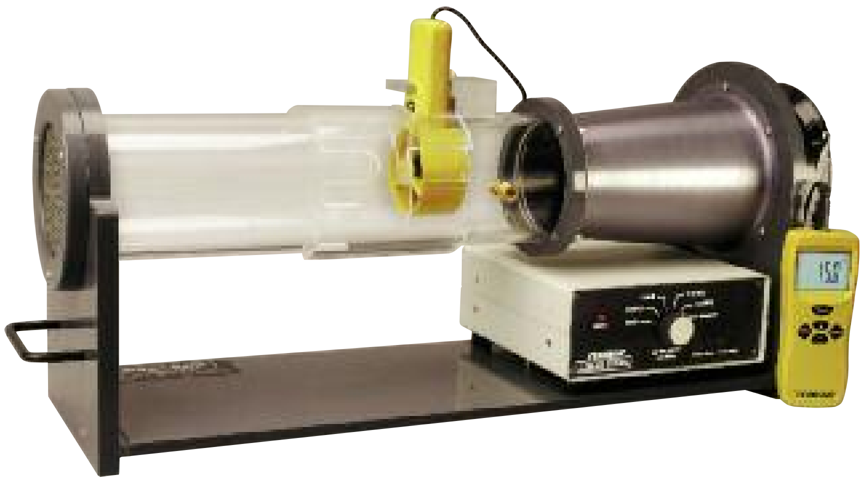
OMEGA's New Benchtop Wind Tunnel: A Versatile Tool that Calibrates Handheld Anemometers

www.omega.com

Whether small enough for a benchtop or large enough to fill a building, whether used to calibrate handheld air velocity instruments or to test spacecraft aerodynamics, whether capable of accelerating air to a few meters per second or to five times the speed of sound, all wind tunnels are basically alike. Their elongated main compartment contains a central test section (where objects with attached sensors are positioned) or an air chamber (where air velocity sensors requiring calibration are positioned). Air streams through the tunnel, and into the test object or the sensor, at a controlled rate, usually driven by a fan.



The WTM-1000 mini wind tunnel can be used to calibrate two popular anemometer types: vane **(shown here)** ***and hot wire. Made in the USA, this product fully satisfies the Restriction of Hazardous Substances*** **(RoHS)** ***directive of the European Union.***

The Wright Brothers didn't invent the wind tunnel—Francis Wenham did so in 1871—but they were the first to design a full-size aircraft based on aerodynamic data gathered from wind tunnel experiments with scale models. Over a two-month period in 1901, they used a homemade wind tunnel to assess the aerodynamic lift and drag of more than 200 wing types. The tunnel attained an air velocity of 27 miles per hour using a double-bladed, two-foot-diameter fan rotated by a two-horsepower motor.

Subsequent increases in aircraft speed have brought about corresponding advances in wind tunnels, with some of the latest capable of generating horsepowers in the hundreds of thousands. No wind tunnel program is more impressive than that of the National Aeronautics and Space Administration, which has more than 40 tunnels, including a decommissioned one in California's Silicon Valley that can accommodate an airplane with a wingspan of 100 feet. Automakers also use wind tunnels, mainly to assess wind noise and drag (reducing drag is an efficient way to improve fuel economy).

In performing aeronautical and automotive tests, wind tunnels move air over stationary objects to simulate objects traveling through still air. Industrial and laboratory wind tunnels usually don't entail this shift in perspective. Used mainly for calibration of anemometers (instruments that measure air velocity), these smaller wind tunnels could be said to more closely duplicate the tested article's field conditions.

“Anemometer” derives from the Greek “anemos” (wind) and “metron” (measure). There are two main anemometer types: vane and hot wire. The mechanical vane anemometer senses the slightest airflow by virtue of a lightweight, multibladed impeller mounted on a hub containing low-friction ball bearings. To take measurements, the impeller is held vertically, facing the airflow. The anemometer’s electronics convert cycles of the rotating impeller to air velocity, expressed on the display in meters per second, feet per minute, miles or kilometers per hour, or knots.

