

FLOW SENSOR COMPARISON

on flexible tubes in realistic test environment

AT A GLANCE

Ultrasonic flow sensors compared to turbine meters

Definition of accuracy and precision

SONOFLOW CO.55 V2.0 - convinces with highest precision and accuracy

SONOFLOW CO.55 V2.0 - contamination-free clamp-on system for use in microbiologically critical environments

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SONOFLOW C0.55 Clamp-On Sensors

Non-Invasive | Contamination-Free



SONOFLOW C0.55 Clamp-On Sensors

Highly Accurate & Precise



SONOFLOW C0.55 Clamp-On Sensors

For multiple Tubing Sizes & Materials



Company Althea, one of the leading North American contract manufacturers specialized in cGMP manufacturing, analytical development, aseptic filling and protein delivery technologies was looking to evaluate flow systems for multiple applications throughout their facilities. One of the main issues was to replace scales for volume measurement by flow sensors. For that reason, three competing flow sensor set-ups were tested for their measuring performance and suitability for the customers' specific applicative needs.

CONTENT OF THE TEST

Test setup

Difference accuracy and precision

Comparison of flow sensors at flexible tubes

Interpretation of the results

TEST SETUP

Sensors	SONOFLOW CO.55/160 V2.0 / Competitor X / Competitor Y
Tubing	RM-2708, 0.5" ID, 0.75" OD
Pump	Watson Marlow 620S pump, ALT-34345
Data Logger	Omega Data Logger, OM-CP-QUADPROCESS-25MA
Feeding	100L plastic carboy
Constraints	Water at room temperature

SENSOR SPECIFICATIONS

	SONOTEC (ultrasonic clamp-on flow sensor)	Competitor X (disposable turbine sensor)	Competitor Y (ultrasonic clamp-on flow sensor)
Accuracy	±2 %	±5 %	±3 %
Precision	±0.5 %	≤1 %	±20 mL/min (max)
Resolution	0.001 ml/min	1 ml/min	2 ml/min

ACCURACY & PRECISION

There is often confusion between accuracy and precision, especially when someone asks how accurate SONOTEC sensors actually are? Accuracy describes the error between the real and the measured value. It is an indication about how close you can get to the correct value. Reversely, precision describes the random spread of measured values around the average measured values. It finally defines how consistent you can get the results. The standard

deviation (STDEV) of a measuring sequence stands for a measure of precision.

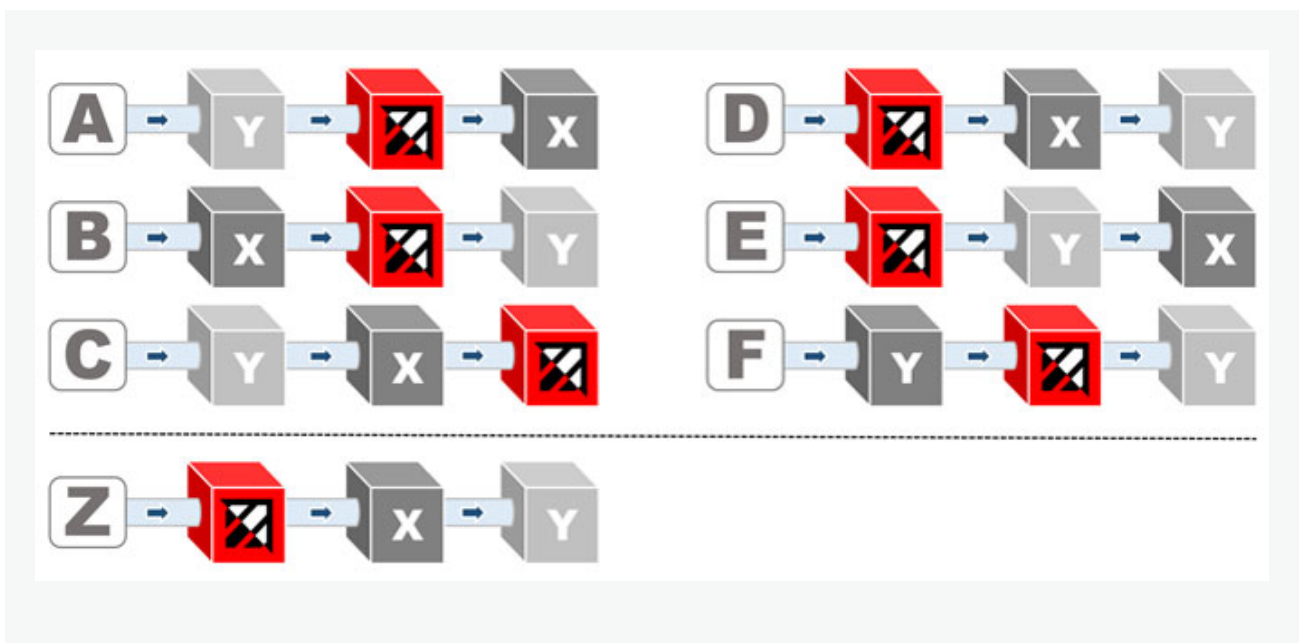
Precision is by far the most critical determinant for any measuring device and the basis for an accurate measurement. A precise flow sensor can be calibrated to become an accurate one; the reverse case is not possible.

