

GE
Measurement & Control Solutions

Rheonik Coriolis Mass Flow Meters





A wide range of high accuracy
Coriolis mass flow meters to
serve a wide spectrum of applications.

Rheonik—Specialists in Precision Mass Flow Metering



GE Measurement & Control Solutions building in Billerica, Massachusetts, USA

Rheonik has more than twenty years of experience in the field of Coriolis mass flow meter design and development.

Beginning in 1984, Karl Küppers began the design of a mass flow meter based upon the Coriolis effect that later became the patented Omega tube Coriolis mass flow meter manufactured by Rheonik today.

After the exhaustive testing of many different designs, the Omega tube meter with torsion rods and mass bars was granted a patent based upon its unique operation and construction features. Compared to other meter designs, the Rheonik Omega tube design offers outstanding performance and mechanical reliability.

Rheonik was founded in 1986 for commercial production of the Rheonik mass flow meter range. Based originally in the town of Maisach near Munich, Germany, the company grew quickly because of widespread success of the Rheonik design. To accommodate increased demand, Rheonik relocated in 2003 to a larger facility in Odelzhausen with greater production and office space.

Rheonik manufactures one of the largest range of Coriolis mass flow meters in the world for customers globally, making it one of the world leaders of Coriolis mass flow meter development and manufacture.

At the factory and in regional offices, Rheonik maintains a team of expert application and service engineers, offering best fit technology identification and specification all the way through to on-site commissioning and in-depth, application troubleshooting and resolution. A factory-trained sales and service network provides local service and support worldwide.

In 2008, Rheonik joined other GE high-technology sensing businesses under a new name—GE Measurement & Control Solutions.

Coriolis Technology Offers Accurate and Reliable Flow Measurement



Oil & gas flow metering skid

The Coriolis effect was discovered by the physicist Gustave Gaspard de Coriolis during the 1830s, and is described as “the inertial force exerted on an object as a result of movement relative to a rotating frame of reference.” This science has been applied to many technologies: hydraulics, machine performance, missiles, ergonomics, ocean and atmospheric circulation and, of course, mass flow metering.

The use of the Coriolis effect as a technique for liquid and gas mass flow measurement was firmly established over 20 years ago. Since then, a number of different designs have been produced.

With the tremendous advances made in electronic signal processing technology in recent years, Coriolis mass flowmeters have become highly accurate and reliable instruments.

Rheonik produces one of the world's largest and most comprehensive range of meters.

- Liquid, sludge and gas measurement capability
- Models to measure flow rates from as low as 0.03 kg/h up to 1,500,000 kg/h (0.07 lb/h to 3,300,000 lb/h)
- Sizes up to 12"/DN300
- Pressure ratings up to 900bar/13,050psig
- Temperature ratings from -255°C to 400°C/-425°F to +750°F
- Fiscal/custody transfer approvals (OIML R117/NTEP)
- ATEX and CSA hazardous area approvals covering most of the world
- Extreme resistance to gas bubbles entrained in the process stream when compared to conventional Coriolis meters
- Unaffected by viscosity, density or pressure changes
- Multifunction measurement capability includes density and temperature
- Available with stainless steel, hastelloy, monel and tantalum wetted materials as standard. Other materials on request

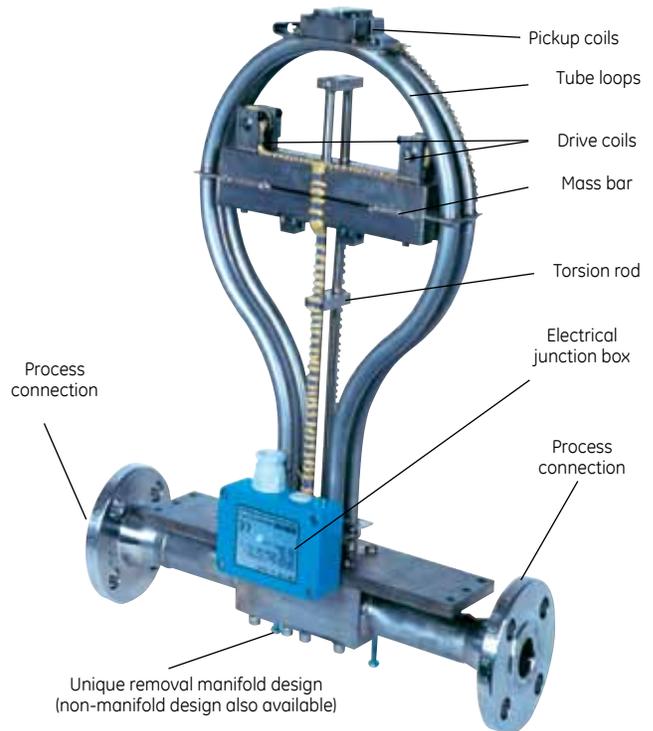
Unique Features at a Glance

All Rheonik Coriolis mass flow meters are manufactured to strictly controlled procedures and quality standards.

