Turnkey Instruments Ltd



Dustmate

Operating Instructions

DUSTMATE KEYPAD QUICK REFERENCE

KEY-PRESS	FUNCTION
[ON]	to switch on
[RESET]	to quit editing to see battery condition & location
[EDIT]	to select the DUSTMATE Editor
[ENTER]	to select an operation or confirm a response to enter the changes made during editing
[START]	to start or stop sampling
[STOP]	to clear memory to review stored results to clear a value during editing
[↑]	to increase a value to say YES
[↓]	to decrease a value to say NO
[NEXT]	to go to the next item or display

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DUSTMATE AND AIRQ FOR WINDOWS

The DUSTMATE environmental monitor can be supplied with AirQ32 for Windows software. This enables results stored in the DUSTMATE memory to be uploaded into your PC when you have completed sampling. Additionally your PC can be used to control and collect results from the DUSTMATE sensor in real time.

AirQ is designed to collect, manage and display data from a range of environment sensors, either as individual sensors or in real-time when connected to a sensor network. The sensors can be used to measure a whole range of environmental quantities such as PM10 particles, airborne fibres, VOCs and pollutant gases.

AirQ is provided with extensive on-line help with hypertext links, clicking an on-screen button with a blue question mark will automatically open the relevant help page.

INSTALLATION OF AIR32Q

The program is supplied on CD and requires Windows 95 or above to operate. An un-installer is provided with the program. Approximately 20 MB of free disk space is required on drive C: to complete the installation

To install in Windows: Insert the CD it should launch automatically if not run **setup.exe**, then follow the on-screen instructions.

AirQ32 will be installed in C:\Airq32. Sample results which can be imported, if required, are to be found in C:\Airq32\Examples.

GETTING STARTED WITH DUSTMATE

Before starting connect a fully charged battery pack via the 6 pin DIN connector

SWITCHING ON: To turn the instrument on, press and release the switched marked **[ON]**. After a short self test (see below) the display will show ***"DUSTMATE ready"***, together with the time and date. If the battery needs re-charging, the display will show ***"DUSTMATE paused"*** and continuously flash ***"Charge battery"***.

The battery must be fully re-charged as soon the ***"Charge battery"*** warning appears.

SWITCHING OFF: Providing the instrument is not sampling it will switch itself off automatically if no buttons have been pressed for 4 minutes. To manually switch off the instrument press **[↑]** and **[↓]** together. The DUSTMATE will not switch off while on-line to AirQ.

DISPLAY CONTRAST: To adjust the contrast of the display press and hold **[RESET]** as the instrument is switched-on until the display goes black after about 3 seconds. Then use the **[↑]** or **[↓]** buttons to darken or lighten the display respectively. Press **[ENTER]** when the required contrast is obtained. DUSTMATE will automatically remember this setting and use it each time it is switched-on. The contrast can only be adjusted as you switch the instrument on, and once set to suit you it should not normally need re-adjusting.

SELF TEST: As DUSTMATE is switched on it carries out certain self tests to make sure it is working correctly. At the end of the self test the display will show ***"Last Serviced at"***, this is the time and date when the instrument was serviced. If this is more than a year ago, the display will show ***"PLEASE HAVE ME FACTORY SERVICED"*** instead.

If the instrument detects a fault with its memory during the self test the display will show ***"MEMORY ERROR"***.

If the instrument has a potential fault the display will show ***"INSTRUMENT FAULT"***.

In both of the above cases, the instrument will automatically revert to its default settings and may still usable - albeit with reduced accuracy. After the error message, the display will show ***"PLEASE HAVE ME FACTORY SERVICED"***. In this case please contact the factory as soon as possible.

MEMORY: If you press **[RESET]** while the display shows ***"DUSTMATE ready"*** or during sampling, the display will switch to indicating the battery voltage, internal case temperature and the percentage of memory used. Release **[RESET]** to revert to the normal display. During dust sampling, when **[RESET]** is released, the display will first show the sample number and instrument location.

The fully charged battery voltage is about 6.4 volts (charger disconnected). It is suggested that the battery is recharged if its voltage drops below 5.9 volts. Sampling will cease automatically and the display will indicate ***"DUSTMATE paused"*** if the battery drops below about 5.8 volts. Sampling will also cease if the case temperature exceeds 50 C.

