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Collison Nebulizer: Selecting the Model and Configuration

The Collison Nebulizer can be purchased in Single, 3, 6, and 24 Jet models manufactured with 316 Stainless Steel or varieties of Teflon and other polymers. Selecting a model can be determined with the following data on Droplet Number Output and Air Flow Through the Collison. For Single, 3, and 6 Jet models available an optional precious fluids jar is available which has a low volume well for working with small amounts of precious materials. Jars are manufactured from the following materials Glass, PolyCarbonate, Ultem, Polysulfone, Peek, Teflon, 316 Stainless Steel. For replacement parts on any model or questions about the Collison Nebulizer, please email sales@chtechusa.com.

Air Flow Through Collison

Pressure psig	Volume of Free Air in LPM			
	1-Jet	*3-Jet*	*6-Jet*	*24-Jet*
20	2	6	12	48
40	3.3	10	20	80
60	4.5	13.5	27	Not Recommended
80	5.8	17.3	34.5	Not Recommended
100	7	21	42	Not Recommended

Droplet Number Output

This describes a numerical analysis of the Collison nebulizer to determine the total number of droplets produced for a given back pressure and the count within 2 standard deviations of the mean droplet size (assuming a log-normal distribution). The Collison nebulizer can be operated with a variety of "jet" numbers depending on the nozzle attachment. Each jet requires approximately 2 LPM of air and produces droplets with an MMAD of 2.5 µm with a GSD of 1.8. The comparable CMAD is 0.89 µm. As given in the table below, the amount of liquid in the nebulizer reservoir used per hour per jet varies depending on the pressure applied to the nebulizer which can be estimated with the following equation:

$$Q_{Liq} = -0.84859 + 0.2636 * \ln(psig)^2$$

To determine the number of droplets produced per jet per hour by the Collison, a resulting log-normal distribution of droplet sizes was assumed. The central concept used to determine the number of droplets produced by the Collison is that the liquid volume contained in the total of all droplets produced must be equal to the volume of liquid produced by the Collison on a time basis.

A spreadsheet was constructed with 600 diameters ranging from 0.05 µm to 20 µm in even increments on a log-basis (-3 to 3 by every 0.01 ln values). The frequency of occurrence of each diameter was computed with the use of the probability distribution function for a log-normal distribution. The volume associated with each diameter was computed using the equation for the volume of a sphere. The "Solver" function in Excel was then used to determine the counts for each diameter that caused the sum of all volumes (for each diameter) to be equal to the volume generated per hour (as per the equation above) while weighting the count for each diameter by their computed frequency of occurrence. From the total number, the count between +/- 2 standard deviations of the mean was calculated. The results given in the table below were converted to a per minute basis and include the liquid output for a single jet as well as the estimated counts for a single, 3, 6, and 24 jet Collison. Concentration outputs from each of the models remain somewhat constant as increasing the number of jets increases particle number and total mass output, but also requires a larger volume of air.

Psi	Q_liq, ml/min	Single Jet	3-Jet	6-Jet	24-Jet
20	0.0253	1.377E+10	4.131E+10	8.262E+10	3.305E+11
40	0.0456	2.486E+10	7.457E+10	1.491E+11	5.965E+11
60	0.0595	3.241E+10	9.722E+10	1.944E+11	7.777E+11
80	0.0702	3.824E+10	1.147E+11	2.294E+11	9.178E+11
100	0.0790	4.304E+10	1.291E+11	2.582E+11	1.033E+12

****** Performed with Dioctyl Phthalate (Particle Number Outputs will be Material Dependent)***