Aerosol Fit Test Photometer
Model 2HF

Instruction Manual

P/N 1800118, Revision A
July 2005

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Guidelines to use 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.

Chapter 1

Aerosol Photometer Overview

Instrument Description

The 2HF is a forward light-scattering, linear photometer. It operates on 90 to 240 volts, 50 or 60 Hz, adjusting automatically. The basic function of the 2HF is to sample respirable atmosphere and report the concentration of particulates in the sample.

The 2HF is compact and lightweight. 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 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.

Figure 1

Aerosol Fit Test Photometer, 2HF

Fit Testing Overview[1]

Definitions

Respirators are devices worn by workers to protect against the inhalation of a potentially hazardous atmosphere. Respirators are categorized into two principal types, air-purifying and air-supplied. Air-Purifying Respirators, APR, remove contaminants from the ambient air. Supplied Air Respirators, SAR, provide air from a source other than the surrounding atmosphere. These two types can be further sub-classified by the manner in which they operate. For example, air-purifying respirators can be non-powered or powered. With non-powered air-purifying respirators, the user draws the air through particulate or gas/vapor filters by inhalation only, unassisted by a blower. Powered air-purifying respirators use a blower to draw air through a particulate or gas/vapor filter. Air-supplied respirators are classified according to the method by which air is supplied and the way in which the air supply is regulated. These methods include self-contained breathing apparatus (SCBA), airline respirators, and combination airline and self-contained respirators.

Regulatory background

The Occupational Safety and Health Administration's (OSHA) Standard 29 CFR 1910.134 - Respiratory Protection requires employers to provide respirators when they are necessary to protect the health of the employee. Furthermore, the standard requires that employers develop and implement a written respiratory protection program when respirators are required. Under this standard, employers may also allow employees to voluntarily wear respirators in circumstances that do not require respiratory protection.

Fit Testing – 29 CFR 1910.134(f)

Fit testing is required for all employees using negative or positive pressure tight-fitting respirators, where such respirators are required by OSHA or where the employer requires the use of such a respirator. A fit test is not required for voluntary users or for escape-only respirators.

The fit test must be performed before the respirator is used in the workplace. It must be repeated at least annually and whenever a different respirator face piece is used or a change in the employee's physical condition could affect respirator fit. If the respirator subsequently becomes unacceptable (i.e., causes irritation or pain) to the employee, the employee must be given the opportunity to select a different respirator face piece and be retested.

Qualitative Fit-Testing (QLFT) may be used to fit test negative pressure air-purifying respirators, if they will only be used in atmospheres less than ten times the Permissible Exposure Limits (PEL). For greater concentrations, Quantitative Fit-Testing (QNFT) must be used. When quantitative fit-testing is used, all full-face piece respirators must meet or exceed a fit factor of 500, while quarter - and half-mask respirators must meet or exceed 100. For all positive pressure, atmosphere-supplying respirators, either qualitative or quantitative fit testing may be used. While atmosphere-supplying respirators are fit-tested in the negative pressure mode, these respirators are most often used as positive pressure respirators in the workplace. Positive pressure atmosphere-supplying respirators that pass the QLFT or QNFT fit test may be used at the higher protection factors assigned these respirators. See Table 1 for a summary.

[1] Source OSHA website available at http://www.osha.gov/SLTC/respiratoryprotection/index.html

Table 1

Acceptable Fit Testing Methods

	QLFT	QNFT
Half-Face, Negative Pressure, APR (<100 fit factor)	Yes	Yes
Full-Face, Negative Pressure, APR (<100 fit factor) used in atmospheres up to 10 times the PEL	Yes	Yes
Full-Face, Negative Pressure, APR (>100 fit factor)	No	Yes
Powered Air-Purifying Respirator (PAPR)	Yes	Yes
Supplied-Air Respirators (SAR), or SCBA used in Negative Pressure (Demand Mode [>100 fit factor])	No	Yes
SAR, or SCBA used in Positive Pressure (Pressure Demand Mode)	Yes	Yes
SCBA - Structural Fire Fighting, Positive Pressure	Yes	Yes
SCBA/SAR - IDLH, Positive Pressure	Yes	Yes
Mouthbit Respirators	Fit-Testing Not Required	
Loose-Fitting Respirators (e.g., hoods, helmets)		

Calculation of the overall fit factor

The calculation of the overall fit factor using individual exercise fit factors involves first converting the exercise fit factors to penetration values, determining the average, and then converting that result back to a fit factor. This procedure is described in the following equation:

$$O_{FF} = \frac{N}{\frac{1}{FF_1} + \frac{1}{FF_2} + \frac{1}{FF_3} + \ldots + \frac{1}{FF_N}}$$

Where:

O_{FF} = Overall Fit Factor;
N = The number of exercises;
FF_1 = The Fit Factor for the first exercise;
FF_2 = The Fit Factor for the second exercise;
FF_3 = The Fit Factor for the third exercise and
FF_N = The Fit Factor for the nth exercise.

