Hygienic, continuous level control technology – Overview and criteria for selection

The key to happiness:
A correct level!

How to find the most convenient level sensor for any application, product and process in the food and beverage production

For maximum resource efficiency, precise and continuous control and output of fill level, volume or mass in all storage, maturation, upstream or other process containers is a basic requirement. The range of measurement systems is as large as it is confusing. Hydrostatic and potentiometric measurement systems as well as weight measurement have proven to be particularly reliable, precise and suitable for the requirements in beverage and food production. But which systems are best suited for which application? Here is an overview.

Selection criteria for level measuring systems

The suitability of level measurement methods for hygienic processing depends on a number of different factors.

The most important are

- **Type, size, shape, material and orientation** (vertical / horizontal) of the vessel
- Required **measuring accuracy**
- **Material properties of the media** (liquid, pasty, bulk material, adhesive, foaming, conductive / non-conductive, carbonized, with turbidity or solids content...)
- **Media temperature** and its dynamic changes
- **Media density** and its dynamic changes
- **Changing media** or always the same medium in the process / tank
- **Location** (outside, inside) and **climatic requirements** (condensation / humidity) for the measurement technology
- **Pressure environment** (atmospheric pressure, pressurized tank / differential pressure measurement)
- **Data output** (indication on display, communication analog / digital / logging system)
- **Installation, accessability and maintenance requirements** (process connection / service life / repairability)

Overview of applications and measuring systems

To meet the diverse requirements of our customers and provide the best solution for each application we offer different measuring techniques and configurations/options. Overall, our expertise in these measurement systems and our ability to provide customized solutions ensures maximum resource efficiency for our customers in the beverage and food production industry.

Hydrostatic measurement: In this technique, the fill level is measured by pressure transmitters at the bottom or top of the container and displayed and/or output to the PLC.

Potentiometric measurement: These sensors determine the fill level by changes in the voltage ratio in the measuring rod of the sensor, which extends into the liquid.

Weight measurement: The mass of the container and its contents is determined by using strain gauges or pressure cells which measure the change in pressure on the legs of the vessel/silo.

This table shows which measuring systems can be recommended for which applications.
On the following pages you will find further details on the various measurement technologies as well as a complete product overview with the most important technical specifications of the individual sensors.

	Hydrostatic						Potentiometric		Weighing systems	
	L3 Neo	SL	LD	P42	HB	D3	NSL-F	NSL-M	Microcell	Load Disc
Outdoor tank (product)	**	***	*	*	*	-	-	-	*	*
Outdoor silo (bulk material)	-	-	-	-	-	-	-	-	***	**
Vertical storage tank	***	**	*	*	*	**	-	-	**	*
Horizontal storage tank	**	*	***	*	*	-	***	***	*	**
Pasteurization balance tank	**	*	*	*	**	-	***	***	-	-
Batch mixing	**	**	*	*	*	-	**	**	-	***
Stirring/mixing	*	*	*	*	*	-	-	-	-	***
Mash tun	***	*	*	*	*	-	**	**	-	-
Lauter tun	**	*	*	*	*	***	-	-	-	-
Wort kettle	***	*	*	*	*	-	-	-	-	-
Whirlpool	***	*	*	*	*	-	-	-	-	-
Maturation	**	***	*	*	*	**	-	-	-	-
Carbonation	**	*	*	*	*	**	***	***	-	*
Upstream tank	**	*	*	*	*	-	***	***	-	-
Aseptic tank	**	**	*	*	*	***	-	-	-	**
Fermenter	**	*	*	*	*	***	***	***	-	**
Filler	*	*	***	*	*	-	***	***	-	-
Spray drying	-	-	-	-	-	-	-	-	*	***
Interchangeable tanks	-	-	-	-	-	-	-	-	-	***
Ingredient container (dry goods)	-	-	-	-	-	-	-	-	*	***
CIP tanks	***	*	*	*	*	-	**	**	-	-

*** very recommended ** very suitable * suitable - not suitable

Further selection criteria:

In addition to the application and the measurement technology itself, there are other parameters that must be considered when deciding on a system or product, such as:

- The **hygienic design** of the sensor and process connection
- The **lifespan** of the components
- Resistance to **chemical or mechanical stress**
- Basic **measurement accuracy**
- The impact of **temperature drift**
- **Display requirement** on site / via remote display / PLC data transmission only
- **Data transmission** (analog / digital)
- Simple operation, etc.

Due to the variety of different requirements, we offer diverse measurement techniques and configurations/options to ensure that you get the best solution for each application.