Vacuum brazing is used for the final assembly of Rheonik Omega tube meters. Each meter is closely inspected to ensure all joints are sound and defect free. Smaller meters with removable cases are sealed with an O-ring, creating an IP65/Type 4X joint, preventing the ingress of foreign material into the housing.

Process connections can be either a removable manifold style or welded directly to the Omega form tubing to create a truly seal-less meter, ideal for processes with hazardous materials.

The pick-up coils and drive coils installed in the meter are constructed of polyamide insulated wire, encapsulated in epoxy resin. High temperature versions have ceramic insulated wiring. Depending upon the size of the meter, up to four PT-100 temperature sensors are installed in the meter for temperature compensation.



There are three main parts to Rheonik's Omega tube meter, each of which has a distinct function. Together, they ensure that each meter produces accurate and repeatable results:

Omega Tube Form

- Design permits increased tube wall thickness
- Active measurement section is entire top half of omega tube and totally decoupled from the process piping
- No deformation of half round measurement section with changing pressure gives repeatable measurement
- Requirement for secondary pressure containment eliminated



Omega Form

Torsion Rod

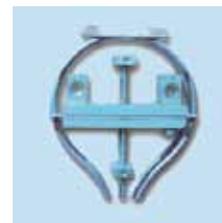
- Helps energize torsion oscillation
- Guides tube movement
- Minimizes stress
- Produces large oscillation amplitudes and extremely good signal-to-noise ratio for best accuracies at low flow conditions



Torsion Rod

High Mass Cross Bar

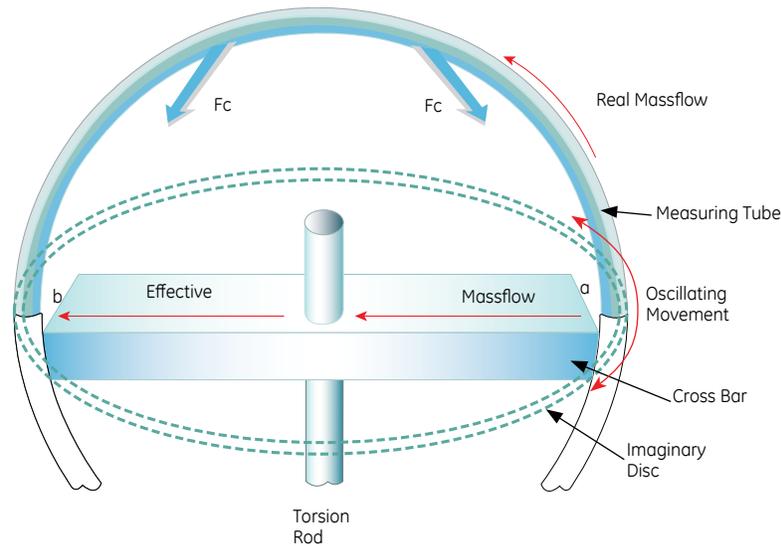
- Reduces susceptibility to external vibration and process borne dampening conditions
- Stabilizes torsion movement
- Works in conjunction with torsion rods to generate harmonic oscillation—tuning fork perpetual motion



High Mass Cross Bar

The Unique Omega Tube Design

The Rheonik range with its unique Omega tube design allows the most challenging mass flow metering applications to be solved. The Omega tube has a torsional oscillation movement rather than the bending motion associated with other, more conventional Coriolis meter designs. The unique mechanical arrangement of the Omega tube meter allows the use of tubing with heavier wall thickness, giving higher pressure ratings, combating abrasion and erosion and eliminating the requirement for the secondary pressure containment found with conventional designs.



Operating Principle

The flexibility of the Rheonik range in terms of applicability and accuracy is due to the patented mechanical arrangement of each meter. Each flowmeter has two measuring tubes parallel to one another and formed into the unique Omega shape, oscillating in opposing directions.

