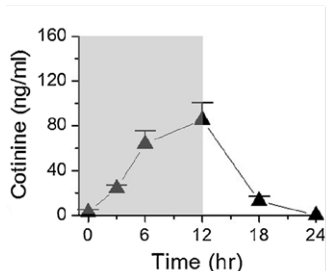
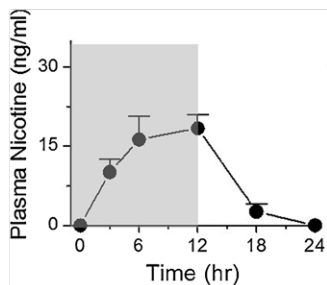


Plasma nicotine and cotinine concentrations

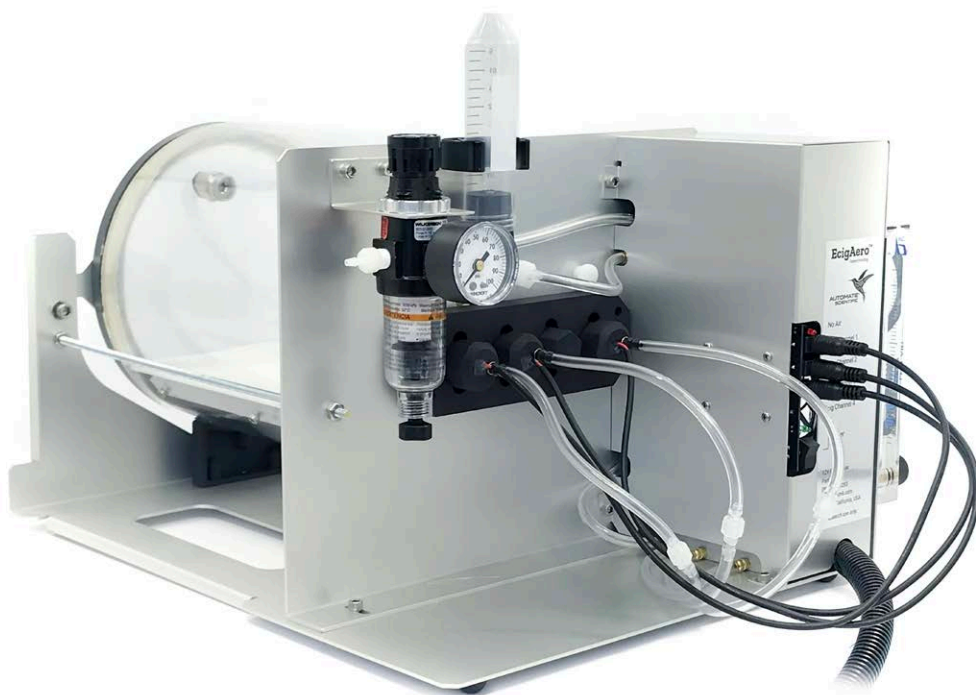


Plasma nicotine and cotinine concentrations (mean \pm SE) as a function of time. Mice were exposed to intermittent E-cig aerosol from 0 to 12 h in the dark phase of 12/12-h circadian dark/light cycle (shaded area indicates exposure to ECigs) for 9 consecutive days. The exposure dose: puff duration = 4 s; 3 puffs per episode with an inter-puff interval = 30 s; one episode per 30 min amounting to a total 24 episodes during the 12-h dark phase. Blood samples were taken in day 9 by the end of the h time point indicated. Time point 0 is the time right before the first episode of daily 12 h exposure of day 9. It is equivalent to time point 24 h of day 8. Plasma nicotine and cotinine levels were measured ($n = 3-5$ mice per time point).

X.M. Shao, et al.