Where to find additional information

OSHA's revised Respiratory Protection Standard went into effect April 8, 1998. The final standard replaces the respiratory protection standards adopted by OSHA in 1971 (1910.134 and 1926.103). The 1910.139 respirator standard that applied only to respiratory protection against Mycobacterium Tuberculosis was withdrawn December 31, 2003. Establishments whose respirator protection programs for tuberculosis formerly covered under 29 CFR 1910.139 were required to adapt their programs to comply with the requirements of 29 CFR 1910.134, effective July 2, 2004.

OSHA Standard

- 29 CFR 1910.134, Respiratory Protection Standard
- Appendix A, Fit-Test Procedures (Mandatory)
- Appendix B-1, User Seal Check Procedures (Mandatory)
- Appendix B-2, Respiratory Cleaning Procedures (Mandatory)
- Appendix C, OSHA Respirator Medical Evaluation Questionnaire (Mandatory)
- Appendix D, Information for Employees Using Respirators When Not Required Under Standard (Mandatory)

OSHA Directive

- CPL 2-0.120, Inspection Procedures for the Respiratory Protection Standard

NIOSH

- NIOSH: Guide to the Selection and Use of Particulate Respirators Certified Under 42 CFR 84.

Web Links

- OSHA's Home Page
  http://www.osha.gov

- NIOSH Home Page
  http://www.cdc.gov/niosh

- NIOSH Directory of State OSHA Programs
  http://www.cdc.gov/niosh/statosh.html

How the Photometer Operates

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 then amplified and displayed on the front panel.

A photometer is ideally suited to detect particulate matter in air or gas, reporting the mass concentrations encountered on a display. Particles from less than 0.1 micron to approximately 600 microns can be detected by the 2HF. Since the photometer reports concentration of particulate matter (relatively independent of size, shape, or color), many applications are possible.

Sampling System

A vacuum pump provides a sample flow rate of 1 to 5 Lpm 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 outside the respirator being challenged, and the DOWNSTREAM position permits sampling of the air that penetrates the respirator under test.

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.

Amplifier

The signal from the photomultiplier tube in the scattering chamber is delivered to an FET operational amplifier capable of a gain increase of 2,500,000. The amplifier augments the phototube signal in a linear fashion and delivers the signal to an analog-to-digital converter that is then sent to the microprocessor.

Chapter 2

Unpacking and Setting Up the Aerosol Fit Test Photometer

Unpacking

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

The Aerosol Fit Test Photometer 2HF consists of a photometer and accessories, including the following:

Table 2

Packing List for the Aerosol Fit Test Photometer Model 2HF

Qty.	Item	Part Number
1	2HF Unit	0200311
1	Power Cord	6700001
1	Serial Cable	T2G0-1120
1	Fit Test Interface Assembly	0600347
1	Operating Manual	1800118
1	Shipping Case	9300132
1	Calibration Certificate	N/A

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

After unpacking, if anything is missing or appears to be damaged, contact ATI Customer Service at (410) 363-9696.

Note

ATI recommends that you save all packing materials for future use, such as shipping the unit back for annual calibration.

Installation

Before you begin

You will need the following items to set up the Aerosol Fit Test Photometer Model 2HF

- ☐ An electrical outlet (110 VAC or 230 VAC).
- ☐ Fit Test Interface Assembly (provided)
- ☐ Operating Range: 35 to 105 degrees Fahrenheit
- ☐ An environment with less than 75% relative humidity.

Note

High ambient temperatures may create instability in the readings

Connecting Electrical Power

Voltage and current requirements for the Aerosol Fit Test Photometer Model 2HF are:

- ☐ 100 to 120 VAC, 5 amps, or
- ☐ 230 to 240 VAC, 2.5 amps

The Aerosol Fit Test Photometer automatically adjusts to operate at the correct AC voltage for the destination country (given this voltage is within the specifications described in Appendix A). This voltage is noted on a label attached to the back panel of the instrument. The power cord contains a plug which is specifically adapted to the destination country.

