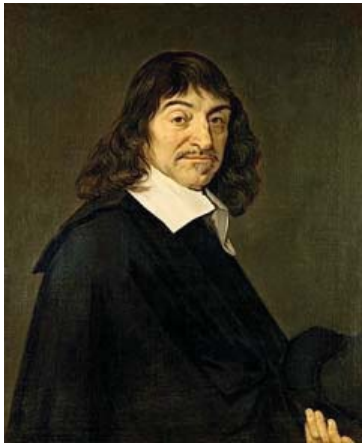


market barometer



René Descartes

Focus this Quarter:

- Do Coriolis meters really use the Coriolis effect?
- Applications for gas flow measurement
- Larger line size vortex meters?

A **Worldflow** publication



Flow Research, Inc.



Bricks, glass, and plenty of daylight for Endress+Hauser's new building in Naarden, the Netherlands.



Q3 2011

The **Market Barometer** is the component of Worldflow that focuses on the flowmeter industry. Every quarter, the Market Barometer shines its spotlight on this industry, looking for important events to discuss or highlight.

We find the events, report them, and place them in the context of the flowmeter industry. The Market Barometer explains and interprets the importance of new technologies, new products, mergers, and acquisitions. We give you the information and ideas you need to generate forecasts, make budget decisions, and implement winning strategies.



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Market Barometer Q3 2011

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Boulder Canyon, Boulder, Colorado

Photo by Flow Research

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Here is the **Worldflow** publication schedule for the next several months:

Q3 2011

Market Barometer—October 2011

Energy Monitor— October 2011

Q4 2011

Market Barometer—November 2011

Energy Monitor—December 2011

Q1 2012

Market Barometer— February 2012

Energy Monitor— March 2012

Coriolis meters: Highly accurate, but a questionable name: Do they really employ the Coriolis effect?

By Jesse Yoder, PhD, Flow Research

For years Coriolis flowmeters have enjoyed a special status in the flowmeter world. While it's difficult to understand how they work, they are unquestionably the most accurate flowmeter made.

Coriolis meters allegedly operate by employing a Coriolis force. This force is usually explained by means of several analogies involving the earth's rotation or a rotating merry-go-round. However, close scrutiny of this explanation leaves some questions as to whether Coriolis flowmeters actually use the Coriolis force.



Jesse in Roosendaal, The Netherlands

But first, what exactly is the Coriolis force?

Coriolis — a perceived effect, not a force

Coriolis flowmeters are named after Gaspard Gustave de Coriolis, a French mathematician and engineer. In 1835, he wrote a paper in which he described the behavior of objects in a rotating frame of reference. While this is sometimes called the Coriolis force, it is more accurately called the Coriolis effect, since it is not the result of a force acting directly on the object, but rather the perceived motion of a body moving in a straight line over a rotating body or frame of reference.

One common example given to illustrate the Coriolis effect is that of a ball propelled through the air a long distance in a straight line from the North Pole towards a target on the equator. By the time the ball arrives at the equator, it will not land at its apparent target, because the earth will have rotated sufficiently underneath the moving ball so that it will land some distance away from the perceived target on the equator. From the perspective of the person standing where the ball is “thrown,” the ball will appear to have curved.

A similar example is someone throwing a ball from the center of a rotating merry-go-round. If she throws the ball at a horse on the edge of the merry-go-round, assuming the merry-go-round is rotating at a rapid pace, she will not hit the horse she is aiming at but perhaps the one after it, since the horse she aimed at will have moved by the time the ball reaches the edge of the merry-go-round.

In both these cases, there is no force acting to push the ball in a curved direction. Instead, its motion will appear to be curved from the perspective of the ball-thrower because the frame of reference is moving underneath the ball. This is why the Coriolis “force” is more appropriately called the Coriolis effect. It refers to the apparent effect on the motion of an object passing over a rotating frame of reference when viewed from the perspective of the point of origin of that moving object.

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Do Coriolis flowmeters embody the Coriolis effect?

If Coriolis flowmeters embody the Coriolis effect, it is logical to assume that they must have rotating tubes. Yet it is not clear why fluid passing through rotating tubes would have a Coriolis effect on the motion of the tubes, since the effect of the fluid is simply the result of inertial motion on the tubes. But in the Coriolis effect, there is no force exerted on the ball thrown on the earth or the merry-go-round apart from the force exerted in throwing the ball. The ball simply appears to curve when viewed from the perspective of the rotating body.

Proponents of the Coriolis theory also cite a similar example when trying to explain the Coriolis effect. They point to a hose full of water that is held in someone's hand. When no water is running through the hose, it remains still. But as water runs through the hose, the hose starts to twist and turn, due to the inertial effect of the running water on the hose. This is very much like the action of fluid on Coriolis tubes, but it is not clear why this is an example of the Coriolis effect. Of course, rapidly flowing fluid through a narrow flexible object like a hose will cause it to twist and turn, due to the inertia of the fluid. If the pipes that carry many of the liquids in a plant were flexible instead of rigid, and the flow velocity was high enough, they would twist and turn as well. But what does this have to do with the Coriolis effect?

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How Coriolis flowmeters actually work

Instead of having a rotating frame of reference, Coriolis flowmeters work on the principle that the inertia created by fluid flowing through an oscillating tube causes the tube to twist in proportion to mass flowrate. Many Coriolis meters have two tubes. They are made to vibrate in opposition to each other by means of a magnetic coil. Sensors in the form of magnet and coil assemblies are mounted on the inlet and the outlet of both flow tubes. As the coils move through the magnetic field created by the magnet, they create a voltage in the form of a sine wave. These sine waves are the key to measuring mass flow.

