

PRODUCT OVERVIEW

LCMass[™]
b y R h e o n i k

**LIQUID
CONTROLS**
A Unit of IDEX Corporation

IDEX
IDEX CORPORATION



General

The LCMASSTM by Rheonik is a patented Coriolis mass flow meter with unique construction features that solve the problem of directly measuring the mass flow of liquids and gases. A complete installation includes an RHM Flow Sensor, and an RHE Remote Transmitter. Each component is described in detail later in this publication.

Market

Specific markets for LCMASST meters include: oil-field exploration and production; petroleum refinery; petrochemical; CNG (compressed natural gas); paints and coatings; pulp and paper; pharmaceutical; food and beverage; agriculture, and more.

Applications

LCMASST meters can be applied in a broad range of applications, but have found particular success in the very low flow applications found in many industrial installations, in the scientific community, laboratory systems, pilot plants, and additive-injection applications. Similarly, these meters are ideally suited for high temperature, high pressure and/or high flow applications because of unique construction features discussed under "Function and Construction of RHM Flow Sensors".

Typical application examples include:

- Fast batching in combination with an electronic batch or process controller, even for small quantities
- Metering in combination with high-pressure piston pumps (pulsating flow)
- Metering for high-temperature and high-pressure processes (up to 660° F)
- Metering for very low "drip" flow rates, e.g., 0.0022 lbs/min
- Metering for highly corrosive liquids, e.g., bromine compounds

Regardless of application, the high accuracy of the device is not significantly affected by changes in pressure, temperature, density, viscosity, flow profile, and multi-phase fluids.

Sizes & Configurations

The LCMASST meters are available in a full selection of configurations and sizes. Models are available in flow ranges from a "drip flow" of 0.0022 lbs/min to 50,000 lb/min (22,700 kg/min), and in process fittings from 1/4" NPT to 12" ANSI.

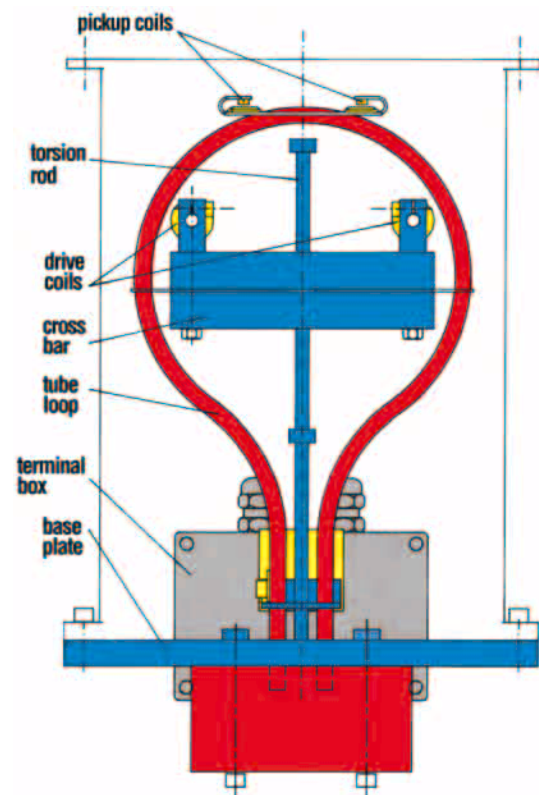
Connections include flanged, threaded, and sanitary. Working pressures range from 580 psi (40 bar) to 11,600 psi (800 bar).

Standard Outputs

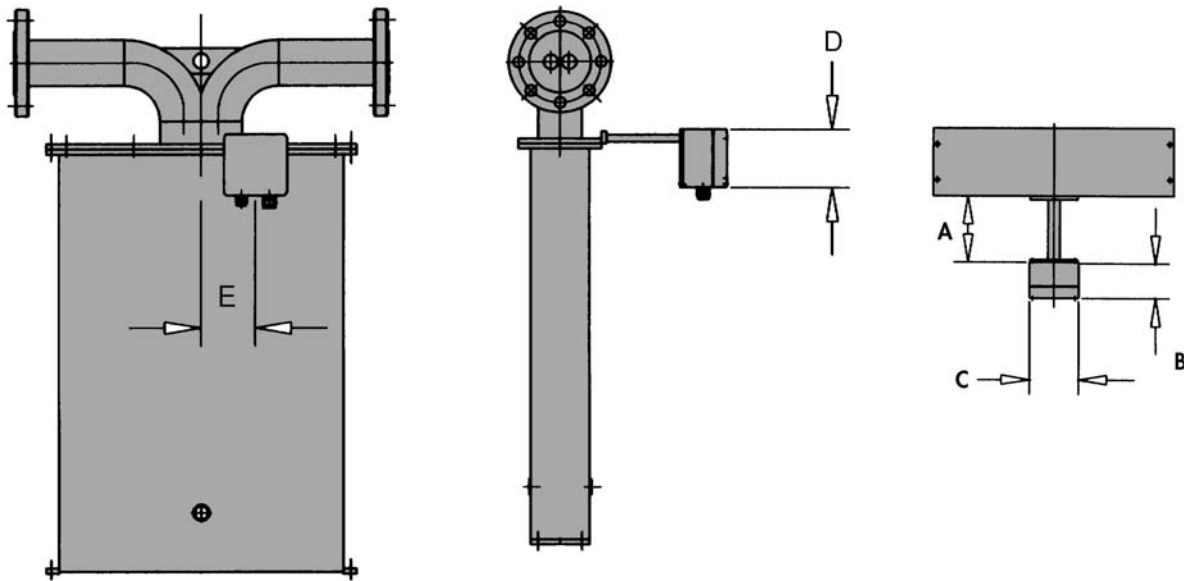
Output data on product temperature, density, and mass flow rate can be provided using the LCMASST meter. The Remote Transmitter (discussed on page 5) provides standard outputs including pulse, 4-20ma, and serial digital.

