

OPERATOR'S MANUAL

for the

2H and 2H-N Aerosol Photometers



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Guidelines to the use of this manual

SYMBOLS

The following symbols are used throughout the manual to draw attention to items or procedures that require special notice or care.

Operator required action.



Note: Contains important information that, if ignored, can cause inaccurate readings.



Caution: Contains information that, if ignored, can cause equipment damage.



Warning: Contains information that, if ignored, can cause injury or death to those handling the equipment.

Conventions

[**Window**] Indicates the information displayed in a window on the Control Panel.

<**Function**> indicates a button on the Control Panel.



1 INSTALLATION

1.1 REQUIREMENTS



NOTE: High ambient temperatures may create instability in the readings.

The 2H requires the following for proper operation:

- Stable electrical power at 90/240 VAC, single phase, 50/60 Hz, 5 amps.
- Environment Operating Range: 35° to 105° Fahrenheit (1.6° to 40.6° Celsius) with less than 75% relative humidity.

1.2 UNPACKING



NOTE: Save all packaging material for future use.

Carefully unpack and remove the 2H Aerosol Photometer and all accessories from its shipping container. If the instrument has been damaged in transit, notify the shipper immediately.

Make sure the following items are included with both the 2H (9300133) and the 2HHP (9300134):

- 1) 1 power cord, 6700001
- 2) 12 feet of clear PVC tubing, 5200116
- 3) Operating Manual, 1800110
- 4) Calibration certificate

The following items are optional. Check the order packing slip.

- 1) Shipping case, 9300145
- 2) 2H-SP Scanning Probe, complete, 9300144
 - a) 1 round isokinetic nozzle (red), T2E0-0572
 - b) 1 rectangular isokinetic nozzle (blue), T2E0-0798
 - c) 1 NSF 1" round nozzle (black), T2E0-0005
 - d) 1 Scanning probe, T2SP-0881

If any of these items are on the order packing slip but missing from the shipment, contact ATI immediately at:

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2 GENERAL INFORMATION

2.1 DESCRIPTION

The 2H is a forward light-scattering, linear photometer. It operates on 100 to 240 VAC, 50 or 60 Hz, adjusting automatically. The basic functions of the 2H are to sample air or other gas and report the concentration of particulates in the sample.

This unit is also available in a nuclear version, the 2H-N. The nuclear version is the same size and has the same features as the 2H, plus a sealed sampling chamber and an additional ULPA filter to contain all contamination within the unit.

The 2H is compact and lightweight, measuring 13.5 x 9.5 x 5.0 inches (34.3 x 24.0 x 12.7 cm) and weighing only 15.5 lbs (7.0 kg). The instrument case is constructed of die cast aluminum and has a swing arm carrying handle that folds up under the case to tilt the unit up for easy viewing. The pressure-sensitive keypad and large, bright LED displays and indicators provide ease of operation and readability. The auto-ranging and one-step zeroing features assure the accuracy of all readings.



WARNING: If the unit is used in a manner not specified within the user's manual, the protection offered by the equipment may be impaired.

2.2 SAMPLING SYSTEM

A vacuum pump provides a sample flow rate of 1 cfm (28.3 liters per minute) for the instrument. It is an oil-free, dual head, rotary vane pump with a direct-coupled DC motor.

A selector valve on the front panel directs the airflow through the sampling system to the scattering chamber from three possible sources. The **CLEAR** position directs clean air from an internal ULPA filter to the scattering chamber for zeroing the instrument. The **UPSTREAM** position permits sampling of the air above the filter being challenged, and the **DOWNSTREAM** position permits sampling of the air that penetrates the filter.

2.2.1 Light Scattering Chamber (LSC)

The scattering chamber is not only an integral part of the sampling system; it is a major component in itself. The scattering chamber is a complex electro-optical unit that consists of a pair of hollow cones connected at the apexes. A pair of collimating lenses first straightens the light emerging from the light source, and then focuses it at the center of the sampling cone. An aperture forms a dark cone around the photomultiplier, preventing light from arriving directly on the photomultiplier. A condensing lens opposite the LED source focuses light scattered into this dark cone onto the photomultiplier tube.



2.2.2 Electronics

The signal from the photomultiplier is amplified and delivered to a signal-conditioning, analog-to-digital converter that is then sent to the microprocessor.

2.2.3 Theory of Operation

When air or gas is drawn through the scattering chamber, particulate matter in the sample passes through the focal point of the scattering chamber. Particulate matter scatters light into the dark cone and onto the photomultiplier tube, which converts the light into an electrical signal. The signal is amplified and digitized, then analyzed by a microprocessor to determine the intensity of the light scattered by the signal. This signal is then compared to a reference signal to provide an output that is normalized by the reference signal.

A photometer is ideally suited to detect particulate matter in air or gas, reporting the mass concentrations encountered on a digital display. Particles from less than 0.1 micron to approximately 600 microns can be detected by the 2H. Since the photometer reports concentration of particulate matter (relatively independent of size, shape, or color), many applications are possible. By using a baseline of 100 micrograms per liter of aerosol, it is possible to directly read the concentrations of aerosol.

2.2.4 Filter Leak Testing: The Most Common Application

The most common application of the 2H is to detect leaks in high efficiency filter systems (HEPA & ULPA). To establish the integrity of a filtration system, a challenge agent consisting of an airborne test aerosol is generated and introduced upstream of the filter. The challenge agent is used to provide enough particulate matter above the filter to allow statistically valid measurements below the filter.

The test aerosol should be introduced into the system on the upstream side of the filter or filters as far from the filters as is practical to insure adequate mixing with the airflow in the duct. A commonly used guideline that assures adequate mixing is ten duct diameters upstream of the filter. A sample of the aerosol/air mixture should be taken from the upstream side, close to the filters under test to verify the necessary upstream challenge. This sample is also used to set the 100% baseline. The 0% baseline is then adjusted using particle-free air supplied by the internal ULPA filter. The instrument is now ready to detect and quantify leakage on the downstream side of the filter as a percentage of the available upstream aerosol/air mixture.

