

LNG tank gauging solution

Measurement and control of level, temperature, density and rollover prediction





Mastering the challenges of LNG inventory management

We provide state-of-the-art solutions and highest accuracy level measurement instrumentation that you perfectly control and monitor the inventory of your tank.

Meeting evolving demands Energy flows around the world may be unpredictable, anyhow you have to predict and control your operation. The complexity of facilities and processes is increasing and at the same time you have to reduce downtimes.

As the industry faces tightening regulations and reduced resources we support across the full life cycle of your project with your deadlines in mind. We enhance your competitiveness with reliable, accurate and traceable asset information.

Need to do more with less? Take advantage from a dependable partner who is by your side for the long haul and ready across the globe, offering:

Safety This topic allows no compromise. We manufacture accurate, robust and reliable instrumentation to ensure safety and elevate your overall reliability and productivity.

Efficiency Just as your goal is to extract maximum resources, ours is to maximize your efficiency and return on investment (ROI).

Availability The LNG storage sector faces three challenges: the availability of resources, services and technology. Endress+Hauser can assist you with each.

The storage of LNG at cryogenic temperatures presents some unique challenges that must be handled properly to ensure that the plant is operated safely and efficiently.

Safety by choice, not by chance

Our portfolio of instrumentation is designed to meet the needs of safe and reliable operation in the oil & gas and chemicals industries. Functional Safety requirements according to IEC 61508 and ISA documents are included by design. Proservo can be used in applications up to SIL3 in homogeneous redundancy. All of our products are designed and qualified in our independently certified laboratories. This includes the development of safety related hardware and software.



Increased productivity

Accurate measurements provide the preconditions for efficient work along the process chain, from production and transport through to processing, storage and distribution. Our highly precise instruments are custom-made to meet respective needs. We also support you to reduce inventory costs and increase productivity with complete inventory visibility 24/7. Our integration capabilities and inventory management software solutions enable collaboration and business decisions among different stakeholders.



Best-fit products, solutions and services for higher availability

For more than 60 years Endress+Hauser has proven to be competent, reliable and trustworthy. We are where you need us, already present in more than 120 countries around the globe.

With our offering ranging from single sensors to complete automated solutions, we are your one-stop partner in instrumentation and automation. We are happy to support you with technical expertise.