The oscillating system is driven with two high mass cross bars mounted on vertical torsion rods:

- The high mass cross bars stabilize the torsional movement, either eliminating or greatly reducing interference from external vibration and providing continued, reliable operation with the presence of oscillation dampening factors such as entrained gas bubbles or non-homogeneity in the process stream.
- The torsion rods minimize stress on the tubing, guide tube movement and help "energize" the torsional motion.

This rugged mechanical arrangement is energy conserving and requires very little power input (typically less than 300mW) to maintain oscillation amplitude.

The design provides for an exceptionally well balanced mechanism that approaches perpetual motion once energized, with a natural frequency that is tuned by the mass of the cross bars and the elasticity of the torsion rods.

Amplitude is controlled by a pair of electromagnetic coils mounted at each side of the Omega tubes. The whole mechanism is symmetrical, ensuring that internal acceleration forces from the measured process are counterbalanced. Whenever mass (either liquid or gas) flows through the oscillating Omega shaped tubes, a Coriolis force is generated, causing a "bending" or "deflection" in the top of the tubes. This deflection is sensed as a

phase shift between two electronic pick ups mounted on the tubes. The degree of phase shift is directly proportional to the mass flowing within the tubes.

This can perhaps be better understood by imagining that the oscillation of the meter measuring tubes (the upper semi-circle of the Omega tubes) is taking place on an imaginary disc with points "a" and "b" on the circumference of the disc. Process material, starting at point "a" and moving across the imaginary disc to point "b" (the path of "effective massflow") will pass through a range of differing velocities along the way.

The Coriolis force ("FC") generated from the oscillations of the disc and the effective mass flow vector is perpendicular to the movement of the mass across the disc and is proportional to the mass flow. In the meter, this force causes the deflection that is sensed by the two pick-up coils.

Versatile Meters for a Wide Range of Applications



Oxygen measurement

The Omega tube Coriolis meter is one of the most versatile meters available on the market today. The Rheonik range contains a wide variety of sizes, optimized to give accurate and reliable performance without compromise and addressing requirements from extremely low flows of 0.001kg/min/0.002 lb/min to 25,000 kg/min/55,100 lb/min at the upper end.

The robust mechanical design of the Omega tube meter lends itself to extreme applications where other meter designs cannot be used. Rheonik meters can be used in processes with temperatures as low as -200°C/-328°F, as high as 400°C/750°F and with pressure requirements up to 900 bar/13,050 psig.

All meters are available for use in hazardous areas, certified to EEx ia IIC/EEx de IIC or Class 1, Div 1, Gr ABCD and many can be supplied with globally recognized approvals for custody transfer applications.

Wetted parts can be manufactured from exotic materials, including Hastelloy and Tantalum for processes that have specific material compatibility requirements.

Unlike conventional Coriolis designs, Rheonik meters can be made with thick wall tubing to address concerns of wear and failure in abrasive or corroding applications.

The pressure ratings of Omega tube meters are consequently much higher, removing the requirement of secondary containment pressure housings commonplace in other Coriolis meter designs.

Rheonik meters are universally applicable to hundreds of different process measurements in many different industries. Examples are:

- Liquid oxygen flow metering
- Chemical pilot plant
- High pressure CO₂/O₂/N₂/H₂
- First liquid hydrogen filling station
- Asphalt blending station (bitumen at 363°C/685°F)
- High accuracy filling stations—custody transfer
- HCL metering using large Tantalum meters
- High temperature metering solutions

Our Transmitter Range

The RHE14 is low cost, compact and ideal for OEM applications. I/O includes 4-20mA, pulse, flow direction and RS232 serial data. Programming and configuration by SensCom software.



RHE 14

DIN Rail Mounting IP20/Type 1 Housing

Power Supply 8 to 24 Vdc

Dimensions 70 x 86 x 58mm/2.8 x 3.4 x 2.3"

Safe area mounting

Optional safety barrier for hazardous area sensor installation and profibus in development

All other Rheonik transmitters have clear, easy to read local displays and intuitive, menu driven set-up and configuration functions. All include diagnostics for fault finding and performance tuning. Features include low flow cut-off, response time, multiple I/O, selectable units and full scaling capabilities. All settings are stored in non-volatile memory and I/O is galvanically or optically isolated.



