

Vaisala CT25K Ceilometer
Installation, Operation, and Maintenance Manual
== Mentor Translation ==
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SAFETY

The laser beam is eye safe exiting the Ceilometer, but it should not be viewed with magnifying optics. Since the unit is connected with 110-V power, electrical safety procedures (including disconnecting the power cable and turning off the internal battery if electrical wiring changes are performed) must be followed (see manual)

INSTALLATION

The installation procedure in the manual describes unloading and unpacking, building the foundation, assembling the unit, and cable connections.

PARTS LIST

1. Ceilometer Measurement Unit
2. Shield
3. Pedestal
4. Maintenance Cable (1 meter with 9 pin D connector)
5. Data Cables (3 ft. with 9 pin D connector) CAB-000045, 50 ft.
6. Twisted Pair RS422 CAB-000086, 50 ft.
7. 12-V power for RS422 Converter CAB-000087
8. 10 ft. 9 pin RS232 cable to Computer in IVan CAB-000085
9. Power Cable (50 ft.) CA-000044
10. Maintenance Terminal (Psion 3a)
11. Computer (connection for data terminal running OS2)
12. RS232 to RS422 and RS422 to RS232 converter boxes.
13. 4 Mounting Bolts and Hardware for Securing Pedestal to Cement Pad (4 nuts M10, washers B10, and foundation screws M10).
14. Spare Parts (spare connector cover, instrument door key, and manuals).

TOOLS REQUIRED

1. Crescent Wrench up to 1/2 inch

INSTALLATION PROCEDURE

Unpacking

The unloading and unpacking procedures are described in the manual which mainly require that the instrument be unpacked from a flat surface, opened from the top side, and avoid scratching the window or lens surfaces. It doesn't say in the manual that this cannot be performed by only one individual, but two people are required for unpacking and installation.

Foundation

The foundation should be a concrete pad at least 200 mm thick (the hole depth for the mounting bolts is 160 mm). The width should be 500 mm or larger (the hole spacing is a square pattern 283 mm on a side). The orientation of the pad ordinarily is made so that the one side of the pad points North-South. Because the TWP is near the equator, this is not as important as orienting the pad so that when the instrument is tilted near the horizon it will hit a large object at least 200 m away for calibration (the Ceilometer only tips to the horizon one way which is clockwise facing the tilting flange). Also, the 50 ft cables require that the pad be placed less than 30 ft from the cable opening of the instrument van containing the computer. The Ceilometer must be at least 5 feet from the instrument van to allow tipping on both sides. Otherwise, the closer to the instrument van the better.

Assembly

Follow the assembly instructions in the manual. Again this should be performed by two individuals. Because of the rain in the TWP it is recommended that the instrument door be shielded from direct rain. See also Maintenance Procedures.

[note: the manual recommends that in rainy locations that the instrument be tilted 15 degrees to shelter the door. However, because this makes comparison with the MPL more difficult we will point the Ceilometer vertically and shield the door seals]

Electrical Connections

“Lock and Tag-out Protocol” will be performed during electrical procedures. The electrical connections are described in the manual. 50 ft cables have been made for the data and power lines. The data cable contains a 9 pin connector (CAB000045). Pin 5 on the connector has been wired to signal ground (pin 4 on the data line from the Ceilometer). Pins 2 and 3 have been connected to data in and out (pins 2 and 3, respectively on the data line). An Adam RS-232 to RS-422 converter has been attached to the base of the Ceilometer and a 12 V line has been run to power the Adam (CAB000087). A cable 50 ft. in length containing two twisted pair wires has been run for the four wires needed for RS-422 communication (CAB000086). Another Adam has been attached in the instrument van to convert RS-422 back to RS-232 for computer communication (CAB000085). This may require that a null modem be used on the

computer collecting the data from the Ceilometer in the instrument van. These cables should be tested for continuity before installation. Follow the grounding procedures. The case nut for grounding is indented on the circular attaching flange. Do not connect power until reading the start-up operation procedure in the manual (presently on page 17 of the manual).

