MASS FLOWMETER SERIES

The World Market for Thermal Flowmeters, 3rd Edition

— OVERVIEW —

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www.FlowThermal.com

Flow Research, Inc.
27 Water Street
Wakefield, MA 01880
United States
[1] 781-245-3200
[1] 781-224-7552 (fax)
www.flowresearch.com

The World Market for Thermal Flowmeters, 3rd Edition

Flow Research presents a new market study on the worldwide thermal flowmeter market, ***The World Market for Thermal Flowmeters, 3rd Edition,*** as part of a ***Mass Flowmeter Series*** that also includes ***The World Market for Mass Flow Measurement (core study), The World Market for Coriolis Flowmeters, 7th Edition***, and ***The World Market for Mass Flow Controllers, 4th Edition***. The thermal flowmeter study reveals the size of the 2022 worldwide market, including the market shares of all major suppliers and forecasts for the market through 2027.

The study achieves multiple objectives:

- Determines worldwide market size and shares for the thermal flowmeter market in 2022
- Provides shipments of thermal flowmeters in revenues and units worldwide and by region
- Provides shipments of thermal flowmeters by type worldwide and by region: inline, single point, and multipoint
- Forecasts market growth for all types of thermal flowmeters through 2027
- Segments data both on a worldwide basis and for each of eight global regions
- Determines the average selling price of thermal flowmeters by type worldwide and by region
- Identifies the industries and applications where thermal flowmeters are used, and market growth sectors
- Analyzes products for the main companies selling into the thermal flowmeter market
- Profiles the main suppliers of thermal flowmeters
- Discusses market forces and suggests strategies for selling into the thermal flowmeter market

Key issues we address

- Use of thermal flowmeters for continuous emissions monitoring (CEM)
- Growing use of thermal flowmeters for environmental monitoring applications
- Use of insertion thermal flowmeters for flare gas measurement
- Role of thermal flowmeters in measuring greenhouse gas emissions
- Increased number of suppliers to this market
- New product and technology developments
- Growth strategies for thermal flowmeter suppliers

Rationale for Study

Thermal flowmeters, whose technology is still relatively young, are an interesting area of development within new-technology flowmeters. Thermal meters grew out of hot wire anemometers, which have roots in the early 1900s. However, it was not until the 1960s that thermal flowmeters were developed. Thermal flowmeters have been around almost as long as ultrasonic (1963), and longer than Coriolis (1977), but they have not yet evolved to the same degree as these competing technologies.

Thermal flowmeters are used almost entirely for gas flow applications because gases are more sensitive to the presence of heat than liquids. One popular application is stack/flue gas, and the thermal flowmeter market has been evolving to meet evolving environmental concerns. In response to continuous emission monitoring (CEM) requirements in the early 1990s, thermal flowmeter companies developed multipoint thermal flowmeters that can measure gas flow to compute flow for an entire pipe, duct, or stack. More recently, with increased focus on climate change, there is a demand for monitoring greenhouse gases in applications that may have been overlooked before. These include measurement and recovery of landfill gas; ethanol distillation and refining; measuring emissions from steam generators, boilers, and process heaters; biomass gasification; recovery of methane from coal mines; flue gas monitoring; and measurement and monitoring of flare gas flow.

Flow Research has been following the thermal flowmeter market since 2002. We first published a worldwide thermal study in 2009, followed by a second edition in 2018. We also include data on the overall thermal market size worldwide and by geographic region in each edition of *Volume X: The World Market for Flowmeters*, now in its 9th edition.

We believe that this is an optimal time to again quantify the size of the worldwide and regional thermal flowmeter markets, and to provide an in-depth look at the factors both supporting and limiting the potential for future growth. We are also excited to present the thermal flowmeter market in the context of the larger mass flow market that includes Coriolis flowmeters and mass flow controllers.

Principle of Operation

Both thermal and Coriolis flowmeters measure mass flow. However, thermal meters measure mass flow quite differently than Coriolis meters, which measure fluid momentum. Thermal flowmeters determine mass flow by measuring the heat-conducting properties of fluids.