As the percentage of memory used approaches 100% you should cease sampling soon as possible and transfer your results to a PC. There is some leeway here, for the memory is only truly full when the indicator shows 120%. Sampling will cease automatically and the display will indicate ***"DUSTMATE paused"*** if the end of the memory is reached.

The battery charger should be connected to the 8 pin DIN connector on the battery pack. When the battery charger is connected, the battery voltage will eventually rise to about 7.25 volts. The battery pack can be charged without the instrument.

DUSTMATE EDITOR

The DUSTMATE Editor allows some of the instrument settings and parameters to be changed. To select the editor press **[EDIT]** while the display shows ***"DUSTMATE ready"*** or during dust sampling, then use **[NEXT]** to select what to edit followed by **[ENTER]** to select. Note that during dust sampling the number of items which can be edited is restricted.

When your instrument is connected to your PC, the settings and parameters can also be changed via the AirQ Configuration Window. Please refer to the next section for details.

Set Dust Alarm: allows you to set the dust concentration at which the alarm will operate. Only available when the alarm is enabled. The alarm operates on the average reading on the Total Particles (Inhalable) channel during the display interval and is expressed as a percentage of the instrument's alarm scale.

On the microgram range the alarm scale is 1000 micrograms, so a 01.00% alarm (default) corresponds to 10 micrograms per cubic meter dust concentration.

On the milligram range the alarm scale is 10 milligrams, so a 01.00% alarm corresponds to 0.1 milligrams per cubic meter dust concentration.

The default alarm setting is 01.00% of scale. Press **[↑]** or **[↓]** to change the flashing digit then **[NEXT]** to move on to the next digit position. Press **[ENTER]** to quit and save the revised entry. Press **[RESET]** to quit without saving. Press **[START]** to reset the calibration factor to 1.00.

Zeroing Interval: allows the user to select the time intervals when autozeros will carried out. The range is 0 hour to 240 hours. The instrument automatically zero itself when starting to sample and thereafter "on-the-hour" at the interval shown on the LCD. If the interval is set to 0 hours, no further zeroes are carried out. Autozeros last for about 5 seconds during

which time the pump is switched off. The default interval is 1 hour. The previous reading is held during autozeros.

Press (and hold to speed up) **[↑]** or **[↓]** to change the interval then press **[ENTER]** to save the revised value.

Results Display: allows the user to select which results will be displayed on the LCD during sampling. The selection can be changed during sampling. The available options are:

Backlighting: select YES to turn on the display backlight for viewing in poor light. The extra power used will reduce the total sampling time on internal batteries by about 30%. Note backlighting can also be controlled via AirQ.

Display Cycling: select YES if you want the display to automatically scan around the available results channels. If you select NO then, during sampling, the results channel shown on the LCD can be changed manually using **[NEXT]**.

Latest Dust: select YES if you want the display to show the latest particle concentration. This will be the time weighted average over the Display Refresh interval.

Average Dust: select YES if you want the display to show the average particle concentration since the sampling started. Note that average results are only available after the first results have been saved in memory (i.e. after the storage interval).

Display Refresh: allows the user to select the time interval at which results display is updated. The range is 1 second to 240 seconds. The value displayed on the LCD will be the average reading taken over this interval. Press (and hold to speed up) **[↑]** or **[↓]** to change the interval then press **[ENTER]** to save the revised value.

Filter & AirFlow: pressing **[ENTER]** shows the time and date the filter was last changed, and the sampling time in minutes it has been used up to a maximum of 65536 minutes (45.5 days).

Press **[RESET]** to display the total mass of dust the instrument (based on its current calibration factor and a flowrate of 600ml/min) thinks it has accumulated (over all samples) on its filter. This is a useful aid to calibration.

Press **[RESET]** to display the total operating time of the pump in hours.

Press **[RESET]** again and you are prompted to change the filter, press **[ENTER]** followed by the password **[START] [START] [START]** to do so. The filter timer and filter mass accumulator (but not the pump time accumulator) will be automatically reset at this time.

