SootScan™ Model OT21

Transmissometer

User Manual

Version 5.0

May 2014

Aerosol d.o.o., Ljubljana, Slovenia

Aethalometer® Model OT21 Manual

Version 5.0, May 2014

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1 Introduction

The SootScan™ Model OT21 Transmissometer allows users to measure and record filter absorbance data relative to a blank reference filter.

These results can be interpreted in terms of the surface loading of particulate material collected on the filter, as a means of providing an analysis for the composition of the sample. As a stand-alone system, the OT21 can be used to collect absorbance data at both ultraviolet (370nm) and infrared (880nm) wavelengths.

The OT21 may be connected via serial cable to a PC, on which the user may record, store, and process the data.

This package includes:

- Optical Transmissometer with dual light source
- Operating keypad,
- LCD screen,
- Serial RS232 and USB communication connector,
- 2 filter trays and adapters for 25mm, 37mm and 47mm diameter filters,
- AC power supply cord.

1.1 Technical specification

Operation: • Supply voltage: 100-240 VAC, 50/60 Hz • Max power consumption: 15W • Fuse: T2AH 250V • Measurement wavelengths: 370 nm and 880 nm
Environmental operating conditions: • Indoor use • Altitude: up to 3000 m • Temperature range: 10 – 40 degrees Celsius (instrument) • Relative humidity range: 10 – 95 rh%
Mechanical specification: • Chassis: Standard Rittal plastic/metal enclosure • Dimmensions: 320 mm x 130 mm x 295 mm • Weight: 5,15 kg
Connectors: • Filter tray • Communication: USB-typeB, COM
User interface: • 2x20 characters display • 4-button keypad • Beeper

The OT21 is sensitive to changes in environment. Keep the instrument away from dust, liquids, and heat. Significant changes in ambient temperature can alter measurement values.

To keep the light sources and diffusing lenses clean, leave an empty filter slide in the instrument when not in use. Use only the correct slides to insert filters into the OT21. Never insert filter slides upside down as this could damage the instrument.

1.2 Safety notes and labels

CAUTION!

READ THIS CHAPTER VERY CAREFULLY BEFORE OPERATING THE INSTRUMENT.

Instrument operation

Read this User's manual BEFORE operating the instrument. INCORRECT instrument operation can be DANGEROUS for the operator.

Unauthorized instrument access and operation

The instrument must be protected against unqualified use. UNAUTHORISED instrument access and operation can be dangerous. The instrument can only be operated by persons who can ensure proper handling due to their qualification, technical skills and practical experience.

Electric shock

CHECK the mains power supply cord ANNUALLY. If the supply cable is DAMAGED, stop using the equipment and contact your authorized representative.

Use ONLY mains power supply cord which is particular for your country for connecting to mains.

Fire and explosion

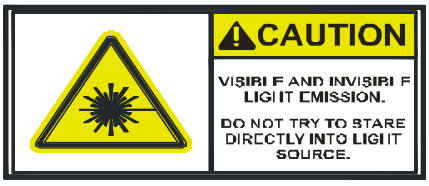
NEVER install the instrument in explosion-risk areas and never use the equipment near flammable substances.

Instrument overheating

ALWAYS assure the instrument operates under proper operating ambient conditions. NEVER install the instrument in spaces with limited air circulation.

Visible and invisible light emission

OT21 light source contains an ultraviolet (UV) and infrared (IR) light emitting diode (LED). The LED source radiates UV and IR light during operation. Precautions must be taken to prevent looking directly at the light source with unaided eyes. NEVER touch or never try to STARE directly into the OT21 light source. This label is affixed on the top cover of the instrument.



Instrument service and repair

UNAUTHORIZED instrument service and repair procedures are NOT ALLOWED. The instrument can only be serviced, repaired or modified by authorized persons. Please contact your authorized representative if you have any problems with the instrument. Please make sure to have the equipment checked regularly for technical safety.

1.3 Instrument identification, connectors and markings

Front panel

The DISPLAY and the KEYPAD are used as a main user interface of the instrument. See chapter 3 for more detailed information.

The Filter tray holds the Blank and Sample filters to me analyzed. See chapter 3 for more detailed information.