A scanning test is performed using the optional 2H-SP hand-held scanning probe. The entire area of the filter is sampled by passing the probe in overlapping strokes across the face and perimeter of the filter. The end of the probe should be held within one inch of the filter face and scanned at a traverse rate of no more than 10 feet per minute (2 inches per second). Overlapping passes should be made over the entire filter face, around the periphery of the filter, along the bond between the filter pack and the frame, and around the seal of the filter. The display indicates the percent of leakage through or around the filter. The scanning probe is supplied with 3 types of nozzles that can be screwed onto the end of the flexible probe. The round, black nozzle is 1 inch

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(25 mm) in diameter, which complies with NSF (National Sanitation Foundation) Standard 49-1992. The rectangular, blue isokinetic nozzle is used for faster scanning and is accepted by many standards, including NSF 49-2002. The round, red nozzle is also an isokinetic nozzle. The isokinetic nozzles are designed for face velocities of 90 ± 20 feet per minute (fpm).

2.2.5 Capabilities



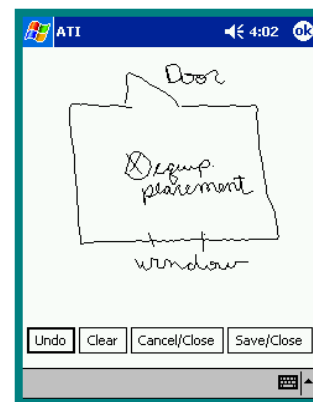
NOTE: Before attempting to operate this unit, become familiar with the features and functions.

Measurements

- % Leakage
- Absolute aerosol concentration

2.2.6 Input / Output features

- Alarm (audible and visual). When a reading exceeds the user selected alarm point, a tone will sound and the display will flash on and off.
- Serial Data Output. % Leakage data is sent out the unit's serial port. This data can be logged on ATI's DAS1 or DAS2 data acquisition systems. The following are screenshots of the DAS1 interface. Contact ATI or your local representative for more information about the data acquisition systems available from ATI.



3 SETUP

3.1 LOCATIONS & FUNCTIONS

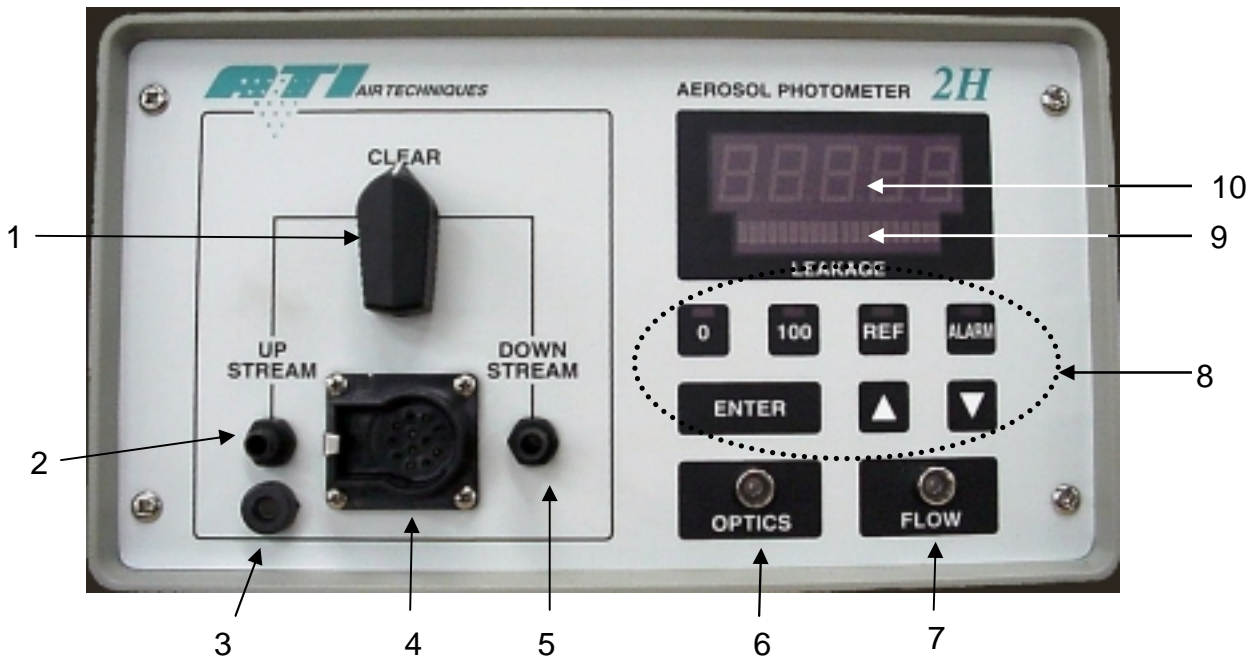


Figure 1. Front View

1. **Selector Valve.** Selects the sample source.
2. **Upstream Sample Port.** Connects to the sample tubing that is used to measure the upstream aerosol concentration.
3. **Scanning Probe Ground Jack.** Electrical ground connection for scanning probe shielding. (Required for CE compliance)
4. **Scanning Probe Connector.** Electrical connection for the optional Scanning Probe.

NOTE: Connect the Scanning Probe before applying power to the 2H. Failure to do so will result in the lack of operation of Scanning Probe's display. If this occurs, simply turn off the power to the unit and restart the system.

5. **Downstream Sample Port.** Connects to the sample tubing or optional Scanning Probe that is used to measure the downstream sample.
6. **Optics indicator light.** Corresponds to the cleanliness of the optics.

Green Light	Less than 10,000mg* of aerosol has moved through the
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	scattering chamber.
Orange Light	More than 10,000mg* but less than 17,000mg* of aerosol has moved through the scattering chamber.
Red Light	More than 17,000mg* of aerosol has moved through the scattering chamber. Servicing of the unit is highly recommended.



* Note: These values are approximate. Actual mass may vary with different airflow rates and aerosols.

7. **Flow indicator light.** Displays green when flow is within 5% of 1 CFM, yellow when flow is from 5% to 10% of 1 CFM, and red when flow is more than 10% above or below 1 CFM.
8. **Function Keys.** Used for setting operating parameters and initiating program routines
9. **Bar Graph Display.** Displays an analog representation of the % leakage to aid in isolating leaks.
10. **Front Panel Display.** Indicates % leakage readings and error messages.

3.2 FRONT PANEL CONTROLS AND INDICATORS

The front panel contains seven pressure-activated function keys. The <0>, <100>, <REF>, and <ALARM> keys each contain a red LED to indicate the state of the switch or to prompt the operator. The <Δ> and <∇> keys are used to scroll among selections as they are shown on the % LEAKAGE display. The <ENTER> key serves as the command key for sending information to the processor and for initiating or stopping system routines. The <Δ>, <∇>, and <ENTER> keys contain no indicator LED.