RHE 07 Panel Mount Transmitter (ATEX, CSA)

Wall Mounting Coated Alloy Housing

Protection class IP20/Type 1

Power supply 230/115 VAC, 24 VDC

Dimensions 142 x 128 x 250mm/5.6 x 5 x 9.8"

Technical Specifications for all Transmitters

Ambient temperature	-40°C to 60°C	RHE 07, RHE 08 and RHE 14 transmitters to be installed outside of hazardous area (RHE 08 can be installed in Cl. 1, Div. 2 area).
Power consumption	< 15 Watt RHE12 < 5 Watt RHE14 < 1 Watt	RHE 11/12 can be installed in the hazardous area. RHM can be installed in hazardous area (ATEX EEx ia IIC T6-T1/CSA Cl. 1, Div.1, Gr. ABCD) if connected to approved RHE unit.



RHE 08 Field Mount Transmitter (ATEX, CSA)	
Wall mounting coated alloy housing	
Protection class	IP65/Type 4/Cl. 1, Div. 2, Gr. BCD
Power supply	230/115 VAC, 24 VDC
Dimensions	207 x 148 x 302mm/8.1 x 5.8 x 11.9"
User Interface	LCD Display, 3 Button Operation



RHE 11 Field Mount Transmitter ATEX	
SS housing for wall, pipe or meter mounting	
Protection class	IP66/EEEx d IIC T5
Power supply	230/115 VAC, 24 VDC
Dimensions	244 x 225 x 200mm/9.6 x 8.9 x 7.9"
User Interface	LCD Display, 3 Button Operation



RHE 12 Field Mount Transmitter ATEX, CSA	
Wall, pipe or meter mounting. Pressure safe housing (coated alloy)	
Protection class	IP66/EEExd IIC T5/Cl. 1, Div. 1, Gr. BCD
Power supply	24 VDC
Dimensions	diameter 115mm/4.5" height 200mm/7.9"
User Interface	LCD display, 2 Button Operation

RHE 07/08/11

Programming	Programmable via 3 buttons
Analogue outputs	2 assignable and scalable 0/4-20mA for flow, density, temperature or volume, galvanically isolated, max. load < 500 Ohm
Digital outputs	1 frequency/pulse output (0-10kHz, max. 30V/50mA), 3 status outputs (limit, error/ alarm, flow direction etc.)
Digital inputs	2 control inputs (remote zero, hold totalizer, tot. reset, quit error/alarm etc.)
RS232/422/485	Serial interface or HART options available.
Display	2 line, 16 character backlit LCD display
Features	Includes built-in single and dual stage batch controller

RHE 07C has optional double pulse output for custody transfer

RHE 12

Programming	Programmable via 2 sensors behind the glass cover
Analogue outputs	1 programmable 0/4-20 mA output, galvanically isolated (intrinsically safe optional)
Digital outputs	1 frequency/pulse output (intrinsically safe optional), HART Error/Alarm condition output (22 mA) RS232/485 options available
Display	2 line, 16 character backlit LCD display

Profibus PA/Foundation Fieldbus in development

Our Flow Sensor Range

Type	Typical Measuring Range ⁽²⁾		Nominal rate	Pressure Rating in bar/psig ⁽⁷⁾	Standard Process Connections	
	Parallel (kg/min / lb/min)	Serial (kg/min / lb/min)	Parallel (kg/min / lb/min)	Temperatures up to 120°C/248°F	Threaded ^(1,3)	Flanged
RHM015 ⁽⁴⁾	0.004 - 0.6 / 0.009 - 1.32 ⁽⁵⁾	0.002 - 0.3 / 0.004 - 0.66 ⁽⁵⁾	0.6 / 1.3	300(400) / 4350(5800)	1/4"	DN15 / 1/2"
RHM03	0.1 - 5 / 0.22 - 11	0.05 - 2.5 / 0.11 - 6	5 / 11	300(150) / 4350(2175)	1/4"	DN15 / 1/2"
RHM04	0.2 - 10 / 0.44 - 22	0.1 - 5 / 0.22 - 11	10 / 22	150(250) / 2175(3625)	1/4"	DN15 / 1/2"
RHM08	1 - 50 / 2.2 - 110	0.5 - 25 / 1.1 - 55	50 / 110	290(900) / 4205(13050)	1/2"	DN25 / 1"
RHM12	2 - 100 / 4.4 - 220	1 - 50 / 2.2 - 110	75 / 165	190(290) / 2755(4205)	3/4"	DN25 / 1"
RHM15	4 - 200 / 8.8 - 441	2 - 100 / 4.4 - 220	150 / 331	150(300) / 2175(4350)	3/4"	DN25 / 1"
RHM20	6 - 300 / 13 - 661	3 - 150 / 7 - 331	300 / 661	110(225) / 1595(3260)	1	DN50 / 2"
RHM30	15 - 750 / 33 - 1653	7.5 - 375 / 16.5 - 827	600 / 1323	150(400) / 2175(5800)	1 1/2"	DN50 / 2"
RHM40	30 - 1500 / 66 - 3307	15 - 750 / 33 - 1653	1250 / 2756	165(250 ⁽⁶⁾) / 2390(3625 ⁽⁶⁾)	--	DN80 / 3"
RHM60	60 - 3000 / 132 - 6614	30 - 1500 / 66 - 3307	2500 / 5512	100(200 ⁽⁶⁾) / 1450(2900 ⁽⁶⁾)	--	DN100 / 4"
RHM80	160 - 8000 / 353 - 17637	80 - 4000 / 176 - 8818	5000 / 11023	100(160 ⁽⁶⁾) / 1450(2320 ⁽⁶⁾)	--	DN150 / 6"
RHM100	240 - 12000 / 529 - 26455	--	10000 / 22046	100(220 ⁽⁶⁾) / 1450(3190 ⁽⁶⁾)	--	DN200 / 8"
RHM160	500 - 25000 / 1102 - 55116	--	23000 / 50706	40(60 ⁽⁶⁾) / 580(870 ⁽⁶⁾)	--	DN300 / 12"

