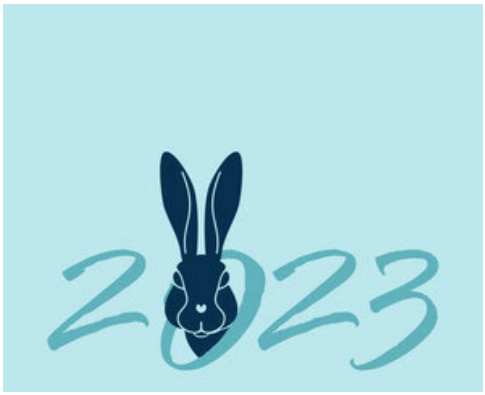
FlowTimes – December 2022

Your strategic update on flow, temperature, and pressure measurement from Flow Research

Executive Editor: Dr. Jesse Yoder. Volume 23, Number 3 – ISSN 1350-7204

1. Wishing you Happy Holidays and a Prosperous New Year

As the holidays approach and we head into a new year, we want to send you our warmest greetings for wonderful holidays and a prosperous new year.



In Chinese astrology, 2023 is the year of the Water Rabbit, which somehow seems propitious for those of us in the flow family. The rabbit is considered one of the luckiest signs, and we hope our in-depth research give a little boost to your business "luck." That said, here are three ways you can help us make you even luckier:

1) **Tell us your needs.** We would like to hear about your research needs for the coming year, including custom projects and help forming partnerships and alliances or setting up distributorships in the U.S.

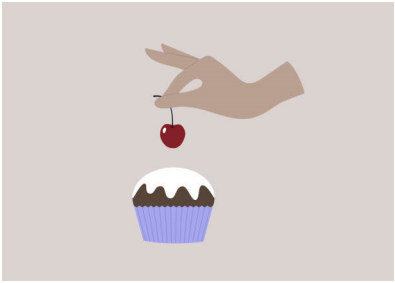
2) **Snag some off-the-shelf studies.** Consider filling out your research library with one or several of the in-depth studies we completed within the last year: positive displacement, turbine, magnetic, and variable area flowmeters, plus all flowmeter technologies in Volume X and Module A, and pressure transmitters. (See descriptions at the end of this newsletter.) It's been a busy year here at Flow Research!

3) **Give us your opinion on our plans for 2023.** Tell us what you think about the studies we are considering providing next year.

   Here is our proposed list of next-year's studies covering the latest 2022 data:

   - We are excited to consider a first-ever ***Mass Flowmeter Series*** that includes a core overview, ***The World Market for Mass Flow Measurement,*** and three important in-depth studies on flowmeters that measure mass directly:

     - ***The World Market for Coriolis Flowmeters, 7th Edition***
     - ***The World Market for Thermal Flowmeters, 3rd Edition***
     - ***The World Market for Mass Flow Controllers, 4th Edition***



Each of the complete and separate studies in the series is interesting and important in its own right, but together they are even stronger.

The core study – the cherry on top – will compile high-level results from each of the studies to give a comprehensive picture of the entire mass flow market. We also plan to include data on indirect (multivariable) mass flowmeters in the core study.

- The **ultrasonic flowmeter market** is one of the most dynamic markets, and we feel it is important to update you now with the latest 2022 data. (Our last study was in May 2021.) Since the ultrasonic flowmeter market is unique in that it consists of three distinct types of meters with fundamentally different applications and industries, we propose our proven three-study approach:

    - ***Core Study: The World Market for Ultrasonic Flowmeters, 7th Edition***
    - ***Module A: The World Market for Inline Ultrasonic Flowmeters***
    - ***Module B: The World Market for Clamp-on and Insertion Ultrasonic Flowmeters***

- ***Volume X: The World Market for Flowmeters, 9th Edition***, and its standalone companion study, ***Module A: Strategies, Industries, & Applications*** will mark 20 years since our first edition in 2003. *Volume X* continues to be our best-selling study.

We welcome your thoughts on these or other studies. Please keep your eye out for proposals coming to your in-box soon, or contact us for your proposal copies if you just can't wait!

Please send any comments to jesse@flowresearch.com.

2. Emerson upgrades Rosemount™ 3051 Pressure Transmitter for faster, intuitive experience

Emerson has added new capabilities to its Rosemount™ 3051 Pressure Transmitter, including enhanced graphical displays, Bluetooth® wireless technology, and built-in diagnostics. In a November 7 press release, Emerson said the transmitter's "powerful" new features make it easier to use, provide more insights and add diagnostic capabilities.

