



PARTICLE GENERATOR PG-100 **Operations Manual**

Without measurement, there is no control.



Particle Generator PG-100

Operator's Manual



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Quality Statement

The Quality Policy of Particle Measuring Systems is to strive to meet or exceed the needs and expectations of our customers, and to align the activities of all employees with the common focus of customer satisfaction through continuous improvement in the quality of our products and services.

Environmental Information

This equipment must be properly disposed of at end-of-life by means of an authorized waste management system. Information regarding dismantling of the equipment and location of any hazardous materials can be located on our web site at:
<http://www.pmeasuring.com/support/papers/disassemblyinstructions>.

Manual Conventions

WARNING

A warning in the text is used to notify the user of the potential for bodily injury or death.

CAUTION

A caution in the text is used to highlight an item that if not done, or incorrectly done, could damage the instrument and/or any materials or devices affected by the instrument.

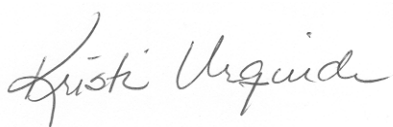
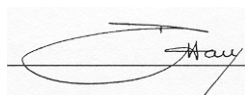
— — NOTICE — —

A notice in the text is an instructional communication regarding requirements or policies issued by Particle Measuring Systems.

NOTE: A note in the text is used to highlight an item that is of operational importance to the user.

It is important that you observe cautions and warnings while performing the procedures described in this manual. Caution and warning labels are located on and inside the instrument to alert you to potentially hazardous conditions. Please familiarize yourself with this information.

CE – Declaration of Conformity

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Application of Council Directive(s):		89 / 336 /EEC, 73 / 23 /EEC	
Standard(s) to which Conformity is Declared:		EMC EN 61326: 1997/A1: 1998/A2: 2001	
		Safety EN 61010-1: 2001	
Manufacturer's Name:		Particle Measuring Systems, Inc.	
Manufacturer's Address:		5475 Airport Boulevard, Boulder, CO 80301 USA	
Manufacturer's Telephone/FAX:		(303) 443-7100 / (303) 449-6870	
Distributor's Name:		Particle Measuring Technique, Great Britain	
Distributor's Address		Unit B1 South, Willow End Park	
		Danemoor, Malvern WR14 1XZ	
		Worcestershire, WR13 6NN United Kingdom	
Distributor's Telephone/FAX:		011-44-1684-312950 / 011-44-1684-312969	
Type of Equipment:		Particle Generator	
Model No:		PG-100	
I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s).			
Signature: 		Signature: 	
Full Name: Kristi Urquidi		Full Name: David Hall	
Position: Vice President Operations		Position: Managing Director	
Place: Boulder Date: January 6, 2002		Place: Malvern Date: January 9, 2002	

WARNING

All I/O cables and accessories must meet current factory specifications in order for this unit to remain in compliance with CE marking requirements. Consult the factory for details.

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Chapter 1

Instrument Description

The PG-100 is a self-contained particle generator system that generates monodispersed polystyrene latex particles for calibrating and testing optical aerosol particle counters. No external air supply is needed.

The PG-100 uses a diaphragm pump to force air through a filter. The filtered air has two possible flow paths each controlled by separate valves. One flow path is through a nebulizer that has monodispersed particles suspended in pure water. The other flow path bypasses the nebulizer.

Both flows combine in a drying chamber where the water droplets evaporate. The monodispersed particle laden air then passes through a long tube and second drying chamber. The particle laden air is now available to challenge a particle counter.

