Buyer's guide: Pressure measurement technology for the food and beverage industry

From theory to practice: focus on pressure measurement

WIKA

Smart in sensing

A decision-making aid for purchasers of pressure measurement technology in the food and beverage industry

Pressure measurement plays a key role in the food industry. From the processing of raw materials to filling and packaging – precise pressure monitoring and control is essential. This is the only way to guarantee the integrity of the processes and fulfil the high requirements of quality management. Choosing the right pressure measurement technology not only affects food safety and product quality, but also the operating costs and sustainability.

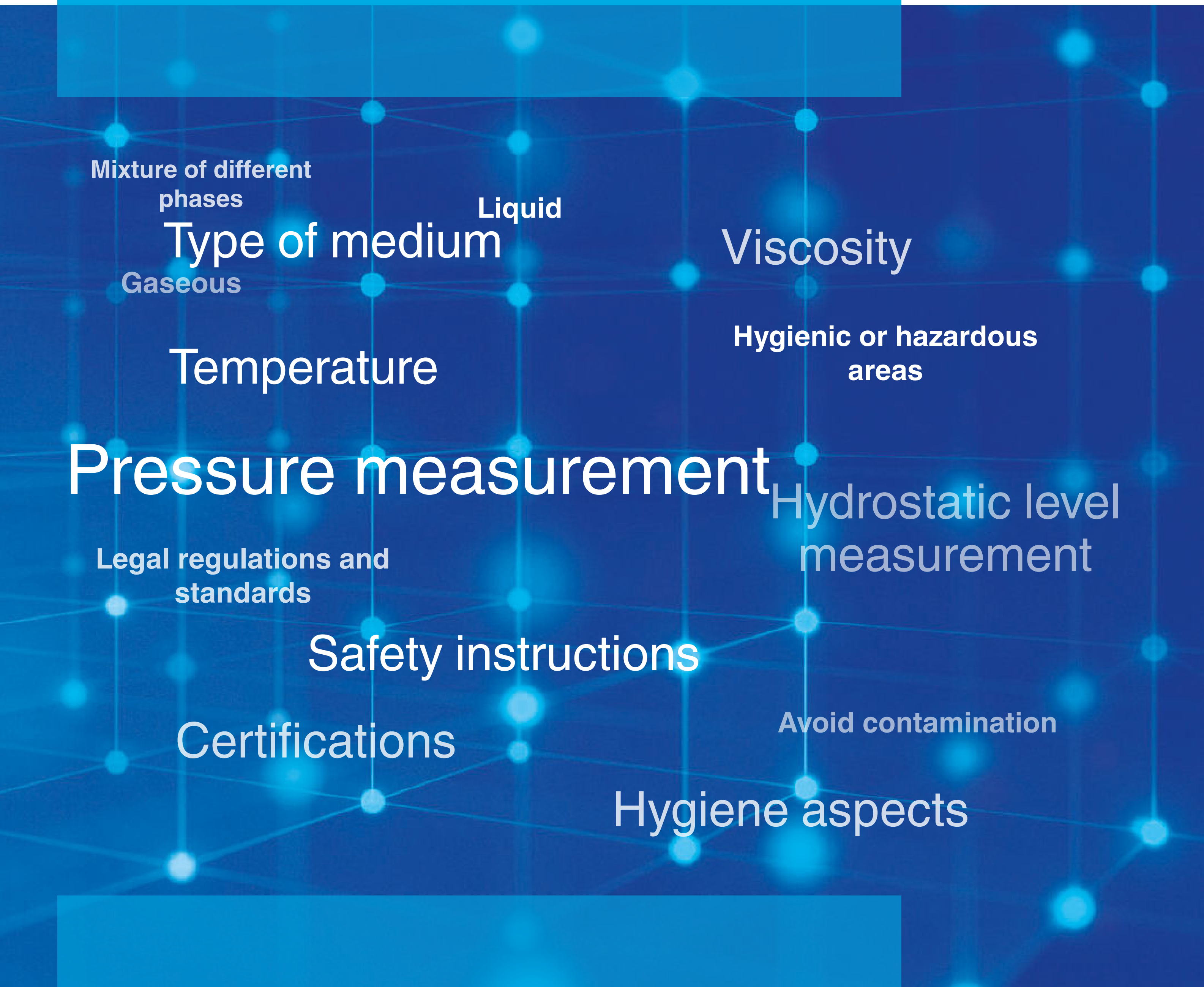
This decision-making aid is designed as a comprehensive guideline. It provides assistance in implementing the functions planned in piping and instrument (P&I) diagrams quickly and soundly in suitable equipment. It therefore makes an important contribution to optimising the demanding processes in food and beverage production.

The guide first looks at the basic criteria for selecting suitable pressure measurement solutions.
The specific requirements for instrumentation in pipeline systems, vessels and homogenisers are discussed below, and examples of suitable solutions for the various processes and applications are presented.

Content overview

1. Initial situation

The complexity of pressure measurement in the food and beverage industry results from a variety of factors that must be taken into account when planning and implementing P&I diagrams. Every application and every process places individual demands on the measurement technology, ranging from the physical properties of the medium to the specific operating conditions.



Given these challenges, it is important to make an informed choice which not only fulfils the technical specifications, but also supports the efficiency and reliability of the processes.

1.1. Basic criteria for selection

A systematic approach to this complex topic is recommended and the following aspects should be considered as a first step:

1.1.1. Mounting situation and process connection

The mounting situation shows what type of installation is involved: Is the pressure to be measured in a pipeline or on a tank or vessel? Where is the measuring instrument located, in the vessel itself or, for example, below the vessel? Depending on the mounting situation, there are various process connection options with different nominal diameters, geometries and profile seals.

It is generally advisable to use **industry-standard, standardised threaded connections**, such as dairy fittings in accordance with DIN 11851, aseptic connections in accordance with DIN 11864, clamps or manufacturer-specific in-line access units such as GEA VARINLINE®. They give the plant designer the opportunity to choose the optimum fitting concept depending on the requirements. The EHEDG position paper[1] provides a selection guide with regard to hygienic design.

1.1.2. Electrical connection and indication options

It should also be considered whether an electrical output signal is required for monitoring and control. In this case, a **pressure sensor**, also known as a pressure transmitter, is ideal. If the application also requires visualisation, a **process transmitter with indication (Pressure Indicating Transmitter – PIT)** or a **pressure gauge** with an electrical output signal can be considered.

Pressure sensor model SA-11

Otherwise, a simple pressure gauge may suffice.

With regard to the pressure indication (PI), the user can choose between analogue or digital indication modules. **Digital displays** make reading easier, reduce transmission errors and enable data to be recorded. In principle, mechanical measuring instruments with analogue displays have proven themselves for mobile applications, as they are independent of any power supply. Mechanical indicators also offer the advantage that they indicate the pressure even after a system component has been switched off, thus contributing to safety and occupational safety in pressurised vessels.

Diaphragm pressure gauge model PG43SA-S

[1] "Easy cleanable Pipe couplings and Process connections", https://www.ehedg.org/guidelines-working-groups/guidelines/guidelines/detail/ehedg-position-paper

1.1.3. Measuring range and accuracy

The measuring range must be selected so that it covers the appropriate standard measuring range, or the next largest if necessary. The transmitters are available in versions with a fixed measuring range, which are well-suited for standard applications. For applications that require greater flexibility, instruments are offered with an adjustable and programmable measuring range so that the measuring instrument can be adapted to different process conditions.

The accuracy of the pressure measuring instrument is important as it directly affects the quality of process monitoring and control. High accuracy is particularly important in critical applications where slight deviations in pressure can have a significant impact on the end product.

1.1.4. Long-term stability

The long-term stability of the measuring instrument must also be taken into account, as temperature fluctuations, mechanical loads and chemical influences can affect the measurement accuracy over time. Choosing a pressure measuring instrument with high accuracy and good long-term stability helps to reduce maintenance costs and increase the reliability of the entire process.