Thermal meters introduce heat into the flowstream and use one of two methods to measure how quickly this heat dissipates. Both methods measure mass flow based on the effects of cooling in the flowstream and rely on the idea that greater cooling results from higher velocity flows:

- The **constant temperature differential** method uses two temperature sensors: a heated sensor and another sensor that measures the temperature of the gas. Mass flowrate is computed based on the amount of electrical power required to maintain a constant difference in temperature between the two temperature sensors.

- The **constant current** method also uses a heated sensor that is kept constant and another sensor that senses the temperature of the flowstream. Mass flow is measured as a function of the difference between the temperature of the heated sensor and the temperature of the flowstream.

Study Segmentation

Geographic Regions

- North America
- Western Europe
- Eastern Europe/FSU
- Mideast/Africa
- China
- Japan
- Asia/Pacific *(without Japan and China)*
- Latin America

Thermal Flowmeters by Mounting Type

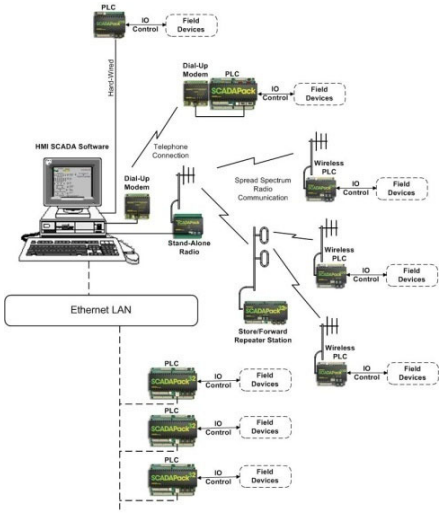
- Inline
- Single Point Insertion
- Multipoint Insertion

Thermal Flowmeters by Fluid Type

- Natural Gas
- Other Gases *(including Industrial Gases and Air)*
- Liquid

Thermal Flowmeters by Intelligence Level

- Smart
- Conventional



Smart Thermal Flowmeters by Communication Protocol

- Foundation Fieldbus™
- HART
- Profibus® DP
- Profibus® PA
- Modbus®
- BACnet
- Bluetooth
- Ethernet
- Other

Thermal Flowmeters by Industry

- Oil and Gas Production, Transportation, and Distribution
- Refining
- Chemical
- Food & Beverage
- Pharmaceutical
- Pulp & Paper
- Metals & Mining
- Electrical Power
- Textile
- Water & Wastewater
- Other

Thermal Flowmeters by Application

- Continuous Emissions Monitoring (CEM)
- Flare Gas/Flue Gas
- Landfill Gas Recovery
- Biogas Recovery
- Biomass Fermentation and Recovery
- Coal Mine Methane Recovery
- Boiler Inlet
- Wastewater Treatment
- Air/Compressed Air
- Sanitary/Hygienic
- Natural Gas Submetering
- Other

Robert Boyle, 17th-century pioneer of modern chemistry known for his law of gases

Thermal Flowmeters by Distribution Channel

- Direct Sales
- Independent Representatives
- Distributors
- E-Business

Thermal Flowmeters by Customer Type

- End-Users
- OEMs
- Systems Integrators
- Engineers/Consultants

Company Profiles

We expect to include these thermal mass flow suppliers in the study:

- ABB
- Binder Group
- Eldridge Products, Inc. (EPI)
- Endress+Hauser
- Fluid Components International (FCI)
- Kurz Instruments
- Magnetrol International
- Sage Metering, Inc.
- TASI Group: Fox Thermal, Sierra Instruments, Vögtlin
- Thermal Instrument
- Tokyo Keiso