Spare Parts List

Presently the only spare parts for the Ceilometer is a spare key to open the unit, and a spare connector cover. It is recommended that future spares include:

1. Spare cable connectors and cables be purchased along with a spare null modem.
2. As more Ceilometers are deployed and adequate module replacement manuals become available, it is recommended that a complete spare set of the Line Replaceable Units (see below) be on-hand at one of the TWP ARCS or,
3. Perhaps when all the ARCS stations are in a spare instrument may be available for emergencies.

OPERATION PROCEDURE

Start-up

Follow the start-up procedure in the manual. This procedure allows checking to see if (when power is connected) that the LEDs inside the instrument light up to show that a connection has been made and power is OK (the power OK light will take a long time to light if the battery is low). Checking that data is being communicated and the measurements are valid is done through the maintenance and data terminal operating procedures.

Maintenance Terminal Procedures

Perform this procedure during installation and each visit of the RESET team (about every 6 months). The purpose of the maintenance terminal is as an aid to calibration, checking the maintenance status of the Ceilometer, and if communication problems develop at the instrument van, then the terminal can be used to determine if there are problems with the instrument or the wiring to the computer. If the maintenance terminal fails all functions below can be accomplished with the data terminal computer, but less conveniently (see Data Terminal procedures below).

The maintenance terminal is a Psion 3a handheld computer with communication software and cable (Serial 3 Link).

1. Connect the Psion to its cable (this connection is not always firm) and to the male connector of maintenance cable and the maintenance cable to the J4 connector at the bottom of the Ceilometer.
2. Press the **on** button of the Psion.
3. Press the system icon button.
4. With the arrow keys move to the icon with CT25K.
5. Press **enter** (ordinarily nothing happens yet).
6. Type "**open**" and **enter** (if the connections are good you will get CT: and then ceilo>) ["**open**" is not echoed to the terminal]
7. Step 6 may have to be repeated several times.
8. When ceilo> appears type "**set message port maintenance**" (after "**set**" typing **enter** will give a menu and the first letter and **enter** gives the next menu so you don't have to type out the whole line). If you forget to type "**message**" a list of baud rates appear and bad things can happen if you change them (This happened to me).
9. Type "**close**".
10. Every 15 seconds two lines like the one shown in example 1 should appear. The data fields are described in the manual. The first number is how many clouds decks there are followed by a zero if there are no problems. The

- second five digit number is the base height (in meters if this option has been set and it should be).
11. To set the option to meters type **"open" enter** and then **"set message units meters" enter** and then **"close" enter**.
 12. To get the message shown in example 2, type **"open" enter** and then **"set message type msg2" enter** and then **"close" enter**.
 13. Type **"open" enter "set message type status" enter "close" enter**, to check the internal temperatures, battery condition, internal voltages etc. (These should be logged each time the RESET team visits the site and abnormal values given attention, e.g. contact the mentor). One way to do this is to press the **menu** button with the CT25K icon highlighted, and select **new file** and name it smmddy for status month day year).
 14. Finally, type **"open" enter "set message port data" enter "close" enter** to transfer the data to the data terminal.

The final configuration for the Ceilometer:

"set message units meters"

"set message angle-cor on"

"set message type MSG2"

"set message profile type h2_noise on"

Example 1

30 01230 12340 23450 FEDCBA98

The last field requires some explanation (the manual is very confusing). It should read 00000100, 00000300, 00000700, or 00000F00 meaning that units are in meters, the internal heater is also on, the fan heater is also on, and the fan is also on (i.e. F means that they are all are on), respectively. If the reading is 00400100 this means that the battery power is low (this often happens when just turned on) and the units are in meters. Each number in each of the eight fields must be converted to binary (4 is 0100 and 1 means ON) and compared to the list of warnings and status interpretations.

predominance of large looking numbers is caused by Vaisala's convention for negative numbers (not in manual). 0001 is one, 0000 is Zero, but FFFF is -1, and FFFE is -2 etc. The largest possible positive number is 7FFF.

Note: When the Psion is used for applications other than the Ceilometer it is possible to interrupt the script file so that the Psion will receive but not be able to transmit. To correct this:

- a) When the CT25k communications icon is selected, press **menu**.
- b) Press **file**, and highlight **execute script** and **enter** to get the script file CT25k going.