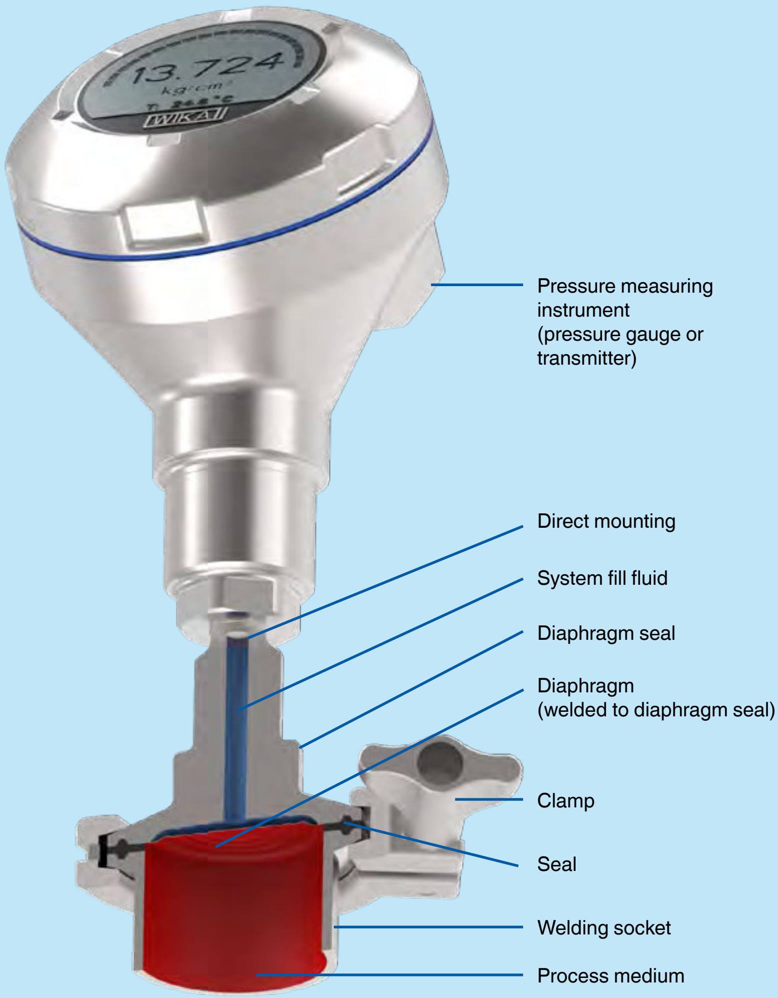
Be aware: Process connections for pressure measurement should be as large as possible!

When measuring pressure in pipelines that come into direct contact with food, the use of diaphragm seals or diaphragm seal systems is common practice. These systems are used to protect the pressure sensor or, in the case of mechanical instruments, the measuring tube from direct contact with the process medium.

A diaphragm seal consists of a **diaphragm** that faces the process, followed by a **pressure transmission medium** and the actual **sensor** or Bourdon tube[2]. Within a diaphragm seal system, the diaphragm separates the medium to be measured from the transmission fluid behind it and fulfils three essential functions: pressure transmission, temperature compensation and volume compensation. **The larger the diaphragm, the better** its ability to compensate for volume changes due to changing ambient temperatures. This means that a larger process connection may be required for sensitive systems or for measurements in small pressure ranges with high temperature fluctuations. The size of the diaphragm and consequently the process connection should therefore be selected in such a way that they enable optimum compensation of the volume changes. At the same time, this consideration must be harmonised with the need to ensure that the flow cross-sections in small pipelines are not enlarged too much.

A pressure gauge with a large nominal size also requires a diaphragm seal with a large nominal diameter to ensure precise pressure measurement.

If small pipelines are planned in the P&I diagram but small pressures are to be measured, it can be a **challenge to determine the correct pressure measuring instrument**. In this case, it is advisable to **contact the measuring instrument manufacturer** directly during the planning phase in order to find the best possible solution.



[2] WIKA blog post „Rohrfedermanometer – das Funktionsprinzip", https://blog.wika.de/know-how/rohrfeder-manometer-das-funktionsprinzip-2/?doing_wp_cron=1726478762.8562920093536376953125

1.1.5. Medium

The medium and the question of whether it is a foodstuff or a secondary circuit, e.g. in a cooling, hydraulic or compressed-air system, are also crucial for the selection of a suitable pressure measuring instrument. In other words, is the application in the "food contact" or "non-food contact" area? In the case of food contact, it is important for the pressure measurement whether the medium is liquid, gaseous, highly viscous, mixed with solids or if it is abrasive.

A process that handles liquid cream, for example, requires regular cleaning with correspondingly high temperatures. This is where the topics of clean-in-place (CIP) and sterilisation-in-place (SIP) come into play. Such a scenario means that the process connection must be easy to clean and comply with hygiene standards.

1.1.6. Operating and ambient conditions

Applications in the food and beverage sector range from low temperatures for freezing (-40 °C) to very high temperatures for evaporation (120-135 °C) and high-temperature heating (135-150 °C). Pressure measuring instruments must **be able to withstand** these **temperatures** either briefly or continuously, depending on the duration of the process. When it comes to measuring the pressure at high temperatures – e.g. the vapour pressure – the requirements for the accuracy of the measurement are very demanding. In such a case, the temperature coefficient must not be too high.

Learn all about instrumentation for pipelines!

The **place of use** itself also influences the pressure measurement. For example, in a fermenting cellar in which cooling tanks containing food are stored, depending on the temperature and humidity, condensation can form. The pressure measuring instruments must be able to withstand this **condensation**. One option here is a temperature equalisation section, which isolates the measuring instrument from the process temperature and thus protects it from rapid temperature changes. This is achieved with the help of a short equalisation section between the process connection and the pressure measuring instrument. For outdoor applications, such as dairy or brewery storage tanks in tropical regions, the measurement technology and electronics must be able to withstand the corresponding temperatures and **air humidity**. It may be necessary to select measuring instruments with suitable cases and IP ingress protection that also guarantee protection against splash water and washdown.

A further aspect is **hazardous areas.** This may be the case for processes involving alcohol or powdery substances such as flour. Here, the measuring instruments must be designed and approved for potentially explosive atmospheres (Ex G - gas / Ex D - dust).

The following sections describe typical applications, special features and corresponding options for pressure measurement in pipeline systems, homogenisers and vessels.

2. Instrumentation for pipelines

2.1. Typical pipeline applications and special features

In the food and beverage industry, pipeline systems form the backbone of production processes, with each pipeline having its own specific requirements. Here it is important to differentiate between aseptic and non-aseptic areas. In aseptic areas, contamination must be prevented to ensure the quality and safety of perishable food. In this demanding environment, diaphragm monitoring (see chapter on ultra-high temperature) plays a pivotal role in diaphragm seal systems.