Under no-flow conditions, the inlet and outlet sine waves are in phase with each other. When fluid is moving through the tubes, the tubes twist in proportion to mass flowrate. The amount of this twist is detected by the inlet and outlet sensors, based on a phase shift (time difference) that occurs in the sine waves formed by the two sensors. The mass flowrate is derived from the difference in phase shift in the sine waves formed by the inlet and outlet sensors.



Coriolis flowmeters or ‘inertial mass’ flowmeters?

It is difficult to see the relation between the Coriolis effect and the inertial principle that Coriolis flowmeters actually operate on. Does a vibrating tube equate to a rotating tube?

In my view, there is at best a metaphorical or analogical relationship between Coriolis flowmeters and the Coriolis force. I think people become mesmerized by the explanations given of the Coriolis “force” and then read the words that explain how the Coriolis meters work and think they understand, but in reality what they are understanding is some kind of analogy or loose relationship but not actually an instance of the Coriolis force at all — perhaps they see the Coriolis effect as a type of metaphor or analogy to the inertial force exerted by fluid flowing through a vibrating tube.

The real problem with attributing a Coriolis force to the Coriolis meter is that the Coriolis force as it is usually explained is a phenomenon about the apparent motion of an object passing over a rotating body when seen from the viewpoint of the rotating body. But proponents of the Coriolis force as applied to the Coriolis meter seem to view the Coriolis effect as a real force acting on the meter and causing it to twist and turn. But this force is simply the inertia of the fluid passing through the tube. I suggest that Coriolis flowmeters should be called “inertial mass” flowmeters instead of Coriolis meters.

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Coriolis patents assume but do not explain the Coriolis force

In doing some research into the patents that underlie Coriolis flowmeters, I found that they assume but do not explain the Coriolis effect. Here, for example, is a quote a patent for a dual tube Coriolis flowmeter by Jim Smith and Don Cage, Micro Motion, dated January 1, 1985. This patent was the basis for some of the dual tube Coriolis meters manufactured at that time:

In the art of measuring mass flow rates of flowing substances it is known that flowing a fluid through a rotating or oscillating conduit produces *Coriolis* forces which are perpendicular to both the velocity of the mass moving through the conduit and the angular velocity vector of the rotation or oscillation of the conduit.

The patent is clearly about Coriolis forces, not a Coriolis effect, and these forces are assumed.

Another issue: the flow splitter

Elsewhere in the patent the authors make the following surprising statement:

The accuracy in making fluid mass flow rate measurements with such a parallel path flow meter will be dependent on both the accuracy with which fluid flow is evenly divided between the two U-shaped flow tubes, and the equivalence of the angular velocities with which the two U-shaped flow tubes are sinusoidally driven. For, if a higher mass flow rate is passing through one U-shaped flow tube than the other, the U-shaped flow tube conducting the higher mass flow rate will generate larger Coriolis force effects.

Later in the paragraph they say that in one example this would have only a one percent effect on uncertainty.

I have seen the splitter in Coriolis meters and I have always wondered what guarantees that the flow is evenly split. Yet I am always told that yes, the flow is always split evenly between the two tubes. Has anyone tested or proved this?

Let me present a couple of factors that could potentially cause the split to be uneven:

1. **Flow profile.** We all know that flow is fastest thru the center of the pipe. But is this perfectly symmetrical? What if the side of one pipe has some buildup near the point it feeds into the splitter. Couldn't this cause the fastest point to be slightly off center and thus to favor one tube over the other?
2. What if the **machining on the splitter** is slightly off? Couldn't this impact the even splitting of the fluid?
3. What if the **machining of the two tubes** isn't exactly identical? Couldn't this cause the mass in one tube to be greater than another?
4. Could the **presence of particles** in the fluid have an impact on the mass in the two tubes if they are unevenly distributed?

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I was quite surprised to read this statement in the Smith-Cage patent, especially considering that the Coriolis flowmeter has accuracy of 0.1 percent. It would be interesting to hear how today's suppliers address this issue.

The “mystique” of Coriolis flowmeters

Coriolis meters do have a kind of “mystique” about them that no other flowmeter has. It may be due in part to the difficulty people have in really understanding how they operate. Also, manufacturers typically enclose the sensors inside a container, concealing their inner workings. No doubt part of this mystique is their high accuracy. But it is important to understand how they work if we are understand how they can be improved or what flaws they may have.

Whatever you call them, there's no denying their increasingly important role

Regardless of what one calls the principles that form the basis of Coriolis flowmeters, there is no denying that these flowmeters are playing an increasingly important role in the flowmeter market today. The Coriolis flowmeter market has been one of the fastest growing flowmeter markets over the past five years. In many process plants, users are selecting them to replace differential pressure (DP) meters. Their use is also growing in the oil & gas industry. Despite their higher initial purchase price, many users find them a good investment when cost of ownership is considered.

One of the most important features of Coriolis flowmeters is that they measure mass flow.

While in many cases volumetric flow is sufficient, it is also desirable at times to measure mass flow. Many products are sold by weight rather than by volume, and in these cases it is often desirable to measure mass flow. Chemical reactions are often based on mass rather than volume, so mass flow measurement is often required in the chemical industry.



While both volumetric and mass flow apply to liquids and gases, mass flow is especially appropriate for measuring gases. This is because gases are much more affected by temperature and pressure than are liquids. Pressure has minimal effect on liquids in terms of compressibility, and is often ignored in making volumetric measurements of flow. The effects of temperature on liquids are also often disregarded, except where high accuracy is desired.

Coriolis flowmeter being calibrated at Colorado Experiment Engineering Station Inc. (CEESI)

Coriolis flowmeters are the most accu-

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rate flowmeter made. While many magnetic flowmeters have accuracies in the range of 0.5 percent, many Coriolis flowmeters achieve accuracy of 0.1 percent. It is the high accuracy of Coriolis flowmeters that is one of the major reasons for their extremely rapid growth over the past five years. Companies that need flowmeters for custody transfer, or want highly accurate measurements in terms of mass, have a good reason to select Coriolis flowmeters.

