OPERATOR'S MANUAL

for the

TDA-2G, 2GN
Aerosol Photometer

PN: T2G0-0878, T2G0-0980, T2GN-0880, T2GN-0981

Air Techniques International
Division of Hamilton Associates, Inc

11403 Cronridge Drive
Owings Mills, MD 21117 USA

TEL: 410 363-9696
FAX: 410 363-9695

www.atitest.com
info@atitest.com

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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 GENERAL INFORMATION

1.1 DESCRIPTION

The TDA-2G is a forward light-scattering, linear photometer. It operates on 90 to 240 volts, 50 or 60 Hz, adjusting automatically. The basic functions of the TDA-2G 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 TDA-2GN. The nuclear version is the same size and has the same features as the TDA-2G, plus a sealed sampling chamber and an additional ULPA exhaust filter to contain all contamination within the unit.

The TDA-2G 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 retractable carrying handles. Fold-up legs under the case 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.

1.2 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.

1.2.1 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.

1.2.2 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.

1.2.3 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 TDA-2G. 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.

1.2.4 Filter Leak Testing: The Most Common Application

The most common application of the TDA-2G 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 leaks on the downstream side of the filter.

A scanning test is performed using the optional TDA-2SP 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 and scanned at a traverse rate of no more than 10 feet per minute (2 inches per second). Separate passes

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

1.2.5 Capabilities

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

Measurements

- % Penetration
- Absolute aerosol concentration

1.2.6 Input/Output features

Alarm (audible and visual)
Alerts the user of penetration readings that exceed the user selected alarm point.
Serial Data Output
Sends test data through a serial communications port that can be stored on a computer.

2 INSTALLATION

2.1 REQUIREMENTS

- Stable electrical power at 90/240 VAC 1PH, 50/60 Hz, 5 amps.
- Environment Operating Range: 35 to 105 degrees Fahrenheit with less than 75% relative humidity.

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

2.2 UNPACKING

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

***NOTE:** Save all packaging material for future use.*

- Make sure the following items are included:

1) 1 power cord, 6700001
2) 12 feet of clear PVC tubing, 5200116
3) Operating Manual, T2G0-0877
4) Calibration certificate

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

1) Shipping case, 9300102
2) TDA-2SP Scanning Probe, complete, T2SP-0879
   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:

Air Techniques International
Division of Hamilton Associates
11403 Cronridge Drive
Owings Mills, Maryland 21117-2247 U.S.A.
Tel: 410 363-9696 Fax: 410 363-9695
www.atitest.com

