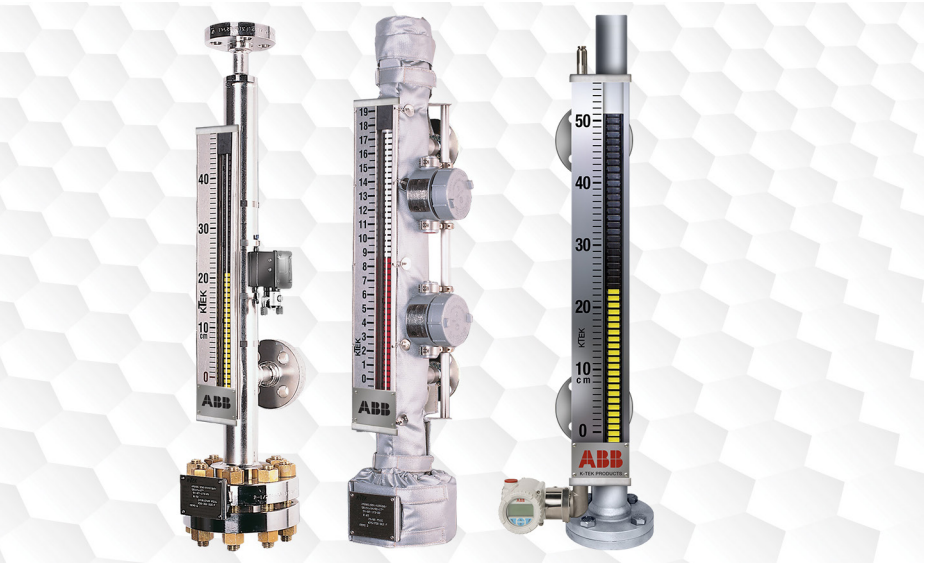
ABB MEASUREMENT & ANALYTICS | WHITEPAPER

ABB K-TEK Level Products

Integrated Level Solutions for the Future



As a market leader in level measurement solutions with the largest selection of agency approved level products, the ABB K-TEK level products line has the proven technology to provide solutions for the most difficult level applications.

Measurement made easy

Why Level Measurement?

Smarter measurement supports safer, more efficient and more sustainable operations, improving uptime and extending service-life, whatever the industry sector. Behind the scenes, it is also helping to keep worldwide infrastructure operating reliably, day-in and day-out.The importance of level measurement in this context cannot be overstated whether be it for Industrial Process Measurement & Control or in Inventory Tank Gauging.

In Applications like Custody transfer, the accuracy of the measurement becomes the critical parameter whereas in the other Process Industrial applications, along with a reasonable accuracy the Safety and Reliability parameters are crucial to ensure the overall success of any business.

In a dynamic system, the Level measurement becomes challenging with the process vessels/tanks which continuously undergoes changes in the behaviors of the measured process fluid due to agitation, mixing, chemical reaction, or emptied out for downstream processes depending on the application needs. In such applications, these processes combined with the fact that these occur at high temperature and/or high pressure pose a safety risk for the equipment and personnel, which makes the Level Measurement even more critical.

Any improper and inadequate control can cause levels in the vessels or tanks to be excessively higher or lower than their safe operating limits resulting in the damage to equipment, affecting the quality of the final product or causing overflow and potentially creating safety and environmental hazards resulting in financial losses.

ABB's Smart Level measurement solutions for Continuous and Point level Detection can be used to measure a wide variety of liquids, including corrosive, flammable and toxic materials while ensuring increased safety, reliability and performance with lower total cost of ownership for your operations. Let's write the future with ABB's smart Level measurement Solutions.

