



# The Science Behind Particle Counting

Part 1 of 3

*How Does a Particle Counter- Count Particles*

## How a Particle Counter Works

Particle counters are essential tools for monitoring air quality in cleanrooms, laboratories, and industrial settings. They measure airborne particles to ensure compliance with environmental standards, support health and safety, and validate manufacturing processes. This document explains how particle counters collect, size, and count particles, as well as their calibration and servicing requirements.

### Principle of Operation

Particle counters primarily use optical detection to measure particles suspended in the air. The process involves:

#### 1. Air Sampling:

- A vacuum pump draws a known volume of air through the instrument.
- An inlet nozzle or tubing system directs the airflow into the detection chamber.

#### 2. Light Scattering:

- Inside the detection chamber, a focused laser beam illuminates the airflow.
- Particles passing through the laser beam scatter light in all directions. The amount and pattern of scattered light depend on the particle's size, shape, and refractive index.

#### 3. Detection and Sizing:

- A photodetector collects the scattered light and converts it into an electrical signal.
- Larger particles scatter more light, resulting in higher signal amplitudes.
- The signal is processed to determine the particle size based on pre-calibrated light scattering profiles.

#### 4. Pulse Height Measurement:

- The amplitude (height) of each electrical pulse is proportional to the particle size.
- The system categorizes particles into size bins (e.g., 0.3  $\mu\text{m}$ , 0.5  $\mu\text{m}$ , etc.) and counts the number of particles in each bin.

### Key Components

- **Sampling System:** Ensures consistent airflow through the device.
- **Laser Source:** Provides a stable and focused light source for scattering.
- **Optical System:** Directs and collects scattered light with lenses and mirrors.
- **Photodetector:** Converts scattered light into electrical signals.
- **Signal Processor:** Analyzes pulse height and duration to size and count particles.
- **Display and Data Storage:** Reports particle counts and sizes in real-time.



## Calibration

Calibration ensures accuracy and reliability of particle counters. The process involves:

### 1. Using Certified Particle Standards:

Monodisperse polystyrene latex (PSL) spheres with known sizes are introduced into the particle counter. The counter's size bins are adjusted to match the known diameters of the calibration particles.

### 2. Testing Across Size Ranges:

Calibration is performed for all size bins to ensure consistent sizing and counting.

### 3. Flow Rate Verification:

The air sampling flow rate is measured and adjusted to the specified value using a calibrated flowmeter.

### 4. Periodic Recalibration:

Manufacturers recommend recalibration at intervals (e.g., annually) or after significant repairs to maintain performance.

## Service and Maintenance

Regular maintenance is crucial for long-term reliability. Key tasks include:

### 1. Cleaning Optical Components:

- Lenses, mirrors, and the laser source may accumulate dust and require gentle cleaning to maintain sensitivity.

### 2. Replacing Consumables:

Air filters and tubing should be replaced periodically to ensure consistent airflow and prevent contamination.

### 3. Software Updates:

Firmware updates may improve functionality or correct errors.

### 4. Factory Servicing:

Some repairs and advanced diagnostics must be performed by the manufacturer or certified technicians.

## Conclusion

Particle counters play a critical role in monitoring air quality and ensuring compliance with stringent cleanliness standards. Proper calibration and maintenance are vital for accurate and reliable operation.

*This article is written by REX Dynamics. We empower controlled environments when it comes to consultation, design, installation, validation & servicing of environmental monitoring solutions. For further information please visit our webpage [www.rexdynamics.se](http://www.rexdynamics.se) or contact us at [info@rexdynamics.se](mailto:info@rexdynamics.se)*