

5 Gauges

A practical guide to 5 gauges, covering the reader intent, the relationship to 5 gauges, key evaluation criteria, common risks, and the information the intended project audience should confirm before taking the next step.



[levelmeter.org](https://www.levelmeters.com/)

Main topic: Magnetic & Local Level Gauges

<https://www.level-meters.com/products/magnetic-level-gauges/>

In the landscape of industrial process control, visual verification remains a cornerstone of safety and operational reliability. While digital sensors and remote monitoring systems provide real-time data to control rooms, local level gauges offer a fail-safe, mechanical method for operators to confirm tank contents on-site. Among the various technologies available, Magnetic & Local Level Gauges are favored for their durability and ability to handle high-pressure or hazardous environments.

When engineers evaluate level measurement strategies, they often categorize solutions based on the physical properties of the media and the mechanical constraints of the vessel. This guide explores the principles and applications of 5 gauges commonly utilized in modern industrial settings, providing a technical framework for selection and installation.

| 1. Principles of Local Level Measurement

Before selecting a specific instrument, it is essential to understand the underlying physics that govern local level indicators. Most local gauges rely on one of three fundamental principles: buoyancy, hydrostatic pressure, or optical refraction.

| The Magnetic Coupling Principle

The most prevalent technology in modern B2B applications is the magnetic level gauge. This device operates on the principle of communicating vessels; the liquid level in the gauge chamber matches the level in the primary vessel. Inside the chamber is a float containing a high-intensity permanent magnet. As the float rises and falls with the liquid level, its magnetic field passes through the chamber wall—which is typically made of non-magnetic stainless steel or plastic—to actuate an external indicator rail.

This indicator rail consists of a series of bi-color magnetic flaps or rollers. As the float moves, the flaps rotate 180 degrees, changing color (usually from white to red or yellow) to represent the liquid level. Because the indicator is completely isolated from the process fluid, there is no risk of leaks or glass breakage, making Magnetic & Local Level Gauges an ideal choice for high-pressure and toxic applications.

| Optical and Direct Visual Principles

Traditional glass gauges rely on direct visibility. In a transparent or reflex gauge, the process fluid is contained within a heavy-duty glass tube or window. The operator views the meniscus of the liquid directly. While simple, these systems require robust sealing and are subject to the chemical compatibility of the glass and gaskets with the process media.

| 2. Technical Analysis of the 5 Gauges

Selecting the right instrument requires a deep dive into the specific types of gauges available. Below are the 5 gauges most frequently specified in industrial engineering projects.

| I. Magnetic Level Gauges (MLGs)

Magnetic level gauges are the industry standard for high-performance level detection. They eliminate the maintenance headaches associated with sight glasses, such as clouding, scaling, and leaks.

Key Advantage: Complete isolation between the process and the observer.

Typical Range: 300 mm to over 6,000 mm (can be sectionalized for greater heights).

Material Options: 316L Stainless Steel, Titanium, Hastelloy, or lined materials like PTFE for corrosive acids.

| II. Reflex Glass Gauges

Reflex gauges utilize a single piece of glass with a prismatic surface facing the liquid. The principle is based on light refraction. In the liquid-filled area, the light is absorbed, appearing dark; in the gas/vapor space, the light is reflected, appearing bright. This creates a sharp, high-contrast line that is easy to read from a distance.

Best For: Clean liquids and steam applications where a clear interface is required.

Limitation: Not suitable for viscous liquids that might coat the prisms.

| III. Transparent Glass Gauges

Unlike reflex gauges, transparent gauges feature two pieces of flat glass on opposite sides of the chamber. This allows light to pass through the medium, enabling the operator to see the color, clarity, or interface of two different liquids (e.g., oil and water).

Best For: Interface measurement and observing liquid characteristics.

Protection: Often fitted with mica shields when used in high-pressure steam service to prevent glass erosion.

| IV. Tubular Level Gauges

These are the most basic form of level measurement, consisting of a transparent tube (glass or plastic) connected to the tank via valves. They are primarily used in low-pressure, non-hazardous applications like water storage or atmospheric oil tanks.

Best For: Cost-effective, low-pressure tasks.

Safety Note: Usually equipped with ball-check valves to prevent catastrophic spills if the tube breaks.

| V. Magnetic Float Level Indicators (Bypass Style)

Similar to the standard MLG, the bypass indicator is mounted to the side of the tank. However, these are often customized with integrated transmitters (such as magnetostrictive or reed chain sensors) and switches. This allows the gauge to serve a dual purpose: local visual indication and remote signal transmission (4-20mA, HART, or Modbus).

3. Selection Criteria and Comparison Table

When choosing between these 5 gauges, engineers must evaluate the process conditions against the mechanical limits of the instrument. The following table provides a general comparison based on standard Welk manufacturing specifications.