The company redesigned user interfaces to provide a simplified, task-based menu structure with common navigation across host and configuration tools. A new, high-contrast, graphical, and back-lit display can operate in eight different languages. Visual icons give better insight to transmitter status.

The new Bluetooth® wireless technology simplifies configuration and service tasks without having to physically connect to a device. A few simple inputs and built-in password protection,

give users have an encrypted data connection from the transmitter to the mobile device or configuration tool.

Additional transmitter upgrades include capabilities that have historically been limited to flowmeters and level devices: Operators can easily configure the device to measure flowrate as well as track total flow. Level measurements are simpler with a built-in configurator to set up level outputs. Volume measurements are also possible for common tank styles or even customized tanks that require a strapping table.

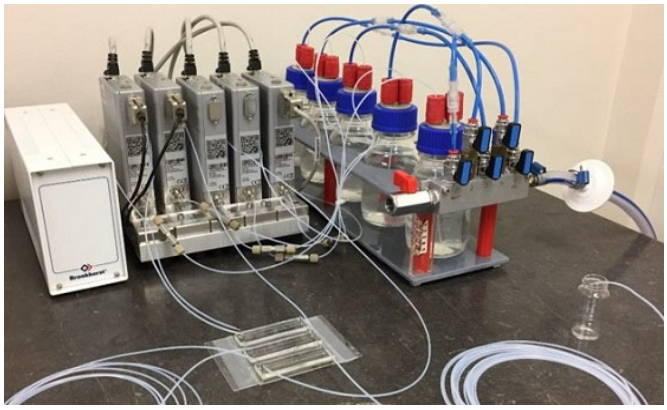
Enhanced Rosemount 3051 pressure transmitter

Built-in diagnostics help the Rosemount 3051 identify issues in electrical loops and impulse lines that could result in the control system receiving incorrect measurements, potentially leading to safety and quality compromising decisions. A built-in diagnostic log tracks all diagnostic events and allows users to always know the device status, even when not connected to the device. Emerson says these capabilities help service technicians address potential problems faster by detecting them early, when they can still be corrected before they jeopardize employee safety, operations, and the environment.

Note: Our new market study, *The World Market for Pressure Transmitters, 5th Edition*, published in June, found that feature enhancements like these are adding value to process performance and contributing to growth in the pressure transmitter market. The study covers the pressure transmitter market from 2019 to 2024. Learn more at www.pressureresearch.com.

3. Bronkhorst's micro-Coriolis mass flow supports COVID organ-on-a-chip research

Bronkhorst High-Tech B.V., a leading provider of thermal mass flowmeters and mass flow controllers (MFCs), is deploying mass flow control at a miniscule level to help scientists understand how COVID-19 invades and impacts the human body.



Bronkhorst Coriolis-based mass flow sensors

The Netherlands-based Bronkhorst specializes in ultra-low flow Coriolis flowmeters and controllers for liquids and gases and achieved a technological breakthrough with its compact and cost-effective mini CORI-FLOW™ Coriolis mass flowmeter/controller series. Now the company is taking small to the extreme.

Researchers at the University of Groningen in the Netherlands have successfully demonstrated the use of Bronkhorst Coriolis flow controllers in a "gut-on-a-chip" system designed to mimic the digestive tract. Accurate and stable control of gas flow, liquid flow, and pressure helps the system grow and maintain healthy cells.

The Coriolis flowmeters in the system were co-developed with the University of Twente, where Bronkhorst's Science Officer, Joost Lötters, works as part-time professor with a team of around 10 people to develop new technologies for future Bronkhorst products.

The flowmeters use a MEMS-based Bronkhorst Coriolis sensor – the lowest flow-measuring Coriolis mass flow sensor in the world – that uses wafer technology similar to semiconductor chips. Most MEMS (Micro Electro Mechanical System) flow sensors are based on thermal measurement principles. They are fast, stable, and can measure liquid flow down to a few nanoliters per minute, but they need to be calibrated for each specific fluid. Coriolis flow sensors do not have this problem. However, since Coriolis forces are harder to detect in small flows, the Bronkhorst and the University of Twente have developed a "surface channel technology" that makes tubes mechanically stable even with extremely thin (1 micrometer) silicon nitride walls.

As Bronkhorst's Science Officer, Lötters is involved in an iMicrofluidics project and initiative at Delft University of Technology designed to support and speed up the development and optimization of organ-on-a-chip systems. They hope to provide researchers with an integrated, compact and modular microfluidic sensor and actuator platform for connecting various types of organs on a chip and monitoring and controlling the output in real time.

