” and “Recertifying Automated Weighing Chamber Environmental Probe”

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1. PURPOSE AND APPLICABILITY

The purpose of this TI is to detail sample handling lab procedures lab assistants must perform, but do not fit in a specific category. They are general tasks performed on a regular basis to keep operations running smoothly in the lab.

2. SUMMARY OF THE METHOD

Many small tasks must be performed on regularly to ensure lab operations run smoothly. These include making new and replacement flashcards, archiving old and disposing of broken flashcards, creating myriad stickers, creating purchase orders, validating and updating weights, entering status adjustments, handling bad field blanks, and closing the quarter after all samples have been collected.

3. CAUTIONS

When making changes to weights in the web application, pay very close attention to make sure the weight is entered correctly.

When making new flashcards, be sure to choose numbers that have not been used before, especially when making replacement cards.

4. EQUIPMENT AND SUPPLIES

Due to the number of different tasks described in this TI, supplies are described in each individual procedure.

5. PROCEDURAL STEPS

5.1 Creating New, Archiving Old and Disposing of Broken Flashcards

Each IMPROVE site has designated flashcards that are only used for that site. The number of designated cards per site depends on the box cycle rotation for that site. Sites that have two blue boxes also have two designated flashcards, and 3-box cycle sites have three designated flashcards. Sometimes a card is lost or damaged and a new card must be assigned.

Other flashcards, called replacement cards, are sent out to sites when the designated cards are late returning to the lab. Flashcards that no longer function properly are noted and discarded.

5.1.1 Site Flashcards

When making a new flashcard, identify the next flashcard ID number to use. The simplest way to do this is to access the web application, navigate to “Sample Boxes”, select the appropriate site name, and press **Search**. Scroll to

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the right to the column called "Flashcard#." Check to see what other flashcard numbers are in use for that site (excluding the one that is being retired). This will provide a better picture of which flashcards have been used.

Some ID numbers will end in "01," Or "02". IDs ending in "01" should be used for new Compact Flash cards. "02" are SD cards used for Controller V4.

The first four digits of the flashcard ID will always remain the same, as that is the site's UC CODE. The 6th number is typically the one that changes. For example, if the flashcards in use are [UC CODE].04.01 and [UC CODE].05.01 and the -04.01 card needs to be retired, the next card should have an ID of [UC CODE].06.01 If the sixth number will exceed 9, change the fifth number to 1 and the sixth number back to "0."

Once a new ID number has been decided upon, create, and apply two new labels for the front and back of the flashcard, using another IMPROVE network card for reference.

5.2 Replacement Boxes

Sometimes a box does not arrive in the lab in time to be processed and prepared for another cycle. When this happens, a replacement box is sent out.

To prepare a replacement box, start by pulling one of the replacement bins from the bottom of the bin rack in the SHOP or cartridge preparation rack. Replacement bins are not labeled and have 3 weeks' worth of cartridges. Make sure the configuration is correct for the box cycle. Retrieve the Velcro label for the site and place it on the bin. Collect the cassette and week bag stickers for the site from the file cabinet and place them in the bin. Place the bin at the Cartridge Preparation station. If a replacement flashcard is necessary, locate the binder that contains all the flashcards. Select any flashcard labeled as **IMPROVE Replacement**. Place the flashcard inside the plastic container and place it inside the bin.

Ensure to flag the late incoming box as "Download only – Replacement being sent out" through the web app under the "Sample Boxes" tab.

5.3 Updating Weights

Sometimes during the Quality Control check, a filter is found with a hole in it or particles that will not come off. When things like this happen, the student assistant or laboratory technician changes out the filter for a new one and notes the new weight. The filter barcode is given to a lead lab assistant, as the new barcode and weight needs to be entered into the Filter Mass table.

Navigate to the WebApp > Analysis Data > Mass. Enter the information for the filter in the search criteria. Select Edit Pre-Weight or Edit Post-Weight. Assign an Analysis QC code of 0-Invalid to the current entry. Select **Okay.** Select **View records details**. Select **(+) New** and populate the table with the correct information. Ensure that the Analysis

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QC Code is 1-Valid. Select + **Add analysis comment**. Enter a comment explaining why the mass was updated.

The Mass table will now have multiple entries for a single sample indicating that the mass was changed. This same method can be used for Post Weight adjustments, or Pre-Weight adjustments needed after a swap.

5.4 Monitoring Field Blanks

Field blank quotas are monitored at the Cartridge Preparation station in the lab application. If too many field blanks are loaded, they are removed by applying an XX status and comment. If a field blank is listed in the database, but is not physically loaded, an appropriate comment must be attached, and the status must be updated to XX.

5.5 Status Adjustments

Status adjustments are performed whenever the status of a filter changes after its information has been entered into SQL database. This is done by changing the status in SQL table adding a comment to explain why the status was changed, and noting the source in which the status was altered. An issue detailing the change is also added to the JIRA project, if applicable, in case any mistake is made making changes in SQL.

There are two important points to remember when making status adjustments:

1. When a change in SQL is made using the Web Application, be very careful to make changes to the correct site, date, module, and ordinal position.
2. It is important to follow a standardized way of commenting in SQL and creating a JIRA issue so searches for information can be done efficiently. Use templates whenever possible.

The following steps describe how to change the status in SQL:

1. Open the file named “2018 Comment Database.xls.” It is located in U:\IMPROVE\LOGS\StatusFlags.
2. If applicable, log in to https://improve.atlassian.net/jira/projects Navigate to the correct site project and create a new JIRA issue template. The Issue type should be a Sample Related Problem. The Priority can be changed to Minor.
3. Next open the Sample Comments document and find the “Status Adjustment” comment. Make pertinent changes to the comment using examples from the “2018 Comment Database”. Update the first relevant sample date, problem with the filter, channel, sample date, and old and new status. If more than one filter is being adjusted, change the number in the upper left corner in the parentheses to match the number of filters being modified. Copy the first line to the JIRA issue’s Summary line, and the rest to the Description field. Create the issue.
4. Log in to the web application: http://improve.aqrc.ucdavis.edu/Filters Navigate to the site, data and module for the filter. Select the “View Filter Details” button

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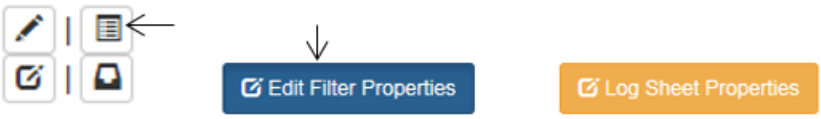
on the upper right side. Then select edit filter properties.



5. Update the appropriate filter status.
6. Click on **Okay** to finalize changes.
7. Click Add new Comment to insert the comment into the Filter Comments. If the scenario differs from the "2018 Comment Database.xls" sheet enter a detailed comment explain the series of events.
8. Select SHL as the source if a comment was made not in relation to the weight. Select Weighing Lab if the comment was made in relation to the weight.
9. Navigate back to the JIRA issue created previously and close it after confirming the status change.

5.6 Printing the Stickers

5.6.1 Cassette Stickers

Open the U:\IMPROVE_Lab\Lab Gravimetric\Stickers. For cassette stickers, choose the correct cassette label file depending on cycle (2-3-2' or 3-2'-2). Press **Enable Content** if needed. Open the correct tab (ABCD for normal sites, ABCDX, or Single Mod). Type in the site name(s) that need stickers and sample date for the first filter. For 5X module sites, also remember to fill in the 5X module with 5A, 5B, 5C or 5D.

Verify the stickers are correct, then click on **File** and press **Print**. In the **Print** menu, make sure the IMPROVE lab printer is selected. The file will automatically attempt to print ten sheets, so modify the number of pages printed so only the active sheets will print. Click **Printer Properties** and change the paper source to **Manual Feed.** Press **Print** and feed the printer blank cassette sticker sheets. After printing, color the sticker sheets by drawing a line down the middle of the 1A column with a red marker, down the middle of the 2B column with a yellow marker or highlighter, 3C column with a green marker or highlighter, and 4D column with a blue marker or highlighter. The 5X module stickers are colored orange highlighter line down the middle of the column, only highlighter should be used as orange marker looks too similar to red marker.

File the colored stickers away into their respective folders in the file cabinet.

5.6.2 Week Bag Labels

Open the Stickers directory to U:\IMPROVE_Lab\Lab Gravimetric\Stickers. To print labels that go on the week bags, choose the "Bag - Labels" Excel file that

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corresponds to the correct cycle for the box in question (2-3-2' or 3-2'-2). If more than one site needs week stickers, use the "Batch Site" tab. Enter in the sites and the first installment date. If only one site needs printing, use the "Single Site" printing. Use yellow stickers for 2-3-2' boxes and green stickers for 3-2'-2. The stickers are 2-5/8" x 1". Print following the same steps as the cassette stickers in section 5.6.1.

