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GT-321 HAND HELD PARTICLE COUNTER OPERATION MANUAL



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Model GT-321 Hand Held Particle Counter Operation Manual

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Technical Support

Should you require support, please consult your printed documentation to resolve your problem. If you are still experiencing difficulty, you may contact a Technical Service representative during normal business hours—7:30 a.m. to 4:00 p.m. Pacific Standard Time, Monday through Friday.

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Safety Notice

The contents of this manual have been checked against the hardware and software described herein. Since deviations cannot be prevented entirely, we cannot guarantee full agreement. However, the data in this manual is reviewed regularly and any necessary corrections included in subsequent editions.

Faultless and safe operation of the product presupposes proper transportation, storage, erection and installation as well as careful operation and maintenance. The seller of this equipment cannot foresee all possible modes of operation in which the user may attempt to utilize this instrumentation.

The user assumes all liability associated with the use of this instrumentation. The seller further disclaims any responsibility for consequential damages.

NOTICE



CAUTION—Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.



WARNING—This product, when properly installed and operated, is considered a Class I laser product. Class I products are not considered to be hazardous.

There are no user serviceable parts located inside the cover of this device.

Do not attempt to remove the cover of this product. Failure to comply with this instruction could cause accidental exposure to laser radiation.

This system contains a laser operating at 850 nm. This wavelength is invisible to the naked eye and can cause damage to the eye if directly exposed. A protective housing protects the unit. To avoid the possibility of accidental exposure, always power down the system any time service or repair work is being preformed.

Repair of instrumentation manufactured by Met One Instruments, Inc. should only be attempted by manufacturer trained service personnel.

Electrical & Safety Conformity

The manufacturer certifies that this product operates in compliance with the following standards and regulations:

- FDA / CDRH This product is tested and complies with 21 CFR, Subchapter J, of the health and Safety Act of 1968.
- European Community (CE) Directive 89/336/EEC
  EN 55011 Group 1, Class B (Emissions) and EN 55082-1 (Immunity)
- IEC 60825-1 Ed.1.1 (1998-01)
- EN 60825-1 W/A11 (1996)
- US 21 CFR 1040.10

Warranty

Products manufactured by Met One Instruments, Inc. are warranted against defects in materials and workmanship for a period of (1) year from the date of shipment from the factory. Offered products not manufactured by Met One Instruments, Inc. will be warranted to the extent and in the manner warranted by the manufacturer of that product.

Any product found to be defective during the warranty period will, at the expense of Met One Instruments, Inc. be replaced or repaired and return freight prepaid. In no case shall the liability of Met One Instruments, Inc. exceed the purchase price of the product.

This warranty may not apply to products that have been subject to misuse, negligence, accident, acts of nature or that have or modified other than by Met One Instruments, Inc. Consumable items such as bearings are not covered under this warranty.

Other than the warranty set forth herein, there shall be no other warranties, weather expressed, implied or statutory, including warranties of fitness or merchantability.

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1. Safety

1.1. Safety Indicators

This manual uses a **CAUTION** and a **WARNING** indication.

Familiarize yourself with the following definitions for the meanings of these indicators.

A **CAUTION** indicates a hazard and calls attention to a procedure that if not correctly followed could result in damage to the instrument. Do not proceed beyond a caution indicator without understanding the hazard.

A **WARNING** indicates a hazard to you and calls attention to a procedure that if no correctly followed could result in injury or even death. Do not proceed beyond a warning without understanding the hazard.