Organ-on-a-chip methods allow researchers to study COVID-19 within 24 hours of infection without touching a human.

For more information visit the Bronkhorst news center or Dr. Lötters' blog on the subject.

4. VA meters – low-cost and surprisingly interesting

The market for variable area (VA) flowmeters is growing as suppliers introduce improvements to meet the increasingly sophisticated needs of today's users, according to our first-ever VA study, *The World Market for Variable Area Flowmeters*, published in October (www.flowva.com). The study found that worldwide VA meter revenues totaled $280 million in 2019 and forecasts a compound annual growth rate (CAGR) of just above one percent worldwide through 2024.

Yokogawa offers glass and metal variable area flowmeters under the Rotameter name

VA flowmeters may be small, simple, and somewhat overlooked in the world of flowmetering, but they're pervasive and essential – and surprisingly complex in how they can be customized and configured to meet specific needs for a wide array of applications. In fact, VA meters measure liquids, gas, and steam in just about any industry. They are found in oil rigs, refineries, process plants, water treatment systems, laboratories, welding lines, dental offices, HVAC systems, and more.

VA meters are not as accurate as most other meters, but they are low-cost; easy to understand, install, use, and maintain; as well as reliable and repeatable. They come in a variety of shapes, sizes, and materials to suit a wide range of applications. And now, with up-to-date communication interfaces and developments in diagnostic functions, they can even integrate into plant asset management systems.

Although most VA meters are still read manually in the field, many can now transmit data to a recorder, programmable logic controller (PLC), or distributed control system (DCS). Even though adding a transmitter with an output signal means the VA meter requires a power supply, it opens opportunities, including aligning with the broader industrial trend for instruments to communicate with each other. Transmitters give VA meters more versatility and make them more suitable for process environments. With a transmitter, for instance, VA meters can serve like a switch, registering flow/no-flow and triggering an action in a process system. Operators can also obtain a reading without having to manually compare the meter's float to tick-marks on the meter.

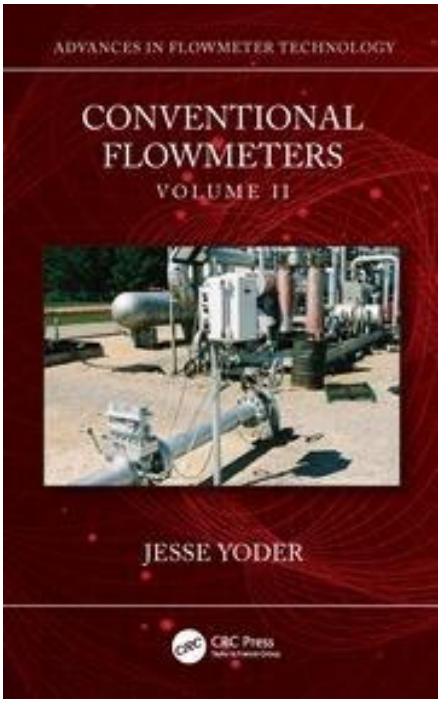
KROHNE VA meters in plastic, glass, and metal

Other innovations are also mitigating traditional VA design limitations to improve performance, simplify installation and maintenance; and accommodate broader temperature and fluid conditions. These include multiple tubes for measuring both gas and liquid, rib-guided and fluted metering tubes for more stable and accurate readings, and valves for greater control and resolution, including for very low flowrates.

To get your copy, click the Order link at www.flowva.com or contact us directly at 781-245-3200 or jesse@flowresearch.com.

5. Just published! *Conventional Flowmeters* by Jesse Yoder

Conventional Flowmeters, the second volume of a new two-book set on flowmeter technology by Dr. Jesse Yoder, is now available from CRC Press. The set*, Advances in Flowmeter Technology*, discusses the history, operating principles, advantages, growth factors, representative companies, applications, and frontiers of research for all 10 types of flowmeters. The first volume, *New-Technology Flowmeters*, was released on September 6.



Conventional Flowmeters, released December 16, covers all five types of conventional flowmeters: differential pressure (DP) and primary elements, positive displacement (PD), turbine, open channel, and variable area.