5.6.3 Box Top Stickers

Open U:\IMPROVE_Lab\Lab Gravimetric\Stickers . For the box stickers that go on the top left of the box, choose the "Box – Top Labels" file that is correct for the box cycle (2-3-2' or 3-2'-2). For labels for multiple sites, use the "Batch site" tab. If printing labels for only one site, use the "Single Site" tab. Print following the same steps as the cassette stickers in section 5.6.1. Use the same labels as the Week Bag labels. Use yellow stickers for 2-3-2' boxes and green ones for 3-2'-2 boxes.

5.6.4 Box Side Stickers

Open U:\IMPROVE_Lab\Lab Gravimetric\Stickers. For the large stickers that are placed on the sides of the blue boxes, choose either "Box - Side Stickers 2-3-2'" or "Box - Side Stickers 3-2'-2" depending on the cycle. Find the page containing the needed site stickers or create a new site label at the bottom of the document (editing Site and UC Code as necessary). Print the page, making sure to use manual feed. In general, use yellow 4 in. X 2 in. yellow labels for 2-3-2' boxes and green 4 in. X 2 in. labels for 3-2'-2 boxes. If the labels being replaced on a box are pink for multi-box sites, make sure to print on pink stickers.

5.6.5 Bin Labels

Open the U:\IMPROVE_Lab\Lab Gravimetric\Stickers. Find the "Bin – Velcro Tags" file. Click on the "Batch Site" tab and enter the site names for sites that need labels. Print using manual feed. Use the appropriate color sticker as designated in the box to the right in the file. To print barcodes only labels, navigate to the "Barcodes Only" tab. Laminate the sheets and place a Velcro adhesive to the backside of the label.

5.7 Adding New Sites

The sample handling laboratory has several responsibilities when a new site is created.

After lab personnel have been informed of the new site code, associated UCCODE, and cycle, blue boxes and a bin are assigned to the site. In order to be able to prepare the first box for the site, lab personnel must notify a database manager to set up the site in SQL. A check list of things to be done can be found in JIRA under Lab Ops, LO-69. Next the first

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filter and sampling information must be entered into the lab application's Cartridge Preparation station.

5.8 Mass Validation

The lab application's Post-Sample weighing station gives automated weigh validation message, as described in *UCD TI #251H,* section 5.4: Troubleshooting. A Lead Lab assistant will review the message and will check if the recorded measurements are valid. Possible steps include:

1. Reweighing filters to confirm Post Weights.
2. Reviewing flow data to confirm flow data corresponds with high or low mass-loading.
3. Reviewing weights for a given week or box for possible swaps, double-sampling, or incorrect installation.
4. Comparing A-to-D mass-difference ratios for relative consistency. These will vary from site to site and between seasons. The "Mass Review" tab of the Improve Data web page (https://shiny.aqrc.ucdavis.edu/ImproveData/) provides helpful mass-differences for all filters, A/D mass-difference ratios for all sampling days, as well as seasonal average for each. The "Early Review" tab is also useful for a zoomed in view on PM2.5/PM10 mass ratio relationship.
5. Changing the filter status to Questionable Data (QD) if filter needs to be reviewed once analysis results are available.
6. Reviewing a month's worth of gravimetric data available in: http://aqrc-sql/Reports/report/Improve_2.1%20Reports/Filter%20Processing%20Lab/Filter%20Mass%20Data%20Validation. Filtering to samples weighing less than 0.005mg and greater than 2.00 mg. In addition, reviewing weights that are ± 0.005 mg for all field blank samples.

5.9 Reviewing Lab Application Pop-ups at Post Weigh

The lab application's Post-Sample weighing station will automatically generate a pop-up message whenever a weight does not meet the criteria below. Balance operators are to write a detailed note that a lead lab assistant will review.

1. Mass difference is less than or equal to 0.005 mg.
    - The Lead Lab assistant will reweigh the filter to confirm the Post Weight, if applicable.
    - Review the Flashcard data and Flow graph data for abnormalities.
    - Using the Web Application, leave the appropriate comment for that sampling date.
    - Use any of the other available tools detailed in section 5.8 to take appropriate action.

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2. A-to-D mass difference ratio is not within a preset range, determined by the lab application.
    - Review the weights for the entire box, if the either the A or D mass is significantly different from surrounding sampling dates reweigh said filter.
    - Review the flow data and PM2.5/PM10 mass ratio for abnormalities within the box. If needed, compare the mass difference to historical records.
3. Field Blank mass difference is outside ± 0.005 mg.
    - The Lead Lab assistant will reweigh the filter to confirm the Post Weight.
    - Using the web application, leave the appropriate comment for that sampling date.

5.10 Cleaning the MTL AH500 Auto handlers

While the MTL AH500 Autohandler door is closed at most times, the chambers will accumulate dust and other contaminants over a week of use. Every Friday, or last business day of the week, the chamber must be cleaned, and the reference filters and weights air brushed.

1. Schedule fifteen minutes, at least one hour before the MTL AH500 Autohandler is loaded with filters, to clean the chamber.
2. If there are any filters remaining in the weighing silos, they must all be unloaded. Do not remove the filters or weights in the garage positions. Place the clean filters in the appropriate bin and organize the sampled filters in a separate bin.
3. Working from the top down, air brush and or wipe down all surfaces inside the chamber. Only use ethanol and low-lint laboratory wipes to clean. Do not use any household cleaners. Take care when cleaning on and around the middle shelf as not to damage the electronic boxes, wiring, or Mettler Balance display unit.
4. Remove the glass lid on the Mettler Balance weighing chamber and press either the left or right button on the display unit to rotate the weighing chamber to the left or right. Air brush the inside of the weighing chamber, directing dust towards the opening when possible. When done, replace the glass lid, and close the weighing chamber. Take care to not move the faraday cage orientation, doing so could cause damage to the faraday cage once routine weighing is resumed.
5. Air brush around the Mettler Balance chamber and confirm that it is level when done. Special care must be taken not to move the Mettler Balance; its position is critical when operating the MTL AH500 Autohandler.
6. Air brush the y-axis threads on the handler arm.
7. Wipe down the protective aluminum plate that occupies the top garage position in each silo.
8. Before handling any reference filter or reference weight in the garage positions,

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note its orientation and location. If handling a filter with a matrix code, the position of the matrix code is critical for it to be recognized by the reader. Airbrush both the top and bottom sides of each reference filter and weight, returning the reference filter or weight to the original orientation. Work one carrier at a time and replace it back to its original garage position before handling another carrier.

9. Clean the bottom of the chamber last. If the polonium strip holder must be moved, make note of its position and orientation relative to the rectangular white sticker placed to the right side.

5.11 Weekly Checks, Tracking and Shipping

Weekly checks are performed by lead lab assistants to ensure timely delivery of boxes, tracking of all filters, and maintenance of equipment. Checks include but are not limited to:

1. Check Field Blank Quota for the month through the Cartridge Preparation station.
2. Track that the multi-box sites have boxes far enough in advance. Reference for the sites is located in U:\IMPROVE_Lab\Lab Gravimetric\Daily Operation files in file “Multi_Box_Sites”.
3. Review and contact operators for Late Boxes located in IMPROVE Status Views.
4. Update Network Status located on IMPROVE Status View page. Update ‘NetworkStatusUpdate_RHR’ workbook located in U:\IMPROVE_Lab\Lab Gravimetric\RHR.
5. Review Outgoing Boxes reports located in IMPROVE status view.
6. Re-inventory Terminal status filters.
7. Schedule UPS pickups for selected sites. Updated list is located in U:\IMPROVE_Lab\Lab Gravimetric\Daily Operation files titles ‘Sites_UPS_Pickup’.
8. Checking the continuous status of the MTL Autohandler RH and temperature levels.

5.12 Recertifying Metal Test Weights

All stainless-steel external test weights are certified annually. The effective dates are shown on each respective certificate. This is regardless of the frequency or duration of their implementation.

Between the two MTL automated weighing systems, there are three sets of test weights in the range of 50 mg, 100 mg, 200 mg, and 400 mg. Each set is labeled by the year of receipt and A (100mg), B (200mg), or C (400mg). For example, the 100 mg test weights received in 2018 is labeled 18A. Each set of test weights is to be recertified by an accredited metrology lab annually. While two sets are in use in each MTL automated weighing system, the third is in the recertification process or in storage. Time the recertification rotation approximately four months apart.

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For manual weighing, there are two sets of test weights at 50 mg and 100 mg. Each set is labeled by the mass range and A, B, C, etc. For example, a 50 mg test weight is labels 50A. A pair or 50 mg and 100 mg manual-weighing test weights are not grouped as sets, but are commonly recertified at the same time. While one set is in use in the lab, the other is in the recertification process or in storage. Time the recertification rotation at least 2 months apart.