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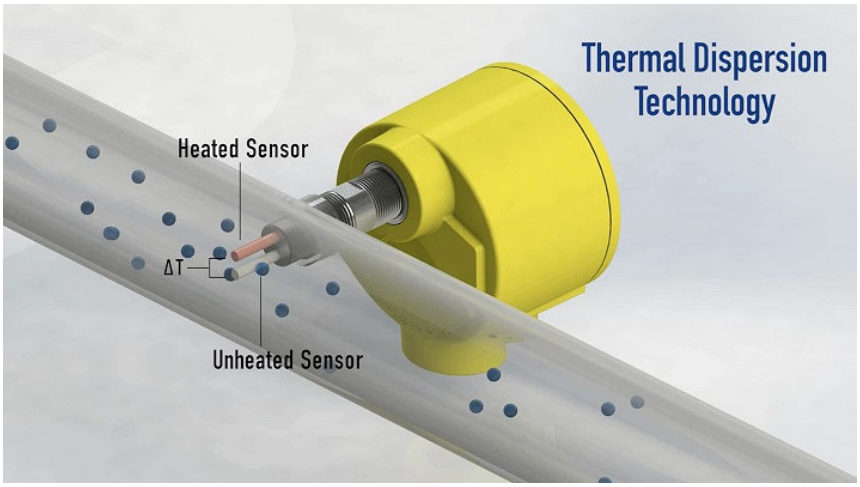


Thermal mass flowmeter technology
(Graphic courtesy of Fluid Components International)

Flow Research, Inc.

Flow Research is the only market research company that publishes studies on all nine flowmeter types and whose primary mission is to research process control instrumentation markets. In addition to studies on both new and conventional flowmeter types, we have researched pressure transmitters; temperature sensors and transmitters, infrared thermometers and thermal imagers; level devices; analytical instrumentation; and selected API-certified valves. We also publish studies on oil & gas and other major flowmeter markets. In addition, Flow Research started a working group on flowmeter calibration (FRWG.org) and published two studies on flowmeter calibration facilities, one each for liquids and gas.

Dr. Jesse Yoder, president and founder of Flow Research

Partnerships and Alliances

Flow Research helps flowmeter companies form alliances and partnerships to provide specific solutions or broaden their customer base and distribution channels. These partnerships can include manufacturers of valves, hoses, transmitters, or other flow-related products, as well as other flowmeter manufacturers.

Distributorships

Are you thinking about expanding your presence in the U.S.? We can help you find distributors for your flowmeters and other instrumentation.

Custom Projects

Companies commission us for custom projects when they want more detailed information on a specific subject than is possible in an off-the-shelf report. They may be evaluating the future or expansion of a product line, determining whether to acquire or merge with another company, or seeking to better understand their customer needs.

Consulting

We also work with companies individually to formulate strategies that help them succeed in an increasingly complex world. Dr. Yoder and his team have studied hundreds of companies and have advised most of the top flowmeter suppliers on market and product strategies.

Research Team Background

Dr. Jesse Yoder, the lead analyst for this study, is President of Flow Research Inc., which he founded in 1998. He has worked as a writer and analyst in process control and instrumentation since 1987 and has created market research studies since 1990. Since then he has written over 280 market research studies, most of them on flow and instrumentation, and over 300 articles on flow and instrumentation for trade journals. (See www.flowarticles.com.)

Dr. Yoder received a PhD in philosophy from the University of Massachusetts Amherst in 1984 and spent 10 years as an adjunct philosophy professor at the University of Massachusetts Lowell

and Lafayette College. Dr. Yoder also worked 10 years as a technical writer, including for the process control division of Siemens, and taught technical writing at Northeastern University and the UMass Lowell.

Dr. Yoder has received two U.S, patents for the flowtube meter, a new dual tube/dual sensor method of measuring flow, in 2015 and 2017. This meter's two prototypes have been tested at CEESI in Nunn, Colorado.

CRC Press published Dr. Yoder's two-book set, *Advances in Flowmeter Technology*, on the history, operating principles, growth factors, representative companies, and frontiers of research for all 10 types of flowmeters. The first volume, *New-Technology Flowmeters*, published September 6, 2022, was followed by *Conventional Flowmeters* on December 15.

In 2015, ISA published Dr. Yoder's book, *The Tao of Measurement*, with Richard E. Morley as co-contributor. Topics included temperature, pressure, flow, time, length, and area.

