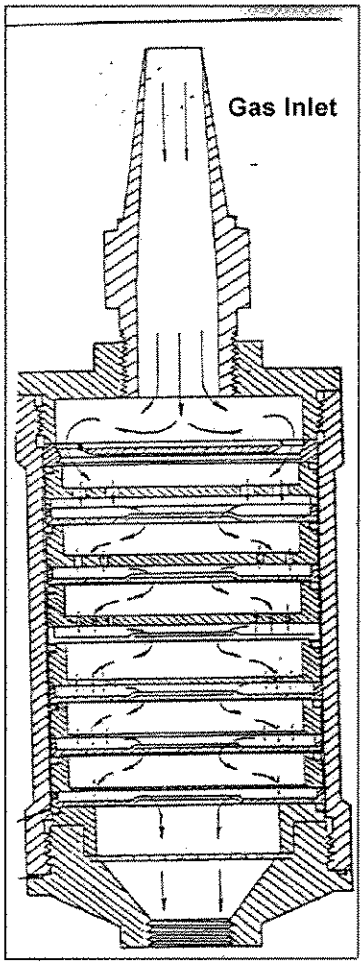
HW 2 Size Distribution of Stack Gas Particles Measured with Instack Cascade Impactor

Name _____

Due Oct 13, 2009 in class



Given:
1 hr sampling with U of Washington Cascade Impactor at 0.5 acfm gas flowrate (instack conditions).
Weight of particles sampled on each of the 7 collection plates and the outlet filter shown in the table below.

Find

a) Total particle masss concentration (grains/ft^3 & μg/m^3)
[% of particle mass less than each jet stage d_{50} and cumulative % of particle mass less than d_{50} shown in table]

b) plot the cumulative % of particle mass less than d_{50} on log probability graph paper

c) particle size distribution mass median diameter

d) particle diameter at 84.13% cumulative mass less than

e) particle diameter at 15.78% of cumulative mass less than

f) geometric standard deviation σ_g of the size distribution

g) PM10 particle mass concentration in grainsft^3 & μg/m^3 provided by the cascade impactor

$$VolGasSampled := \left(0.5 \cdot \frac{ft^3}{min}\right) \cdot (60 \cdot min)$$

$VolGasSampled = 30\,ft^3$ $\quad$ $VolGasSampled = 0.849505\,m^3$

Cascade Impactor Jet Stage	Impactor Aero Cut Diameter (da_{50}, microns)	Wt Particles Collected (mg)	(gm)	% Weight Increment	Cumulative % Particle Wt Less than da_{50}
1	30	10.709	.010709	10.0 %	100 – 10.0 = 90.0%
2	15	8.567	.008567	8.0 %	90.0 – 8.0 = 82.0%
3	7	14.993	.014993	14.0%	82.0 – 14.0 = 68.0%
4	3	19.276	.019276	18.0 %	68.0 -18.0 = 50.0%
5	1.5	16.063	.016063	15.0 %	50.0 -15.0 = 35.0%
6	0.8	14.993	.014993	14.0 %	35.0 – 14.0 = 21.0%
7	0.3	11.780	.01178	11.0 %	21.0 - 11.0 = 10.0%
Filter		10.709	.01709	10.0 %	
	Total Wt of Particles	107.09 mg	0.10709 gm	100.0 %	

EPA Particle Size Distribution Module http://www.epa.gov/air/oaqps/eog/bces/module3/distribu/distribu.htm

