Coriolis
Flow meters

- Product family introduction
- Principle of operation
- Product review
- Applications
- Key product features

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SITRANS F C

Product family

Principle of operation

Product overview

Application

Key features

Coriolis Mass Sensors:
  DI 1.5  
  DN 4  
  DI 3 – 40  
  DN 50 – 150

Coriolis Mass Electronics:
  Mass 6000  
  IP-67 NEMA 4X  
  19” Rack Mount  
  FC070

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Volumetric flow can be subject to errors due to temperature, pressure and viscosity variations.
Principle of operation
Overview of Coriolis Mass Flow principal

Product family

Principle of operation

Product overview

Application

Key features
High immunity against changing process conditions and vibrations is achieved with unique center block concept.

Only one pipe, with no welds. Ideal for CIP applications.

Safe pipe design. We use the market’s thickest pipe and offer a choice of high grade stainless steel or Hastelloy for corrosive applications.

All Siemens sensor constructions are intrinsically safe to Class 1 Division 1 meeting industry’s toughest challenge.
Principle of operation

MASSFLO® - MASS 2100 DI 3 – 40, 1/8” – 1½”
Model 2100 tube design
Principle of operation

Phase difference with zero flow

Phase difference with flow (Mass)

Drive Coil

Pick up 1

Pick up 2

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Principle of operation
Principle of operation
Principle of operation

Frequency measurement gives fluid density

- Density is inversely proportional to frequency
- All meters calibrated on air and liquid and at elevated temp.
- MASS 6000 signal converter outputs, density, temperature and mass flow

\[
\text{Density} = A + B \left(1 + \frac{\alpha}{t} T^2\right)
\]

With air \(F_1 = 142.09\) Hz

With water \(F_2 = 124.12\) Hz

\[
T = \frac{1}{fr} \quad [s]
\]

\(A, B = \) Calibration constants
\(\alpha = \) Density TC
\(t = \) Liquid temperature
\(T = \) Periodic time
\(fr = \) Resonance frequency
Coriolis mass flow meter measurement

Phase \(\rightarrow\) Coriolis reaction \(\rightarrow\) Mass flow [lb/h]

Frequency \(\leftrightarrow\) Resonance \(\rightarrow\) Density [lb/ft³]

Temperature \(\leftrightarrow\) Liquid [°F]

Volume flow \(\leftrightarrow\) Calculated \(\leftrightarrow\) Mass/Density
One Platform. Infinite solutions

Product family
- SiFlow FC070
- MASS 6000 Exd
- MASS 6000 19"
- MASS 6000 19” wall mount
- MASS 6000 IP 67/NEMA 6

Principle of operation

Product overview

Application

Key features
- Greater flexibility
- Compact or remote
- One type transmitter for all sizes
- Industry specific sensors and transmitters
- Flexible logistics handling
- Quick reaction to changing customer demands – even after ordering – delivery

In brief: competitiveness

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# Transmitters

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<td>Profibus PA, Hart</td>
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<tr>
<td>Power supply</td>
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# Transmitters

## Product family

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<th>DN 4 / (^{1/4})&quot;</th>
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<td>Measuring range</td>
<td>kg/h (lb/h)</td>
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<tr>
<td>Pressure 316L</td>
<td>bar (psi)</td>
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<tr>
<td>Pressure C-22</td>
<td>bar (psi)</td>
</tr>
<tr>
<td>Pipe material</td>
<td>1.4435 (316L) Stainless steel or Hastelloy C-22</td>
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## Principle of operation

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<th>DI 40 / 2&quot;</th>
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<tr>
<td>Measuring range</td>
<td>kg/h</td>
<td>65</td>
<td>250</td>
<td>1,000</td>
<td>5,600</td>
<td>25,000</td>
</tr>
<tr>
<td>Measuring range</td>
<td>lb/h</td>
<td>140</td>
<td>550</td>
<td>2200</td>
<td>12,345</td>
<td>55,100</td>
</tr>
<tr>
<td>Pressure 316L</td>
<td>bar (psi)</td>
<td>230 (3336)</td>
<td>230 (3336)</td>
<td>265 (3844)</td>
<td>130 (1885)</td>
<td>110 (1595)</td>
</tr>
<tr>
<td>Pressure C-22</td>
<td>bar (psi)</td>
<td>365 (5294)</td>
<td>350 (5076)</td>
<td>410 (5946)</td>
<td>200 (2900)</td>
<td>185 (2683)</td>
</tr>
<tr>
<td>Pipe material</td>
<td>1.4435 (316L) Stainless steel or Hastelloy C-22</td>
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## Product overview