One important development is the introduction of large line size Coriolis flowmeters. Formerly, only Rheonik produced Coriolis flowmeters for line sizes above six inches. In the past few years, Micro Motion, Endress+Hauser, and KROHNE have all entered this market. Rheonik itself was acquired by GE Sensing, and is still producing large line size meters. While all the Coriolis flowmeters above six inches are large and somewhat unwieldy, they have been selling well enough to have a significant impact on the market.

Despite their hefty price tag, 8-, 10-, and 12-inch Coriolis meters, many of which are designed for custody transfer applications, are selling well in the oil & gas industry. Most recently, Endress+Hauser introduced a 14-inch Coriolis flowmeter designed for custody transfer applications. End-users are willing to pay a higher price for the high accuracy and reliability of Coriolis flowmeters when measuring high value products like crude oil. Likewise, end-users pay a high initial price for ultrasonic flowmeters for custody transfer of natural gas, because they want the high accuracy and reliability of ultrasonic meters. In both these cases, lifecycle costs outweigh initial purchase price considerations.

While most of the large line size Coriolis flowmeters use the traditional bent tube design, KROHNE has introduced a large line size Coriolis meter using its straight tube Coriolis design.

While this meter is somewhat longer than the bent-tube meters, it is less bulky because the straight tube design requires less space. This may prove to be a strategic advantage to KROHNE in the competition for the large line size Coriolis flowmeter market.

Other competitors are also entering the market. In fact, we mention three fresh names later in this issue of the *Market Barometer*:

TRICOR Coriolis Technology, a TASI Group/AW-Lake brand, has tapped the experience of engineers with strong Coriolis pedigrees to create a line they claim offers the best price and performance for compact Coriolis flowmeters. Don Cage, a Coriolis “Founding Father,” and Jim Ruesch, who has four U.S. Coriolis patents, are principal mechanical engineers.

Racine Federated Inc. (RFI), well known for a range of flowmeters, is partnering with the lesser-known Applied Flow Solutions (AFS) to develop and manufacture Coriolis mass flowmeters for the global process and automation markets.

PreCim, new company in Israel has set out to break the line size barrier on Coriolis flowmeters. It was established August 2010 by three entrepreneurs: Tal Mokady, Dr. Ran Gabai, and Dr. Arnon Gat.

So, whether it's called an inertial mass flowmeter or something more catchy, the meter we know as Coriolis is here to stay.

Gas applications provide flowmeter opportunities

*Excerpted from The World Market for Gas Flow Measurement, 2nd Edition
Module D: Strategies, Industries and Applications*

In the rapidly evolving world of gas measurement, increasingly demanding requirements from applications are driving changes in flowmeter technology.

Producers are pushing the frontiers to extract gas from harder-to-reach places – out at sea, under shale, from sand, even biogas from landfills and dairy farms. They are striving to conform to evolving standards for hazardous and other conditions as well as monitor emissions to meet environmental standards. They are constantly seeking to optimize efficiency and maximize profits through the use of instruments providing more easily verified readings, and a clearer picture of what is happening at any given moment so that they can respond before problems escalate and profits flow out the pipe.

Consequently, flowmeter manufacturers are making significant improvements, particularly to ultrasonic and turbine flowmeters, the high end workhorses in the gas world. Orifice plates and other techniques using primary elements are still holding their own in gas, but are less amenable to improvement. However, at least one supplier, DP Diagnostics, has been developing diagnostics for differential pressure flowmeters, including orifice plates, cone, and Venturi meters over the last few years. Coriolis flowmeters, known for their high accuracy, are also starting to create a presence in the gas flow market. Thermal mass meters have a strong presence in the increasingly important emissions monitoring niche.

As flowmeters improve technologically and become smarter, they are becoming an integral part of an energy delivery system that also delivers comprehensive information about the health of the system and the quality and composition of the gas. As a gas pipeline director told Flow Research, “It’s a different world today. What we value most is system connectivity– connecting the right information to the people who need it most so that we can deliver energy to our customers.”

Some of the most important gas measurement applications for flowmeters include:

- Custody Transfer
- Utility/Billing (fiscal measurement)/Submetering
- Emissions Testing/Monitoring, including Continuous Emissions Monitoring (CEM) and Flare Gas/Flue Gas
- Compressed Natural Gas
- Compressed Air
- Liquefied Natural Gas
- Shale Gas
- Landfill Gas/Biogas Recovery
- Industrial Gas Processes
- Burner Controls

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Market Research: Gas Applications

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Custody transfer

Among all gas flow applications, custody transfer is forecast to have the fastest growth over the next five years.

Much of the new technological development in ultrasonic and Coriolis flowmeters is aimed at developing flowmeters that excel at custody transfer. The most common flowmeters found in this application are still differential pressure and turbine. However, ultrasonic are making huge gains here as they are often the preferred technology in new capital projects and are also important options in the replacement market. Vortex flowmeters recently gained custody transfer approvals from the American Gas Association (AGA-9) and should also begin to accumulate market share here. The use of Coriolis meters in custody transfer is also growing as more countries and organizations accept mass flow as units for flow and as installations become smaller, since Coriolis meters have no need of straight runs.

The effect of these early approvals of DP and turbine meters for custody transfer purposes resulted in a large installed base of DP and turbine flowmeters used for custody transfer of natural gas. It was not until 1998 that the AGA issued AGA-9, a report on the use of ultrasonic flowmeters for custody transfer applications. However, ultrasonic flowmeters were not introduced into the market until 1963, and it took a number of years for the technology to develop to the point where it was capable of being sufficiently accurate for custody transfer.