If you do not wish to change the filter, just press **[RESET]**.

You will then be prompted to set the sample airflow to its correct value. Connect a 4 mm OD plastic tube and flow meter to the inlet Luer fitting on top of the instrument. The correct sample flow during is **600 cc/min**. Use [] or [] to change then [ENTER] to save the new value.

Adjust Clock: allows the time to be changed to compensate for daylight saving. On selection, the minutes value will flash to indicate it can be adjusted, use **[↑]** or **[↓]** to change then **[ENTER]** to save the new value, the hours value will then flash and can be adjusted likewise. The date can only be changed at the factory.

The time and date are set by AirQ to the PC time when on-line sampling starts.

Autostop Counter: allows the duration of the sample to be set. If set to zero, the instrument will sample until stopped manually. The instrument will cease sampling after the indicated number of saves to memory (i.e. the sample

duration will be Autostop Count times Storage Interval). Use **[↑]** or **[↓]** to change then **[ENTER]** to save the new value. If ***Auto Restart*** is ON, the instrument will automatically start a new sample of the same duration.

Storage Interval: allows the user to select the intervals in time at which results are stored in memory. The range is 1 minute to 60 minutes if ***Save in Seconds*** is OFF, 1 to 240 seconds if ON The value stored is the average reading taken over the storage interval.

Press (and hold to speed up) **[↑]** or **[↓]** to change the interval then press **[ENTER]** to save the revised value. The storage interval cannot be changed when sampling.

Mass Calibration: allows you to change the calibration factor for each of the size fractions in terms of mass concentration per volume of air. This calibration cannot be altered while the instrument is sampling dust.

The default setting is 01.00, allowing an adjustment range of 990%. For a given dust, the calibration factor is equal to the gravimetric mass obtained from a filter weighing divided by the DUSTMATE Mean reading taken over the same period.

Press **[↑]** or **[↓]** to change the flashing digit then **[NEXT]** to move on to the next digit position. Press **[ENTER]** to quit and save the revised entry. Press **[RESET]** to quit without saving. Press **[START]** to reset the calibration factor to 1.00.

DUSTMATE Setup: the instrument is provided with several settings which can changed by the user . Press **[↑]** to say YES to a particular setting, **[↓]** to say NO. Then press **[ENTER]** to save the revised entry and move on to the next. Press **[RESET]** to return to the editor.

Differential Mode: select YES to allow the instrument to measure differences between TSP and PM2.5, or PM10 and PM2.5. **This option is only available when memory has been cleared.** AirQ will

automatically sense if the mode has changed and upload the new settings describing the differential channels PM10-PM2.5 and TSP-PM2.5 etc.

Workplace Mode: select YES to measure and record the workplace size fractions of Inhalable, Thoracic and Respirable. NO to measure and record the environmental size fractions of Total Particles (TSP), PM10, PM2.5 and PM1. The option to change modes is only available after the sample memory has been cleared. See ***How Does it Work?*** and Appendix C for additional information on size selection and measurement ranges.

Total Particles: select YES to allow the instrument to measure and record the particle concentration during sampling based on all the particles physically entering the inlet without additional electronic selection. Environmental mode only.

Measure in µg/m³: select YES to cause the instrument to measure and record the *total particle concentration in micrograms per cubic metre* with a resolution of 0.1 up to a maximum of 6000 600 µg/m^3. Otherwise results are measured in *milligrams per cubic metre* with no electronic size selection (i.e. PM10, PM2.5 and PM1 not available) up to a maximum of about 60 mg/m^3.

PM10 Particles: select YES to allow the instrument to measure and record PM10 particles electronically selected from those physically entering the inlet. Environmental mode only.

Measure in µg/m³: select YES to cause the instrument to measure and record the *PM10 particle concentration in micrograms per cubic metre* with a resolution of 0.1 up to a maximum of 6000 600 µg/m^3. Otherwise results are measured as *number > 10 micron per cubic centimetre*.

PM2.5 Particles: select YES to allow the instrument to measure and record PM2.5 particles electronically selected from those physically entering the inlet. Environmental mode only.