Function and Construction of RHM Flow Sensor

The RHM Flow Sensor contains two tube loops configured as shown, below. Flow direction is the same in both loops. The loops form part of an oscillating system that also includes two horizontally mounted high mass crossbars and two vertically mounted torsion rods. The torsion rods are connected together on both ends. The natural frequency of the oscillating system is a function mainly of the mass of the crossbars and the elasticity of the torsion rods. The system is excited (driven) by electromagnetic coils to provide a controlled amplitude, with the resulting oscillation being sensed by a pair of pick-up coils. See illustration, below.



RHM Flow Sensors Extended Temperature (ET) and High Temperature (HT) Versions

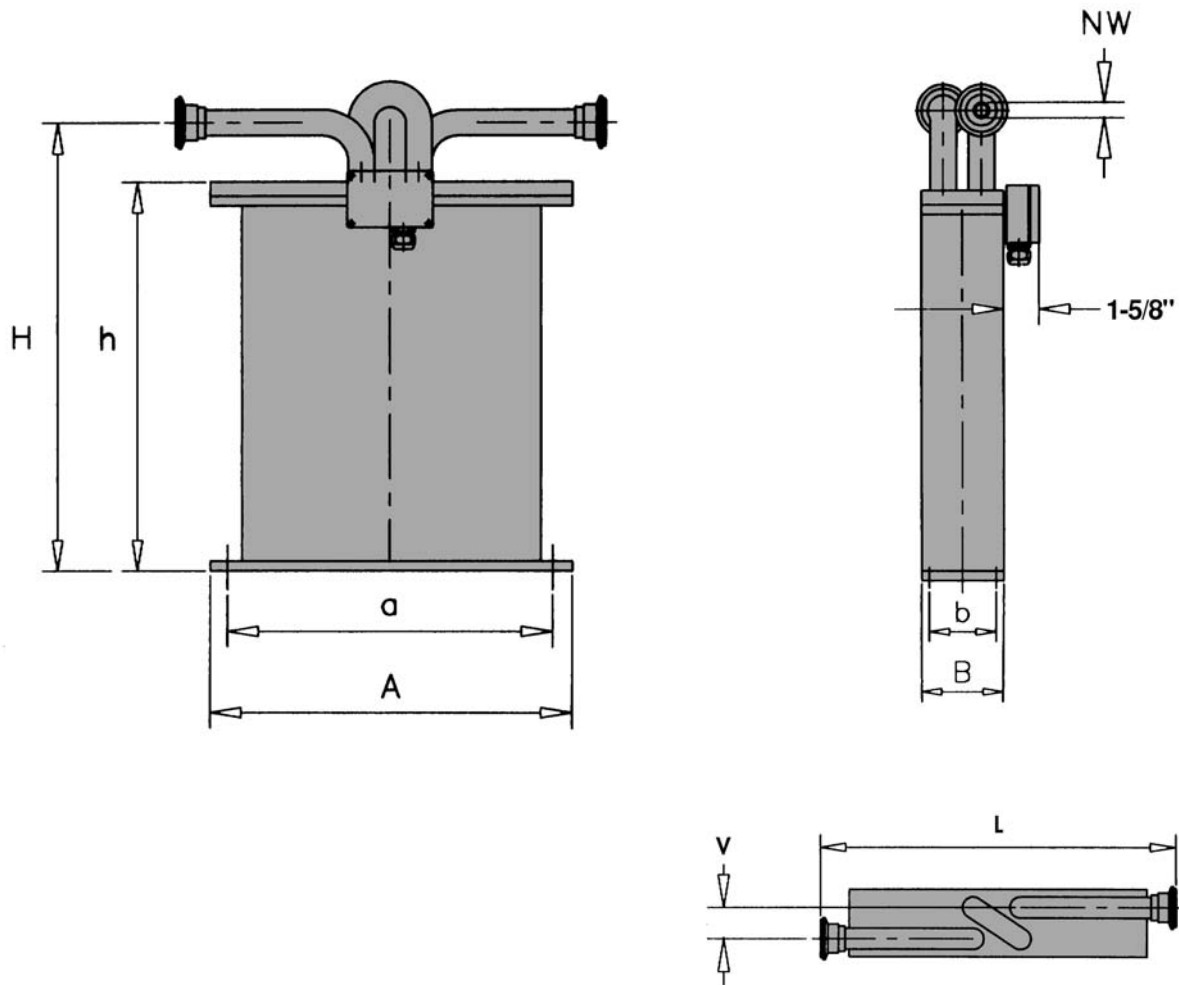


Type RHM	Dimensions (inches)*				
	A°	B	C	D	E
015	3-7/8	1-1/2	3-7/8	2-1/2	0
03	3-7/8	1-1/2	3-7/8	2-1/2	0
04	3-7/8	1-1/2	3-7/8	2-1/2	0
06	5-7/8	1-1/2	3-7/8	2-1/2	0
08	5-7/8	1-1/2	3-7/8	2-1/2	0
12	5-7/8	1-1/2	3-7/8	2-1/2	0
15	5-7/8	1-1/2	3-7/8	2-1/2	0
20	5-7/8	1-1/2	3-7/8	2-1/2	0
30	5-7/8	1-1/2	3-7/8	2-1/2	5-7/8
40	9-7/8	3-1/2	4-3/4	4-3/4	9-7/8
60	9-7/8	3-1/2	4-3/4	4-3/4	11-3/4
80	9-7/8	3-1/2	4-3/4	4-3/4	11-3/4

° Maximum permitted temperature at junction box is 175°F.

