

ASHRAE Guideline 26-2008

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ASHRAE GUIDELINE

Guideline for Field Testing of General Ventilation Devices and Systems for Removal Efficiency In-Situ by Particle Size and Resistance to Flow

Approved by the ASHRAE Standards Committee on June 21, 2008, and by the ASHRAE Board of Directors on June 25, 2008.

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Foreword

Purpose “to provide a test procedure for evaluating the in-situ performances of general ventilation filtration devices and systems”

Foreword

Theoretically - any MERV 1 – 16 filter could be tested.

Practically - MERV 11 and higher.

Foreword

Counting particles 0.3 to 5.0 μm

Particles in the 1.0 to 5.0 micron range are present in low numbers (less than 1% by count) in outdoor and supply air. They also have higher sampling-system losses.

Results in the range $> 1.0 \mu\text{m}$ will have lower accuracy.

Foreword

Field measurements generally result in larger uncertainties in the results compared with laboratory measurements.

- Temporal and spatial variability in particle concentrations
- Limitations on sampling locations
- Use of field instrumentation

Foreword

Intent to provide practical method which maximizes precision and accuracy of the results while quantifying the method by recommending appropriate sampling locations, methodologies and instrumentation.

Acknowledgement

Patterned after – ***“Eurovent 4/10-2004
In Situ Fractional Efficiency
Determination of General Ventilation
Filters”***

Test Equipment and Setup

- Particle Counter

- Capable to measure 0.3 μm to 5.0 μm

- Minimum of 4 ranges

- Minimum of two ranges below 1.0 μm

Test Equipment and Setup

- Particle Counter issue - Concentration Limit

Undiluted samples shall not be taken at concentrations above the particle counter's allowable measurable concentrations which is defined as "50% of the maximum accurately measurable concentration as stated by the manufacturer of the particle counter"

Test Equipment and Setup

■ Diluter

- Used if necessary to reduce particle concentration levels to within acceptable concentration limits.
- Maintaining acceptable concentration limits is necessary to achieve good statistical data.
- When diluter is used must be used on both upstream and downstream samples.

Test Equipment and Setup

- Pump – Used to control the rate of flow through the sample probes.

A pump is not necessary when the counter flow rate is sufficient for isokinetic sampling.

Use flowmeter and a isoaxial sampling nozzle when using a pump.

Test Equipment and Setup

- Sampling probes

Diameter of the nozzle is dependent on sample flow in order to get isokinetic sampling.

Diameter of nozzle should not be less than 8mm.