Measure in µg/m³: select YES to cause the instrument to measure and record the *PM2.5 particle concentration in micrograms per cubic metre* with a resolution of 0.01 up to a maximum of 600 600 µg/m³. Otherwise results are measured as *number > 2.5 micron per cubic centimetre*.

PM1 Particles: select YES to allow the instrument to measure and record PM1 particles electronically selected from those physically entering the inlet. Environmental mode only.

Measure in µg/m³: select YES to cause the instrument to measure and record the *PM1 particle concentration in micrograms per cubic metre* with a resolution of 0.01 up to a maximum of 600 µg/m³. Otherwise results are measured as *number > 1 micron per cubic centimetre*.

Inhalable Particles: select YES to allow the instrument to measure and record the particle concentration according to the Inhalable Convention electronically selected from those physically entering the inlet. Workplace mode only.

Measure in µg/m³: select YES to cause the instrument to measure and record the Inhalable particle concentration in micrograms per cubic metre with a resolution of 0.1 up to a maximum of 6000 600 µg/m³. Otherwise results are measured in milligrams per cubic metre with no electronic size selection up to a maximum of about 60 mg/m³.

Thoracic Particles: select YES to allow the instrument to measure and record Thoracic Convention particles electronically selected from those physically entering the inlet. Workplace mode only.

Measure in µg/m³: select YES to cause the instrument to measure and record the *Thoracic particle concentration in micrograms per cubic metre* with a resolution of 0.1 up to a maximum of 6000 µg/m³. Otherwise results are measured as *number >10 micron per cubic centimetre*.

Respirable Particles: select YES to allow the instrument to measure and record Respirable Convention particles electronically selected from those physically entering the inlet. Environmental mode only.

Measure in µg/m³: select YES to cause the instrument to measure and record the *Respirable particle concentration in micrograms per cubic metre* with a resolution of 0.1 up to a maximum of 6000 µg/m³. Otherwise results are measured as *number > 4 micron per cubic centimetre*.

PM2 Particles: select YES to allow the instrument to measure and record PM2 particles electronically selected from those physically entering the inlet. Workplace mode only.

Measure in µg/m³: select YES to cause the instrument to measure and record the *PM2 particle concentration in micrograms per cubic metre* with a resolution of 0.01 up to a maximum of 600 µg/m³. Otherwise results are measured as *number> 2 micron per cubic centimetre*.

Save in Seconds: select YES for the instrument to save to memory in multiples of one second, NO to save in multiples of one minute. Note memory capacity will be used very quickly if one second storage is used. You cannot use multiples of one second when sampling on-line with AirQ for the program will always reset it to multiples of one minute. However, you can upload to AirQ off-line samples stored in multiples of one second.

Password Protect: select YES to force a password to be required to access the DUSTMATE Editor or the Sampling Mode. The entry password is **[START] [ENTER] [ENTER] [NEXT]**, a * will appear on the display as each key is pressed. Prevents un-authorised tampering with the instrument settings.

Auto Restart: select YES for the instrument to restart sampling automatically after recovery from a low battery voltage, over temperature or ***Autostop*** countdown. A low battery voltage will cause the sampling to pause. Note if the battery voltage drops too low the instrument will close

down completely and must be restarted manually.

Also used in conjunction with the **bar code wand** accessory to stop and start a new sample when a new location bar code is scanned into the instrument.

Alarms Enabled: select YES to cause the alarm to activate when the dust concentration exceeds the specified alarm level. Select NO to disable the alarm. The integration time for the alarm output is equal to the display refresh interval. The ***Dust Alarm Level*** can only be adjusted when the alarm is enabled. When the alarm is triggered the instrument will beep at half second intervals.

Location ID: allows the user to change the named location of the instrument. Up to 16 alphanumeric characters can be entered. Press (and hold to speed up) **[↑]** or **[↓]** to change the flashing character then **[NEXT]** to move on to the next character position. Press **[ENTER]** to quit and save the revised entry. Press **[RESET]** to quit without saving. Press **[START]** to clear the whole entry to underscores

Operator ID: allows the user to change the name identification of the instrument operator. The characters are edited in the same fashion as Location above.

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EDITING WITH AIRQ

From the AirQ Configuration Window the following DUSTMATE sensor settings and parameters can be altered.