You are responsible for plugging the power cord into a matching receptacle. To connect the Fit Tester to electrical power, do the following:

1. Check to make sure the Aerosol Photometer is turned off. (Refer to figure 4 for the location of the power switch.)
2. Plug the power cord into a matching power outlet.

Warning

Before connecting the power cord to the power outlet, make sure the cord has not been cut or otherwise damaged during shipment.

Caution

To prevent damage to the Aerosol Fit Test Photometer, make sure the voltage listed on the back panel matches the power outlet where you plug it in.

Connecting the Sampling Line

The Aerosol Fit Test Photometer comes standard with a Fit Test Interface Assembly.

Before you operate the unit, connect the appropriate sampling device to the unit according to the following instructions:

Connect the sampling line (Transparent blue tubing terminated by a male Quick Coupling fitting) to the “SAMPLE” port.

Connect the aerosol reference sampling line (Clear tubing terminated by a female Quick Coupling fitting) to the “100 PCT” port.

Caution
When using Quick Coupling, make sure the latch is fully engaged before inserting the matching coupling.

Chapter 3

Description of the Aerosol Fit Test Photometer Controls and Indicators

Front Panel Connectors and Indicators

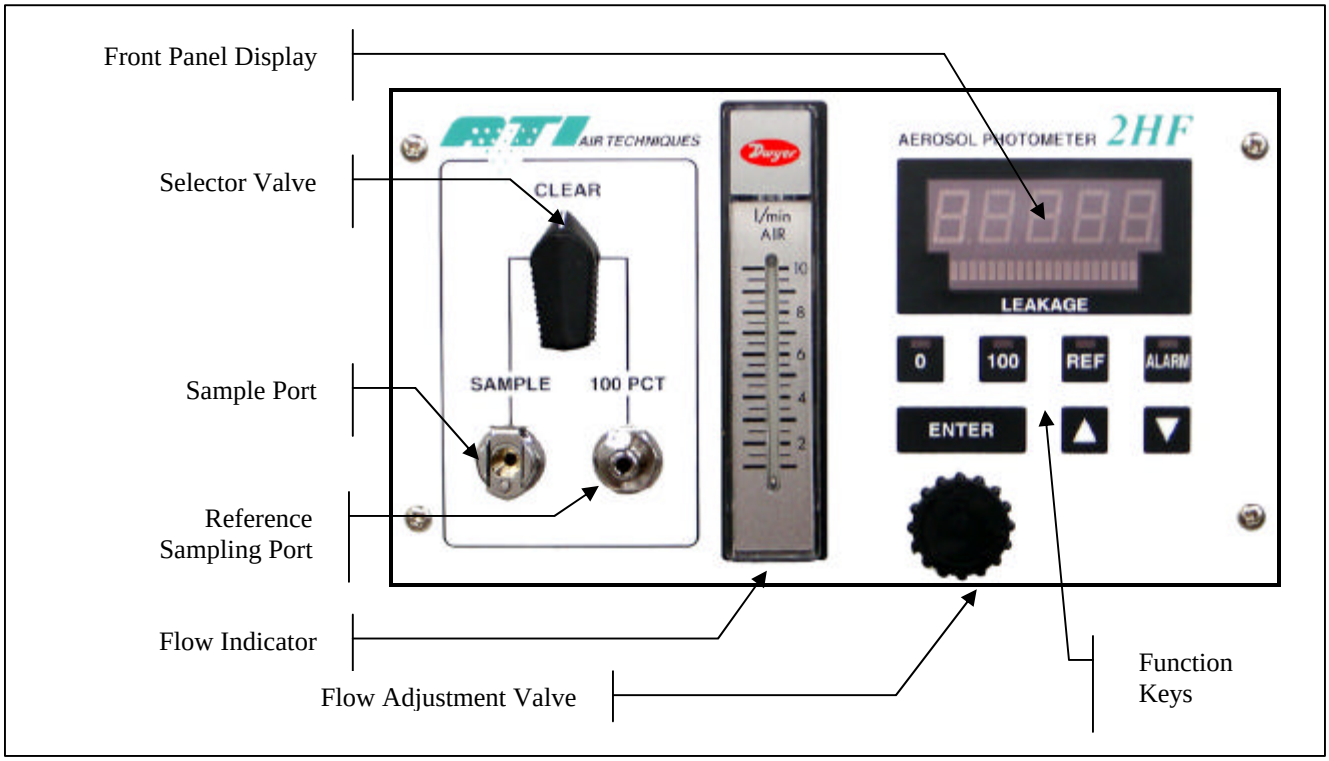

Figure 2

Front Panel - Aerosol Fit Test Photometer, 2HF

1.	**Front Panel Display**	Indicates % leakage readings and error messages.
2.	**Selector Valve**	Selects the sample source.
3.	**Sample Port**	Connects to the sample tubing that is used to measure the chamber aerosol concentration.
4.	**Reference Sample Port**	Connects to the respirator sample tubing.
5.	**Flow Meter:**	Displays the flow drawn through the scattering chamber in liters per minute.
6.	**Function Keys**	Used for setting operating parameters and initiating program routines
7.	**Flow Adjustment Knob**	Adjusts the flow rate of sample being drawn in the unit.

Front Panel Keypad and Flow Adjust

Figure 3

Keypad and Sample Flow adjust -

Aerosol Fit Test Photometer, 2HF

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 <D> and <Ñ> keys are used to scroll between 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 <D>, <Ñ>, and **<ENTER>** keys contain no indicator LED.

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

The knob allows control over the flow being sampled by the unit.

