



Level



Pressure



Flow



Temperature



Liquid
Analysis



Registration



Systems
Components



Services



Solutions

Technical Information

Proline Promass 40E

Coriolis Mass Flow Measuring System

The mass flow measuring system with low cost and basic functionality. The economical alternative to conventional volume flowmeters.



Application

The Coriolis measuring principle operates independently of the fluid's physical properties, such as viscosity and density.

- Extremely accurate measurement of liquids and gases, e.g. additives, oils, greases, acids, alkalis, lacquers, paints and natural gas
- Fluid temperatures up to +125 °C
- Process pressures up to 40 bar
- Mass flow measurement up to 70 t/h

Approvals for hazardous area:

- ATEX, FM, CSA, TIIS

Approval in the food industry/hygiene sector:

- 3A

Connection to process control systems:

- HART

Relevant safety aspects:

- PED (Pressure Equipment Directive)

Features and benefits

The Promass measuring devices make it possible to record different process variables (mass/volume/corrected volume) for various process conditions during measuring operation.

The Proline transmitter concept comprises:

- Modular device and operating concept resulting in a higher degree of efficiency

The Promass sensors, tried and tested in over 100000 applications, offer:

- Flow measurement in compact design
- Insensitivity to vibrations thanks to balanced two-tube measuring system
- Immune from external piping forces due to robust design
- Easy installation without taking inlet and outlet runs into consideration

Function and system design

Measuring principle

The measuring principle is based on the controlled generation of Coriolis forces. These forces are always present when both translational and rotational movements are superimposed.

$$F_C = 2 \cdot \Delta m (v \cdot \omega)$$

F_C = Coriolis force

Δm = moved mass

ω = angular velocity

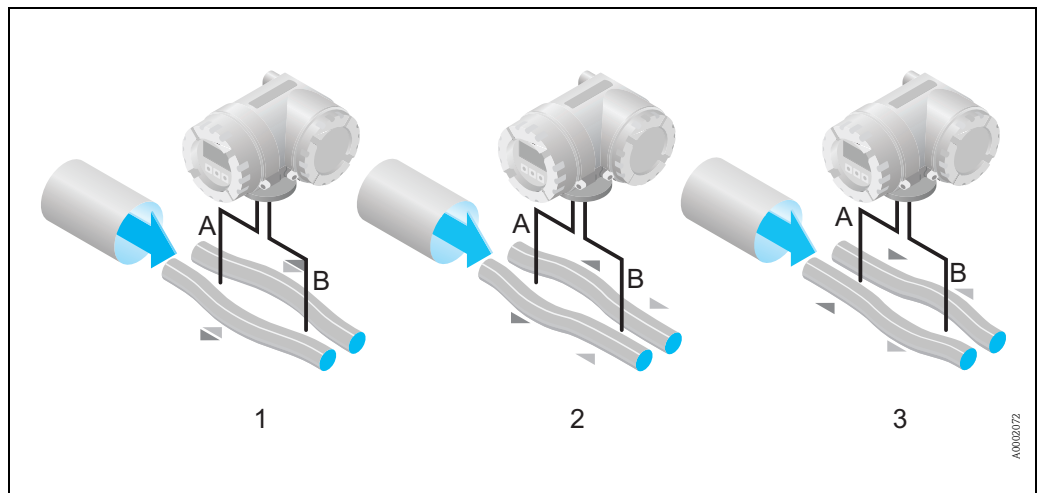
v = radial velocity in the rotating or oscillating system

The amplitude of the Coriolis force depends on the moving mass Δm , its velocity v in the system and thus on the mass flow. Instead of a constant angular velocity ω the Promass sensor uses oscillation. In the sensor, two parallel measuring tubes containing flowing fluid oscillate in antiphase, acting like a tuning fork. The Coriolis forces produced at the measuring tubes cause a phase shift in the tube oscillations (see illustration):

- At zero flow, in other words when the fluid is at a standstill, the two tubes oscillate in phase (1).
- Mass flow causes deceleration of the oscillation at the inlet of the tubes (2) and acceleration at the outlet (3).

The phase difference (A-B) increases with increasing mass flow. Electrodynamic sensors register the tube oscillations at the inlet and outlet.

System balance is ensured by the antiphase oscillation of the two measuring tubes. The measuring principle operates independently of temperature, pressure, viscosity, conductivity and flow profile.



The Coriolis flow measuring principle

Volume measurement

The measuring tubes are continuously excited at their resonance frequency. A change in the mass and thus the density of the oscillating system (comprising measuring tubes and fluid) results in a corresponding, automatic adjustment in the oscillation frequency. Resonance frequency is thus a function of fluid density. The density value obtained in this way can be used in conjunction with the measured mass flow to calculate the volume flow.

The temperature of the measuring tubes is also determined in order to calculate the compensation factor due to temperature effects.

Measuring system

The measuring system consists of a transmitter and a sensor (compact version).

- Promass 40 transmitter
- Promass E sensor (DN 8...50)

Input

Measured variable

- Mass flow (proportional to the phase difference between two sensors mounted on the measuring tubes to register a phase shift in the oscillation)
- Volume flow (calculated from mass flow and fluid density. The density is proportional to the resonance frequency of the measuring tubes).
- Measuring tube temperature (by temperature sensors) for calculatory compensation of temperature effects.

Measuring range

Measuring ranges for liquids:

DN	Range of full scale values (liquids)
	$\dot{m}_{\min} (F) \dots \dot{m}_{\max} (F)$
8	0...2000 kg/h
15	0...6500 kg/h
25	0...18000 kg/h
40	0...45000 kg/h
50	0...70000 kg/h

Measuring ranges for gases:

The full scale values depend on the density of the gas. Use the formula below to calculate the full scale values:

$$\dot{m}_{\max} (G) = \dot{m}_{\max} (F) \cdot \frac{\rho_{(G)}}{320 \text{ kg/m}^3}$$

$\dot{m}_{\max} (G)$ = Max. full scale value for gas [kg/h]

$\dot{m}_{\max} (F)$ = Max. full scale value for liquid [kg/h]

$\rho_{(G)}$ = Gas density in [kg/m³] under process conditions

Worked example for gas:

- Sensor type: Promass E, DN 50
- Gas: air with a density of 60.3 kg/m³ (at 20 °C and 50 bar)
- Max. full scale value (liquid): 70000 kg/h

Max. possible full scale value:

$$\dot{m}_{\max} (G) = \dot{m}_{\max} (F) \cdot \frac{\rho_{(G)}}{320 \text{ kg/m}^3} = \frac{70000 \text{ kg/h} \cdot 60.3 \text{ kg/m}^3}{320 \text{ kg/m}^3} = 13190 \text{ kg/h}$$

Recommended measuring ranges:

See Page 11 ("Limiting flow")

Operable flow range

Flow rates above the preset full scale value do not overload the amplifier, i.e. the totalizer values are registered correctly.

Input signal

Status input (auxiliary input):

U = 3...30 V DC, R_i = 5 kΩ, galvanically isolated.

Configurable for: totalizer reset, measured value suppression, error-message reset, start zero point adjustment.

广州晋合水处理设备有限公司



地 址：广东省广州市海珠区工业大道333号华新园区7幢218
电 话：020-88191905
传 真：020-61139917
邮 编：510300
邮 箱：jinhewater@jinhewater.com
网 址：<http://www.jinhewater.com>

Endress+Hauser 
People for Process Automation