Location: with AirQ the operator is always ***"Remote Control"***

Refresh Time: the DUSTMATE storage interval.

Alarms ON at: the DUSTMATE alarm level as % of alarm range

Dust Calibration: the DUSTMATE calibration factors

Measure TSP/Inhalable: set DUSTMATE to measure TSP/Inhalable

Measure PM10/Thoracic: set DUSTMATE to measure PM10/Thoracic

Measure PM2.5/Respirable: set DUSTMATE to measure PM2.5/Resp.

Measure PM1/PM2: set DUSTMATE to measure PM1/PM2.

Micrograms/mtr3: set DUSTMATE to measure in micrograms/mtr3

Alarms Enabled: set the alarm to operate if exceeded.

AirQ Controlling: allow AirQ to control the alarm, not DUSTMATE

Password Protect: password required for DUSTMATE keypad.

Note you cannot change in or out of ***Workplace Mode*** using AirQ, but it will sense which mode you are in and get the appropriate descriptions from the sensor. Please refer to the AirQ online help for further information.

DUSTMATE SAMPLING MODE

The Sampling Mode allows you to manually tell DUSTMATE to start or stop sampling and to review the sample results stored in its memory. To select the Sampling Mode press **[START]** when the display shows **"*DUSTMATE ready*"**. You will then be prompted with various questions:

RESET MEMORY ?: Select YES if you wish to set the instrument memory back to the beginning and the sample number back to 1. You must do this before changing to or from Workplace Mode. Make sure you have uploaded all the results you wish to keep before doing this as they will be lost irretrievably when the memory reset. Press **[ENTER]** to execute the selection. As a precaution, if you have said YES, the instrument will prompt you with:

ARE YOU SURE ?: select YES to confirm the memory reset and then **[ENTER]**.

START SAMPLE nn: where nn is the identification number (between 1 and 85) of the sample you are about to start. It will be Sample 1 if you have just reset the memory. Select YES if you wish to start sampling and press **[ENTER]** to execute. The pump will turn on and dust sampling will commence and the display will show ***"...sampling..."***. If display cycling is not selected, use **[NEXT]** to step through the results channels. If you select NO the review results option appears (providing some results are already in memory).

REVIEW RESULTS: select YES if you wish to review the results saved so far, then **[ENTER]** to execute. The review will show on the LCD. For each completed sample, the sample identification number, its start and stop time, its location and the mean dust concentration over the sampling period will be displayed. Press **[NEXT]** to move on to the next sample. Press **[RESET]** to quit.

You can also select the Sampling Mode whilst DUSTMATE is sampling. In this case only one option is available:

STOP SAMPLE nn: where nn is the identification number (between 1 and 85) of the dust sample currently being taken. Select YES if you wish to stop sampling and press **[ENTER]** to execute. The pump will stop and dust sampling will cease. Providing the sampling duration was long enough to have saved results in memory, when you next start sampling the sample identification number will automatically increase by one. If no results were saved, the sample number will not change. If Sample 85 is reached you will be invited to reset the memory to Sample 1.

The present time and date, the time the sample started and the sample number can also all be displayed on the LCD whilst DUSTMATE is sampling by pressing and releasing **[RESET]**. Note that the time the sample started is recorded as when the first result is stored.

REMOTE SAMPLING WITH AIRQ

AirQ can be used to start and stop sampling and continually gather results remotely when the DUSTMATE is connected to a PC. Please refer to the AirQ on line help for instructions on how to do this.

Note that if the sampling is started in this way, the operator will automatically be called "Remote Control". In addition the internal memory of the DUSTMATE will not be used (and the internal sample number will not be incremented) as the results are continually being transferred to the PC.

If the PC looses communications with DUSTMATE for more than about 4 minutes, DUSTMATE will automatically cease sampling and restart a new sample using its next internal sample number with results being stored in its internal memory for uploading later to the PC. In other words just like the manual sampling mode described in the previous section.