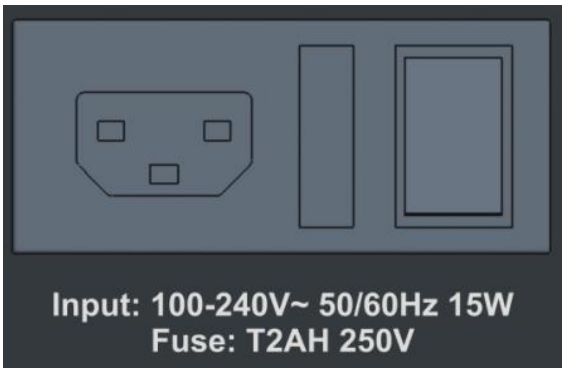
Back panel

The identification label on the back panel of the instrument shows the following identification marks of the instrument: Manufacturer, Type, Model and Serial number.

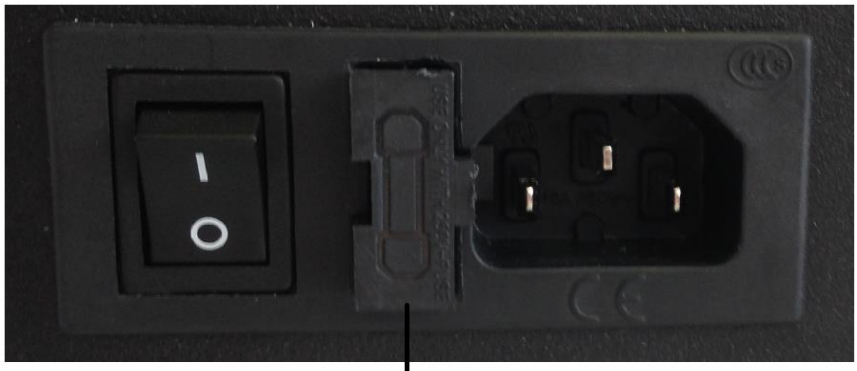
Transmissometer - Aethalometer®
Magee Scientific

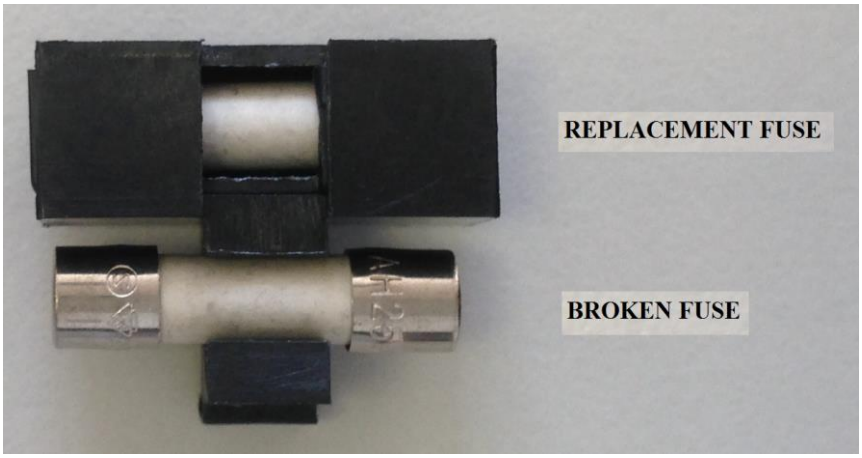
Model: **SootScan™ Model OT21**
Serial number: **OT21-Sxx-xxxxx**
Date: Month, Year
Developed and manufactured in Slovenia by **Aerosol d.o.o.**

Connect the mains supply cord to the mains inlet connector and switch ON the instrument. The mains inlet contains a fuse and also a replacement fuse (Fuse type: T2AH, Farnell code: 2126526).

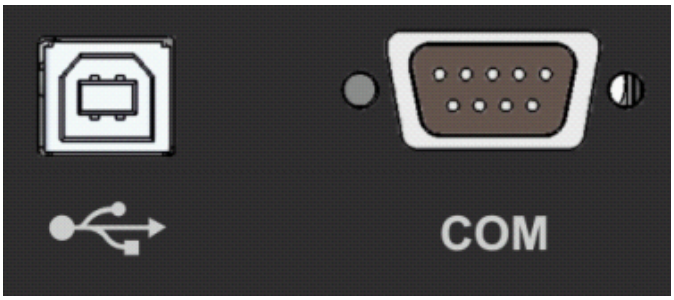


To replace the Mains fuse first remove the power supply cord. Then remove the fuse drawer. You can find the replacement fuse in the drawer, next to the broken fuse.