Although the new-technology flowmeter market is growing faster than the conventional market, more conventional technology meters are still deployed in the field, according to Dr. Yoder. Some users are staying with conventional meters because manufacturers are introducing more accurate, stable, reliable, and versatile meters. New developments include more accurate and stable pressure transmitters, cone and other new primary elements, reversible flow, dual rotor turbine meters, new materials to extend the life of ball bearings in turbine meters, and enhanced manufacturing techniques.

Conventional Flowmeters is available from Routledge, Amazon, and other online sites.

6. New facilities help E+H keep up with growth

New E+H facility in Reinach inaugurated in July

Endress+Hauser celebrated the opening of a nearly 150-meter-long building in Reinach, Switzerland on July 1, 2022. The new facility, with more than 25,000 square meters of space – about the size of four soccer fields – was built with roughly 19,000 cubic meters of concrete and 2,200 tons of reinforced steel and other materials. Over the past five years the number of employees at the Reinach location in the Swiss canton of Basel-Landschaft has grown by 20 percent to more than 2,000.

The beautiful new building, which Flow Research was privileged to experience in May while still under construction, is home to Endress+Hauser Flow, the product center for flow measuring technology, as well as Endress+Hauser Digital Solutions, which is responsible for all issues related to digital communication and automation solutions within the Group.

In June, Endress+Hauser dedicated a new production and office building in Cernay, France, one of the Group's fastest growing locations. The facility was designed primarily for manufacturing

the company's Promag H and Dosimag H magnetic meters, but will also manufacture its ultrasonic and vortex meters.

In May, Endress+Hauser Canada celebrated the opening of one of Canada's "greenest" commercial buildings, a customer experience and process training center in Burlington, Ontario. The 4,400-square-meter facility also houses a large calibration lab, repair facility, and state-of-the-art office and recreational space for around 120 people.

To solidify its presence in the U.S., Endress+Hauser inaugurated a state-of-the-art Houston Campus in Pearland, Texas on October 26, 2021. The new campus boasts the largest process training unit in the country, with 200 Endress+Hauser instruments and seven tanks as well as a laboratory for measurement technology and process analytics. It is also equipped for the accredited calibration of flow, temperature, and pressure measurement instruments in the Endress+Hauser lab or on-site at the customer location with a mobile calibration system.

7. A year full of meaningful research data

Since December 2021 we have published studies offering both breadth and depth on just about every flowmeter technology:

- December 2021 (476 pages): *The World Market for Positive Displacement Flowmeters, 3rd Edition,* our first PD study in a decade, finds that despite competition from new-technology meters, positive displacement meters are holding their own, especially in the oil & gas market. PD flowmeters are the workhorses in the flowmeter world. (www.FlowPD.com)

- April 2022 (1,316 pages): *Volume X: The World Market for Flowmeters, 8th Edition* and *Module A: Strategies, Industries, and Applications* finds that the worldwide flowmeter market is now strong and trending upward following the pandemic slump as the economy regains its footing and rising oil & gas prices drive exploration and production. The two studies cover market share, market size, and more for all 11 flowmeter technologies. (www.FlowVolumeX.com)

- June 2022 (460 pages): *The World Market for Pressure Transmitters, 5th Edition* finds that pressure transmitter revenues worldwide equal more than 40% of the worldwide flowmeter market. Pressure is one of the most widely measured variables in the process industries, with an important relation to flow, level, and temperature. Differential pressure flow measurement overlaps with the worldwide flowmeter market. (www.pressureresearch.com)

- July 2022 (526 pages): *The World Market for Magnetic Flowmeters, 7th Edition* finds that magnetic flowmeters are running neck and neck with Coriolis meters as a revenue leader in the global flowmeter market. Magmeters are among the most widely used types of meters for measuring the flow of water and other liquids. (www.flowmags.com)

- September 2022 (566 pages): *The World Market for Turbine Flowmeters, 3rd Edition* reveals that new product developments are keeping the large and stable turbine meter market competitive. (www.flowturbine.com)

- October 2022 (384 pages): *The World Market for Variable Area Flowmeters*, our first VA study ever, found that the market is holding its own as suppliers introduce improvements to meet the increasingly sophisticated needs of today's users. (www.flowva.com)

- May 2021 (1,634 pages): *The World Market for Ultrasonic Flowmeters, 6th Edition* and its companion modules on inline and clamp-on/insertion ultrasonic meters found that the ultrasonic flowmeters is growing faster than expected. (www.flowultrasonic.com)

- September 2020 (536 pages): *The World Market for Coriolis Flowmeters, 6th Edition* found that Coriolis is one of the fastest growing flowmeter markets. (www.flowcoriolis.com)

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