Rear Panel Connectors

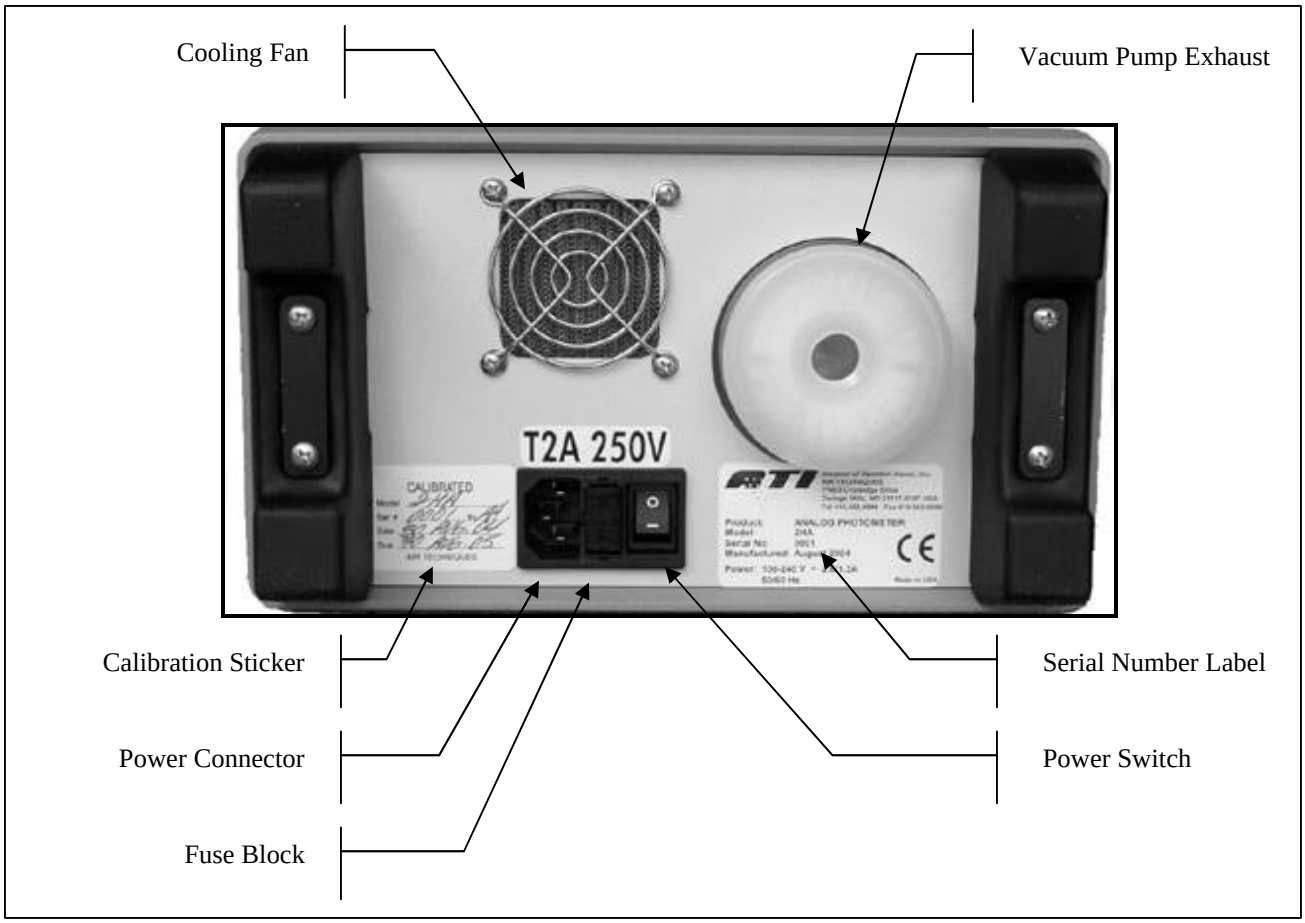

Figure 4

Rear Panel - Aerosol Fit Test Photometer, 2HF

1. **Cooling Fan:** Maintains airflow through the unit's enclosure to stabilize electronics.
2. **Calibration Sticker:** Displays the current calibration date and the due date for the next calibration
3. **Power Connector:** Connects to the Power Cord.
4. **Fuse Block:** Contains 2-amp fuse and spare fuse.
5. **Vacuum Pump Exhaust:** Allows a filter to be installed to eliminate particulate emissions.
6. **Serial Number Label:** Lists the model, serial number and utility requirements.
7. **Power Switch:** Turns the system power on and off.

Data Output

The Aerosol Fit Test Photometer 2HF features an RS-232 connector located on the side of the unit in the form of a 9-pin female D-subminiature connector.

The RS-232 Port provides a serial output to a computer that can be read and stored using any standard communications package such as Windows Hyper-terminal. Information is sent out the RS-232 Port each time the Front Panel Display is refreshed, approximately once per second.

See Appendix C for more details on the Serial Port data output and communications parameters.

Chapter 4

Operating Instructions for the Aerosol Fit Test Photometer

Initialization

Apply power to the 2HF by setting the rocker switch to the 1 position (On). Verify that the display is fully lit displaying **[**88888**]** ("Bar Graph" scans for 20 seconds) with a fully illuminated bar graph beneath. (This display must occur before the 2HF is ready to use.) Verify that the selector valve knob is turned to the CLEAR position.

Setting Parameters

The 2HF has eleven operating parameters, nine 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 accessible for programming only at the factory. The eleven parameters, and their default settings, are listed in this addendum.

Table 3

2HF Programmable parameters and associated functions

Parameter	**Function**
L0	Run
L1	Audible alarm On/Off
L2	Display refresh rate (Not time based)
L3	100% Sample duration time
L4	Fit testing load time
