

Blue H2

A practical guide to blue h2, covering the reader intent, the relationship to blue h2, key evaluation criteria, common risks, and the information the intended project audience should confirm before taking the next step.



Main topic: Main Page
<https://www.level-meters.com/>

As the global industrial sector shifts toward decarbonization, hydrogen has emerged as a cornerstone of the future energy mix. Among the various "colors" of hydrogen, blue h2 represents a critical bridge technology. It allows for the continued use of natural gas infrastructure while significantly reducing carbon emissions through integrated carbon capture, utilization, and storage (CCUS). For process engineers and plant managers, the production, transport, and storage of blue h2 present unique technical challenges, particularly regarding the precision of level measurement in high-pressure and chemically complex environments.

Reliable level instrumentation is essential not only for the efficiency of the hydrogen reforming process but also for the safe operation of carbon capture units. This guide explores the technical requirements for monitoring levels in blue h2 infrastructure and provides an engineering framework for selecting the appropriate measurement technologies.

| The Technical Context of Blue H2 Production

Blue h2 is produced primarily through Steam Methane Reforming (SMR) or Autothermal Reforming (ATR). In these processes, natural gas (methane) reacts with steam or oxygen under high pressure and temperature to produce hydrogen and carbon dioxide. Unlike "grey" hydrogen, where the CO2 is released into the atmosphere, blue h2 facilities capture up to 90-99% of these emissions.

The infrastructure required for blue h2 involves several distinct stages, each requiring specific level measurement solutions:

1. Feedstock Storage: Monitoring natural gas and water levels.
2. Reforming Stage: Managing high-temperature condensate and steam levels.
3. Carbon Capture Units: Monitoring amine or solvent levels in absorber and stripper columns.
4. Hydrogen Purification (PSA): Managing separator levels.

5. Storage and Logistics: Monitoring high-pressure gaseous hydrogen or cryogenic liquid hydrogen tanks.

| Measurement Principles and Technology Overview

Before selecting an instrument for blue h2 applications, it is vital to understand the physics behind different measurement principles. Each technology interacts differently with the physical properties of hydrogen and the chemicals used in carbon capture.

| 1. Radar Level Measurement (ToF)

Radar level meters operate on the Time of Flight (ToF) principle. The sensor emits a high-frequency electromagnetic pulse (typically in the 80 GHz range) that travels to the surface of the medium, reflects, and returns to the sensor. The distance is calculated based on the travel time and the speed of light.

Non-Contact Radar: Ideal for corrosive liquids like the amines used in carbon capture. Since the sensor does not touch the medium, it is protected from chemical degradation.

Guided Wave Radar (GWR): Uses a physical probe to guide the pulse. This is particularly effective for low dielectric constant (ϵ_r) liquids. Since hydrogen in liquid form has a very low dielectric constant (approximately 1.23), GWR provides a stronger return signal than non-contact radar in cryogenic storage applications.

| 2. Ultrasonic Level Sensors

Ultrasonic sensors emit high-frequency sound waves. The time taken for the echo to return from the liquid surface determines the level.

Application: These are best suited for water treatment tanks and atmospheric pressure chemical storage within the blue h2 plant.

Limitation: Ultrasonic waves are affected by gas density and temperature gradients. In high-pressure hydrogen environments, the speed of sound changes significantly, making ultrasonic sensors less suitable for the reformer or high-pressure storage stages compared to radar.

| 3. Hydrostatic Level Transmitters

Hydrostatic measurement relies on the principle that the pressure at the bottom of a vessel is proportional to the liquid height ($P = \rho gh$).

Application: Used frequently in vented tanks or pressurized vessels (using differential pressure).

Consideration: For blue h2 applications, the wetted diaphragms must be carefully selected. Hydrogen atoms are small enough to permeate through many metals, leading to "hydrogen embrittlement" or hydrogen stripping in gold-plated or specialized alloy diaphragms. Welk provides specialized transmitters designed to resist this permeation.

| 4. Magnetic Level Gauges (MLG)

MLGs utilize a float containing a permanent magnet that moves with the liquid level inside a bypass chamber. This magnet flips external flags for visual indication and can be paired with a reed chain transmitter for remote monitoring.

Application: Excellent for high-pressure separators and storage tanks where a clear visual reference is required alongside electronic data. Since the liquid is contained within a robust metal chamber, it offers high safety for hazardous blue h2 environments.

| Selection Criteria for Blue H2 Applications

Choosing the right instrument requires balancing accuracy, safety, and media compatibility. The following table provides a general selection framework for various stages of blue h2 production.