Test Equipment and Setup

- Sampling lines

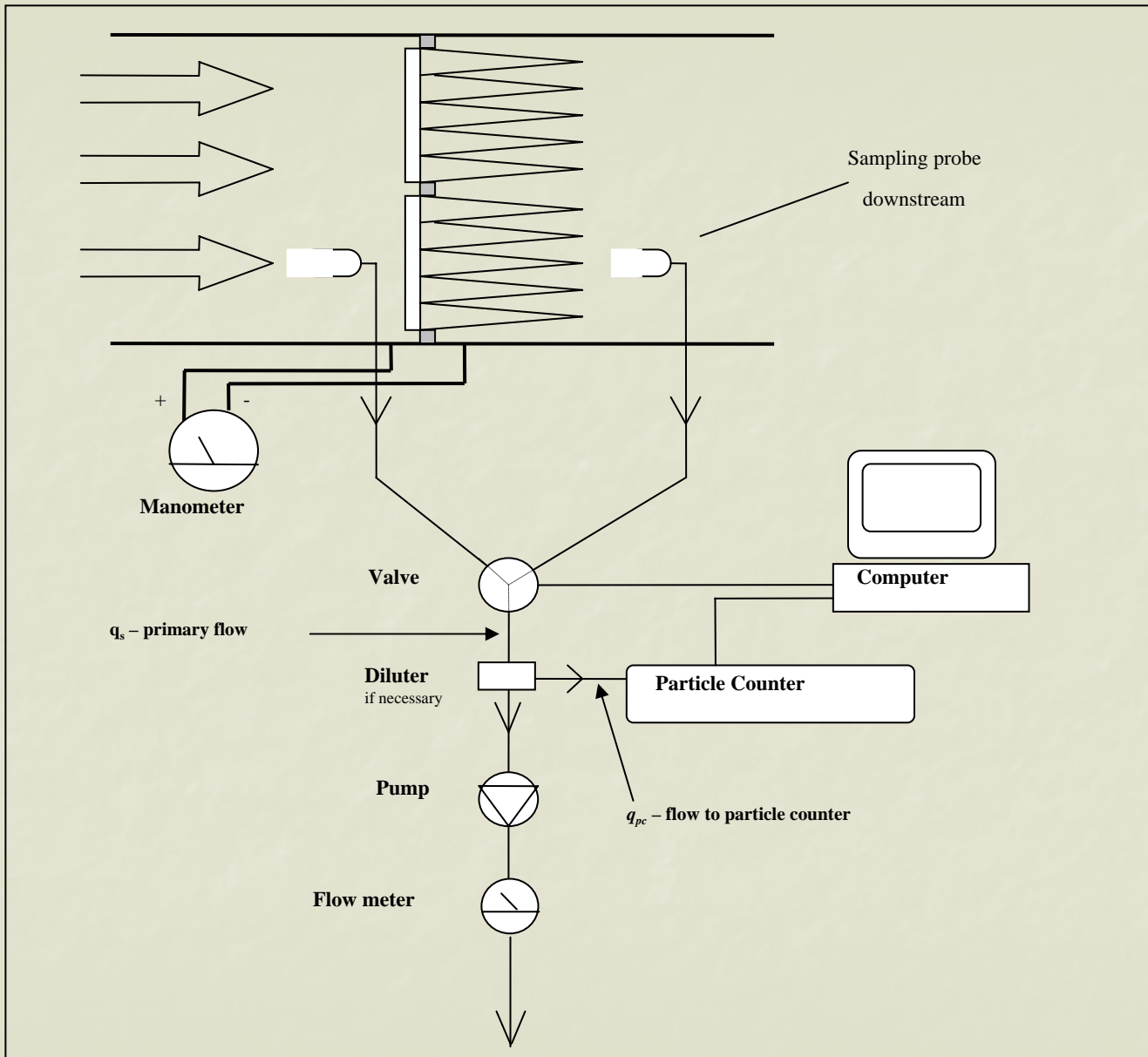
Upstream and downstream lines should be as short as possible and of equal length.

Material should be type that minimizes particle losses.

Test Equipment and Setup

- Valve (manual or automatic)

May be used to switch between upstream and downstream sample locations.



Test Equipment and Setup

- Other instruments

For measuring air velocity, relative humidity, temperature, and resistance to airflow.

Instruments chosen in accordance with Chapter 14 "Measurement and Instruments" of the 2005 ASHRAE Handbook

Site Evaluation

- Filter installation Pre-Testing Inspection
- Necessary to determine whether a filter installation is suitable for evaluation using this guide.

Filter Installation Pretesting Inspection Form

1. Air Handling Unit

	Description	Yes	No	Note #
a.	Adequate overall air tightness?			
b.	Doors have adequate seal (very little air leakage)?			
c.	Doors available on both sides of air filter banks?			
d.	Doors have provision for opening/closure from inside AHU?			
e.	Adequate space (up/downstream) of filter banks for probe placement & measurement?			
f.	Adequate space (up/downstream) of other equipment (i.e. coils, fan, etc.) for instrument placement & measurement?			
g.	Sample ports located & labeled (up/downstream) of filter banks?			
h.	Adequate overall interior cleanliness?			
i.	Adequate overall exterior access to AHU?			
j.	Any hazardous conditions (i.e. slip, head knockers, standing water, chemical)?			
k.	Adequate guards provided on the fans & motors?			
l.	Can the airflow through the filters be set to a constant value for the duration of the test?			

2. Local Instrumentation

	Description	Yes	No	Note #
a.	Are differential pressure gauges working properly & calibrated?			
b.	Are pressure taps properly aligned? (i.e., not bent, broken, or clogged)			
c.	Is there a velocity gauge working properly and calibrated?			
d.	Is there a temperature gauge working properly & calibrated?			
e.	Is there an RH gauge working properly & calibrated?			

3. Filter/Frames

	Description	Yes	No	Note #
a.	Bank #1 - Proper seating/sealing of filters?			
b.	Bank #1 - Clamping hardware in place?			
c.	Bank #1 - Filters free from damage?			
d.	Bank #2 - Proper seating/sealing of filters?			
d.	Bank #2 - Clamping hardware in place?			
e.	Bank #2 - Filters free from damage?			
f.	Bank #3 - Proper seating/sealing of filters?			
g.	Bank #3 - Clamping hardware in place?			
h.	Bank #3 - Filters free from damage?			

