UCD IMPROVE Technical Information #276B

Performing HIPS Analysis

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

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DOCUMENT HISTORY

Date Modified	Initials	Section/s Modified	Brief Description of Modifications
05/20/21	SRS	All	Previous anthologized document version separated into individual TIs.
7/26/2022	LMK	7.2, 7.5	Updated figure 3, software version and wording.

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LIST OF FIGURES

1. PURPOSE AND APPLICABILITY

The purpose of this technical information (TI) document is to describe the process of performing light absorption analysis on routine IMPROVE samples and field blanks with the Hybrid Integrating Plate/Sphere System (HIPS).

2. SUMMARY OF THE METHOD

The HIPS system is stabilized at least 4 hours prior to use. The detectors are registered to a set value. A registration verification is performed using a set of 15 selected IMPROVE samples serving as verification filters. In addition, reanalysis of a selected set of previously analyzed IMPROVE filters is done to monitor system stability. After the verification and reanalysis filters have been measured and the results meet designated criteria, IMPROVE filters are then analyzed. A LabVIEW program is used to collect data and write it to the database.

3. DEFINITIONS

- HIPS: Hybrid Integrating Plate/Sphere System
- IMPROVE: Interagency Monitoring Program of Visual Environments
- TI: Technical Information

4. CAUTIONS

Make sure the correct slide tray is being loaded for analysis. Loading the wrong tray will cause the recorded data to be incorrect.

Do not forget to write to database after each tray has been analyzed, as the values recorded on the LabVIEW program will be written over as soon as analysis of the next tray begins. There is also an option to "write to file" this will only be used under special circumstances.

5. PERSONNEL QUALIFICATIONS

A trained laboratory technician, under the supervision of the spectroscopist and/or the laboratory manager, performs all analyses utilizing the HIPS system, including registration verifications, adjustments (if necessary), reanalysis, and analysis of routine IMPROVE samples.

6. EQUIPMENT AND SUPPLIES

The following equipment and supplies are used for HIPS analysis:

- Hybrid Integrating Plate/Sphere System

- Registration filter and registration verification set
- Reanalysis set
- Slides with IMPROVE filters
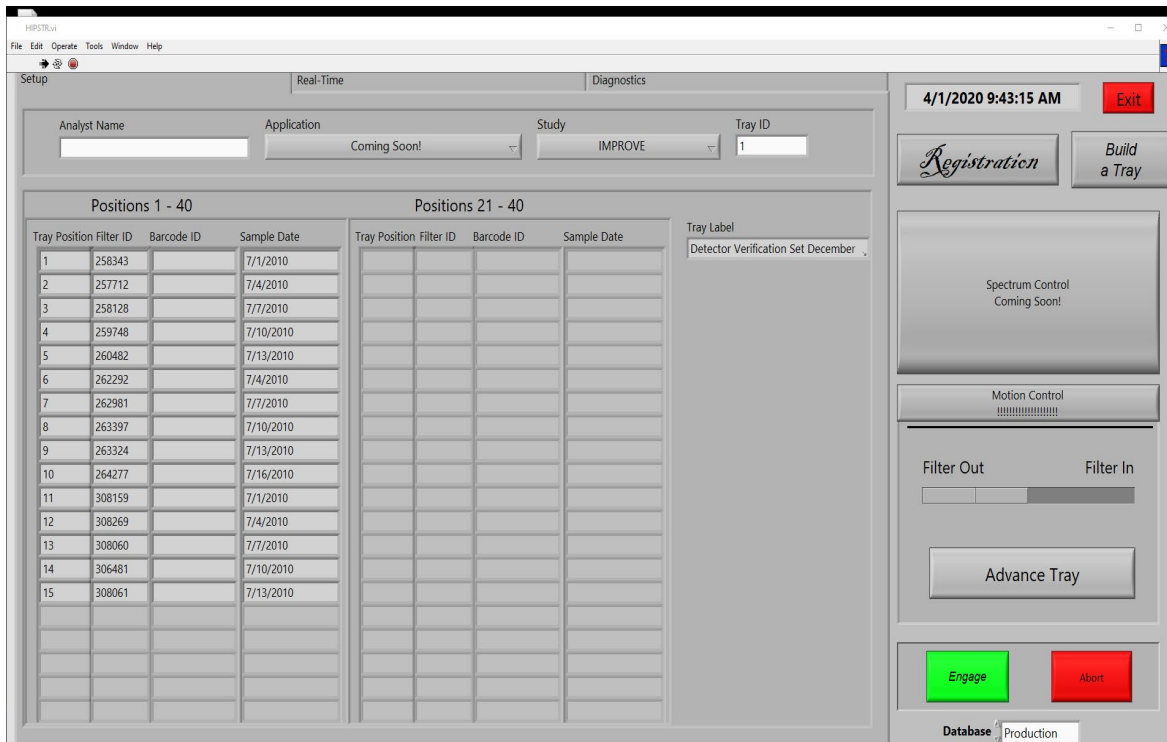- Computer connected to HIPS