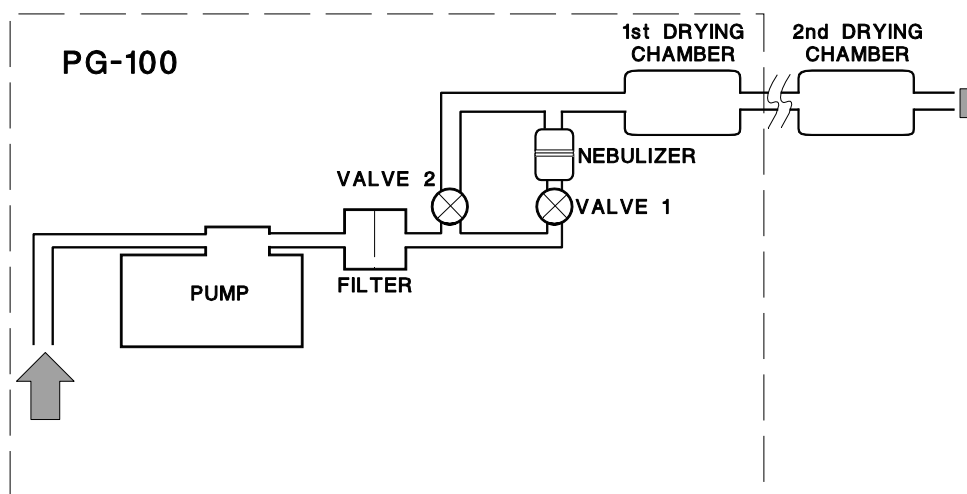
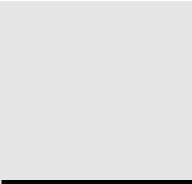


Table 1-1: PG-100 Air Flow Diagram

Lower sample flow rate particle counters may receive the appropriate concentration directly from the drying chamber. Higher sample flow rate counters (>0.1 cfm) require a filter-tee assembly to supply sufficient flow for the counter.

Particle generation is not an absolute science. It requires experimentation and practice to achieve desired results.



Chapter 2 Specifications

Power^a 100 VAC, 50–60 Hz, 2 A
OR
120 VAC, 50–60 Hz, 2 A
OR
220–240 VAC, 50–60 Hz, 1 A

Dimensions (w, h, d) 8.25 in. x 10 in. x 11 in.

- a. Correct power line voltage for country of intended use must be specified when ordering.

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Chapter 3 Operations

NOTE: Please read entire Operating Instructions.