1. Recertification is requested through the group or department purchaser.
2. After a set of recertified weights are received back at the Sample Handling Laboratory, all packing and purchasing documentation must be copied for the group or department purchaser.
3. Scans of the certificates are filed in this directory: U:\IMPROVE_Lab\Lab Gravimetric\Balance QA and Testing\Reference Weights\Test Weight Certificates. There is a separate file for each test weight.
4. Original copies of the certificates are filed in a binder in the Sample Handling Lab. There is a separate binder for Sample Handling Lab test weights and Carbon Lab test weights. There is a divider for each test weight.
5. Information from the certificates are entered in the IMPROVE WebApp: https://improve.aqrc.ucdavis.edu/ReferenceWeights.
    a. On the Metal test weight tab, locate the test weight by its Label.
    b. Click on the Details button.
    c. In the Certifications section, click the Add button and input data into all required fields based on the information from the certificate, then click on the Create button to finalize the entry.
6. Information from the certificates are entered into the MTL Filter Weighing Software (FWS).
    a. Under the Administration section, navigate to the Calibration Weights tab.
    b. On the list to the left, select the test weight name and click on Edit Calibration Weight.
    c. Input data into all required fields based on the information from the certificate, then click on the Save button to finalize the entry.
7. Generate a report for the Laboratory Manager.
    a. Weigh the recertified test weights ten times each on each MTL automated weighing system. There is a QC Check procedure set up for this.
    b. Using another weight's report or a past report as a template, query and copy over the ten replicate measurements foe each test weight, calculate averages from each MTL system, and compare the averages between MTL systems. The Report tab covers full instructions and a template for presenting this information to the Laboratory Manager.
8. U:\IMPROVE_Lab\Lab Gravimetric\Balance QA and Testing\Reference Weights\Test Weight Acceptance\
9. Notify the Software Development group and request an update to the certified values on the Sample Handling Lab Daily QC page:

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https://shiny.aqrc.ucdavis.edu/balance_daily_ops/. Provide the ID number, certified mass, and upper and lower ranges.

5.13 Recertifying Automated Weighing Chamber Environmental Probe

Every Vaisala environmental monitoring unit is recertified annually. The effective dates are shown on each respective certificate. This is regardless of the frequency or duration of their implementation.

Between the two MTL automated weighing systems, there are three Vaisala environmental monitoring unit. Each is labeled VAIHMT and a number and each is to be recertified by an accredited lab annually. While two are in use in each MTL automated weighing system, the third is in the recertification process or in storage. Time the recertification rotation approximately four months apart.

1. Recertification is requested through the group or department purchaser.
2. After a Vaisala environmental monitoring unit is received back at the Sample Handling Laboratory, all packing and purchasing documentation must be copied for the group or department purchaser.
3. Scans of the certificates are filed in this directory: U:\IMPROVE_Lab\Lab Gravimetric\Balance QA and Testing\Vaisala Environmental Monitoring Unit Certificates. There is a separate file for each test weight.
4. Original copies of the certificates are filed in a binder in the Sample Handling Lab.
5. Replacement of the hardware is done after the MTL system is entirely shut off.
    a. Close the FWS.
    b. Close the Environmental Monitoring Software.
    c. Shut down the computer.
    d. Turn off the Autohandler and HVAC power using the circular buttons on the front of the unit.
    e. Flip the cutoff switch on the back of the MTL automated weighing chamber.
    f. Unscrew and unplug the currently-installed Vaisala environmental monitoring unit, and install the replacement unit.
    g. Power everything back on in the opposite order as in the instructions listed above.
    h. Through the Environmental Monitoring Software and FWS, confirm that the temperature and humidity are read.

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UCD IMPROVE Technical Information #251S

Box Cycles and Cartridge Orientation

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

July 15, 2022
Version 3.0

Prepared By: DocuSigned by: Anthony Kawamoto 3A49A57FF666452... Date: 10/4/2022

Reviewed By: DocuSigned by: Jason Giacomo B62B01F81613421... Date: 10/4/2022

Approved By: DocuSigned by: Marcus Langston 0A10CFCF79B0452... Date: 10/4/2022

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1. PURPOSE AND APPLICABILITY

The purpose of this TI is to describe the different box cycles used for IMPROVE sites, proper cartridge orientation and configuration, and to explain the quarter naming system used to organize filters for analysis.

2. SUMMARY OF THE METHOD

IMPROVE sites run on one of two box cycles, which are referred to as 2-3-2' (Yellow Bin) and 3-2'-2 (Blue Bin). Cycles are differentiated by cartridge configuration, bin color, and box labels. Each cycle is three weeks long, with loaded cartridges for each week. Cartridges are configured according to the week and cycle to which they belong. After the filters have been sampled and returned to the sample handling laboratory, they are organized for analysis and separated into four different quarters based on the months in which they were sampled.

3. PROCEDURAL STEPS

3.1 Types of Bins

There should be two different color bins found at the "Box Sending/Receiving" station, YELLOW and BLUE. YELLOW bins typically have yellow stickers, while BLUE bins have their site names on green stickers. Sites with more than 2 boxes in circulation either bin color have a PINK or WHITE dot on their label. Bins of either color with WHITE dots are shipped through the United States Postal Service (USPS) instead of the United Parcel Service (UPS) (all bins designated with yellow, green, and pink site stickers are sent by UPS).

3.2 Bin Contents

3.2.1 Primary Filters

Each yellow and blue bin should contain three plastic bags labeled Week 1, Week 2, and Week 3. Each plastic bag should contain four or five cartridges. There are five types of cartridges: 1A (red), 2B (yellow), 3C (green), 4D (blue), and 5X (orange) (Figure 1). For 5X module sites each bag should have one of each type of cartridge, regular sites will only have 1A, 2B, 3C and 4D cartridges. Cartridges contain three to four cassettes. The cassettes in A and D cartridges contain PTFE filters. The cassettes in B cartridges contain nylon filters, and the cassettes in C cartridges contain quartz filters.

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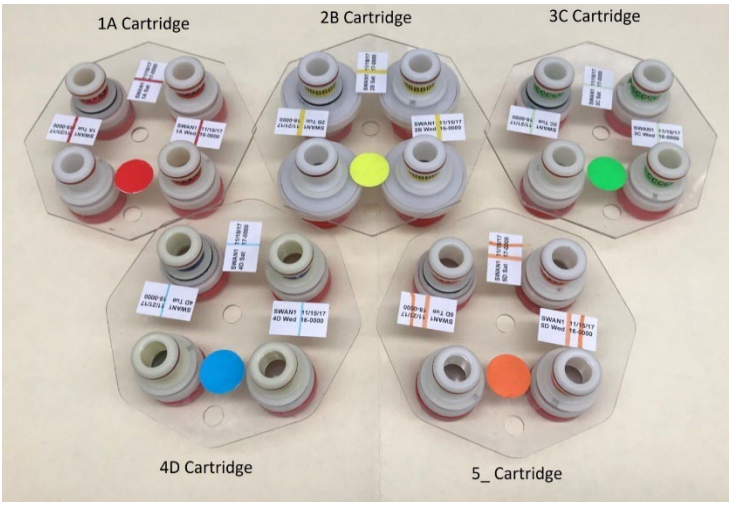
Figure 1. Contents of one zip lock bag (one week).



3.3 Proper Cartridge Orientation

The proper orientation of the cartridge is with the labels facing up. There are two holes in each cartridge—one in the middle and one on the outer edge. If looking at the cartridge head- on, orient the cartridge so that the outer hole is facing 6 o'clock. Ensure that the color-coded circular sticker is above the outer hole, as this helps to orient the cartridge.

With the cartridge properly oriented, the sampling of the cassettes runs in a counter-clockwise manner. The bottom right cassette or the first position is always the first sampled followed by the top right (the second position) and then sometimes the top left (the third position) (Figure 2), depending on the week.

Two or three of the cassettes in each cartridge will have labels next to them. The label for each cassette can be found above in the picture. Printed labels contain the site name, the date of the sample, the sample day (Mon-Sun), and the cartridge type. Sometimes handwritten labels will appear in the third position. These are for field blanks, which are filters that are not sampled, but instead are used as controls. Handwritten labels will have the site name, sampling date, and cartridge type. Any unlabeled cassettes are considered "dummies" and do not contain any sample. Dummy cassettes contain a colored piece of paper and a clear circular sheet instead of a filter except for the B cassettes. For the 1A dummies, a red piece of paper and a clear sheet are used. The same protocol follows for 3C and 4D dummies, except that 3C dummies use a green piece of paper and 4D dummies use blue. The 2B dummies use two white circular sheets with the word "PALL" in blue writing. A dummy cassette can be identified by removing the red cap on the bottom of the cassette (Figure 3).

All cassettes containing filters (except for the field blanks) should have a neck-tie around the center. Neck-ties are thin stickers that contain both the color and name of the type of cassette they are for. For example, neck-ties for 1A filters are red and have "AAAAAAA" typed on them; neck-ties for "B" filters are yellow and have "BBBBBBB"

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typed on them, etc. All of the neck-ties should be facing upright except for the 4D. This sticker should be put on so that the typed Ds are upside down.

Figure 2. Proper cartridge orientation.