Utility/billing/submetering

Diaphragm meters have a foothold in the utility/billing area. The main competition for PD meters is from single jet, multi-jet, compound, and Woltmann turbine meters rather than from new-technology meters because industry approvals for utility and billing for new-technology meters such as Coriolis, vortex, and ultrasonic are at least several years away.

The general rise in energy prices have also given rise to an increased demand by industrial and commercial natural gas consumers to better manage this cost. Depending on the local utility, there are varying opportunities for large users to contract for more preferable volume rates if they can accurately forecast their own future demand. In so doing, the utility supplier can better plan their own needs and, in turn, they offer price rewards to the user as an incentive to partner.

Users have also found benefits in submetering within their own facility. In so doing, energy usage can become part of departmental or functional cost centers, as this cost is measured, assessed, and tracked ('totalized') over time. Submetering also permits a company to simply better manage its overall energy conservation efforts, as the firm can acquire more local data and pinpoint specific energy sinks or wasteful practices.



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Emissions testing/monitoring, including CEM and flare gas/flue gas

The growth in environmental awareness has spawned a host of new environmental regulations that require companies to detect and reduce the emission of many airborne pollutants. Examples of these pollutants would include sulfur dioxide and nitrous oxide, the two principal causes of acid rain. The US Environmental Protection Agency (EPA) initiated a program to reduce pollution in the atmosphere in the 1990's, and this program has been expanded greatly since the real effects of global warming are now better understood and accepted.



In the past, Europe has been ahead of the United States in environmental awareness, and consequently European countries can be expected to be on the same path in monitoring greenhouse gas emissions. Other countries such as China and India have lagged behind Western countries in environmental monitoring, but this is changing as the effects of greenhouse gases become more apparent. There is a great deal of construction and development especially in the Mideast, and this will require an enhanced amount of environmental monitoring

Measurement and monitoring of flare and flue gas flow

Flare systems are used to burn off waste gases from refineries, process plants, and power plants. Flares can be a single pipe or a complex network of pipes. Flares are subject to strict environmental regulations. Flues typically are large pipes, stacks, ducts, or chimneys that dispose of gases created by a combustion process. Ultrasonic, vortex, averaging Pitot tubes, and thermal meters are used to measure flare and flue gas.

One of the biggest challenges of measuring flare gas is large turndown. Flare gas flow can range from low fuel gas purge during normal operation to large flow during emergency relief and/or total plant blowdown. Ultrasonic flowmeters can cope with a wide range of flow, and they also offer low pressure drop, tolerate some condensed liquid, operate at high temperatures, and introduce no internal, insertion, or moving parts to block flare lines.

Compressed Natural Gas (CNG)

Compressed Natural Gas (CNG) is natural gas compressed to a volume and density that is practical to transport as a fuel supply. It consists primarily of methane, compressed to a pressure at or above 2,400 pounds per square inch, which is less than one percent of its volume at standard atmospheric pressure. It is stored in special high-pressure containers at 200–248 bar (2900–3600 psi). CNG is used as a substitute for gasoline, diesel and propane/LPG but it is cleaner as well as safer, because it disperses quickly if spilled. CNG can also be mixed with biogas.

Coriolis, ultrasonic, and primary elements are typically used to measure CNG.

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Market Research: Gas Applications

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Compressed air

The creation of compressed air is one of the major electrical energy sinks of many industrial processes, and is oftentimes the number one cost point in a process. At the same time, in the renewable energy industry compressed air is slowly emerging as part of an innovative technique to achieve energy storage.

Compressed air energy storage (CAES) is a 30-year-old technology which uses off-peak energy to store pressurized air in one or more types of storage facilities. This highly pressurized air is then released at times of peak demand and, once heated and expanded, is used to drive a combustion turbine to create electricity.

The success of CAES has been limited by two primary factors: immense storage facilities - such as abandoned salt mines or depleted natural gas reservoirs - are needed to make CAES economical on a utility basis, and until recently the market was not prepared to capitalize CAES development. However, there has been recent renewed investment interest in this energy storage technique in response to the rise in energy prices as economies strengthen following the recession.

Liquefied natural gas

Liquefied natural gas (LNG) is a vital method of transporting and storing natural gas. The primary advantage of LNG is that it reduces the ordinary volume of natural gas by orders of magnitude, approximately one six hundredth of its gaseous form. This feat is accomplished by cooling the natural gas to approximately -260°F (-162°C).

Coriolis, differential pressure, turbine, and ultrasonic flowmeters are the technologies most often employed within this application. Ultrasonic and Coriolis flowmeters have found competitive advantage here because of their accuracy and reliability, but equally because of their non-intrusive design. Because their design does not impede the flow stream, higher throughput is available to operators at the same pipe diameters which might otherwise be equipped with turbine or differential pressure flowmeters. Higher throughput means greater revenues per unit of time.



Shale gas

One of the biggest trends in the industry is shale gas. Other unconventional sources, including tight sands and coalbed methane deposits, as well as production in offshore waters, are expected to remain relatively stable from 2009 to 2035.

Shale gas constitutes a strong potential market for flowmeter manufacturers. Most flowmeter

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Market Research: Gas Applications

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manufacturers are still exploring the best way to meet the challenges of measuring shale gas flow. One of the biggest challenges is unpredictability, both of the consistency of the fluid (water vs. gas, and even sand and other particulates) and how fast it will come out of the ground, which can change suddenly, and also varies from play to play.

Landfill gas/biogas

Landfill gas and biogas recovery are emerging applications for gas measurement, with their own challenges, including low or sporadic flow. Typically landfills and biogas installations don't produce enough volume to make ultrasonic flowmeters affordable, but they provide opportunities for thermal mass, turbine flowmeters, and orifice plates.