The % LEAKAGE display is an array of high-visibility LEDs that forms a display screen. The Front Panel Display shows alphanumeric messages. Below it is a Bar Graph Display that gives a visual indication of internal photometer cycling or an analog representation of quantity or percentage.

The Scanning Probe contains an unlabeled display on the pistol grip that is a half-scale duplicate of the % LEAKAGE Indicator. The two displays are driven by the same electronics and will always read exactly the same.

The Selector Valve, the Scanning Probe connector, and the two barbed fittings are discussed later.

3.3 SCANNING PROBE CONNECTIONS

If using the 2H with the Scanning Probe, connect the probe's electrical connector to the 12-pin connector on the front panel of the 2H before applying power to the photometer. Otherwise, the display on the Scanning Probe will not function. Connect the probe's sampling hose to the barbed



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DOWNSTREAM fitting to the right of the 12-pin connector. The cable and sampling hose are bound as a single, flexible umbilical. Select the appropriate probe nozzle and screw it onto the threaded end of the flexible portion of the Scanning Probe.



Note: When using the TDA-2SP Scanning Probe with the 2H, the probe must be connected to the photometer before the power is turned on. Otherwise the 2H will not detect the probe and no display will be observed on the pistol grip. If this occurs, switch the power off, verify that the probe is connected properly, and then switch the power back on.

3.4 REAR PANEL CONNECTIONS

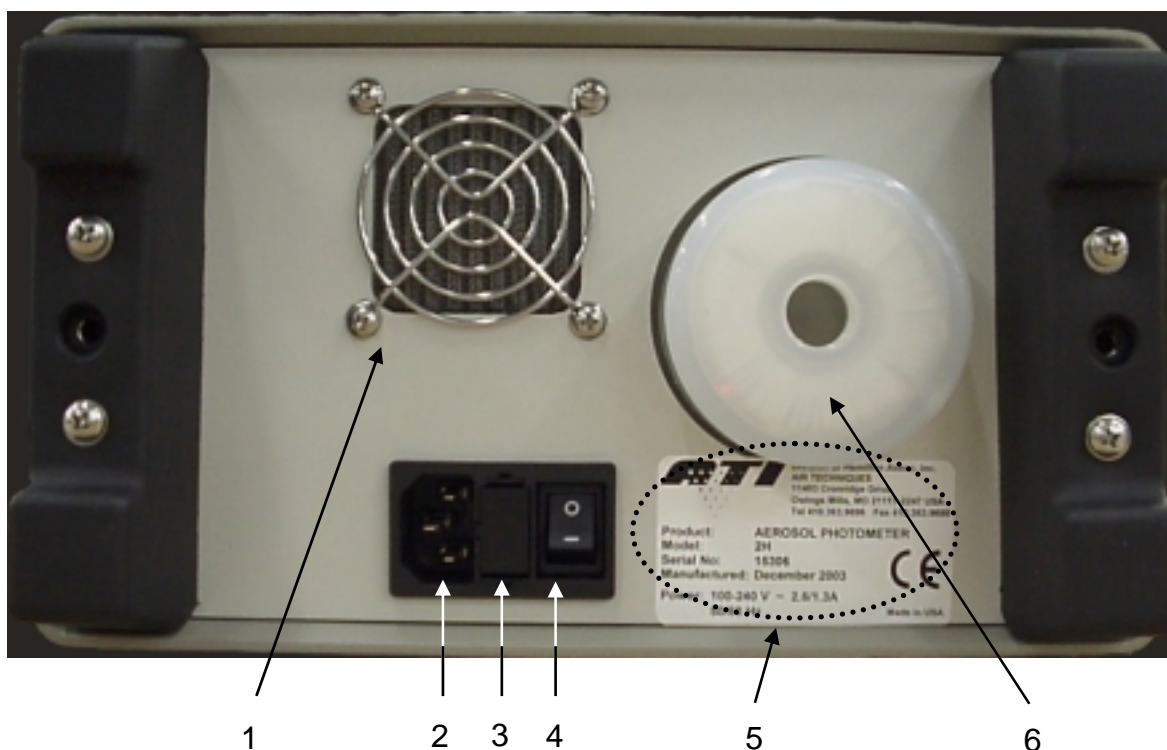


Figure 2. Rear Panel

1. **Cooling Fan** – Maintains airflow through the unit’s enclosure to stabilize electronics.
2. **Power Connector with** –Connects to the Power Cord.
3. **Fuse Block** – Contains 2-amp fuse and spare fuse.
4. **Power Switch** – Rocker Switch. Turns system power on and off.
5. **Serial Number Label** – Lists the model and serial number.
6. **Vacuum Pump Exhaust** – Allows a filter to be installed to eliminate particulate emissions.

The rear panel contains a recessed, 3-pronged male Power Connector, with an integral fuse block and power switch, and a Vacuum Pump Exhaust HEPA Filter.

CAUTION: The 2H should always be positioned so that the Power Switch, located on the rear panel, is readily accessible in the event the unit needs to be powered off quickly.

The Power Connector accepts the female end of the Power Cord that comes with the unit. The internal power supply is a universal supply that can operate at either 50 or 60 Hz and with any voltage from 90 to 240 volts, for use in virtually all countries. Therefore, any plug with the correct female end (IEC-320 standard) may be attached to the unit and the universal power supply will automatically switch to use the supplied input power.

The Vacuum Pump Exhaust HEPA Filter is provided so that the sensitive environments of cleanrooms can be maintained. The air expelled by the unit is continually filtered of all particulate matter generated by testing aerosols and the unit using this HEPA exhaust system.

3.5 SIDE CONNECTION

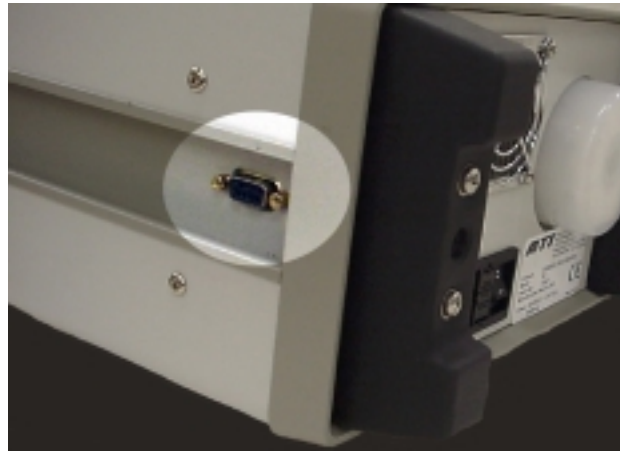


Figure 3. RS-232 Port

RS-232 Port. % Leakage data is continuously sent via the RS-232 port as it is updated on the Front Panel Display, approximately once per second.