Resolution indicates the smallest detectable change in flow that a sensor can measure.



FLOW SENSOR COMPARISON ON FLEXIBLE TUBES - SENSOR SETUP

Test set-ups A/B/C/D/E/F represent a 60 minutes run each, while the sensors have been re-clamped from test to test as visualized in the chart above. Setup Z, however, was the only 180 minutes run performed.

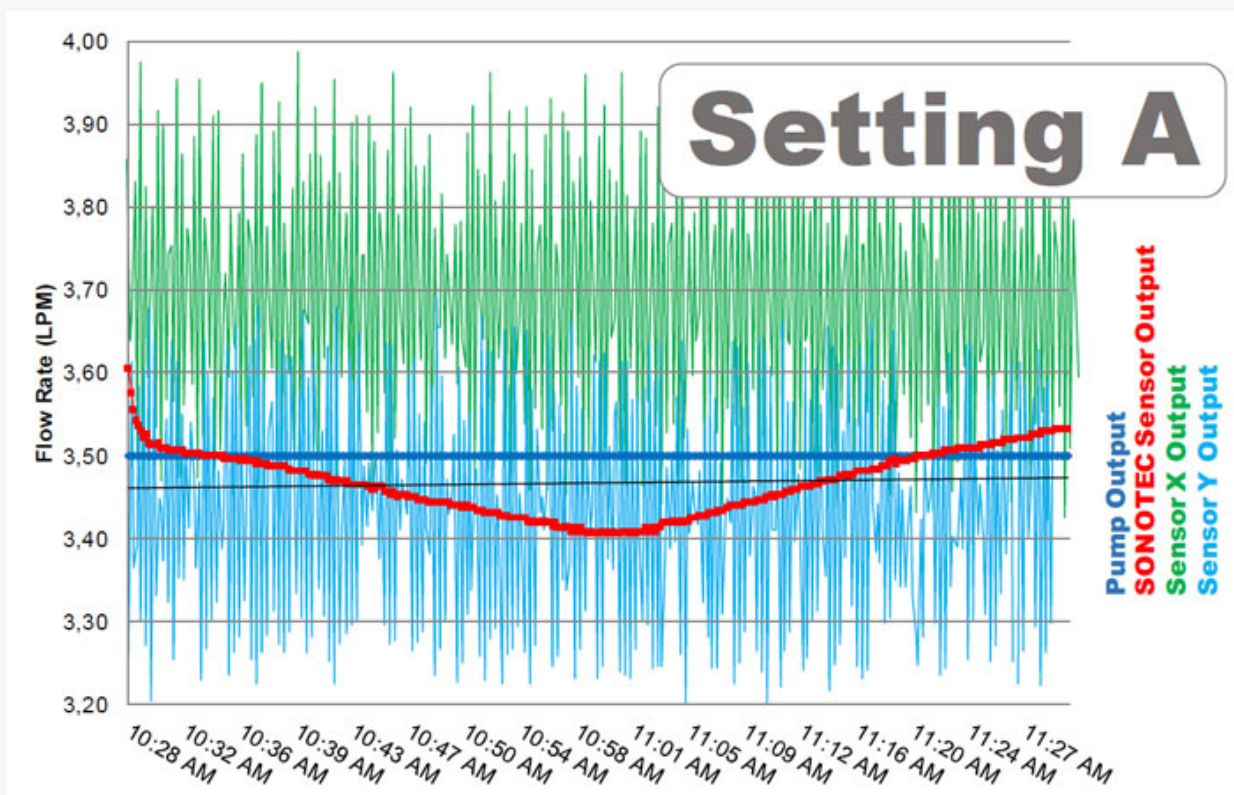


The sensor setup was chosen to minimize systemic measurement errors while comparing the sensors to each other. All test conditions were kept as stable as possible by using the same sensor and application set-up in steady ambient conditions such as temperature and air pressure. All sensors have been calibrated to the applied test setup to finally refer to the pump output at 3.5 litres per minute.

FLOW SENSOR COMPARISON ON FLEXIBLE TUBES – MEASURING RESULTS (PUMP OUTPUT: 3.5 LITRES/MINUTE; 60/180 MINUTES RUNS)

Setting	STDEV (Litres/Minute)			Average Flow Rate (Litres/Minute)			Accuracy		
	X	Y	Z	X	Y	Z	X	Y	Z
A	0.0388	0.1630	0.1433	3.47	3.69	3.43	-0.86%	5.43%	-2.00%
B	0.0288	0.1670	0.1415	3.48	3.65	3.43	-0.57%	4.29%	-2.00%
C	0.0524	0.1692	0.1482	3.48	3.85	3.37	-0.57%	10.00%	-3.71%
D	0.0492	0.1639	0.1380	3.47	3.64	3.59	-0.86%	4.00%	2.57%
E	0.0382	0.1810	0.1324	3.44	3.24	3.35	-1.71%	-7.43%	-4.29%
F	0.0362	0.1684	0.1459	3.45	3.17	3.51	-1.43%	-9.43%	0.29%
Z	0.0260	0.1467	0.1357	3.38	3.08	3.49	-3.43%	-12.00%	-0.29%

FLOW SENSOR COMPARISON ON FLEXIBLE TUBES – VISUALIZED MEASURING RESULTS (PUMP OUTPUT: 3.5 LITRES/MINUTE; 60/180 MINUTES RUNS)



SONOFLOW CO.55 V2.0 STANDS OUT FOR HIGH PRECISION AND BEST ACCURACY –

INTERPRETATION OF THE RESULTS