Application Stage	Typical Medium	Recommended Technology	Key Consideration
SMR Steam Drum	High-temp Water/Steam	Guided Wave Radar	High temperature and pressure resistance.
Amine Absorber	Amine Solvent	Non-contact Radar	Resistance to foaming and chemical corrosion.
CO2 Storage	Liquid CO2	Hydrostatic (DP)	Density changes with temperature.
Condensate Separator	Water/Hydrocarbons	Magnetic Level Gauge	Visual verification of interface levels.
H2 Buffer Tank	Gaseous Hydrogen	Radar (80 GHz)	Ability to handle high pressure (up to 700 bar).
Cryogenic H2	Liquid Hydrogen	Guided Wave Radar	Low dielectric constant and -253°C temperatures.

| Installation and Engineering Considerations

When integrating level sensors into a blue h2 facility, several engineering factors must be addressed to ensure long-term reliability.

| Material Compatibility and Hydrogen Embrittlement

Hydrogen is notoriously difficult to contain. In its gaseous state, it can penetrate the crystalline structure of metals, causing them to become brittle and crack. For hydrostatic transmitters and wetted radar probes, materials such as 316L stainless steel are standard, but for high-pressure blue h2 stages, specialized coatings or alloys like Hastelloy C276 may be required.

| Hazardous Area Certification

Hydrogen is highly flammable with a wide explosive range (4% to 75% in air). All level measurement instruments used in the vicinity of blue h2 production or storage must carry appropriate ATEX, IECEx, or North American hazardous area certifications (Class I, Div 1/2). Welk instruments are designed to meet these stringent safety standards, ensuring that electronic components are isolated from the process atmosphere.

| Nozzle and Internal Obstructions

For radar and ultrasonic installations, the physical geometry of the tank is critical. Nozzles should be positioned away from the tank wall to avoid false reflections. In blue h2 separators, internal baffles or agitators can interfere with signals. In such cases, using a stilling well or a Guided Wave Radar can bypass these obstructions to provide a stable reading.

| Limitations of Current Technologies

While modern instrumentation is highly advanced, there are inherent limitations to consider in blue h2 processes:

Dielectric Constant: As mentioned, liquid hydrogen has a very low dielectric constant. Standard non-contact radar may struggle to detect the surface without high-sensitivity electronics or the use of a stilling well.

Gas Phase Interference: In high-pressure hydrogen tanks, the dense gas phase can slightly slow down the radar signal. While this error is often negligible, high-precision custody transfer applications may require compensation for the gas phase refractive index.

Foaming in Carbon Capture: The amine solvents used to capture CO₂ in the blue h2 process are prone to foaming. This can absorb ultrasonic signals or cause "false levels" for radar. Selecting a radar frequency that can penetrate foam or using a magnetic gauge is often the preferred solution.

| Practical Maintenance Guidance

To maintain the accuracy of level measurement in blue h2 systems, a proactive maintenance schedule is recommended:

1. **Calibration Verification:** Periodically check the zero and span of hydrostatic transmitters, as sensor drift can occur in high-pressure environments.
2. **Probe Inspection:** For Guided Wave Radar, inspect probes for buildup or coating, especially in carbon capture units where solvent residues may accumulate.
3. **Seal Integrity:** Regularly check the process seals and O-rings. Hydrogen-specific elastomers (like specialized Viton or PTFE) should be inspected for signs of degradation.

For more detailed technical specifications and to explore our full range of industrial measurement solutions, please visit our [Main Page](#).

| Frequently Asked Questions (FAQs)

Q: Can I use a standard ultrasonic sensor for liquid hydrogen?

A: It is not recommended. Liquid hydrogen exists at cryogenic temperatures (-253°C), which is far below the operating range of standard ultrasonic transducers. Additionally, the vacuum-jacketed tanks used for liquid hydrogen storage make ultrasonic mounting difficult. Guided Wave Radar or specialized differential pressure systems are the industry standards.

Q: How does blue h2 production affect the lifespan of a level sensor?

A: The primary factor is the environment. In the carbon capture stage, corrosive solvents can shorten the life of wetted parts if the wrong materials are chosen. In the high-pressure hydrogen stage, hydrogen embrittlement is the main risk. Choosing the correct metallurgy (e.g., 316L or gold-plated diaphragms) ensures a service life comparable to standard industrial applications.

Q: Is radar measurement affected by the high pressure in blue h2 storage?

A: High pressure increases the density of the gas above the liquid. While radar is much less affected by pressure than ultrasonic technology, extremely high pressures can cause a slight delay in the signal travel time. Modern 80 GHz radar sensors often include software algorithms to compensate for these effects.

Q: What is the benefit of blue h2 over green hydrogen in terms of instrumentation?

A: From a measurement perspective, blue h2 is more complex because it involves the additional infrastructure of carbon capture (amine tanks, CO2 compressors, etc.). Green hydrogen (electrolysis) is chemically simpler but still requires high-level precision for water purity and hydrogen storage. Blue h2 instrumentation must handle a wider variety of chemicals and process conditions.

| Conclusion

The successful implementation of blue h2 projects relies heavily on the accuracy and reliability of process data. By understanding the measurement principles of radar, ultrasonic, and hydrostatic technologies, engineers can design systems that are both safe and efficient. Whether managing the corrosive environment of a carbon capture unit or the extreme pressures of hydrogen storage, selecting the right level instrument is a fundamental step in the transition to a low-carbon economy. For expert assistance in selecting the right equipment for your project, visit our Main Page to review product options and application support.