It is recommended that this data be logged to either one of ATI's data acquisition systems, the DAS1 or the DAS2. Contact ATI or your local representative to learn more about data logging options.

If using a terminal program to receive this data, a straight cable must be used (as opposed to a null modem cable). If using a Pocket PC (PPC) to receive data, the type of cable will depend upon the brand of PPC. Contact ATI customer service for complete details.

4 OPERATION

4.1 INITIALIZATION

If the Scanning Probe is being used, connect it to the Scanning Probe Connector and the Downstream Port. Verify that the Selector Valve is in the **CLEAR** position. Apply power to the 2H by setting the Power Switch to the **1** (On) position. The following events will occur:

1. The display will show “8.8.8.8.8.”
2. All of the LEDs in the bar graph will be illuminated.
3. The LEDs in the 0, 100, REF, and ALARM buttons will be illuminated.
4. A short beep will sound.
5. Flow sensor indicator LED becomes active.

These events indicate that the unit has started and also give the user the opportunity to check the integrity of all the LEDs with the exception of the optics LEDs. The flow LED should be green, yellow, or red. The optics LED will be off at this time. After a few moments, the firmware revision (main PCB) will be displayed.

Next the screen will go blank and, after a few more moments, another short beep will sound. The reference light will blink, indicating that it is time to select a reference. Follow these steps to complete the setup:

1. Press **<ENTER>**.
2. Use the **<Δ>** (Up) and **<∇>** (Down) function keys to select the reference of choice.
3. Press **<ENTER>**.
4. Use the **<Δ>** (Up) and **<∇>** (Down) function keys to select the internal reference factor.
5. Press **<ENTER>**.
6. The unit will scan while adjusting the detector gain level.

The zero LED will begin to blink indicating that it is time to set the zero reference. Verify the selector valve is set to clear.

7. Press **<ENTER>**.

The bar graph display will scan to indicate that the unit is sampling the zero reference value. Upon completion a short tone will sound and the unit will begin sampling and sending data via the serial port.

4.2 SETUP PARAMETERS

The 2H has twelve (12) operating parameters (not counting L0), eight (8) of which are programmable by the operator to facilitate setting up the instrument for operation. Some of these parameters have been factory set, but can be optionally reset by the operator. If required, these parameters can be returned to the factory default setting at any time. Other parameters are

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accessible for programming only at the factory. The twelve parameters are listed in the table below. Valid ranges and default settings for each parameter are also listed, where applicable.

Parameter	Description	Valid Range	Default Value
L0	Run	-	-
L1	Audible Alarm	ON / OFF	OFF
L2	0% Sample Time	5 - 120 seconds	10 seconds
L3	100% Sample Time	5 - 120 seconds	10 seconds
L4	Decimal Places	3 - 4	4
L5	Internal Reference	-	-
L6	Hour Meter	-	-
L7	Load Factory Defaults	-	-
L8	Software Revision	-	-
L9	Bar Graph Display	ON / OFF	ON
L10	Display Intensity	1 - 8	6
L11	0% Purge Time	0 - 120	0
L12	100% Purge Time	0 - 120	0

To enter the parameters setting menu proceed as follows:

1. Press <Δ> function key (Up arrow). The display will read “- - - -”
2. Press <ENTER>. L0 will be displayed.



NOTE: If the <ENTER> key is not pressed within 3 seconds, the unit will return to sampling mode.

3. The <Δ> (Up) and <∇> (Down) function keys are used to scroll through the parameters from L0 to L12.
4. To access a parameter once it is displayed, press the <ENTER> function key.
5. Select the desired setting for the parameter by using the <Δ> (Up) and <∇> (Down) function keys.
6. When the desired setting is displayed, press the <ENTER> function key to store the setting.
7. When the setting of the parameters is complete, scroll to L0 and press <ENTER>. The unit will return to sampling mode.

4.3 CHANGING SETUP PARAMETERS

L0 – Exit Parameter Menu



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This is a non-programmable parameter. This parameter is used to both enter and exit the parameter setting menu. When L0 is selected, the programmable parameter settings are included in the operating routine. Scroll to L0 and press <ENTER> to return to running mode.

L1 – Audible Alarm ON / OFF

Options: Off
 On

Default: Off

Enables or disables the audible portion of the 2H alarms. The unit parameter is factory set to off.

When L1 is displayed in the parameter menu, press the <ENTER> function key to access the stored setting. Press the <Δ> (Up) and <∇> (Down) function keys to change the displayed setting between ON and OFF.

Press <ENTER> to set the selection and return to the parameter select menu. [L1] will be displayed.

L2 – 0% Sample Time

Options: 5 - 120

Default: 10

Establishes the period over which the 0% aerosol sample is average.

When [L2] is displayed in the parameter menu, press the <ENTER> function key to access the stored setting.

Press the <Δ> (Up) and <∇> (Down) function keys to change the displayed setting between 5 and 120. Press <ENTER> when done. L2 will be displayed.

L3 – 100% Sample Time

Options: 5-120

Default: 10

Establishes the period over which the 100% aerosol sample is averaged.

When [L3] is displayed in the parameter menu, press the <ENTER> function key to access the stored setting.



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Press the <▲> (Up) and <▼> (Down) function keys to change the displayed setting between 5 and 120. Press <ENTER> when done. [L3] will be displayed.

L4 – Decimal Places to be displayed

Options: 3 or 4

Default: 4

This parameter is used to select either 3 or 4 decimal places on the % Leakage Display.

When [L4] is displayed in the parameter menu, press the <ENTER> function key to access the stored setting.

Press the <▲> (Up) and <▼> (Down) function keys to move the displayed setting between 3 and 4 on the display (3=0.001%, 4=0.0001%).

Press <ENTER> to set the selection and return to the parameter select menu. [L4] will be displayed.

L5 – Aerosol Reference Selection

Options: DOP, PAO, USER, HIGH

Default: DOP

When [L5] is displayed in the parameter menu, press the <ENTER> function key to access the stored setting.