Approval for Testing Form

This approval of the two parties allows for the gathering of filter installation data to provide both parties with an understanding of the actual system performance resulting in acceptable future filtration configuration and performance.

Customer:
Address:

Contractor:
Address:

of Air Handlers:
Environmental Parameters to be measured: (resistance to airflow, air velocity, temperature & RH)
Filter Installation Testing Protocol: Guideline 26
Note: A completed filter installation pre-testing inspection form must accompany this form. (see appendix A)

Comments:

Acceptance (Check one box)

With comments:	Without Comments:	Not accepted:
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Customer representative:	
Signature	Date:

Test Procedure

Air velocity – necessary to be measured for determining isokinetic sampling.

Should be maintained at constant rate during testing.

Test Equipment and Setup

Relative humidity – can effect particle counter.
Where measured is important.

Filter system efficiency – At upstream and
downstream probe locations

Filter efficiency – upstream or downstream

At particle counter

Test Equipment and Setup

Temperature – also effects particle counter

Particle counts should not be measured
when temperature below freezing

Test Equipment and Setup

- Removal Efficiency Tests – 3 types
 - Filter Efficiency
 - System Efficiency
 - Other “System” Tests

Test Equipment and Setup

- Particle Counter - Same particle counter used for sampling upstream and downstream.

Test Equipment and Setup

- Sample Volume – all samples to be minimum of 1.0 liter of air (0.035 ft³) or sample time of 20 seconds whichever time is longer.

Minimum number of particles in each range is 37 p/L (1048 p/ ft³) needed to calculate a removal efficiency

Test Equipment and Setup

- Purging Sampling Lines – before each upstream and each downstream data set.

Purge time must be at least 5 times the calculated time required for a particle to travel from the sample probe to the particle counter.

Test Equipment and Setup

- Particle Counter Zero Count Test – HEPA
99.97 @ 0.3 μ m

Sum of particles in all ranges - No more than 10
p/L (280 p/ft³)

Test Equipment and Setup

- “Prescreening” - Concentration Limits

Need to establish that the upstream and downstream particle concentrations are within the range of the measuring equipment (particle counter and diluter) and high enough to produce reasonable statistically accuracy for the results.

Test Equipment and Setup

- Concentration Limits – High Side

Must be below particle counters allowable measurable concentration. Otherwise dilutor must be used.

Test Equipment and Setup

- Concentration Limits – Low Side

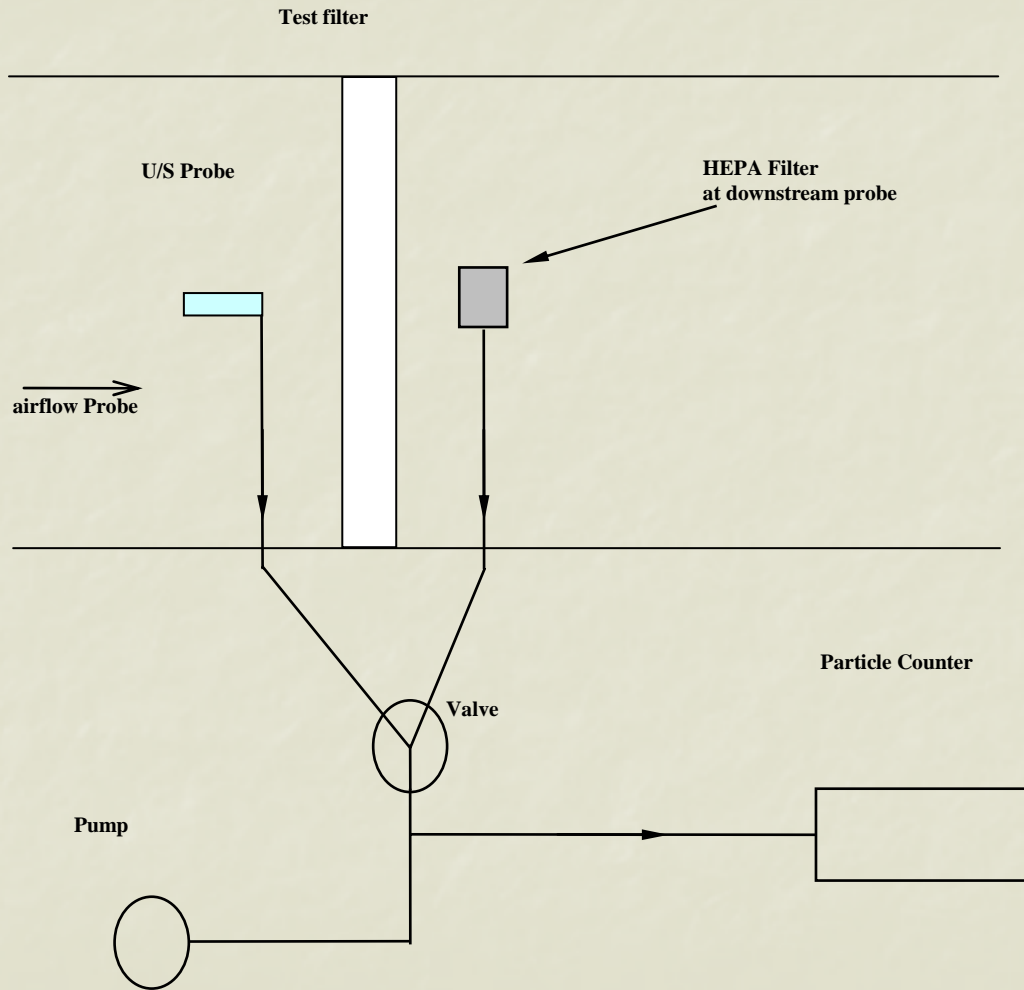
Each particle channel range should have a minimum number of particles [37p/L (1048 p/ft³)]

