



**New Star  
Environmental LLC**

"Providing Instrumentation for Air Quality"

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## Products > Stack Monitors > Particle Instrumentation

[back](#)



### In-Stack Cyclones

Cyclones are in-stack samplers which easily attach to U.S. EPA Method 5 probes or other stack sampling equipment and measure the PM10 and / or PM2.5 size distribution of particulate emissions.

The cyclones meet all specifications of U.S. EPA Method 201A - Determination of PM10 Emissions (Constant Sampling Rate Procedure) and Preliminary Method 4 - Determination of PM10 & PM2.5 Emissions (Constant Sampling Rate Procedures). These methods describe the procedures to measure particulate matter emissions equal to or less than a nominal aerodynamic diameter of 10 $\mu$ m (PM10) and 2.5 $\mu$ m (PM2.5) by extracting a gas sample at a predetermined constant flowrate through the in-stack cyclone(s) (the constant flow is necessary to maintain the size cuts of the cyclones), and with a filter that is at the stack temperature. The cyclones separate particles with nominal aerodynamic diameters of PM10 and PM2.5. Variations from isokinetic sampling conditions are maintained within well-defined limits. The particulate mass is determined gravimetrically after removal of water.

Particles are size-fractionated by means of a single or dual cyclone arrangement followed by an integral 2.5-inch (63mm) back-up filter holder.

A typical cyclone kit includes a set of sampling nozzles to maintain the desired flow rate and still sample isokinetically. The kits come complete with all required fittings and adapters and a box of back-up filters. The cyclones fit through a standard 4-inch sampling port (but use of any nozzle less than 0.160-inch diameter requires a sampling port diameter of 6 inches) and all parts are ruggedly constructed of 316 stainless steel to withstand the rigors of in-stack usage. The cyclones are quickly disassembled for analysis.

#### FEATURES

- Meets all specifications of U.S. EPA Method 201A for PM10 and Preliminary Method 4 for PM10 & PM2.5
- High capacity - typically can collect up to 10 grams of particulates
- Accurate for gravimetric & chemical analysis
- Provides longer sampling times for better averaging
- Saves manpower with no reloading required at each sampling point
- Determines fractional efficiency of gas-cleaning equipment (using optional cyclones of various sizes)

#### PRINCIPLE OF OPERATION

Suspended stack gas particles are sampled isokinetically through the cyclone's sampling nozzle. The gas enters the cyclone body tangentially and creates a vortex flow pattern. Centrifugal forces cause particles larger than the cut-point of the cyclone to move radially outward to the wall of the cyclone body and collection cup where they are deposited. As deposits on the inner wall build up, they move downstream into the collection cup and are retained. Thus, extremely large samples can be collected!

Since centrifugal forces are greater than gravitational forces, the cyclones can be operated in any orientation. Particles smaller than 10-microns pass through the first cyclone to a second cyclone (if used) which has smaller dimensions. This second cyclone creates a stronger

#### Specifications:

<b>Nozzles</b>	From 0.136" to 0.390" for Method 201A & 0.125" to 0.390" for Preliminary Method 4
<b>Filter Holder</b>	63mm, stainless steel
<b>Dimensions of PM10 Cyclone</b>	3.63" (9.20cm) H x 1.76" (4.47cm) diameter
<b>Dimensions of PM2.5 Cyclone</b>	1.93" (4.90cm) H x 1.00" (2.54cm) diameter

vortex pattern and smaller particles (2.5-microns) are collected from the air stream. The back-up filter collects all particles smaller than the cut-point of the last cyclone in the series.

#### **OPERATION**

The sampling nozzle for the desired flow rate and stack velocity is selected. The assembled cyclone(s) are attached to the sampling probe and inserted into the stack. A pump is turned on, the flow rate is set and initial & final sampling times and stack temperatures are recorded. After sampling, the probe is moved to the next sampling point. After sampling all points, the cyclone is disassembled and the particle deposits in the collection cup and on the internal wall surfaces of each cyclone are brushed or rinsed into a preweighed filter or dish. The particles are weighed to obtain the mass of particulates in each cyclone and if desired, the particles can be analyzed chemically.

Condensable emissions are also PM10 and PM2.5, but the above mentioned in-stack methods measure only the component of particulate matter emissions that are solid or liquid at stack conditions. U.S. EPA Method 202 of Appendix M to 40 CFR Part 51 in combination with these methods will measure total PM10 and PM2.5 emissions.

#### **APPLICATIONS**

- Particle size distribution for PM10 and / or PM2.5
- Performance specifications of control equipment
- Particle deposition after leaving the stack
- Respirable fraction & health effects