Note: Refer to section 4.5, page 20 “changing the reference” to change the selection or reestablish internal reference.

See A-7 for correction factors to be used in conjunction with other challenge aerosols.

Press <ENTER> to set the selection and return to the parameter select menu. [L5] will be displayed.



L6 – Hour Meter

Options: N/A

Default: N/A

Displays the total running time for the unit.

When [L6] is displayed in the parameter menu, press the <ENTER> function key to display the hour value.

L7 – Load Factory Defaults

Options: (- - - -) NOT enabled, indicating factory default loading has NOT been selected

(LOAD) Enabled, indicating factory default loading has been selected

Default: (- - - -) Not enabled

[L7] is used to restore the factory default settings to all the user programmable parameters.

When [L7] is displayed in the parameter menu, press the <ENTER> function key. Press the <Δ> (Up) and <∇> (Down) function keys to move between [- - - -] and [LOAD].

Press <ENTER> to set the selection and return to the parameter select menu. [L7] will be displayed.

L8 – Software Revision

Options: N/A

Default: N/A

[L8] displays the current revision that is being used by the 2H main firmware.

L9 – Bargraph Display

Options: OFF - Disabled
ON - Enabled

Default: ON - Enabled

[L9] is used to enable or disable the analog bargraph display beneath the numeric portion of the % Leakage display.



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When [L9] is displayed in the parameter menu, press the <ENTER> function key to access the stored setting.

Press the <Δ> (Up) and <∇> (Down) function keys to move the displayed setting between 0 and 1 on the display.

Press <ENTER> to set the selection and return to the parameter select menu. [L9] will be displayed.

L10 – % Leakage Display Intensity

Options: 1-8

Default: 6

[L10] is used to adjust the intensity of the green LED display in the % Leakage display.

When [L10] is displayed in the parameter menu, press the <ENTER> function key to access the stored setting.

Press the <Δ> (Up) and <∇> (Down) function keys to move the displayed setting between 1 and 8 on the display.

Press <ENTER> to set the selection and return to the parameter select menu. [L10] will be displayed.

L11 – 0% Purge Time

Options: 0 - 120

Default: 0

Set the length of time for the system to run before taking reading when calculating the zero value.

When [L11] is displayed in the parameter menu, press the <ENTER> function key to access the stored setting.

Press the <Δ> (Up) and <∇> (Down) function keys to change the displayed setting between 0 and 120 seconds. Press <ENTER> when done. [L11] will be displayed.

L12 – 100% Purge Time

Options: 0 - 120

Default: 0



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Set the length of time for the system to run before taking reading when calculating the 100% value.

When [L12] is displayed in the parameter menu, press the <ENTER> function key to access the stored setting.

Press the <Δ> (Up) and <∇> (Down) function keys to change the displayed setting between 0 and 120 seconds. Press <ENTER> when done. [L12] will be displayed.

4.4 SETTING UP THE ALARM FUNCTIONS

The 2H has an alarm feature which can alert the user when particle concentration exceeds a user-selected % Leakage value. To set the alarm features, perform the following steps:

1. After system initialization, press the <ALARM> function key.
2. The **ALARM** LED will flash and the current alarm setting ([ON] or [OFF]) will be displayed.
3. Press the <Δ> (Up) and <∇> (Down) function keys to change the displayed setting.
4. If changing the alarm set point is not desired, the <ENTER> function key may be pressed to return to sampling mode. If this is the case, press <ENTER> and proceed to step 8.
5. If the alarm set point is to be changed or checked, press the <ALARM> function key again to enter the set point mode.
6. Press the <Δ> (Up) and <∇> (Down) function keys to change the displayed set point.
7. Press the <ENTER> key two (2) times to return to the unit to sampling mode. The red LED over the ALARM key will remain illuminated to indicate the alarm is active.
8. Setup of the alarm is now complete. When the measured concentration exceeds the set point, the display will flash. If the audible alarm parameter (L1) is set to **ON**, a tone will also be heard.

4.5 CHANGING THE REFERENCE

During the initialization sequence immediately following unit startup, the user is required to select a reference. To change the desired reference anytime thereafter, perform the following steps:

1. Press the <REF> function key. The **REF** LED will flash and the display will go blank.
2. Press the <ENTER> function key. If the <ENTER> key is not pressed within about three (3) seconds, the unit will return to sampling mode.
3. Use the <Δ> (Up) and <∇> (Down) function keys to select the desired reference.
4. Press the <ENTER> function key.
5. Use the <Δ> (Up) and <∇> (Down) function keys to select the desired internal reference factor. The default value is 100.
6. Press the <ENTER> function key.

The zero LED will begin to blink indicating that it is time to set the zero reference. Verify that the selector valve is set to clear.

7. Press <ENTER>.
8. The bar graph display will scan to indicate that the unit is sampling the zero reference value. Upon completion, the unit will return to the sampling mode.

4.6 UPSTREAM AEROSOL MEASUREMENTS (DOP OR PAO)



Note: Do not perform the steps in this section until completing section 4.1, Initialization.



Note: If there is a concern that the zero baselines may have drifted, the operator may re-zero the instrument at any time by positioning the selector valve to the clear position, pressing the <0> button, and pressing <ENTER>.



WARNING: The unit should be placed on a flat, stable surface with the area to be monitored within reach of the sample lines.

1. Insert the **UPSTREAM** sample line into the upstream aerosol / air mixture.



Note: The sample line should be as close to the upstream side of the filter as possible.

2. Turn the Selector Valve to the **UPSTREAM** position. This switches the sample airflow to the **UPSTREAM** sampling port on the front panel. The **% LEAKAGE** display indicates the upstream concentration as compared to the reference that was set in the initialization section. If 100 was used as a reference value the indicated % Leakage corresponds to a microgram per liter value.



Note: Adjust aerosol for desired challenge aerosol concentration.

4.7 MEASURING % LEAKAGE - USER DEFINED REFERENCE (USER)

1. Insert the **UPSTREAM** sample line into the upstream aerosol/air mixture.



Note: The sample line should be as close to the upstream side of the filter as possible.

2. Turn the Selector Valve to the **UPSTREAM** position. This switches the sample airflow to the **UPSTREAM** sampling port on the front panel. The **% LEAKAGE** display indicates the upstream reading.
3. Press the <100> button and press <ENTER>. The unit will begin scanning for a 100% reference value.

