Measuring and recording systems for standard-compliant and rule-based pasteurization –

overview, applications, and selection criteria

Focus on food safety:

How can instrumentation in the food and beverage industry help optimize pasteurization processes, ensure product quality, and save costs and resources?

Pasteurization is one of the most heavily regulated and monitored processes in food and beverage production. Standards and regulations such as PMO, HACCP, IFS Food, and hygiene standards like 3A and EHEDG aim to protect consumer safety by providing precise guidelines for the implementation and documentation of pasteurization.

The focus is on consumables where microbial contamination can pose a health risk to consumers, such as:

- All types of dairy products,
- Juices and juice drinks,
- Fermented products such as cottage cheese and protein drinks,
- Plant-based milk substitute drinks,
- Other foods and beverages.

In this whitepaper, we will explore various measuring and recording systems that help to ensure compliant pasteurization and document it according to regulations.

Various processes and systems are commonly used for pasteurization. In the food and beverage sector, these are primarily:

- **High-Temperature Short-Time (HTST) Pasteurization:** The product is held at 161–163 °F (72–73 °C) for 15–20 seconds in a continuous process in a tubular or plate pasteurizer.
- **High-Temperature ESL Pasteurization:** Used to produce Extended Shelf Life products at temperatures of 185–280 °F (85–134 °C).
- **Ultra-High Temperature (UHT) Pasteurization:** The product is heated to 280–300 °F (135–150 °C) for 2–4 seconds, mainly used to produce UHT milk.
- **VAT or Low-Temperature Long-Time (LTLT) Batch Pasteurization:** Conducted in special tanks with agitators (VAT = Vertical Agitated Tanks) at approximately 145 °F (63 °C) for 30 minutes for milk, followed by batch processing into cheese, cottage cheese, or other products.

In the USA, all processes in the dairy industry require monitoring and documentation to ensure compliance with standards. PMO-certified chart recorders have traditionally been used for this purpose, but digital recording systems (PPR – Paperless Process Recorder) with M-b certification are now available.

Overview of applications and measurement and recording systems

	HTST / ESL	UHT	VAT	M-b / PMO Certificate
Temperature Sensors				
TSBA / TSMA Modular RTD and Temperature Sensor	***	***	**	
FD DART Digital Reference Thermometer	***	***	***	Yes
CT (in VAT Pasteurization Controls System)	*	*	***	Yes
Pressure Sensors				
P42 Pressure Transmitter	**	**	-	
GB Differential Pressure Switch	***	***	-	Yes
EL Gauge	**	**	-	
ELS Steam Gauge	**	***	**	
Continuous Level Sensors				
L3 Hydrostatic Level sensor	**	**	-	
HB Hydrostatic Level sensor	***	***	-	
Point Level Sensors				
LS Capacitive Level Switch	***	***	***	
Flow Sensors				
IZMAG Electromagnetic Flow Sensor	**	**	**	
IZMS Electromagnetic Flow Sensor	***	***	***	Yes
FMQ Electromagnetic Flow Sensor	**	**	**	
Process Recorders				
PPR Paperless Process Recorder (digital)	***	***	***	Yes
AV9900 Chart Process Recorder	***	***	**	Yes
AJ300 (in VAT Pasteurization Controls System)	*	*	***	Yes
Turbidity Sensors				
ITM-51 Turbidity Sensor	**	**	-	
ITM-4 Turbidity Sensor	***	***	-	

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

Everything from a single source

We offer all the necessary instrumentation and recording technology for safe process control in pasteurization plants, tailored to hygienic applications. "Hygienic By Design" is our company guideline and the basis for our entire product portfolio, designed, developed, and manufactured specifically for the food and beverage industry.

In addition to the complete product range for these applications, we offer comprehensive service, from expert advice from application specialists to fast and customer-oriented technical support, including on-site service if required.

Requirements for measuring systems for pasteurization skids

Pasteurization is crucial for ensuring the safety of food and beverage products. Even slight deviations from specifications can endanger consumer health and pose a high economic risk for manufacturers. Depending on when an incorrect pasteurization is detected (after production / after filling / after delivery to retailers / after sale to end customers), a rule of thumb assumes that the costs can increase by a factor of at least 10 at each stage.

Due to the high risk potential for consumers, numerous laws, ordinances, standards, and regulations aim to prevent contamination by microorganisms such as bacteria, yeasts, and molds. Measuring instruments and process recorders help control, monitor, and log pasteurization processes in semi- or fully automated plants.

The suitability of measuring devices for pasteurization processes depends on a variety of key factors. In addition to the criteria commonly used for hygienic applications in the food industry, the following are the most relevant:

Standards and regulations: A wide range of legal and normative requirements apply to the production of food and beverages in general, and to pasteurization in particular. Examples include:

- **PMO** (Pasteurized Milk Ordinance)
- **HACCP** (Hazard Analysis Critical Control Point)
- **FDA** (Food and Drug Administration)
- **EU regulations** for food safety
- **DIN EN ISO 22000** (German / European / International standard)
- **FSSC 2200** (Food Safety System Certification)
- **IFS Food 8** (International Featured Standard)
- **3-A / EHEDG** hygiene standards (Sanitary Standards Inc. / European Hygienic Engineering & Design Group)

The sensors used should help the manufacturing company comply with these standards and regulations by providing the relevant certificates, such as M-b, 3-A, EHEDG, DIN-ISO 9001, CE, CRN.