* Dimensions to nearest 1/8 inch; not for construction use. Consult factory for appropriate Engineering drawing, if required.

RHM Flow Sensors, Type S - Sanitary Connections



Type RHM	Inlet Dia NW	Dimensions (inches)*								Weight (lbs)
		A	a	B	b	H	h	L	V	
015	1/4	5-3/4	5-1/8	1-5/8	1	8-1/8	6-3/4	7-1/2	0	4
03	1/4	5-3/4	5-1/8	1-5/8	1	8-1/8	6-3/4	7-1/2	0	4
04	1/4	5-3/4	5-1/8	1-5/8	1	8-1/8	6-3/4	7-1/2	0	4
06	1/2	7-1/8	6-1/2	2-3/8	1-5/8	12-5/8	9-1/8	9	0	11
08	1/2	7-1/8	6-1/2	2-3/8	1-5/8	12-5/8	9-1/8	9	0	11
12	3/4	11-3/4	11-1/4	2-3/4	2	21-1/4	17-7/8	13-3/4	1	33
15	3/4	11-3/4	11-1/4	2-3/4	2	21-1/4	17-7/8	13-3/4	1	33
20	1	11-3/4	11-1/4	2-3/4	2	21-1/4	17-7/8	15	1	40
30	1-1/4	23-5/8	22-7/8	4-3/4	3-1/2	39	32-7/8	11-3/4	2	150
40	1-1/2	28-3/8	27-1/8	7-1/8	5-3/4	43-1/4	38	15-3/4	2-3/8	310
60	1-1/2	37-3/8	35-7/8	9-7/8	9-1/2	54-1/2	49-1/4	19-5/8	3-3/4	520

* Dimensions to nearest 1/8 inch; not for construction use. Consult factory for appropriate Engineering drawing, if required.

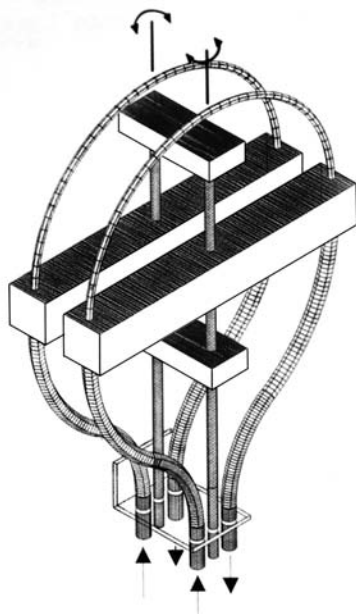
With no flow through the meter, the two tubes oscillate completely out of phase with one another. As product flows through the meter, the oscillating tubes are delayed or advanced due to Coriolis forces. As a result, a variable phase differential is developed between the two tubes that is proportional to the mass flowing through the unit and measured by the sensors located on the tubes.

There are significant design features of the sensor that set this meter apart from other meters. Those features include:

- **Patented torsion rod design** to minimize tube stress and eliminate tube-stress fractures. The design is unique in that the Coriolis force is

produced by a very slight torsional

twisting motion of the tubes about an axis. This motion places very low fatigue stress on the tubes and contributes to the long service life that is a characteristic of the design



- **High mass dual cross bar support**

of oscillating flow tubes to drastically reduce susceptibility to “noise” or external vibrations that may interfere with the accuracy of other meters

- **Increased tube-wall thickness** relative to other Coriolis mass flow meters ensures that meter accuracy is unaffected by changes in pressure, and permits operation at high working pressures up to 11,600 psi. The increased tube-wall thickness also eliminates the need for secondary containment around the meter. Pressure rating of the flow tubes is equal to or greater than the ANSI flange rating.

- **Tube construction of 316 Ti stainless steel**, which is a superior grade to “L” series stainless steel and compatible with a wider range of liquids. Other tube materials, such as Hastelloy and even Tantalum are available for highly corrosive media.

Each of these features contributes to superior performance and long service life, and makes the RHM Flow Sensor design unique in the industry.

Mechanical Construction Features

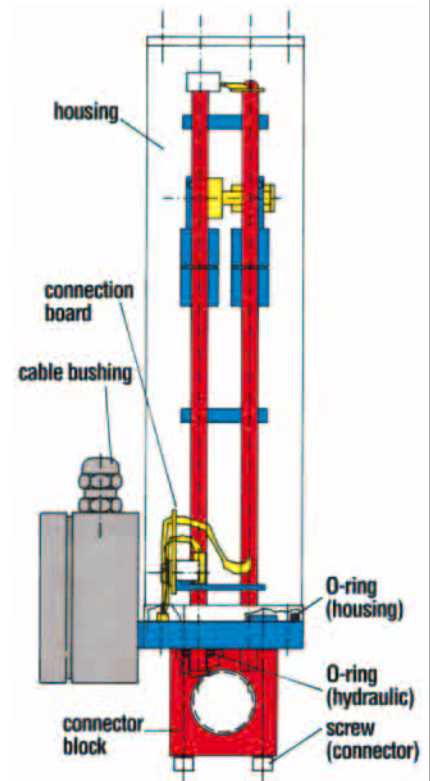
The oscillating structure and all its parts, including a base plate, are vacuum-brazed.