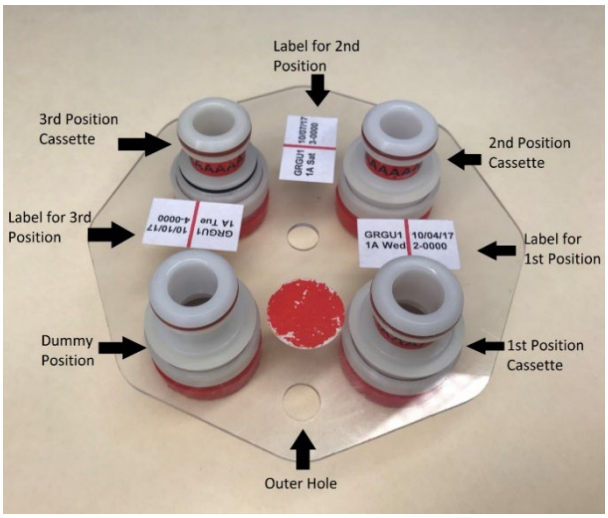
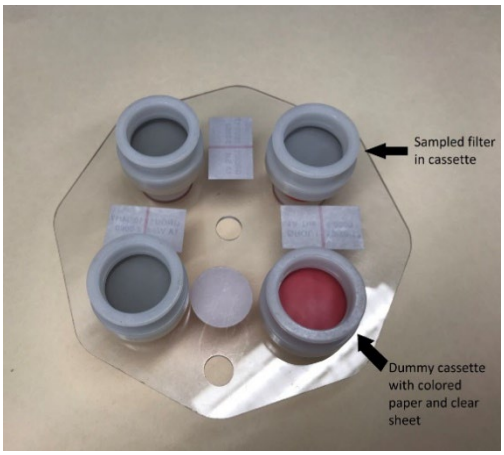


Figure 3. Identification of dummy cassettes.



Some cartridges contain a cassette with a black rubber band, also called an ‘O-ring,” around its center and label (Figure 4). The black rubber band allows this cassette to be manually moved between cartridges when necessary. The location of this movable position is dependent upon the box cycle.

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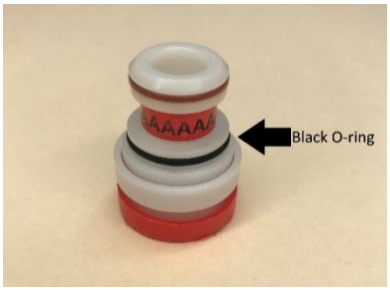
Figure 4. Movable cassette (O-ring).



3.4 Box Cycles

There are two different types of box cycles, which are referred to as the 3-2'-2 and the 2-3-2'. Cycles can be identified based on the stickers found on both the bins and the boxes they are shipped in. 3-2'-2 have a green sticker with the site code printed on it on both the blue boxes and the blue bins. 2-3-2' have a yellow sticker with the site code printed on the yellow bin and the blue box.

3.4.1 3-2'-2 (Blue Bin)

3-2'-2 bins have three filters in the first week, two filters in the second week, and two filters in the third week. In the first week, the first two cassette positions contain a filter. The third position, which is the top left position, is a movable cassette (the one with the O-ring) containing a filter. A dummy is in the fourth position.

In the second week, there are filters in the first two positions. The third position is left empty. When the box is out in the field, operators remove the movable position found in the first week and insert it into this open space in the second week's cartridge. The empty space found in this cartridge is denoted by the apostrophe after the "2" in "3-2'-2." The fourth position is a dummy.

In the third week, there are two cassettes with filters and two dummies. This is the only week in which field blanks can be found for a 3-2'-2. They will be in the third position (top-left) instead of a dummy.

3.4.2 2-3-2' (Yellow Bin)

2-3-2' bins have two filters in the first week, three filters in the second week, and two filters in the third week. In the first week, there are two cassettes with filters and two dummies. This is the only week in which field blanks can be found for a 2-3-2'bin. They will be in the third position (top-left) instead of a dummy.

In the second week, the first two cassette positions contain a filter. The third position (top-left) is a movable cassette, which also contains a filter. Operators in the field will remove the movable position and place it into the third week during their sample change. The fourth position is a dummy.

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In the third week, the first two positions contain cassettes with filters, and the 3rd position is left empty. The movable cassette will be inserted into this space when it is out in the field. The empty space found in this cartridge is denoted by the apostrophe after the "2" in "2-3-2'." The fourth position is a dummy.

3.5 The Quarter Naming System

When filters are organized for analysis, they are separated into four different quarters based on the months in which they were sampled. Every quarter is given a three-digit code for identification purposes. The quarter is identified by the month and the year. January through March are identified as A months, April through June are B months, July through September are C months, and October through December are D months.

Therefore, there are four quarters in a year each labeled A, B, C or D. The last two digits of the year in which the quarter began are found after the quarter letter. For example, October of 2012 through December of 2012 would be D12, while January through March of 2013 would be A13.

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UCD IMPROVE Technical Information #251T

Data and Records Management

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

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Prepared By: DocuSigned by: Anthony Kawamoto 3A49A57FF666452... Date: 10/4/2022

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1. PURPOSE AND APPLICABILITY

The purpose of this TI is to describe the different databases, programs, macros, and other data connections used daily in the sample handling laboratory to manage, view, and organize data.

2. DATA AND RECORDS MANAGEMENT

Multiple databases, programs, and macros are employed in the initialization, tracking, and organization of IMPROVE filters. These are listed and briefly described below:

2.1 Databases

The sample handling lab uses a variety of databases daily. All of them are SQL databases, primarily accessed by users through the lab application and the web application.

IMRPOVE database: The IMPROVE database houses the majority, if not all data, within the IMRPOVE network. The tools and tables the sample handling lab uses frequently are noted below.

a. Filter Table: The Filter Table database includes all non-analytical data for a single filter. Data is written to the Filter Table through the lab application.

b. WEIGHTS: The WEIGHTS database, tied to the Filter Table database through the lab application and web application, is organized to include the mass and identification data for each filter in a single record. Each record contains analysis QC code, site, sample date, channel, status, pre-weight, post-weight, sample weight, pre-temperature, post-temperature, pre-relative humidity, post-relati`ve humidity, pre-weight time and date, post-weight time and date, microbalance used for pre-weight, microbalance used for post-weight, and initials.

c. Reference Weights for Manual Balance: The Reference Weights data is accessed through the IMPROVE database and is organized to include the initials of the balance operator, the date and time, the weight value, the name of the microbalance, and any related comments.

d. Lab Blanks: The Lab Blanks data is accessed through the lab application and is organized to include the following information for the balance (Mettler 1); filter identification name; pre-weight date; post-weight date; number of days between the pre- and post-weighing of the filter; and initials of the balance operator responsible for each measurement.

e. Lotnums: The lot number data is accessed through the web application and records the lot number, manufacturer, filter media type, filter diameter, applicable module configurations, start date and time of a new lot, end date if the lot is complete, and any associated comments.

f. Ambient RH/Temp: The ambient RH and temperature data is accessed through the web application. Based off a probe located in the sample handling lab,

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records are taken for relative humidity and temperature in real-time. The web application displays a comparison of two graphs; the first one displays the last seven days of data and the second on displays the last 31 days of data.

g. MTL database: The MTL database houses all of the weight records, relative humidity, and temperature for all of the sampled, blank, reference, and test filters processed through the MTL AH500 chambers. The data for the routine IMPROVE production is transferred to the IMPROVE database.

h. Reference Weights for MTL AH500 chambers: The Reference weights for the MTL AH500 chambers are accessed through the MTL database and is organized to include the weight ID, weighing date, weighing type, weight value, RH, and temperature.

i. AH500 Chamber RH/Temp: The chamber RH and temperature data is accessed through the MTL database. Based off a probe located within each unit, records are taken for relative humidity and temperature in real-time. When an artifact is weighed, the data is tagged with a measurement of RH and temperature at the given time.

2.2 Macros and Other Data Connections

The sample handling lab uses a variety of macros, reports, a web application, a web interface, and a data connection to perform vital tasks. These will be listed and described below.

1. B_Filter_Inventory_ION: This macro organizes nylon filter data into sets of 400 filters for organization and shipping purposes.
2. C_Filter_Inventory_CARBON: This macro organizes quartz filter data and is similar to ION_Contractors
3. A_Filter_Inventory: This macro is used to sort and organize 1A ($PM_{2.5}$) filter data into sets and separate into Months. 1A filters are analyzed by FT-IR primarily in the order created by this macro.
4. Problems_Contractors: This macro is used to sort terminal status filter data into sets of 400 filters for organization and shipping purposes.

All the Contractor macros store the set lists they create in folders labeled by analysis or filter type. All 2B filter set lists are placed in an Ions folder, all 3C filter set lists (including inactive-C's) in a *Carbon* folder, and all 1A filter sets in an *XRF* folder.

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UCD IMPROVE Technical Information #251U

Mass Data Validation of Reweigh Request

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

July 15, 2022
Version 3.0

Prepared By: DocuSigned by: Anthony Kawamoto 3A49A57FF666452... Date: 10/4/2022

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1. PURPOSE AND APPLICABILITY

The purpose of this TI is to describe how gravimetric analysis is validated in the IMPROVE network when a reweigh request has been made by the data validators. Mass data validation includes procedures for reweighing filters, revising analyzed data, and reporting final validated results. This TI can only be applied to 1A and 4D PTFE routine IMPROVE filters, since gravimetric data does not exist for all other filter types. To apply this TI, all involved IMPROVE samples must be analyzed and a reweigh request must be submitted by the Data Validation group to the Sample Handling Lab.