7. PROCEDURAL STEPS

7.1. Preparation

1. Turn on the HIPS system at least 4 hours prior to intended use so the laser and detectors can stabilize.

2. Before starting analysis, make sure that the air compressor system is functional.

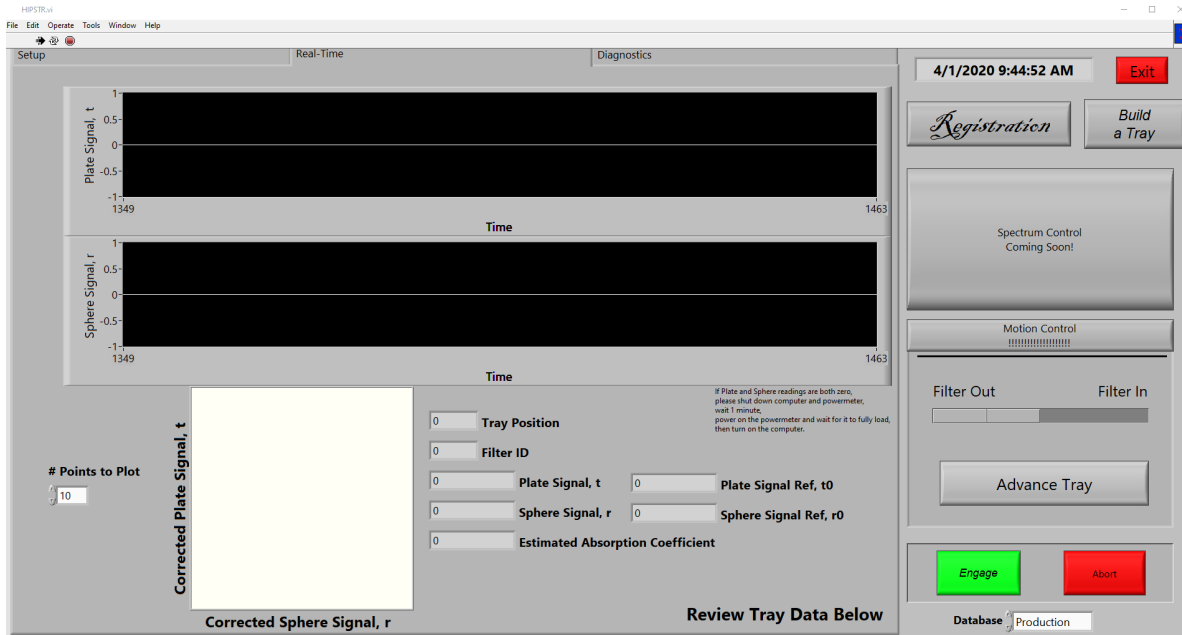### 7.2. Registration of HIPS Detectors

1. Go to C:\HIPS\Applications\HIPSTRv2.7.exe

Figure 1. HIPS LabVIEW main screen.

2. Click the white arrow in the top left corner to engage the program (the arrow changes to black when the program is engaged).
3. Enter your initials in the "Analyst name" box.
4. Navigate to the "Real-Time" tab.

Figure 2. LabVIEW Real-Time tab.

5. Retrieve the verification slide tray and place it in the instrument, the tray is labeled "Detector Verification Set December 2011". Ensure the slide tray is in the correct orientation and properly aligned, refer to Figure 10 below (numbers 1-40 will be visible on the side of the slide tray). Line position 1 up with the slide arm. Slide position 1 (first filter in the slide tray) in by clicking "Filter In". To slide this filter back out click "Filter Out". If the arm jams while attempting to load position 1, gently push or pull on the arm to correct it. The slide tray can be unloaded from the instrument and reloaded if misaligned. Once position 1 has been properly aligned, proceed to step 6.