Test Equipment and Setup

- System Zero Count Test – downstream

Put HEPA filter on downstream sample probe and sample for a minimum of one minute.

Allowable maximum concentration in each size range is 0.05% of the upstream concentration



Test Equipment and Setup

- Isokinetic Sampling – minimizes errors

Collection air velocity can be adjusted by changing diameter / number of sampling probes or changing the sampling flow rate.

Must be within $\pm 20\%$ of the air stream velocity being sampled.

Test Equipment and Setup

- Assess variability of both space and time to determine most appropriate probe locations.

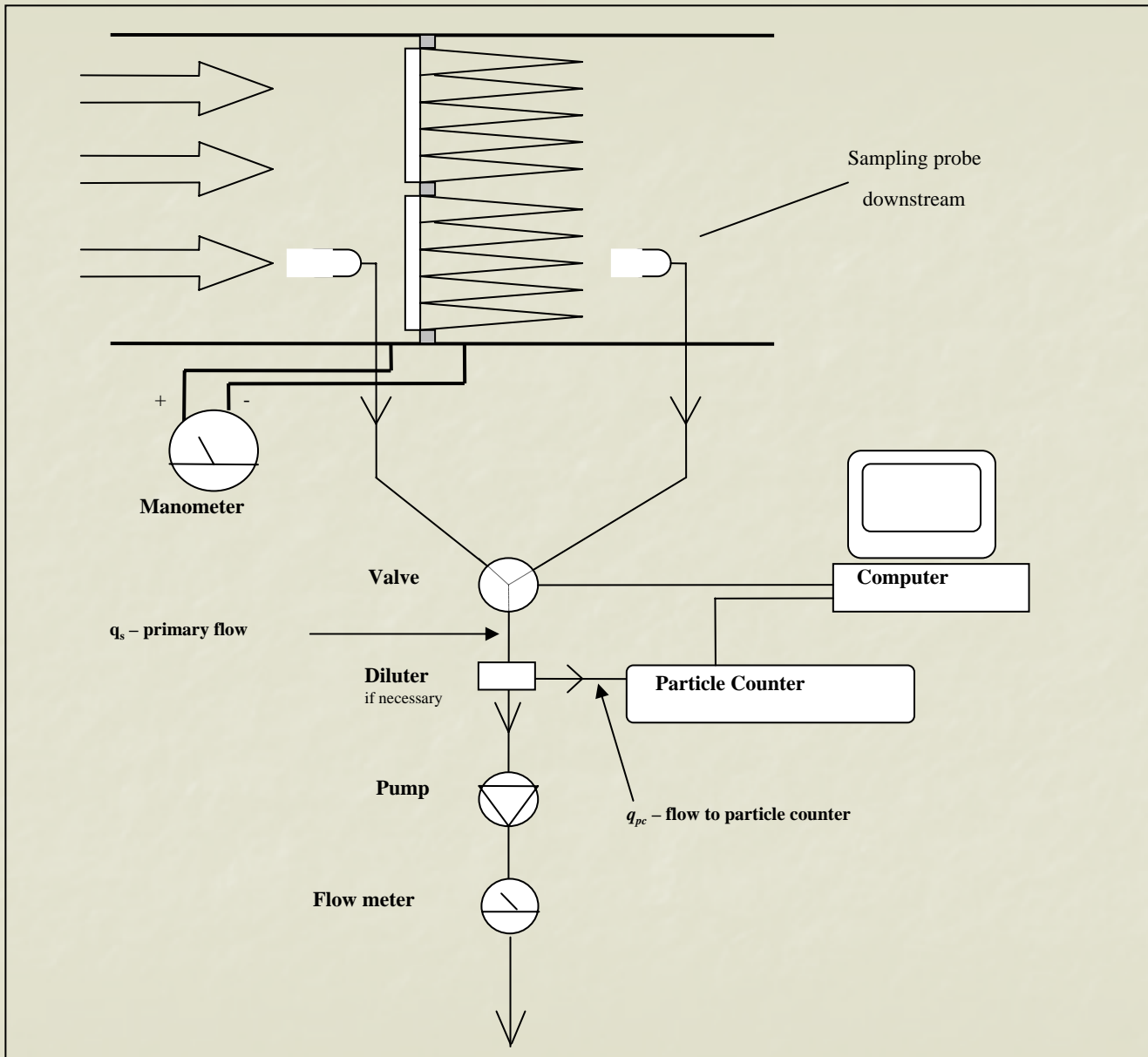
Take 5 samples at 1 location – time.