Journal of Neuroscience Methods

Easy pharmacokinetics and addiction aerosol studies



EcigAero™ Aerosol Exposure Apparatus

Patent Pending | NIH Grant 1R41DA044788

The EcigAero provides an important tool for studying the acute effects of vaping electronic cigarettes (ECigs) and the chronic effects of multiple ECigarettes a day for long periods of time by repeatedly exposing rodents to ECig aerosol in a home cage-like environment. Our system provides a powerful toolkit for in vivo studies of ECig effects on cardiovascular, respiratory and nervous systems, metabolism and carcinogenesis as well as facilitating new therapeutic discovery. ECig addiction studies will have important implications in nicotine replacement therapy (NRT) for smoking cessation.

As electronic cigarettes are a relatively new product, studies are needed to determine their long-term detrimental effects. ECigs may contribute to nicotine addiction and are unlikely to discourage conventional cigarette smoking among youths, thus, generating a new market for nicotine dependence.

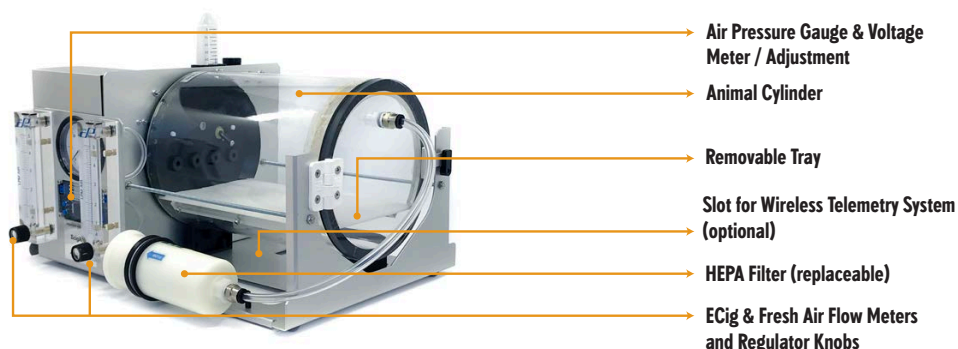
ECigs generate aerosol, not simple nicotine vapor as incorrectly claimed by the ECig industry. Mainstream and second-hand ECig aerosols not only contain nicotine and propylene glycol and/or glycerin, but also detectable levels of toxins including carcinogens and heavy metals such as formaldehyde, benzene, nitrosamines, cadmium and lead. Therefore health



risk and toxicology studies on animal models exposed to ECig aerosol, not limited to nicotine, are urgently needed.

In order for drug abuse studies with animal models to be relevant to humans, it is necessary that the routes of drug administration, the physical properties (vapor or aerosol), the pharmacokinetics (PK) and target tissue concentrations of the drug are comparable between humans and animals.

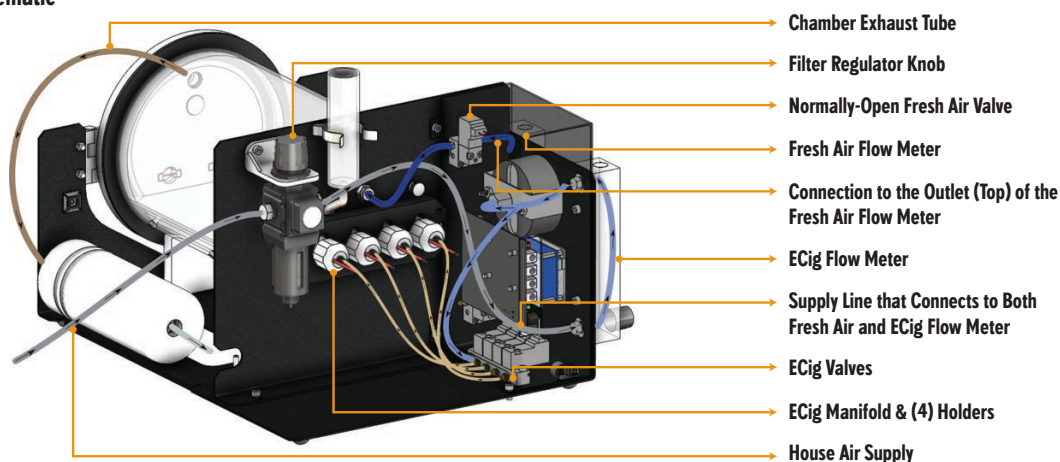
Front View



Rear View



Flow Schematic



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Accessories

AutoMate Scientific offers a number of products which complement the EcigAero: Aerosol Nebulizer, ECig Manifolds specific to manufacturer, Exposure Control Software (Windows) and ValveLink8.2 WiFi/digital/manual controller.