2. SUMMARY OF THE METHOD

The Data Validation group submits a reweigh request for the current month(s) that is undergoing validation. When the reweigh, request is submitted the data is at Level 2 validation. A lead laboratory technician reviews each reweigh case individually and applies the appropriate procedures. This includes reviewing analysis data, flow rates, weights, field and filter issues, filter and sample event comments, and multiple databases. If necessary, a reweight on the post mass is conducted, compared to the original post weights, and other corresponding analytical data. The lead lab assistant compiles reviewed documentation and creates a report with the findings. The Data Validation group reviews the report and concludes if any further action needs to be implemented. If further action needs to be taken, the Data Validation group and lead lab assistant thoroughly document each change.

3. DEFINITIONS

- Validation Comment: The section within the Reweigh Request Document that thoroughly explains why the sample is being submitted for a reweigh request.
- Reweigh Request Document: This document is provided by the Data Validation Group and includes the sample FilterID, Filter Barcode, Sampler, Objective, Sample Date, Module, Issue type, Requested action, original pre-weigh, original post-weigh, original difference, Premass Balance, PostMass Balance, issue type, and a validation comment.
- Reweigh Report: The addition to the Reweigh Request Document that will be submitted to the Data Validation group explaining the findings, addressing the validation comment, and documenting the procedures that were implemented for each case. The report includes the following additions to the original Reweight Request Document:
    - Post Mass Reweight
    - Reweight Mass Difference
    - Difference between Post Mass Reweight and Original Post Mass
    - Indicator showing if the difference between Post Mass Reweight and Original Post Mass is within ± 10 µg

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- Visual gradient
- Revision of databases
- Weigh Lab Response that addresses the Validation Comment

4. CAUTIONS

Be careful when handling network filters. Dropping or damaging these can change their weight measurements significantly, creating a discontinuity when comparing original weights and reweights. Take note of the orientation in which the filter was loaded into the corresponding Petri dish or D-slide. When loading the filter pack into the appropriate compartment assure to load it in the same orientation it was unloaded.

When reviewing filter mass data ensure that the data in review has an analysis QC code of 1-valid. Any other analysis QC code is not applicable to routine data.

5. PERSONNEL QUALIFICATIONS

Trained lead laboratory technicians are the only personnel who will perform the mass data validation of reweigh requests. Lead lab assistants must be trained by a PI or a lead lab technician familiar with procedures before performing these tasks.

6. EQUIPMENT AND SUPPLIES

- Computer accessible to Improve Management Site and Improve Data Web Applications
- Improve 2.1 Database
- MTL Database
- XPR6UD5 Mettler Microbalance
- Forceps
- Selected sampled A and D PTFE filters

7. PROCEDURAL STEPS

7.1 Receiving Request for Reweighs

Via the Data Validation group receive a request to reweigh selected A and D PTFE filters. Within the request there is the Reweigh Request Document containing: FilterID, Filter barcode, Sampler, Objective, Sample date, Module, Issue type, Requested action, Original pre-weigh, Original post-weigh, Original difference, Pre-mass balance, Post-mass balance, Issue type, and a Validation comment explaining why the sample is being submitted for a reweigh request. Based off this comment, determine which of the following procedures needs to be implemented.

7.2 Querying Pre Mass and Post Mass data via MTL Database

The data present in the Improve Management Site is pulled from the Improve 2.1

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database. Before the filters are processed through the Pre-Sample Weigh-In and Post-Sample Weigh-In stations they are weighed through the MTL Autohandler Chamber. All the pre-mass and post mass records are saved in the MTL Database. When the filters are processed through the Pre-Sample Weigh-in and Post-Sample Weigh-In stations the data is copied from the MTL database to the Improve 2.1 database. Miscommunication is at times noted when a filter barcode has multiple weights associated with it or the MTL Autohandler Chamber has complications reading the filter matrix code. The MTL database is compared to the Improve Management Site to ensure that no discrepancies are present.

1. Via Microsoft SQL Server Management Studio connect to Server Name: **aqrc-pc-fwssql** select **NEW QUERY**.
2. From saved queries execute a query to pull the mass data for the filter.
3. Update **Filter ID** and **wd.WeighingDate** to reflect the filter present.
4. If the filter was pre-weighed and/or post-weighed through the MTL Autohandler Chamber compare the pre-mass and/or post mass to those noted in the Reweigh Request Document.
5. In the Reweigh Report, create a column titled **DB Match?** If the two sources have matching weights write **YES**. If the two sources do not have matching weights note what the discrepancy is. If the filter was not pre-weighed or post-weighed through the MTL Autohandler Chamber write **NA**.
6. If the masses do not match between the two sources, further investigate the issue. This may be the source behind the filter's QD status or reweigh request.
7. If a discrepancy between the two sources confirms the factors within the validation comment, note it in the weigh lab response section of the Reweigh Report. Thoroughly state which weights are suggested for edit and why.
8. If the reasoning for the validation comment was addressed by noting a discrepancy between the two database sources, the filter reweigh request is complete. No further actions are needed.
9. Update the post-mass as outlined in TI 251R Section *5.3 Updating Weights*. Format the cell as 'cell style' 'Good' to indicate the matter has been resolved, and the case is pending validator review.

7.3 Reweighing Filter

1. Retrieve filter from the appropriate archived location. Module type A filters are analyzed and used by multiple parties. If retrieving an A filter for reweighing inform all impacted parties.
2. Ensure that the Mettler XPR6UD5 balance is ready for use in both Autohandler chambers by referring to section 6.2. In TI 251 A.
3. Retrieve filter from corresponding slide. Load into carriers and weigh through corresponding Autohandler Chamber referring to section 5.2, Weighing in the

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MTL Autohandler Chambers, in *UCD IMPROVE TI 251 H: Post-Sample Weigh In*.

4. Take note of the orientation in which the filter was loaded into the slide. The side facing upward should be the side were the deposit was loaded and analyzed on. The alphanumeric code and matrix code should be legible. If the filter was found 'upside-down' take note.
5. Observe the filter under a white background. Based off the amount of deposit present, assign the filter one of the following gradient deposits: light, medium-light, medium, and medium-dark, dark. These terms are relative and are dependent on what is routinely seen. Ensure to observe each filter under the same background and lighting for consistent results. Take note of any uneven sampling, scratches, holes, or other damage to the filter that may be present. In the Reweigh Report, add a column titled **Visual**. Under this column write out the gradient deposit that was assigned to the present filter as well as any additional notes.
6. Observe the filter on hand and ensure that the physical barcode matches the barcode in the Reweigh Request Document. If the barcode matches continue. If the barcode does not match, investigate if there was a filter swap that occurred and how.
7. Via Microsoft SQL Server Management Studio connect to Server Name: **aqrc-pc-fwssql**, query the filters that were weighed for the given day. Record the weight for the given filter in the Reweigh Report under a column titled **Reweight**.
8. In the Reweigh Report create a column titled **New Mass Differences**. This is the difference between the Reweight and the Original Post Mass.
9. Create an additional column in the Reweigh Report titled **Match**. If the Post Mass Differences is ± 10 µg, write **YES**. If the Post Mass Difference is not ± 10 µg, write **NO**. Note that this a general guideline and may not apply to all cases. Cases it may not apply to include heavily deposited filters or filters with a high mass difference.

7.4 Reviewing Additional Improve Data Analysis

Prior to deploying the reweigh request, the Data Validation team conducts a Level 1B and Level 2 validation. Please refer to *UCD TI #351C: Data Validation* for a detailed explanation. Once the validation is complete several filters are flagged as QD for a variety of reasons. To further understand the validation comments of the reweigh request and the accuracy of the data, review the scatter plots site-by-site examination of time series for the following:

- Sulfur versus Sulfate concentrations
- PM_{10} and $PM_{2.5}$ Mass

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- $PM_{2.5}$ gravimetric mass and reconstructed mass

Navigate to the Improve Data site: https://shiny.aqrc.ucdavis.edu/ImproveData/.

1. Select the **Validation** Tab.
2. Under **Site** enter the Sampler name. Note that **RT** stands for routine sites and **CL** stands for collocated sties. Sites with a fifth ordinal position module will have both RT and CL.
3. Enter the date range for the impacted filter spanning a total of 6 months to examine overall trends surrounding the sampling date.

7.4.1 Sulfur versus Sulfate

For the purpose of this TI the Sulfur versus Sulfate plot is used to determine any discrepancies within the 1A filter. If the Sulfur/Sulfate ratio is an outlier and all other 2B analytical components pass validation it may be an indication of a 1A swap or error in analysis. Refer to this plot if **Issue Type** on the Reweight Request document indicates discrepancies between the Sulfur/Sulfate ratios. Refer to *UCD IMPROVE TI #351C: Data Validation* for further explanation.

