DataRAM 4 ™

Model #DR-4000
March 2010

NOTE: Guides are to be used by trained personnel only and DO NOT replace the manufacturer's operations or technical manuals. These guides were developed by field personnel for utilization by EPA and their contractors and are helpful in quick start-up and operations. Various limitations have been identified through the experience of the development group. Different makes, models, and updates to this equipment may change the limitations. It is recommended that calibration, maintenance, and use be recorded in a log book. If you have any changes or revisions please email one of the following: stevenson.peter@epa.gov, boykin.michael@epa.gov, chong.margaret@epa.gov, kroone.janice@epa.gov, zintak.leonard@epa.gov.

Uses:

The MIE DataRAM 4^{TM} measures the concentration of airborne particulate matter (aerolized liquid or solid), as well as mean particle size, air temperature and humidity, providing direct and continuous readout as well as electronic recording of the information. It covers a wide measurement range: from 0.001 mg/m^3 (0.1 μg/m^3) to 400 mg/m^3, a 4 million-fold span, corresponding to very clean air up to extremely high particle levels.

Applications:

Measure scattering, angstrom coefficients, and visual range.

- DR-4000 measures the scattering coefficient at two wavelengths (in units of inverse megameters) and computes the coefficient at the reference wavelength of 550 nanometers, as well as the angstrom exponent (a measure of atmospheric fine particle size). Based on the 550 nm scattering coefficient, the instrument then calculates the visual range in kilometers.

Complete digital communications.

- The DR-4000 has both RS232 and RS485 data ports for two-way digital communications. Special, Windows™ compatible software (provided with the instrument) facilitates data transfer either in real-time or from the logged memory. All operational and programming functions can be controlled from a remote location through the RS485 communications port. Sampling start and stop as well as data transfer can be controlled via modem or other digital transmission paths. Self-calibrating internal filter A 37 mm membrane filter (adapter provided) can be used in place of the zeroing HEPA filter cartridge for gravimetric calibration and/or chemical analysis of collected particulates.

Limitations:

- High humidity may cause elevated readings.
- Annual factory cleaning and calibration required.
- Routinely change dust filters.
- Not designed to sample highly corrosive aerosols or solvent fumes.
- The DataRAM4 must be protected from all forms of precipitation.
- Never operate without one of its internal filters in place.
- Due to the relatively low flow rate, the unit may not be applicable for fence line monitoring of cleanups involving low concentrations of contaminants in soil.

Quick Start-up and Operation:

- Make sure that the rear panel power switch is in the upward position.
- Remove the sampling inlet protective cap by pulling up on the knurled metal outer piece and lifting it off. Place the sampling inlet protective cap on the inlet storage post located on the rear panel of the instrument.
- Press ON key for 2 seconds. The MAIN MENU will automatically appear in about 5 seconds.
- Remove the CD ROM from the rear of the users manual and load the software onto your computer.
- From the MAIN MENU select ZERO/INITIALIZE by moving the cursor to that line. Key ENTER. The pump starts up and ZEROING/INITIALIZING will be completed in 4 to 5 minutes.
- After the zeroing/initializing sequence is completed, if the following screen appears:

```
                    ZEROING/INITIALIZING
        READY!:
        SOURCE 1:                       NORMAL
        SOURCE 2:                       NORMAL
```

Then, return to the MAIN MENU by keying EXIT, otherwise see manual for trouble shooting.

Key NEXT for Edit MENU

- **Selecting Logging Parameters:**
At the EDIT MENU key **ENTER** while the cursor is flashing on LOGGING PARAMETERS. Key + to toggle between the ENABLE and DISABLE logging function. Key the ▼ cursor and set the LOG PERIOD to 00:00:60 (60 seconds) using the ➤ cursor to move between significant digits and the + or - key to increase or decrease the values. Key the ▼ cursor to reach the TAG line (Run #) and ▼cursor to reach the AUTO START line (for most field applications these should be noted but not modified). Key **EXIT** to return to the EDIT MENU. Change TAG# to 01 and keep AUTO START in DISABLED function.

Now return to the MAIN MENU screen by keying NEXT.

- Selecting Set-Up Parameters:
- To select SETUP PARAMETERS on the EDIT MENU, key ENTER when the cursor is on it and make changes as per your requirement. A typical screen will look like the following:

```
DISPLAY AVG:                10 SEC
CAL FACTOR:                 1
UNITS:              (MASS) μg/m³
SIZE CORRECTION:  DISABLED
```

The second set up screen can be displayed by keying NEXT; and looks like the following:

```
RH CORRECT:                 DISABLED
TEMPERATURE UNITS:          F
FLOW RATE:                  2.00 LPM
```

At the second Setup Screen the relative humidity RH CORRECT should remain DISABL *when relative humidity is less than 50%*. If relative humidity is greater than 50% or operated during a wet weather period, the RH CORRECT should remain DISABL BUT you should attach the DR-TCH Temperature Conditioning Heater. The TEMPERATURE UNITS: C and the FLOW RATE: 2.00 LPM remain as the default. Key NEXT twice to get screen to set the time and date, **should** this require resetting.