Take 1 sample at 5 locations - space.

- Coefficient of Variation (CV) is determined.

Test Equipment and Setup

- Data Set – each data set shall consist of a minimum of 6 individual particle samples for each probe location.
- Number of Data Sets – Minimum of 4 downstream data sets and 3 upstream data sets .
- Alternate between downstream and upstream. Starting with downstream sample.



Test Equipment and Setup

- Upstream Sampling Probe(s)

Located at points with consistent and stable velocity readings.

Upstream sampling probe positioned so a representative sample is obtained and within 24" of the upstream filter surface.

Test Equipment and Setup

- Downstream Sampling Probe – Filter Efficiency Testing

Locate 12" downstream of filter and in the center of the filter.

Test Equipment and Setup

- Downstream Sampling Probe – System Efficiency Testing

Located as far downstream of the filters as possible but before the next major HVAC system component that could remove particles from the airstream.

Expression of Results

A complete report shall include:

- Filter Installation Pre-Testing Inspection Report
- Approval for Testing Form
- Test report including:

Expression of Results

- Owner Information
 - Name, address, phone, e-mail
 - Building name
 - AHU designation
 - System description

Expression of Results

- Test / AHU Information
 - Type of test conducted (filter efficiency, system efficiency, or “other” system test)
 - Test date and time
 - Filter installation date
 - Location of test filter(s) in bank
 - Schematic drawing of the installation showing sample points for resistance to airflow and particle sampling.

Expression of Results

- Test / AHU Information
 - Was a diluter used?
 - Probe locations
 - Upstream and downstream
 - Air supply (% outdoor, indoor, or mixed)
 - Operation description (daily usage)
 - Filter face area in the system (per bank)
 - Other remarks about conditions that could influence results

Expression of Results

- Filter Description
 - Filter description(s)
 - Filter model / identification number(s)
 - Filter size(s) and quantity
 - Media type
 - Media color
 - Estimated filter media area

Expression of Results

- Equipment used
 - Particle Counter
 - Manufacturer and model number
 - Calibration date
 - Flow rate
 - Particle size ranges
 - 5% Coincidence value
 - Temperature, RH, Resistance to Airflow, Air Velocity
 - Manufacturer and Model #
 - Calibration date

Expression of Results

- Data
 - Zero count data
 - Particle counter zero
 - Sampling system zero
 - Pre-screening of concentrations
 - Minimum and maximum
 - Air velocity
 - Before and after sampling and average
 - Coefficient of variation (CV)

Expression of Results

- Temperature and RH
 - Within the AHU
 - At the particle counter
- Resistance to airflow

Expression of Results

- Removal Efficiency
 - The average removal efficiency for each particle size channel within the range 0.3 – 5.0 available from the particle counter
 - Upper and lower uncertainty values for each particle size channel – 95% confidence level
 - Coefficient of variation (CV) for each particle size channel
- Raw data – include all of it

Get a copy of Guideline 26

- It has all the information presented
- Plus:
 - Errors and Data Analysis
 - Calculation of Results
 - Optional Enhanced Test System
 - Examples