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Inventory	1	Keep track of inventory in terms of volume or weight Level – key component in a tank gauging system for reliable and accurate inventory control
Process Efficiency	2	Storage tanks are not filled to full capacity, will incur the unnecessary expense of additional vessels. – Accurate level measurement increases efficiency
Safety	3	Filling vessels above their capacities can cause safety hazards—spills (overflowing) in open vessels – Preventing overfills and leak detection is also important for meeting environmental regulations
Consistent Supply	4	Processes require a steady supply of inputs and outputs – Consistent supply is directly related to the end product quality
Custody Transfer	5	Based on a level measurement converted into volume or weight (from mathematical equations or strapping tables) – Custody Transfer – Commercial and Legal

Figure 1 Why Level Measurement?

A Complete Solution: Point Level vs Continuous Level

Modern instrumentation uses many different technologies to satisfy the ever-growing requirements for level measurement in a wide variety of applications. Some instruments measure level directly, while others indirectly measure by sensing another variable that is related to level. In Liquid Level Measurement, instruments can be divided into two basic categories: Point level and Continuous level sensors. The figure-2 shows the table of the most commonly used technologies in each category.

What are Point Level Instruments?
Point level instruments are those senses variation in liquid levels based on the presence or absence of liquid media at various points in a vessel or tank. Point Level Instruments can detect either single point, Dual or Multi-point. Most often, the function of point level sensors are high level or low level alarms, spill-prevention sensors, pump protection alarms, or as pump control components.

Following are the most common Point Level Technology used in the Industry:

- Thermal Dispersion
- Buoyancy
- Vibrating Fork
- RF Capacitance
- Magnetic Coupled

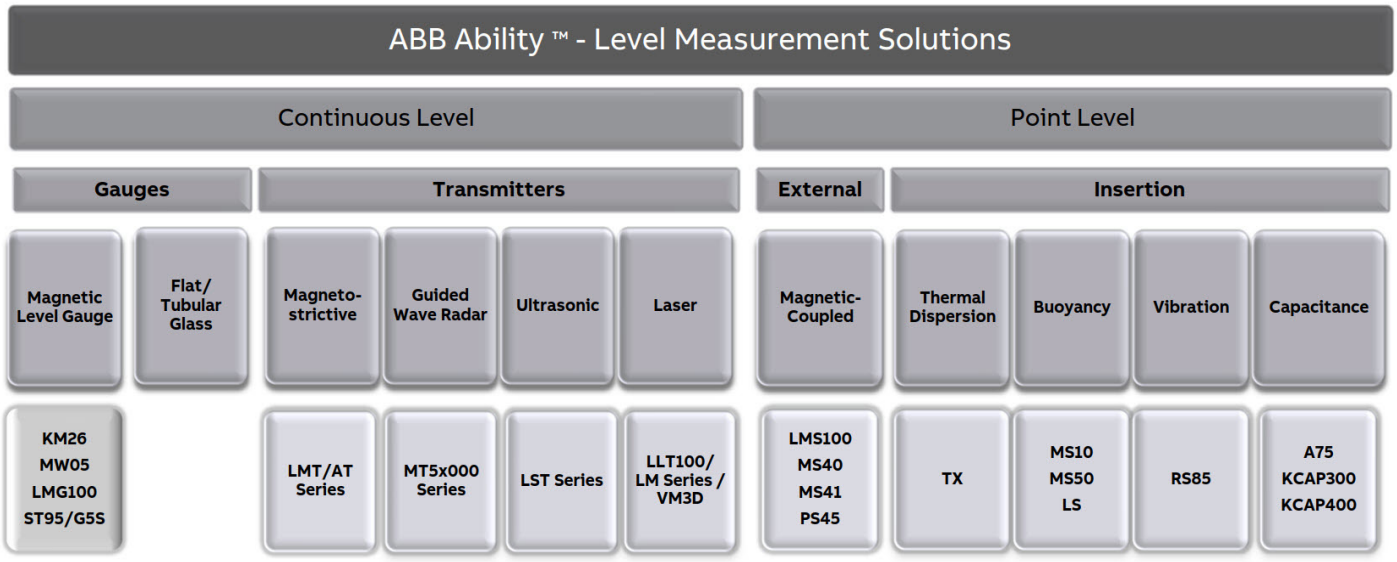


Figure 2 Level Measurement Solutions

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What are Continuous Level Instruments?
Continuous level instruments transmits the accurate level of a vessel/tank continously, over the full span of measurement. This is most often used for process control through a level absolute precision and accuracy is of crucial importance. Following are the most common Continous Level Technology used in the Industry:

- Magnetic Level Gauge
- Magnetostrictive
- Guided Wave Radar
- Laser
- Ultrasonic
- Differential Pressure

While these technologies and the instruments may have similarities and overlaps with one another, they suit different applications & meet the needs, some technology may not be appropriate or not best suited in certain conditions over the other. If you need a liquid level solution for an industrial or other application, but aren't sure if which continuous or point-level instrument to select, please contact your nearest ABB Level Measurement expert for support (www.abb.com/level).

Level Measurement: Seeing is Believing

This is true with the Magnetic Level Gauge (MLG) which was initially developed as a replacement solution for the costly and dangerous direct contact sight glasses based level indicators. But over time, this technology has become much more than a simple replacement measuring device; it has become the method of choice for measurement in a wide range of processes. With the advancements in the technology over the period of time the Magnetic Level Gauges can safely be used with flammable, corrosive or toxic liquids; or where operating conditions exceed safety limits of glass. The rugged construction of these level gauges make them ideally suited for use in operating environments where extreme temperature (-195^{0}C/-320^{0}F or 538^{0}C/1000^{0}F) and/or pressure (344Bar/5000Psi) may be encountered.

How does the Magnetic Level Gauges Work?
The basic Magnetic Level Gauge system (Figure-3) consists of a Float, Float chamber and an Indicator assembly. The float chamber is connected directly to the process vessel. The float contains a magnet assembly and is designed and weighted to float in the process liquid submerged approximately 70 to 80%. The indicator assembly consists of a hermetically sealed glass or polycarbonate tube containing the shuttle or magnetic bar graph indicator and a graduated scale corresponding to the desired operating range. The indicator assembly is mounted in close proximity to the float chamber. Magnetic coupling exists between the float and the indicator.

As the float follows the changing liquid level, the indicator changes position to reflect that level based on the magnetic coupling action.

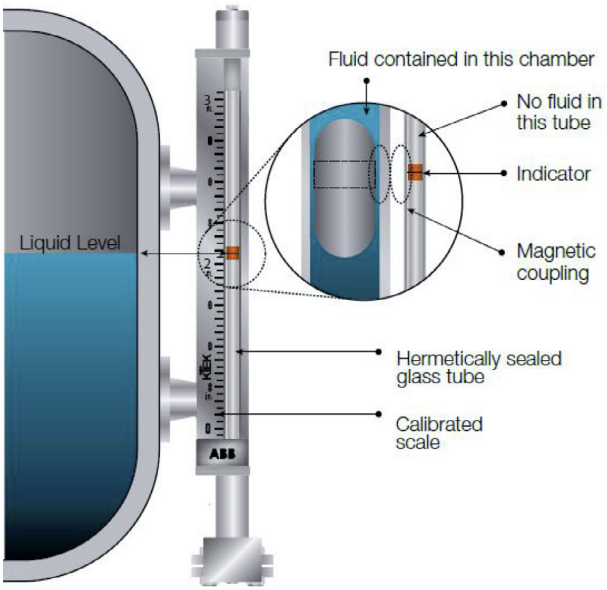


Figure 3 Magnetic Level Gauge Principle

Safety & Hazardous risk to the every equipment and everyone in the ecosystem!
In many industrial applications the process is often required to have extremely aggressive media and often requires the bulk storage of highly corrosive or acidic chemicals that react with standard materials of the level measuring equipment's. Therefore, it is not advisable to use such level devices, made of the standard materials to measure such tank levels, as those would degrade quickly and, consequently, provide inaccurate information and potentially end up in a diasaster.