Note: The DR-TCH must be attached directly to the sampling inlet port and the DR-4000 must be ON (110 VAC required) and have air pumping through it before plugging in the DR-TCH. Subsequently, the DR-TCH must be unplugged before turning off the DR-4000. CAUTION!! The DR-TCH gets hot and the should not be handled until it has sufficiently cooled.

Key NEXT again for the next set up screen to display. In this screen set site-specific Action Level and Alarm.

```
ALARM              ENABLED
LEVEL (μg/m³)                        500 (for example)
AUTO ZERO:                           ENABLED
INTERVAL:                            2 HRS
```

Now return to the MAIN MENU screen by pressing EXIT then the NEXT key.

- Initiate sampling by selecting START RUN and ENTER key.

- At the end of sampling period terminate the run by keying EXIT. Confirm the run termination by keying ENTER.

To access stored data either for viewing on the DataRAM 4[TM] screen or for downloading to a PC file, select the VIEW/ TRANSFER DATA line on the MAIN MENU, and then key ENTER.

TAG # 02
VIEW LOGGED DATA
TRANSFER TEXT FILE
DELETE LOGGED FILE

This is the first of two tag summary screens. You can use the + and - keys to toggle between different tag numbers. The other information is the beginning and end time, and the duration of the run.

TAG # 12
START   11:23   09 MAY 03
END   11:27   09 MAY 03
LOG PERIOD   00:00

Key **NEXT** to access the second logged data screen.

TAG # 12   43 POINTS
AVG CONC   0.011 MG/M3
MAX   0.022 11:27 09 MAY
AVG.   0.007 MG/M3

After reviewing the appropriate data, key **EXIT** to return to the VIEW LOGGED DATA screen.

- Use the ▼ to place the cursor at the TRANSFER TEXT FILE menu and key **ENTER**. Attach the RS-232 cord to the rear of the DataRAM DR-4000 and the other end to the communications port (COMPORT) on your computer. Follow the directions to download the logged data for the Tag numbers selected. Following the downloading of data, you can use the various options on the accompanying software to create tables, graphs, etc. to present the data. After completing the successful download of data key **EXIT** to return to the VIEW LOGGED DATA screen

- Use the ▼ to place the cursor at the DELETE LOGGED DATA menu and key **ENTER**. You have the option to DELETE TAG DATA or DELETE ALL DATA. Use the ▼ to place the cursor at the appropriate option and key **ENTER**. As a failsafe you will be asked to ENTER TO CONFIRM or EXIT TO CANCEL. A screen will appear to inform you that a distinct TAG number has been deleted, key **NEXT** to return to the DELETE

LOGGED DATA screen where another TAG can be deleted. If all data was deleted keying **NEXT** will return you to the VIEW /TRANSFER DATA screen.

- To Power Off the DR-4000, press and hold the On/Off key for 2 seconds. To Power Off key **ENTER**.

Calibration/Operational Test:

The DR-4000 is factory calibrated in accordance with National Institute of Standards and Testing (NIST) gravimetric standard protocols for particulate levels in air. The zeroing of the instrument will be the determination of whether factory cleaning/servicing is necessary. A reading of BACKGROUND HIGH following the zeroing of the instrument is indicative that the internal optics need cleaning. This can be performed using the special tool that consists of a cut-off cotton swab inserted into a plastic sleeve and held by a right-angle Allen wrench using denatured alcohol.

Before initiating a measurement run it is advisable to perform the automatic zeroing and internal check out sequences, to ensure optimal operation. See Star-Up for the procedure.

The DR-4000 is easily calibrated by adjusting the calibration constant to agree with gravimetric measurements obtained from the on-board filter. As the photometric response of the instrument is exactly linear over its entire operating range, only single point gravimetric calibration is needed. The second point of the straight response line is the zero concentration obtained by self-purging.