3 SETUP

3.1 LOCATIONS & FUNCTIONS

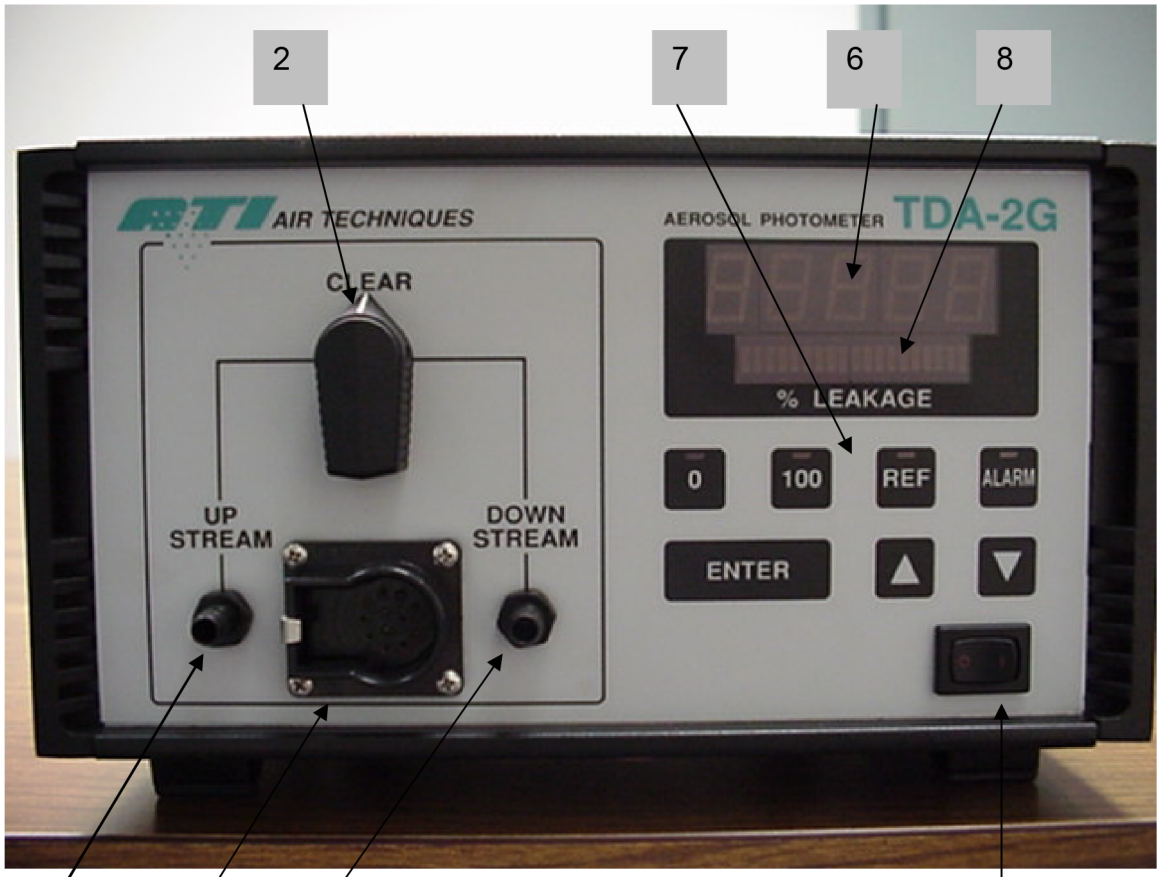

Figure 1. Front View

Power Switch – Rocker Switch. Turns system power on and off.
Selector Valve – Selects the sample source.
Upstream Sample Port – Connects to the sample tubing that is used to measure the upstream aerosol concentration.
Downstream Sample Port - Connects to the sample tubing or optional Scanning Probe that is used to measure the downstream sample.
Scanning Probe Connector – Electrical connection for the optional Scanning Probe.

***NOTE**: Connect the Scanning Probe before applying power to the TDA-2G.*

Front Panel Display – Indicates % leakage readings and error messages.
Function Keys – Used for setting operating parameters and initiating program routines
Bar Graph Display – Displays an analog representation of the % leakage to aid in isolating leaks.

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 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 **<Δ>, <∇>,** 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. 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 Power Switch is located in the lower right corner of the front panel. The 2-position rocker switch is unlabeled, containing only the symbols **0** (Off) and **I** (On).

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

3.3 FRONT PANEL CONNECTIONS

If using the TDA-2G with the Scanning Probe, connect the probe's electrical connector to the 12-pin connector on the front panel of the TDA-2G before applying power to the photometer. Connect the probe's sampling hose to the barbed **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 TDA-2G, the probe must be connected to the photometer before the power is turned on. Otherwise the TDA-2G 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