Non-contact continuous level measurement technology is an option for such applications. However, this solution does not provide the reliable mechanical visual indication that you may prefer as "Seeing is Believing". In addition these solutions also require the vessel or tanks to have opening where these can be mounted that expose the risk to the aggressive media during the maintenance and repair. These devices need to also have the wetted material made of exotic alloys similar to titanium or others, which are resistant to these aggressive chemicals measured, making these solutions very expensive.

A cost effective and safe alternative in such applications with aggressive media is a chemical or corrosion resistant coating on a Magnetic level gauge so it can withstand the extreme chemical reactions of the process. Gauges including the floats coated with chemical resistant materials such as Tefzel® and Halar® shall improve the performance and life of the level measurement solution operating reliably for very long periods of time.

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Shouldn't your level measurement solution meet the same design requirements as your vessel/ piping system and safety standards?

With the customized Engineered Solutions & with the advancements in design and manufacturing technologies, the MLG Level Solution can meet this requirement by having each MLG float chamber designed to meet the ANSI/ASME B31.1, B31.3 or ASME Section VIII whichever is most applicable. In addition, certifications like PED, ASME and ATEX Constructional Safety increases the confidence and reliability of solutions for such extreme applications. The hermetically sealed float designed for specific conditions of the applications and the Scale assembly tested to meet highest standards of the Ingress Protections like IP68 increases the accuracy, reliability and performance in all types of weather!

