HOW DIFFERENT TUBES IMPACT SENSOR ACCURACY

1 Introduction

To ensure the highest possible accuracy, all em-tec BioProTT™ Clamp-On sensors are pre-adjusted and calibrated according to customer specifications prior to shipment. Nevertheless, it can happen that the tube material used during the application and process differs from the one the sensor was adjusted and calibrated for. While it is always an option to send the sensor(s) back to em-tec for an readjustment and re-calibration for the new tube material, it is also possible to compensate for the difference in tube material by using a calibration factor. In this TechNote, we will take a closer look at the possible differences and what impact the use of a calibration factor can have on measurement results.

Figure 1:
BioProTT™ Clamp-On SL
with Tube

2 Test Setup

2.1 What was tested?

To illustrate the influence different tubes can have on the flow measurement values, a sensor was adjusted for one specific tube with an inner diameter of 1/2", wall thickness of 1/8", and an outer diameter of 3/4". This sensor was then used for flow measurements using different tube models, i.e. tubes which all had the same dimensions but were different tube models; some were also made of different materials (e.g. silicone, BPT, etc.).

2.2 How was it tested?

One BioProTT™ Clamp-On SL 1/2" x 1/8" (Article No. 13652) was adjusted to a non-gamma-treated APHP-0500-0750 according to the standard em-tec process. After the adjustment, the APHP-0500-0750 was exchanged for different tube models.

All flow measurements were carried out on the same test stand that was used for the adjustment of the sensor. The reference flow rate was measured using an electromagnetic flow sensor (Siemens SITRANS FM MAG 1100). The medium for all tests was water at a controlled temperature of 21 °C.

3 Result

3.1 Overview

What we observed during the tests—the results of which are shown graphically in figure 2—is that although there are differences between the non-gamma-treated APHP-0500-0750 and the gamma-treated APHP 0500 0750R-G, they are relatively small, i.e. the measurements results are within the defined tolerance limits for both tubes. For all other tubes, i.e. tubes made of different materials, the deviations were bigger and the values were consequently no longer within the defined tolerance limit. The initial results of the tests are shown in figure 2.

Determining and using a specific calibration factor for each tube (see table below) helped to match the flow readings with the readings given by a reference system — although the sensor was not adjusted to the tube. This can be seen in figure 3.

The only tube which continued to show higher deviations — higher in comparison to the deviations of other tubes — despite the use of the calibration factor, is the Masterflex® 06508-82 PharMed® BPT, which is not a silicone tube, meaning the difference in material has a higher impact on the readings. Nevertheless, with a tube of the same dimensions the sensor was originially adjusted for (i.e. inner diameter and wall thickness), the measurement values were still within the defined tolerances.

What must be kept in mind is that the calibration factors determined here are applicable only for this test and setup and need to be determined for every case individually. For more information on how to determine the calibration factor, please have a look at our Tech Note "Determining the Calibration Factor".

Tubes*		Determined Calibration Factor
AdvantaSil® APHP-0500-0750	*See end of this TechNote for additional information.	0.99
AdvantaSil® APHP-0500-0750R-G		1.00
AdvantaFlex® APAF-BP-0500-0750		1.04
AdvantaSil® APST 0500-0750		0.98
C-Flex® 374 0,5		1.01
Dow Corning® Pharma 50		1.01
Watson Marlow® Pumpsil® 913.A127.032#82		0.97
Dow Corning® Pharma 65		1.01
Dow Corning® Pharma 80_1/2“		1.01
Masterflex® 96410-82		0.98
Masterflex® 06508-82 PharMed BPT		1.04