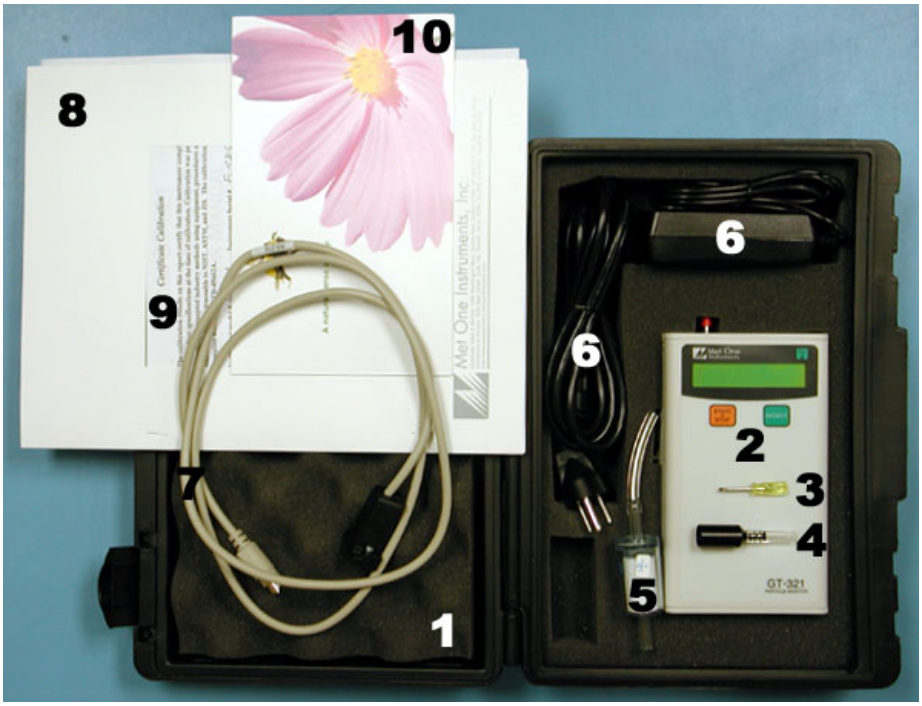
2. Setting Up

2.1. Unpacking

When you unpack the GT-321 and accessories, inspect the carton for obvious damage. If the carton is damaged notify the carrier. Unpack everything and make a visual inspection.

You should have the following:

1. Carrying case
2. GT-321 Hand Held Particle Counter
3. Miniature screwdriver
4. Iso-kinetic Sample Probe with a short piece of tubing
5. Zero Particulate Filter (Met One Part Number G3111)
6. Universal AC to DC converter module with IEC AC power cord
7. RS-232 Serial Cable
8. Operation Manual
9. GT-321 Calibration Certificate
10. Color Brochure (optional)

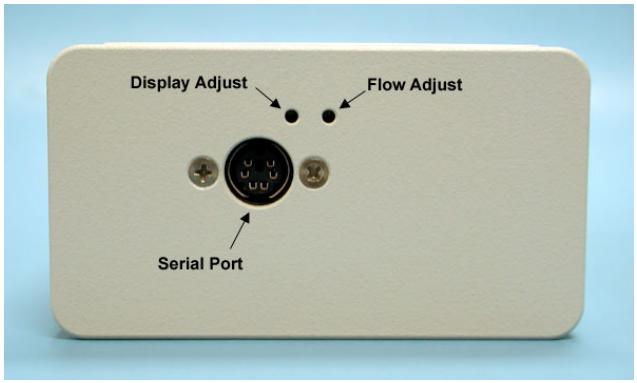


If any of the above components are missing contact your supplier.

Keep the carton and packing material for reuse.

2.2. Familiarization





Item	Description
Power Switch	Used to turn ON and OFF power to the unit.
Charging Jack	Plug Universal AC to DC converter module into the jack to charge the batteries.
Iso-kinetic Filter	Reduces count errors due to mismatched sample flow velocity.
Display Adjust	Adjusts the LCD display contrast (Section 5.6).
Flow Adjust	Adjusts the flow rate of the unit (Section 5.5).
Serial Port	Can be used to access internal commands (Section 7).

2.3. Test Run

The battery pack inside the GT-321 should be charged for 15 hours prior to use (see section 5.3 – Battery Pack). Once the battery pack is fully charged, **remove the rubber cap** from the GT-321 inlet nozzle. The inlet nozzle protrudes from a hole in the top of the GT-321 case.

Next, turn on the power switch that is located on the left side. The LCD display on the GT-321 will indicate **0.3u.** If there is no display or a dim display the LCD contrast may require adjustment (see section 5.6).

Press the **<SELECT>** key several times and note that the display sequences through the particle size selections of **0.3u**, **0.5u**, **1.0u**, **2.0u**, and **5.0u**. Select the 0.3u size, then hold the GT-321 with the inlet nozzle pointing upward.

Finally, press the **<START>** key. You should hear the internal vacuum pump start running. After 9 seconds (subsequent readings every 6 seconds) a number will appear on the display representing the number of particles per cubic foot larger than 0.3µm.

If the sample was taken in a relatively clean area the count may be as low as 200,000 whereas in a dusty area it could be as high as 3,000,000. The GT-321 will continue to take 9 more 6-second samples. The results from the 10 samples are then averaged and displayed.

This finishes the test run. Always remember to turn the power off when not in use to conserve battery power.

The GT-321 is now checked out and ready for use, however, you should read the rest of this manual to better understand how to use and maintain this instrument.