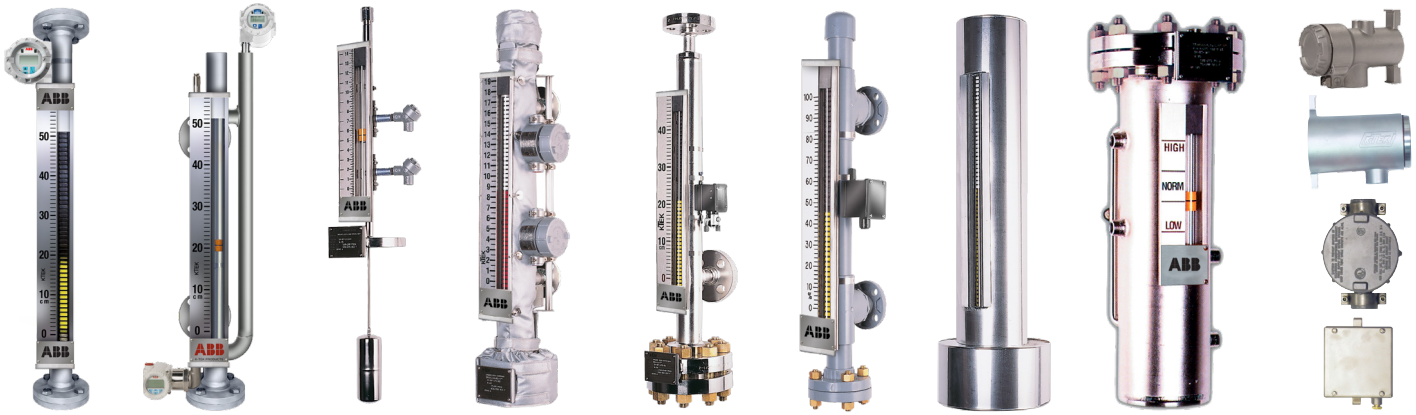


Figure 4 KM26 Series MLG & Switches

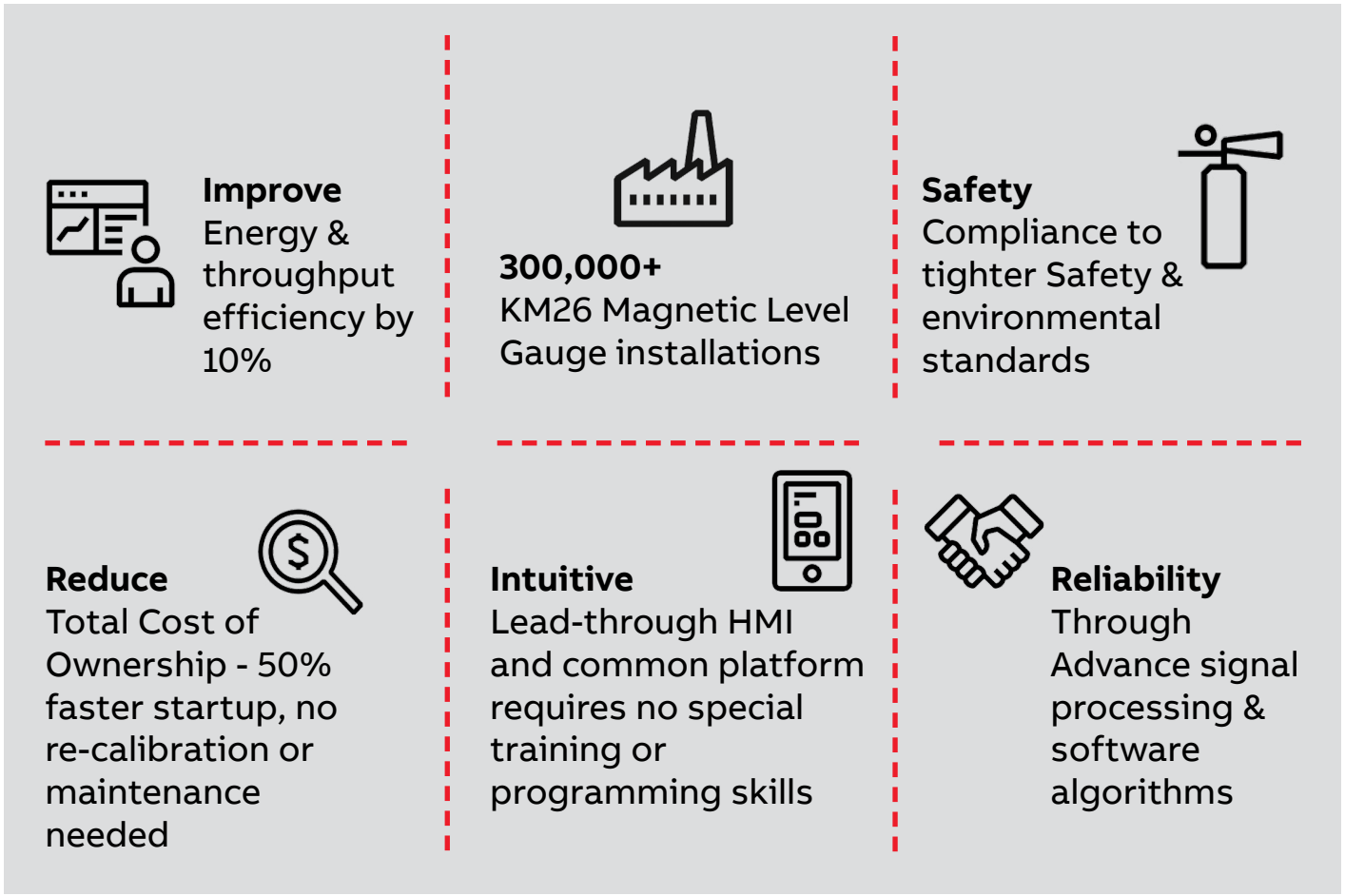


Figure 5 ABB Ability™ - Level Measurement Solutions

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Power of Integration

The Magnetic Level Gauge (MLG) technology provides the user a continuous level indication using the integrated float & scale assembly that provides the user the confidence in the measurement as it offers the visual indication to believe the measurement. At times, this poses the challenge for operators the possibility of level measurement and control remotely. The Magnetostrictive technology complements the MLG technology and provides an excellent solution to this problem. The magnetostrictive loop powered transmitter with continuous level measurement capability with 4-20mA HART output when strapped externally on the MLG can now offer a complete and easy level measurement and control solution. Integrated Level measurement solutions which provides you the capability to believe what you see!