Note: If error E4 is given then 100% calibration failed. The most likely reason this would happen is if there is not enough aerosol present to take an accurate reading. Press <ENTER> to clear the error. The unit defaults back to the previous reference setting.



4. After the 100% reference value has been successfully captured, the <0> LED will blink, indicating that the 0% reference must be calibrated.
5. Switch the selector valve to **CLEAR** and press the <ENTER> button. The unit will scan for the 0% reference value.
6. After the unit has finished scanning for the 0% reference, switch the selector valve to <DOWNSTREAM>. The % **LEAKAGE** display indicates the concentration as compared to the upstream value.

4.8 TESTING WITH THE 2H

After the 100% and 0% baselines have been established, the unit is ready for testing operations. During testing operations, readings may be taken from either the Front Panel Display or the Scanning Probe, lessening operator distraction.

Testing is performed as follows:

1. Turn the selector valve to **DOWNSTREAM** to permit sampling through the Scanning Probe.
2. Pass the end of the probe over the filter being tested at the rate required by the standard or recommended practice being employed.
3. Read and record the data as it is displayed on either the pistol grip of the probe or the Front Panel Display. Once the 100% baseline has been properly defined, the display readings are given directly in % leakage.

Note: Most current standards and recommended practices require leaks of greater than 0.01% to be identified and repaired.

4.9 VERIFYING THE UPSREAM CONCENTRATION DURING TEST

Turn the Selector Valve to the **UPSTREAM** position. The % **LEAKAGE** display shows the concentration of the upstream challenge aerosol in percent of upstream calibration.

The photometer is comparing the real-time concentration of the upstream challenge to the concentration of this same source when it was initially used to establish the 100% baseline. In other words, it is comparing the current concentration level to the starting level.

If the reading seems reasonable, normal testing may be resumed by turning the Selector Valve back to the **DOWNSTREAM** position.



Model 2H

If the concentration of the challenge aerosol has changed significantly, the upstream source should be examined for the cause. Once the situation has been corrected, the upstream challenge aerosol should be restarted, stabilized, and then used to re-establish the 100% baseline as described previously.

5 MAINTENANCE

Scheduled Maintenance

5.1 WEEKLY

- Clean the scanning probe screens. These are located on the black and red circular scanning probe nozzles.
- Clean the gross particulate screen located at the base of the flexible scanning probe extension.
- Remove any loose debris from the Scanning Probe and front panel sampling ports.

5.2 ANNUALLY

- Return the 2H to a factory authorized facility for calibration and cleaning. Please contact the ATI Customer Service Department at 410-363-9696 for a return authorization number. A service date will be scheduled for your instrument at that time.

A Return Authorization can also be obtained using ATI's website or by sending an e-mail requesting service information to info@atitest.com. A customer service representative will process your information and contact you with a Return Authorization, necessary instructions and information within 48 hours.

5.3 GENERAL MAINTENANCE PROCEDURES

The 2H Aerosol Photometer is a sturdy, solid-state electronic instrument designed to hold up under extended field use. The only moving parts are the vacuum pump, the Selector Valve and the ventilating fan at the rear of the chassis. Field level maintenance is limited to replacement of the HEPA exhaust filter and the fuse. Procedures for these operations are contained in this section.



NOTE: The internal electronics are not user serviceable. Any electronic problems must be analyzed and repaired at an authorized service center.

At present, there is no error message or indication on the front panel that the scattering chamber light source is not working. If the scattering chamber light source has burned out, the operator will witness a lack of response on the unit's % **LEAKAGE** display.

5.4 RECOMMENDED SPARE PARTS

Spare components are not supplied with the 2H or the 2H-N nuclear unit and must be ordered separately. See section A-4 for a list of recommended spare parts that may be purchased in kit form or individually. These lists include only parts replaceable by the user in the field. Other repairs requiring instrument or component recalibration must be performed at an ATI service center.



5.5 CLEANING THE TDA-2SP SCANNING PROBE SCREENS

The TDA-2SP Scanning Probe is a rugged, low maintenance device. The probe contains a coarse wire screen near the base of the flexible neck to prevent fibers and large particles from being drawn into the photometer. In addition, there are screens in each of the two round nozzles that thread onto the flexible neck. The blue rectangular nozzle contains no screen.

If the screens accumulate a significant amount of debris and become partially clogged, it can interfere with the airflow and affect the accuracy of the photometer and may put an unnecessary strain on the vacuum pump.

It is recommended that all screens be wiped clean with a lint-free cloth before use each day.

If the screens are punctured, replace them immediately. Spare nozzles and replacement scanning probe components can be ordered from ATI (see Section A-4).

To access the screen in the flexible neck, unscrew the flexible extension from the probe body. A small tool may be necessary to reach into the neck to remove and wipe the surface of the screen.

5.6 REPLACING THE MAIN POWER FUSES

Position the 2H with the rear panel readily accessible. Locate the fuse block at the center of the power entry connector. Press the top and bottom tabs toward the center and pull the fuse block straight out from the power entry connector. The two (2) fuses will be exposed for inspection and/or replacement. Replace the fuse block by gently inserting it back into the power entry connector until the tabs snap back into their original location.

5.7 REPLACING THE HEPA EXHAUST FILTER

Position the 2H with the rear panel readily accessible. Rotate the HEPA exhaust filter in a counter-clockwise direction until the threads are free of the rear panel bushing. Install the new replacement filter in the same orientation as the filter that was replaced. Care should be taken to avoid cross-threading the filter housing. When installed correctly a cylindrical well should be visible through the filter port. This design directs exhausted airflow to the outside of the filter media core, providing greater surface area and prolonging service life.



Model 2H

A-1. SPECIFICATIONS

Dimensions (L x W x H)

13.5 in x 9.5 in x 5.0 in

34.3 cm x 24.0 cm x 12.7 cm

Weight

2H	Aerosol Photometer (standard use)	15.5 lbs (7.0 kg)
2H-N	Aerosol Photometer (nuclear use)	15.5 lbs (7.0 kg)
TDA-2SP	Scanning Probe	2.5 lbs (1.1 kg)

Input Power

90 to 250 volts AC, 50 or 60 Hz, 1.5 amps

Fuse

250 volts, 2.0 amps slow blow (5 x 20 mm)

Dynamic Range

0.00005 to 120 micrograms per liter

Accuracy

1% of full-scale for the amplifier decade range in use

Repeatability

0.5% full-scale for the amplifier decade range in use

Sampling Rate

1 CFM (28.3 LPM)

Data Output

RS-232: Port settings: 2400, 8, N, 1 (Continuous output)

RS-232 Cable Requirement

A straight-through DB-9 serial cable is required. ATI part number T2G0-1120 or equivalent.