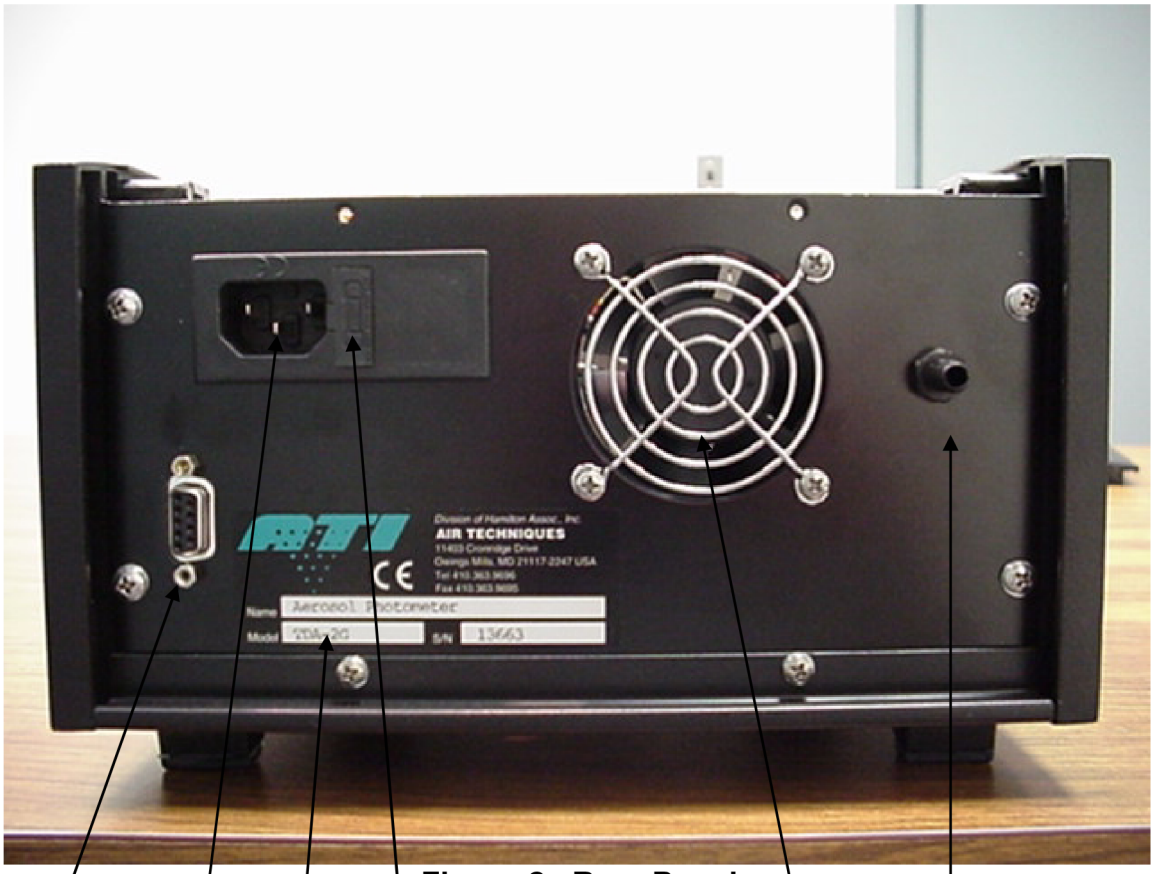

Figure 2. Rear Panel

1. **Power Connector** – Connects to the Power Cord.
2. **RS-232 Port** – Sends continuous serial output of % penetration readings as they are updated on the Front Panel Display.
3. **Vacuum Pump Exhaust** – Allows a filter to be installed to eliminate particulate emissions.
4. **Fuse Block** – Contains 2-amp fuse and spare fuse.
5. **Cooling Fan** – Maintains airflow through the unit's enclosure to stabilize electronics.
6. **Serial Number Label** – Lists the model and serial number.

The rear panel contains a recessed, 3-pronged male Power Connector, a 9-pin female D-subminiature connector for an RS-232 computer interface, and a barbed fitting for the Vacuum Pump Exhaust.

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.

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.

The barbed fitting is the exhaust from the unit's vacuum pump. This fitting is provided so that the sensitive environments of cleanrooms can be maintained. The air sampled by the unit can be sent to either an external in-line filter or to an exhaust system.

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 TDA-2G by setting the Power Switch to the **1** position (On). The bar graph scans for 20 seconds, then all the display segments light. Verify that all Front Panel Display segments light fully with a full bar graph beneath (**IIIIIIII)**. This display must occur before the photometer is ready to use.

4.2 SETUP PARAMETERS

The TDA-2G has ten operating parameters, seven 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 ten parameters, and their default settings, are listed below.

Parameters

L0 – Enter/Exit Parameter Menu
L1 – Audible Alarm On/Off
L2 – Display Refresh Rate (Not time based)
L3 – 100% Sample Duration Time
L4 – Decimal Places to be displayed

L5 – Aerosol Reference Selection (P1=DOP, P2=PAO Oil or P3=Factor of P1)
L6 – Hour Meter (Total operating time)
L7 – Load Factory Defaults
L8 – Software Revision
L9 – Enable/Disable bar graph display
L10 – Display Intensity Adjustment

To enter the parameters setting menu proceed as follows:

1. Press <ENTER> function key.
2. Press <Δ> function key (Up arrow). The first parameter L0 will be displayed on the % Leakage indicator.
3. The <Δ> (Up) and <∇> (Down) function keys are used to scroll through the parameters from L0 to L10.
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. 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.