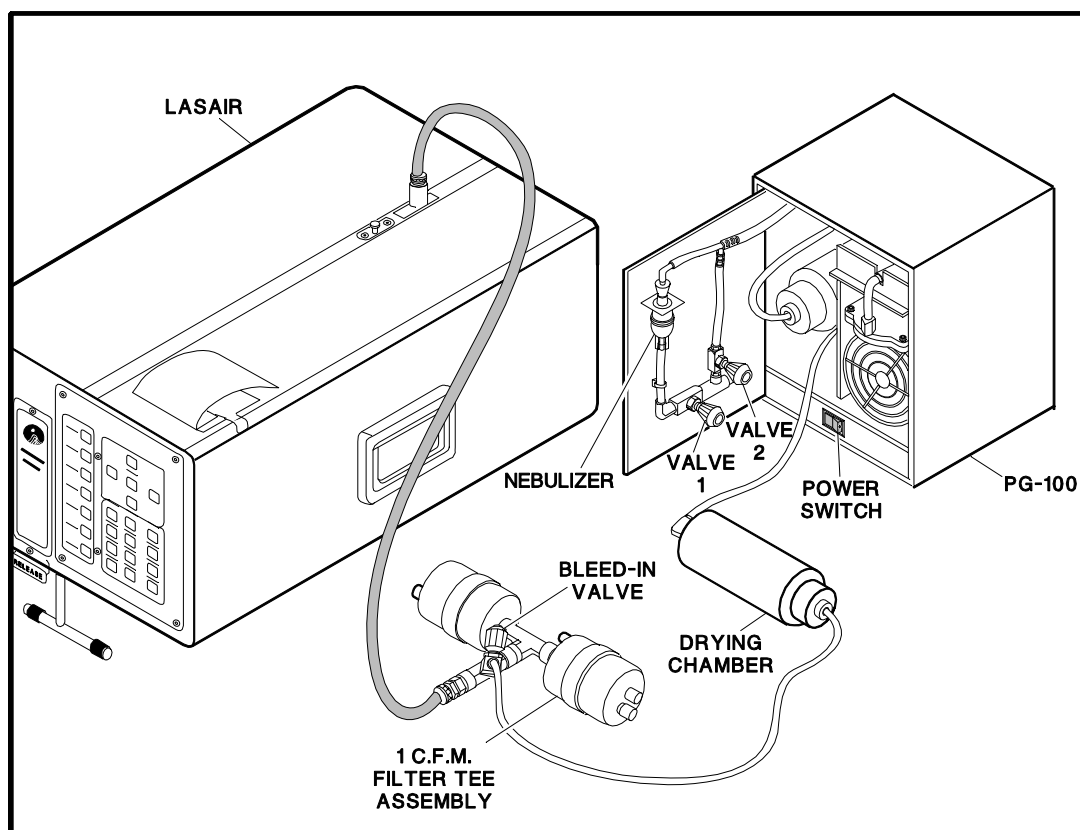


Figure 3-1: PG 100 Components

The PG-100 is operated with the door open. It comes supplied with one PMS-NEB05 nebulizer.

To operate the PG-100:

- 1** Remove the nebulizer from the PG-100 by first twisting and pulling the stopper from the top of the nebulizer, then rolling the O-ring down the tube at the nebulizer base. Push the nebulizer down and out of the holding plate, and then twist the nebulizer until it releases from the plastic tube connected to the base of the nebulizer.
- 2** Unscrew the two pieces that form the nebulizer housing. Fill the lower portion of the housing with distilled or deionized particle free water. Put one drop of monodispersed particles into the water, screw the nebulizer halves together, and mix the particles and water by gently agitating the nebulizer. Particle sizes larger than 1 micron may need several drops.

If the particle solution appears hazy or cloudy, one drop is usually sufficient. If the particle solution is mainly transparent, several drops may be needed to achieve sufficient concentration. Trial and error is the best method to achieve the correct concentration.

NOTE: Never fill the lower portion of the nebulizer housing more than 1/2 full as leakage may occur.

- 3** Replace the nebulizer into the PG-100 door with its inlet tube connected. Do not insert the stopper at this time.
- 4** Open both valves completely by turning them fully counterclockwise.
- 5** Turn the power switch on.
- 6** To generate fog at the nebulizer, begin to close valve number 2 until a gentle fog is visible escaping from the top of the nebulizer.
- 7** Replace the stopper in the nebulizer.
- 8** When using a filter-tee, place the end of the filter-tee particle inlet tube into the open end of the second drying chamber (see drawing).

The filter used with .01 CFM, or less, instruments does not include a valve. Remove the filter from the .01 instrument's inlet tube, and place the end of the sample inlet tube into the open end of the PG-100 drying chamber.

- 9** Start sampling with the particle counter as per its instruction manual.
- 10** When using a filter-tee open the valve three turns counterclockwise.
- 11** Higher or lower concentrations can be generated by adjusting valve 2. Check to see that the maximum count rate of the particle counter isn't being exceeded. Particles larger than 1 micron may need to be "driven" harder (close valve 2 further). Note that it is quite difficult to reliably nebulize particles larger than 2 microns - special equipment and techniques are required. Contact the factory.

The quality of the monodispersed particles will be greatly affected by the quality of the water used for suspension and dilution, and by the settings of the valves of the PG-100 and filter-tee assembly. Monitoring of the monodispersed particles size distribution is easily accomplished with a high-resolution spectrometer such as the PMS HS-LAS.

Filtered deionized or distilled water is typically adequate. For smaller sizes (less than 0.2 micron diameter) ultrapure deionized water such as that used in semiconductor fabrication facilities is best. The PG-100 can be used to test the purity of the particle dilution water if the water (without any monodispersed particles) is placed in the (clean) nebulizer.

Theoretically, the PG-100 will work best if one particle is present in each water droplet created. In practice it is found that there are often several particles in each droplet. When a multiple-particle droplet evaporates, an agglomerate particle (doublet, triplet, etc.) is formed. This gives rise to a broader distribution of particle sizes than expected. Dilution of the concentration in the nebulizer will usually help reduce the number of agglomerates. Adjustment of the valves of the PG-100 to create the smallest droplets will also help generate the best (narrowest) distribution. While striving for the best monodispersed distribution, it is important to maintain the appropriate concentration, therefore, there is a practical lower limit to dilution.