The hot-wire anemometer employs a probe tipped with an electrically heated sensor typically composed of two platinum resistance temperature detectors (RTDs) or two beaded thermistors. Placed in an air stream, the first RTD or thermistor cools, changing resistance. The anemometer calculates air velocity based on the sensor’s cooling effect. The function of the second RTD or thermistor is to compensate for ambient temperature. In recent years, hot-wire anemometers incorporating RTDs have earned a reputation for superior durability, sensitivity, and speed of response.

Found in meteorological, climate control, pollution monitoring, and laboratory applications, anemometers have their biggest user base in HVAC, where their principal purpose is air duct balancing. This task involves many readings and calculations—not a major challenge for today’s computerized anemometers. They can store hundreds of readings and even multiply mean velocity by a duct’s cross-section to arrive at measurements in cubic feet per minute.

Still, an anemometer won’t do an HVAC technician much good unless it’s calibrated, and the calibration standard against which almost all anemometers are measured is the industrial wind tunnel. The leading calibration labs have large closed-circuit (also called closed-loop) tunnels that use temperature-controlled recirculated air and that have test sections spacious enough for all but the bulkiest anemometers. A 25-foot-long wind tunnel, for example, dominates Omega Engineering’s highly regarded calibration lab in Stamford, Connecticut.

Low turbulence, high accuracy, and excellent repeatability make custom-built tunnels on this scale worth the investment for the busiest labs. Smaller independent labs and in-house calibration departments rely on benchtop wind tunnels. Omega itself has for some time marketed a 0.15 to 45 meters per second benchtop wind tunnel that, fully equipped, costs around $12,000. Now the company has a second product that makes wind tunnel ownership even more attractive.

The new WTM-1000 laboratory-grade “mini” wind tunnel draws on Omega’s decades of calibration experience and on the imagination of its talented design team. Add quality components and the precision workmanship of Omega’s suburban Philadelphia manufacturing plant, and what you get is a benchtop wind tunnel for calibrating *either* vane or hot-wire anemometers. Most other wind tunnels in this class handle only one anemometer type, and Omega’s $2,995 price is a breakthrough. Moreover, the WTM-1000 satisfies the European Union’s recently implemented Restriction of Hazardous Substances (RoHS) directive.

This wind tunnel has a four-inch-diameter air chamber and an accuracy of ±1% of reading. There are four fixed air velocity settings: 2.5, 5, 10, and 15 meters per second. At the factory, each setting is calibrated against a NIST-traceable reference standard, with internal potentiometer adjustments made through the four openings in the control panel. The tunnel's "remote" option lets a user connect a separate potentiometer to control air velocity externally. This option also enables control of air velocity through a personal computer.

Built to meet the rigors of professional calibration labs, the WTM-1000 has a sturdy plastic stand with large handles. Air velocity settings on the control panel are given in meters per second and feet per minute. The quiet yet powerful DC fan, at the wide end of the anodized aluminum cone, draws air into the chamber through the turbulence-reducing honeycomb baffle. Reference lines etched into the clear plastic cylinder aid precise centering of the anemometer sensor, away from the turbulent airflow next to the cylinder wall. Easily adjusted clamps and sleeves ensure that the vane housing or the hot-wire probe stays firmly in place. The user manual includes instructions on compensating for barometric pressure and temperature variations. The WTM-1000 is backed by Omega's warranty and by one of the best technical support programs in the industry.

"The HVAC industry, small metrology labs, and users in science and academia have been looking for a versatile yet affordable benchtop wind tunnel," said Shahin Baghai, Omega's product development senior engineer. "We've broken the $3,000 price barrier with a quality product that will calibrate either a hot-wire or a vane-type anemometer. Now almost anyone can afford a wind tunnel—just as, 20 years ago, it became possible for almost anyone to afford a personal computer."