



A Halma company

# Breathing Easy with Alicat Flow Devices

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Shaina Shay • ALICAT SCIENTIFIC MARKET MANAGER





## We Set the Standard

**The COVID-19 pandemic** has resulted in unprecedented challenges for modern medicine. Procuring and manufacturing the medical supplies needed for hospital staff to support the critically ill while protecting themselves from the disease has become a priority for governments everywhere.

To meet growing demand, companies that manufacture ventilators are working hard to increase output. Due to their repeatability and accuracy, Alicat mass flow controllers and pressure controllers are being used in ventilator test stands to calibrate and test these new ventilators.

COVID-19 is an infectious virus that attacks healthy lung tissue which can result in mild to severe respiratory complications. While the majority of people infected have only mild symptoms, approximately 14% require hospitalization and oxygen support.<sup>1</sup> Mechanical ventilators are used to support those who are severely impacted by the virus. Ventilators feed humidified and pressurized air into the lungs to assist in oxygen uptake. Current estimates suggest that the United States has about 200,000 ventilators, but many may already be in use.<sup>2</sup>

## Calibration Stations

Alicat mass flow and pressure controllers are used as calibration standards in the manufacturing process. Our controllers offer an industry leading controllable range, and feed a variety of set points to a ventilator to test accuracy and repeatability of these life support devices. This ensures ventilators are operating within the desired parameters.

Ventilators require specific flow rates and pressure conditions to ensure sufficient oxygen delivery to patients making accurate calibration of ventilators very important. The oxygen concentration in the air being delivered is set depending on FiO<sub>2</sub> (Fraction of Inspired Oxygen), which is the lowest amount of oxygen that can help the patient reach the level of required blood oxygenation.

Because lung capacity varies by individual, a ventilator needs to be able to flow different amounts of oxygen-rich air to each patient with great accuracy. The amount of air a ventilator pumps into a patient's lungs is dependent on many different factors which include lung function and oxygen saturation in the blood. Mechanical ventilation can be triggered by oxygen saturation levels or by a pre-determined number of breaths per minute. It is very important that the ventilator is calibrated against a reliable and stable standard so displayed flow rate and the actual flow rate being inspired is the same every time (repeatability).

Alicat Device	Model	Repeatability	Accuracy	Control response time*
High-flow meter	M	$\pm(0.2\%$ of reading + 0.02% of full scale)	$\pm(0.8\%$ of reading + 0.2% of full scale)	<1 ms
High-flow mass flow controller	MC	$\pm(0.2\%$ of reading + 0.02% of full scale)	$\pm(0.8\%$ of reading + 0.2% of full scale)	30–50 ms
Dual-valve mass flow controller	MCD	$\pm 0.2\%$ full scale	$\pm(0.8\%$ of reading + 0.2% of total span from positive full scale to negative full scale)	100 ms
Pressure controller	PC	$\pm 0.08\%$ full scale	$\pm 0.25\%$ of full scale	100 ms
Dual-valve pressure controller	PCD	$\pm 0.08\%$ full scale	$\pm 0.25\%$ of full scale	100 ms

\*Control response can be adjusted to be faster/slower using PID tuning.

## Verification and Testing

To ensure each ventilator is operating within the required specifications for all settings used in the field, the calibrated ventilators must go through a testing process to ensure they are operating at a set standard. This testing process is crucial to determining the performance of the device.

Alicat mass flow meters output flow rate, pressure, and temperature to confirm that the ventilators are supplying oxygen at the desired conditions. In a wide range of available options, protocols, and measurement ranges, Alicat devices offer ease of automation to increase the efficiency of the testing process.

## Critical Specifications

Alicat devices meet critical calibration standards to ensure proper operation in calibration, verification, and testing processes for ventilators. The standards these test benches must meet include specifications such as: repeatability, accuracy, and control response time.

**Repeatability** (also called Precision) describes the closeness of measurements between separate tests when no other factors change. Alicat's repeatability ensures that the tidal volume of each repetitive breath measured and provided by the Alicat in testing can be trusted to be within the required specifications, and ensure proper ventilator function.

**Accuracy** relates the difference between the measured air flow and actual air flow in the system. Our accuracy ensures that you will get the right amount of air flow through the system ensuring your instrument always functions within tolerance.

**Control response time** indicates the amount of time it takes the controller to adjust to changing conditions (flow or pressure) it is given. Fast control response time is critical to both accurately simulate breathing and test a variety of flow and pressure conditions quickly. The measurements on both Alicat meters and controllers are updated every millisecond, so you know the data can be trusted.

Alicat specifications for these parameters are shown above; a list of the full specification sheets for these devices can be found at [alicat.com/specs](https://alicat.com/specs).

Alicat is committed to helping meet the demands of ventilator production with products that are reliable, precise, and meet the demands of medical device testing. Our application engineering team is here to partner with you to determine the best technology for your application.

**Want to learn more? Contact one of our expert applications engineers today.**

- 1 "Clinical management of severe acute respiratory infection (SARI) when COVID-19 disease is suspected." World Health Organization, 2020.
- 2 "Ventilators explained: Key device in fight against coronavirus." Aljazeera Health, 29 March 2020, <https://www.aljazeera.com/news/2020/03/ventilators-explained-key-device-fight-coronavirus-200329065155185.html>. Accessed 3 April 2020.



**Shaina Shay** is a policy and research expert, specializing in environmental resource management. She has led campaigns resulting in smart, sustainable policies around the world, and joined Alicat in 2019 as the environmental market specialist.

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**WORLD HEADQUARTERS:**

7641 N Business Park Drive  
Tucson, Arizona 85743, USA

[www.alicat.com](http://www.alicat.com)

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**EUROPE REGIONAL OFFICE:**

Geograaf 24 • 6921 EW Duiven  
The Netherlands

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**CHINA AND SOUTHEAST ASIA  
REGIONAL OFFICE:**

2nd Floor, Block 63, #421 Hong Cao Rd, Xuhui District,  
Shanghai, PRC 200233

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**INDIA REGIONAL OFFICE:**

M/s Halma India Pvt. Ltd.  
C/O Avire India Pvt. Ltd.  
Plot No. A-147, Road No. 24  
Next to Spraytech Circle,  
opp. Metropolitan Company  
Wagale Industrial Estate, Thane (West) 400604, Maharashtra, India

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**REPRESENTATIVES WORLDWIDE****SWEDEN / DENMARK**

Kompauto Nordic AB  
Box 265  
771 26 Ludvika  
Ph: +46 10 130 10 00  
[info@kompauto.com](mailto:info@kompauto.com)  
[www.kompauto.com](http://www.kompauto.com)

**NORWAY**

Kompauto Norway AS  
Pb 30  
5854 Bergen  
Ph: +47 55 55 86 99  
[info@kompauto.com](mailto:info@kompauto.com)  
[www.kompauto.com](http://www.kompauto.com)



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