### Application

### Key features

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<td>113,400</td>
<td>192,000</td>
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<tr>
<td>Measuring range</td>
<td>lb/h</td>
<td>93,900</td>
<td>191,800</td>
<td>250,000</td>
<td>423,300</td>
</tr>
<tr>
<td>Pressure 316Ti / C-4</td>
<td>bar (psi)</td>
<td>100 (1450)</td>
<td>100 (1450)</td>
<td>100 (1450)</td>
<td>40 (580)</td>
</tr>
<tr>
<td>Pipe material</td>
<td>1.4571 (316Ti) Stainless steel or Hastelloy C-4</td>
<td></td>
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## Pipe design

<table>
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MASS 2100 DI 1.5 / 1/16"

In industry, accurate recipe control means everything!

The MASS 2100 DI -1.5 is the preferred meter for research and development and pilot-plant applications for liquid or gas measurement, when measuring small quantities is CRITICAL!

1. The meter is installed with a single quick release clamp fitting and a single multi-plug connector that is fast and cost effective.

2. High immunity to noise with the centre block, together with balanced pipe loops. Together they ensure dependable long-term stability eliminating influences from process conditions.

3. Plug & Play. Install and commission a meter in less than 10 minutes.

4. Single-pipe design optimizes hygiene and safety. All our sensors consist of one single pipe without any welds ensuring that steam or CIP cleaning can be carried out with confidence.

Mount the clamp
Fit the meter in the clamp and tighten
Connect the pre-wired multi-plug connector
Fit back plate to converter and measurement can commence
FC 300 – DN-4

**Product family**

**Principle of operation**

**Product overview**

**Application**

**Key features**

**One pipe, no welds**
Ideal for CIP applications

**Choice of corrosion resistant sensor materials**
Stainless steel EN 1.4435 or Hastelloy C-22

**Corrosion and installation optimized enclosure**
Stainless steel or Hast C-22 matching most environments
MASS 2100 DI 3 – DI 40 / 1/8“ – 1.5“

- Optimum meter performance is achieved through a differentiated sensor design
- High accuracy 0.1% of rate with a large turndown
- Self draining in horizontal installation
- Minimum pressure loss due to a large internal diameter throughout the entire meter

1. High immunity against changing process conditions and vibrations is achieved with unique center block concept
2. Only one pipe, with no welds. Ideal for CIP applications
3. Safe pipe design. We use the market’s thickest pipe and offer a choice of high grade stainless steel or Hastelloy for corrosive applications
4. All Siemens sensor constructions are intrinsically safe to Class 1 Div 1 meeting industry’s toughest application challenges
**DN 50 - 150**

**MC1 DN 50 – DN 150 / 2“ – 6“**

- Space saving sturdy design
- Insensitive to pipeline stresses and vibrations
- Self draining in both horizontal and vertical positions
- Rigid, solid mounting structure
- Optimally oriented inductive sensors generate large signal amplitudes
- Parallel S-tube design enhances accuracy and turndown ratio

In the large size category, the MC1 offers the ideal fit between size, maximum flow capacity and ease of installation.
Applications

Industries
- Chemical
- Petrochemical
- Food & beverage
- Pharmaceutical
- Automotive
- Refining
- Power & utility
- Industrial
- R&D

Fluids
- Liquids
- Gasses
A meter for each burner:

Eight SITRANS FC MASSFLO meters, 2100 series Di40’s were installed. The Sensors formed part of the block load regulation system and each one measured the fuel fed to one of 6 burners.

A new power station decided to install 48 MASSFLO meters, type 2100 Di25, one for each gas burner. These were used to regulate the following sequence better than the traditional sensors:

- Measure the mass flow of fuel to each nozzle
- The signal is transmitted to the central, pc based control and regulation system
- The air is regulated in matched with the flow for an optimal burn
The main purpose of the flow meter is to keep the paint flow consistent in a control loop, and meter the amount of paint used.

MASS 6000 Coriolis with its superior performance reduced the consumption of paint more than 30 percent.

The reduction of the response time in flow measurement makes the control loop of the spray robot work faster and more accurately.