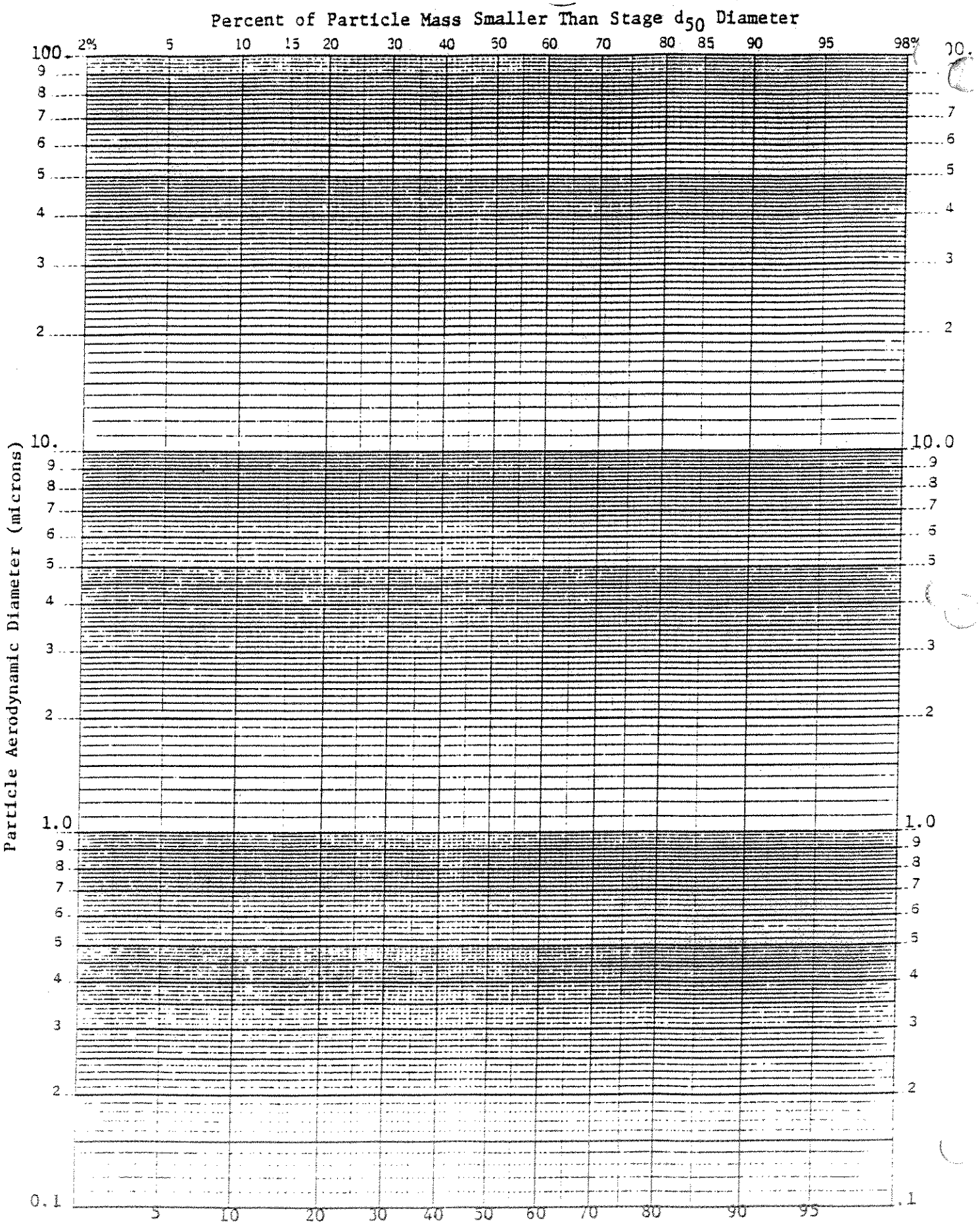
$$\sigma_g := \left(\frac{d_{84.13}}{d_{15.78}}\right)^{0.5}$$

σ_g = geometric standard deviation of the size distribution

$d_{84.13}$ is the particle diameter with 84.13% of the cumulative particle mass less than this diameter

$d_{15.78}$ is the particle diameter with 15.78% of the cumulative particle mass less than this diameter

Obtain these % from your log probability graph size distribution plot


Percent of Particle Mass Smaller Than Stage d_{50} Diameter
2% 5 10 15 20 30 40 50 60 70 80 85 90 95 98%
Particle Aerodynamic Diameter (microns)
100
10.
10.0
1.0
0.1
5 10 20 30 40 50 60 70 80 90 95