If communications are subsequently recovered, AirQ will attempt to start a new on-line sample and, if successful, results from this new on-line sample will not be stored internally in the DUSTMATE memory. The measurements taken when the DUSTMATE was off-line will, however, be retained and should be uploaded to the PC if required. This can be done even when the sensor is sampling on-line. Do not select **Auto Restart** in the ***Dustmate Setup*** menu if you are sampling on-line with AirQ, it will prevent AirQ taking proper control of the sensor. When you start sampling on-line the DUSTMATE clock is automatically synchronised with that of your PC.

SAMPLING WITH DUSTMATE – HOW DOES IT WORK?

Do not sample with the instrument if the ambient temperature is above 40 C, or if the instrument is in direct sun such that the case temperature will rise above 40 C. Doing so will shorten the life of the laser and invalidate the product warranty. The instrument will automatically pause sampling and turn the laser off if the case temperature exceeds 50 C.

DUSTMATE uses a light scattering technique to determine the concentration of airborne particles and dust in the size range from about 0.4 microns (1 micron = 10^{-6} metre) to about 20 microns in diameter. Above 20 microns, all particles are sized as 20 microns.

The air sample is continuously drawn into the instrument by a pump with a flow rate set by the microprocessor at 10 cc per second (600 cc/min). The incoming dusty air passes through a laser beam in a photometer and then through a filter to remove the particles before reaching the pump.

On the microgram per cubic metre ranges, the instrument sizes individual particles as they pass thorough the laser beam. Over 20,000 particles a second can be sized before coincidence (two particles in the beam at once) effects occur. This typically corresponds to a concentration of much greater than 6000 micrograms per cubic metre.

The light scattered by the individual particles of dust is converted into a electrical pulse which is proportional the size of the particle. A unique feature of the Turnkey photometer is that only light scattered through very narrow angles is measured. This narrow angle scatter is virtually the same for black or white particles of the same size. That is, it doesn't depend on the material composition of the particle; on the other hand, the easier to measure right angle scatter is highly dependant on material composition.

The intensity of the light pulse is therefore an indicator of particle size and from this the microprocessor is able to calculate the expected mass of the particle. It actually assumes the material density of the particle is 1.5 and this is where the mass calibration factor comes in to play. However, for most airborne dusts a density of 1.5

grams/cc is a good approximation.

Having evaluated the mass of the particle, the microprocessor then evaluates the likely chance of deposition of the particle according to the sampling convention being used. These sampling conventions are reproduced in Appendix C. Thus for the Thoracic Convention a 6 micron particle has a 80.5 % of chance of deposition, hence only this percentage of its evaluated mass is accumulated.

Over the course of the sample integration period this mass accumulation continues as more and more particles pass through the laser beam. A calibration factor to compensate for material density is applied to the final accumulation to produce a mass concentration reading for the dust being sampled. The shortest accumulation period is one second.

When properly calibrated, results are expressed in micrograms per cubic metre with a resolution down to 0.01 microgram. The average and latest concentrations can be shown on the display provided they have been selected in the *Results Display* portion of the Editor.

The milligram range is activated by selecting NO for ***Measure in µg/m³*** for Total Particles, or Inhalable in Workplace Mode. If the milligram range is selected all the electronic size selection options are automatically disabled.

Note that the milligram range is for indication purposes only, since at these high concentrations several particles may be present in the laser beam at the same time. Accurate sizing therefore proves impossible and the reading is based on the statistical fluctuations in the signal. For this reason the milligram range may show some statistical scatter at low concentrations. However, it is proportional to the dust concentration and sufficient to show if remedial action is working.

The instrument is normally fitted with a TSP inlet which should be cleaned periodically.

Various size selective inlets are also available for the instrument. These are the PM10, PM5 and PM2.5 impactors. These can be used to collect a size selected gravimetric

sample on the instrument's filter. Of course if a size selective inlet is used, the electronically size selected mass calculated by the instrument no longer strictly valid (for example, PM10 would become PM10 squared with a PM10 inlet), but the Total Particle channel will represent the particle mass seen on the instrument's filter.

Note that DUSTMATE will cease sampling and the display will show ***"DUSTMATE paused"*** when the battery voltage drops below about 5.8 volts, or the temperature rises above 50C. Before pausing, the instrument will correctly terminate the present results store in memory so that nothing is lost. It will also turn the backlight off to conserve power. If you wish the instrument to restart automatically (with a new sample number) if the battery voltage recovers (for example, if the charging is intermittent), or if the temperature cools, make sure **Auto Restart** is selected in the *DUSTMATE Setup* menu.