L5	Aerosol reference selection (P1=DOP / P2=PAO Oil)
L6	Hour meter (Total operating time)
L7	Load factory defaults
L8	Fit factor calculation option
L9	Enable/disable bar graph display
L10	Display intensity adjustment
L11	Quantity of exercises and duration

To enter the parameters setting menu proceed as follows:

1. Press **<ENTER>** function key.
2. Press <D> function key (Up arrow). The first parameter L0 will be displayed on the "% LEAKAGE" indicator.

3. The <D> (Up) and <Ñ> (Down) function keys are used to scroll through the parameters from L0 to L11.
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 <D> (Up) and <Ñ> (Down) function keys.
6. When the desired setting is displayed, press the **<ENTER>** function key to store the setting.
7. Following the selection of the parameter setting, the display will return to the main parameter menu, ready to select either another parameter or L0 to return to running mode.

L0 – Enter/Exit

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 (1) On

Default:
Off

Enables or disables the audible portion of the 2HF 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.

A **[–]** appearing in the % Leakage display indicates that this parameter is currently disabled. A **[1]** indicates an active parameter.

Press the <D> (Up) and <Ñ> (Down) function keys to change the displayed setting between 0 (disabled) and 1 (enabled).

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

L2 – Display Refresh Rate

Options:
1-20

Default:
7

Establishes the relative frequency at which the display is refreshed (updated). This frequency is relative to the cycling of the system microprocessor and is not time dependent.

Note
The system is continuously sampling, but for the operator's convenience, only the highest "% Leakage" is displayed at each refresh cycle.

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

Press the <D> (Up) and <Ñ> (Down) function keys to move the displayed setting between 1 and 20 on the display (1=fastest, 20=slowest).

Press **<ENTER>** to set the selection and return to the parameter select menu (**[L2]** will be displayed).