Aerosol nebulizer with direct connections to cylinder

Part #19-N



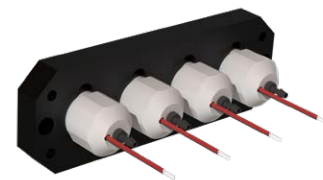
EcigAero™ myblu Liquidpods

Part #19-BL



EcigAero™ JUULpod manifold

Part #19-J



EcigAero™ Battery-powered (bluPLUS+) manifold

Part #19-BP



Key Features

Direct delivery for ideal aerosol

No tubing, bends, mixing chambers, fans or pumps between the ECig and the rodent chamber. Aerosols deteriorate rapidly during transport and dilution when passing through tubing and chambers due to droplet coagulation, condensation and vaporization. We have characterized the particle size distribution of the ECig aerosol in our chamber†. The EcigAero maintains consistent aerosol characteristics to those at the mouthpiece where humans inhale ECig aerosol. The pulmonary distribution of the aerosol generated in this device correlates with that generated by ECigs during typical human use.

Multiple “real” electronic cigarettes

The EcigAero will accommodate up to four (4):

- First generation Blu PLUS+ ECigs (battery powered)
- Second generation JUULpods™ or myblu™ Liquidpods
- Third generation “mod” tanks with universal “510” industry-standard threads
- Can be used along with any aerosol via nebulizer (optional)

The aerosols are delivered at a highly regulated pressure with a flow rate between 0 and 4 liters per minute (LPM). Pods and tanks are precisely energized with 0.1V accuracy. The EcigAero tests the inhalation exposure of REAL ECigs rather than de novo generated mixtures of nicotine + E-liquid. The exposure doses of our rodent models were verified by plasma nicotine levels/PK and with our software can be controlled by varying the number of ECigs simultaneously activated, puff duration, inter-puff intervals and frequency of puffs.

The capacity for multiple ECigs allows for:

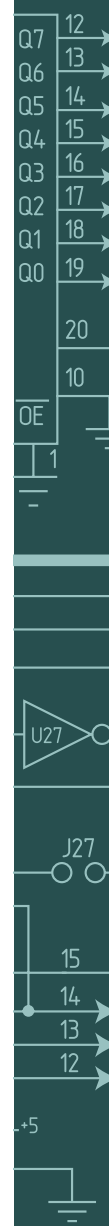
- Longer experiments than a single ECig battery or tank
- Higher concentrations of aerosol if multiple ECigs are delivered simultaneously
- Side-by-side testing of different ECig flavors or nicotine concentrations

Fresh air

For chronic intermittent ECig aerosol exposure with animals, there should be fresh air flow between aerosol deliveries (when ECigs are not activated) which removes the residual ECig aerosol and provides fresh air for normal breath of rodents. Proper air flow is important for consistence of ECig exposure and for the health of the rodents during chronic experiments in the exposure chamber, as it more closely mimics human behavior of ECig devices. The EcigAero delivers fresh air at 0 to 5 LPM for up to 40-50 air changes per hour (ACH).

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Fully programmable

The ECig aerosol, nebulizer aerosol and fresh air can all be independently programmed with 10 millisecond accuracy to regulate the dose of aerosol exposure and simulate the vaping pattern of ECig users. Programs can last up to 72 hours allowing researchers to coordinate aerosol delivery with simulated wake-sleep, day-night schedules at their convenience. In human vapers, exposure to e-cigarettes is chronic and intermittent with episodic inhalations during wakefulness and abstinence during sleep leading to circadian fluctuations of blood nicotine levels. As with conventional cigarette smoking, the episodic inhalation patterns of ECig users can induce cycles of activation, desensitization and resensitization of nicotinic acetylcholine receptors (nAChRs) in body systems that may contribute to a number of different aspects of nicotine effects, e.g. addiction and cardiovascular effects.