A-2. TROUBLESHOOTING

CONTROLLER Error Messages

ERROR CODES – SYSTEM PROBLEMS

Problems	Cause	Corrective Action
E1 – Calibration flags not set	The unit has not been calibrated or the unit has lost memory.	Return the unit to ATI or Authorized service center for repair and service as soon as possible.
E2 – LSC voltage not stable	Concentration readings are not stable enough to perform a reliable 100% or 0%.	<ol style="list-style-type: none">1. Ensure that the selector valve is in the correct position and try again.2. Check the aerosol source.
E3 – Optics Dirty	Sufficient aerosol condensation and/or particulates have built up on the internal optics such that a cleaning is highly recommended.	<ol style="list-style-type: none">1. Return the unit to ATI for repair and service as soon as possible.
E4 – 100% calibration failed	There is insufficient aerosol for the unit to capture a reliable 100% value for the USER reference.	<ol style="list-style-type: none">1. Check the aerosol source.2. Use a higher concentration as the 100% reference.



A-3. QUICK SETUP REFERENCE

SETUP

To enter setup, press <Δ> then <ENTER>

Press <Δ> or <∇> then <ENTER> to select function, then <Δ> or <∇> to change

- L0 Run
- L1 Audible Alarm (On/Off)
- L2 0 Sample Time (5 to 120 seconds)
- L3 100% Sample Time (5 to 120 seconds)
- L4 Decimal Places (3 or 4)
- L5 Internal Reference (Current Selection Displayed)
- L6 Hour Meter
- L7 Factory Defaults
- L8 Software Revision
- L9 Bar graph (On/Off)
- L10 Display Intensity
- L11 Zero Purge Time (0 to 120 seconds)
- L12 100% Purge Time (0 to 120 seconds)

AUDIBLE ALARM (ON) or (OFF)

- <ALARM> Displays Status (On or Off), <Δ> or <∇> to change, <ENTER> to exit,
- <ALARM> Pressed a second time before <ENTER>, displays Set Point, (0.010 by default) <Δ> or <∇> to change.
- <ENTER> Accept Alarm Set Point. Displays On/Off status again, <Δ> or <∇> to change.
- <ENTER> Accept status and return to **RUN** mode. Alarm LED will remain lit.
*Note: Use L1 to turn the audible portion of the alarm On or Off.

INTERNAL REFERENCE

Set Selector Valve to **CLEAR**

- <REF> (Blinks)
- <ENTER> Calibration reagent (**PAO** or **DOP**), also ***USER** or ***HIGH**
Use <Δ> or <∇> to change
- <ENTER> Displays µg/l of concentration to be displayed as 100 when sampled.
Use <Δ> or <∇> to change
- <ENTER> (O Blinks)

Ready for Testing



Model 2H

***USER** is a stored sampled concentration saved by the user, to be displayed as 100%.

This value is stored in memory until a new value is sampled and saved by the user.

To set: After completing the setting **100%** procedure below, Press the **REF** button and “**USER**” will be displayed. Press **<ENTER>**, **0** will blink; turn the Selector Valve to **CLEAR**, and press **<ENTER>**.

***HIGH** allows sampling of concentrations above 130µg/L, exceeding 200µg/L. This setting should only be used for sampling quickly and sparingly, as such concentrations will adversely affect the cleanliness of the optics.

SETTING 100%

Connect Upstream Sample Line & set Selector Valve set to **UPSTREAM**

<100> **<100>** key LED flashes

<ENTER> Bar graph scans .The unit averages 100% for a time defined by the L3 setting. When the **<0>** LED flashes turn the **Selector Valve** to **Clear**.

<ENTER> Sets 0%.

***Note:** This setting can be saved by pressing **REF**, **<ENTER>**, and resetting **0**).

(See ***USER** above)

Ready for Testing

OPTICS and FLOW LEDS

OPTICS LED: Green - Optics clean. Less than 10,000mg** of aerosol has moved through the scattering chamber.

Orange - More than 10,000mg, but less than 17,000mg**, of aerosol has moved through the scattering chamber.

Red- More than 17,000mg** of aerosol has moved through the scattering chamber. It is strongly recommended that the unit be serviced.

***Note:** The unit can continue to be operated by using the **SETTING 100%** procedure above.

**** Note:** These values are approximate and may vary depending on the flow and/or the aerosol being used.

FLOW LED: Green- Flow within 5% of 1 CFM.

Orange- Flow within 5% to 10% of 1 CFM

Red- Flow is more than 10% above or below 1 CFM



A-4. ACCESSORY LIST

Item	Part Number	Description
1	9300142	2H Spare parts kit (see list below for components)
2	9300143	2H-N Spare parts kit (see list below for components)
3	9300145	Shipping case
4	9300144	Scanning probe assembly, complete with 3 nozzles
5	T2SP-1095	Scanning probe extension, 12 ft.
6	T2E0-0005	NSF 49:1992 Scanning probe nozzle
7	T2E0-0572	1" Isokinetic, round (red)
8	T2E0-0798	NSF 49:2002 Isokinetic, rectangular (blue)
9	6700001	Replacement line cord, 120V
10	5200116	1/4" ID PVC sample tubing (specify length)
11	T2G0-1120	Straight-through serial cable, 6 ft.
12	0600287	Screen holder assembly
13	6400001	Fuse, 2 amp, 5 x 20 mm

2H Spare parts kit (Recommended 1 year consumable parts) 9300142	
Component	Quantity
ULPA filter (internal reference air filter), 5500001	(1)
Pump exhaust filter (internally mounted filter) 5500002	(2)
Filter, HEPA, 36mm (internal and rear exhaust filter) 5500123	(2)
<i>Replacement probe screen</i>	
5/16" diameter, T2SP-0883	(1)
1-7/16" diameter, T2SP-0884	(1)



Model 2H

31/32" diameter, T2SP-0885	(1)
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2H-N Spare part kit, 9300143	
ULPA Filter, 5500001	(2)
Selector valve, T2G0-0931	(2)
Sealed cone w/ fittings, T2GN-0949	(2)
Brass fittings, T2G0-0907	(4)
Brass fittings, 5100006	(8)
Poly-flo tubing, 5200102	(25 ft)
PVC tubing, clear, 5200116	(5 ft)

For use with 2H-SP only

Scanning Probe flex-probe segments	
Segment, 5100001	(3)
Female threaded end segment, 5100004	(1)
Male threaded end segment, 5100002	(1)
Male close nipple, 5100101	(1)



Model 2H

A-5. WARRANTY

International Warranty
Air Techniques International

Air Techniques International, hereinafter referred to as ATI, warrants the equipment purchased hereunder to be free from defect in materials and workmanship under normal use and service, when used for the purpose for which it is designed, for a period of (1) one year from the date of shipment. ATI further warrants that the equipment will perform in accordance with the technical specifications accompanying the formal equipment offer.