Summarizing all six 60 minutes runs and the 180 minutes run, the average standard deviation of the SONOFLOW CO.55 V2.0 sensor of 0.0406 litres per minute indicates the highest precision of all three tested sensors. This number, however, represents an average precision of 1.16 % of the SONOTEC device, compared to 4.04 % (Sensor X) and 4.82 % (Sensor Y).

As the precision specifies the repeatability of the sensor describing how consistent results could be reached; accuracy in turn, defines the error between the real and the measured value. Accuracy, indeed, is finally an issue of a high precision and an optimum calibration of the sensor.

With reaching the best values of the standard deviation during each run, the SONOFLOW CO.55 V2.0 shows the best precision of all competing sensor set-ups. This outstanding performance makes sure to also reach consistently high accuracies, ranking the SONOFLOW CO.55 V2.0 top in five of seven of the simulations realized. This, however, could be even topped by an improved calibration to the test environment.

The high resolution of the SONOFLOW CO.55 V2.0 is thus also one of the key reasons reaching these exceptional results.

SONOFLOW CO.55 V2.0 – ADVANTAGES AT A GLANCE

- Non-invasive sensor solution to be easily clamped on the flexible tubing
- No additional electronics board needed; less installation effort and less cabling
- Available in aluminum and stainless steel housing to fulfil high GMP standards
- Sensors are able to switch devices on its own (e.g. pump)
- Software for specific adjustments, e.g. in-house calibration
- Manifold outputs: 4-20 mA, RS485, 0-20 kHz, switching
- Fast return on investment (ROI) compared to yearly costs of disposable sensors
- Sustainable as the sensor is re-usable

FURTHER PRODUCT INFORMATION



SONOFLOW CO.55 | Clamp-On Sensor

...for non-invasive flow measurement at flexible tubes



WORLDWIDE



Do you have any questions?

Mandy Reber

+49 (0)345 / 133 17-832

m.reber@sonotec.de