Hydrostatic Level Measurement

In this technique, the fill level is measured by pressure transmitters at the bottom of the container and displayed and/or output to the PLC.

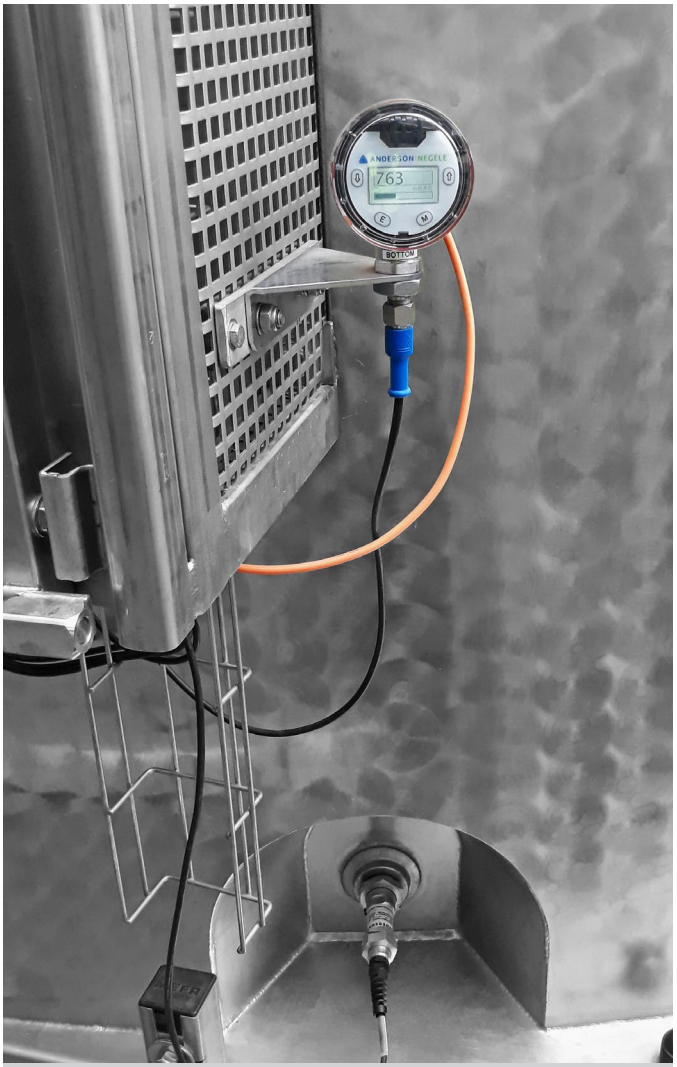
To transmit measurement results to the PLC, pressure transmitters use an internal piezoelectric signal converter that converts the mechanical pressure of the fill level from the pressure membrane into a proportional voltage signal, which is then converted into a 4...20 mA standard signal or other protocol, such as digital IO-Link.

Modern sensors, such as the L3 Neo, already offer **tank linearization and density compensation** in their electronics, as well as an integrated **RTD temperature measurement element** that captures the process temperature in real-time for the calculation of the specific density. Thanks to **highly precise temperature compensation, the sensor can output measurements – with very high accuracy – in gallons, liters, kilograms or other volume units**, even in dynamic temperature scenarios. Conventional sensors can drift up to 0.4 % per 10 °C in such cases, while **the L3 Neo offers a temperature drift of just 0.03 % per 10 °C, providing significantly higher precision with a basic accuracy of only 0.1 %.**

For which products and applications is hydrostatic level measurement suitable?

The classic application is for large liquid containers such as **product acceptance, storage or mixing tanks.**

However, due to its exceptional performance, the L3 Neo also guarantees highly accurate level measurement for **smaller process vessels,** where hydrostatic sensors were previously considered insufficiently precise. This significantly expands the range of applications for this easy-to-install, reliable, low-maintenance, and hygienic measurement technology:



Remote version of the L3 Neo level sensor. The head unit with display can thus be placed in an easily accessible location.

Common practice for storage and maturation tanks: Simple installation of hydrostatic level sensor (here L3 Neo), temperature sensor and point level switch on the underside of the tank

- Suitable for **all types of liquids,** including product, CIP media, water, regardless of conductivity, viscosity, density, ...
- Can be used for **vertical and horizontal vessels,** regardless of height, volume, material or shape, both indoors and outdoors, even in very humid environments.
- Effective for tanks with **changing media** with **varying densities.**
- Suitable for **pressurized tanks** such as fermenters, where two pressure transmitters can be used for level control.
- Useful for **mixing tanks** in **batch production.**
- Capable of measuring **rapid level changes,** such as during filling.
- Can be used for **non-metallic tanks.**
- Ideal for applications with **temperature drifting,** providing significantly higher precision with an accuracy of 0.1 %.

