

Single, Straight-Tube Coriolis Sensors: Installation Best Practices for Cleanability and Drainability

Biopharmaceutical manufacturing requires cleanable and drainable process equipment

Biopharmaceutical manufacturing is performed in a highly sterile environment. Bioreactions take place over an extended period of time. For example, it can take 6 to 8 weeks to complete a single bioreactor batch. Given the time that is committed to manufacturing biopharmaceuticals and their market value, eliminating chemical and biological contamination sources is a top priority for biopharmaceutical manufacturers.

In a best-case scenario, contamination will only reduce the yield of the desired end product. In the worst case, the microbe or mammalian cell culture will either not produce or will create an unintended product. For flow metering, maintaining the hygienic requirements of the process translates into delivering flow sensors that are fully cleanable and drainable.

Trade-offs to consider when cleanability and drainability are competing with measurement accuracy

Coriolis meters are the best performing flow measurement technology available on the market today. Compared to other flow measurement technologies, Coriolis meters also have the widest useable flow range. Consequently, Coriolis meters are often selected for applications where measurement accuracy is very important. However, in hygienic processing applications system cleanability and drainability are frequently more critical priorities. When selecting a meter, it is therefore very important to evaluate the requirements related to cleanability and drainability as well as measurement accuracy. One must take into consideration that flow measurement accuracy can be compromised when cleanability and drainability must be ensured.

The very best Coriolis measurement performance is realized at higher mass flow rates and process fluid velocities. There is less induced pressure drop across single, straight-tube Coriolis sensors compared to curved-tube sensors. Single, straight-tube sensors have a smaller useable flow range than curved-tube sensors. To optimize the flow measurement performance by increasing the mass flow rate through the sensor, single, straight-tube Coriolis sensors are often sized to be smaller than the associated process piping. This smaller single, straight-tube sensor delivers improved measurement accuracy with very little impact on pressure drop across the meter.

Unfortunately, in these cases the smaller sensor tubing will also act much like an orifice or dam in the process piping, allowing process fluid to accumulate in the piping on either side of the sensor.

Best practices to ensure cleanable and drainable single, straight-tube sensor installations

In hygienic processing applications, single, straight-tube Coriolis sensors are often installed in horizontal process piping. Likewise, system drainability is almost always a requirement for these applications. To ensure system drainability, one must be careful when selecting the process end connections for the application. It is possible to install a smaller single, straight-tube sensor in process piping having a larger inner diameter. This creates conditions where contamination might occur. In order to get the benefits of a fully drainable and cleanable single, straight-tube sensor, here are some best practices.

1. Install sensors in a vertical pipeline. To deliver full sensor drainability, the preferred orientation for single, straight-tube Coriolis sensors is in a vertical section of piping. However, many applications require that the meter be installed in a horizontal orientation.
2. If the sensor must be installed in a horizontal pipeline, use process end connections that are the same size as the sensor connections. Under these conditions, if the process end connections are larger or smaller than the sensor, the system will never be fully drainable. (Note: In vertical installations, this is not an issue).
 - If the process piping (tubing) must be larger than the sensor, eccentric reducers may be used to ensure full drainability. In this case, the process end connection and the sensor must be the same size. See Figure 1. Consult with your local Micro Motion® representative for more information on eccentric reducer suppliers in your area.

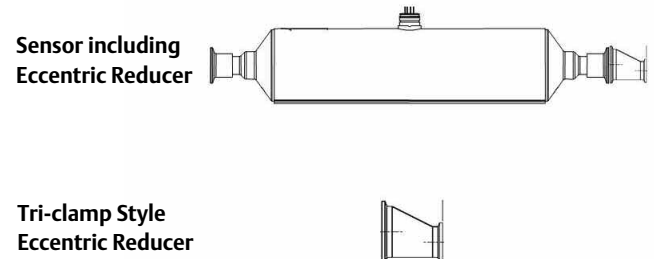


Figure 1. Example Installation: Single, Straight-Tube Coriolis Sensor with Eccentric Reducer

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- As part of the cleaning process, skid-based systems may be purged with nitrogen at the end of the cleaning cycle. When using eccentric reducers, it is possible to trap gas in the section of process piping adjacent to the reducer. Meter performance can be impacted when this gas passes through the sensor, i.e. "slug" flow.
3. The ASME Bioprocess Equipment Standard (ASME BPE-1997), section SC-3.12.1, includes recommendations regarding how to install process piping to ensure full drainability. In general, the ASME BPE-1997 recommends a minimum drop of 1/4-inch per foot (approximately 2 cm per meter) of piping. The angle of the process piping can have an impact on the reducer length in the sloping process line.

Questions to answer when selecting single, straight-tube Coriolis sensors for drainable applications

- Will the meter be used in a hygienic processing application?
- Will the meter be installed in a vertical or horizontal section of pipe?
- If the process piping is horizontal, what is the slope of the line?
- What are the performance (or accuracy) requirements for the application?
- What is the allowable pressure drop for the application?
- Does the metering application require full drainability?
- Are there any flow rate or fluid velocity constraints for the process? (Many biopharmaceutical products are shear sensitive.)

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