1. Navigate to the Sulfur/Sulfate scatterplot
2. Hover over the impacted date, noting the ratio value. The ratio value should be near 1.0. Consider surrounding sampling dates and overall trends for the site and sampling season.
3. If the ratio value is near 1.0 or falls into the overall trend of surrounding sampling dates document the findings in the weigh lab response. If the ratio is an outlier document the finding in the weigh lab response as a possible resolution for the validation comment. Note that S3/SO4 analysis is only conducted for 1A filters.
4. If necessary, refer to *UCD IMPROVE TI #351C: Data Validation* for in-depth explanation of S3/SO4 analysis and calculations.

7.4.2 Mass Ratio

Refer to this plot if **Issue Type** on the Reweigh Request Document indicates discrepancies between the PM2.5/PM10 ratios. $PM_{2.5}$ and PM_{10} create a mass ratio. Ideally $PM_{2.5}$ should be smaller than PM_{10}, the ratio varies depending on site and season. If any of the following criteria are met the ratio is noted as an outlier:

- $PM_{2.5}$ or PM_{10} mass is negative
- $PM_{2.5}$ is significantly greater than PM_{10}
- PM_{10} is abnormally high

Refer to *UCD IMPROVE TI #351C: Data Validation* for further explanation if

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necessary.

1. Navigate to the $PM_{2.5}/PM_{10}$ scatterplot.
2. Hover over the impacted date, noting the ratio value.
3. If the mass ratio is a significant outlier, document findings in the weigh lab response as a possible resolution for the validation comment.

7.4.3 Reconstructed Fine Mass (RCMN)

Refer to this plot if **Issue Type** on the Reweigh Request Document indicates discrepancies between the PM2.5 and RCMN values The RCMN is constructed using an intricate equation and compared to the gravimetric mass. Ideally RCMN and gravimetric mass should agree well. If they do not it may be an indication of a filter swap, error in sampling, or error in analysis for the 1A module. Refer to *UCD IMPROVE TI #351C: Data Validation* for a further explanation.

1. Navigate to the RCMN bar plot.

   Compare $PM_{2.5}$ from the mass ratio scatter plot to $PM_{2.5}$ from the RCMN bar plot. Values should be similar or equal. If values are not equal (write **RCMN>$PM_{2.5}$** or **RCMN < $PM_{2.5}$)** document findings in the weigh lab response as a possible resolution for the validation comment.
2. Refer to *UCD IMPROVE TI #351C: Data Validation* for in-depth explanation of RCMN calculations.
3. If none of the checkpoints conducted so far addresses the validation comment in the reweigh request, navigate back to the Improve Management Site: improve.aqrc.ucdavis.edu/AnalysisData/Mass. Enter **Sampler** four letter code. Enter surrounding sampling dates in **Start Date** and **End Date**. For **Analysis QC Code** do not select any.
   a. Review surrounding sampling dates mass ratio general trends.
   b. Make note of any specific trends that may address the validation comment.
   c. Review any analysis QC code **2- Repetitions and Reanalyzed data**.
   d. Make note of any inconsistencies between 1-Valid mass and 2-Repetitions and Reanalyzed mass (i.e. swaps between masses) that may address the validation comment.
   e. Review any other Analysis QC Code (0-5) for additional mass data.

7.4.4 Reviewing Flow Rates

1. Refer to section 6.5, Using Improve Data Management Web Application Flow Graphs, in *UCD IMPROVE TI #251E* to review flow rates for the

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impacted filter.

2. Make note of any abnormalities in the flow rates that may address the validation comment in the Reweigh Report.

7.4.5 Reviewing JIRA

1. Navigate to JIRA via improve.atlassin.net
2. Under the main menu navigate to **PROJECTS**.
3. Within the search icon enter the four-letter code of the sampler (e.g., BIBE). Select priority and **ORDER ISSUES BY: Created**.
4. Browse through the issues near the sampling date. These issues primarily refer to any sampling events that occurred in the field. Some issues may refer to filter-specific comments such as swaps.
5. Take note of any JIRA issues that address the validation comment. If there is an associated JIRA issue write the name of the issue (e.g., BIBE-48) and a paraphrasing of the issue in relation to a resolution to the validation comment.

7.5 Field Blanks

A reweigh request will usually only be submitted for a field blank if the original difference is too high or too low. The mass criteria for a field blank is ± 5 µg. Anything outside of those parameters is outside of the criteria.

1. Follow procedure 7.1-7.4.
2. Via the Improve Data page: https://shiny.aqrc.ucdavis.edu/ImproveData/ navigate to the **Field Blanks** tab.
3. Under **Category** navigate to **Mass**.
   a. Under **Parameter** select **PM2.5** for 1A filter or **PM10** for 4D filter.
   b. Enter the appropriate date range.
   c. Enter the **Filter ID,** note this is not the same as filter barcode. FilterID can be found in the Improve2.1 database.
   d. **Zoom** to **Field Blanks** and select **Show field blanks**.
4. The selected Filter ID will be highlighted on the scatterplot with an orange X.
   a. Underneath the scatterplot, view the $PM_{2.5}$ or PM_{10} difference between the sampled filter and field blank.
   b. The field blank's value should be significantly lower than the sampled filter. If the values are similar this may be an indication that the field blank received a sample.
   c. Populate the Reweigh Report with the corresponding fields.

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7.6 Results and Suggestions

Based off Procedure 7.1-7.5 conduct an informed response that addresses the validation comment. Include any suggestions for pre-mass or post mass changes and the reasoning behind it. Refer to reweight masses, visual inspection, flow rate graph, analysis scatterplots, databases, and JIRA issues if applicable.

1. For cases where the validation comment has been resolved and the post mass has been updated, format the cell to Cell Style "Good". For cases where the validation comment has not been resolved and further investigation via the validators is required format the cell to Cell Style "Neutral".
2. After addressing the validation comment for all requested filters, email the Data Validation team the completed Reweigh Report.
3. Save file in U:\IMPROVE_Lab\Lab_Gravimetric\Validation Requests\Reweighs\Response\YYYY.
4. The Data Validation Team will report back with any additional changes to pre-weight, post weight, and/or filter status.
5. For post weight changes navigate to the Improve Management Site: improve.aqrc.ucdavis.edu/AnalysisData/Mass enter the filter information. Select **Edit Pre-weight record** or **Edit Post-Weight Record**.
    a. Under the **Analysis QC Code** Select **0-Invalid** for the current record. This will create an invalid-record and redirect back to the "GRAV Analysis" page.
    b. Select **(+) Add Grav Analysis.**
    c. Populate the highlighted fields with the correct information. Ensure that the **Analysis QC Code** selected is **1-Valid.**
    d. Select **(+) Add Analysis comment**. Enter a detailed comment as to why a mass value was updated.
    e. If needed, enter an Analysis Flag by selecting **Edit Flags**. Populate the highlighted fields and enter the appropriate analysis status. Click on **Add Selected**. Note that an Analysis Comment or Analysis Flag will only affect the gravimetric analysis and not the entire filter.

8. DATA AND RECORD MANAGEMENT

All data is stored in the AQRC-SQL and aqrc-pc-fwssql servers. Network data can be queried through the IMPROVE_2.1 database. MTL data can be queried through the MTL Database. Refer to *UCD IMPROVE TI #251T: Data & Records Management* for a description on daily data management in the sample handling laboratory.

8.1 Network IMPROVE Data

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The IMPROVE Data page is used to view all data analysis for each filter type. For this TI, the page is utilized to view data analysis for A, D, and field blank PTFE filters. Through this page, sulfur vs. sulfate, mass ratio, reconstructed fine mass, and field blank analysis can all be viewed.

8.2 JIRA

JIRA is a tool that was developed by Atlassian to track issues and project management. Issues in JIRA are created to track sampling-event, field-related, equipment, and filter-related issues. Users have the ability to create, add-on, and browse issues. Issues are given a workflow to show the status. Once the issue has been given a resolution the issue can be closed out.

8.3 Analysis Mass Data

The Improve Management Site Analysis Data Mass page contains mass information pertaining to the A and D PTFE filters. It includes the analysis QC code, filter barcode, sampler, sample date, module typed code, ordinal position, filter purpose, filter status, pre-mass, post-mass, difference, pre-relative humidity, post-relative humidity, pre-temperature, post temperature, pre-mass date, pre-mass initials, pre-mass balance, post-mass date, post-mass initials, and post-mass balance. A new pre- or post-mass record can be generated with a different analysis QC code. The Analysis QC Code are as follow: 0-Invalid, 1-Valid, 2-Repititions and Reanalyzed data, 3-Test data, 4-Superseded Data, 5-Invalid Replicate/Repeat Data, 6-Routine Replicate.

