

## 1 Introduction

The SonoTT™ FlowMeasurement System was developed for the non-invasive measurement of volumetric flows within flexible tubing systems. It is mainly used on heart-lung machines or on ECMO and dialysis devices. Consisting of the SonoTT™ Ultrasonic FlowComputer and a compatible SonoTT™ Clamp-On Transducer, the system works independently and can be quickly set up and installed.



Figure 1: SonoTT™ FlowMeasurement System

With a rising need for the evaluation and display of the flow inside extracorporeal tubing systems, the SonoTT™ FlowMeasurement System provides essential information concerning flow rates and can help detect and prevent possible complications. All parts of the system can be easily disinfected and the sensor is clamped around the tube without any contact to the medium to comply with the strict hygienic standards and requirements within clinical environments. The function of the SonoTT™ FlowMeasurement System is based on the ultrasonic transit time method. The volumetric flow rate is determined through the transit time difference between ultrasonic signals that are alternately sent with and against the flow direction. The ultrasonic signal is directly influenced by five parameters:

- medium type
- medium temperature
- tube size
- tube material
- the flow range (Qmin and Qmax)

To ensure the highest possible accuracy, each of our sensors is adjusted and calibrated according to these parameters. In addition, there are also external factors that impact the accuracy. This application note will highlight and explain these factors so that perfusionists and other clinical personnel can maintain and optimize the accuracy on site.

## 2 Setup

### 2.1 Sensor Positioning

For best results, we recommend that the sensor is clamped onto a straight section of the tube. Any bends or kinks in the tubing can affect the flow profile of the fluid and can therefore lead to displayed flow values that are not necessarily representative of the flow within the whole tubing system. Ideally, the straight inlet section on either side of the tube is 10 times the inner diameter (ID) of the tube. For a sensor with the size of 1/4" x 1/16", where the first number refers to the inner diameter, an ideal inlet section would be 2 1/2" or 63.5 mm. If it is not possible for the inlet section to be straight for the recommended length, try to find the straightest available section of the tube and position the sensor there.



Figure 2: Sensor Positioning

Furthermore, please align the arrow on the lid with the flow direction inside the tubing system. If not aligned, the flow rate will be displayed as negative value.

### 2.2 Tubing

When setting up the system, please make sure that the SonoTT™ Clamp-On Transducer and the tubing are compatible. The adequate tube size is indicated on the sensor lid. Selecting matching tubes and sensors is important as the acoustic coupling (i.e. signal strength) is directly related to the signal quality.

If the tube is too small, there is so-called empty space within the flow channel, which can attenuate or even break the ultrasonic signal. If the tube is too big, the sensor lid either does not close at all, which reduces the signal quality, or the tube is crammed into the flow channel and thus deformed, which also impacts the signal as well as the flow path of the medium.

Once the right tube is selected, the sensor can be clamped on. To insert the tube in the sensor, apply even pressure and try to not stretch or pull the tube as this could affect the geometry of the tube and/or create cracks in the material, both of which might impact the ultrasonic signal and thus the measurement values. To fix the tube in its final position, close the lid tightly. The lid is closed correctly if there was an audible “click” from the snapper.

**Please note:** The tube should fit snugly into the flow channel without being crammed.



Figure 3: Tube fits properly

### 2.3 Application Parameters

Another important factor during setup and use are the parameters of your application. Every em-tec sensor is pre-adjusted and calibrated according to customer specifications.

The relevant parameters are:

- medium type
- medium temperature
- tube size
- tube material
- flow range (Qmin and Qmax)

For the best results, please make sure to respect the parameters indicated in the documentation (i.e. the Calibration Information Sheet of the sensor).

## 3 Measurement

There are several steps that should be followed before and during the flow measurement in order to ensure the highest possible accuracy.

### 3.1 Acoustic Coupling

For ultrasound-based measurement systems, the acoustic coupling plays a pivotal role for the measurement and for the accuracy. The acoustic coupling rate describes the signal strength and indicates the quality of the signal. Since our measurement relies in part on the signal quality, a sufficient coupling rate is mandatory for an accurate measurement. The acoustic coupling rate is displayed as % and should always exceed 50%.

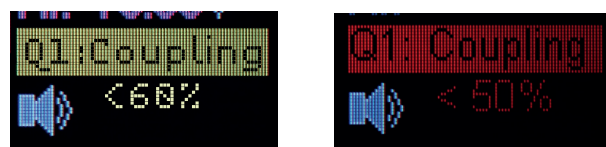


Figure 4: Display of the acoustic coupling rate on the SonoTT™ Ultrasonic FlowComputer

### 3.2 Zero Flow Adjustment

One of the key steps throughout the setup procedure is the zero flow adjustment. It levels any existing offsets and helps to improve the measurement and its accuracy. For safety reasons, it is obligatory to perform a zero flow adjustment before switching on any pump. The SonoTT™ Ultrasonic FlowComputer can be zeroed via the zero field on the display which is accessible from all sub menus.

During the zero flow adjustment, it is essential that

- the liquid does not move.
- the tube is completely filled with liquid.
- there are no air bubbles in the tube.
- the acoustic coupling rate is greater than 50%.
- the SonoTT™ FlowMeasurement System is set up correctly.

The zeroing time should not exceed 60 seconds. Once the system has been zeroed, the flow measurement can be carried out.

## 4 Maintenance

The SonoTT™ FlowMeasurement System is a very low-maintenance system and does not need any extensive care. The sensors in particular are designed for long-term use and made to last. To maintain and optimize accuracy, we recommend regular calibrations to be carried out. Ideally, the time between calibrations should not exceed 24 months. For more information regarding the adjustment and calibration, please contact em-tec GmbH.

Additionally, we also advise cleaning the device with the detergents recommended in the operating instructions of either the SonoTT™ Ultrasonic FlowComputer or the SonoTT™ Clamp-On Transducer after every use and to perform regular visual checks to ensure that there are no damages to the devices that might impact the flow measurement.

## 5 Contact

If there are any questions concerning the information in this document, please do not hesitate to contact em-tec GmbH.

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