Gauge Type	Max Pressure (Approx.)	Max Temperature	Visibility	Chemical Resistance
Magnetic Level Gauge	Up to 250 bar (25 MPa)	-196°C to 450°C	Excellent (Bi-color)	High (Lined options)
Reflex Glass Gauge	Up to 40 bar (4 MPa)	Up to 400°C	High Contrast	Moderate (Glass limited)
Transparent Glass	Up to 120 bar (12 MPa)	Up to 400°C	Good (Requires light)	Moderate (Mica needed)
Tubular Gauge	Up to 10 bar (1 MPa)	Up to 150°C	Good	Low to Moderate
Bypass MLG w/ Transmitter	Up to 200 bar (20 MPa)	Up to 450°C	Excellent	High

Critical Factors for Selection:

- Specific Gravity (SG):** For magnetic gauges, the float must be engineered to the specific gravity of the liquid. If the SG is too low (e.g., below 0.4), the float may need to be larger or made of specialized materials like titanium to maintain buoyancy.
- Viscosity:** Highly viscous fluids can impede the movement of a float in an MLG or coat the glass in a reflex gauge, leading to false readings.
- Corrosiveness:** Ensure that all wetted parts, including gaskets and O-rings, are compatible with the process media.

| 4. Installation Considerations for Local Gauges

Correct installation is paramount to ensure the accuracy and longevity of Magnetic & Local Level Gauges. Failure to follow engineering best practices can lead to mechanical binding or inaccurate readings.

| Vertical Alignment

The gauge chamber must be installed perfectly vertical. Even a slight tilt can cause the internal float to rub against the chamber walls, leading to friction that prevents the float from following the liquid level accurately. Use a spirit level during the mounting of the side-side or side-bottom flanges.

| Isolation and Venting

Every gauge should be installed with isolation valves (ball or needle valves) at the top and bottom process connections. This allows for maintenance or replacement without draining the entire vessel. Additionally, a drain valve at the bottom and a vent plug at the top are necessary for clearing sediment and relieving pressure during commissioning.

| Magnetic Interference

For magnetic gauges, ensure that no large ferrous structures or high-voltage cables are located within 100 mm to 200 mm of the indicator rail. External magnetic fields can interfere with the coupling between the float and the flaps, causing the flaps to flip erroneously.

| 5. Limitations and Safety Prohibitions

While robust, these 5 gauges have specific limitations that must be respected to prevent equipment failure or personnel injury.

Magnetic Particles: If the process fluid contains ferromagnetic particles (e.g., iron filings or magnetite), they will adhere to the internal float. This increases the float's weight and eventually jams it. In such cases, a magnetic filter must be installed upstream of the gauge.

Flash Point and Boiling: In applications where the liquid is near its boiling point, rapid pressure changes can cause the liquid in the chamber to flash into vapor. This turbulence can damage the float or cause erratic readings. Damping springs or oversized chambers may be required.

Glass Fragility: Direct-reading glass gauges should never be used in areas where they are susceptible to mechanical impact unless they are fitted with protective metal shields.

| 6. Maintenance and Troubleshooting FAQ

Q: Why are the flaps on my magnetic gauge showing random colors?

A: This usually indicates a loss of magnetic coupling. It can be caused by the float sinking (due to a leak or change in liquid density), magnetic interference from nearby equipment, or the float moving too fast during a rapid pressure surge. Reset the flaps using a handheld magnet and check the float integrity.

Q: How often should I clean a reflex glass gauge?

A: This depends on the fluid purity. In boiler applications, scaling can occur quickly. A monthly visual inspection is recommended. If the contrast between the dark and light sections becomes blurred, the glass should be cleaned or replaced.

Q: Can I use a magnetic level gauge for interface measurement?

A: Yes. By weighting the float to a specific density that falls between the SGs of the two liquids (e.g., between 0.8 for oil and 1.0 for water), the float will sink through the top layer and float on the bottom layer, accurately indicating the interface level.

Q: What is the maximum length for a single-piece gauge?

A: While Welk can manufacture chambers up to 6 meters, shipping and structural stability usually dictate that gauges over 3 meters are shipped in sections and joined on-site with flanges.

| Conclusion

Understanding the nuances of these 5 gauges allows engineers to design safer and more efficient process systems. Whether the application demands the extreme pressure resistance of a magnetic level gauge or the simple visual clarity of a reflex gauge, selecting the correct technology is a matter of matching the physical properties of the media with the mechanical capabilities of the instrument. For complex applications involving hazardous chemicals or extreme temperatures, Magnetic & Local Level Gauges remain the most reliable choice for local visual verification.