Telemetry

The EcigAero can hold a short-range antenna below the chamber for implanted telemetry systems such as the DSI PhysioTel® Implantable Telemetry that remotely measures blood pressure, ECG and other physiological parameters of the freely-moving rodent and continuously during acute or chronic exposure experiments. Our electronics and valves are isolated from the antenna and have been tested to avoid interference with the ultra-low power transmissions from implantable devices.

Additional Features

- The EcigAero **accommodates** up to 5 unrestrained, unanesthetized, freely-moving mice or 1 rat. **Unit** comes equipped with a water reservoir and removable tray for easy cleaning.
- Replaceable HEPA filter for use in a fume hood or lab bench.
- Small, light footprint: 16 in x 10 in, 12 in (h).
Recommended table space: 18 in x 18 in.
- You can learn more about the included valve controller at <https://www.autom8.com/perfusion-systems-overview/valvelink8-2-controller>.

† A mouse model for chronic intermittent electronic cigarette exposure exhibits nicotine pharmacokinetics resembling human vapers. Xuesi M. Shao, T. Friedman, et al. Journal of Neuroscience Methods, Vol 326, October 2019. <<https://doi.org/10.1016/j.jneumeth.2019.108376>>

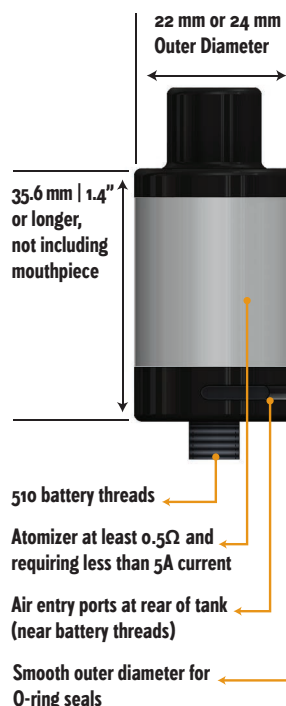
EcigAero™ Universal "510" thread manifold

Part #19-510



Can accommodate most vape tanks that are either 22mm or 24mm in diameter with 510 battery threads and air entry ports on the end near the battery threads. The holders will not fit tanks that have air entry ports near the front (mouthpiece), and they will only fit tanks with a round outer diameter and overall length greater than 1.75". The holders use O-rings to seal to the outer diameter of the tanks, so tanks with large grooves or embossed designs on the body may not seal. Please contact AutoMate Scientific if you have questions about whether a specific tank will fit.

ECig Tank Sizing Chart



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ValveLink®8.2**WiFi/digital/manual controller**

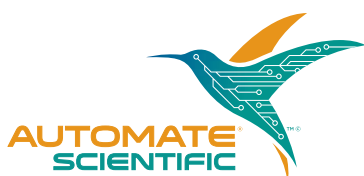
Part #01-18w

**Ordering information**

Part No.	ECigAero™ Aerosol Exposure Apparatus
19-3-R	EcigAero Rodent aerosol exposure apparatus (rat & mouse size, 4 ECigs)

Part No.	ECig Manifolds
19-J	EcigAero JUULpod™ manifold
19-BP	EcigAero blu PLUS+ manifold (battery-powered)
19-510	EcigAero Universal "510" thread vape "tank" manifold
19-BL	EcigAero myblu™ Liquidpods manifold
19-N	Aerosol nebulizer with direct connections to cylinder for ECig

Part No.	ValveLink, Software and Accessories
19-ECS	EcigAero Windows Exposure Control Software
01-18w	ValveLink8.2 WiFi/digital/manual controller
19-H2O	Replacement rodent drinking reservoir and sipper tube
19-HEPA	Replacement HEPA filter
compressor	Quiet air compressor (115 VAC) - 220V also available



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