PMO Certificate „M-b“: The "Memorandum of Milk Ordinance Equipment Compliance" (M-b) is a letter of conformity issued by the FDA to indicate that a particular device or system complies with a section or application within the "Grade A Pasteurized Milk Ordinance." Before the FDA issues an M-b, a technical product review by one of the US Regional Dairy Equipment Review Committees is required. An issued M-b helps your plant and quality teams to always be audit-ready, whether for state inspections, internal reviews, or third-party audits.

Measurement accuracy: Pasteurization specifications define precise values for the processes. The more accurately these values are adhered to, the safer the end product will be.

For **temperature sensors,** the highest possible measurement accuracy, repeatability, and long-term stability, combined with the lowest possible temperature drift, ensure that the pasteurization process can be controlled according to specifications. Additionally, the measurement accuracy of the temperature sensor influences **energy costs** and **process duration** if the medium does not need to be heated higher and longer than required for safe pasteurization.

A VAT batch pasteurizer equipped with temperature sensors for the product and air space, as well as a recording system in accordance with PMO specifications (M-b certified)
Photo Credit: Tessa Dairy Machinery (www.tessadm.com)

In continuous pasteurization processes, high measurement accuracy is also fundamental for **flow meters** to precisely control the factors of quantity, time, and temperature at all times. individual **pressure transmitters or a differential pressure sensor** must ensure and monitor that the pressure of the pasteurized milk in the heat exchanger is always slightly higher than in the raw milk supply (in the case of heat recovery) or than the cooling medium to avoid the risk of recontamination.

Hygienic design: The hygiene requirements applicable to all processes in food and beverage production apply particularly to the pasteurization process. The sensors, process connections, and surfaces of components that come into contact with the product must be designed for **CIP/SIP cleaning** and allow for **dead space-free installation.** The installation requirements of 3-A and EHEDG for the sensors used should be strictly adhered to (see download links).

Note on EHEDG Hygienic Standard Type EL Class I

Information on installation according to EHEDG standard is available on our website:
www.anderson-negele.com/EHEDG.pdf

Click on the PDF icon to download the document.

Click or Scan

Note on 3-A Sanitary Standard 74-

Information on installation according to 3-A standard is available on our website:
www.anderson-negele.com/3A74.pdf

Click on the PDF icon to download the document.

Click or Scan

The website of the 3-A and EHEDG organizations provide many additional documents that describe the hygienic requirements for pasteurization systems in detail.

Tamper resistance: Systems that are externally monitored and audited in accordance with PMO requirements must offer the option of affixing legal seals. The same applies to digital process recorders: there physical devices must also allow legal, and the software must provide digital tamper resistance in the same level. Tamper resistance is part of the PMO approval through an M-b (Memorandum-b), which Anderson-Negele's PPR/Legendary system was the first digital process recorder to receive.

Avoiding the risk of failure: When selecting sensors, it is important to ensure that they offer a long service life and a low risk of failure. If a sensor fails during the process, the entire production volume since the start of continuous pasteurization or the entire batch in VAT processing must be re-pasteurized or may even be lost. In addition, the entire system must be cleaned in accordance with CIP-SIP specifications. The cost factor exceeds the pure sensor costs many times over. Therefore, high quality standards should be set for the instruments, and only proven products from established suppliers should be considered.

Forward and backward compatibility: All components in a pasteurization plant should be compatible with linked systems. Newer generation replacement devices should be able to completely replace the functions of the old generation. This is the only way to guarantee that processes can be carried out with a high degree of repeatability when components are replaced.

Everything from a single source: It is a great advantage when all the required instrumentation, including the necessary certificates and documentation, as well as technical support and repair services, can be provided from a single source.

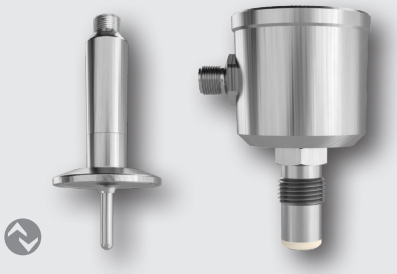
Various manufacturers of pasteurization equipment rely on Anderson-Negele sensors and recording systems for their basic instrumentation, as these support and ensure the long-term operation of the equipment at the highest level.