Challenge: Condensate in damp and cold environments or in outdoor tanks

Problems such as **drifting or unstable measurements** can occur due to condensation, particularly in humid environments or with outdoor storage containers.

For relative pressure measuring cells with compensation capillaries, a thin tube leads the atmospheric pressure from the environment to the back of the measuring diaphragm. For sensors with diffusion-open double diaphragms, a separate pressure diaphragm is used for atmospheric pressure and hydrostatic pressure. Both methods have a fundamental disadvantage: the diffusion of water vapor cannot be permanently prevented. Condensing water vapor can cause sensor drift or fluctuating measurement values.

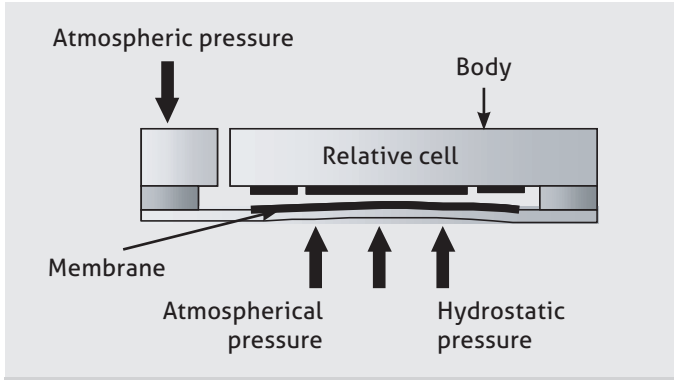
However, this is not the case with the SL, where atmospheric pressure is detected through a second, hydraulically connected measuring cell. **This hermetically sealed measuring system makes it impossible for gases and moisture to enter, ensuring consistently precise measurement values.**

The special, hermetically sealed measuring system of the SL is completely protected against condensation or moisture.

Challenge: Hydrostatic measurement from the top

Filler bowls often rotate and have complex geometries. Some tank types have a heating system integrated at the bottom part. Others are installed so that access from below is not possible. Such conditions make bottom-mounted sensors impractical.

Besides top-mounted potentiometric sensors there is also a hygienic hydrostatic solution with the LD. It's dipstick design is based on the "SL" platform and equals its technical performance, effectively replacing outdated technologies like ball floats and capacitance probes, despite the constant motion and varying levels typical of filler bowls.



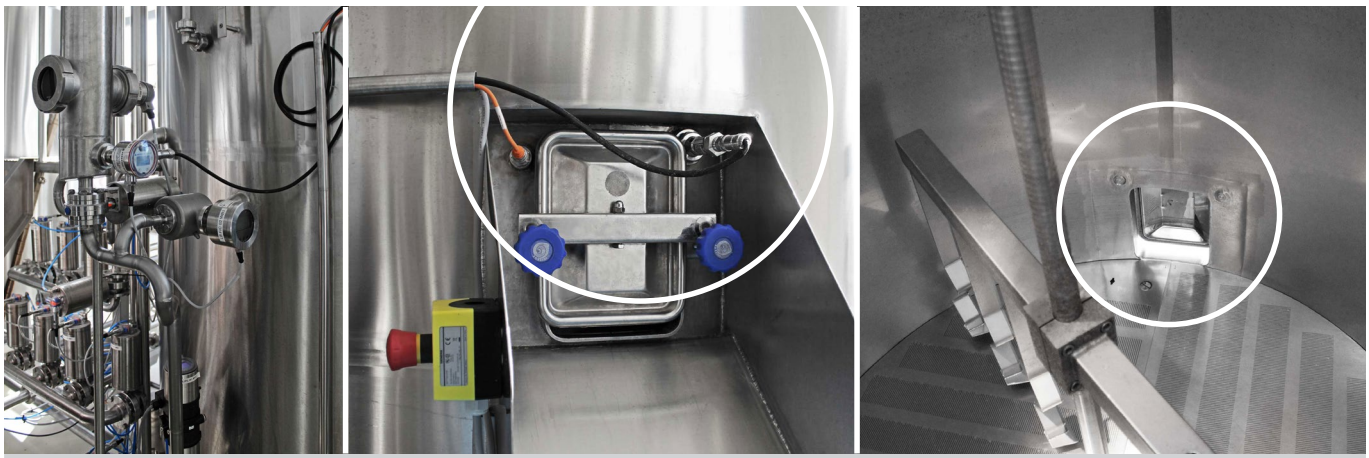
Structure and function of the relative cell

Challenge: Differential pressure control, e.g. in fermeteation vessels or lauter tuns

In an **open system** (vessel with atmospheric pressure), one pressure sensor on the underside of the vessel is sufficient, as the external pressure conditions do not change.