4.3 CHANGING SETUP PARAMETERS

L0 – Enter/Exit parameter menu

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 TDA-2G 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 <Δ> (Up) and <∇> (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 <∆> (Up) and <∇> (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 <∆> (Up) and <∇> (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 – Decimal PLaces to be displayed

Options: 3 or 4

Default: 3

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: P1-DOP
P2-PAO Oil
P3-Factor of P1

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

See A-7 for correction factors to be used in conjunction with P3 setting.

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 <Δ> (Up) and <∇> (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 – Software revision

Options: N/A

Default: None

L8 displays the current operating revision that is being used by the TDA-2G.

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 <∆> (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: 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 <∆> (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).

4.4 PREPARING TO TEST

Once the initialization & warm-up cycle has been completed, the TDA-2G is ready for operation. The unit should be placed on a flat, stable surface with the area to be monitored within reach of the sample lines.

Caution: *If the power to the unit is interrupted between initialization and operation (for example, to relocate the unit), the selected set points and the reference value will remain in memory. Gain settings from a 100% baseline definition, however, will be erased from memory.*

To prepare the TDA-2G for testing:

Turn the Selector Valve to **CLEAR**.

(If the Internal Reference is not being used, proceed to step 5.)

1. Press the <**ENTER>** function key.
2. Immediately press the <**REF>** (internal reference) key (within 3 seconds). The **% LEAKAGE** display will briefly flash the internal reference option in use ([**P1], [P2], or [P3]**, followed by the value of the internal reference . (For example, [**P1]** followed by [**100.0]** would be the manufacturer's internal reference setting for DOP (P1) at 100 micrograms per liter.)

If a different internal reference setting is required, press <**Δ>** or <**∇>** function keys to raise or lower the value until the desired value is reached.

3. Press <**ENTER>**. The system will perform its internal gain adjustment for the new value. The bar graph sweeps from left to right until the task is completed, approximately 15 to 30 seconds. When completed, the red LED over the <**0>** key will begin flashing.
4. Press <**ENTER>** to automatically zero the instrument. This takes approximately 5 seconds and is accompanied by short beeps. When zeroing is completed, the instrument gives a prolonged beep.

CAUTION: Do not turn the valve from **CLEAR** until the beeps stop.

Note: *If there is a concern that the zero baselines may have drifted, the operator can re-zero the instrument. This may be done at any time during operation by performing step 10 below.*

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

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

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. If the Internal Reference has been used to normalize the instrument response to 100 ugm/l, the upstream concentration in micrograms per liter is reported. (If the internal reference has not been established, the display will read **8.8.8.8.8,** proceed to step 6.)

The instrument is now ready to perform an automatic 100% adjustment using the upstream aerosol sample as a reference.

6. Press the <**ENTER>** key.
7. Immediately press the <**100**> key and observe that the red LED on the key begins to flash.
8. Press <**ENTER>** to establish 100% baseline. This establishes the 100% limit of measurement and provides a readout that is a percentage of the actual upstream aerosol level.

Note: *The bar graph will scan left to right across the bottom of the* ***% LEAKAGE*** *display indicating that the unit is electronically adjusting the internal gain. This can take from 2 to 200 seconds to complete, depending on the aerosol level present.*

The TDA-2G automatically establishes the 100% baseline as follows:

The bar graph goes off below the **% LEAKAGE** display screen and the audible alarm sounds indicating that the unit is averaging the 100% reading over the time period established by parameter **L3** (5-120 seconds).

At the end of this period, the LED over the <**0>** key begins flashing and the audible alarm turns off. The unit has completed setting the 100% baseline using the upstream sample.

A flashing LED over the <**0>** key indicates that the unit needs to be re-zeroed.