The stainless steel housing covering the sensor is bolt-connected and O-ring sealed to the base plate. Hydraulic connectors are also screwed against the base plate where O-ring seals seal against the flow tubes. This construction provides a significant advantage in cleaning and changing process fluids because the connectors can easily be removed. In addition, this construction is ideal for fluids that have a tendency to coat the inner walls of the tubes or to solidify at ambient temperatures.

The standard material for all wetted parts is 316 Ti stainless steel, with Hastelloy and Tantalum available for highly corrosive media. Units supplied with Hastelloy and Tantalum include flanges that are directly welded to the tube ends to eliminate seals inside the flow path (Type F, Version 3). The same is true for sanitary fittings to meet clean in place (CIP) standards.

Electrical Construction Features

The coils are of thermoplastic-insulated wiring (polyimide-coated) molded in epoxy resin. Starting at the coils, the wiring is fixed onto the tubes and routed via the most secure route to a connection board (see illustration at right). From the connection board, the wiring is routed directly into the terminal box, which has a terminal block for cabling. The RTD temperature sensor which is attached to the flow-tube is similarly connected.



Specifications and dimensional data are provided on pages 4 through 11.

Specifications

ACCURACY:

Meter performance capable of:

Mass Flow: +/- 0.2% of rate over range 20:1
 +/- 0.5% of rate over range 50:1
 Density: RHM06 & RHM08; 0.010 g/cc
 RHM12 thru RHM20; 0.005 g/cc
 RHM30 thru RHM160; 0.002 g/cc
 Temperature: +/- 1.8° F or 0.4% of reading

REPEATABILITY:

Meter performance capable of:
 Mass Flow: +/- 0.1% of rate
 Temperature: +/- 1.8° F

TEMPERATURE RANGE:

Transmitter: 15° F to 122° F

Flow Sensor:	Temperature Range:
N	-4 to 248°F
T	-328 to 122°F
E	-58 to 410°F
H	32 to 662°F

VISCOSITY RANGE:

Flow Sensor: Unlimited

MATERIALS OF CONSTRUCTION:

Tubes supplied in 316 Ti, standard. Hastelloy or Tantalum (wetted parts) available on request.

AGENCY APPROVALS:

Flow Sensor

Environmental: NEMA 4X
 Electrical: CSA Intrinsically Safe, Class I, Division 1, Groups A, B, C, D
 Sanitary: 3A Approval available on meters with serial flow tubes

Transmitter

Environmental: Model RHE07 (IP20)
 Model RHE08 (IP64)
 Electrical: Model RHE08, Class I, Division 2, Groups C & D non-incendive
 Model RHE11, EEx de {ia} IIC Explosion Proof

NOTE:

The above-listed data covers standard meters, only. For special needs (temperature, pressure, material, process connections, etc), please contact the Liquid Controls factory.