3. GT-321 Overview

3.1. Description

The GT-321 is designed to be a small, easy to use and completely portable hand-held particle counter that can provide fast and accurate measurement of particulate contamination in particles per cubic foot. The GT-321 has 5 selectable size ranges of 0.3, 0.5, 1, 2, and 5 micron.

The GT-321 contains a laser diode based sensor, NiCd battery pack, vacuum pump, microprocessor electronics, LCD display and user input keys all in one small package. The accuracy of the GT-321 is certified according to ASTM and JIS standards and comparable to larger more expensive bench top particle counters. The fast 6-second response of the GT-321 makes it especially useful for troubleshooting contamination problems and tracing contamination leaks to the source.

The laser diode based sensor inside the GT-321 utilizes a specially designed elliptical mirror for high light collection efficiency and improved signal to noise. Precision optics

collimate the laser beam into a thin, very intense beam resulting in increased signal and a high concentration limit of 3,000,000 particles per cubic foot. This high concentration limit allows the GT-321 to be used for indoor and outdoor aerosol particulate measurement.

3.2. Applications

- Controlled Environments
- Indoor Air Quality Studies
- Process Control
- Ventilation Systems
- Filter Testing
- Laboratory and Manufacturing Environments
- Concerned citizen groups that want to do their own air quality studies
- Hospitals and nursing homes
- Efficiency testing of residential air purifiers
- Emissions Sourcing

3.3. Certifications and Compliance

- CE Certified
- NIST traceable calibration in accordance with JIS B 9921 and ASTM F328 and ASTM F649
- In accordance with ISO 14644-1:1999(E) and ISO 14644-2:2000(E)

4. Operation

4.1. Iso-kinetic Sampling

The GT-321 comes with an iso-kinetic probe that attaches to its inlet nozzle with the short piece of Tygon tubing provided. Attach the other end of the tubing to the GT-321 inlet nozzle (See section 2.2 Familiarization).

The iso-kinetic probe helps reduce count errors related to the sample flow velocity and the aerodynamics of small particles. The iso-kinetic probe should be used for most sampling applications. When taking a sample of typical indoor or outdoor aerosols the opening of the iso-kinetic probe should always face upward. The GT-321 can be held in your hand or placed on a flat surface with its display facing towards you.

When sampling in an area having constant airflow, such as a clean room, duct, vent or the downstream side of a filter, always face the opening of the iso-kinetic probe into the air flow. The length of the connecting tubing going from the inlet on the GT-321 to the iso-kinetic probe can be increased if necessary but count losses, especially for larger particles, will become a problem after approximately a four-foot length. Try to keep the tubing length short.

The sampling height will affect the GT-321 particle count reading. Taking a sample near the floor can give results several times higher than a sample taken at eye level.

When using the GT-321 to find the source of a contamination problem, be aware that not all contamination problems are continuous, some are the result of a short-term event or burst of particles. Locating the source will require taking a number of samples in the same spot.

4.2. Taking a Sample

CAUTION: **Never sample smoke, paint spray, oil mist, reactive, or pressurized gasses to avoid damaging the sensor optics.**

Remove the rubber cap from the GT-321 aerosol inlet nozzle and attach the Iso-kinetic probe. Turn the GT-321 power switch on. Press the **<SELECT>** key and select the particle size range of interest.

When you select a particle size, you are setting a lower size limit for the counter in the GT-321. The industry standard setting for a particle counters size selection is 50% counting efficiency. This means that the GT-321 will count ½ of the particles of the selected size when a sample is taken. Counting efficiency increases rapidly to 100% for particles larger than the selected size. All particles larger than the selected size are counted. This type of counting is defined as cumulative counting.

After selecting a particle size, press the **<START>** key. You will hear the pump inside the GT-321 activate. After 9 seconds the first sample result in particles per cubic foot is displayed. The GT-321 will automatically take a series of 10 samples; each sample after the initial sample that includes 3 seconds of warm-up time for the internal pump takes 6 seconds. The display will update every 6 seconds with the new result. After all 10

samples are taken the GT-321 averages the results of the 10 samples for a more accurate result. The display will hold the average result until the start key is pressed to take another sample or until the unit is switched off. The **<STOP>** key is used to stop a sample at anytime.

Any data accumulated is lost when the **<STOP**> key is pushed.

5. Maintenance

5.1. Service Schedule

WARNING: There are no user serviceable components inside this instrument. The covers on this instrument should not be removed or opened for servicing, calibration or any other purpose except by a factory-authorized person. To do so may result in exposure to invisible laser radiation that can cause blindness.