In contrast, a **closed system** (pressure vessel) can be subjected to varying pressures, which can affect the pressure at the bottom of the vessel.

To measure the fill level in such a system, two sensors are required to separately determine the process pressure at the bottom and the head pressure at the top. The differential pressure sensor D3 combines two pressure stems and calculates the correct fill level directly in its electronic device. This measuring method can completely avoid installation problems and measurement deviations that can occur in systems with capillaries.



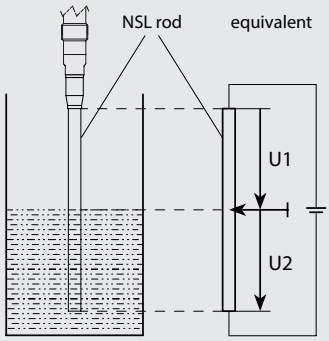
Dfferential pressure control with the D3, here installed in a lauter tun with the sensor stems above and below the spent grains cake and the display at an easily accessible place.

Potentiometric Level Measurement

Potentiometric sensors determine the fill level by **changes in the voltage ratio in the measuring rod of the sensor, which extends into the liquid.**

The NSL Series offers a versatile and efficient solution. It can be installed from above, below, and even on the side of a tank with a curved measuring rod. The length up to max. 3 m and the shape can be precisely matched to the vessel.

An additional, patented measuring method determines the immersion state of the electrode rod in the medium and ensures **that false readings due to adhesions and foam are avoided.**



With a rod length of up to 3 m, a response time of 100 ms and a measuring accuracy of 1 % of the rod length, the NSL offers high-precision, extremely fast evaluation. It is therefore particularly suitable for process feed tanks with rapid level changes

The NSL is also suitable for foaming, pasty or creamy products, here with installation from above in a feed mixing container of a rice pudding production plant

For which products and applications is potentiometric level measurement suitable?

Potentiometric measurement is ideal for both **closed and open process, feed, and storage tanks, as well as pressurized tanks.** For **non-metallic tanks,** a sensor variant with a reference rod can be used.

The method **is insensitive to foam and adhesions, has excellent measurement accuracy, and has an extremely short response time.** This makes it the ideal solution for a wide range of products and applications in the dairy, brewery, and beverage processing industries.

Here you find a short overview:

- **All liquids** such as product, CIP media, water with conductivity > 50µS/cm
- Applications such as **milk heaters, filling systems, ice cream lines, separators, horizontal vessels, process feed tanks, mixing tanks...**
- **highly** or **differently foaming media**
- **pasty or sticky media** such as creams, ice cream, sauces...
- **pressurized tanks**
- **rapid level changes,** e.g. during filling
- **non-metallic** tanks
- **Varying media in one tank** (automatic adaptation to changing media)

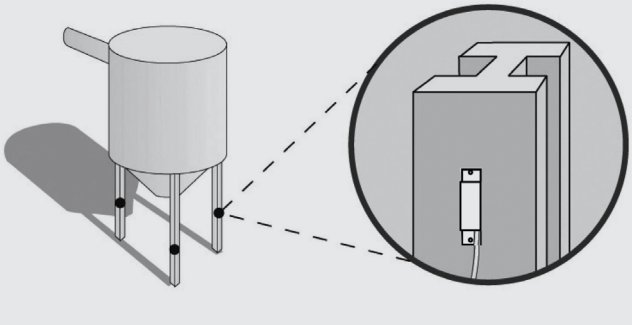
Inventory control through weighing systems

Content monitoring by weight measurement is particularly suitable for **storage silos, both for dry goods and liquids, as well as for all types of interchangeable containers.** Two systems are available: Bolt-on load cells for screwing onto the leg construction, and substructure load discs that are mounted under the container feet.