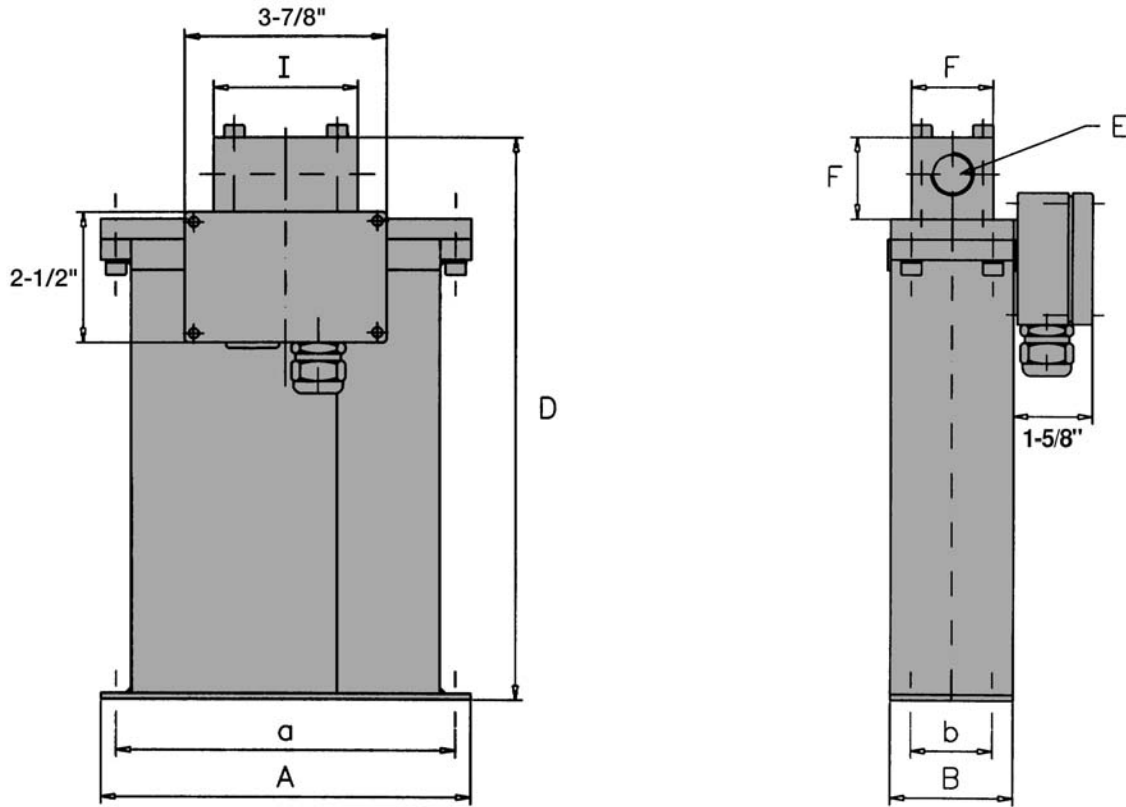
Technical Data for RHM Flow Sensors

Type	Pressure Rating, psi	Flow Measurement Range, (lbs/min)			Process Connections, inches	
		Parallel		Serial	Threaded	Flanged
		Standard Meters (20:1)	Special Order Meters (50:1)	Standard Meters (20:1)		
RHM015	4717	0.008-0.17	0.008-0.4*	0.004-0.08	1/4"	1/2"
RHM03	2177 (4717)*	0.22-4.4	0.22-11*	0.11-2.20	1/4"	1/2"
RHM04	2177	0.44-8.8	0.44-22*	0.22-4.40	1/4"	1/2"
RHM06	2903 (5800)*	1.10-22.0	1.10-55*	0.55-11.0	1/2"	1"
RHM08	4354	2.20-44.0	2.20-110*	1.10-22.0	1/2"	1"
RHM12	2903 (4350)*	4.40-88	4.40-220*	2.20-44.0	3/4"	1"
RHM15	2177 (4350)*	8.81-176	8.81-440*	4.40-88.0	3/4"	1"
RHM20	2177 (3600)*	13.2-264	13.2-660*	6.60-132	1"	2"
RHM30	2177 (3600)*	22.0-440	22.0-1100*	11.0-220	1-1/2"	2"
RHM40	2177 (3600)*	66.1-1322	66.1-3305*	33.0-660	N.A.	3"
RHM60	580 (2900)*	110-2200	110-5500*	55-1100	N.A.	3"
RHM80	550 (2175)*	350-7000	350-17500*	N.A.	N.A.	6"
RHM160	800	661-13220	661-55000*	N.A.	N.A.	12"

* Numbers in parentheses are for *special order* higher pressure tubes with increased wall thickness.

* Flow rates shown (in italics) are *maximum flow rates for Special Order Meters* calibrated to provide a 50:1 flow measurement range. Consult factory for special construction details.

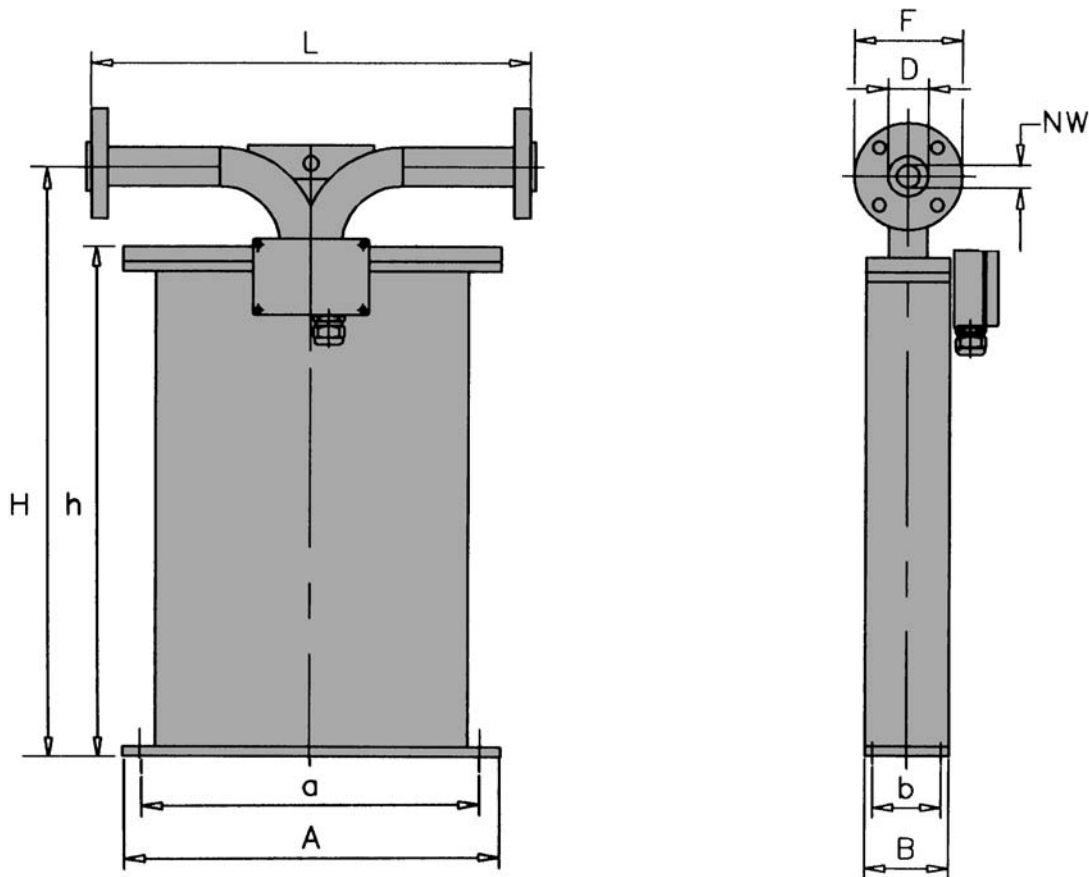
RHM Flow Sensors, Type G - Threaded Connections