L3 – Sample Duration Time for 100% Level

Options:
5-120

Default:
10

Establishes the period over which the 100% aerosol sample is averaged. This frequency is relative to the cycling of the system microprocessor and is not time dependent.

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

Press the <D> (Up) and <Ñ> Down) function keys to move the displayed setting between 1 and 20 on the display (5=shortest, 120=longest).

Press **<ENTER>** to set the selection and return to the parameter select menu (**[L3]** will be displayed).

L4 – Load Time

Options:
5-360

Default:
5

Establishes the length of loading time before the unit begins sampling. This frequency is relative to the cycling of the system microprocessor and is not time dependent.

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

Press the <D> (Up) and <Ñ> (Down) function keys to move the displayed setting between 5 and 360 on the display (5=shortest, 360=longest).

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

L5 – Internal Reference Base

Options:
P1 – DOP P2 – PAO Oil P3 – Factor of P1 (See Section A-6)

Default:
P1

Establishes the internal reference base response based upon a gain setting stored during factory calibration. Selecting P1 with a reference setting of 100 will give a % Leakage reading of 100% when the unit samples 100 ug/l of aerosol concentration.

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

Press the <D> (Up) and <Ñ> (Down) function keys to move the displayed setting between P1, P2 or P3.

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

L6 – Hour Meter

Options:
None

Default:
None

Displays the total running time for the unit.

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

Press **<ENTER>** to set the selection and return to the parameter select menu (**[L6]** will be displayed).

L7 – Load Factory Defaults

Options:
(-) Not enabled – Indicating factory default loading has not been selected (1) 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 to access the stored setting.

Press the <D> (Up) and <Ñ> (Down) function keys to move the displayed setting between – and 1.

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

L8 – Fit Factor Calculation

Options:
0 - Uses 100% average from first & last concentration 1 - Uses 100% average from the beginning & end of each exercise

Default:
0 - Uses 100% average from first & last concentration

L8 is used to select the 100% concentration used for the fit factor calculation.

When **[L8]** is displayed in the parameter menu, press the **<ENTER>** function key to access the stored setting.

Press the <D> (Up) and <Ñ> (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 (**[L8]** will be displayed).

L9 – Bargraph Display

Options:
0 – Disabled 1 – Enabled

Default:
1 – Enabled

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

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

Press the <D> (Up) and <Ñ> (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:
5

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 <D> (Up) and <Ñ> (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 – Number of Test Exercises and Duration

L11 is used to select the total number of test exercises. Each test exercise is associated with a unique duration.

Number of test exercises:

Options:	
1 – 25	Number of exercises per test
(-)	Continuous sampling mode

Default:
17

Note
Continuous sampling uses only the initial 100% concentration to calculate the fit factor.

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

Press the <D> (Up) and <Ñ> (Down) function keys to move the displayed setting between 1 and 25 or (-) on the display.

Press **<ENTER>** to set the selection and return to the test exercise duration menu.

Exercise duration:

Options:
0.1 – 20 Minutes

Default:
1

Press the <D> (Up) and <Ñ> (Down) function keys to move the displayed setting between 0.1 and 20 on the display. The exercise number is displayed along with the duration that is selected.

Press **<ENTER>** to set the selection and return to set the duration for the remaining exercises.

After the last exercise duration is set the display will return to the parameter select menu (**[L11]** will be displayed).

The Flowmeter Feature

The Aerosol Fit Test Photometer Model 2HF comes standard with a Flowmeter indicator. This useful feature allows the user to ensure that the unit is operating at the desired flow rate.

Operation

In order to read the Flowmeter, place the unit on a horizontal surface and turn it on. You will then be able to read the value of the flow through the unit by proceeding as follows:

The standard technique for reading a Variable Area Flowmeter is to locate the highest point of greatest diameter on the float (middle of the ball), and then align that with the theoretical center of the scale graduation. In the event the float is not aligned with a graduation, an extrapolation of the float location must be made by the operator as to its location between the two closest grads.

Note
While in operation the unit can be tilted in any direction and its functionality will not be affected. However, In order to accurately read the Flowmeter, the unit must be on a horizontal surface.