ATI will repair or replace any such defective items that may fail within the stated warranty period, PROVIDED:

1. That any claim of defect under this warranty is made within thirty (30) days after discovery thereof and that inspection by ATI, if required, indicates the validity of such claim to ATI's satisfaction; and
2. That the defect is not the result of damage incurred in shipment to or from our factory; and
3. That the equipment has not been altered in any way whether as to design or use, whether by replacement parts not supplied or approved by ATI, or otherwise; and
4. That any equipment or accessories furnished but not manufactured by ATI, or not of ATI design, shall be subject only to such adjustments as ATI may obtain from the supplier thereof.

ATI's obligation under this warranty is limited to the repair or replacement of defective parts with the exception noted above. If the equipment includes a scattering chamber, ATI's warranty does not extend to contamination of the scattering chamber by foreign material.

At ATI's option, any defective equipment that fails within the warranty period shall be returned to ATI's factory for inspection, properly packed with shipping charges prepaid. No equipment shall be returned to ATI without prior issuance of a return authorization by ATI.

No warranties, express or implied, other than those specifically set forth herein shall be applicable to any equipment manufactured or furnished by ATI and the foregoing warranty shall constitute the Buyer's sole right and remedy. In no event does ATI assume any liability for consequential damages, or for loss, damage or expense directly or indirectly arising from the use of ATI products, or any inability to use them either separately or in combination with other equipment or materials or from any other cause.

AIR TECHNIQUES INTERNATIONAL

Division of Hamilton Associates, Inc
Owings Mills, MD U.S.A.

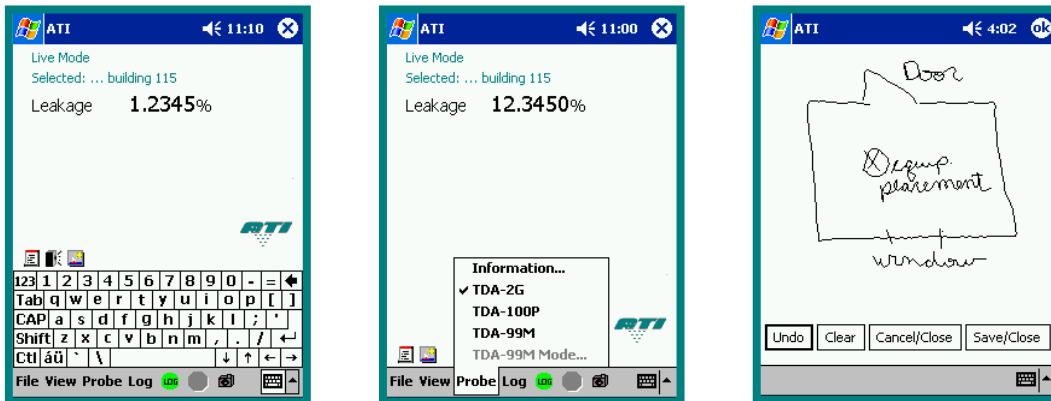


Model _____ Serial Number _____ Date Purchased _____

Purchaser _____

A-6. RS-232 COMMUNICATION

The 2H serial output is formatted as a continuous string of ASCII numeric characters. The recommended method for capturing this data is to use the DAS1 or DAS2 data acquisition system from ATI. Shown below are screenshots from the DAS1 on a pocket PC. Contact ATI customer service for details and other information.



Alternatively, this data can be captured with a generic terminal. The required port protocol is: 2400, N, 8, 1.

A-7. AEROSOL CORRECTION FACTORS

DOP Substitute liquid	Generator Pressure Factors	DOP Internal Reference Setting
DOP (DEHP)	1.00	100
PAO (Emery 3004)	1.15	73
DOS (DEHS)	1.22	96
Mineral Oil	1.10	90
Ondina Oil (Ondina EL)	1.34	79
Kaydol	1.18	92
Polyethylene Glycol (PEG400)	1.33	111
Paraffin Oil	1.21	89
Corn Oil	1.17	88

The above values are for use when substitute liquids are used in-place of the liquid specified for the Factory equipment calibration and setup.

The generator pressure factors are used as multipliers for the applied pressure to a Type III-A Laskin nozzle generator.

Example:

- DOP-20 psi applied with dilution airflow of 135 cfm yields 100 µg/l.
- PAO-23 psi (20 psi x 1.15 correction factor) applied with dilution airflow of 135 cfm yields 100 µg/l.

The above DOP settings are required for a 100% reading of 100 µg/l of the DOP substitute liquid.

Example:

- DOP with DOP selected - 100 required for 100% response to 100 µg/l.
- DOS with DOP selected - 96 required for a 100% response to 100 µg/l of DOS.



Note: The above correction factors apply only to air operated generators. If a thermal type generator, TDA-5A or TDA-5B, is being used the upstream concentration must be sampled to obtain a 100% setting.



A-8. DECLARATION OF CE CONFORMITY

We: **AIR TECHNIQUES INTERNATIONAL**
11403 Cronridge Drive
Owings Mills
Maryland 21117-2247
USA
Tel: (410) 363-9696
Fax: (410) 363-9695
Website: <http://www.atitest.com>

declare under our sole responsibility that the product,

2H Digital Aerosol Photometer

is in conformity with the following directives:

Application of Council Directive(s):	Standard(s) to which Conformity is Declared:
Electromagnetic Compatibility Directive (89/336/EEC)	EN 61326-1:1998
Low Voltage Directive (73/23/EEC)	EN 61010-1:2001

Design documentation is maintained at:

Air Techniques International
11403 Cronridge Drive
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Eric Hanson
President
Air Techniques International

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Maryland 21117-2247



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