

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:	<small>DocuSigned by:</small> <i>Anthony Kawamoto</i> <small>3A49A57FF666452...</small>	Date: 10/4/2022
Reviewed By:	<small>DocuSigned by:</small> <i>Jason Giacomo</i> <small>B62B01E81613421...</small>	Date: 10/4/2022
Approved By:	<small>DocuSigned by:</small> <i>Marcus Langston</i> <small>0A10CECE79B0452</small>	Date: 10/4/2022

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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.

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

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.

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

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 “Installation 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

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”.

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

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.

- 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.