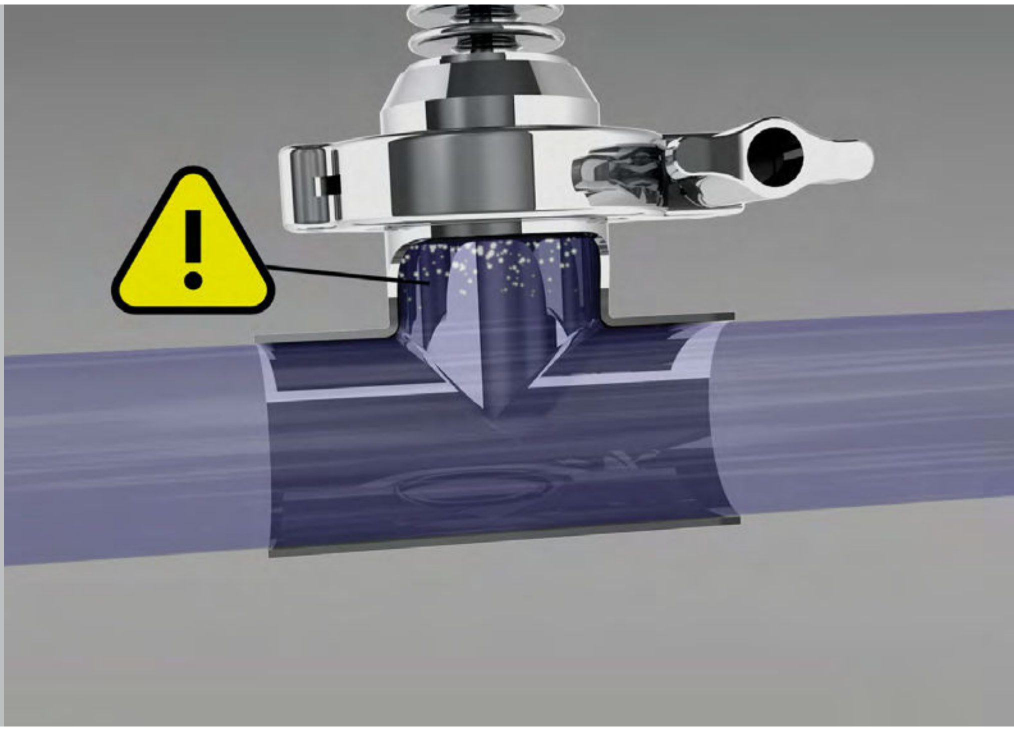
2.1.1. Pipelines in aseptic areas

Ultra high temperature (UHT) is an important process in the production of food and beverages to ensure product quality and safety and to extend shelf life. With this, products such as milk, milk alternatives, fruit preparations or baby food are heated for a few seconds at a temperature up to +150 °C in order to kill microorganisms, such as bacteria, while preserving the nutritional value and flavour in the best possible way. After this process step, the aseptic area begins, which requires good hygienic design and strict cleaning and sterilisation procedures.

Contamination in this area usually leads to costly product losses and production downtime. Such harm can go **unnoticed** for a long time until microbiological tests, which can take several days, finally detect contamination. This delays the rectification of the problem and the resumption of normal operation. The financial losses due to downtime and costs for water, energy and cleaning agents, in the course of thorough cleaning and sterilisation, are often considerable. With pressure measurement, the integrity of the aseptic area is therefore of crucial importance. Diaphragm seals with flush diaphragms minimise dead spaces and facilitate cleaning, but are susceptible to damage from pressure peaks during sterilisation. If, for example, damage to the diaphragm seal due to a pressure spike leads to a leakage in the diaphragm, the pressure transmission medium may leak out and enter the product. In such a case, the product can replace the diaphragm seal's fill fluid unnoticed. The measuring instrument then continues to work and the diaphragm rupture is not detected. Another consequence can be contamination behind the diaphragm, which ultimately contaminates the product.

The most effective protection here is provided by diaphragm seal systems with a double diaphragm and monitoring element. Such a system, with integrated diaphragm monitoring, immediately signals a diaphragm rupture and can still withstand the process pressure afterwards. Diaphragm monitoring enables mechanical defects to be recognised at an early stage, preventing uncontrolled damage and ensuring the safety of the entire production process.

These considerations from UHT systems are generally also relevant for the selection of pressure measurement technology in CIP and SIP lines, as well as in conveyor lines in aseptic areas.



Contamination of the pipeline in aseptic production processes carries high risks. Diaphragm seal systems with double diaphragm and monitoring element ensure maximum safety in the production process.

If pressure measuring instruments on conveyor lines are exposed to constant vibrations or load changes caused by pumps or other process components, **damping systems** must be used to prevent damage to the measuring instrument. Pressure gauges with glycerine filling are therefore used for mechanical measuring instruments that are subject to such influences.

The steam line itself, which only conveys steam, is aseptic in principle. Here it is more a question of protecting the measuring instruments from the hot steam and integrating appropriate cooling elements.

The filling lines, through which the finished product is fed at the end, generally have smaller diameters and are also associated with smaller process connections. In order to minimise the formation of dead spaces, which can serve as potential sources of contamination due to deposits, the use of appropriate in-line measurement technology is recommended (see chapter Pressure measurement in the process flow).

In relation to pipeline applications, **filter monitoring** also plays an important role, e.g. in beer filtration. By measuring the pressure both upstream and downstream of the filter, the condition of the filter can be continuously monitored. In this way, possible blockages, irregularities or damage that could impair the efficiency of the filter can be detected at an early stage. Differential pressure measurement is a favoured method here, as it provides precise information on pressure differences and is therefore a reliable indicator of filter integrity.

For **nitrogen or pack gas lines**, standard process connections can be used as these do not require regular cleaning. However, it should be noted that special regulations apply to the materials that may be used when pack gases or nitrogen come into direct contact with the product or are incorporated into the product. These regulations for food contact materials vary internationally and must be carefully checked to ensure compliance with the respective legal requirements.

2.2. Pressure measurement in the process flow

In principle, there are three options for pressure measurement in the process flow: T-piece, in-line housing and in-line design[3]. The term "in-line" means that the measuring instrument is integrated directly into the process line.

Video on the topic

2.2.1. T-piece

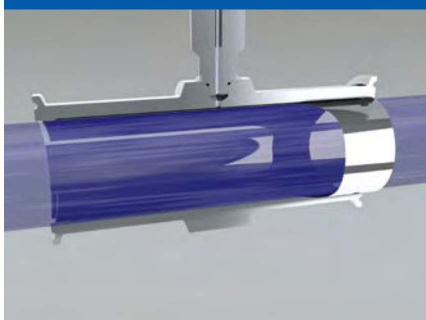
A T-piece is a T-shaped pipe connection that is inserted into the pipeline and forms a branch where the pressure measuring instrument is located. This arrangement enables pressure measurement at a point that is not directly in the main flow of the process line. T-pieces are particularly useful when an instrument needs to be retrofitted or good accessibility for maintenance work is required. They offer a simple and cost-effective way of measuring pressure. Although T-pieces can be designed to meet hygienic standards, they require careful design and installation. The "1D rule" applies, which states that the branch should be shorter than one times its diameter. Otherwise there is a risk of dead spaces.

2.2.2. In-line access unit

The in-line access unit or in-line housing has a design in which the housing is seamlessly fitted into the pipeline so that the process medium flows through the in-line housing in which the measuring instrument is integrated. The in-line housing ensures a dead-space free transition from the process line to the measuring instrument. It is therefore self-draining. However, due to the flow changes at the extended mounting point, there are still areas where product deposits may not be completely removed during the cleaning cycle. If longer cleaning times are required as a result, this gives rise to higher costs for energy, cleaning agents and water.

2.2.3. In-line design

On the other hand, there is the advanced principle of the in-line design. With this, the measuring instrument is integrated directly and without interruption into the process flow. This configuration features a streamlined design that ensures optimum flow of the medium through the pipeline and minimises flow disturbances and pressure losses. As there are no dead spaces, it is ideal for aseptic areas. Measuring instruments with an in-line design can be cleaned just as easily and quickly, and sterilised just as reliably, as a straight piece of pipeline[4]. This reduces downtime and the consumption of water, energy and cleaning agents. The investment in an in-line design usually pays for itself quickly through higher process efficiency and product quality.



[3] Video 'In-line measurement in the food and beverage industry' https://www.youtube.com/watch?v=Fkjpctp99MU
[4] 'Savings potential in the CIP cleaning of production plants through consistent hygienic design', Diploma thesis by Andreas Dorner, TU Munich, Food Technology and Biotechnology programme, 2009