(1) ISO G and NPT threads available

(2) Typical range for standard meter. Special ranges available

(3) Different sizes available

(4) Optional fine tuning: parallel 0.002 - 0.6kg/min / 0.005 - 1.32 lb/min serial 0.001 - 0.3kg/min / 0.0025 - 0.66 lb/min

(5) Maximum pressure rating of Omega tube

(6) Process Connection may derate overall pressure rating

(7) Pressure rating (in brackets) refers to optional heavy duty or special versions. Others available

Accuracy and Repeatability General Technical Specifications

Accuracy and Repeatability (including zero drift) are stated at a reference condition of H₂O, 14.7psig, 68°F. Range is turn down from nominal flow rate. Optional special calibration and fine tuning for enhanced accuracy in customer specified ranges (including low flow) is available.

Standard Models	
Range 1:20	±0.20% of rate or better
Range 1:50	±0.50% of rate or better
Repeatability	Better than ±0.10% of rate
Optional Gold Line Models Fine Tuned to Your Application	
Range 1:10	±0.10% of rate or better*
Range 1:20	±0.10% of rate or better*
Repeatability	Better than 0.05% of rate*

*Only selected models available as Gold Line - consult factory

Pressure rating				
Ratings stated in the table above refer to meter tubes up to 120°C/248°F. Pressure ratings are lower for meters with higher temperature range. Most meters are available with higher pressure ratings - please consult factory for details.				
Temperature Range	RHMType	Temperature in °F	Temperature in °C	Temp. Class (For EEX ia IIC Version)
Normal	NT	-4 to +248	-20 to +120	T4 - T6
Extended 1	ET1	-328 to +122	-200 to +50	T6 (Ex approval for T> -45°C only)
Extended 2	ET2	-49 to +410	-45 to +210	T2 - T3
High	HT	32 to 662	0 to 350	T1 - T3
Very high	VHT	32 to 752	0 to 400	No EEx approval
Wetted materials parts				
Standard material of construction is 316Ti/1.4571 Stainless Steel. Optional materials include Hastelloy, Tantalum, Monel and Inconel. Consult factory for others. PTFE is used in meters requiring seals.				

The above tables are a summary of the standard meter range. Special and custom version meters are available on request.

All hazardous area meters carry ATEX and/or cCSAus approvals. All standard versions comply with EU PED and ASME standards.

For the selection of the most suitable meter for your application, including assessment of pressure drop, please contact us with your full process details.

About us

GE has united the technological innovation and experience of industry leaders in the design and manufacture of advanced sensing and measurement solutions into one world-class business—GE Measurement & Control Solutions.

GE's products measure temperature, pressure, liquid level, moisture and humidity, gas concentration, and flow rate for applications ranging from environmental, medical, and pharmaceutical to automotive, aerospace, chemical, and petrochemical.

From high-quality hand-held and portable field calibrators to stand-alone measurement instruments and systems, GE provides end-to-end solutions that can help you monitor, protect, and control your critical processes and applications.

Pressure



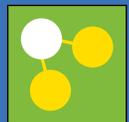
Flow



Temperature



Gas



Moisture



Humidity



Level





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BR-174C