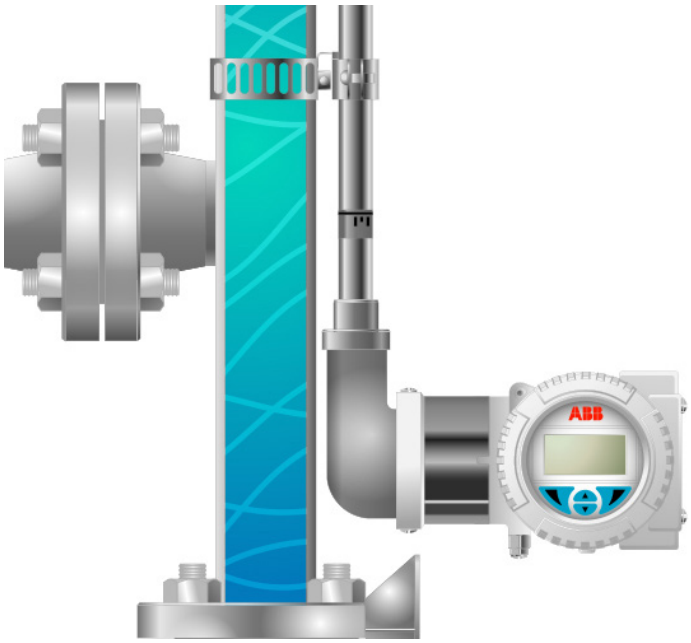


Figure 6 Integrated LMT200 with KM26 MLG

With the latest advanced signal processing capabilities, the magnetostrictive transmitter delivers reliable measurements having built-in advanced diagnostics with waveform display and signal conditioning allowing the user to ensure optimal performance and increased uptime with no need for additional tools or equipment. This transmitter when externally mounted on to a MLG provide users with installation flexibility and easy modification on site as they can be easily be changed from top to bottom mount or from left to right of the MLG chamber orientation with no modification of equipment required.

The external mounted transmitter is based upon the magnetostrictive principle (Figure-7).

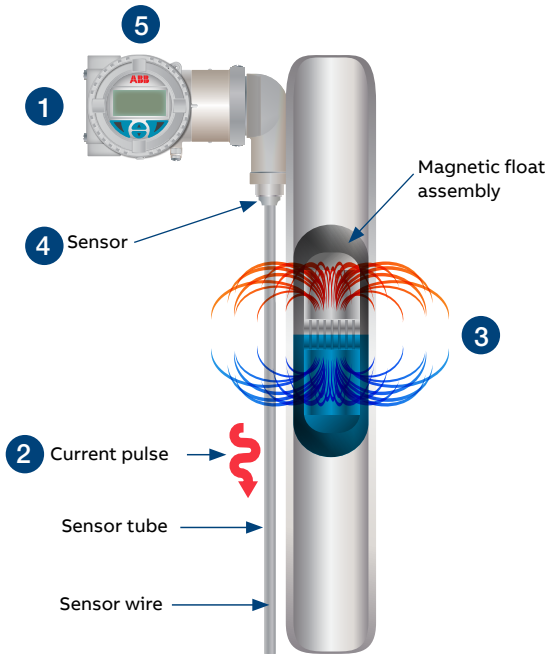
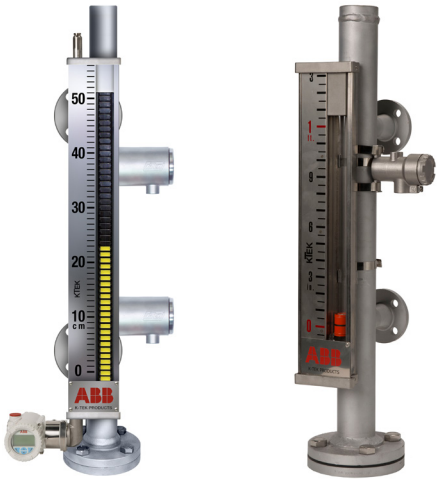