Industrial gas processes

Industrial gases are both numerous and necessary throughout the full range of industrial processes. Some gases are the actual product of a process, while others represent a catalytic component of a process or are consumed by and within the process itself.

Perhaps nowhere else is a manufacturing process more highly regulated than in pharmaceuticals. There have been notable instances in this industry where a company's failure to maintain the highest standards of product quality has had disastrous effects for either the firm or the people relying on its products, or both (e.g.: Genzyme and its production of Cerezyme[®] and Fabrazyme[®]). Employee safety is the other key component of this industry. Employees are frequently in proximity to bacterial agents, especially if they are in research and development or other laboratory work.

Another growth area within the pharmaceutical industry is in the relatively narrow field of inhalation powders.

Burner controls

The measurement of inlet boiler, furnace, and steam generator air is a classic example of gas measurement. Today, this application is given serious consideration by end-users intent on minimizing energy costs while maximizing combustion output. The primary drivers in this application are the ability to be able to more accurately measure air flows on a highly repeatable basis to consistently ensure complete combustion and, therefore, a cleaner exhaust.

The benefits of more complete combustion include a reduction fuel usage, reducing air pollution, and reducing the risk of secondary combustion (e.g.: explosions) from unburned flue gases. Part of the energy savings can also be driven by preventing excess amounts of hot flue gas from escaping, where this gas is intended to be used as, for instance, a secondary source of heat. When these objectives are obtained, operating costs are reduced.

Emissions from these same devices must also be measured due to the volumes of gaseous products that are produced (e.g., nitrous oxide, carbon monoxide, carbon dioxide).

www.gasflows.com

Companies

Endress+Hauser inaugurates new building in the Netherlands

September 2, 2011 — Endress+Hauser's Dutch sales center has moved into a new building in Naarden, the Netherlands. The modern office building cost just under \$10.9 million (€8 million).

“We wanted a groundbreaking office building which creates the best possible working conditions for all our people,” says Rob Hommersen, managing director of the sales center. “We also stressed that the architecture should reflect openness, sustainability and transparency.”

A high atrium with glass frontage characterizes the new building; a masonry facade lends it elegance. The building has been constructed with eco-friendly materials and meets high standards in terms of energy consumption. Almost 5,000 square meters of floor area accommodate offices, a workshop, a logistics area and a restaurant. If needed, the building can be easily enlarged.

In 1960, a small sales office in the Netherlands was the first foreign subsidiary of the young Endress+Hauser company. Today, the sales center employs over 130 people. The new building in the small town of Naarden, 20 kilometers south-east of Amsterdam, was erected immediately next door to the previous headquarters.

In the Netherlands, Endress+Hauser cooperates mainly with global customers in key industries such as water & wastewater, food & beverage, oil & gas and chemical. Thanks to the development of the business with service offerings and automation solutions, the Dutch sales center has seen above average growth in the past years.

www.endress.com



Bricks, glass and plenty of daylight: Endress+Hauser's new building in Naarden, the Netherlands.

Fuji Electric starts Indonesian sales & marketing subsidiary

October 3, 2011—Fuji Electric Co., Ltd has established and begun operations of a sales and marketing subsidiary in Jakarta, Indonesia, PT Fuji Electric Indonesia (FEID).

Fuji Electric has positioned the Indonesian market as one of the most important areas for its overseas business strategies. Indonesia is the largest market in the Association of South-east Asian Nations (ASEAN) and generates robust domestic demand. Moreover, Indonesia is expected to undergo continuous economic growth.

In the past, Fuji Electric has exported plant equipment such as steam and geothermal generators to Indonesia, and sold component products such as inverters and servo systems through Singapore-based Fuji Electric Asia Pacific Pte. Ltd. By establishing this sales and marketing subsidiary, Fuji Electric intends to tailor marketing activities to the local market, promote the Fuji Electric brand, and strengthen sales of a wide range of products and systems to various kinds of plant systems.

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The subsidiary will sell general products, including inverters, servo systems, uninterruptible power supply systems (UPSs), and electric distribution and control equipment, as well as industrial factory automation systems and other related systems. It will also provide sales support to various kinds of plant systems involved in the production of civil infrastructure, including electrical power, traffic, and waterworks.

PT Fuji Electric Indonesia plans to sell \$23.5 million in 2012. Teruo Yamamoto will serve as president of both FEID and Fuji Electric Asia Pacific Pte., Ltd.

www.fujielectric.com

Four Japanese companies to form a global water brand

July 20, 2011 — Tokyo Keiki Inc., Nagano Keiki Co. Ltd, Chino Corporation, and OVAL Corporation have agreed to enter into a basic agreement to form a comprehensive business tie-up for the global water business. The arrangement is aimed at providing the companies greater access to the global water market, which has been expanding rapidly in recent years.

Tokyo Keiki, a leading manufacturer in instruments that include ultrasonic flowmeters and level gages, maintains a high share of the domestic water and sewerage market. Nagano Keiki is a leading player in the pressure gage market in Japan and the world. Chino, a leading manufacturer of instrument and control equipment, including sensors, loggers, and recorders, has a solid reputation around the world for product quality and performance. OVAL, one of the largest makers of fluid measurement equipment in Japan, has experience in overseas markets, especially in oil.

www.worldflow.com

The four companies plan to create a new brand and new products for both domestic and overseas water majors and plant makers.

www.tokyo-keiki.co.jp

Lorentzen & Wettre to enhance ABB's pulp & paper portfolio

Zurich, Switzerland, Oct. 3, 2011 – ABB, the leading power and automation technology group, today announced that it has completed its acquisition of **Lorentzen & Wettre** from ASSA ABLOY AB.