CAUTION: *Anytime the internal gain circuit has been adjusted, the unit must be re-zeroed. The TDA-2G will not proceed until this has been accomplished*.

9. Turn the Selector Valve to the **CLEAR** position and press <**ENTER>**. When the zero has been established, the beeps will stop, and the **% LEAKAGE** display shows [**.0000]** (or **[.000]**, depending on the number of decimal places determined by parameter **L4**).

CAUTION: Do not to turn the valve from **CLEAR** until the final tone is heard.

You are now ready to begin testing.

The operator can re-zero the unit at any time during testing. To do this:

10. Turn the Selector Valve from the testing position to **CLEAR**.
11. Press <**ENTER>** and then the <**0>** key. The LED on the <0> key begins to flash.
12. Press <**ENTER>** to start the instrument defining the 0% baseline.

When the zero has been re-established, the beeping stops and the **% LEAKAGE** display screen will show **.0000** (or **.000**, depending on the number of decimal places determined by parameter **L4**).

4.5 TESTING WITH THE TDA-2G

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 % penetration.

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

VERIFYING THE UPSTREAM CONCENTRATION DURING TEST

If testing is carried out over an extended period of time, or if the downstream concentrations appear to read suspiciously low, the operator should verify the upstream challenge aerosol concentration.

CAUTION: This can be carried out only if the Internal Reference has been established and the upstream sample line is connected to the Upstream Port on unit.

NOTE: This procedure only verifies the upstream aerosol challenge to the filter; it does not establish the 100% baseline of the photometer.

To verify the upstream concentration:

1. 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.

   If further verification is required, proceed to the next step to determine the actual concentration of the challenge aerosol.

2. Press the **REF** key while sampling upstream of the filter. Observe that the **REF** LED illuminates, the **100** LED goes out, and the **% LEAKAGE** display bar graph begins to sweep left to right.

   Note: *If the unit was not set up for an internal reference value of 100 at the beginning of testing, this function will not be accurate.*

   After approximately 15 seconds, the **% LEAKAGE** display will illuminate giving the actual concentration of the upstream sample in micrograms per liter for about 3 seconds. This should be recorded and compared to readings taken when the 100% baseline was initially established.

   Next, the **% LEAKAGE** display will go blank while the bar graph begins to sweep, the **100** LED illuminates, and the **REF** LED goes off, indicating that the unit is returning to the 100% baseline previously established.

   The **% LEAKAGE** display will illuminate to indicate that the unit has returned to the 100% baseline.

3. If the re-verification indicates that 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.

4. If the re-verification indicates that the concentration of the challenge aerosol has not changed significantly, return the Selector Valve to the **DOWNSTREAM** position and continue testing.

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 TDA-2G 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 TDA-2G 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 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.

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 TDA-2G or the TDA-2GN 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 course 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.

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

TDA-2G	Aerosol Photometer (standard use)	15.5 lbs (7.0 kg)
TDA-2GN	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)

Null-modem cable, part # T2G0-1119 or equivalent, is required.

A-2. TROUBLESHOOTING

CONTROLLER Error Messages

ERROR CODES – SYSTEM PROBLEMS

Problems	Cause	Corrective Action
E1 – Out of Range	Upstream aerosol challenge exceeded the units operating range. Challenge in excess of 135% of initial 100% setting will result in this error.	Reduce the amount of upstream challenge aerosol.
E1 – Out of Range	Loss of scattering chamber light source.	Return the unit to ATI for repair and service as soon as possible.
E1 – Out of Range	Amplifier output below its initial straylight level.	Return the unit to ATI for repair and service as soon as possible.
E2 – Future	N/A	N/A
E3 – System Fault	Internal electronic or software malfunction.	Turn system power off and then on. If the error does not repeat, continue to use normally. If the error repeats, return the unit to ATI for service and repair.
E4 – Memory Fault	Loss of internal memory values. This message is only displayed at the first power-up following loss of memory. The “Internal Reference” key will be disabled allowing use only with an actual upstream sample to set the 100% level.	Return the unit to ATI for repair and service as soon as possible.