Data Terminal Procedures

The data terminal performs in the same way that the maintenance terminal does (however a null modem is required) after RS232 communications software has been installed on the data terminal computer. This computer is a Consultronics Linebacker hardened laptop computer running Windows with OS2 version 2 for communications. However, any compatible operating system with networking capabilities should work. Presently, the computer uses OS2 as the operating system and a communications file from Vaisala called CTVIEW modified by Larry Hatfield to collect the data and send it to a pikup directory on the linebacker computer.

Communication settings:

1. the baud rate (2400)
2. number of bits (7), and
3. parity (EVEN)
4. stopbits (1)

is set up in the CTVIEW program. Data are collected hourly and shipped using DROPSHIPPER to the data system and begin a new file(this is exactly the same as the procedure for logging the MWR data, and you can refer to the MWR procedures for more details). The files are identified by **yymmddhh.tmp** and the DROPSHIPPER changes this to **yymmddhh.cel**.

The final configuration for the Ceilometer is

"set message units meters"

"set message angle-cor on"

"set message type MSG2"

"set message profile type h2_noise on"

Data Terminal for Maintenance Procedure

To use the Data Terminal as the Maintenance Terminal if there are problems with the Maintenance Terminal:

1. Press **Alt+Esc** while the computer is collecting data.
2. Move cursor to CYCLE.BAT.
3. Press right mouse control.
4. Press **C** to close file.
5. Press **Y** to accept closing.
6. Press right mouse control.
7. Press **W** to open OS/2 Window.
8. Type "**cd lw**" to change directory to livewire.
9. Type **lw21** to run communications software.
10. Press **Alt+Z** to open menu.
11. Press **Alt+P** to change port settings.
12. Highlight each setting and change with **enter** to 2400 baud, 7 bits, and Even Parity.
13. Type "**open**" (no echo) to change settings.
14. After maintenance or calibration is complete, press **Ctrl+Esc** to prepare to reboot computer.
15. With OS/2 Window Highlighted press **Delete**.
16. Press right mouse control.
17. Press **D** to shutdown.
18. **Enter** for OK to shutdown (three times).
19. When window says you can press **Ctrl+Alt+Delete** and computer should reboot and begin to run CYCLE.BAT.

MAINTENANCE

The maintenance procedures described in the manual include inspection of warnings and alarms from the maintenance and data terminals, checks of the window conditioner air blower, and window cleaning.

Air Blower Check Procedure

To check blower operation:

1. Connect Maintenance Terminal (the Data Terminal can also be used; see Data Terminal procedures).
2. Type "**open**" (again the computer does not echo).
3. After prompt CT: type "**set message port maintenance**" if maintenance terminal is used.
4. Type "**close**" and wait to see if data is transferred to maintenance terminal.
5. Type "**open**" again.
6. Type "**set control blower on**".
7. Put your ear next to Ceilometer to hear if blower comes on (it is very quiet).
8. If blower does not come on check blower connector and wiring to blower. If problem persists, notify mentor. The Ceilometer will still provide useful data when the window is dry.
9. Type "**set message port data**" and check to see if data communications is returned to the instrument van computer.

At each RESET visit the door seals should be examined for deterioration and replaced if necessary.

Tools Required

1. Soft lint-free cloth
2. Mild detergent

Warnings and Alarms

Alarms should be checked by looking for something other than 0 in the second character of the data line (refer to mentor or contacts).

Window Cleaning

The window should be cleaned once per week with a soft lint free cloth and mild detergent or sooner if the last field in the data line shows a warning (something like 00800300 where the 8 means only the window is contaminated or 00C00300 if the

window is contaminated and the power is low) a W should also appear in the second character.

CALIBRATION

The calibration procedure is based on the ability of the instrument to tip parallel to the ground. Comparison with MPL heights during low cloud situations can also be informative, however the relative low resolution of the MPL makes this comparison only a qualitative performance check.

