Classical Scattering Aerosol Spectrometer

SOP – DRAFT -

MEASUREMENT OF THE AMBIENT AIR PARTICLE SIZE DISTRIBUTION USING THE PMS CSAS-100-HV

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1. PURPOSE AND APPLICABILITY

This Standard Operating Procedure contains the protocol for measurement size distribution of ambient aerosol particles at ambient relative humidity using the forward scattering laser aerosol spectrometer PMS model CSAS-100-HV.

2. DEFINITIONS

$FSNC_{xxx-yyy}$: particle number concentration in the size range from xxx µm to yyy µm in cm^{-3} where
xxx = midpoint of size bin – binwidth/2
yyy = midpoint of size bin + binwidth/2

SOP : Standard Operating Procedure

3. DATA QUALITY OBJECTIVES

The objective for the size distribution measurements is to obtain highly time resolved data of the particle size distribution of ambient aerosol particles in four overlapping size ranges from 0.5 µm to 47 µm. Quality assurance objectives for the spectrometer are as follow:

Accuracy: Average of the particle number concentration within
30 % of APS derived concentrations between 0.5 and 2.5 µm
50 % of APS derived concentrations between 2.5 and 10 µm
100 % of APS derived concentrations for larger particles
Sizing accuracy for PSL particles +- one channel in the lowest applicable size range.

Precision: integral particle number concentration should be within at least ±20% for replicate measurements of a nebulized salt solution.

Lower Limit: 100 cm^{-3} for a 4 min sample in all 4 size channels of the instrument.

Completeness: At least 80% data completeness.

4. DATA QUALITY ASSURANCE

The components to achieving data quality objectives are:

1. Written standard operating procedure (this SOP);
2. Verification of installation
3. Careful operator training
4. Daily and weekly system checks as outlined in the SOP,
5. Routine collection of dynamic blanks
6. Routine calibrations,
7. Routine data review and
8. On-site audits.

5. HEALTH AND SAFTEY WARNINGS

1. The CSAS Probe uses a 5 mW He-Ne Laser. Although the laser beam is totally shielded within the instrument under normal operating conditions objects inserted into the inlet might reflect the laser light and cause damage to the unprotected eye. Never insert objects (like screwdrivers or mirrors) into the inlet of the probe.

6. CAUTIONS

N/A

7. INTERFERENCES

N/A

8. RESPONSIBILITIES

N/A

9. EQUIPMENT AND MATERIALS

9.1 Equipment

1. CSAS-100-HV probe located under a roof on top of the shelter
2. CSAS-100-HV control unit inside the shelter
3. Power supply and data cable between probe and control unit
4. Special serial cable between control unit and data acquisition computer
5. Data acquisition software (to be developed)
6. Standard bubble flow meter (Gilibrator)

9.2 Paper materials

1. Field forms to record performance in the field
2. Laboratory book forward scattering aerosol spectrometer

10. PROCEDURES

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10.1 STARTING THE SPECTROMETER IN THE FIELD

1. Verify that the power switch on the probe is switched on
2. Switch on the power switch on the control unit.
3. Verify the setting of the control switches on the power unit. The switches must be set in the following way. If any switch is set different reset the switch to the position described below and note the change in the field book for the CSAS.

4. Channel (A) must be set to ACT
5. Switch B must be set RESET/RUN
6. Print all analogs (C) must be set OFF
7. Size range (D) must be set to 4 (=cycling all size ranges)
8. Second digit of thumbwheel (E) must be set 1
9. Third digit of thumbweel (F) must be set 1

10. Print interval (G) must be set to minute
11. After the position of these switches has been verified check the laser Reference voltage. The reference voltage should be larger than 4.5 V. Note the actual reference voltage in the lab book.
12. Start data acquisition software on the computer
13. Press start (H) on the control unit. This will start the clock of the control unit.

IT IS NOT POSSIBLE TO MEASURE IF THE CLOCK IS NOT RUNNING

14. Check Clock indicator LED (I): Should be blinking if not press start again
15. Check whether data are recorded by the computer once a minute
16. Check CRT display for particle counts

10.2. ROUTINE OPERATION OF THE INSTRUMENT

NOTE: ANY MANIPULATIONS OTHER THAN THOSE EXPLICITELY STATED IN THIS SOP BY ANY OPERATOR WILL CAUSE MORE PROBLEMS. PLEASE DON'T TRY TO FIX PROBLEMS YOURSELF UNLESS YOU ARE ABSOLUTELY SURE WHAT YOUR ARE DOING.

10.2.1 Every other day check of the CSAS

1. Check the laser reference voltage and record in lab book. If laser reference is smaller than 4.5 Volts call primary operator for assistance.
2. Check all settings on the control unit. Reset to standard positions and mark in the lab book if necessary.
3. Stop the data acquisition program.
4. Copy the data file to floppy and via network to main computer.

5. Restart data acquisition program.
6. Check data file for completeness, note any down times with possible reasons in the lab book.
7. Visually check particle size distribution display for any inconsistencies (Note this requires basic knowledge on what it should look like, if you think that there is something wrong describe the possible problem in the lab book along with date and time of the observation. This will allow reevaluation of the questionable time period later).

10.2.2 Weekly checks of the Instrument

1. Check the flow rate of the probe with the Reference flow meter. Record the sample flow in the lab book. If the sample flow differs from the set point by more than 10 % inform the primary operator. Data can be used if the deviations are larger than 10 %, however, large deviations tend to indicate an upcoming problem with the blower of the probe.
2. Check the sizing capabilities of the probe with 2 Latex sizes in the overlap of the size ranges (Preferably 2.5 µm and 5.0 µm). Indicated sizes should be within one adjacent size bin to the nominal size bin. Record the actual size bin in the lab book.
3. Compare the number concentrations indicated by the instrument using nebulized salt solutions with respective APS measurements. Number concentrations should be comparable within 30 %.

Report any discrepancies between standard operating and performance parameters to Thomas Tuch.

<u>Please do not try to fix problems yourself.</u>

11. Data storage

Time and date stamped size distribution data will be stored initially as comma delimited ASCII in a continous append file on the harddisk of the data acquisition computer. These raw data will be merged every other day into a continuous EXCEL spreadsheet. Missing data, suspicious data and calibration data will be flagged in this spreadsheet along with a written plain language explanation for the reason of the flagging. Raw Data and Spreadsheet data will be copied every other day to the hard disk of the main computer of the super site. All data raw data files and spreadsheet files collected on the harddisk of the main computer will be copied every other day (daily during intensives) to two CD-Rs labeled with the date of the copy. One CD-R will remain at the supersite, the other copy will be transported to the UMCP campus in College Park.
All original lab books with information on the performance will be kept at the supersite during the measurement period. A scanned version of each page will be stored along with the data set in a separate file. These scanned pages will be stored along with the data files in a separate subdirectory of the Data CDs.
Further evaluation and manipulation of the data will follow the procedures defined in the Data Management/Storage SOP.