Delivering ABB’s customers.....

- Flexibility: high performance ensures versatile applicability
- Increased Profitability
- Robustness and reliability
- Paint savings

**Automated painting robots:**

With automated painting robots, two parameters are crucial:

- **Speed**
- **Accuracy** of paint dosing

**Speed** increases the flexibility and profitability of the equipment, while **accuracy** returns top quality results of the end products.
Applications

Product family

Principle of operation

Product overview

Application

Key features

• Can coating
• Beer + CO₂
• Hops additive
• Beer wart measurement Fraction Flow - S.G
• Sugared water
• Alcohol content
• Cooling control
• CIP cleaning, monitoring and control
Applications

The plants environment can be quite a challenge to a flow meter as there is a great deal of vibration from many large tools and motors.

The Siemens Mass flow adapted with built in noise filters in the transmitter to smooth out the flow signal and actual mass measuring to handle the ever changing process chemistry.

Manufacturers of polyurethane foam, is dependent on an accurate ratio of ingredients that make up polyurethane in all its' different formations.

Correct dosing is key, the demands on flow measurement equipment is heavy.

A typical plant can use 10 or more Coriolis flow sensors, per process with many process under one roof.
Applications

Product family

Principle of operation

Product overview

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Key features

- Measurement on Brix water
  - Sugar additive
- Dosing of additives
  - Additives: Flavors, color, preservatives etc.
- Continuous mixing of liquids
- Dosing of Co2
- CIP cleaning
- Bottling
Applications

- Collection of raw milk at dairy
- Tanker truck distribution for delivery
- Milk standardization (skimmed milk and cream)
  - Density measurement
- Cheese production
- Equipment Cooling
- CIP cleaning
Flow seminar

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Applications

MASSFLO® - MASS 6000 Flow Transmitter

What is fraction?
Definition: Fraction is part of a mixture

What can be measured?
Liquids consisting of two components (A + B) homogeneously mixed up. It can e.g. be measured how much alcohol in volume % there is in a spirit mixture.

Other examples:
NaoH Milk/cream
Salt Coffee
Sugar etc.
Sulphuric acid

I.e. water-soluble, oil-soluble and similar media
Applications

What is fraction?

Product family
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Density

Product A
Product B

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Benefits with Coriolis

Direct mass flow measurement (liquids, gases)
No compensation necessary for temperature/density changes

Independent of fluid characteristics
Flow profile does not affect measurement. Accuracy across the board, no matter the flow rate or process fluid

Simultaneous determination of several process parameters
Sensor provides information about mass flow, density, temperature, as well as volumetric flow – One sensor multiple variables
Benefits with Coriolis

High accuracy
Accuracies of ±0.1% of reading over a wide measuring range

Wide dynamic range
Turndown of better than 100:1 enables measurements over a wide range (250, 500:1 possible depending on flow specs)

Low cost of ownership
Easy to install
No moving parts
Long term stability
Considerations with Coriolis meters

Limitation in sizes

Material compatibility

Pressure loss
Considerations with Coriolis meters

Problem: Zero Point Drift

The Coriolis meter detects a phase shift, which is falsely interpreted as flow

Reasons for Zero Point Drift

Mechanical installation of the Coriolis meter (pipe stress and external mechanical forces)

Balancing of the system

Material expansion due to temperature changes in the process

External pipe vibration

Air or sediment collecting in the tube
Minimize all pipe vibrations as much as possible!

Use flexible hose on inlet and outlet

Place meter as far as possible from vibrating items

Pulsation dampeners (Needed in connection with pulsating Pumps if req.)
Coriolis Mass Flow Installation

- Avoid “cross talk“ between sensors
- Use flexible hose between sensors
- Use flexible hose between manifolds
- Place sensors on separate mounting frames
Coriolis Mass Flow Installation

Self draining in horizontal and vertical installation

Double pipe MASS MC1

Horizontal installation, self-draining, $\alpha = 2 - 4^\circ$
Coriolis Mass Flow

- Sizes from 1/16” – 6”
- Single tube up to 1 ½”
- Integrated sensor prom
- Density measure to 0.0005g/cc
- No up stream / down stream requirements
- 0.1% accuracy
- Service menu
- Liquids / gas
- Non-conductive fluids
- 1/16” – 1 ½” meters are self draining in the horizontal mode
- Add on communication modules