

The Siemens logo is displayed in a bold, teal, sans-serif font.

Ingenuity for life

A large-scale water treatment facility with multiple circular tanks and metal walkways. The tanks are filled with water, and the walkways are elevated above them. The background shows a line of trees under a clear sky.

Proven performance to meet real-world needs will always outweigh specs that “in theory” seem to be more impressive

Imagine you are out shopping for a new car. It will only be needed for quick errands like a five-minute trip to the grocery store once a week. You have a choice between two vehicles.

The first is a comfortable, fuel-efficient sedan that hardly ever breaks down, offers a smooth ride at reasonable speeds, and will last for about 20 years. The second is a flashy sports car that costs about ten times more, but it will go from zero to 100 kilometres per hour in a heartbeat, and can handle corners like a Formula 1 race-car. But considering that it will never be driven at high speed, let alone go around corners that fast, it's a no-brainer the sedan would be the right buying decision for the vast majority of people.

The same rationale applies when it comes to ultrasonic transmitters used in places like water and wastewater treatment facilities.

Make sure you understand test results in full context when choosing a water/wastewater measurement instrument

Understanding specs

Based on the results of a range of different tests that are conducted, there are all kinds of specifications you can look at to compare competing products. But that information will not be helpful – and can even be misleading – if you do not view it in the context of what is needed for the real-world task at hand.

Consider the accuracy specs on the SITRANS Probe LU and a competitor's offering to illustrate the point.

In accordance with International Electrotechnical Commission (IEC) standard 60770-1, the SITRANS Probe LU has non-linearity measurement accuracy that is the greater of 6 mm (0.24") or 0.15% of span (including hysteresis and non-repeatability). Non-repeatability (included in non-linearity specification) is 3 mm (0.19"), while resolution is 3 mm (0.19") and the hysteresis error is 0 mm.

A competitor's product lists their accuracy as having accuracy of $\pm 0.2\%$ of the measured distance, plus 0.05% of the range, while the resolution depends on the measured distance. It's 1 mm for a distance less than 2 m, 2 mm for a distance of 2-5 m, etc.



SITRANS Probe LU was designed with the real world in mind, with a number of attributes that make it compelling for every-day, practical use

Theoretical versus real-world testing

At first glance, the competitor's product appears to have much better specifications. But are they applicable to the real world or are they just theoretical? And how do you compare significant differences in the methodologies of determining accuracy?

The IEC 60770-1 specification is based on uniform testing methods for evaluating the performance of transmitters with either a standard analogue electric current output signal or a standard pneumatic output analogue signal (in accordance with IEC 60381-1 or IEC 60382). The tests can be applied to transmitters with other output signals, but allowances must be made for differences.

IEC 60770-1 demands that worst-case accuracy be quoted based on actual physical tests against a standard. Tests for the SITRANS Probe LU are performed in a "shooting gallery" where the actual distance is verified using a precision system with calibrations traceable to national standards. It's important to keep in mind that the results of this test include all inaccuracies caused by timing, temperature and analogue-digital and digital-analogue conversions.

See Figure 1 for the test results. Note that the worst-case deviations are ± 4 mm, with the greatest deviation occurring at beyond 5 m. That is critical because for Open Channel Monitoring (OCM) applications, the Probe LU is typically used within a range of 3 m.

See Figure 2 for the accuracy at the "real-world" distance of 3 m. In this case, it's dramatically different at ± 1.5 mm, well within the specification.

Resolution in the real world

It's a similar story when you consider resolution. Theoretically, it seems the competitor's device has better resolution operating at 80 KHz than the Probe LU at 54 KHz. At Standard Temperature and Pressure (STP), the speed of sound is 344 m/s and the echo detection of the first quarter wave of the return signal ($\frac{1}{4} \lambda$) of an 80 KHz signal is approximately 1.1 mm, compared to 1.6 mm for 54 KHz.