Unit Setup

1. Depress the power rocker switch to the 1 (On) position.
2. At the beginning of a test cycle, **[**88888**]** is displayed.
3. Press the **<ENTER>** and then **<100>** key. The **<100>** LED will begin to flash, prompting the operator to set the selector valve to the upstream position.
4. After setting the selector valve to upstream, press **<ENTER>**. The unit will begin the process of adjusting for the 100% upstream concentration present.
5. At the end of the 100% process the **<100>** LED will remain on and the **<0>** LED will begin to flash prompting the operator to return the selector valve to the clear position.
6. After setting the selector valve to clear, press **<ENTER>**. The unit will begin the process of setting the zero base for testing.
7. When the zero setting is complete the exercise number will flash in the % Leakage display. At this time the operator should instruct the test subject to enter the aerosol chamber while at the same time setting the selector valve to the downstream position.
8. After the test subject is connected to the appropriate sample lines and the selector valve is in the downstream position, press **<ENTER>**.
    a. The unit will sample for the programmed load time, then a short audible tone will sound to indicate the start of the test exercise. If the fit factor calculation value selected during programming of L8 was "0", proceed to 8b. If "1" was selected for L8 skip to 8c.
    b. The next exercise number will flash in the % Leakage display. Press **<ENTER>** and repeat step 8a until the last exercise is complete. Go to step 9.
    c. The **<100>** LED will begin flashing to prompt the operator to obtain an intermediate 100% level for the fit factor calculation. Turn the selector valve to the upstream position and press **<ENTER>**. The unit will sample the aerosol challenge present. Repeat steps 7 & 8 until the last exercise is complete. Skip to step 10.
9. Go to step 4
10. Go to step 5
11. Go to step 6

Note

The fit factor displayed during each exercise is for reference only. This factor is based on the initial 100% concentration only. The actual fit factor is not calculated until the completion of all the selected test exercises.

Chapter 5

Maintaining and Servicing the Aerosol Photometer

Maintenance

Weekly

- Remove any loose debris from the Scanning Probe and front panel sampling ports.

Annually

- Return the 2HF 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.

Note

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.

General Maintenance Procedures

The 2HF Aerosol Fit Test 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 ULPA 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.

There is no indicator on the front panel showing 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 display.

Changing the ULPA filter

To change the ULPA filter, unscrew the filter from its housing on the back of the unit. Replace it by a new ULPA filter (ATI part # 5500123).

Changing the fuse

To change the fuses, open the fuse holder located on the power entry module. Replace any burned fuse by a new fuse (ATI part # 6400001).

Recommended Spare Parts

Spare components are not supplied with the 2HF and must be ordered separately. See section A-2 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.

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

Caution
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 Appendix B for the accessory list).

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.

Appendix A

Specifications

Specifications

The following specifications—which are subject to change—describe the most important data regarding the Aerosol Fit Test Photometer 2HF.

Table 4

Specifications of the Aerosol Fit Test Photometer Model 2HF

Dimensions (L x W x H)	
English (inches)	10.1 x 14.3 x 5.8
Metric (centimeters)	25.7 x 36.3 x 14.7
Weight	
2HF	15.5 lbs (7.0 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	Fit factors from 1.00×10^6 to 1.00
Accuracy	1% of full scale for the amplifier decade in use
Sampling rate	Variable from 2.0 L/min to 10 L/min
Flowmeter Accuracy	4% of full scale (± 2.12 L)
Data Output	RS-232 Port settings: 19200, 8, N, 1

Specifications are subject to change without notice.

Appendix B

Accessories and Spare Parts List

Part Number List

2HF Accessories List:

Part Number	Description
9300113	Fit Test Shroud Kit (Include Fiberglass Rods, Shroud and Y-Hose Aerosol Extender).

Spare Parts

2HF Spare parts (Recommended 1 year consumable parts):

Qty.	Item	Part Number
1	Filter, HEPA, 36mm (rear exhaust filter)	5500123
2	Slow Blow 2A fuse (5x20mm)	6400001

2HF Spare parts:

Qty.	Item	Part Number
1	Replacement Line Cord, 120V (USA)	6700001
1	Replacement Line Cord, 220V (Europe)	T2E0-0063

Appendix C

Communication Serial Port

Settings

The 2HF serial port settings are described in the following table.

Table 5
Serial Port Settings for communication with the 2HF

Bits per second	19200
Data bits	8
Parity	None
Stop bits	1
Flow Control	None

Data Output

The 2HF serial output is formatted as a string of ASCII numeric characters as demonstrated below (in bold font) for a six exercises Fit Test:

The 2HF RS-232 output format using “First/Last” 100% aerosol method with the L8 parameter (Fit Factor Calculation) set at “0”.