If you are using AirQ to control the instrument on-line do not select **Auto Restart** in the DUSTMATE Settings menu - this will confuse the software! AirQ will automatically restart sampling under its control once the pause condition has cleared.

When sampling off-line, each dust sample taken with DUSTMATE is identified by a sample identification number, and optionally the operator and location. A review of the completed sample results can be done by DUSTMATE itself or alternatively the stored information uploaded to AirQ for Windows software.

UPLOADING STORED RESULTS

To upload stored results to AirQ connect the PC-Link lead to the 8 pin DIN connector on the battery pack and to one of the serial ports of your PC. Then refer to the on-line help provided with AirQ. You can upload stored results while DUSTMATE is still sampling (although you cannot upload the current sample being taken). If the DUSTMATE is not sampling you can also use AirQ to erase its memory and change other settings of the instrument.

MAINTENANCE

The are no user serviceable parts inside the DUSTMATE instrument case. The manufacturer's warranty is invalidated if the case seal is broken.

The DUSTMATE photometer contains a Class 3B laser which may cause eye damage if the photometer is opened.

CHARGING THE BATTERY: To re-charge DUSTMATE battery, connect the charger supplied with the instrument 8 pin DIN connector on the battery pack. Switch on the mains power to the charger. A full charge takes about 12 hours.

With a fully charged battery, DUSTMATE can be operated for over 4 hours. For longer sampling periods you must leave the battery charger (or any other 12 volt dc power supply) permanently connected to the battery pack.

Always recharge the battery as soon as possible after the **"*Charge Battery*"** warning appears on the display.

To get the best performance and battery life out of your DUSTMATE it is important that the battery is kept in good condition.

If the battery has gone into deep discharge through neglect or miss-use, it may take up to 72 hours of re-charging to fully recover its capacity.

The battery pack can recharged separately from the instrument and spare battery packs can be purchased to swap during sampling.

CHANGING THE CALIBRATION FILTER: The calibration filter is designed to collect dust particles for calibration purposes and to protect the pump and photometer. It is located on the rear of the instrument.

The recommend filter type is Whatman GF/A 25mm fibre glass circles.

To change the filter, remove the 3 countersunk screws securing the filter cap to its base. The cap contains the filter circle secured by an O-ring. Check the O-ring is in good condition when replacing the filter. Check too the smaller O-ring for the off-centre exhaust tube on the base. Proper sealing cannot be obtained unless both O-rings are fitted. Make sure the small O-ring is aligned with the exhaust tube before refitting the filter cap.

Never run the instrument without the calibration filter. There is a foam pad which acts as a backup filter in the filter cap but damage to the pump or photometer might still occur. The foam pad is washable.

CALIBRATION: To calibrate the instrument divide the weight of dust on the filter (in micrograms) by the volume of air passed through it. This is the *Filter Concentration* and the Calibration Factor should be adjusted by the ratio (Filter Concentration)/(Average Dust Reading). For a single sample the accumulated dust reading is equal to the average dust reading for that sample. See below for calibrations over multiple samples.

As an aid to calibration Dustmate will automatically record the number of minutes the filter has been used for, up to a maximum of 65536 (about 45 days). It will also record the *Accumulated Dust Mass* in milligrams it has seen (over all samples) using its old calibration factor and assuming a flow rate of 600 ml/min. See the ***Filter and Airflow*** section of the Editor. In this case, the Calibration Factor should be adjusted by the ratio (Increase in Filter Mass)/(Accumulated Dust Mass).

Because the instrument cannot determine the material density, the calibration factors may change depending on the type of dust.

CLEANING THE INLET: Before sampling begins make sure that the **TSP Inlet** or **Impactor** is clean. The inlet is a push fit into the metal Luer fitting on the instrument ltop. Remove the inlet by gently pulling and twisting to leave the Luer fitting in the lid.

The **Impactor** cap is held in place by three M3 Allen cap screws. The impactor plate is exposed when the cap is removed and should be cleaned and lightly coated with Vaseline petroleum jelly to make sure that impacted particles are retained on it.