Sensor, vacuum pump and filter replacement requires access to the inside of the GT-321 and a factory-authorized person must do this. Contact Met One Instruments for service information.

Calibrating particle sensors like the one in the GT-321 requires specialized equipment and a skilled technician. Met One Instruments, Inc. maintains a calibration facility for calibrating particle counters according to industry-accepted methods like ASTM and JIS using NIST traceable standards. The sensor in the GT-321 should be calibrated on a yearly basis.

5.2. Service Schedule Table

Item To Service	**Frequency**	**Done By**
Zero test	Weekly	Customer or Factory Service
Flow rate test	Monthly	Customer or Factory Service
Inspect internal filter	Yearly	Factory service only
Inspect pump	Yearly	Factory service only
Test battery pack	Yearly	Factory service only
Calibrate Sensor	Yearly	Factory service only

5.3. Battery Pack

CAUTION: There are no user serviceable components inside the GT-321. Do not attempt to change the internal battery pack. The wrong battery pack could cause serious damage or a fire. The GT-321 should be sent to a service center where a factory qualified person would change and properly dispose of the battery pack.

When the battery is low enough to need charging, a “Battery Low” message is displayed on the display and the pump will not turn on when the **<START>** key is pushed.

To charge the battery pack, connect the AC power cord from the AC to DC converter module to an AC power outlet. The module is universal and will work with power line voltages of 100 to 240 volts, 50 to 60 Hz. Take the plug on the end of the cord coming from the converter module and plug it into the charger input socket on the side of the GT-321 just below the power switch (See section 2.2 Familiarization). To fully charge a discharged battery pack may take up to 15 hours.

The battery pack inside the GT-321 when fully charged will power the GT-321 for about five hours of continuous use. Under normal intermittent or manual operation however, there is considerably less battery drain and up to 10 hours of use is possible.

If the GT-321 is to be used powered by its battery pack on a daily basis, connect the charger after each day of usage. It will not damage the battery pack to leave it connected to the charger for long periods.

When the GT-321 is always used in an area where AC power is available. Leave the charger connected to the GT-321.

If the GT-321 is to be stored, fully charge the battery pack first. Storing a discharged NiCd battery for any length of time will degrade its performance.

5.4. Zero Test

False counts caused by air leaks or spurious noise will cause errors, especially when sampling relatively clean aerosols. A zero count test is easy to do.

Attach the zero test filter (Met One Part Number G3111) to the GT-321 inlet nozzle. The zero filter removes 99.99% of all particles larger than 0.3 micron. The zero filter must be large enough that it does not create a restriction and load down the small vacuum pump inside the GT-321. Since the air passing through the GT-321 is now virtually particle free, the output should be zero.

Select the 0.3 micron range on the GT-321 and take a sample. The result of the 1-minute sample should be zero counts. If it does not read zero it is probably due to a leak in the flow path inside the GT-321 or the zero filter is bad. If it is determined that there is a leak, the GT-321 must be sent back to the factory for repair.

5.5. Flow Rate Test

The sample flow rate of 0.1cfm is set at the factory. However, wear from continued use will degrade the motor and vacuum pump. Variation in the flow rate will reduce the accuracy of the instrument.

Testing the flow rate is an easy procedure. It requires a flow meter that is ±3% accurate at 0.1cfm. The flow meter must be non-loading (low restriction). The tiny vacuum pump inside the GT-321 can be easily loaded down by even a small restriction. Most hot wire and differential pressure types of flow meters are non-loading.

To test the flow rate, connect the flow meter to the sample inlet nozzle of the GT-321 using a short piece of flexible 1/8“ (3 mm) ID tubing, Tygon tubing is a good choice. Turn on the GT-321 and note the flow meter reading. The flow rate should be 0.10cfm ±5%.

The flow rate can be adjusted by a trim pot located in one of the two access holes in the bottom of the GT-321 case (See section 2.2 Familiarization). Use the small screwdriver that came with the GT-321 to make the adjustment. Turn the adjustment pot clockwise to increase the flow and counter-clockwise to decrease the flow.

5.6. Display Contrast Adjust

A characteristic of LCD display is that their contrast is affected by temperature. Use the small screwdriver provided to make the adjustment. The location of the Display Adjustment is shown in section 2.2 Familiarization. Turn the adjustment pot to obtain the desired contrast.

6. Troubleshooting

WARNING: There are no user serviceable components inside this instrument. The covers on this instrument should not be removed or opened for servicing, calibration or any other purpose except by a factory-authorized person. To do so may result in exposure to invisible laser radiation that can cause blindness.