The initial “100%” set from the unit internal reference feature does not print to the RS-232 port.

Additional text lines output (including software revision) are not shown on this page to minimize the amount of text. The text in bold is explanatory in nature and not part of actual print statements. The sample data is based on 6 exercises at 30 seconds each (Approximately 1.2 samples per second).

```
|,0,  0.001358 ,00:01:41:95
|,0,  0.001314 ,00:01:42:39          ;25 lines initial zero set from unit internal
                                     reference feature

|,100,  5.433458 ,00:08:30:40
|,100,  5.439079 ,00:08:30:83        ;25 lines initial 100% set using aerosol sample

|,0,  0.002569 ,00:09:22:28
|,0,  0.002537 ,00:09:22:71          ;25 lines initial zero setting from unit using
                                     aerosol sample

|,DATA,  0.005237 ,00:09:47:84
|,DATA,  0.005848 ,00:09:48:27       ;35 lines from “Test 1” followed by

End ofexercise 1.00000000:09:49:15   ; formatting of line is exactly as transmitted

|,DATA,  0.005474 ,00:10:10:99
|,DATA,  0.005907 ,00:10:11:43       ;35 lines from “Test 2” followed by
```

```
End ofexercise 2.00000000:10:12:30

|,DATA,  0.007148 ,00:10:33:51
|,DATA,  0.007018 ,00:10:33:94       ;35 lines from "Test 3" followed by

End ofexercise 3.00000000:10:34:81

|,DATA,  0.013514 ,00:10:55:97
|,DATA,  0.013441 ,00:10:56:40       ;35 lines from "Test 4" followed by

End ofexercise 4.00000000:10:57:28

|,DATA,  0.007951 ,00:11:19:31
|,DATA,  0.008862 ,00:11:19:74       ;35 lines from "Test 5" followed by

End ofexercise 5.00000000:11:20:62

|,DATA,  0.005736 ,00:11:42:23
|,DATA,  0.006468 ,00:11:42:67       ;35 lines from "Test 6" followed by

End ofexercise 6.00000000:11:43:54

|,100,  4.826561 ,00:12:04:36
|,100,  4.836323 ,00:12:04:79        ;25 lines initial 100% set using aerosol sample

|,0,  0.002527 ,00:12:25:59
|,0,  0.002699 ,00:12:26:03          ;25 lines final zero setting from unit using
                                     aerosol sample
```

Exercise 1 Fit Factor	Exercise 2 Fit Factor	Exercise 3 Fit Factor	Exercise 4 Fit Factor	Exercise 5 Fit Factor	Exercise 6 Fit Factor	Total Fit Factor
1852	1573	1398	395	724	1359	918

Virtual Keypad Interface (via RS-232)

Table 6
Virtual Keypad Interface via RS-232 for the 2HF

Key	RS-232 String
<DOWN>	|0~
<UP>	|1~
ALARM	|2~
REF	|3~
100	|4~
0	|5~
ENTER	|6~
<ABORT>	|7~

Appendix D

Contacting ATI

For Technical or Application Questions

If you have any difficulty setting up the Aerosol Fit Test Photometer 2HF or application questions about this instrument, contact an applications engineer at ATI (410) 363-9696.

For Customer Service

If the Aerosol Fit Test Photometer 2HF is not operating properly, or if you are returning the instrument for service, contact ATI Customer Service (410) 363-9696. Customer Service will need this information when you call:

- ☐ The instrument model number
- ☐ The instrument serial number
- ☐ A purchase order number (unless under warranty)
- ☐ A billing address
- ☐ A shipping address.

Use the original packing material to return the Aerosol Fit Test Photometer Model 2HF to ATI. If you no longer have the original packing material, use sufficient packing material so the instrument is not damaged during shipping.

Appendix E

Warranty

Part Number	1800118 / Revision A/ July 2005
Address	Air Techniques International / 11403 Cronridge Drive / Owings Mills, MD 21117 / USA
Phone No.	(410) 363-9696
Fax No.	(410) 363-9695
E-mail Address	info@atitest.com
Limitation of Warranty and Liability	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: a. 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. b. That the defect is not the result of damage incurred in shipment to or from our factory. c. 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. d. 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.
Service Policy	Our service policy is designed to give prompt attention to any problems. If you encounter a defective product or discover a malfunction, please call ATI Customer Service to obtain a return authorization at (410) 363-9696.

Notes

Notes