Figure 3. Slide tray orientation showing a routine sample tray.

6. Click the "Advance Tray" button to move the tray one position at a time until position 3 is aligned to load into the instrument (the filter in position 3 is ACAD1 07/07/10). This is the current registration filter.
7. Once position 3 is lined up slide the filter in by clicking "Filter in".
8. With position 3 inserted wait a few seconds for the Transmittance (T) and Reflectance (R) values on the screen to stabilize. Once the values stabilize, click the "Registration" button. The T and R values should now read 437 and 332, respectively. If they are not within ± 1% of these values, click "Registration" again.
9. Slide the position 3 filter out and back in and verify the values are still within ± 1% of 437 and 332. If not, click the "Registration" button again and repeat. Once complete, remove the tray from the instrument.

7.3.   Detector Registration Verification and Adjustments

1. Navigate to the "Set-up" tab, from the Study dropdown box select "IMPROVE" and type a "1" in the "Tray ID" field.

2. The filter information will auto-populate and the tray label on the screen will read "Detector Verification Set December 2011".

3. Place the verification set slide tray in the instrument and line up position 1. Refer to step 5 in section 6.2 "Registration of HIPS Detector" if further instructions are needed for proper alignment.

4. Select the green "Engage" button and the system will automatically analyze all filters in the slide tray. Scroll down to see the data recorded in real-time.

5. When the tray is finished analyzing, click "Write Tray Data to Database."

Figure 4. Write Tray Data to Database.
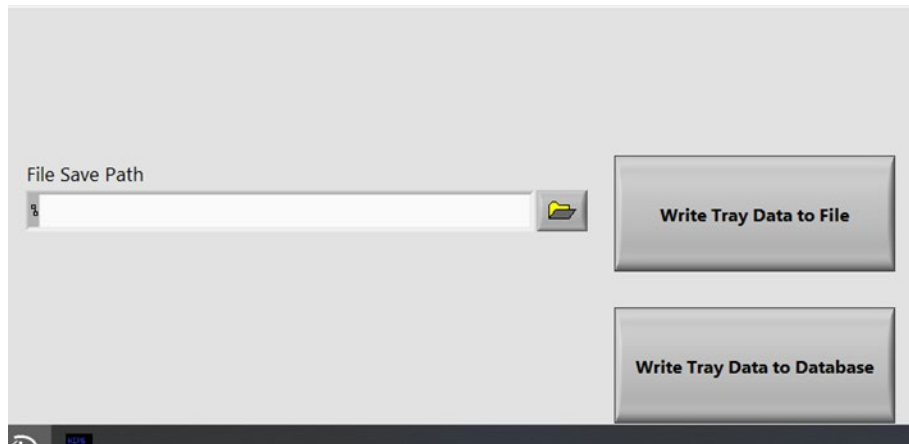
6. Perform a QC check on the verification results to ensure the system is suitable for use. See TI 276C, "Quality Assurance/Quality Check of PM$_{2.5}$ Loaded Filters Using Hybrid Integrating Plate/Sphere (HIPS) Method for Measuring Light Absorption" for details.

7.4. Reanalysis

1. Navigate to the "Set-up" tab and from the Study dropdown box select "IMPROVE" and type a '2' in the "Tray ID" field.

2. The filter information will auto-populate and the tray label on the screen will read "Reanalysis Set June 2010."

3. Retrieve the reanalysis slide tray and place it in the instrument lining up position 1, the tray is labeled "Reanalysis Set June 2010". Refer to step 5 in section 6.2 "Registration of HIPS Detector" if further instructions are needed for proper alignment.

4. Select the green "Engage" button and the system will automatically analyze all filters in the slide tray. Scroll down to see the data recorded in real-time.

5. When the tray is finished analyzing, click "Write Tray Data to Database".

6. Perform a QC check on the reanalysis results to ensure the system is fit for use. See TI 276C, "Quality Assurance/Quality Check of PM$_{2.5}$ Loaded Filters Using Hybrid Integrating Plate/Sphere (HIPS) Method for Measuring Light Absorption" for details.