A-3. QUICK SETUP REFERENCE

SETUP

To enter setup, press <**ENTER**> then <Δ>
L0 - Run
L1 - Audible Alarm
L2 - Display Rate
L3 - 100% Sample Time
L4 - Decimal Places
L5 - Internal Reference
L6 - Hour Meter
L7 - Factory Defaults
L8 - Software Revision
L9 - Bar graph
L10 - Display Intensity

ALARM (ON)

<**ENTER**>
<**ALARM**> LED Flashes – (when [----] is displayed, alarm is disabled)
<**ALARM**> Last alarm set point displayed, <Δ> or <∇> to change
<**ENTER**> Alarm set point entered and LED will stay lit

ALARM (OFF)

<ENTER>
<ALARM> Set point displayed
<ALARM> --- displayed indicating alarm will be disabled
<ENTER> Alarm disabled

INTERNAL REFERENCE

Set Selector Valve to **CLEAR**

<ENTER>
<REF> Calibration liquid and Internal reference display, e.g., [P1] and [100.0]. Use <Δ> or <∇> to change
<ENTER> Scans 15 seconds then <0> key flashes
<ENTER> Sets 0%, which takes about 5 seconds

Ready for Testing

SETTING 100%

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

<ENTER>

<100>	<100> key LED flashes
<ENTER>	Bar graph scans then <100> key LED flashes. 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%. This takes about 5 seconds

Ready for Testing

UPSTREAM CHALLENGE QUICK CHECK FEATURE

Note:Will function only if the Internal Reference was established

Connect the Upstream Sample Line & set Selector Valve to UPSTREAM. Assure that the Upstream Sample Line is sampling the upstream aerosol challenge.

Initially the % LEAKAGE display shows about 100%.

<REF>Bar graph scans 15 sec. – displays actual upstream challenge for 3 sec and returns to 100% baseline

A-4. ACCESSORY LIST

Item	Part Number	Description
1	T2G0-1038	**TDA-2G Spare parts kit** (see list below for components)
2	T2GN-0948	**TDA-2GN Spare parts kit** (see list below for components)
3	9300102	**Shipping case**
4	T2SP-0879	**Scanning probe assembly, complete with 3 nozzles**
5	T2SP-1095	**Scanning probe extension, 12 ft.**
6	T2E0-0005	**NSF Scanning probe nozzle**
7	T2E0-0572	**1" Isokinetic, round (red)**
8	T2E0-0798	**Isokinetic, rectangular (blue)**
9	6700001	**Replacement line cord, 120V**
10	5200116	**¼" ID PVC sample tubing (specify length)**
11	T2G0-1119	**Null-modem cable, 6 ft.**

TDA-2G Spare parts kit (Recommended 1 year consumable parts)

Component	Quantity
ULPA filter, 5500001	(1)
Pump exhaust filter, 5500002	(2)
Replacement probe screen set, 3 pieces	
5/16" diameter, T2SP-0883	(1)
1-7/16" diameter, T2SP-0884	(1)
31/32" diameter, T2SP-0885	(1)

TDA-2GN Spare part kit

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 TDA-2GN 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)

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 TDA-2G serial output is formatted as a continuous string of ASCII numeric characters.

0.0001
0.0000
0.0000
0.0001
0.0024
0.0013
0.0001
0.0000

The require port protocol is: **2400, N, 8, 1.**

A-7. AEROSOL CORRECTION FACTORS

DOP Substitute liquid	Internal Reference Factors
DOP (DEHP)	**1.00**
PAO (Emery 3004)	**0.73**
DOS (DEHS)	**0.96**
Mineral Oil	**0.90**
Ondina Oil (Ondina EL)	**0.79**
Kaydol	**0.92**
Polyethylene Glycol (PEG 400)	**1.11**
Paraffin Oil	**0.89**
Corn Oil	**0.88**

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 mg/m3**
- **PAO-23 psi (20 psi x 1.15 correction factor) applied with dilution airflow of 135 cfm yields 100 mg/m3**

Internal reference factors are multipliers for the reference setting required for a100% reading.

Example:

- **DOP with P1 selected - 100 required for 100% response to 100 mg/m3**
- **DOS with P3 selected - 0.96 (0.96 X 100 DOP value) required for a 100% response to 100 mg/m3**

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.