USB-TypeB and COM connectors are intended for connecting the OT21 to PC computer running the OT21 application. See chapter 4 for more detailed information about the PC application.



Do not try to open the instrument. The instrument contains delicate mechanic and electronic parts which can be serviced only by trained personnel.

2 Instrument Description

The OT21 is designed for simple operation. Figure 2.1 provides a labeled display of the front and back panels of the instrument.

Figure 2.1: OT21 Front Panel with Filter Tray inserted in Position 1

2.1 Filter Slides

The filter trays hold the sample and blank filters in place, permitting accurate absorbance measurements to be made.

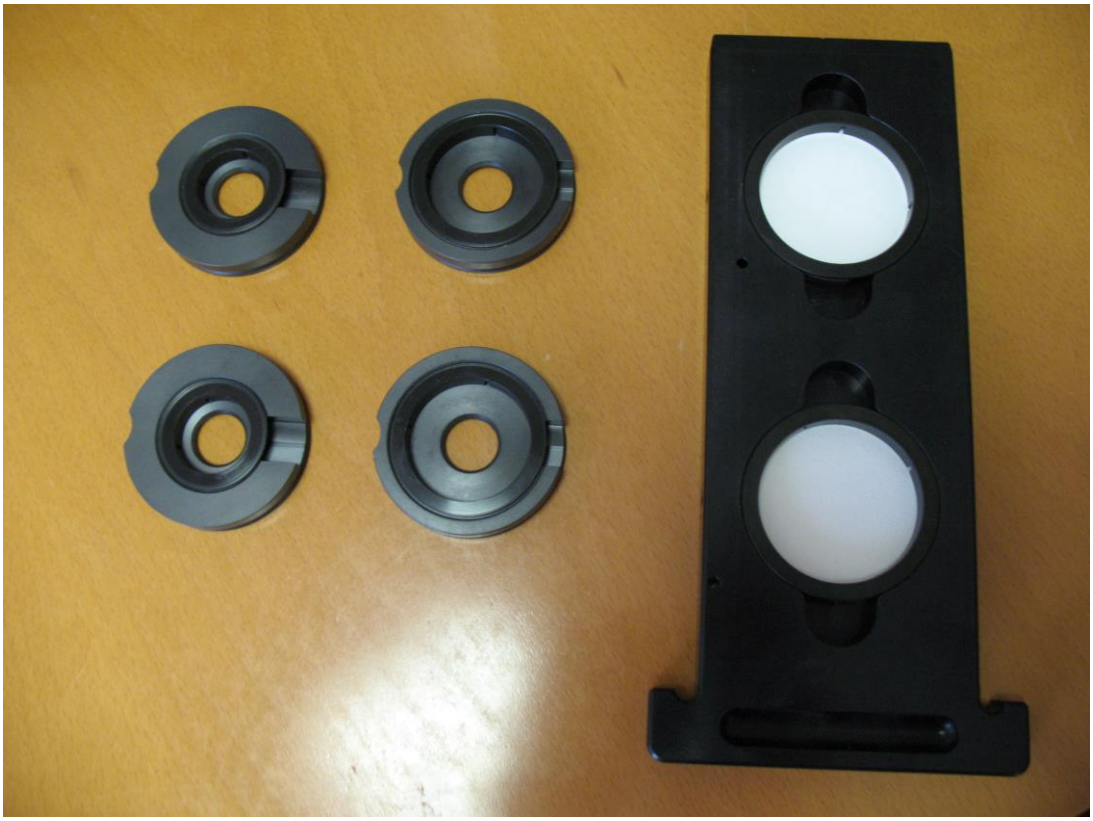


Figure 2.2: Filter Slides with 25mm and 37mm adapters.