Calibration Check Procedure

1. Connect Maintenance Terminal (see maintenance terminal procedure).
2. Type "**open**" **enter**, and then "**set message angle_cor off**" to disable angle correction for a distance measurement.
3. Type "**set message port maintenance**" and "**close**".
4. Loosen the two screw heads on the Ceilometer tipping mount and point Ceilometer at fixed target a known distance away (at least 300m).
5. If the beam is too low or the target is too close error 4 (obstructed beam) will show as the first character on the data line from the maintenance terminal.
6. When a proper target is selected and a 1 shows as the first character on the data line, the distance (within 15 meters) will show as the second set of 4 numbers on the data line from the maintenance terminal.
7. If the distance shown differs from the measured difference by 30 m or more realign and try again. If the difference is still greater than 30 m log difference and contact instrument mentor. [note: the beam divergence is very small (0.6 mrad) so that larger targets like buildings are easier to hit but the distance will vary depending on where the beam hits the building]
8. Reopen the maintenance port and type "**set message angle_cor on**" and "**set message port data**" and "**close**".
9. Check to see that data is being transferred to the data terminal.
10. This procedure should be performed every time the RESET team visits the site.

REPAIR

Repair elements include replacing line replaceable units and troubleshooting guides taken from the manual. It is recommended that because of the difficulty in repairing a unit in the field that a complete spare Ceilometer be available in the field for replacement.

Note: The manual refers to a Technical Reference Manual that is required for unit replacement. This manual has been requested but has not yet been sent. The manuals are being written and should be available by December 1995.

Line Replaceable Units

<u>Component</u>	<u>Item No.</u>	<u>Approximate Cost (in \$US)</u>
CPU	DMC 50A	1,540
Transmitter Assembly	CTT21	795
Receiver Board	CTR21	675
Blower Assembly	CT2688	420
DC Converter	DPS51	865
Power Cable	CT3839	124
Data Cable	CT3838	81
Backup Battery	4592	69

Troubleshooting (see vendor manual)

In case of malfunction do the following:

1. Check the cable connections.
2. Check the presence and correctness of line voltage (frequency 45-65 Hz).
3. Check the operation states of the LEDs in the device>
4. At the data line, check that the connection and the configuration is correct.
5. Switch on the device (internal switches to on).
6. Check the data messages by using the maintenance terminal.
7. Check the adjustment of the device (section 4.5 in manual).
8. Check the status message (section 4.4.4 in manual).

PACKING PROCEDURE

1. Open Ceilometer.
2. Turn off Blower Power, Main Power, and Battery switches.
3. Unplug Power Cable from power in the instrument van.
4. Unplug data cable from null modem and RS422 converter.
5. Unplug power and data cables from the Ceilometer.
6. Wrap up 50 ft. power and data cables so that they can be tested for continuity before reinstallation.
7. Open blue hatch used for cleaning the Ceilometer window.
8. Unscrew large blue plastic covered screws holding Ceilometer cover to the measurement unit.
9. Remove cover and place on a soft surface.
10. Two people are required to remove bolts from rotating flange holding the measurement unit to the Ceilometer stand and remove the measurement unit.
11. Place the measurement unit on a soft surface.
12. Remove the bolts securing the stand to the concrete pad.
13. Put the measurement unit and desiccant bags in a sealed bag to avoid moisture during shipping.
14. Pack the following items in a single or separate shipping containers (if packed together be sure to completely surround the measurement unit with packing material):
 - a) The measurement unit.
 - b) The measurement unit cover (make sure it is packed so that it cannot be crushed).
 - c) The Ceilometer stand.
 - d) The box containing the RS232 to RS422 converter.
 - e) The two 50 ft power and data cables.
 - f) Hardware for mounting four bolts on a cement pad
 - g) A sealed envelope containing the instrument manual and this document, the two keys to open the instrument, and the maintenance cable.
 - h) The Psion 3a maintenance terminal (seal in a bag with a desiccant bag and surround with packing material).
 - i) Separately pack the data terminal computer, the null modem, and the RS422 to RS232 converter (Wrap these separately in sealed bags with desiccant bags and wrap each in packing material).
 - j) j. Separately pack any spare parts for the Ceilometer purchased before shipment (see Spare Parts recommendations).

k) k. Label the box or boxes with CEILOMETER and the contents.