Lorentzen & Wettre
A MEMBER OF THE ABB GROUP

Lorentzen & Wettre manufactures equipment for quality control, process optimization, and test instrumentation for the pulp & paper industry. The acquisition enhances ABB's position as a leading pulp and paper solutions provider and complements ABB's existing portfolio. Lorentzen & Wettre will be integrated into ABB's Process Automation division.

Lorentzen & Wettre's solutions include automated fiber and pulp analysis, consistency transmitters, moisture sensors, laboratory paper testing instruments, automated paper testing system, and service agreements. Some of the company's products interoperate with pressure transducers and flowmeters.

www.abb.com www.lorentzen-wettre.com

Cameron to buy LeTourneau in \$375M cash deal with Joy Global

Houston; August 31, 2011 — Cameron has agreed to acquire LeTourneau Technologies Drillings Systems and Offshore Products divisions from Joy Global Inc. for approximately \$375 million in cash. The boards of Cameron and Joy Global Inc. have unanimously approved the transaction. Closing is scheduled

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during the fourth quarter of 2011.

LeTourneau is a well established provider of drilling equipment and rig designs and components for both the land and offshore rig markets. LeTourneau's products include elevating systems, skidding systems, cranes, top drives, rotary tables, draw works, mud pumps, and rig control and power systems.

"The addition of LeTourneau's portfolio of drilling equipment and rig components adds to our existing products offering and enhances the growth opportunities for our drilling systems platform", said Jack Moore, Chairman and CEO of Cameron. This acquisition is expected to add to Cameron's 2012 earnings.

Cameron is a leading provider of flow equipment products, systems and services to worldwide oil, gas and process industries.

www-c-a-m.com

SMAR turns 37

On April 1, SMAR commemorated 37 years of history. With around 1.000 employees and present in several countries, SMAR has consolidated its position in the automation market, as one of the best recognized companies in the world.



Through these years, the company has established solid relationship with its clients, suppliers and collaborators. "SMAR is proud in taking part in this technological evolution, including for producing the world's most advanced platform in the automation open system", states César Cassiolato, Director of Marketing, Quality and Project Engineering and Services.

In the coming years, SMAR targets to keep on evolving and contribute to improve the technical standards of the segments it serves.

Siemens again No. 1 in Dow Jones Sustainability Index

Munich, Germany; September 8, 2011 — Siemens AG has been ranked the most sustainable company in its industry for the fourth time in a row. In the Dow Jones Sustainability Index (DJSI) – the sustainability rating established by Dow Jones and SAM – Siemens has again taken first place in the Diversified Industrials category, which includes companies like 3M, General Electric, Toshiba, and Thyssen Krupp. Out of a possible 100 points, Siemens received 90 – its highest overall rating to date and a further improvement over last year's result of 87 points. The company has now been honored by the DJSI 12 times in a row for its sustainable activities.

The company planned to generate revenue of €25 billion (\$34 billion) with its Environmental Portfolio in fiscal 2011. With revenue from the Portfolio totaling €28 billion (\$38.1 billion) in fiscal 2010, Siemens not only achieved this target a year earlier than planned; it considerably exceeded it. The company now wants to generate more than €40 billion (\$54.4 billion) in revenue with green technologies by the end of fiscal 2014.

www.siemens.com

Sierra's online store goes global

Monterey, CA; August 16, 2011 — This week, Sierra opens its online store to the global community. Customers in the United Kingdom, India, and numerous other countries will now have access to the largest selection of factory direct mass flowmeters and controllers avail-

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able anywhere on the web.

With a wide range of models and hundreds of units in stock, international customers can now purchase units on Sierra's website at www.sierrainstruments.com/shop and get them shipped next day with no expedite fees. Sierra's proprietary selection tool allows customers to easily configure and purchase a customized instrument online without loss of delivery time.

Customers also have access to a personal application engineer during the online sales process. Upon purchase, they are assigned a Sierra expert from one of 150 offices in over 50 countries. Their Sierra field support team remains their point of contact throughout the life of the Sierra product.

www.sierrainstruments.com.

People

IDEX names Andrew Silvernail as new Chief Executive Officer

Lake Forest, Illinois; August 08, 2011 — IDEX Corporation today announced the promotion of Andrew Silvernail to the position of Chief Executive Officer, effective August 10, 2011, succeeding Larry Kingsley, who indicated his plans to leave IDEX to assume the position of Chief Executive Officer of Pall Corporation. Mr. Silvernail was also appointed to the company's board of directors, effective August 10, 2011.

Silvernail, 40, joined IDEX in January 2009, and most recently held the position of Vice President and Group Executive, leading three of the company's business segments - Health & Science Technologies, Dispensing, and Fire & Safety/Diversified Products - comprising more than half the company's annual revenue. To

facilitate an orderly transition of leadership, Larry Kingsley will remain as Chairman of the company's board of directors. Kingsley is expected to step down as Chairman of the board of directors by December 31, 2011.

www.idexcorp.com

Siemens appoints new CEO in Brazil following investigation

Siemens has appointed Paulo Ricardo Stark (42) to serve as its new CEO in Brazil. The company has separated from Addison Antonio Primo (58), the previous head of its business activities in Brazil, with immediate effect. An internal compliance investigation recently revealed that a serious violation of Siemens guidelines occurred within Siemens Brazil prior to 2007. Siemens has a no-tolerance policy for compliance violations. The company stands for clean business everywhere and at all times. The internal investigations in the case are continuing.