Do not remove the four Allen button screws on the instrument lid which hold the Luer fitting in place.

When replacing the impactor make sure the Luer fitting is pushed down hard.

The Luer Inlet can itself be removed for cleaning by gently pulling and twisting. Replace by carefully pushing and twisting.

CORRECT FLOW RATE: To provide the correct particle size selection characteristic the instrument the flow rate must be set to 600 cc/min. It is recommended that the instrument flowrate is checked and adjusted periodically using a rotameter or other type of flowmeter.

ZERO CHECKING: The instrument zero can be checked for value and stability by inserting the supplied GF/A syringe filter into the Luer inlet while sampling

ALWAYS REMOVE THE IMPACTOR OR OTHER INLET FROM THE LUER FITTING BEFORE PLACING THE INSTRUMENT IN ITS YELLOW CARRYING CASE. FAILURE TO DO SO MAY DAMAGE THE INLET WHEN THE LID IS CLOSED. MAKE SURE THERE ARE NO OTHER ITEMS NEAR THE INLET WHEN THE LID IS CLOSED.

It is recommended that DUSTMATE be factory serviced once per year or earlier if the instrument self test warns of an instrument fault.

Turnkey Instruments Ltd and its distributors can offer a Service Contract for your DUSTMATE which includes a lifetime guarantee for your instrument. Please contact your supplier for details.

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APPENDIX A – TABLE OF RECORDING TIMES

The instrument is fitted as standard with a 32 k byte memory.The recording duration will be reduced slightly if a large number of separate samples recorded. The memory is full when the indicator shows 120%.

Particles only (4 channels)

Save Interval	Recording duration
1 second	1 hour
5 seconds	5 hours
1 minute	2.5 days
5 minutes	12.5 days
15 minutes	37.5days
60 minutes	150 days

APPENDIX B

Technical Specification

Measuring Ranges (with unity calibration factor)	(i) zero to > 6000.0 micro-grams per cubic metre with a resolution of 0.1
	(ii) zero to > 60.000 milli-grams per cubic metre with a resolution of 0.001
Calibration Filter	Whatman GF/A 25 mm circle
Operating time	> 4 hours from fully recharged internal battery
Battery Pack	1.2Ah 6 volt with charging circuit and belt clip. 6 pin DIN connector for instrument 8 pin DIN connector for charger, PC Link and bar code wand
Operating temperature	-5 C to +40 C. Must be sampling prior to excursions below freezing.
Humidity	up to 100%. Water must be prevented from entering the inlet or exhaust
Particle size range	0.5 to 15 microns diameter
Pump flow rate	500 cc per minute
Dimensions	100 x 160 x 90 mm plus handle and battery pack

APPENDIX C

Collection Efficiencies in % for Particle Size Conventions

Aerodynamic Diameter µ	Inhalable	Thoracic	Respirable	PM10
0.0	100	100	100	100
1.0	97.1	97.1	97.1	100
2.0	94.3	94.3	91.4	94.2
3.0	91.7	91.7	73.9	92.2
4.0	89.3	89.0	50.0	89.3
5.0	87.0	85.4	30.0	85.7
6.0	84.9	80.5	16.8	81.2
7.0	82.9	74.2	9.0	75.9
8.0	80.9	66.6	4.8	69.7
9.0	79.1	58.3	2.5	62.8
10	77.4	50.0	1.3	55.1
11	75.8	42.1	0.7	46.5
12	74.3	34.9	0.4	37.1
13	72.9	28.6	0.2	26.9
14	71.9	23.2	0.2	15.9
15	70.3	18.7	0.1	4.1
16	69.1	15.0	0	0
18	67.0	9.5	0	0
20	65.1	5.9	0	0

Taken from BS EN481: 1993 and EN 12341:1997

Total Particles	100% for all diameters
PM2.5	100% for diameters less than 2.5 micron 0% for diameters greater than 2.5 micron
PM2	100% for diameters less than 2 micron 0% for diameters greater than 2 micron
PM1	100% for diameters less than 1 micron 0% for diameters greater than 1 micron

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