Type RHM	Threaded Conn., E (NPT)	Dimensions (inches)*							Weight (lbs)
		A	a	B	b	D	F	I	
015	1/4	5-3/4	5-1/8	1-5/8	1	7	1-1/8	2	4
03	1/4	5-3/4	5-1/8	1-5/8	1	7	1-1/8	2	4
04	1/4	5-3/4	5-1/8	1-5/8	1	7	1-1/8	2	4
06	1/2	7-1/8	6-1/2	2-3/8	1-5/8	10-3/4	1-5/8	2-3/4	11
08	1/2	7-1/8	6-1/2	2-3/8	1-5/8	10-3/4	1-5/8	2-3/4	11
12	3/4	11-3/4	11-1/4	2-3/4	2	19-3/4	2	4-3/4	33
15	3/4	11-3/4	11-1/4	2-3/4	2	19-3/4	2	4-3/4	33
20	1	11-3/4	11-1/4	2-3/4	2	19-3/4	2-3/8	5-1/2	40
30	1-1/2	23-5/8	22-7/8	4-3/4	3-1/2	37	3-7/8	6-1/4	150

* Dimensions to nearest 1/8 inch; not for construction use. Consult factory for appropriate Engineering drawing, if required.

RHM Flow Sensors, Type F - Flanged Connections - Version 3 with welded flange for special materials or high temperature



Type RHM	Dimensions (inches)*										Weight (lbs)
	A	a	B	b	D ^Δ	F ^Δ	H	h	L	NW	
015	5-3/4	5-1/8	1-5/8	1	1-1/4	3-1/2	8-1/8	6-3/4	8-5/8	1/2	9
03	5-3/4	5-1/8	1-5/8	1	1-1/4	3-1/2	8-1/8	6-3/4	8-5/8	1/2	9
04	5-3/4	5-1/8	1-5/8	1	1-1/4	3-1/2	8-1/8	6-3/4	8-5/8	1/2	9
06	7-1/8	6-1/2	2-3/8	1-5/8	2	4-1/4	12-5/8	9-1/8	10-1/4	1	18
08	7-1/8	6-1/2	2-3/8	1-5/8	2	4-1/4	12-5/8	9-1/8	10-1/4	1	18
12	11-3/4	11-1/4	2-3/4	2	2-1/2	5	21-1/4	17-7/8	15-3/4	1-1/2	40
15	11-3/4	11-1/4	2-3/4	2	2-1/2	5	21-1/4	17-7/8	15-3/4	1-1/2	40
20	11-3/4	11-1/4	2-3/4	2	3	6	21-1/4	17-7/8	18-1/8	2	55
30	23-5/8	22-7/8	4-3/4	3-1/2	4-1/4	7-1/2	39	32-7/8	28-1/2	3	170
40	28-3/8	27-1/8	7-1/8	5-3/4	4-1/4	7-1/2	—	38	28-1/2	3	310
60	37-3/8	35-7/8	9-7/8	5-7/8	4-1/4	7-1/2	—	49-1/4	28-1/2	3	520
80	44-7/8	42-1/8	13	7-7/8	4-1/4	7-1/2	71-1/2	59-5/8	35-3/8	3	950
160	63	61.8	20	15-3/4	12-3/4	16	71-3/8	58-3/4	35.5	10	1,300

* Dimensions to nearest 1/8 inch; not for construction use. Consult factory for appropriate Engineering drawing, if required

^ΔDimensions shown (D & F) are for ANSI 150 flanges. For other flanges, refer to ANSI B16.5 handbook.

Technical Data For RHE Remote Transmitters



RHE 07 *Rack mounted version*
Environmental Protection Class: (IP20)
Power Supply: 110/220V AC (50/60 Hz): 24V DC



RHE 11 *Explosion Proof Version*
Protection Class: EEX de {ia} IIC Explosion Proof
Class I, Division 1, Group C & D, pending.
Power Supply: 110/220V AC (50/60 Hz): 24V DC



RHE 08 *Wall-mounted version*
Environmental Protection Class: (IP 64)
Class I, Division 2, Group C & D, non-incendive
Power Supply: 110/220V AC (50/60 Hz): 24V DC

Specifications for remote transmitters

Temperature Range: 15 to 120°F
Power Consumption: < 15 watts

Power Supply: 110/220V AC(50/60 Hz) +/- 10%
24V DC +/-10%

Display: Two lines; 16 characters each line

Analog Outputs: Two programmable outputs (0 or 4-20ma) for flow, density, temperature, or volume ; internally powered galvanically isolated; maximum load < 1000 ohm; accuracy +/- 0.05% of full scale

Pulse Outputs: One open collector optically isolated frequency (pulse) output; 0 to 10,000 Hz, maximum. 30V/50mA