Paulo Ricardo Stark is a native of Brazil. He is an electrical engineer with wide-ranging international experience. His work for Siemens includes stints in Mexico and in several positions in Germany, where he most recently headed a Business Unit in the company's Industry Sector. Paulo Stark is taking over an important and rapidly growing Regional Company. Siemens has been active in Brazil for more than 105 years, where it generated revenue of some €1.8 billion and new orders of €2.1 billion in fiscal 2010. The company has roughly 10,000 employees, 13 production facilities, and seven research centers in Brazil and wants to continue participating in the country's dynamic growth – for example, with sustainable infrastructures for cities and major events as well as offerings for the oil and gas industry and the renewable energies segment.

www.siemens.com

Upcoming Trade Shows: 2011 & 2012

Aquatech, Amsterdam & International Water Week Conference

November 1-4, 2011

Amsterdam RAI Convention Centre
The Netherlands

www.amsterdam.aquatechtrade.com

World's leading exhibition on process, drinking & wastewater technology.

Power-Gen International 2011

December 13-15, 2011

Las Vegas Convention Center
Las Vegas, Nevada

www.power-gen.com

An industry leader in providing comprehensive coverage of trends, technologies, and issues facing the generation sector, with more than 1,200 exhibitors and 19,000 attendees.

2011 European Autumn Gas Conference

November 15-16, 2011

Paris

www.theeagc.com

This event, sponsored by Eni, Total, and GDF Suez, is one of the longest running annual gas conferences in Europe.

MagyarRegula - International Exhibition for Automation, Measurement and Control 2012

March 20-23, 2012

SYMA

H-1146 Budapest, Dózsa György út 1.
Hungary

+36 1 460-1100

+36 1 460-1160 (fax)

www.bvents.com

One of the most important forums for Hungary's industrial automation and measurement technology.

American Gas Association Operations Conference

May 1-4, 2012

Hyatt Regency - San Francisco, California

Margaret Watson

media@otcnet.org

+1.972-952-9304

MCAA Industry Forum

May 20-22, 2012

Peachtree Executive Conference Center,
Peachtree City, Georgia

www.measure.org/meetings/Forum.htm

58th International Instrumentation Symposium (IIS)

June 4-8, 2012

Hyatt La Jolla

La Jolla, California

Sponsored by the Aerospace Industries, Test Measurement, and Process Measurement and Control Divisions of ISA, IIS covers measurements/sensors, instrumentation systems, data and advanced system/sensor technology, and many other state-of-the-art areas. Deadline to submit an abstract is January 20, 2012.

8th International Symposium on Fluid Flow Measurement (ISFFM)

June 20-22, 2012

Antlers Hilton Hotel

Colorado Springs, Colorado

www.isffm.org

Industrial research laboratories, universities, government laboratories, and industrial field study teams will present information on a wide variety of research and technology topics associated with fluid flow measurement: wet gas and multiphase flow measurement, ultrasonic metering, measurement uncertainty, critical flow, fluid properties and gas analysis, liquid metering, velocimetry and optical methods, and facilities and primary standards. Abstracts for papers are due by December 31, 2011.

Company Korner: Roxar AS

Emerson's Roxar digs 'deep' to offer solutions to oil & gas issues



Roxar, considered by market participants to be the industry leader in installed multiphase meters, calls itself “an international technology company to the oil & gas industry.” Roxar claims to have installed thousands of meters worldwide, of all types. Roxar is considered a leader in 3D geological modeling, integrated simulation software, and multiphase metering hardware.

The Norwegian Roxar ASA became part of the Emerson Process Management family in May 2009. At that time it had an annual revenue of US\$200 million and 28 offices in 19 countries with a network of wholly owned offices in Europe, the Americas, Africa, CIS, Asia Pacific and the Middle East. Roxar's International customer base included all of the multinationals, major independents and the majority of national oil companies. The purchase was credited with a nearly three



Roxar Permanent Downhole Monitoring System

percent (\$178 million) favorable impact on Emerson Process Management's sales.

At the time Emerson claimed to be creating “the world's first integrated automation solutions company whose products span from sub-sea oil and gas reservoirs, to platform and floating production, to transmission, and ultimately through refining and production of goods.” Roxar added subsea reservoir management and production optimization for global upstream exploration and production (E&P) customers to Emerson's

portfolio.

Since that time, Roxar has been maintaining its momentum:

- On February 2, 2010, Emerson announced that its Roxar subsea wet gas meters are to be installed in the Greater Gorgon fields, one of the world's largest untapped natural gas fields, operated by Chevron Australia Pty Limited. The contract was signed with Vetco Gray, a GE Oil & Gas business.
- On January 5, 2001, Iraq's South Oil Company awarded Emerson a contract to provide crude oil metering systems and related technologies for the new Al-Basra Oil Terminal now under construction in the Persian Gulf, including Roxar, and Daniel measurement instruments.
- In May 2011 Emerson released Roxar RMS 2011, a new version of its reservoir modeling software claiming to more realis-

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Facts about Roxar AS

Headquarters: Stavanger, Norway

Revenue: \$200 million reported in May 2009 (parent Emerson revenue, \$21 billion in 2010)

No. of employees: est. 900 in 2008 before Emerson acquisition

Year founded: 1999

Ownership: Emerson — a unit of Emerson Process Management

Offices: Norway, with major regional service centers in London, Houston, Bahrain, Kuala Lumpur, and Moscow

Company Korner: Roxar AS

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tically represent a field's complexity. It also launched a new version of its production management system, Roxar Field-watch 2.3.

- In September 2011 Emerson launched its Roxar CorrLog & SandLog Wireless transmitters for an integrity management system combining Emerson's Smart Wireless technology with Roxar corrosion and sand monitoring instrumentation. It also launched its new Roxar downhole flow sensor system.

What Roxar does

Roxar develops solutions for reservoir management and production optimization for oil & gas companies challenged with maximizing returns from their reservoir assets. Roxar's modeling technologies permit well operators to visualize the configuration of a reservoir for development planning and reservoir monitoring.