To insert a filter in the slide, first select the correct adapter size (25mm, 37mm or 47mm diameter). Orient the slide such that the depressed pocket in the center of the slide is facing up.

Place a Blank reference filter in the circular slide pocket at Position 1 (Outer tray position) and the Sample filter in the circular slide pocket at Position 2 (inner tray position). The openings to the right of the filter pocket may be used to insert or remove filters with tweezers. Grasp the slide by the handle and insert into the slot until it **clicks** (and beeps) into Position 1. Press the ENT button to start the measurement cycle and follow the instructions on the LCD screen to complete the analysis.

2.2 LCD Output and User Interface

During operation, the instrument's LCD screen provides all necessary prompts and outputs. To navigate the LCD screen menus and prompts, there are four keypad buttons on the OT21.

These are: ESC (ESCAPE), LEFT, RIGHT, and ENT (ENTER):

- Press the ENT key to start data collection.
- Press the ESC key to cancel data collection.
- Use the LEFT and RIGHT arrow change the display format.

3 Basic Operation

To operate, turn ON the instrument using the power switch on the rear panel. The LCD screen will illuminate and display an initial splash screen. To navigate this and all menus, use the LEFT and RIGHT keys to scroll, ENT to select, and ESC to return to the previous menu.

To make a measurement press ENT key when in Measure Filter menu, which is also the Main menu. Before attempting to analyze the filters, please leave the instrument switched on for 20 min to equilibrate. Use LEFT and RIGHT keys to select:

- **Use new blank**: Start a new measurement by measuring Blank filter first and then measuring the Sample filter.
- **Use previous blank**, which is applicable only if the previous Blank filter measurement already exists: If you have many Sample filters to analyze, you can, to speed up the process measure many sample filters using always the same blank filter.

If you select **Use new blank** and press ENT key the LCD screen will prompt you:

1) **Insert blank filter; Move to position 1:**
   Load the slide with a Blank filter and push the slide into the instrument as far as Position 1 (outer tray position). The OTDAQ will perform dual wavelength measurements at both wavelengths, to determine the transmission of the Blank sample. If the slide is moved once the measurement has started, an error message will appear and the system will return to the MAIN MENU.

Once the Blank filter has been measured the system will prompt for the Sample filter:

2) **Insert sample filter** (in not done before); **Move to position 2:**
   Push the slide further in to Position 2 (inner tray position), and the optical transmission of the Sample filter will be measured at both wavelengths.

After the OTDAQ has finished its measurements, the LCD screen will display the result.
By pressing LEFT or RIGHT key, after the measurement process is completed, you can switch between two result display options:

- ATTENUATION
- RAW DATA

If ATTENUATION Display Format is selected the ATTENUATION is calculated as:

$$ATTENUATION = 100 * \ln\left(\frac{blank\_filter\_transmitted\_intensity}{sample\_filter\_transmitted\_intensity}\right)$$

1. UV ATTENUATION: Ultraviolet Attenuation

2. IR ATTENUATION: Infrared Attenuation

The displayed ATTENUATION result is un-rounded. We recommend that for most analytical use, the ATTENUATION value should be calculated manually and rounded to two decimal places or use the calculated attenuation in the PC application. For this you can use the RAW DATA Display Format.

If RAW DATA output Display Format is selected then the OTDAQ will display:

UVB: Ultraviolet Blank Filter transmitted intensity
UV: Ultraviolet Sample Filter transmitted intensity
IRB: Infrared Blank Filter transmitted intensity
IR: Infrared Sample Filter transmitted intensity

You can calculate manually the Ultraviolet and Infrared ATTENUATION as:

$$ATTENUATION = 100 * \ln\left(\frac{UVB}{UV}\right)$$

or

$$ATTENUATION = 100 * \ln\left(\frac{IRB}{IR}\right)$$

The process described above may be repeated for as many test filters as desired.

After the measurement is completed you have two options:

1. Press ESC key to exit and return to Main menu.

2. Press ENT key to repeat the last Sample filter measurement. It is also possible to measure many different Sample filters by replacing the Sample filter and each time and pressing ENT key. In this case you can speed up the process even more, since you don't need to reselect **Use previous blank** in the Measure Filter menu.

