

## BioProTT™ Steps For Optimizing Accuracy

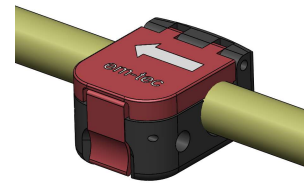
The BioProTT™ flow measurement system operates using the principle of Transit Time ultrasound (see technical information on TT ultrasound). The calibration of the flow sensor (“transducer”) is affected by the acoustic properties of the tubing and media through which the ultrasound beams travel. Factors that affect the acoustic properties of the tubing and media, can also affect the accuracy of your flow measurement. It is important to understand the methods to ensure optimized accuracy with the system.

- **ENSURE PROPER CALIBRATION OF THE FLOW TRANSDUCER FOR TUBING, MEDIA AND TEMPERATURE**

em-tec BioProTT™ Clamp-On Transducers can be calibrated for a variety of temperatures, tubing and media types. Factory calibration of the transducer for the actual temperature, tubing and media type that will be used is recommended. Using the transducer with temperature, tubing or media that differs from the factory calibration may lead to decreased accuracy, unless the user adjustable calibration factor is employed.

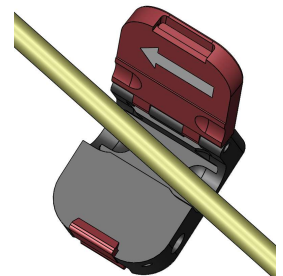
- **USE THE PROPER TUBING**

Tubing size is a very important factor for proper operation of the transducer. Transducers are sized specifically for certain tubing sizes to ensure a proper fit of the tube in the transducer cavity. Tubing that is too large for the transducer will not allow the cover to close, which may reduce acoustic coupling and interrupt the signal. Tubing that is too small for the transducer will create air spaces which will attenuate the ultrasound signal.



Proper Sized Tubing

Tubing made of different materials will have different acoustic properties, which will affect the rate at which the ultrasound signal travels through the tubing. The factory calibration will take this into account, adjusting the timing and signal for the particular tubing type that will be used with the sensor. If the tubing type is changed from the tubing that was used for the factory calibration, you must adjust the calibration factor to ensure optimal accuracy. Certain tubing materials may negatively affect the ultrasound signal and cause low signal or acoustic error to occur.



Tubing Too Small

- **MEDIA TYPE**

Standard factory calibration is usually provided for water at 20°C. Several factors affect the acoustic velocity of the media, such as temperature, concentration of salts or sugars, presence of air or particles. For best possible accuracy, the factory calibration should be performed using the actual media that will be used. Since it is not always possible to send certain types of media to the factory, a calibration can be performed on water and an on-site calibration can be performed using the user adaptable calibration factor on the BioProTT™ flow meter.

- **TEMPERATURE**

Temperature of operation is critical to the accuracy of the BioProTT™ flow measurement system. Since changes in temperature will affect both the acoustic properties of the tubing and of the media, it is important to use the transducer at the temperature for which it has been calibrated. A variation of  $\pm 5^{\circ}\text{C}$  is acceptable. If the actual

temperature of operation differs by more than  $\pm 5^{\circ}\text{C}$ , the user adaptable calibration factor should be adjusted on site to ensure optimal accuracy.

#### • ATTACH THE TRANSDUCER PROPERLY

To ensure the best possible accuracy it is recommended that the transducer is clamped on a straight section of tubing. Sharp bends in the tubing will affect the flow profile of the media travelling through it and cause the transducer to read flow which is not indicative of flow in the rest of the tube. A straight inlet section of approx. 10 times inner tube diameter (10xID) before and 3 times (3x ID) after the transducer is recommended, or the straightest available section.

Make sure to place the transducer on the tubing with the arrow pointing in the direction of flow in order to get positive readings. Make sure to close the lid on the transducer until it clicks into place. Failure to close the lid may reduce coupling and cause measurement error. Make sure there is no dirt or build-up of coupling agents e.g. Vaseline in the cavity of the transducer which may attenuate the ultrasound signal. Any foreign material can be carefully cleaned with mild detergents. If necessary, the sensor can be disinfected with alcohol based surface disinfectants.

- Attach on straight tubing
- Arrow in direction of flow
- Close the cover
- Remove dirt and grime
- Adequate coupling



#### • ENSURE SUFFICIENT COUPLING

Since the ultrasound signal will not travel through air, it is important to ensure that there are no air spaces between the transducer and the tubing. A thin layer of acoustic couplant, such as Vaseline, is recommended. A poor signal strength (RSS value) may be an indicator of inadequate coupling. There are two methods to monitor the signal strength throughout the measurement. BioProTT™ flow meters are equipped with both a digital and analogue output that will monitor signal strength. Signal strength of at least 60% indicates good signal and will ensure accurate flow measurements.

#### • LET THE SYSTEM EQUILIBRATE

When you first clamp the transducer on to the tubing, it may be colder or warmer than the tubing and media running through it. It is best to let the system equilibrate for 5-10 minutes before recording flow measurement so the tubing, media and transducer can stabilize. Flow measurements can be taken before this time, but the best possible accuracy will occur after equilibration of the system.

#### • ZERO THE OFFSET

To account for the small offset associated with the system, the BioProTT™ flow meter is equipped with an easy access zero adjust button. Make sure to press the offset button with media in the tube (so there is good signal strength) but with the flow stopped. Failure to stop the flow when using the zero offset button will result in measurement errors or failure of the system to return to zero flow.

For further information regarding the operation of the BioProTT™ flow measurement system please refer to the operating instructions.