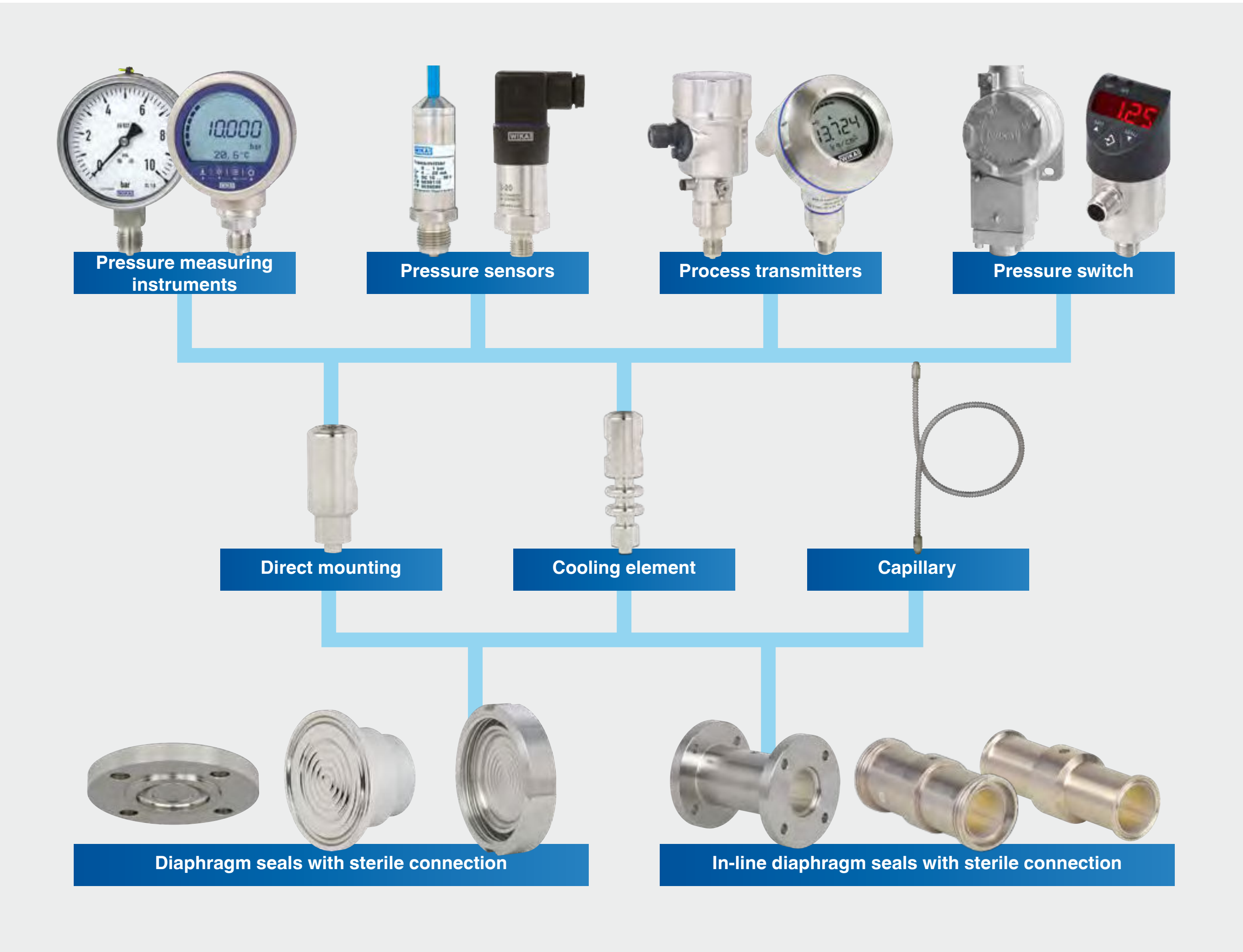
2.3. Diaphragm seal systems

2.3.1. Properties, design, principle

As described in chapter 1 under "Basic criteria for selection", **diaphragm seals** separate the measuring instrument from the medium by means of an elastic metal diaphragm. Compared to ceramic principles, they offer the advantage that additional sealing elements are not required and maintenance costs are therefore lower. They also withstand dynamic loads and temperature fluctuations better, whereas, for example, ceramic cells can easily be destroyed by pressure peaks and are therefore associated with a safety risk. This is because ceramic splinters are difficult to detect and can only be detected using X-ray technology or removed using filters. Diaphragm seals are typically used in T-pieces and in-line housings – or in vessel applications (see chapter 4).

The **in-line diaphragm seal** is a special form of diaphragm seal. Here, the tubular diaphragm is integrated directly into the pipeline. This means that there is no disruptive turbulence, no corners, no dead spaces or other obstacles in the direction of flow. Additionally, this leads to self-cleaning of the measuring chamber. The principle of the in-line diaphragm seal is suitable for in-line design and applications where the diaphragm seal can be easily integrated into a pipe. However, the diaphragm is relatively sensitive. Therefore, rapid temperature changes during cleaning and sterilisation processes are not recommended, and caution is also advised in applications with high shear forces.

In general, the interior of the diaphragm seal system between diaphragm and pressure measuring instrument is completely filled with a **pressure transmission medium**. Depending on the temperature range, industry and application, there are various options as to which liquids are suitable for the food sector. Of the approximately 90 variants that WIKA has in its programme, three are approved for the food sector: glycerine, Neobee® M-20 and medical white mineral oil. Medical white mineral oil has proven itself in many applications. Alternatively, Neobee® M-20 is used, especially in breweries, as it has little effect on the beer foam. Glycerine, for example, is not suitable for low temperatures as it then becomes viscous.



Possible combinations when constructing a diaphragm seal system

Watch out: Manufacturers need process temperatures!

In principle, the thermal influences on the pressure transmission medium must be taken into account when selecting a diaphragm seal. This fluid expands or contracts when the temperature changes, which must be compensated for by the diaphragm. When pressure is applied to the diaphragm, it deforms slightly inwards and transfers the pressure to the sensor. To ensure precise pressure measurement, it is therefore important to inform the pressure measurement technology manufacturer of the minimum and maximum process temperatures as well as the ambient temperatures, e.g. via a corresponding questionnaire[5]. With this information, the manufacturer can correctly calculate the system and confirm that the selected diaphragm seal will work under the given conditions. This procedure enables a quick and reliable decision to be made.

2.3.2. System components

In addition to the diaphragm seal itself, a diaphragm seal system also includes other components that can vary depending on the application. For example, pressure gauges, pressure sensors, transmitters or pressure switches can be adapted to the hygienic process with the aid of the diaphragm seal. When installing diaphragm seals in food applications, direct mounting is preferred in most cases, where the pressure gauge or process transmitter is mounted directly onto the diaphragm seal. This is particularly practical where the temperatures usually remain below 150 °C. For applications with higher temperatures or if additional insulation is required, it may be necessary to use a cooling element or capillary lines to create a greater distance between the process medium and the measuring instrument. Capillaries are also suitable for inaccessible measuring locations.

Terminology:
Transmitter, pressure sensor, process transmitter

The term transmitter refers to an instrument that records a physical variable such as pressure, temperature or humidity and converts it into a measurable signal. Transmitters that have a fixed pressure range and are designed for a specific, unchanging measurement task are referred to in this document as pressure transmitters or pressure sensors. The process transmitter, on the other hand, allows the measuring range and other parameters to be adapted to the specific requirements of the process and the pressure range to be programmed.

Pressure sensor model S-20 with diaphragm seal 990.22

Process transmitter model UPT-21

[5] WIKA questionnaire for diaphragm seals https://www.wika.com/media/Questionnaires/English/qu_ds_en_co.pdf

Process transmitters are notable for their programmability and can be flexibly adapted to different pressure ranges. With higher accuracies and turndown functions, process transmitters can, for example, be configured so that they precisely map a measuring range of 0 to 10 bar to a more specific range such as 0 to 3.76 bar, making optimum use of the 4-20 mA signal transmission. There is usually the option to add an indication module as well. However, it should be noted that the accuracy of the transmitter is based on the maximum pressure range and, depending on the turndown, the relative measuring deviation may increase when the measuring range is adjusted.

Furthermore, process transmitters enable a plant to be equipped with the same type of transmitter, regardless of the required pressure ranges. This permits standardisation to one measuring instrument, which simplifies stock-keeping and makes maintenance easier. The adaptability of the instruments provides users with a standardised and efficient measurement solution that increases the flexibility and accuracy of process control and monitoring.

Due to their versatility and precision, process transmitters are also suitable for hydrostatic level measurement (see chapter 4).

Pressure sensors are compact and cost-effective. The space-saving design makes it possible to construct machinery and systems with a smaller installation space and thus reduce manufacturing costs. Due to the lower cost of both the electronics and the development, they are more cost-effective than the more complex process transmitters. These characteristics make pressure sensors an attractive option for many applications where reliable pressure measurement with a fixed measuring range is required, without straining the budget. The measurement signal can then be forwarded to a higher-level control system and used for corresponding control tasks in the process.

