

Promass

A practical guide to promass, covering the reader intent, the relationship to promass, key evaluation criteria, common risks, and the information the intended project audience should confirm before taking the next step.



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In the landscape of industrial process control, the demand for high-precision measurement has led to the widespread adoption of Coriolis mass flow technology. Often referred to by the industry-standard term Promass, these instruments represent the pinnacle of multivariable measurement, capable of capturing mass flow, density, and temperature simultaneously. While level measurement instruments, such as those found on the Main Page, provide critical data regarding the volume and surface position of liquids in tanks, Coriolis meters offer a complementary data set by measuring the actual mass of the fluid moving through the system. This guide explores the engineering principles, selection criteria, and practical application of Promass technology within modern industrial environments.

| Understanding the Coriolis Measurement Principle

The fundamental operation of a Promass meter is based on the Coriolis effect, a phenomenon of physics first described by Gaspard-Gustave de Coriolis in the 19th century. In an industrial meter, this principle is applied by inducing a controlled vibration in one or more measuring tubes through which the process fluid flows.

| The Oscillating Tube Mechanics

When there is no flow, the measuring tube (or tubes) vibrates at a resonant frequency in a symmetrical manner. As fluid begins to move through the vibrating tube, the Coriolis force is generated. This force acts on the fluid particles, causing the tube to experience a slight distortion or "twist."

Electromagnetic sensors located at the inlet and outlet of the tube pick up this vibration. Because of the Coriolis force, the vibration at the outlet lags behind the vibration at the inlet. This time difference, known as the phase shift, is directly proportional to the mass flow rate of the fluid. Because mass is an intrinsic property that does not change with temperature or pressure, these meters provide an exceptionally stable and accurate measurement compared to volumetric flowmeters.

| Multivariable Data Acquisition

Beyond mass flow, Promass meters are inherently capable of measuring other critical process variables:

1. **Density:** The resonant frequency at which the tube vibrates depends on the mass of the tube and the fluid inside it. As the density of the fluid changes, the resonant frequency shifts. By measuring this frequency, the meter can calculate the fluid's density in real-time.
2. **Temperature:** To compensate for the thermal expansion of the measuring tubes, a high-precision temperature sensor is integrated into the meter. This data is also available as a secondary process output.
3. **Calculated Variables:** By combining mass flow and density, the internal electronics can calculate volume flow and concentration (e.g., Brix or Plato scales in food and beverage applications).

| Technical Selection and Specification

Selecting the correct Promass meter requires an understanding of the process fluid's characteristics and the mechanical constraints of the piping system. Unlike hydrostatic level transmitters or ultrasonic sensors, which are often mounted on the exterior or top of a vessel, a Coriolis meter is an inline instrument that must handle the full pressure and temperature of the process stream.

| Practical Selection Table

Parameter	Requirement/Specification	Engineering Consideration
Flow Range	0.1 kg/h to 2,000 t/h	Match the meter size to the nominal flow, not the pipe size.
Accuracy	±0.05% to ±0.1% of rate	Critical for custody transfer and high-value chemical dosing.
Temperature Range	-200°C to +350°C	Cryogenic or high-temp applications require specialized housings.
Pressure Rating	Up to 400 bar (40 MPa)	Ensure flange ratings match the maximum system surge pressure.
Wetted Materials	Stainless Steel, Hastelloy, Tantalum	Must be chemically compatible with the process medium.
Tube Design	Single-tube vs. Dual-tube	Dual-tube offers higher sensitivity; single-tube is easier to clean.

| Installation Considerations for Optimal Performance

While Promass meters are known for their robustness, their reliance on high-frequency vibrations makes them sensitive to certain environmental factors. Proper installation is the most significant factor in achieving the rated accuracy of the instrument.

| Mounting Orientation

The orientation of the meter depends largely on the phase of the fluid. For liquid applications, the meter should ideally be installed in a vertical pipe with the flow moving upwards. This ensures that the measuring tubes remain full and prevents the entrapment of air bubbles, which can disrupt the vibration. If horizontal installation is necessary, the tubes should point downwards (flag-down) to avoid sediment buildup, or upwards (flag-up) if the fluid is a gas to prevent liquid condensate from collecting.