A system for continuous HTST pasteurization. Flow meters, temperature sensors, pressure gauges, and a recording device from Anderson-Negele ensure reliable processes here.
Photo Credit: Tessa Dairy Machinery (www.tessadm.com)

Product Overview

Temperature Sensors / Reference Thermometers

Continuous pasteurization: Precision control and recording of product temperatures in the process steps of heating, holding, regeneration, cooling, return / recirculation, buffer tank / filling.
Batch pasteurization: Precision control and recording of product and air space temperature in the VAT



TSMA / TSBA

- For vessels and pipes from DN25
- Flush design available
- Accuracy < ±0,1 K
- Extremely robust and permanently precise
- Optional programming display

Temperature: FD

- Digital Reference Thermometer
- 21 CFR 113 for retort applications
- Measuring range -50 to 350 °F
- Display distance from sensor up to 1500'

Pasteurization Controls Package: VAT

Complete system including:
- One AJ-300 Circular Chart Recorder
- Two CT8V probes for airspace and product temperature measurement

Pressure Sensors

Monitoring trouble-free operation in the balance tank, heating / regeneration, cooling and other process steps. Control of the regeneration to ensure a higher pressure in the pasteurized milk flow compared to the raw milk flow by two separate pressure transmitters or one differential pressure transmitter

Transmitter: P42

- Extremely robust and vacuum-proof
- Process temperatures up to 250 °C / 482 °F
- Response time < 5 ms
- Absolute or relative measurement cell

Gauge: EL

- Extremely robust against pressure shocks and vibrations
- One-piece stainless-steel design
- Mechanical dampening
- 90 mm display
- Two-point adjustment

Differential Pressure: GB

- Efficient control of continuous pasteurizer regenerators
- Three sensors available (SR / TFP / SY)
- Range options standard and UHT

Steam Gauge: ELS

- Process temperatures up to 205 °C / 400 °F
- Ideal for applications with SIP, UHT or thermal cycling
- Fully hygienic design

Continuous Level Sensors

Monitoring constant product level in the balance tank

Hydrostatic: L3

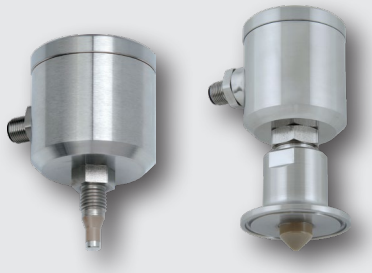
- Always precise due to significantly reduced temperature effect
- Direct output of volume, level or pressure
- Integrated tank linearization and density compensation
- Various models / options

Hydrostatic: HB

- Compact design developed for pasteurization balance tanks
- Robust and durable dual diaphragm architecture and welded stainless enclosure
- High accuracy with temperature compensation and pressure cell technology

Point Level Detectors

Prevention of overfilling the balance tank or the VAT



Conductive: LB / Capacitive: LS

- Reliable point level control even with foamy or viscous media
- Hygienic installation on top, below, or side
- Very fast reaction time
- Also for double-walled vessels

Electromagnetic Flow Sensors

Supervision of the flow velocity to ensure the correct minimum holding time of product

Electromagnetic: IZMAG

- From the compact, robust, low-cost all-arounder to the high-end version
- Measuring range 30 l/h to 280 000 l/h (8 gal/hr to 74 000 gal/hr)
- Measuring accuracy up to ±0.2 % ±1 mm/s
- Process temperature up to 165 °C / 325 °F, CIP up to 130 °C / 266 °F (30 min.)

Flow Meter: IZMS

- Measuring range 30...280 000 l/h (8 ...74 000 gal/hr)
- Measuring accuracy up to ±0.25 % ±2 mm/s
- Process temperature up to 165 °C / 325 °F, CIP up to 130 °C / 266 °F (30 min.)

Electromagnetic: FMQ

- From the compact, robust, low-cost all-arounder to the high-end version
- Measuring range 30 l/h to 280 000 l/h (8 gal/hr to 74 000 gal/hr)
- Measuring accuracy up to ±0.5 % ±2 mm/s
- CIP up to 130 °C / 266 °F (30 min.)

Process Recorders

Automatic logging of all data of the pasteurization process to document correct operation. Available as chart recorders or as digital version (Paperless Process Recorder).

Paperless Process Recorder PPR

- PPR is the first digital process recorder with M-b
- For audit-ready digital records and annotations, streamlined workflows, remote access and approval and secure storage
- Avoids consumables cost and unplanned downtimes

Chart Recorder AV9900

- Failsafe chart recorder for up to 4 inputs
- 4-color marker pen cartridge with synchronized printing
- Built-in scale and data printing

Pasteurization Controls Package: VAT

Complete system including:
- One AJ-300 Circular Chart Recorder
- Two CT8V probes for airspace and product temperature measurement

Turbidity Sensors

Additional control of the correct process operation, supervision of the cooler (to avoid contamination through cooling agent), control of CIP-/SIP cleaning quality

ITM-51

- Front-flush design with backscatter light technology
- Easy installation due to screw or clamp connection
- Measuring range: 200...300 000 NTU
- High safety and durability due to glass-free sapphire optics

ITM-4

- Four-beam alternating light technology (90° scattered + 180° transmitted light)
- Measuring range: 0...5 000 NTU
- Measuring accuracy: resolution 0.1 %
- Response time < 1 sec.
- Many process connections from DN25 to DN100

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