Pressure switches are rarely used in the food and beverage industry, as many plants already have integrated switching and control functions in their control systems. Nevertheless, pressure switches offer a valuable solution for special requirements, especially when a switching function independent of the main control system is required. Electronic pressure switches react to pressure changes and send an electronic signal as soon as the pressure exceeds or falls below a defined threshold value. This allows them to control actuators directly.

Safety pressure switches and pressure measuring instruments with switch contacts, on the other hand, are also able to switch loads such as pumps and perform simple control tasks independently.

2.4. Measuring the pressure in the process flow with WIKA

The following product overview shows a range of WIKA instruments that are suitable for pressure measurement in pipelines. When making a decision, the considerations in the chapter “Basic criteria for selection” should also be taken into account. In general, WIKA offers both systems with integrated diaphragm seals and, alternatively, a modular system in which diaphragm seals can be combined with various indication elements, sensors, process transmitters and switches.

Instrumentation for pipelines

	DMSU-22SA	DMSU-21SA	DSSA-11SA	DSS18F	DSS19F	SA-11	UPT-21	UPT-20	S-20	PSD-4	PGT23	DMS-FP	DPT-EL	DPT-20	IS-3
Instrument model / Measurement principle	Process transmitter in in-line design	Process transmitter	Pressure switch	Pressure gauge	Pressure gauge	Pressure transmitter	Process transmitter	Process transmitter	Pressure transmitter	Pressure switch with output signal	Pressure gauge with output signal	Diaphragm monitoring	Differential pressure transmitter	Differential pressure transmitter	Pressure transmitter
Accuracy	1%	0.1 % … 0.5 %	0.5 % … 1 %	1.00 %	1.00 %	0.25 % … 0.5 %	0.1 .. 0.5 %	0.1 .. 0.5 %	0.125 … 0.5	0.50 %	1.00 %	0.10 %	0.1 % … 0.5 %	0.065 … 0.15 %	0.25 % … 0.5 %
Display	Digital	Digital	LED	Analogue	Analogue		Digital	Digital		Digital	Analogue		Digital	Digital	
Adjustable measuring range	x	x					x	x		x		x	x	x	x
Communication	4 … 20 mA, HART	4 … 20 mA, HART	IO-Link			4 … 20 mA	4 … 20 mA, HART®	4 … 20 mA, HART®	4 … 20mA	4 … 20 mA, IO-Link	4 … 20 mA	4 … 20 mA, logger data	4 … 20 mA, HART®, PROFIBUS® PA oder FOUNDATION™ Fieldbus	4 … 20 mA, HART®, PROFIBUS® PA oder FOUNDATION™ Fieldbus	4 … 20 mA
Overload limit	1.2 to 1.5 times	1 times	2 times	1.3 times	1.3 times	2 to 4 times	3 times	3 times**	2 to 5 times**	1.7 times**	1.3 times**	3 times**	3 times**	160 bar**	3 times**
Diaphragm monitoring	x	x										x			
IP protection	65, 66/67	65, 66/67	65, 67	65	65	65, 67, 6K9K	65, 66/67	65, 66/67	65 ,67, 6K9K	65, 67	65, 66	65, 66/67	65, 66/67	65, 66/67	65, 67
Upper temperature limit	150 °C	150 °C	150 °C	130 °C	130 °C	150 °C	150 °C	150 °C / 260 °C*	150 °C / 260 °C*	150 °C / 260 °C*	150 °C / 260 °C*	150 °C / 260 °C*	150 °C / 260 °C*	150 °C / 260 °C*	150 °C / 260 °C*
For hazardous areas		x					x	x			x		x		x
Special features	Dry measuring cell, robust sensor element	Suitable for all common measuring locations	Compact			Compact, fully welded	Rotatable large display and connection	Rotatable large display and connection	Compact, all-metal case for washdown areas	Rotatable display and connection	Local indication, independent of any power supply	Individually configurable	SIL 2, electronic differential pressure measurement	SIL 2, differential pressure measurement for static, high pressures	Compact
Process connections	All common hygienic	Clamp connection	Clamp connection	Milk thread fitting	SS 1145	All common hygienic	All common hygienic	Threaded connections	Threaded connections	Threaded connections, clamp connection	Threaded connections	Clamp connection	Threaded connections	Threaded connections	Threaded connections
Can be combined with diaphragm seal	Integrated	Integrated	Integrated	Integrated	Integrated	Integrated	Integrated	Yes (also in-line)	Yes (also in-line)	Integrated	Yes (also in-line)	Integrated	Yes (also in-line)	Yes (also in-line)	Yes (also in-line)

The table provides guidance by comparing important selection criteria for pressure measurement in pipelines with the corresponding products from the WIKA product range, all of which are suitable for UHT, CIP and SIP applications.

* in combination with diaphragm seals for direct mounting up to 150 °C, for operation with a cooling element up to +260 °C

** The permissible maximum operating pressure range of diaphragm seal systems is determined by the component(s) having the weakest performance data. This can be limited by the pressure transmitter or the diaphragm seal. The values specified here refer to the characteristics of the pressure transmitter.

The systems with integrated diaphragm seal include:

DMSU22SA

The DMSU22SA process transmitter is an example of a sophisticated **in-line design** that represents the optimum solution for a wide range of applications, e.g. for use in UHT systems, aseptic areas, heat exchanger feed and discharge lines as well as for SIP and CIP processes. With a thick-walled sensor tube made of stainless steel, the process transmitter offers reliable in-line pressure measurement without the need for a system fill fluid and is significantly more robust than conventional in-line diaphragm seals – especially when it comes to pressure surges, highly viscous process media or large temperature jumps. The integrated diaphragm monitoring provides direct feedback in the event of sensor failure, which further increases the safety and reliability of the system. In combination with easy cleaning and the optimised hygienic design without any dead spaces, the DMSU22SA eliminates the risk of contamination. Its unique properties ensure maximum safety, even in demanding applications, e.g. with abrasive media. The DMSU22SA is compatible with all common process connections for aseptic applications and fulfils relevant standards such as EHEDG and 3-A.

DMSU21SA

With the DMSU21SA **diaphragm monitoring system** with HART® protocol, not only the measuring signal, but also the status of the integrated diaphragm monitoring can be transmitted to the process control. It is particularly suitable for sensitive, aseptic products and retrofit projects in existing plant.

DSSA11SA

The compact diaphragm seal system is at least 30 % smaller than comparable products and is designed for continuous operation in CIP and SIP processes. The integration of **IO-Link** opens up convenient monitoring, configuration and diagnostics options. The DSSA11SA can be used for pressure monitoring or as an electronic PNP/NPN switch for process control.

DSS18F/DSS19F

With the DSS18F (**dairy fitting**) and DSS19F (process connection in accordance with Svensk Standard SS 1145), this pressure gauge with attached diaphragm seal allows for pressure measurement and monitoring in process stages such as filtration, separation, pasteurisation and in filling systems.

SA-11

The pressure transmitter supports a variety of aseptic process connections and is suitable for process temperatures up to 150 °C.

UPT-21
The process transmitter with flush diaphragm has integrated temperature compensation and is ideal for applications that require an intelligent sensor. Via the display and operating module or the **HART® Interface**, it can be configured directly on site or remotely via a process control system.

Product examples for mounting on diaphragm seals:

S-20
The pressure transmitter measures pressure precisely and reliably, and it does this in three accuracy classes. With up to 100 mio. load cycles and a **long-term stability** of up to < 0.1 %, it delivers exact data, constantly.