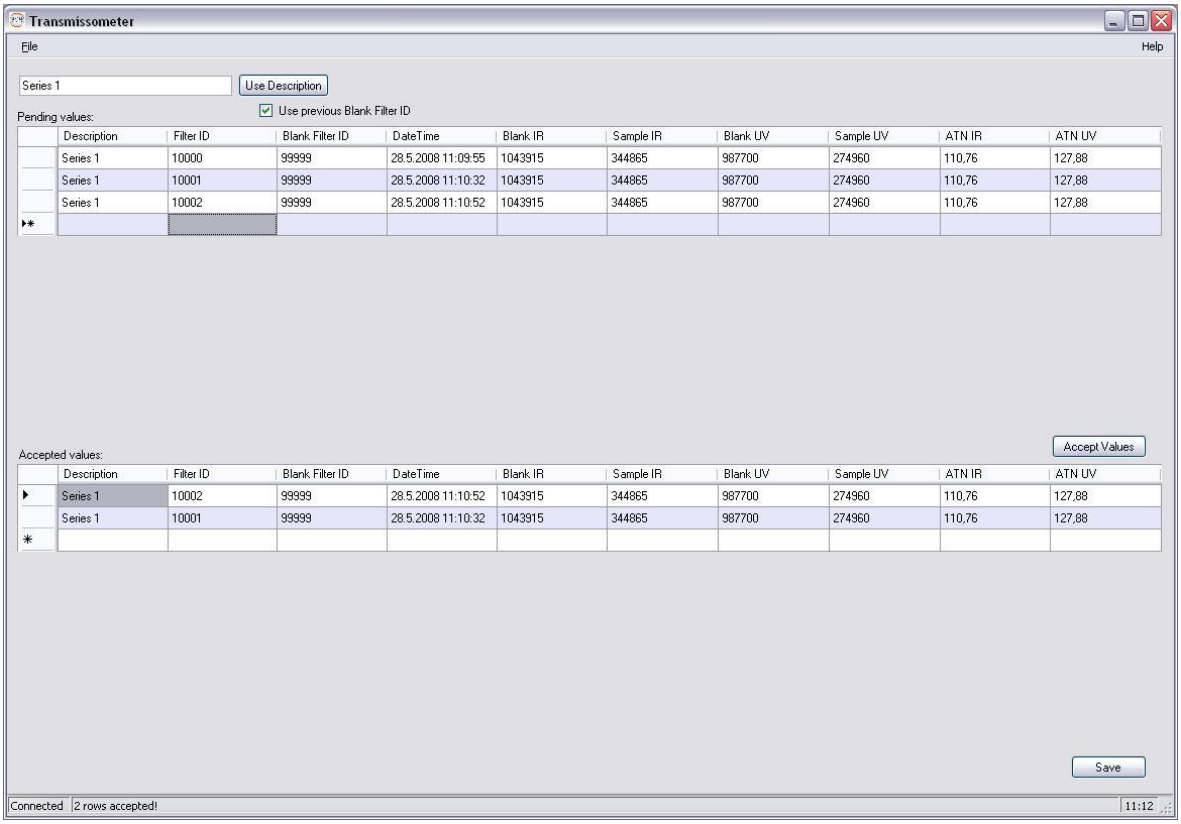
3.1 List of errors codes

10 = LIGHT SOURCE ERROR
20 = LIGHT SOURCE CURRENT TOO HIGH
30 = BLANK FILTER TOO LIGHT
40 = BLANK FILTER TOO DARK
50 = SAMPLE FILTER TOO LIGHT
60 = SAMPLE FILTER TOO DARK
70 = TRAY ERROR

4 PC application software

4.1 Connection

Start the Transmissometer PC application:



The Transmissometer PC application software can be connected to the Transmissometer over USB or Serial RS232 connection and is used as a data logger:

- If Transmissometer is running and is connected over the USB cable, the PC application will automatically connect over USB.

- If no USB cable is plugged in when Transmissometer software is running you can always connect USB cable later and application will automatically connect with Transmissometer.
- Alternatively, you can plug in serial cable into PC and to the back of the Transmissometer

and manually open COM on the application (note: pick the right COM port from the list left to the OpenCOM button.

- If both USB and RS232 cables are connected, the USB connection will be active.