Figure 7 KM26 MLG with LMT200

1. The device electronics generates a low energy current pulse at fixed intervals.
2. The electrical pulses create a magnetic field which travels down a specialized wire inside the sensor tube.
3. The interaction of the magnetic field around the wire and the magnetic float causes a torsional stress wave to be induced in the wire. This torsion propagates along the wire at a known velocity, from the position of the magnetic float and toward both ends of the wire.
4. A patented sensing element placed in the transmitter assembly converts the received mechanical torsion into an electrical return pulse.
5. The microprocessor-based electronics measures the elapsed time between the start and return pulses (Time of Flight) and converts it into a position measurement which is proportional to the level of the float.

To achieve a higher level of reliability and to have additional safety in the level measurement system with the MLG with the externally mounted Magnetostrictive transmitter is recommended to add one or two magnetically coupled point level switches. In this case, one technology (Magnetostrictive) is used for the continuous measurement and the other (Magnetically coupled point level switch) as a high level switch for overfill prevention. When the magnetic level gauge switch is mounted on a MLG or an external chamber that contains a magnetic float, it can sense high or low level points within a vessel. Its unique magnetic coupling action avoids the need for seals, diaphragms, springs, or torque tubes. Magnetic coupling eliminates process contact and connections, ensuring total isolation from the process. Mounting and adjustment is often achieved via a small screw driver and have an easy field replaceable core assembly.

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KM26 with MS41 Switch KM26 with LMS100 Switch

Figure 8 KM26 MLG with LMT200

Compact design of these switches fits in tight places on chambers allowing flexible mounting options. Depending on the amperage rating of this externally mounted point level switch, it can be used for Alarm or to Control Pumps directly or through the PLC/DCS systems.

Three Major Groups of Magnetic Level Gauge Switches are:

- Low Current – 1 Amp rated (LMS100)
- High Current – 10 Amp rated (MS41)
- Pneumatic Switches (PS45)

MLG Switches are magnetically actuated level switches which require no power to operate; they are externally mounted on the Level Gauges and have no direct contact with the process media as opposed to in-process or insertion type point level switch technologies such as Thermal Dispersion, Vibrating Fork or RF Capacitance. The MLG with the external magnetostrictive transmitters and external mounted point level switches is the safest solutions in critical applications with aggressive media as the these are non-invasive solutions reliably providing the continuous level measurement and overfill protection.

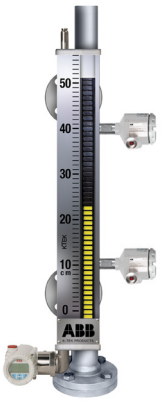


Figure 9 KM26 MLG with LMT200 and TX Switches

Some critical application designs may require the MLG with Point Level switches operated with float independent technology . The Thermal Dispersion Switch or the Vibrating Fork based switch mounted directly onto the MLG chamber with separate process connections for each is the best solution to overcome the challenges in such critical applications. This solution provides safety through the redundancy and independent switch technology . Industry demands that this type of installation is made with an extruded outlet which can be met by the superior manufacturing capabilities of a modern factory. Any other joint design would cause distortion to the chamber that would interfere with float travel affecting the Level measurement.

Safe & Reliable Solutions to Increase Productivity & Profitability.

ABB's Smart Level Measurement Solutions can be safely used to measure a wide variety of liquids, including corrosive, flammable and toxic materials. The wide & superior range of Level Measurement Solutions provides the flexibility of integrating next generation advanced continuous level transmitters & point level switches in a Magnetic Level Gauge as one powerful integrated platform ensuring increased safety, reliability and performance while reducing the total cost of ownership compared to the cost of older technolgoy or multiple separate solutions, the associated accessories and maintenance schedules, saving the customer a lot of money, saves space, reduces weight, minimizes leak potential, and since this is completely factory assembled and tested, no onsite fabrication & calibration required. Let's write the future with ABB's Smart Level measurement Solutions. Together.

Whitepaper by:
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