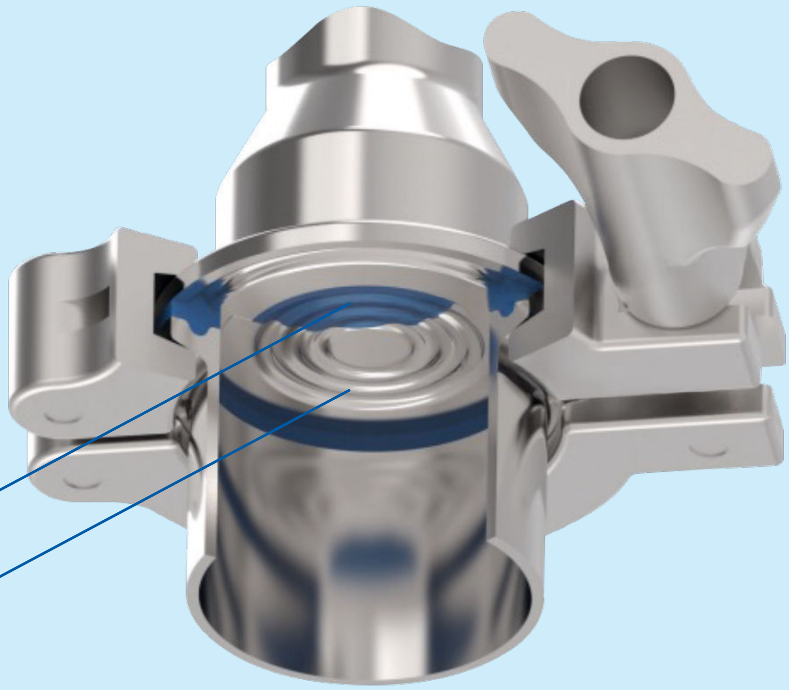
UPT-20
The process transmitter, with the assistance of the corresponding diaphragm seal, can be adapted to the most **difficult conditions** in the process industry. It can thus be used at extreme temperatures and with aggressive, corrosive, heterogeneous, abrasive or highly viscous media. Otherwise, it has the same features as the UPT-21 listed above.

PSD-4
The electronic pressure switch with display is the universal solution for industrial automation tasks. Status monitoring with **IO-Link** enables continuous monitoring, with the display showing the pressure values in an easily readable format. With the scalable analogue output, the measuring range can be adjusted in a ratio of 5:1, thus reducing variants and storage costs.

PGT23
The **Bourdon tube pressure gauge** is used wherever the process pressure has to be displayed on site and a signal transmission to the central control system or remote control room is required at the same time. Through the combination of a mechanical measuring system and precise electronic signal processing, the process pressure can be read securely, even if the power supply fails or is switched off.

DMS-FP diaphragm monitoring system

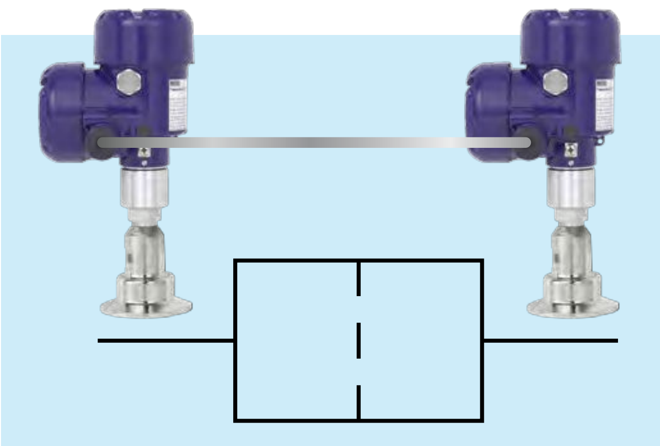
WIKA's patented diaphragm monitoring for diaphragm seals, with double diaphragm design, can, in combination with measuring instruments and diaphragm seals, be integrated into various instrument variants. It ensures that, in critical process sequences, neither the medium escapes to the environment nor the system fill fluid enters the product. In combination with the DMSU21SA, variants customised to the process are possible.



Internal diaphragm

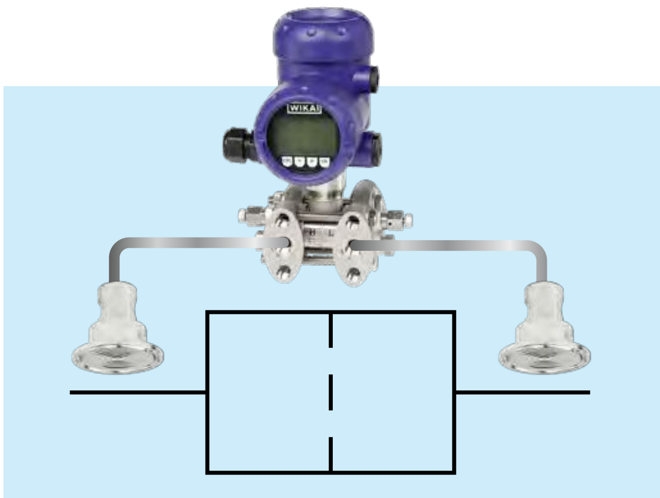
Outer diaphragm

Differential pressure transmitters for filter monitoring are always used in conjunction with diaphragm seal systems. The following products are available:



DPT-EL

The electronic differential pressure transmitter utilises differential pressure measurement in primary and secondary circuits with two sensors and is suitable for **easy filter monitoring**.



DPT-20

Alternatively, the DPT-20 differential pressure transmitter offers greater measuring accuracy and scalable measuring ranges for applications that require **more-demanding filter monitoring**.

Click here for the instrumentation of vessels, tanks and silos.

3.1. Typical vessel applications and special features

Vessels play a central role in the food and beverage industry, whether for the storage, processing or transport of products. Each vessel application brings its own specific challenges,
which require careful selection and customisation of the instrumentation.

3.1.1. Silos

In the food and beverage industry, pressure measuring instruments are primarily used for closed silos. Here it is important to ensure that the ventilation, in particular, is sufficient and that the pressure in the silo does not exceed or fall below critical values. When storing powdery media such as flour or icing sugar, it is important to use flush-mounted measuring instruments. These are designed in such a way that they prevent the medium from accumulating on the measuring surface, which could impair the measurement accuracy. Furthermore, the measuring instruments must comply with the relevant safety standards and be approved for use in potentially explosive atmospheres for dust.

3.1.2. Tanks

There are two categories of **tanks**: open or vented tanks and closed tanks.

For **open tanks**, a pressure sensor can be attached to the bottom of the tank and the fill level can be determined using the pressure of the liquid column above the sensor in accordance with the principle of hydrostatic level measurement.

Process transmitters are ideal for demanding processes that require precise and consistent measurements. They can save specific characteristic curves for different vessel geometries in order to take into account the shape of the tank during measurement – such as a conical base that merges into a cylindrical area. The transmitter adjusts the pressure values accordingly so that the level can be converted directly into volume and can be displayed on indicators. This functionality is particularly useful for systems in which the shape correction of the vessel cannot be stored in the control system.

For less complex applications, or for systems where the vessel geometry can be stored in the control system, simple pressure transmitters are sufficient. This reduces the investment costs. However, it should be noted that applications with small vessels may require transmitters with high accuracy.

The design of closed tanks with venting is considered in a similar way to open tanks. However, when using vent valves, the pressure must be taken into account until the valve responds or opens. This can lead to pressure jumps of a few mbar or a few cm water column in the measurement when the valve triggers. If this deviation is too large for the control system, a differential pressure measurement, as with closed tanks, should be used.

Closed tanks are often located in aseptic areas. Here, too, it is possible to measure the fill level hydrostatically. There are various methods for this.

For differential pressure measurement in primary and secondary circuits, a measuring instrument is installed at the bottom and a second measuring location in the upper area of the tank, in order to take into account the pressure blanketing or overpressure at the upper section of the vessel. A system with a flexible and easy-to-lay cable is recommended for the measuring locations, which are usually several metres apart. Capillary lines, on the other hand, are complex to install and sensitive to temperature. Differential pressure systems in which both sensors are integrated in the measuring instrument and the signal from the upper sensor is subtracted from the total pressure directly in the instrument, so that the pure level signal is immediately available, are suitable for this procedure.

An alternative that measures very precisely is a differential pressure transmitter with a single differential pressure measuring cell and two diaphragm seals. These systems are used, in particular, for high static pressures. This means when there is a high pressure for inert gas blanketing (see below, Pressure monitoring section) or when high pressures are used to empty the tanks. The selection of the appropriate measuring system depends on the specific requirements of the application – primarily on the required accuracy and the hygienic standards.

3.1.2.1. Pressure monitoring in closed tanks

Pressure blanketing during the storage of foodstuffs in tanks is a critical process that uses an inert gas such as nitrogen to prevent the food from coming into contact with oxygen, from the air, and other contaminants. It is essential to monitor and regulate the overpressure in the tank precisely so that the pressure remains constant during the removal of contents and no pressure drop affects the product flow.