Avoid over-driving small particles, as this greatly increases the number of particle agglomerates that are generated. Check the fogging action at the nebulizer, verifying that the fog is very light.

Different combinations of settings should be tried for valve 2 and the filter-tee valve to find the optimum setting to maximize the amount of time that particles can be generated (at an acceptable count rate) without refilling the nebulizer.

It is important to allow excess particle laden air to flow freely around the filter-tee's particle inlet tube at the drying chamber outlet. If this surplus air is restricted the particle generator and its nebulizer will be over-pressurized, and the particle counter inlet may be subject to positive pressure, rendering the particle sizing and counts invalid.

Some monodispersed particles contain surfacants that, when dried, will form particles that will contaminate the sample with many small particles (often at 0.1 micron and smaller). Dissolved solids in the water may also become a problem when they coalesce in the drying chambers.

To change particle sizes, remove the nebulizer, dump its contents, rinse several times with clean water, and refill with pure water and drop(s) of particles.

If frequent particle size changes need to be made it may be desirable to order spare nebulizers from Particle Measuring Systems, as you will no longer need to dump unused (expensive) particles and clean the nebulizer between every size change. Particle suspensions which have been stored in nebulizers for long periods may result in agglomerates. Very small particles (0.1 micron or less)

will tend to begin clumping after 10–15 minutes. Most particles left in the nebulizer will rapidly degrade after a day or two of storage. When the quality of the suspension in a nebulizer is in doubt, rinse the nebulizer and mix the particle solution again.

Chapter 4

Maintenance

Rinse the nebulizer after each use. Avoid running the PG-100 until the nebulizer is dry as this makes cleaning more difficult. Particles dried onto the nebulizer can be most easily removed with an ultrasonic cleaner, water, and detergent—unscrew the two nebulizer halves and pull the center part out of the bottom housing before cleaning. Rinse all three pieces with pure water after cleaning. **Do not use solvents!**

Be sure to fully seat the center section upon reassembly.

Unlike the particles of contamination dried inside the nebulizer, any dried particles adhering to the drying chamber walls and the long tube usually do not present a sample contamination problem, as their numbers are insignificant compared to the quantity of particles being generated by the nebulizer. The drying chambers can be cleaned by removing them from the PG-100. The long tube can be replaced with Particle Measuring Systems part number WR085 (specify length when ordering).

Spare nebulizers are available from the Particle Measuring Systems Order Processing department. The type supplied with the PG-100 is the small plastic NEB05 (best choice for particles from 0.1 to 2 microns).

Also available:

NEB05 glass nebulizer	Works well with 0.055 to 1 micron particles
NEB04 large plastic nebulizer	Works from 0.75 to 5 microns.
Filter-Tee Assemblies:	• FIL-1 for 1 CFM instruments • FIL-.1 for 0.1 CFM instruments • FIL-.01 for 0.01 CFM or lower flow rate instruments (does not use particle inlet valve, as this is not necessary for 0.01 CFM < instruments).

Particles are available from the Particle Measuring Systems Order Processing Department.

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Chapter 5

Troubleshooting

Problem	Possible Solutions
Nebulizer leaks	Do not overfill the nebulizer. Apply Teflon® tape to nebulizer threads.
Nebulizer sputters rather than fogs	Re-seat center section of nebulizer.
Insufficient counts	• Check fogging action, reduce to minimum. • Reduce flow through filter-tee valve. • Dilute particle solution in nebulizer by 50%.
Insufficient counts	Insufficient counts, Make sure the nebulizer is fogging. Be careful not to overdrive. If the fog is visible proceed with the following steps: • Open filter tee valve. • Increase particle concentration. Remove the stopper and add one or more drops of particle concentrate. Replace the stopper.
Lack of “peak” in particle distribution	• Contaminated water. Test with water only in nebulizer to determine background counts. • Old particle mixture. Mix new solution. • Dirty nebulizer. Ultra-sound in water and proper detergent. • Improper jet alignment in counter. Test with other particles and determine if poor peak is consistent with all particles tested. Refer to service manual for counter.
Good peak in proper channel but second,, smaller peak in larger channel(s)	Overdriving of nebulizer. Make sure fogging action is minimal. Overdriving will cause agglomerates or doublets.

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