

Vega Test

A practical guide to vega test, covering the reader intent, the relationship to vega test, key evaluation criteria, common risks, and the information the intended project audience should confirm before taking the next step.



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In the field of industrial process automation, ensuring the accuracy of level measurement instruments is critical for operational safety, inventory management, and process efficiency. The term "Vega test" is often used by instrumentation engineers to refer to the comprehensive diagnostic, commissioning, and verification procedures applied to high-frequency radar and ultrasonic level sensors. Whether performing a routine check on a legacy device or commissioning a new 80 GHz radar transmitter, understanding the underlying measurement principles and testing protocols is essential for maintaining reliable data.

This guide provides a detailed technical overview of how to evaluate level measurement performance, the physics behind the sensors, and the practical steps required to perform a thorough verification of industrial level instruments.

| Fundamental Principles of Level Measurement

Before conducting a vega test or any diagnostic verification, engineers must understand the physics governing the two primary non-contact measurement technologies: Radar and Ultrasonic.

| Radar Level Measurement (ToF and FMCW)

Most modern radar level meters operate on the Time-of-Flight (ToF) principle or Frequency Modulated Continuous Wave (FMCW) technology.

Pulse Radar: The sensor emits short microwave pulses toward the medium. These pulses are reflected by the surface and received back by the antenna. The distance is calculated based on the time elapsed between emission and reception, using the constant speed of light.

FMCW Radar: The sensor emits a continuous signal with a constantly changing frequency. The difference between the emitted frequency and the received frequency (reflected from the product surface) is proportional to the distance. FMCW is generally preferred for high-precision applications due to its superior signal-to-noise ratio.

| Ultrasonic Level Measurement

Ultrasonic sensors utilize mechanical sound waves. The transducer emits an ultrasonic pulse that travels through the air, hits the surface of the medium, and returns to the sensor. Because the speed of sound is significantly affected by air temperature, these sensors typically include an integrated temperature probe to compensate for changes in the medium's atmosphere.

| The Vega Test Framework: Diagnostic and Commissioning Procedures

A comprehensive vega test involves several stages, ranging from bench-top verification to in-situ echo curve analysis. These steps ensure that the instrument is not only functioning but is also optimized for the specific geometry of the vessel.

| 1. Bench Testing and Pre-Installation Calibration

Before an instrument is mounted on a tank, a bench test is performed to verify basic electronics and scaling.

Zero and Span Check: Engineers simulate minimum (0%) and maximum (100%) levels to ensure the 4-20mA output or digital protocol (HART, Modbus, Profibus) matches the expected values.

Reference Distance Verification: Positioning the sensor at a known distance (e.g., 2 meters) from a flat reflective target to confirm the factory calibration accuracy.

| 2. In-Situ Echo Curve Analysis

The most critical part of a modern vega test is the analysis of the echo curve (envelope curve). This is a visual representation of all reflections within the tank.

Signal Strength: The primary reflection from the product surface must be significantly higher than the background noise.

False Signal Suppression: Also known as "mapping," this process involves recording reflections from internal tank obstructions (agitators, ladders, heating coils) and instructing the software to ignore them. A successful test ensures that the sensor can distinguish the true level even when the surface is near an obstruction.

3. Loop Integrity Test

Once installed, the sensor must be tested as part of the wider control loop. This involves verifying that the signal reaches the PLC/DCS accurately and that any high-level or low-level alarms trigger at the correct physical heights.

Key Evaluation Criteria for Industrial Level Sensors

When conducting a vega test, engineers evaluate the instrument against specific performance benchmarks. The following table outlines the selection criteria for different technologies commonly used in industrial applications.