However, continuous monitoring of the pressure blanketing is not only required during extraction, but also during storage or interim storage. The pressure drop method makes it possible to identify leaks – a drop in pressure can indicate the need to tighten connections or top up with nitrogen. Depending on the degree of automation, this may require the use of a transmitter with a suitable output signal, a pressure gauge with switch contact or a pressure switch. With manual monitoring, a pressure gauge is sufficient to monitor the pressure conditions and initiate appropriate measures.

In addition, a deliberately increased overpressure can accelerate the extraction process. Regulating the pressure also makes it possible to control the solubility of the gas in the product. If it is undesirable for the gas to dissolve in the foodstuff, it is necessary to work with minimal pressures. Such applications require precise transmitters that are capable of reliably measuring and regulating low pressures. The selection of the right measuring instrument therefore depends on the desired overpressure, the required measuring range, the appropriate process connection with a correspondingly large diaphragm seal and the required response time. If the tank is located outdoors, transmitters with suitable cases must be used.

3.1.3. Feed vessels

Feed vessels play an important role before critical processing steps in the process chain, such as separation. They are used to ensure a continuous flow of material and that downstream equipment such as pumps, fillers, separators or other units are always supplied with sufficient material to prevent dry running. Monitoring and controlling the fill level in a feed vessel is therefore crucial to guarantee smooth operation and ensure that the material is conveyed. The selection criteria for the instrumentation of a feed vessel are similar to those of a tank.

3.1.4. Stirring and mixing tanks

In stirring and mixing tanks, the movement of the contents due to stirring can lead to an uneven profile that makes it difficult to measure the level or other parameters. To compensate for these fluctuations, it may be necessary to integrate damping into the electronic measuring system. This damping serves to stabilise the output signal of the measuring instrument in order to provide more reliable data. Careful tuning of the damping is advisable to ensure precise process control in stirring and mixing tanks. For tanks with anchor stirrers and external scrapers, it is important to install measuring instruments so that their diaphragms are either flush or slightly recessed to avoid contact and pressure from the scrapers.

In the case of a cooker, the measuring instrument must also be designed for process temperatures of at least 100 °C.

3.1.5. Cleaning

When selecting measuring instruments for vessels, it is fundamentally important that they support easy cleaning. They must fit into the process connection adapter in such a way that no residues remain. Particularly in the case of vessels with rotating nozzles for cleaning, also known as rotating jet cleaners, care must be taken to ensure that the sensor is not directly hit by the cleaning jet in order to avoid damage. The sensor should be positioned so that it is protected by the connection adapter.

3.2. Monitor pressure and overpressure in vessels with WIKA

The following products represent a selection of WIKA instruments that are particularly suitable for pressure and overpressure monitoring in vessels. The considerations in chapter “Basic criteria for selection” should also be taken into account when making the decision.

Find out more?
Click for contact

Instrumentation for vessels, tanks and silos

	PG43SA-S	PG43SA-C	PG43SA-D	CPG1500	MA	SA-11	UPT-21	UPT-20	DPT-EL	DPT-20
Instrument model	Diaphragm pressure gauge	Diaphragm pressure gauge	Diaphragm pressure gauge	Digital pressure gauge	Pressure switch	Pressure transmitter	Process transmitter	Process transmitter	Differential pressure transmitter	Differential pressure transmitter
Accuracy	1.6%	1.6%	2.5%	0.025% … 0.5%	1.0%	0.25% … 0.5%	0.1 ... 0.5%	0.1 ... 0.5%	0.1% … 0.5%	0.065 … 0.15%
Display	Analogue	Analogue	Analogue	Digital			Digital	Digital	Digital	Digital
Adjustable measuring range					X		X	X	X	X
Communication				Logger data via Bluetooth	Switch contact	4 … 20mA	4 ... 20mA, HART®	4 ... 20mA, HART®	4 ... 20mA, HART®, PROFIBUS® PA oder FOUNDATION™ Fieldbus	4 ... 20mA, HART®, PROFIBUS® PA oder FOUNDATION™ Fieldbus
Overload limit	2 to 5 times	5 times up to DN40	5 times up to DN40	3 times	Up to 60 bar	2 to 4 times	3 times	3 times**	3 times**	160 bar**
Diaphragm monitoring			X							
IP protection	54	6	54	65	66	65, 67, 6K9K	65, 66/67	65, 66/67	65, 66/67	65, 66/67
Upper temperature limit	150 °C	150 °C	150 °C	150 °C / 260 °C*	150 °C / 260 °C*	150 °C	150 °C	150 °C / 260 °C*	150 °C / 260 °C*	150 °C / 260 °C*
For hazardous areas		X		X	X		X	X	X	X
Special features	Dry measuring cell, robust sensor element	Compact, robust sensor element, dry measuring cell	Dry measuring cell, robust sensor element	With logger function	SIL2 or SIL3	Compact, fully welded	Rotatable large display and connection	Rotatable large display and connection	SIL 2, electronic differential pressure measurement	SIL 2, differential pressure measurement for static, high pressures
Process connection	All common hygienic	All common hygienic	All common hygienic	Threaded connections	Threaded connections	All common hygienic	All common hygienic	Threaded connections	Threaded connections	Threaded connections
Can be combined with diaphragm seal	–	–	–	Yes (also in-line)	Yes (also in-line)	Yes (also in-line)	Yes (also in-line)	Yes (also in-line)	Yes (also in-line)	Yes (also in-line)
Main fields of application	High tanks, stirring and mixing tanks, washdown areas	Small transport vessels, stirring and mixing tanks, washdown areas	Tanks, stirring and mixing tanks, aseptic, washdown areas	(Mobile) vessels, washdown area	Silos	Open/ vented vessels, cookers, washdown-area	Open/ vented vessels	Open/ vented vessels	Hydr. level In closed vessels	Hydr. level In closed vessels

The table provides guidance by comparing important selection criteria for pressure measurement technology in vessels, tanks and silos with the corresponding products from the WIKA product range.

* in combination with diaphragm seals for direct mounting up to 150 °C, for operation with a cooling element up to +260 °C

** The permissible maximum operating pressure range of diaphragm seal systems is determined by the component(s) having the weakest performance data. This can be limited by the pressure transmitter or the diaphragm seal. The values specified here refer to the characteristics of the pressure transmitter.

PG43SA

The diaphragm pressure gauges of the PG43SA family are very robust due to their mechanical measuring principle and the absence of pressure transmission media. They are suitable for gases, compressed air, steam, liquid, pasty, powdery and crystallising media and can also withstand the demands of stirring and mixing tanks. The **PG43SA-S** is suitable for high tanks, the compact **PG43SA-C** for small transport vessels. **The PG43SA-D** offers additional safety through the integrated diaphragm element monitoring, similar to the diaphragm monitoring mentioned above.

Video on the topic

PG43SA-S

PG43SA-C

PG43SA-D

CPG1500

The accuracy of digital measurement technology and the simplicity of an analogue measuring instrument are combined in this precision digital pressure gauge. It features high precision and simple handling. A data logger is integrated into the instrument, which can record up to 50 readings. In combination with the diaphragm seal **model 990.22**, the CPG1500 is an optimal solution for many vessel applications and is also suitable for leak monitoring on mobile aseptic vessels.

MA

The mechanical pressure switch is suitable for pressure monitoring in silos. The robust switch enclosure (IP66) made of aluminium alloy can withstand harsh and corrosive outdoor conditions. It is fitted with one or two microswitches that enable the direct switching of an electrical load of up to AC 250 V and 20 A – without the need for auxiliary power for the switching process.

Hydrostatic level measurement on open or vented tanks

SA-11
The pressure transmitter is suitable for hydrostatic level measurement in open or vented vessels in simple applications and for cookers.

UPT-20/21
The process transmitter is ideal for hydrostatic level measurement in open or vented vessels that require a higher precision.

Hydrostatic level measurement on closed tanks

DPT-EL
The electronic differential pressure transmitter in primary and secondary circuits is suitable for hydrostatic level measurement in closed vessels and potentially explosive atmospheres. The option of using two transmitters of different designs allows the use of a flush-mounted system at the bottom of the vessel, while an open process connection is easily possible in the upper area of the tank.