Microcell® bolt-on load cells: These devices are compact and reliable sensors designed for the cost-effective and safe measurement of quantities in all types of metal-supported containers. They eliminate measurement inaccuracies caused by angle of repose, bridging, moisture content, or compaction. The sensors are simply screwed onto the metal feet (bolt-on). Integrated strain gauges detect changes in the metal caused by even the slightest changes in the container contents and transmit them as measurement signals to the controller.

For which products and applications are Microcell® Bolt-On Load Cells suitable?

- **Robust, retrofittable inventory measuring systems** for all types of single or multiple containers
- For **metal substructures**
- For **outdoor and indoor applications**
- **Mounting on feet** or **metal frames**
- Can be retrofitted and calibrated **for any container fill level**



Easy to retrofit: Microcell® load cells with integrated strain gauges are suitable for all types of storage silos with metal base constructions.

The Load Disc weighing systems can also be installed underneath interchangeable tanks or other process vessels and turn your vessel into a precision scale.

Substructure weighing modules: Load Disc weigh systems are designed to measure the contents of process or storage containers dynamically and accurately, detecting even the slightest weight changes. They are mounted between the container's feet and the foundation, with their low profile ensuring stability and resistance to tipping. They can compensate for lateral forces caused by stirring systems. Their compact, hygienic design with polished surfaces and high protection class makes them easy to clean and suitable for use in food and pharmaceutical applications.

For which products and applications are Load Disc Weighing systems suitable?

- **Mixing** and **agitating tanks**
- **Bulk material tanks** and **storage hoppers**
- For **all types** of **dry goods** and **liquids**
- Also for **corrosive media**
- **Interchangeable containers** for mixing systems
- For **loads** from **100 kg** to **10 t**
- For **indoor** and **outdoor use**
- For **hygienic** and **non-hygienic applications**

Product Overview

Hydrostatic Level Sensors

L3 Neo

- Accuracy < 0.10 % of the measuring range, Minimized drift < 0.03 % / 10 °C
- Direct output of volume, level or pressure
- Integrated tank linearization and density compensation
- 4...20 mA, IO-Link (Flex-Hybrid technology) or HART 7.0
- Ranges -14.7...500 PSI (-1...35 bar)

SL

- Climate-proof level sensor with hygienic installation system
- Hermetically sealed measuring system: No drift problems due to condensation
- Very high accuracy (±0.2 %) and long-term stability

LD

- Dipstick version with "SL" technology, for top mounting
- For level heights from 15" to 72"
- No welding with media contact required

P42

- Robust and durable - even at process temperatures up to 250 °C (482 °F)
- Fast, precise and cost-effective solution for common requirements
- With IO-Link

HB

- Specifically designed for balance tank, CIP vessel, and other hygienic level control applications
- Rugged reliability in the harshest applications and environments
- Very compact design

Differential Pressure Sensor

D3

- Two outputs for level (differential pressure) and head pressure
- Ranges -1...35 bar (-14.7...500 PSI)
- Measuring accuracy +/- 0.15 %
- Mass / volume output selectable

Potentiometric Level Sensors

NSL-F / NSL-M

- Accuracy Ideal for applications with foam
- Insensitive to adhesions
- Measurement independent of temperature and pressure
- For level heights from 50 mm to 3 m

NSL Options

- Separate version (remote)
- Two-rod version (for non-metallic containers)
- Curved measuring rod (for side mounting, curvature adaptable to container shape)
- PEEK insulation at the end of the rod

Weighing Systems

Microcell®

- Permanently reliable inventory measurement for all containers with metal leg constructions
- Extremely durable (> 20 million measuring cycles)
- Simple installation or retrofitting on metal legs

Load Disc

- For loads from 100 kg to 10 t
- Measuring accuracy up to 0.03%
- Long service life
- Individually configurable

North America
Anderson Instrument Company Inc.
Fultonville, NY 12072
USA
Tel. +1 518-922-5315
Fax +1 518-922-8997
info@anderson-negele.com

Europe / EMEA
Negele Messtechnik GmbH
Raiffeisenweg 7, 87743 Egg an der Guenz
GERMANY
Tel. +49 8333-9204-0
Fax +49 8333-9204-49
sales@anderson-negele.com

India
Anderson-Negele India
Kurla (West), Mumbai – 400 070
INDIA
info.india@anderson-negele.com

China
Anderson-Negele China
518 Fuquan North Road, Shanghai,
200335
P.R. CHINA
Tel. +86 400 666 1802-7
china.sales@anderson-negele.com

Latin America
SPTech
Tamboré - Barueri - São Paulo
BRASIL
Tel. +55 11 3616-0150
atendimento@sptech.com

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