A factory-authorized person should do replacement of the sensor, vacuum pump, filter or any component inside the GT-321.

Symptom	Possible Cause	Correction
Does not turn on, no display	1. Low battery 2. Defective Battery	1. Charge battery 10 hrs 2. Send to service center
Display turns on but pump does not	1. Low Battery 2. Defective pump	1. Charge battery 10 hrs 2. Send to service center
Keypad functions do not Work	Loose connector or defective component inside	Send to service center
Sample result remains at zero after sampling	1. Pump stopped 2. Laser diode bad	1. Send to service center 2. Send to service center
Sample result is lower than normal	1. Flow rate is low 2. Something may be stuck in the inlet nozzle and blocking the beam 3. Contaminated optics in sensor	1. Check flow rate 2. Blow into nozzle with a can of 'Aero Duster'. Do not put any object down into the nozzle 3. Send to service center
Sample result is higher than normal	1. Air leak in sensor 2. Noisy laser	1. Send to service center 2. Send to service center
Battery pack does not hold a charge	1. Defective or worn out battery pack 2. Defective power cords 3. Defective charger module or chords	1. Send to service center 2. Check with an Ohm-meter 3. Contact your distributor to get another charger

7. Serial Communication Protocol

The GT-321 serial communication protocol supports real time data acquisition using a basic terminal program such as HyperTerminal.

Communication port setting = 9600 baud, 8 data bits, no parity and one stop bit.

Serial Commands – [ASCII Character(s)]:

0 = Start Counting

Start a one minute count cycle.

1 = Change Size Range

The GT-321 displays five different size ranges. The Change Size Range command is used to select the next size range. This command is equivalent to pressing the Select Key.

D0<Enter> = Disable Automatic Records

Do not output a record after each count cycle.

D1<Enter> = Enable Automatic Records

Output a record after each count cycle.

L = Send last record

Output the data from the last count cycle.

? = Display Commands

Output the help menu.

Example Record (CSV – Comma Separated Variable):

SIZE1,COUNT1,SIZE2,COUNT2<LF>

SIZE1	=	Channel one size - fixed size (Note 2)
COUNT1	=	Channel one count
SIZE2	=	Channel two size - selectable size (Note 3)
COUNT2	=	Channel two count
<LF>	=	Line feed

Notes:

1) The GT-321 will display one size range, but the unit actually has two count channels.
2) Channel one size (SIZE1) is fixed at the smallest size (normally 0.3 microns).
3) Channel two size (SIZE2) is selectable using the Select Key or the Change Size Command. The standard sizes are 0.5, 1.0, 2.0 and 5.0 microns. SIZE2 will default to 0.5microns when the channel one size (0.3u) is selected.

8. Specifications

Measuring principle	Particle counter, light scatter
Light Source	Laser Diode, 40 mW, 850 nm
Measurement ranges	0.3, 0.5, 1, 2, 5 micron size ranges
Accuracy	±10%, to calibration aerosol
Sensitivity	0.3µm = 2 to 1 peak to valley (JIS), 2 to 1 S/N
Concentration limit	3,000,000 particles per cubic foot
Measurement time	6 seconds, 1 minute
Flow rate	0.10 cfm (2.831 lpm)
Display	16 character LCD
Power	6 V NiCd battery pack
Charger	AC to DC module, 9 V, 350 mA
Operating Temperature	0° to 50° C
Storage Temperature	-20° C to +60° C
Size	L 15.9 cm, W 9.3 cm, D 6.25 cm
Weight	0.79 kg, 28 ounces
Supplied accessories	Operation Manual, Serial Cable, Universal AC to DC Converter Module with AC Power Cord, Iso-kinetic SampleProbe, Screwdriver, Case, Zero test filter (Met One Part Number G3111)

Declaration of Conformity

CE MARKING

Manufacturers Name:	Met One Instruments, Inc.
Manufacturer's Address:	Met One Instruments, Inc. 1600 NW Washington Blvd Grants Pass, Oregon 97526 United States of America Phone: 541-471-7111 FAX: 541-471-7116 E-Mail: metone@metone.com

Declares, that the product(s):

Product Names:	Particulate Monitor, Aerosol Mass Monitor, Particle Counter
Model Numbers:	GT-321, GT-321-1, GT-331, GT-521
Product Options:	All

Are in compliance with the following documents:

EMC:	Emissions:	CISPR 11:1990 / EN 61326-1
	Immunity:	EN50082-1 / EN 61326-1

Tom Pottberg
President
January 26, 1999

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