Feature	80 GHz Radar	26 GHz Radar	Ultrasonic	Hydrostatic
Accuracy	±1 mm	±2 mm	±0.2% of range	±0.1% of span
Measuring Range	Up to 120 m	Up to 30 m	Up to 15 m	Up to 200 m
Process Temp.	-196 to +450 °C	-40 to +250 °C	-40 to +80 °C	-40 to +100 °C
Pressure	Vacuum to 160 bar	Vacuum to 40 bar	Atmospheric	Submerged depth
Media Type	Liquids and Solids	Liquids and Solids	Liquids and Slurries	Liquids only
Best Use Case	Small nozzles, high precision	General purpose tanks	Water/Wastewater	Deep wells, vented tanks

For a comprehensive look at available hardware and technical specifications, engineers can [Review product options and application support on the official manufacturer Main Page.](#)

| Installation Considerations and Best Practices

The success of a vega test often depends more on the installation quality than the sensor itself. Even the most advanced radar can fail if poorly positioned.

| Nozzle Geometry and Placement

Nozzle Height: The nozzle should be as short as possible. If a nozzle is too long or narrow, the radar beam may reflect off the internal welds, creating a large "dead zone" at the top of the tank.

Wall Distance: Sensors should never be mounted in the center of a tank (to avoid multiple reflections) or too close to the wall (to avoid signal interference). A general rule is to mount the sensor at 1/4 to 1/3 of the tank diameter from the wall.

| Obstruction Avoidance

Level sensors must have a clear line of sight to the product surface. If an agitator is present, the test must be performed while the agitator is running to ensure the "false signal suppression" can effectively filter out the moving blades.

| Dead Zones (Blocking Distance)

Every non-contact sensor has a "dead zone" directly below the antenna or transducer where measurement is impossible. For ultrasonic sensors, this is typically 250 mm to 800 mm depending on the frequency. For 80 GHz radar, this zone is significantly smaller, often less than 50 mm.

| Operational Limitations and Risks

While modern instrumentation is robust, certain process conditions can compromise the results of a vega test.

1. **Low Dielectric Constants (ϵ_r):** Radar relies on the reflectivity of the medium. Non-polar liquids like oils and solvents have low dielectric constants ($\epsilon_r < 2.0$), which result in weaker return signals. In these cases, a stilling well or guided wave radar may be required.
2. **Heavy Foam:** Foam can absorb radar signals or scatter ultrasonic waves. If the foam is dense and conductive, the sensor may incorrectly identify the top of the foam as the liquid level.
3. **Dust and Condensation:** While 80 GHz radar is highly resistant to dust, heavy buildup on an ultrasonic transducer face can dampen the mechanical vibration, leading to a "Loss of Echo" error.
4. **Turbulence:** Rapidly moving surfaces can cause signal scattering. Software damping and signal averaging are used to stabilize the reading, but extreme turbulence may require a bypass pipe for accurate measurement.

| Frequently Asked Questions (FAQ)

Q: How often should a vega test be performed for calibration verification?

A: For most industrial applications, an annual verification is sufficient. However, in regulated industries like pharmaceuticals or custody transfer, semi-annual or quarterly testing may be required.

Q: Can I perform a vega test while the tank is in operation?

A: Yes, most modern diagnostic software allows for "live" echo curve recording. This is actually preferred for mapping out false reflections from agitators or falling scales during the fill cycle.

Q: Why does my sensor show a full tank when it is actually empty?

A: This is often caused by a "double bounce" or a strong reflection from a nozzle weld or internal obstruction that has not been properly mapped out during the initial commissioning test.

Q: What is the difference between accuracy and repeatability in these tests?

A: Accuracy is how close the measurement is to the true physical distance. Repeatability is the ability of the sensor to provide the same result under the same conditions over time. In many B2B process control applications, high repeatability is more critical than absolute accuracy.

| Conclusion

Conducting a thorough vega test is a fundamental skill for maintaining modern industrial plants. By understanding the measurement principles of radar and ultrasonic technologies, following strict installation guidelines, and utilizing echo curve analysis, engineers can ensure their level measurement systems provide reliable data for years to come. For further technical documentation and to explore specific instrument models, visit the Main Page of the equipment provider.