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UCD IMPROVE Technical Information #251V

Replacement Filters and Swaps

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

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Prepared By: DocuSigned by: Anthony Kawamoto 3A49A57FF666452... Date: 10/4/2022

Reviewed By: DocuSigned by: Jason Giacomo B62B01F81613421... Date: 10/4/2022

Approved By: DocuSigned by: Marcus Langston 0A10CECE79B0452... Date: 10/4/2022

UCDAVIS
AIR QUALITY RESEARCH CENTER

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1. PURPOSE AND APPLICABILITY

This TI describes the proper procedures for creating replacement filters and conducting filter swaps for all IMPROVE network sites at the sample handling lab level. Its purpose is to establish guidelines for how to perform these tasks.

2. SUMMARY OF THE METHOD

IMPROVE replacement filters are created and swaps are conducted in the mission to have as many valid samples as possible for each sampling site. Each scenario is unique but may include creating a replacement box in the database, creating a physical replacement swap, and undergoing a box, cartridge, and/or filter swap.

3. DEFINITIONS

- Box properties: properties unique to a single box including the primary key 'ID' followed by sampler, installment date, current lab station, and date for completion of each LabApp station.
- Filter Properties: properties unique to a single filter including primary key 'ID' followed by barcode, lot number, sample deposit area, pre-mass, post mass, storage tray ID, tray position, and filter comments.
- Box ID: unique identifier for each box.
- Cartridge ID: unique identifier for each cartridge.
- FilterID: unique identifier for each filter.
- Barcode: unique physical identifier for PTFE routine filters.
- Event Comment: comment placed on all modules for a sampling date.
- Filter Comment: comment placed on a single filter

4. CAUTIONS

Good data practice must be executed when altering the database. Making any changes in the Web Application directly writes to the Improve_2.1 database. Pay very close attention to all metadata for each filter. Extract the original data, if required, prior to conducting any swaps. Any errors made may not be reversible and may directly impact the data.

Duplicate records for the same sampler, sampling date, filter purpose, and filter status cannot exist across multiple FilterIDs. Be diligent about updating filter purpose to 'UF'.

Swaps at the sample handling level are only conducted if no analyses past gravimetric have been performed, and the sample handling lab remains in custody of all associated filters.

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5. PERSONNEL QUALIFICATIONS

Trained lead laboratory technicians are the only personnel who will create replacement filters or conduct swaps. Lead lab technicians must be trained by a PI or a lead lab technician familiar with procedures before performing these tasks.

6. EQUIPMENT AND SUPPLIES

- Computer accessible to Improve Management Site and Improve Filter Processing Application (Lab App).
- IMPROVE calendar
- Replacement bins and cartridge parts
- Cartridge preparation tools

7. PROCEDURAL STEPS

7.1. Creating a Box Through the Web Application

Boxes are routinely generated through the Cartridge Preparation Station. There are specific instances when a box has to be manually generated through the Web Application. The scenarios include, but are not limited to:

- A box was lost via mail carrier in route to the IMPROVE site.
- A box was lost by the operator before sampling for the entire cycle.
- A box was stolen at the IMPROVE site, before sampling for the entire cycle.
- A box was unable to be generated through the Cartridge Preparation Station because it was sent out late and dates can no longer be altered through the station.

Only trained lead lab technician can create a box. It is vital to ensure all of the dates entered are parallel to the IMPROVE calendar and the desired cycle.

1. Assess the case and the reasoning as to why a box needs to be generated. Contact the operator and field group, if applicable, to ensure minimal loss of samples. Note that portions of a box such as a week or two can be created through the flexibility of the **Schedule** tool. Confirm if an entire box needs to be generated or only a portion (one week or two).

2. Navigate to the Web Application https://improve.aqrc.ucdavis.edu/. Select the **Operations** tab, and select the **Schedule** subtab. In the search bar enter the desired “Sampler”. Navigate to the bottom of the screen and select **Add New Box**.

3. By referencing the IMPROVE calendar enter the desired “InstallDate” and select **Create**. This item can be edited at a later time if entered incorrectly, but the date

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must be correct once the box is assembled. The "InstallDate" must be parallel to the box cycle. For example, if the installment date for the cycle is 04/12/22, but only the second week needs to be created with a start date of 04/19/22, the "InstallDate" has to remain as 04/12/22. Altering the "InstallDate" affects other web pages. Select option for "This is a replacement box (check to set lab station to pre-weigh)".

4. Select **Add New Cartridge**. This will prompt the "Create Cartridge" Page. Select the "SampledModuleID" from the drop-down list; this will be 1A for the first cartridge. Based on the IMPROVE calendar select **Install Date** for the week; note that this is different from sampling date. Enter **1** for "ScheduleWeek". This section defines the week the sample is scheduled to run. Select **Create**.
5. In the "Box Details" page ensure that all of the items for the cartridge are correct, if incorrect select **Edit**. Select **Add Filter** to add filters to the created cartridge. In the "Create Filter" page select the **Cartridge Position** from the drop-down menu. A "used" comment will be added if a filter already exists for the position. Based on the IMPROVE calendar, enter the "SampleDate" and "QuarterPostion". Select the "MovableCassette", if the filter added is the o-ring third position. Select the "LotId" from the drop-down menu. Select **Create**. On the "Box Details" page ensure that the items for the filter added are correct. Repeat this step until all filters for the selected cartridge are added.
6. Review the contents of the created cartridge, edit any items if needed. Select **Clone** to clone the cartridge for the remaining three or four modules. Select "Destination Module" and "Destination Lot" from the drop-down menus. Select **Create**. Review contents of the cloned cartridges.
7. Repeats steps 4-7 until all three weeks or remaining desired weeks have been created for the box. If the site has a 5th module make sure to **Clone** the cartridge for the selected 5th module.
8. If the original box contained a field blank, ensure that a field blank is created for the replacement box. **Add Filter** for the selected week and module. For 3-2'-2 boxes the field blank will be added in position 3 of week 3. For 2-3-2' boxes the field blank will be added in position 3 of week 1. DO NOT select "MovableCassette" option.
9. Through the Web Application navigate back to the Sample Boxes tab. The created box should be live on the page. Enter the Flashcard #, Cartridge Preparation Date, Cartridge, and Preparation Initials. If any field blanks were created, assign Filter Purpose FB.

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10. Assign UF (Unused Filter) Filter Purpose to all filters that are not intended for use (i.e. the original box that was lost). Within the IMPROVE database, only a single sampling date can have a valid filter status and a SA (Sampling) filter purpose.
11. If any swaps need to take place refer to section 7.3, contact data validation team if needed, and create a JIRA issue if applicable.

7.2. Creating a Physical Replacement Box

1. Assemble a complete box or a portion of a box based on the case and IMPROVE calendar.
2. Generate cassette stickers, ensuring that the site name and first sampling date are correct. When highlighting the cassette stickers, add an additional pink line to each module type. Once the box returns from the field, the additional pink line will inform us that the operator installed the "replacement box" instead of the original box or vice versa.
3. Since the box was already created and is live in the database, no interaction with the Lab App is required at the Cartridge Preparation level. If the replacement box has a field blank, follow the same procedure in the cartridge preparation station *UCD IMPROVE TI #251I: Cartridge Preparation Station.*
4. The box should be live at the pre-weigh station. At this point, the box can be treated as a routine network box. Once the box has been fully processed, notify a lead lab tech that the box is ready for shipment.

7.3. Swaps

The filter, cartridge, and box records found in the IMPROVE database are digital twins to their physical items. A digital twin is a virtual representation, serving as the real-time counterpart of a physical object. When swaps are conducted, fields in the record are updated to match the physical chain of events.

Swaps can be conducted by a trained lead lab tech, at the sample handling lab level, only if no filters have undergone analyses and all samples remain within custody of the sample handling lab. Swaps are to be conducted after sampling, when filters return from the field. If any or all filters have already received analyses, a swap must be conducted by a trained member of the data validation team.

Within the Web Application (https://improve.aqrc.ucdavis.edu/Swap) there are three levels of swaps that can be conducted at the sample handling level: Box Swaps, Cartridge Swaps, and Filter Swaps.

7.3.1. Box Swaps

Box swaps are conducted and applicable when two entire boxes, from the same box cycle, are swapped in the field. All cartridges must align for the swap to be successful. If any other swaps occurred within the box, filters will have to be

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swapped using either the Cartridge Swap Tool in section 7.3.2 or Filter Swap Tool in section 7.3.3.

