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Titan Enterprises Explores the Relationship Between Repeatability and Accuracy of Flowmeters

The demand for high-accuracy meters in flow measurement

has indeed grown over the years, driven by various factors such as stricter government regulations and the need for more precise measurements in critical applications. Manufacturers of flow measurement devices like [Titan Enterprises](#) are continually investing in research and development to introduce new technologies that enhance the accuracy and performance of their flow measuring instruments. This includes innovations such as improved sensor technology, [advanced signal processing algorithms](#), and enhanced calibration methods.

An important aspect

to [Titan Enterprises' R&D](#) is reviewing the performance of our flowmeters and delivering improvements in product design and materials that improves both the accuracy and repeatability (reliability) of these flow measurement devices.

“A high-quality flowmeter,

carefully produced with a design and construction to tight tolerances and with high-quality materials as well as low wear and fatigue characteristics, is a precise meter with a quantifiable value of repeatability.” (R.C. Baker, 2016).

Repeatability and Accuracy

are distinct terms used to define the performance and quality of a flowmeter.

So what is Repeatability?

The standard description

is the flowmeter's ability to produce the same result on repeated runs under identical operating conditions. Repeatability is often something that the design of the instrument defines and without excellent repeatability, a flowmeter cannot have good performance.

At Titan Enterprises

we set our [calibration rigs](#) to record a certain number of pulses depending on the type of meter. The flow rigs accurately interpolate the rig and meter pulses and will not accept a reading unless it is within pre-set limits, usually set at 0.1% of repeated points. Repeatability is expressed as a \pm percentage.

Repeatability

can deteriorate at low flow rates so manufacturers may specify this value as a percentage plus a constant uncertainty value, or as a percentage of full-scale reading, rather than a percentage of measured flow rate.

Titan's highly repeatable

small turbine flow meters are successfully employed in [batching processes and dispensing applications](#) particularly within the food and beverage, chemical, medical and laboratory sectors. They have excellent repeatability ($\pm 0.1\%$) making them ideal for dosing systems and can be calibrated in-situ.



What is Accuracy?

Accuracy of a flowmeter

relates to the quality of the measurement device and how close a measured reading is to the true flow. It is generally accepted that Accuracy is used as a qualitative term, where Linearity and Uncertainty measurements are the quantitative terms defining the accuracy of a flowmeter.

Linearity

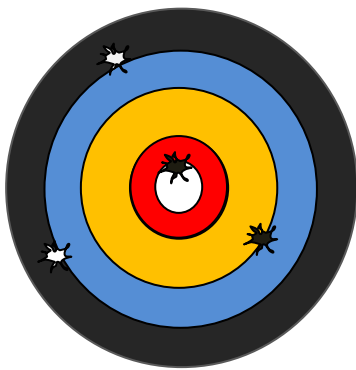
is usually defined by stating the maximum deviation of the reading over a stated flow range (e.g. $\pm 1\%$ of flow rate). It is the ability of the flow meter to remain within specified limits over its entire flow range determined by its design. The standard way of expressing linearity is error of reading. A frequently used alternative in some industry sectors is percentage of full-scale deflection or FSD.

Measurement uncertainty is the level of potential error in calibration, i.e. the range of values within which the true values lie with a specified probability. It is accepted that there is always a margin of error in any taken measurement and this uncertainty is quantified as a \pm percentage.

Accurate flow rate measurement

is influenced by an array of variables, including pressure, temperature, density and viscosity of the fluid. All of these factors are typically included in a calibration record. The very best calibration houses claim a measurement uncertainty as good as $\pm 0.02\%$, though more typically $\pm 0.1\%$ when these factors are properly controlled.

The following images illustrate the **relationship between repeatability and accuracy**:



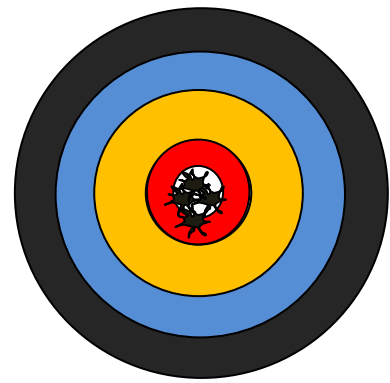
Poor accuracy / poor repeatability

High accuracy is not achievable without high repeatability.



Good repeatability / poor accuracy

Good repeatability does not guarantee accuracy - but then this is not always important to the process. Not all applications require highly accurate flow readings, such as batching processes used in the beverage industry, particularly as flowmeter calibration can be adjusted in-situ.



Good accuracy / good repeatability

A flowmeter with both high accuracy and repeatability would generally come at a higher price. However, this investment is highly desirable in the medical, pharmaceutical and chemical sectors where small volume, high-value product is dispensed/dosed.

Overall, the trend towards higher-accuracy flow meters

is likely to continue as industries evolve, and the demand for precise measurements in critical applications grows. This evolution is driven not only by regulatory requirements but also by the ongoing pursuit of process optimisation, efficiency gains, and improved product quality across various sectors.



Visit Titan Enterprises' website f

or further information on flow measurement or to discuss specific technical applications, please contact [Titan Enterprises](#) on +44 (0)1935 812790 or email sales@flowmeters.co.uk.

Titan Enterprises Ltd

Drawing upon over 40-years of flowmeter innovation - Titan Enterprises Ltd is a leading manufacturer of high-performance flow measurement solutions, including the Atrato[®] ultrasonic flowmeter, Oval Gear flowmeters, low flow Turbine flow meters and a flow instrument range. Titan's company philosophy of "pushing the envelope by trying to do things a little different and better" has resulted in sales of over 2 million flowmeters and components into 50 countries worldwide and a repeat purchase percentage of 95%. All flow meters produced by Titan Enterprises are designed and manufactured to ISO9001 and calibrated to an uncertainty of $\pm 0.25\%$.

February 2024

titanpr134-FMRepeatability&Accuracy

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