7. Steps 1-6 are repeated following the completion of sample analysis each day, as an end of day QC check.

7.5. IMPROVE Samples

1. Verify T and R values for the registration filter, position 3 of the verification set before beginning routine analysis. Retrieve the verification slide tray and align position 1. Navigate to the "Real-Time" tab. Then click the "Advance Tray" button on the screen twice to align position 3, then click "Filter In". If the values are within ± 1% of 437 (for T) and 332 (for R) then proceed with routine analysis. If the values are not within ± 1% of 437 (T) and 332 (R) press the registration button on the screen. The values will reset to 437 (T) and 332 (R). Slide the filter out by clicking "Filter Out" and remove the verification slide tray.

2. Navigate to the "Set-up" tab of the LabVIEW program.

3. In the "Analyst Name" field, fill in your initials.

4. From the study dropdown box select "IMPROVE"

5. Select the first tray for analysis and enter the LabVIEW tray number indicated on the tray label into the "Tray ID" field. The filter ID information will auto-populate on the screen.

6. Verify the first and last filter barcode IDs in the slide tray with the information on the screen. The slide(s) will need to be opened to view the barcode on the filter support ring. Once verified sandwich the filter between the slides and place back in the slide tray. Exercise caution when opening slides and only remove one slide at time from the slide tray to ensure order integrity.

7. Load the slide tray to the instrument, lining up position 1.

8. On the screen click "Engage" and the tray will run automatically. Scroll down to see the data recorded in real time.

9. When the tray finishes analyzing, verify T and R values were recorded for every filter in the slide tray and for the neutral density material (NDM), once verified click "Write Tray Data to Database."

10. Remove the tray from the HIPS instrument and place the tray back in the position it was removed from.

11. Repeat steps 5-10 for analyzing additional routine IMPROVE samples.

12. Every 200 filters (typically 5 trays), the registration filter needs to be re-registered. Refer to section 6.2 Registration of HIPS Detector for step-by-step procedure. Additionally, if the HIPS instrument is left idle for more than 10 minutes the registration filter will need to be re-registered.

13. Following the completion of routine sample analysis each day the reanalysis set is reanalyzed. Data for the reanalysis set is immediately ingested for end of day QC. Refer to Section 7.4: Reanalysis for step-by-step procedure.

When analyzing the slide tray containing 37 mm filters (this will be a separate labeled tray for 37 mm filters) use the "write to file" option. The file will be named as: Year_Month_BYIS_37mm.csv

and saved here:

U:\IMPROVE_Lab\LASER\000-WorkingSpreadsheet-000.

7.6. Troubleshooting

1. If the system jams, just give the slide arm a gentle push or pull. The system should continue on as if nothing happened. It may be necessary to reanalyze samples immediately following a jam of the slide arm. If the arm bumps into the system aggressively this can shift the alignment and adjustments may be needed.
2. To check the alignment after a slide arm jam, load position 3 of the verification set and verify T and R values, are within $\pm$ 1% 437 (T) and 332 (R). If the values are within 1% continue with analysis, if not additional troubleshooting is required.
3. If the values for position 3 (registration filter) are not within $\pm$ 1% of 437 and 332 then the Registration of HIPS Detectors will need to be done again. Refer to Section 6.3 for detector registration steps. Once this step is complete confer with the spectroscopist before resuming analysis of routine IMPROVE samples.
4. If a slide tray is not aligned properly start by removing the slide tray from the slide changer. Place the tray back in the slide changer and use the slide arm as a guide. When properly aligned the number 1 on the side of the slide tray will be covered by the slide arm, refer to Section 6.3, Figure 11. Slide the first filter in with the program. Once the arm moves slide 1 in without jamming you may proceed with analysis.
5. If the software freezes please wait a couple of minutes before getting a lab lead.
6. If the software has an error during analysis, the entire tray will need to be reanalyzed. Do not transmit data until the entire tray has been reanalyzed.
7. If filter information between LabVIEW and the physical samples does not match, stop analysis and get a lab lead.

8. REFERENCES

UCD IMPROVE TI 276C: Quality Assurance/Quality Check of PM$_{2.5}$ Loaded Filters Using Hybrid Integrating Plate/Sphere (HIPS) Method for Measuring Light Absorption