DPT-20
When it comes to complex processes that require high measurement accuracy and scalable measuring ranges, the differential pressure transmitter is ideal for hydrostatic level measurement in open and closed vessels.

Click here for instrumentation for homogenisers

4. Homogenisers

4.1. Background

Homogenisers are crucial for preventing the separation of constituents in liquids. A typical example is fresh milk, where the fat droplets are crushed under pressure during homogenisation and evenly distributed in the milk. For this purpose, the pre-heated and standardised milk is fed into the homogeniser where it is forced through a fine gap under high pressure. This process breaks down the fat droplets into smaller particles that no longer clump together. After homogenisation, the milk undergoes a further heating process to pasteurise it and kill germs. It is then cooled and can be further processed or bottled.

Homogenisers are not only used in the dairy industry, but also in beverage production and other food areas where an even distribution of ingredients is required. These include mixed milk drinks, ice cream and cheese products, as well as fruit juices, smoothies, salad dressings and ketchup.

4.2. Special features

The input pressure at the homogeniser is usually between 3 and 5 bar, for which an in-line measuring instrument in the pipeline is suitable. The homogenisation pressure, which is between 100 and 1,500 bar depending on the process, is measured at the valve. The pressure pulsations caused by the piston pump require the use of precise and robust pressure measuring instruments that are fitted with special connections and damping functions. This damping is crucial to minimise the pulsations and thus extend the service life of the measuring instruments. To prevent pressure peaks and possible damage to the measuring instruments, it is important to avoid air bubbles in the food, which are compressed by the piston pump.

When selecting a suitable measuring instrument, the process connection will already be specified by the machinery manufacturer. As a rule, the measuring instruments are then based on a diaphragm seal system (see also chapter 2 "Diaphragm seal systems"), which can have a modular structure like WIKA's modular system. The subtle differences in the internals of the measurement technology are crucial here in order to ensure a long service life of the instruments under the demanding conditions. In addition, the instruments must have damping to minimise the effects of pulsations and ensure a stable measurement signal.

4.3. Measure the homogenisation pressure with WIKA

990.30

The model 990.30 diaphragm seal is part of WIKA's modular diaphragm seal system (see page 14) and was specifically developed for the extreme dynamic pressure loads during the homogenisation process. Complex structural features allow pressures of up to 2,500 bar and ensure a long service life. It can be combined with various indicators, pressure switches or process transmitters from the WIKA portfolio and therefore offers maximum flexibility.

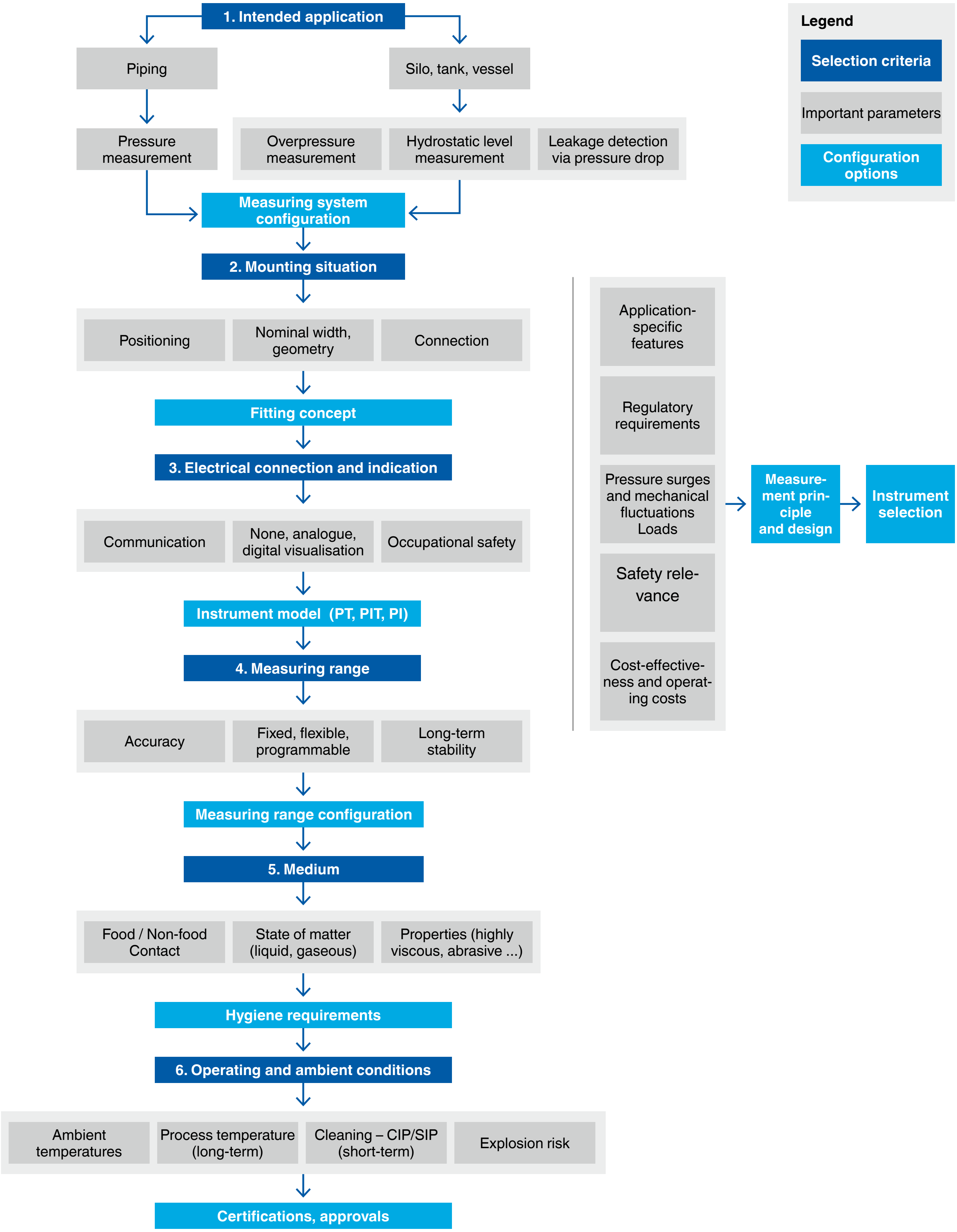
5. Conclusion

Pressure measurement is a critical process parameter with far-reaching implications for food safety, product quality and operational efficiency. By utilising advanced technologies and smart sensors, experts such as designers and project engineers in the food and beverage industry can increase their company's productivity.

As one of the leading suppliers in this field, WIKA has a broad portfolio, not only of pressure gauges, but also of instrumentation for measuring temperature, level, force, weight and flow. The right product, including comprehensive services, is therefore available for every application in the food and beverage industry. As a provider of end-to-end solutions, WIKA not only supports its customers with products, but also accompanies them from the planning phase through to implementation and calibration – a holistic approach that guarantees safety and efficiency from a single source.

Find out more?
Click for contact

Assistance in finding the right pressure measurement technology for the food and beverage industry



If you need support in selecting the right measuring instrument or have questions about integration into your systems, our WIKA team will be happy to provide you with tailored advice. We help you to find the optimum solution for your measurement requirements. Our questionnaire for diaphragm seals is also available to help you with your selection.

Contact us to discuss your requirements and benefit from our expertise.

Click for contact

To the questionnaire for diaphragm seals

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The WIKA Group is a global market leader in pressure and temperature measurement. The company also sets the standard in the measurement of level, force and flow, and in calibration technology. The broad portfolio of high-precision instruments, IIoT solutions and comprehensive services makes WIKA a strong and reliable partner for all the requirements of industrial measurement technology. The family-run business, founded in 1946, has a global presence with 11,000 employees. This includes our own subsidiaries, production sites and development departments, such as the Innovation Center in Klingenberg. There alone, over 100 engineers work on innovative sensing solutions that provide answers to global challenges. WIKA's unique experience and know-how make sensing technology smarter, add more value and prepare it for a sustainable future: Smart in sensing.

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