Additional Operation Information:

- The instrument can be operated and/or charged in any of three orientations, horizontally (front panel vertical), tilted resting on locked down handle and two rear rubber pads, and vertical (front panel horizontal facing upwards) resting on four rear rubber pads.
- The front panel contains the 10 touch switches (keys), LCD screen for operation and the touch switches provide "popping," tactile feedback .
- Alarm Level:
- The alarm function can be enabled/disabled and the alarm level (trigger threshold) can be selected by the user through the DataRAM 4^{TM} keyboard. While the alarm is on, it can be disabled momentarily by pressing any key on the DataRAM 4 ^{TM}.
- The DataRAM 4 ^{TM} has several different operating modes.
    - Set-Up Mode: The DataRAM 4 ^{TM} enters the Start-Up Mode as soon as the instrument is switched on. All parameter and status changes must be performed while in the set-up mode.
    - Run/Data logging Mode

Principles of Operation:

Real-time airborne particulate concentration and size measurements
The DataRAM 4™ (Model DR-4000) continuously monitors the real-time concentration and median particle size of airborne dust, smoke, mist, and fumes. In addition, air temperature and humidity are displayed.

With appropriate particle discriminators it provides measurements correlated with PM10, PM2.5, PM1.0, and respirable fractions. It's patented two-wavelength particle detection system provides the volume median particle diameter of the sampled aerosol, over a concentration range of up to 400 mg/m3. Unlike typical particle counting devices, the DR-4000 is totally immune to particle coincidence errors, even at the highest concentrations. Volume median particle sizes down to 0.05 μm can be measured by this unique spectral nephelometric (light scattering photometer) technique with active air sampling (i.e. using an internal pump).

Monitors mass concentrations of particulate (PM 2.5). The DR-4000 monitors the concentrations of particulates in ambient air by a combination of aerodynamic size preselection, two-wavelength nephelometry, and concurrent sensing/correction for relative humidity. This patented technique provides a continuous measurement of PM2.5, independent of particle size and moisture - without heating, diffusion drying, or denuding the sample stream.

Detection Limits:

Response Range:
 It covers a wide measurement range: from 0.001 mg/m^3 (0.1 μg/m^3) to 400mg/m^3.Calibrated against Arizona road dust. Calibration will vary with different particulate matter.

Concentration measurement range mg/m^3	Precision	Accuracy	Resolution
0.0001- 400	1% or 0.001 mg/m^3	2% of reading	0.1% of reading

Routine Maintenance:

The DR-4000 is designed to be repaired at the factory. No user serviceable components reside within the metal enclosure with the exception of the filter cartridge or the analytic filter holder. Access to the internal components of the unit by others than authorized MIE personnel voids the warranty

Maintenance Needed	Frequency	Performed By	Manual Reference
Return the DR-4000 to the factory for routine maintenance.	Every 2 Years	Authorized MIE personnel.	page 32
Cleaning the lenses in the sensing chamber.	BACKGROUND HIGH reading after Zeroing	DR-4000 Operator	Section 12.5 Page 34
Replace the HEPA Filter cartridge (MIE Part No. MSA-95302).	Following Exposure to excessively high particulate levels	DR-4000 Operator	Section 12.4.1 Page 33
Install an Analytic Filter.	When particulate samples are to be collected..	DR-4000 Operator	Section 12.4.2 Page 33

Note: Change the dust filter on a routine basis.

Battery Information and Charging Schedule:

- Battery: Internal battery: rechargeable sealed lead-acid gel-cell type, 7.2 Ah, 6V, 20-hour run time between charges (typical). AC line: universal voltage charger/power supply, 100-250 V, 50 - 60 HZ.

- **Note**: To enable operation with either its internal battery or with the charger/power supply, the 3-position power selector switch must be placed in its upward position.

NOTE: It is recommended that due to the many types of rechargeable battery configurations, that Equipment Managers verify proper battery charging and operation through monthly equipment operation until battery is discharged prior to recharging.

Main Inventory of Items/Accessories:

- Soft-shell carrying case (MIE model RAM-2-184-1).
- Digital communications cable (MIE model DR-DOC).
- Communications software disk (MIE model DR4-COM).
- Universal AC power supply/charger (MIE model RAM-2-183-1) .
- Standard filter cartridge (installed) (MIE model MSA-95302).
- Analytical Filter Holder (MIE model RAM-2-182-1).
- Instruction manual.

Inventory of Optional Accessories:

- Omnidirectional Sampling Inlet (MIE model DR-OSI).
- Temperature Conditioning Heater (MIE model DR-TCH).
- In-line Impactor Head (10 and 2.5 m) (MIE model DR-PM10/2.5).
- Sampling Dilution Unit (MIE model DR-SDU).

Contact Information (Technical Support):

Website: http://www.thermo.com/eidhttp//www,thermo.com/eid
email: http://www.thermo.com/com/cda/contactus/home/1,1032,,00.html

Address:
Environmental Instruments
27 Forge Parkway
Franklin, MA

Phone #: 866-282-0430 (toll free in USA) (Bob Francis, extension 5049)
            508- 520-0430(outside USA)
            508-520-1460 (fax)

DR-4000 with DR-TCH   **Rear View of DR-4000**

Instrument Panel: