

Level Sensing on Reflective and Soft Surface Targets

Level sensing sounds straightforward until you look at what's actually inside the tank. A flat water surface and a cone of granular powder don't behave the same way acoustically — not even close. Engineers designing level measurement systems need to account for both ends of that spectrum, and often everything in between, within a single installation.

This application note breaks down how target surface characteristics affect ultrasonic level measurement and why SensComp's electrostatic ultrasonic sensors handle the full range of conditions more reliably than piezoelectric alternatives.

Two Extremes, One Sensor Challenge

Ultrasonic level sensors work by emitting a pulse and timing the echo that bounces back from the target surface. The quality of that echo depends almost entirely on what the surface does with the incoming sound energy.

Reflective targets, such as calm liquids, flat metal, and smooth plastics behave predictably. The pulse hits a hard, flat interface and returns a strong, clean echo. Most ultrasonic sensors, including piezo-based units, handle these targets reasonably well under controlled conditions.

Soft and absorptive targets are a different problem. Materials like grain, powder, foam, and loose fill absorb acoustic energy instead of reflecting it. What does come back is faint, scattered, and often buried in noise. Piezo sensors, with their lower sensitivity and narrow bandwidth, frequently lose the return signal entirely. The system reads "empty" when the bin is full, or the measurement jumps erratically as the sensor picks up noise instead of a valid echo.

The challenge gets worse when reflective and absorptive targets exist in the same system — a liquid with a foam layer on top, for instance, or a tank that holds water one week and slurry the next.

Why Reflective Surfaces Aren't Always Easy

Even "cooperative" targets can cause problems. Turbulent liquids scatter the return signal. Narrow tanks create multipath reflections where the pulse bounces off the sidewalls before returning to the sensor, producing false distance readings. Highly reflective surfaces at close range can saturate a sensor that's still ringing out from its transmit pulse, creating a dead zone where measurement isn't possible.



APPLICATIONS

Silos and bins (grain, powder, granular materials)

Chemical storage tanks

Slurry tanks

Liquid storage tanks

Bulk agricultural commodity storage

Water tanks and reservoirs

Wastewater treatment

Corrosive chemical tanks

High-humidity process environments

Bulk material handling

Automated filling systems

Inventory management via level data

Fluid reservoirs in mechanical systems

Piezo transducers are particularly susceptible to this last issue. Because they're resonant devices, they ring for a relatively long time after transmitting. That ring-out window becomes a blind spot — and in shallow tank applications or systems where the sensor is mounted close to the maximum fill level, that blind spot lands exactly where you need data most.

How Electrostatic Ultrasonic Sensor Technology Handles Soft and Reflective Targets

SensComp's electrostatic ultrasonic transducers address these challenges through fundamental differences in how they generate and receive sound.

Sensitivity on soft targets: Electrostatic transducers operate at approximately 40 dB greater sensitivity than piezo counterparts. That's not an incremental improvement — it's orders of magnitude more signal detection capability. Faint, scattered echoes from powder, grain, foam, and other absorptive surfaces that fall below a piezo sensor's detection threshold are well within range for an electrostatic transducer.

Minimal dead zone on reflective targets: Because electrostatic transducers are non-resonant, they quiet down quickly after transmitting. Ring-out is minimal, which shrinks the near-field dead zone and allows accurate measurement much closer to the sensor face. A single electrostatic transducer can cover a range from 1 inch to over 40 feet — handling both shallow-tank and deep-tank applications without swapping hardware.

Thermal stability across operating conditions: Frequency and gain remain stable from -40°C to +85°C. There's no resonant frequency drift to compensate for, which means the system doesn't need recalibration as ambient conditions change throughout the day or across seasons. For outdoor tanks, silos, and bins that see wide thermal swings, this eliminates a common source of measurement error.

Broadband pulse for better surface discrimination: The broadband nature of the electrostatic pulse captures a richer acoustic picture of the target surface. This helps the system

distinguish between a valid echo from the actual material surface and noise from multipath reflections, foam layers, or tank wall interference.

Practical Considerations for System Design

When specifying an electrostatic ultrasonic sensor for level measurement across mixed target types, keep these factors in mind:

Mounting position: Center-mount the sensor above the tank to minimize sidewall reflections. In bins with conical fill patterns, aim the sensor at the area most representative of average fill level rather than the peak of the cone.

Environmental protection: For tanks containing corrosive chemicals or high-humidity environments, SensComp's Environmental Grade transducers with parylene coatings and stainless-steel housings provide long-term durability without sacrificing acoustic performance.

Temperature compensation: While the transducer itself is thermally stable, the speed of sound in air changes with temperature. A co-located temperature sensor allows the system to compensate for this variable and maintain measurement accuracy across conditions.

Beam angle selection: The SensComp Series 600 transducer's 15-degree beam angle works well for most tank geometries. For smaller tanks or applications requiring a wider coverage area, the SensComp Series 7000 transducer's 17-degree beam in a more compact form factor may be a better fit.

The Bottom Line

Level sensing across reflective and soft surface targets doesn't require two different sensor technologies. It requires one sensor with enough sensitivity to handle the worst-case target and enough range flexibility to cover the full application envelope. SensComp's electrostatic ultrasonic transducers deliver both, backed by decades of proven performance across industries that depend on accurate level data.

For help specifying the right transducer for your level sensing application, [contact our engineering team](#) or [explore our sensor selector tool](#).