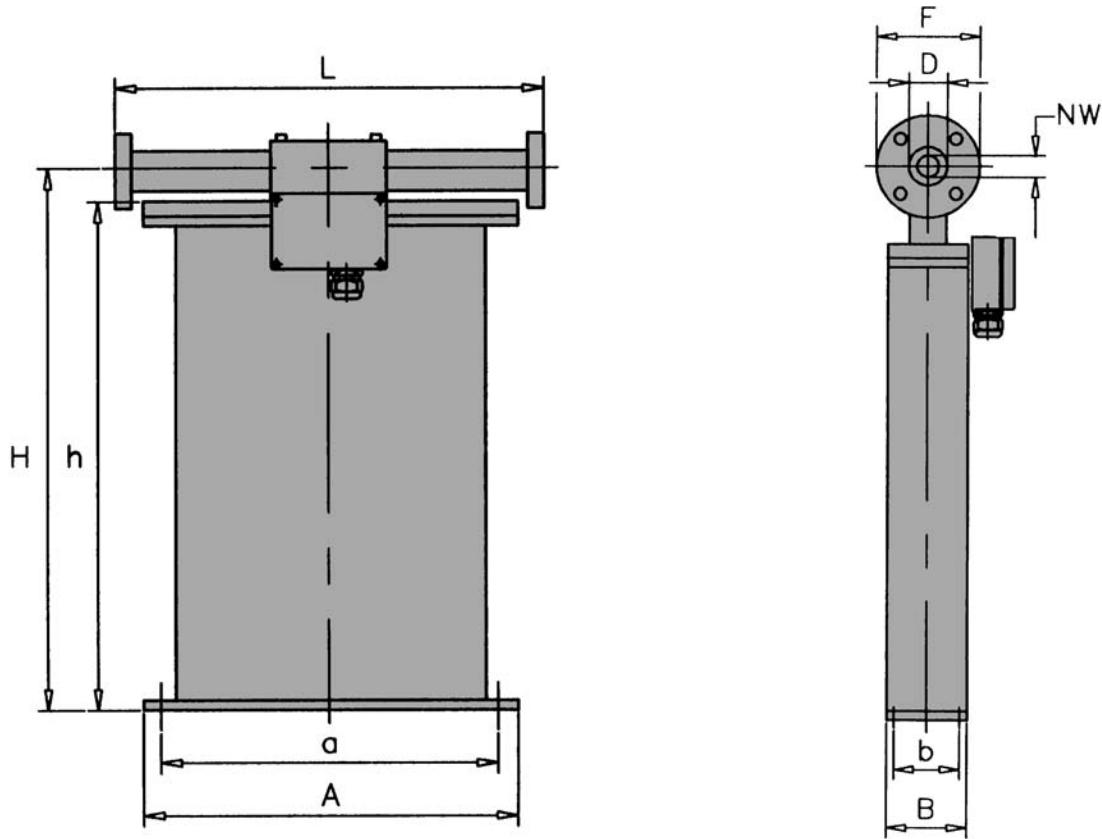
Digital Inputs: Two programmable status input switches, optically isolated: (zero, hold totalizer, reset totalizer, error acknowledgement)

RS422/485: Serial interface (optionally available). RS 485 units can be addressed in a 4-wire BUS.

Features: Remote Transmitters are field programmable via three pushbuttons (optically actuated for explosion-proof transmitter). All settings are stored in non-volatile memory. Self-diagnostics appear on the two-line display in plain language. All outputs are galvanically isolated. Other features include: low-flow cut off, response time, and output units in grams, kilograms, ounces, pounds, tons, °C, °F, etc.

Options: HART protocol (RHE 08 and RHE 11 only).

RHM Flow Sensors, Type F - Flanged Connections - Version 1 with removable flange connector (Teflon Sealing)