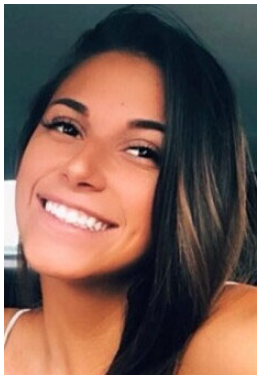
Belinda Burum

Belinda Burum, Vice President, joined Flow Research in 2002. Since then, she has served as senior strategic advisor and been involved with most of our projects and publications. She has also worked as a writer and editor in journalism, advertising, and high tech marketing communications and customer references for 40+ years in the U.S. and Switzerland and is a published author and book editor. She has travelled extensively and enjoyed teaching English in Massachusetts, California, and Ecuador.

Leslie Buchanan, Research and Publication Production Associate, joined Flow Research in 2010 with a variety of skills from work and life experiences here and abroad. She assists with research and writing and handles many publication aspects of Flow Research projects.

Vicki Tuck, Administrative Assistant, joined Flow Research in 2012. She has years of experience in both the fast-paced law firms of Boston, and in various nonprofit organizations. She handles a wide variety of office functions – essential to keep any business running – including keeping our database current, maintaining the *Worldflow Handbook*, as well as assisting in many other ways.

Kaleigh Flaherty, Director of Marketing, created social media posts for us starting in May 2021 before going back to school to finish her degree in marketing at Coastal Carolina University in Conway, South Carolina. She rejoined us in August 2022 to expand our social media presence and manage other outreach activities.



Kaleigh Flaherty

For more information on Flow Research, please visit our website at www.flowresearch.com. Please follow us on Facebook, Twitter, Instagram, and LinkedIn (as "Flow Research, Inc."). We also invite you to join our Flow Research LinkedIn group.

Recent and Currently Scheduled Flow Research Studies

New-Technology Flowmeter Studies

Mass Flowmeter Series	www.massflows.com
The World Market for Mass Flow Measurement (Core Study)	
The World Market for Coriolis Flowmeters, 7th Edition	www.flowcoriolis.com
The World Market for Thermal Flowmeters, 3rd Edition	www.flowthermal.com
The World Market for Mass Flow Controllers, 4th Edition	www.flowmfc.com
The World Market for Magnetic Flowmeters, 7th Edition	www.flowmags.com
The World Market for Ultrasonic Flowmeters, 7th Edition (3-part series: Core, Inline, and Clamp-on and Insertion)	www.flowultrasonic.com
The World Market for Vortex Flowmeters, 7th Edition	www.flowvortex.com
The World Market for Multiphase Flowmeters, 2nd Edition	www.flowmultiphase.com
Multiphase: Module A: The World Market for Watercut Meters	www.watercutmeters.com

Conventional Flowmeter Studies

The World Market for Pressure Transmitters, 5th Edition	www.worldpressure.com
The World Market for Primary Elements, 2nd Edition	www.flowplate.com
The World Market for Positive Displacement Flowmeters, 3rd Edition	www.flowpd.com
The World Market for Turbine Flowmeters, 3rd Edition	www.flowturbine.comm
The World Market for Variable Area Flowmeters	www.flowva.com

Cross-Technology Flowmeter Studies

Volume X: The World Market for Flowmeters, 9th Edition	www.flowvolumex.com
Volume X: Module A: Strategies, Industries, and Applications	www.flowvolumex.com
The World Market for Gas Flow Measurement, 4th Edition	www.gasflows.com
Gas Module A: Applications and Strategies for Gas Flow Measurement	www.gasflows.com
Gas Module B: Natural Gas Production, Consumption, and Flow Measurement in the Oil & Gas Industry	www.gasflows.com
Flowmeters in the Oil & Gas Industry	www.oilflows.com

Flow Calibration Studies

Core Study: Worldwide Gas Flow Calibration Facilities and Markets	www.flowcalibration.org
Module A: Worldwide Liquid Flow Calibration Facilities and Markets	www.flowcalibration.org

Temperature

Market for Temperature Sensors in the Americas, 3rd Edition	www.tempresearch.com

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Why Flow Research? Because we . . .

- Are the only company whose sole focus is the flowmeter instrumentation market
- Research all new-technology and conventional flowmeters
- Contact every known supplier
- Offer our studies in both electronic and color-printed hardcopy versions
- Draw on flowmeter data dating back to 1992, when we began actively following the market

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