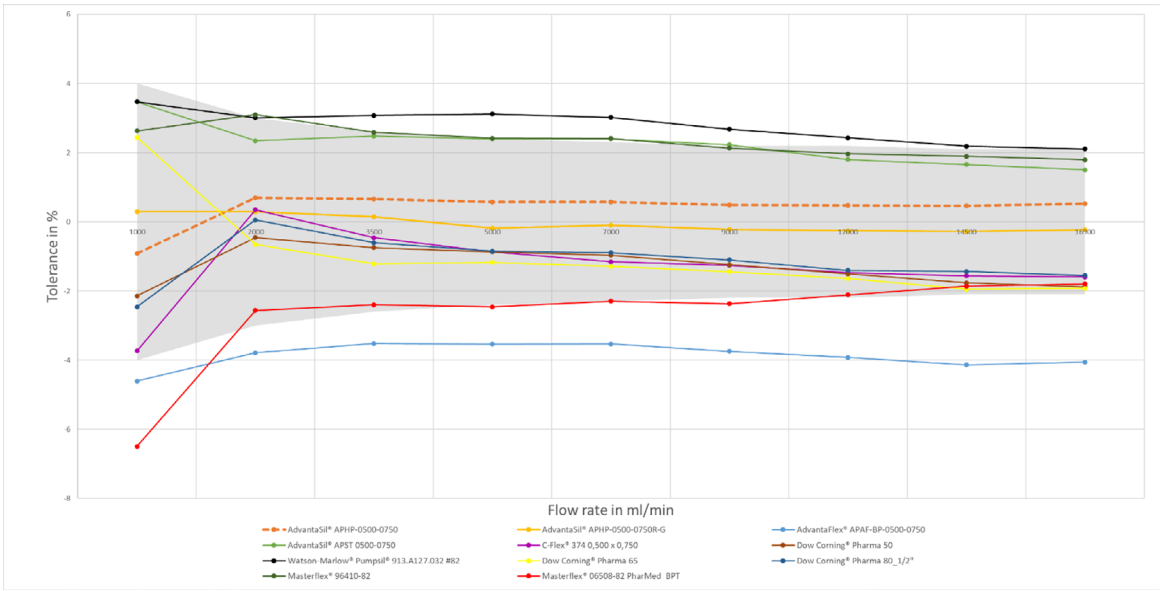

Figure 2: Initial flow readings using different tubes

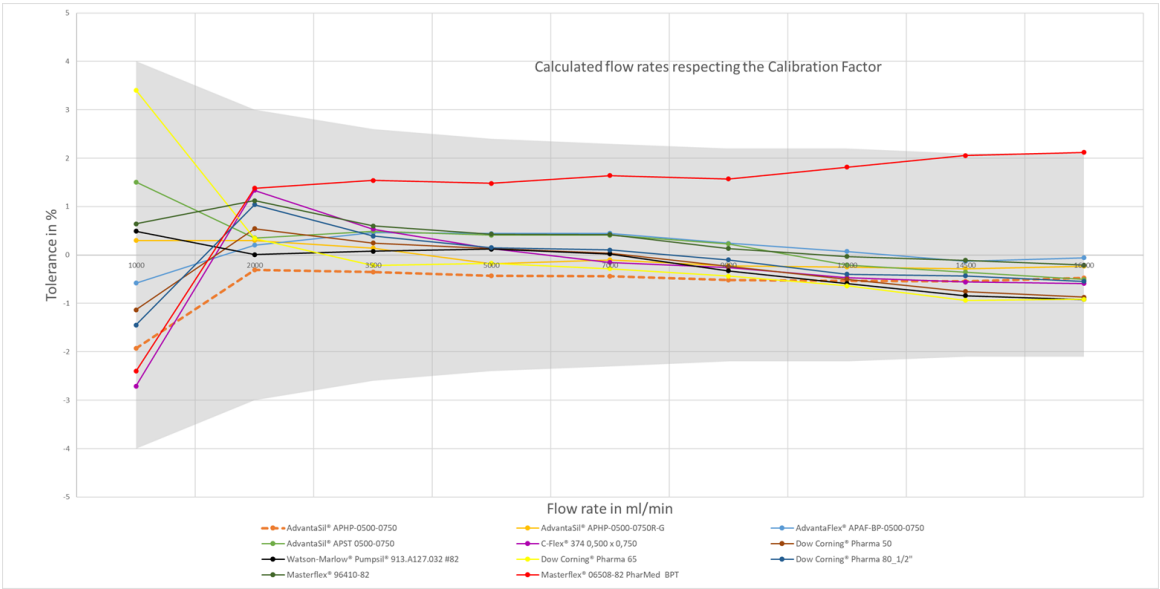

Figure 3: Flow readings using different tubes in combination with their specific calibration factors

3.2 Why is the sensor adjustment still important?

The function of our sensors is based on the ultrasonic transit time method, which represents an acoustic measurement principle. This method measures the transit time of ultrasonic signals that are sent through a measurement section with and against the flow direction. The difference in transit time is then used to determine the volumetric flow rate.

The transit time of an ultrasound signal does not only depend on the flow direction, but is also influenced by other factors.

Among these factors are:

- the type of medium
  → Different media have different densities, acoustic properties, etc.
- the temperature of the medium
- the tube
  → Both the tube material and the thickness of the tube wall can impact the acoustic signal.
- the flow rates

As all these factors above have an influence on the transit time and therefore the measurements, a customer specific adjustment is necessary to ensure the accuracy of the Clamp-On sensor and consequently the overall system. Nevertheless, some influences, such as the tube material, can be minimized by determining and using the calibration factor.

4 Contact

If there are any questions concerning the information in this document or if you are having trouble at any point during the determination of the calibration factor, please contact em-tec GmbH.

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