In multiphase meters, Roxar's voxel-based signal processing and electrode geometry provides information never previously available, including multiple flow velocity data and near wall measurements.

Roxar has two main divisions: Software Solutions and Flow Measurement.

History and Organization

Roxar was originally formed in 1999 as the result of a merger between Multi-Fluid ASA and Smedvig Technologies AS. In 2001, Roxar ASA acquired Fluenta AS, a company specializing in multiphase meters, flare gas meters, and sand monitoring. (Roxar later sold off the flare gas measurement and metering



The company's newest multiphase flowmeter, Roxar MPFM 2600, represents the third generation of Roxar technology.

business to a newly formed Fluenta in 2007.)

In 2007, the company was acquired by CorrOcean ASA, and following this merger, the company was publicly traded once again on the Oslo Stock Exchange as Roxar ASA. Most recently, in 2009, Roxar was acquired by Emerson and became part of the Process Management group.

Roxar Flow Measurement AS

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www.roxar.com

TRICOR introduces 2" Coriolis flowmeter, TCM-65K

AW-Lake Company's TRICOR Coriolis Technology has introduced a 2" Coriolis flowmeter, TCM-65K. The liquid flowmeter has a basic accuracy of ± 1.0 percent of flowrate. The maximum mass flowrate is 65,000 Kg/Hr. TRICOR claims its flowmeters have the accuracy and performance of leading Coriolis meters at a pricepoint 20 to 40 percent lower. The company also has plans to introduce a 1/8" meter soon, TCM-325, which will have a maximum flowrate of 325 Kg/Hr and the same accuracy.

TRICOR Coriolis Technology products are designed and engineered in Colorado & Wisconsin & Germany. Its state-of-the-art manufacturing facility in Germany is equipped with superior calibration and test equipment.

TRICOR engineers have been intimately involved with the development and evolution of Coriolis flow instrumentation since the begin-

ning. In fact, many of the critical patents for Coriolis technology bear TRICOR engineers' names.

TRICOR Americas Headquarters are located at AW-Lake Company in Franksville, Wisconsin.

www.tricorflow.com

Litre Meter expands range with new TRICOR Coriolis meters

August 2, 2011 — UK flowmeter specialist Litre Meter has expanded its range of metering options with Coriolis flowmeters from US-based manufacturer TRICOR.

Coriolis meters are employed in a wide range of applications worldwide in the oil and gas, petrochemical, food and beverage, and life sciences sectors. Litre Meter is now able to supply the full TRICOR range of Coriolis instruments to its UK customers.

The meters offer a measuring accuracy of between ± 0.10 per cent and ± 0.50 per cent, even in longterm operation and across a temperature range from -100 to $+150^{\circ}\text{C}$ depending on the meter selected. The mass flowrates that can be measured range between 300 kg/hr and 65,000 kg/hr while the volumetric flow range which can be measured is between 300 l/hr and 65,000 l/hr. TRICOR Coriolis meters are pressure rated up to 350 bar. Densities can be measured up to 4500 kg/m³

The TRICOR product line complements the range of flowmeters built by Litre Meter in its own premises in Buckingham. The company offers a broad range of metering technologies suitable for virtually every liquid, gas or steam



TRICOR TCM-65K

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measurement application and has particular expertise in measuring low flowrates.

Litre Meter CEO Charles Wemyss said: “Litre Meter’s strength has traditionally been in flowmeters for particularly demanding situations, often with meters almost custom-designed and built for particular applications. TRICOR Coriolis Technology gives our customers access to a wide range of accurate and robust meters which meet the needs of a vast range of industry applications.”

www.litre-meter.com

RFI adds Coriolis flowmeter in partnership with AFS

August 1, 2011 — Dave Perkins, CEO of Racine Federated Inc. (RFI), Racine, WI and Wayne L. Pratt, President and CEO of Applied Flow Solutions (AFS), Scottsdale, AZ announce a partnership to develop and manufacture Coriolis mass flowmeters for the global process and automation markets.

The addition of a Coriolis mass flow option provides customers of Racine Federated’s Flowmeter Group a complete line-up for all major flow measurement technologies.

“Applied Flow Solutions’ deep technical knowledge and demonstrated experience in delivering best-in-class Coriolis technology to market made AFS an attractive partner,” said Perkins. “An advanced Coriolis meter, when combined with Racine Federated’s customer service and worldwide network of distribution partners, will give the market an outstanding new option for mass flow metering applications.”

With more than 25 years of experience in flow measurement, Pratt is excited to bring this new

family of products to market in concert with Racine Federated. “Coriolis mass flow measurement is a passion at AFS,” said Pratt, “We’re truly excited to find a partner in Racine Federated whose passion for flow measurement technology and customer service rivals our own.”

The new line of Coriolis meters will feature several advanced features, including extensive onboard process and batch control capability, PC software for commissioning and diagnostics, and a self-filling/self-draining tube design. Meters will be available in 2012 in a variety of sizes and option configurations. These options will include size ranges from 1/16" to 3" diameter, construction in either stainless steel or Hastelloy. The sophisticated, next-generation electronics will be available in both sensor and remote mounting configurations with a wide range of popular communication protocols. And, standard units will be rated up to 150°C (302°F), with high-temp models rated to 230°C (446°F).

www.racinefed.com

PreCim aims to break the line size barrier

Special to Worldflow

A new company in Israel has set out to break the line size barrier on Coriolis flowmeters. PreCim was established in August 2010. Its large line size Coriolis meters are still in the development stage.

The company aims to develop and manufacture the world’s smallest flowmeters for large diameter lines, enabling a precise measurement of high flowrates.

www.precim.com