Examples of Box Swaps include but are not limited to:

- Box X was lost/not delivered so Box Y of a future cycle was used.
- Box X was unused from an old cycle, it was used in place of Box Y of a future cycle.
- Box X was lost/not delivered so Box Y was assembled for the identical sampling dates, but not processed through the Improve database.
- Box X was assembled and processed through the database, but never used/shipped out because the site was offline.
- Box X was sent to the wrong site and sampled fully in the incorrect site.
    - This usually happens with the same cycle of boxes, but an instance could occur where a 2-3-2' box samples in place of a 3-2'-2 box and vice versa

1. Navigate to SQL Server Reporting Services http://aqrc-sql/Reports/browse/. Select **Imrpove_2.1 Reports → Filter Processing Lab → Filter Data Validation**. Enter the selected start date in the section "Sample Date Min" and the end date in section "Sample Date Max". Select the site name in the "Sampler List" drop-down menu. Select **Download as Excel**.
    a. Extract all associated data into "FilterSwapTemplate" located in U:\IMPROVE_Lab\Lab Gravimetric\Daily Operation files\BoxSwaps
    b. Populate the **SwapInformation** tab with details about the swap. Paste the originally extracted data on the left table in the **SwapData** tab. The table on the right will hold the counterpart of the swap.
2. Access Box Swap Tool within the Web Application https://improve.aqrc.ucdavis.edu/Swap. Select **Boxes**. The "Swap Boxes" view will have two sections titled "Box X" and "Box Y". Under each section enter any Filter ID or Filter Barcode for both boxes. Select **Update**. All box properties, cartridge details, and filter details will be displayed under the Box Properties.
3. Review all cartridge and filter information for each box. Make sure it matches both of the boxes that are intended for a swap. Ensure that all cartridges align, i.e. cartridge 1 from "Box X" has three filters and cartridge 1 from "Box Y" has three filters as well. If the cartridges do not align, the swap has to be conducted by either the Cartridge Swap Tool or Filter Swap Tool.
4. Select **Swap labels**. This will swap the "Installment Date Box Label" for both boxes involved.
5. Scroll to the bottom of the page, where the comments tables are visible. An automatic "Event Comment" and "Filter Comment" will be applied to the entirety of both boxes. If additional information is required for the swapping

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event, "Add Custom Text". In "Comment Source", select **SHL**. Select **Swap Data**.

6. Navigate back to the Sample Boxes page for each box. After a swap is performed the filter status and filter purpose need to be addressed.
    a. If either of the boxes that underwent the swap, was not intended to sample, all filters will need to be updated to Filter Purpose "UF", with inclusion of any field blanks.
    b. All routine filters will need to be updated to Filter Status "SW-Swapped Sample Dates". Within the Sample Box page of the given box, navigate to Set Box Status. Within Set Box Status navigate to the Filter Status drop-down menu. Select **SW**. Click **Okay**.

7.3.2. Cartridge Swaps

Cartridge swaps are conducted and applicable when two cartridges are swapped before a sampling event or during a sampling event. Both cartridges have to align in terms of the number of samples. If a single cartridge contains a field blank, the field blank will not undergo a swap. However, if both cartridges contain field blanks, the filters will be swapped.

If cartridges do not contain the same number of filters or field blanks do not need to be swapped, filters will have to be swapped using the Filter Swap Tool in section 7.3.3.

Examples of Cartridge Swaps include but are not limited to:

- A site came back online but does not have a new box:
    - One or two weeks of an old unused box are used in place of the current box.
- A site came back online, but did not have a new box at the moment. The old Week 3 unused filters were used in place of the current Week 1. A new box was generated and sent out. In the new box:
    - Week 1 filters were never used
    - Week 2 & Week 3 sampled correctly
- Weeks are used in the incorrect order:
    - Example: Week 3 bag is used instead of Week 1
- Cartridges are input into any wrong module.

1. Cartridge swaps typically contain fewer samples in comparison to a box swap. If needed extract the original data. Navigate to SQL Server Reporting Services http://aqrc-sql/Reports/browse/. Select **Imrpove_2.1 Reports → Filter Processing Lab → Filter Data Validation**. Enter the selected start date in the section "Sample Date Min" and the end date in section "Sample Date Max".

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Select the site name in the "Sampler List" drop-down menu. Select **Download as Excel**.

a. Extract all associated data into "FilterSwapTemplate" located in U:\IMPROVE_Lab\Lab Gravimetric\Daily Operation files\BoxSwaps

b. Populate the **SwapInformation** tab with details about the swap. Paste the originally extracted data on the left table in the **SwapData** tab. The table on the right will hold the counterpart of the swap.

2. Access Cartridge Swap Tool within the Web Application https://improve.aqrc.ucdavis.edu/Swap. Select **Cartridges**. The "Swap Cartridges" view will have two sections titled "Cartridge X" and "Cartridge Y". Under each section enter any Filter ID or Filter Barcode for both cartridges. Select **Update**.

3. Review all cartridge information for each cartridge. Make sure the details match both of the cartridges intended for a swap Ensure that all cartridges align, i.e. "Cartridge X" has three filters and cartridge "Cartridge Y" has three filters as well. If the cartridges do not align, the swap has to be conducted by using the Filter Swap Tool.

4. Select **Swap Location**. This will swap the Physical Location, including the BOX ID and Box Installment Date, if cartridges are located within different boxes.

5. Select **Swap Label**. This will swap Installment Date labels for each cartridge. The Installment Date is the Tuesday the cartridge was set to install based on the IMPROVE calendar.

6. When conducting the cartridge swap, keep in mind that all sampling data, Field data, and log sheet data will be swapped.

7. Scroll to the bottom of the page, where the comments tables are visible. An automatic "Filter Comment" will be applied to the entirety of both cartridges. If additional information is required for the swapping event, "Add Custom Text". In "Comment Source", select **SHL**. Select **Swap Data**.

8. Navigate back to the Sample Boxes page for each cartridge. After a swap is performed the filter status and filter purpose need to be addressed.

   a. A If either of the cartridges that underwent the swap, was not intended to sample, all filters will need to be updated to Filter Purpose "UF", with inclusion of any field blanks.

   b. All routine filters will need to be updated to Filter Status "SW". Any terminal filters will remain as is or be updated to their respective terminal statuses.

7.3.3. Filter Swaps

Filter swaps are conducted and applicable when any two filters are swapped before a sampling event, during a sampling event, or after sampling. The sample

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handling can conduct swaps on filters only if all filters are still within custody of the sample handling lab. If the filters have been deployed to their respective analytical laboratories and/or are currently undergoing analysis, trained personnel from the data validation team will need to take over the process.

The Filter Swap tool can also be used to swap a sampled filter, with filter purpose "SA", and a field blank filter with filter purpose "FB".

Examples of Filter Swaps include but are not limited to:

- An RT filter was swapped with a FB filter.
- An RT filter was swapped with a CL filter.
- One or more same module filters were swapped within the same box.
- A 1A filter was swapped with a 4D filter (uncommon).
- The cartridge was installed incorrectly (rotated clockwise or counter clockwise), and one or more filters sampled on the incorrect day.

1. Filter swaps typically contain fewer samples in comparison to a box swap. If needed extract the original data. Navigate to SQL Server Reporting Services http://aqrc-sql/Reports/browse/. Select **Imrpove_2.1 Reports → Filter Processing Lab → Filter Data Validation**. Enter the selected start date in the section "Sample Date Min" and the end date in section "Sample Date Max". Select the site name in the "Sampler List" drop-down menu. Select **Download as Excel**.
    a. Extract all associated data into "FilterSwapTemplate" located in U:\IMPROVE_Lab\Lab Gravimetric\Daily Operation files\BoxSwaps
    b. Populate the **SwapInformation** tab with details about the swap. Paste the originally extracted data on the left table in the **SwapData** tab. The table on the right will hold the counterpart of the swap.
2. Access Filter Swap Tool within the Web Application https://improve.aqrc.ucdavis.edu/Swap. Select **Filters**. The "Swap Filters" view will have two sections titled "Filter X" and "Filter Y". Under each section enter the Filter ID or Filter barcode for both associated filters. Select **Update**.
    a. Review Filter Properties for each corresponding filter. Filter Properties are unique to each Filter ID and cannot be swapped, all other properties associated with the sample can be swapped.
3. Select **Swap filter physical location**. This will swap the Physical location between the two filters, including the sample cartridge ID and the cartridge position, i.e. what position and cartridge the filter sampled on.
4. Select **Swap sampling properties**. This swaps all sampling properties between the two associated filters which includes, sampler, module, sample date, quarter position, purpose, and status.

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   a. Select **Update filter statuses.** All filters that undergo a swap must have a filter status of "SW". If the swap involves a field blank, both filters must be assigned filter status "SP-Field Blank/Sample Swap".

5. Select **Swap field data**. This swaps all field data including controller filter readings and flow source data records.
6. Select **Swap logsheet data**. This swaps all associated log sheet data, if any has been entered for either filter through the Lab Application.
7. If either filter currently has Analysis Data, a swap cannot be conducted at the sample handling level and a trained staff from the data validation team needs to be alerted.
8. Scroll to the bottom of the page, where the comments tables are visible. An automatic "Filter Comment" will be applied to both filters. If additional information is required for the swapping event, "Add Custom Text". In "Comment Source", select **SHL**. Select **Swap Data**.
9. Navigate back to the Home page and Filters tab, search each filter. After a swap is performed the filter status and filter purpose need to be addressed.
   a. If either of the filters that underwent the swap, was not intended to sample, all filters will need to be updated to Filter Purpose "UF", with inclusion of any field blanks.
   b. Any terminal filters will remain as is or be updated to their respective terminal statuses.

8. DATA AND RECORD MANAGEMENT

All data is stored in the AQRC-SQL server. Network data can be queried through the IMPROVE_2.1 database. Refer to *UCD IMPROVE TI #251T Data & Records Management* for a description of daily data management in the sample handling laboratory.