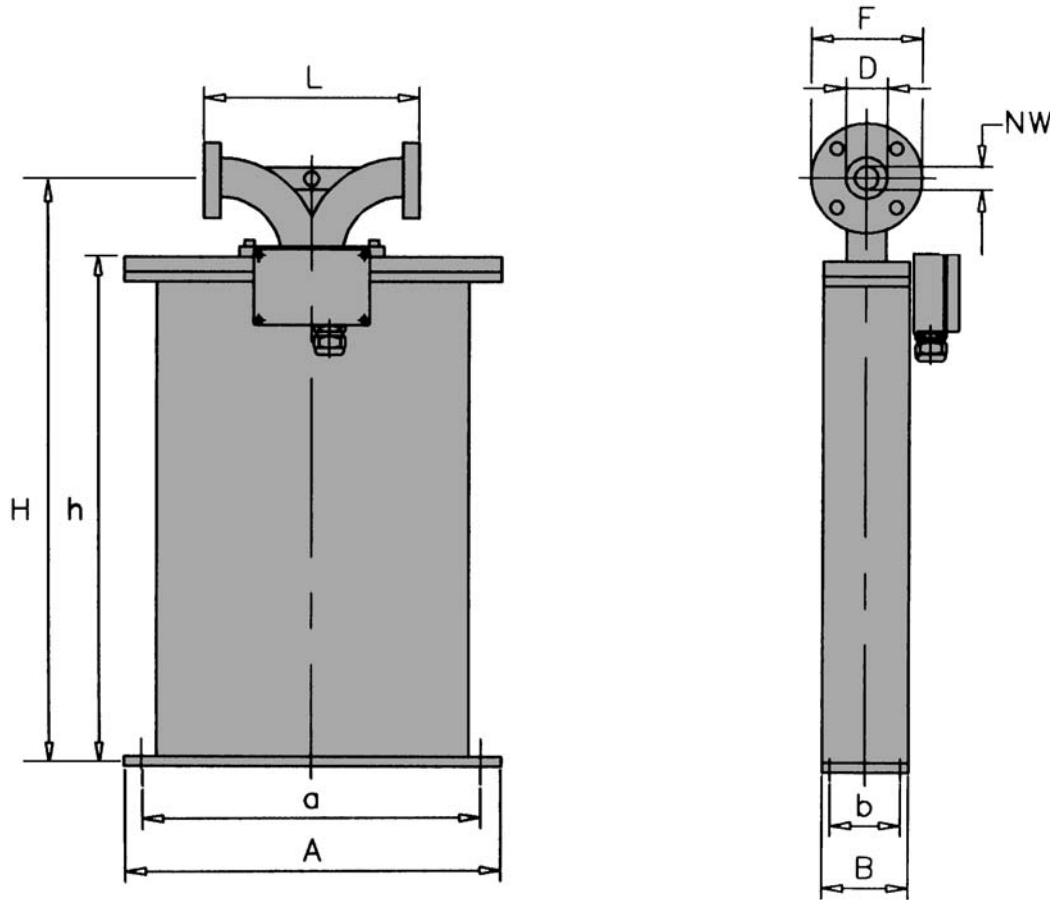


Type RHM	Dimensions (inches)*										Weight (lbs)
	A	a	B	b	D ^Δ	F ^Δ	H	h	L	NW	
015	5-3/4	5-1/8	1-5/8	1	1-1/4	3-1/2	8-1/8	6-3/4	8-5/8	1/2	9
03	5-3/4	5-1/8	1-5/8	1	1-1/4	3-1/2	8-1/8	6-3/4	8-5/8	1/2	9
04	5-3/4	5-1/8	1-5/8	1	1-1/4	3-1/2	8-1/8	6-3/4	8-5/8	1/2	9
06	7-1/8	6-1/2	2-3/8	1-5/8	2	4-1/4	10	9-1/8	10-1/4	1	18
08	7-1/8	6-1/2	2-3/8	1-5/8	2	4-1/4	10	9-1/8	10-1/4	1	18
12	11-3/4	11-1/4	2-3/4	2	2	4-1/4	18-7/8	17-7/8	15-3/4	1	40
15	11-3/4	11-1/4	2-3/4	2	2	4-1/4	18-7/8	17-7/8	15-3/4	1	40
20	11-3/4	11-1/4	2-3/4	2	3	6	19-1/8	17-7/8	18-1/8	2	55
30	23-5/8	22-7/8	4-3/4	3-1/2	3	6	35-3/8	32-7/8	28-1/2	2	170

* Dimensions to nearest 1/8 inch; not for construction use. Consult factory for appropriate Engineering drawing, if required.

Δ Dimensions shown (D & F) are for ANSI 150 flanges. For other flanges, refer to ANSI B16.5 handbook.

RHM Flow Sensors, Type F - Flanged Connections - Version 2 with removable cast flange connector (Teflon Sealing)



Type RHM	Dimensions (inches)*										Weight (lbs)
	A	a	B	b	D ^Δ	F ^Δ	H	h	L	NW	
40	28-3/8	27-1/8	7-1/8	5-3/4	4-1/4	7-1/2	45-1/2	38	28-1/2	3	310
60	37-3/8	35-7/8	9-7/8	5-7/8	4-1/4	7-1/2	57-1/8	49-1/4	28-1/2	3	520

* Dimensions to nearest 1/8 inch; not for construction use. Consult factory for appropriate Engineering drawing, if required.

Δ Dimensions shown (D & F) are for ANSI 150 flanges. For other flanges, refer to ANSI B16.5 handbook.

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Backed By Our Worldwide Reputation For Quality, Accuracy and Advanced Design.

WARRANTY:

Liquid Controls, ("Seller") products are warranted against defects in material or workmanship for a period of one (1) year from date of installation, provided that the warranty shall not extend beyond twenty-four (24) months from the date of original shipment from Seller. Seller's obligations, set forth below, shall apply only to failure(s) to meet the foregoing obligations provided that Seller is given written notice within thirty (30) days of any occurrence from which a claim of defect arises. If a warranty dispute occurs, the Purchaser shall be required to provide Seller with proof of date of sale. The minimum requirement to establish date of sale shall be a copy of the Seller's invoice. In the event that a factory inspection by Seller or its designee(s) supports the validity of a claim, at the discretion of Seller, repair, replacement or refund shall be the sole remedy for defect and shall be made, free of charge, ex-works factory. In no event shall Seller be liable for any special, consequential, incidental, indirect or exemplary

damages arising out of warranty, contract, tort (including negligence) or otherwise, including but not limited to, loss of profit or revenue, loss of use of the product or any associated products and/or equipment, cost of substitute goods or services, downtime costs or claims of or by Purchaser's clients or customers. In any event, the total liability of Seller for any and all claims arising out of or resulting from the performance, non-performance or use of the product shall not exceed the purchase price of the individual product giving rise to the claim. All other guaranties, warranties, conditions and representations, either express or implied, whether arising under any statute, common law, commercial usage or otherwise are excluded. Electronic Products require installation, start-up and servicing by local factory-trained service representatives. In the absence of installation, start-up and servicing of Electronic Products by Seller trained service representatives, this warranty is null and void.

Seller's obligations as set forth above shall not apply to any product, or, or any component or part thereof, which is not properly installed, used, maintained or repaired, or which is modified other than pursuant to Seller's instructions or approval. NOTE: The above warranty applies only to products manufactured by Liquid Controls, Lake Bluff, Illinois. Private label, OEM, and/or products manufactured by Liquid Controls licensee(s) are specifically excluded from the above warranty. Consult factory for all non-Liquid Controls manufacturers' warranties. NO IMPLIED OR STATUTORY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE SHALL APPLY. *3 Year/3 Million Gallon Warranty applies to MA-7 metering chamber only, 3 Year/1.8 Million Gallon Warranty applies to MA-5 measuring chamber only, and both warranties apply only when the meter is installed on a bulk delivery truck which has been calibrated and sealed by an authorized third party and is operating in the United States or Canada.

Backed By Our Worldwide Reputation For Quality, Accuracy and Advanced Design.

**LIQUID
CONTROLS**
A Unit of IDEX Corporation



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