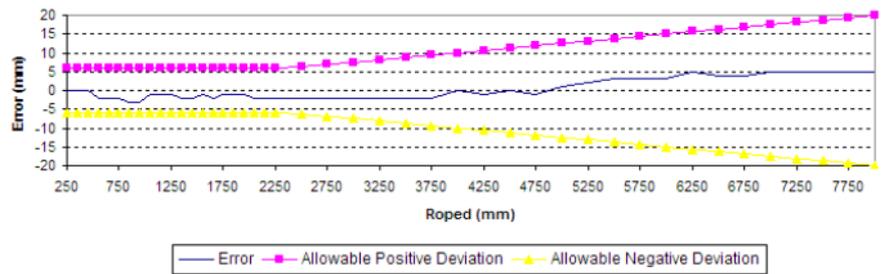


Figure 1: SITRANS Probe LU accuracy testing to 8 m (typical): Test results clearly show deviations. Keep in mind most OCM applications are within a range of 3m.

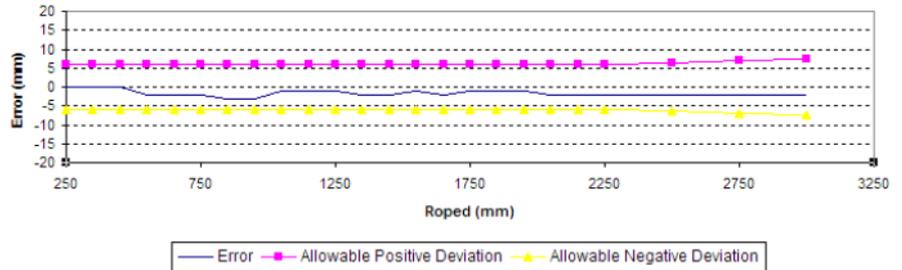


Figure 2: SITRANS Probe LU accuracy testing to 3 m (typical): "Real-world" distance of 3m clearly shows ± 1.5 mm, well within the specification.



Understanding accuracies in real applications is important to consider when comparing devices.

But that 0.5 mm advantage is only theoretical. Real-world factors paint a very different picture. In practical use, attenuation due to flow stream turbulence, as well as temperature and moisture variations must be taken into account. The attenuation of an 80 KHz signal in free air with a relative humidity of 40% is almost 50% greater than that of a 54 KHz signal. It then becomes impossible to determine exactly where $\frac{1}{4} \lambda$ of the reflected signal occurs. As a result, in the real world, the theoretical advantage of 80 KHz over 54 KHz is negated.

Real-world advantages

The fact is the SITRANS Probe LU was designed with the real world in mind, with a number of attributes that make it compelling for every-day, practical use. Of note:

- Echo processing in the device provides a high signal-to-noise ratio (measured at 25 dB at the maximum range), and advanced algorithms (i.e. Sonic Intelligence) are embedded in the software to provide continuously reliable performance under changing conditions
- The sensor's high signal acoustic output requires significant face movement, which ensures self-

cleaning, so condensation or build-up of algae typical in water/wastewater treatment have negligible effect on performance, with even the most difficult rain and wind conditions having minimal consequence

- Balance between transducer size, frequency and range. Consider a fog horn. The low frequency carries a long distance. The same concept applies in ultrasonic level, the lower the frequency the further the distance the sound will travel but requires a larger transducer to produce the sound. Taking into account the applications ultrasonics are designed for, 54 kHz was chosen as

the best frequency balancing accuracy against challenging applications with adverse environments, sensor size, and range.

- Designed for real world applications. With a temperature range from -40°C to 85°C reliable operation is assured in almost any ambient environment.
- The transducer is fully sealed, isolating its electronics from vapour and ingress. And the highly intelligent ultrasonic controller can be installed away from the dirty, confined space of a wet well, for example, in a controlled and easily accessible area.

A wise choice

With more than 45 years of experience serving the industry, Siemens has deployed about 1.5 million level instruments in various applications. Most of our sensors have been working for more than 20 years, while requiring practically no maintenance.

The bottom line is that when deciding on an instrument, accuracy and all other attributes must be considered in the context of industry-accepted testing for real-world conditions. With the SITRANS Probe LU, purchasers can rest assured they are getting one of the most "tried and true" devices available – a sensor that will perform reliably day after day and year after year in the real world.

Siemens AG

Process Industries and Drives
Östliche Rheinbrückenstr. 50
76187 Karlsruhe
Germany

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