| Vibration and Stress Isolation

Because the meter operates by measuring micro-vibrations, external mechanical vibrations from pumps or heavy machinery can introduce noise into the signal. It is standard practice to support the piping immediately before and after the meter. Furthermore, the meter should never be used to support the weight of the pipe; flanges must be perfectly aligned to prevent mechanical stress on the measuring tubes, which can cause zero-point drift.

| Straight Pipe Runs

One of the primary advantages of Coriolis technology over ultrasonic or vortex flowmeters is that it typically does not require long straight runs of pipe before or after the instrument. The measurement is independent of the flow profile (laminar or turbulent). However, in extremely high-precision applications, a short straight run (3 to 5 pipe diameters) is still recommended to minimize turbulence-induced noise.

| Limitations and Operational Challenges

Despite their versatility, Promass meters are not a "one-size-fits-all" solution. Engineers must be aware of the following limitations:

Entrained Gas: Small amounts of gas in a liquid stream (or liquid droplets in a gas stream) can cause "slug flow." This significantly dampens the tube vibration and can lead to measurement errors or a total loss of signal. Modern meters use advanced digital signal processing (DSP) to mitigate this, but it remains a challenge.

Pressure Drop: Because the fluid is often split into two smaller tubes within the meter, there is a measurable pressure drop across the device. This must be accounted for in the system's hydraulic calculations, especially for high-viscosity fluids.

Capital Cost: Coriolis meters are among the most expensive flow measurement technologies. Their use is typically justified by their extreme accuracy and low maintenance requirements, but for simple water flow, other technologies may be more cost-effective.

Physical Size and Weight: High-capacity meters can be extremely heavy and large, requiring specialized lifting equipment and reinforced piping supports.

| Synergy with Level Measurement Systems

In many industrial applications, mass flowmeters and level meters work in tandem to provide a complete picture of mass balance. While a Promass meter tracks the mass entering or leaving a vessel, a radar or hydrostatic level transmitter from the Main Page monitors the inventory within the tank.

This redundancy is vital for safety and accounting. For instance, in a chemical reactor, the mass flowmeter ensures the correct stoichiometric ratio of reactants is added, while the level meter acts as a high-level alarm to prevent overfilling. If the density of the fluid changes due to temperature fluctuations, the Coriolis meter provides the real-time density data needed to calibrate the level meter's readings, particularly when using hydrostatic pressure for level calculation.

| Frequently Asked Questions (FAQ)

Q: Does a Promass meter require periodic recalibration?

A: While Coriolis meters are very stable, many regulated industries (such as oil and gas or pharmaceuticals) require annual verification. Most modern units offer internal diagnostic suites that can verify the meter's health without removing it from the process line.

Q: Can these meters measure non-conductive liquids?

A: Yes. Unlike electromagnetic flowmeters, which require a minimum fluid conductivity, Coriolis meters are unaffected by the electrical properties of the fluid. They work equally well on deionized water, hydrocarbons, and liquid gases.

Q: How does viscosity affect the measurement?

A: Mass flow measurement is independent of viscosity. However, high-viscosity fluids will result in a higher pressure drop across the meter. It is essential to size the meter correctly to ensure the pump can overcome this resistance.

Q: Can a Coriolis meter replace a weigh scale?

A: In many batching applications, yes. Because it measures mass directly, it can provide the same data as a load-cell-mounted tank but with the advantage of being an inline, continuous measurement that does not require the tank to be physically isolated from the piping.

| Conclusion

Promass technology remains the gold standard for mass flow and density measurement in the B2B industrial sector. By understanding the underlying Coriolis principle and adhering to strict installation guidelines, engineering teams can achieve unparalleled process transparency. When integrated with reliable level measurement solutions, these instruments form the backbone of efficient, safe, and accurate industrial automation systems. For those seeking to optimize their measurement loops, evaluating the synergy between inline mass flow and tank level monitoring is a critical step toward operational excellence.