The connection status (CONNECTED or DISCONNECTED) is displayed in the bottom left corner.

4.2 Operation

Before Transmissometer sends data you **FIRST** need to scan the **Filter ID** and **Blank Filter ID**. You can also type in the *Filter ID* and *Blank Filter ID* manually with keyboard.

The Transmissometer sends the measured data to PC application after the measurement process is completed. The PC application then calculates and displays the calculated IR and UV attenuation.

For next measurements you can check the *Use previous Blank Filter ID* checkbox and it will automatically copy the *Blank filter ID* from previous row when new *Filter ID* will be entered.

Description field is left for user to enter comments or some other type of identification (series or area of measurements, or some other note on the measurement), for the measurements. You can enter it manually for each cell or type it into textbox field in the upper left corner and it will automatically add it to each next row when *the Filter ID* will be scanned.

4.3 Data manipulation

Data in the *Pending values* table can be sorted with the press on the column name.

You can delete rows by pressing on the row header and press delete button on the keyboard. When you wish to accept the data you select rows which you want to accept by holding control button and clicking the row headers or click the upper left corner header of the table and then press the *Accept* button. The data will be copied to the *Accepted values* table. Before saving you **FIRST** need to accept the values. When you wish to save the accepted data you press the *Save* button. It will open the *File save dialog*. You enter the file name and select file type you wish to save data in. File types supported are *XML* and *CSV*.

Later you can always open the saved data and continue with measurements by clicking the *File menu* and *Open* or with keyboard shortcut *CTRL + O*. The values will open to *Pending values* table.

5 Optical verification procedure

The Magee Scientific "SootScan™" Model OT21 Optical Transmissometer measures the attenuation ('ATN') of light transmitted through a Sample Filter (front position of Sample Tray) relative to a Reference Filter (rear position of Sample Tray). This measurement is performed at two wavelengths: 880 nm in the Infra-Red ('IR' measurement); and 370 nm in the Ultra-Violet ('UV' measurement). To verify the consistency of performance of the Model OT-21, we offer a set of Neutral Density Filter Disks that may be used periodically to check the analyzer response. These ND filters are made from standard photometric materials and supplied in a protective case. They exhibit reproducible absorbance at the two analytical wavelengths, and are certified against a traceable photometric standard.
Re-validation of each Transfer Standard Kit is recommended on an annual basis.

ND filter test procedure

Principle:

Measure attenuation of each ND filter and write the results into corresponding cell in the ND filter test Excel spreadsheet (file accompanied with the manual). For the »blank« measurement use an empty 25mm adapter (position 1). For sample measurements put each ND filter in the 25mm adapter (position 2). ND filter test Excel spreadsheet will calculate average difference between the reference values and measured values. Instrument passes the test if average ND filter test results are below 10, as shown in the spreadsheet.
A sample test report template table is provided for use in the field (Table 1).

Procedure:

- Measure a »blank«. Use an empty 25mm adapter (position 1)
- Measure sample. Use 25mm adapter with ND filter only (position 2)
- Write results into corresponding cell (A1, A2, B1…D2) in ND filter test sheet in Excel
- Repeat procedure for each ND filter (OD= 0.15; 0.3; 0.4; 0.6)
- Check results.

Reference				
OD	0,15	0,3	0,4	0,6
ATN @ 370 nm	**75**	**143**	**205**	**309**
ATN @ 880 nm	**63**	**95**	**111**	**201**
Measured ATN				
370 nm	A1	B1	C1	D1
880 nm	A2	B2	C2	D2
diff @ 370	A3=abs(A1-75)	B3=abs(B1-143)	C3=abs(C1-205)	D3=abs(D1-309)
diff @ 880	A4=abs(A2-63)	B4=abs(B2-95)	C4=abs(C2-111)	D4=abs(D2-201)

CONFORMITY

	Value	criterion	CONFORMITY
370 nm	**AVG(A3:C3)**	if <10	**YES / NO**
880 nm	**AVG(A4:D4)**	if <10	**YES / NO**

Table 1. Optical test report template

6 Technical support and contact information

Please contact the service department through our web sites (Service & Support):

www.mageescientific.com

www.aerosol.si

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