EPA REPORT: "EVALUATION OF ELECTROSTATIC SPRAYERS FOR THE APPLICATION OF DISINFECTANTS"

	FLOW RATES	SURFACE COVERAGE	DROPLET SIZE		SAFETY		ELECTRICAL CHARGE				GROUNDING	POWER	MANUFACTURING LOCATION	PRICE
	EPA results of flow rates (oz/min)	Manufacturer's recommended surface coverage (ounces of disinfectant per 1000 ft2)	EPA results for Volume Median Diameter size (VMD DV0.5) using deionized water	EPA results of Volume Median Diameter (VMD DV0.5) using tap water	Per EPA: VMD ≥ 40 microns	Median droplet size range for optimal electrostatic efficiency and to minimize risk of respiratory issues (Quartiles: Q1 of >73 and Q3 of <114) with Median VMD of 92	EPA: Sprayer electrical charge	EPA results of sprayer electrostatic charge	Per EPA, minimum electrostatic charge needed	Per EPA, meets minimum charge-to-mass ratio (q/m) of at least 0.1 mC/kg to provide electrostatic benefits	Grounding Required	Corded (AC) or Cordless (Battery)	Location of Manufacturing	Average Online Pricing
Protexus/EvaClean/ Victory PX200ES HH (on)	3.7	40	37	84	✓	✗	⊕	.11-.13 .46	0.1	✓	Yes	Cordless Battery	China	$714
Protexus/EvaClean/ Victory PX200ES HH (off)	3.8	N/A	40	90	✓	✗	⊕	0.004-0.005	0.1	✗	Yes	Cordless Battery	China	$714
Protexus/EvaClean/ Victory PX300ES backpack; red (40 micron) nozzle	3.9	28	40	65	✓	✗	⊕	0.049-0.053	0.1	✗	Yes	Cordless Battery	China	$1,574
Protexus/EvaClean/ Victory PX300ES backpack; green (80 micron) nozzle	4.5	28	36	58	✓	✗	⊕	0.045-0.049	0.1	✗	Yes	Cordless Battery	China	$1,574
MaxCharge SC-ET	3.7	Spray until wet per label	28	31	✗	✗	⊖	(-3.28 to -3.56)	0.1	✓	Yes	Corded AC	USA	$3,237
EMist EPIX360 HH*	1.9	2	83	105	✓	✓	⊕ ⊖	0.28-0.29	0.1	✓	No	Cordless Battery	USA	$995
360 Sterile R40	6.1	53	44	75	✓	✗	Not electrostatic	0	0.1	✗	Yes	Cordless Battery	China	$2,195
ByoPlanet Clorox Total 360	4.1	14	46	53	✓	✗	⊖	(-6.05 to -5.74)	0.1	✓	Yes	Corded AC	USA	$5,990
Husqvarna Garden sprayer	17	N/A	50	180	✓	✓	Not electrostatic	0	0.1	✗	No	Hand Pump	China	$67
Airofog Flex ULV cold fogger	4.4	N/A	43	46	✓	✗	Not electrostatic	0	0.1	✗	Yes	Yes	China	$290
IPIHSIUS KB-1500 12L	11.2	N/A	42	43	✓	✗	This device was not tested for spray charge due to the sprayer becoming non-functioning after the DSD tests		0.1	✗	Yes	Corded AC	China	$219

SOURCES:

EPA Study Source: https://www.epa.gov/healthresearch/evaluation-electrostatic-sprayers-application-disinfectants

*In the EPA evaluation the EMist unit is incorrectly listed as EM360 HH. The tested unit was the EPIX360 HH.

The Volume Median Diameter (VMD) refers to the midpoint droplet size (median), where half of the volume of spray is in droplets smaller, and half of the volume is in droplets larger than the median. A VMD (DV0.5) of 53, for example, indicates that half of the volume is in droplet sizes smaller than 53 microns, and half the volume is in droplet sizes larger than 53 microns.EPA: It has been suggested that a charge of at least 0.1 mC/kg is needed to elicit electrostatic benefits (Gaunt and Hughes, 2004). Lastly, the electrostatic charge results were not affected by the presence of ions in the water, nor when spraying disinfectants, and were not affected by spray distance.

"Droplet Size Inhalation
Per the EPA study, "A majority of the devices evaluated had average VMDs ≥ 40 microns." However, the EPA states elsewhere, "Spray droplet particle size (regardless of the ability to change nozzles that impact particle size) should be limited to a volume median diameter (VMD) ≥40 µm."

Particle size in inhalation toxicity is usually defined by their mass median aerodynamic diameter (MNAD) and aerodynamic equivalent diameter (AED) in micrometers (µm). According to Human Health Risk Assessment of Inhaled Materials, the term inhalable fraction refers to the mass fraction of particles capable of entering into the respiratory system. Particles of >25µm AED generally fall into the extrathoracic fraction, the fraction of the inhalable particles that can deposit in the area of the respiratory tract lying between the nostrils/ mouth and the distal end of the larynx. Particles of ≤25µm AED fall into the thoracic fraction, fraction of inhalable particles that can penetrate the head airways and enter the airways of the lung. Particles of ≤10µm AED fall into the respirable fraction, fraction of particles capable of penetrating the respiratory tract to the level of the on-ciliated airways and gas-exchange regions of the lungs.

Diameter and Weight
Droplet sizes are measured in microns. A micron is 1/1000 millimeter, or about 1/25,000 of an inch. For perspective, a human hair is about 100 microns in diameter. Spray droplets smaller than 150 microns tend to be the most prone to drift. These small droplets fall more slowly than large droplets. They do not have enough weight to overcome air resistance and are likely to float in wind currents. Even small changes in droplet diameter make big differences in droplet weight. An increase in droplet diameter from 150 microns to about 190 microns doubles the droplet weight. An increase in droplet diameter from 150 microns to about 240 microns increases the weight 4 times. Doubling the diameter to 300 microns increases its weight, and also its volume, by 8 times. Heavier droplets fall more quickly and are less affected by air movement.

Size and Number
When the size of spray droplets is reduced, their numbers increase, and the potential for drift also increases. Reducing droplet diameter in half multiplies the number of droplets by eight. The characteristics of the nozzle tip (type, fan angle, orifice size, etc.) and spray pressure have the greatest influence on droplet size."

Spray Quality
'Spray quality' or 'droplet size spectrum (DSS)' refers to the droplet sizes that a particular nozzle produces; described in terms ranging from "Extremely Fine" to "Ultra Coarse""

According to the WHO Pesticide Evaluation, the time it takes for a droplet size ranging from 20 – 50 µm VMD to fall 10 meters ranges from 14 minutes to 135 seconds. To reduce potential and harmful respiratory system outcomes, EMist recommends the output particle size be above 60 µm VMD.

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