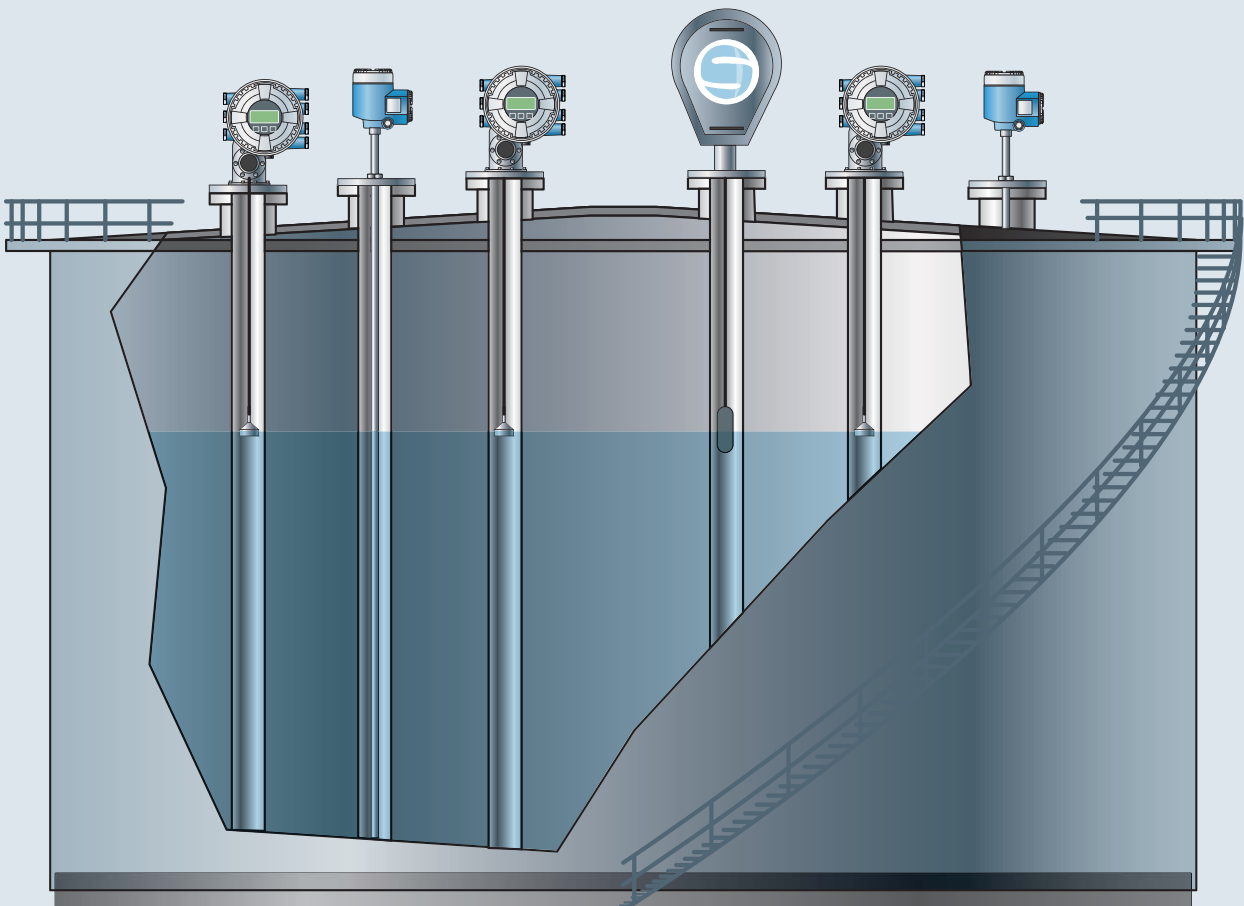
LNG tank gauging solutions

Measuring and managing of LNG inventories is a sophisticated task. We offer the high quality instrumentation you need in combination with in-depth industry know how and engineering and maintenance services.

The challenge A typical LNG tank works with a wide range of instruments to measure liquid level, liquid density, liquid and vapour temperature, liquid and vapour pressure, skin temperature and much more. Additionally you have to make sure that two layers of different densities are not rapidly mixing with the side effect of large amounts of gas being released, also known as rollover.

Our solution Our high accurate level gauges and instrumentation in addition with the Tankvision inventory management system guarantee you highest transparency of inventories in the plant or headquarters. Keeping the constant temperature of the liquid gas, such as -200°C , also results in many technological challenges in handling cold temperatures. We offer a temperature monitoring system for the cooling down and the leak detection. In addition our LTD system monitors the level, temperature, density profiling and rollover prediction. That is not only important if you want to know what is happening in the tank, but also helps you to determine the next process actions.

Level, temperature, density, rollover: LTD System SI-7000



Instruments to measure and display inventory data

Level: Proservo NMS8x

The intelligent tank gauge Proservo NMS8x is designed for high accuracy liquid level measurement in custody transfer and inventory control applications with NMI- and PTB-approvals. It meets the relevant requirements according to OIML R85 and API 3.1B and it is SIL2/3 certified.

- Accuracy: $\pm 0.4\text{mm}$
- Measuring range: up to 55m (std), longer range is optional, on demand basis



Temperature: Multi-point average temperature Prothermo NMT539

The Prothermo NMT539 is an intelligent HART signal converter with a combined multi average temperature measurement for cryogenic liquids, LNG, LPG and Butane.

- Measurement variables:
Liquid and Gas
- Temperature range:
-200 to + 235°C
- Measuring range:
up to 99.9m



Level, temperature, density, rollover: LTD System SI-7000 by Scientific Instruments, Inc.

The LTD system SI-7000 creates a density and temperature profile of the tank. With its Stainless steel 316 mechanical body is the most applicable for LNG tank and marine applications (FLNG and FSRU).

- Stainless steel 316 mechanical body is superior for rust and corrosion resistance
- Operating pressure: 0.4 bar
- Measuring range: up to 56 m (std), longer range is optional, on demand basis



Local indicator: Loop-powered Field Indicator RIA15

The indicator shows the measured signal on the large, backlit display. No separate power supply is required, the indicator is powered directly from the 4 to 20mA HART loop. It displays the measured 4 to 20 mA HART values.

- 5-digit measured value display with dimension, bargraph and backlight
- No external power supply required
- Allows the HART® transmission protocol to pass unimpeded



Skin temperature: Multiplexer TM188

TM188 is a multiplexer and transmitter mounted in a hazardous area designed to accept up to 16 RTD inputs. System reliability can be increased by providing dual redundant fieldbus (RS 485 modbus). We offer the relevant RTD sensors to match your application.



Local indicator: Field Display FD188

The Field Display supports a range of parameters, such as level, average temperature, 16 temperature elements, profile points and other alarms. Metric and imperial units are supported for the different data items. It supports Modbus Master/Slave Mode. The unit is normally configured to listen to data on a fieldbus produced by a Master device polling slave devices.



Solutions for inventory management

Data acquisition system: Tankvision Multiscan NXA83B



NXA83B is a dedicated tank inventory system. It is ideally suited for tank farms with various protocols used for communicating with the installed field devices and/or redundancy needs.

- A robust industrial operating system with embedded software ensures high stability and availability
- Legacy protocol management; allowing gradual upgrades
- No hard disc or fans - no wear out
- Predefined or customized operator screens via the optional touch display for typical operation
- Connects to Tankvision LMS for additional functionality

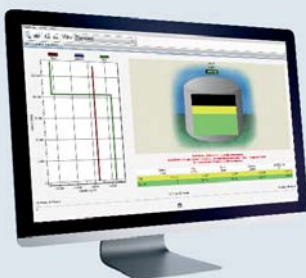
LNG tank management system (LMS): Tankvision LMS inventory management software



The Tankvision LMS inventory management system features reliable LNG real time management. It is a truly open and redundant system and allows tank redundant data, a multi user system with remote access capability. It can be used as a client/server or stand alone package. Features:

- Inventory calculation
- Gauge operation
- LTD detail monitor
- Alarm generation
- Real time trending and historical trends
- Profile viewers
- Stratification analysis
- Skin temperature distribution graphic
- Schedule command, etc.

LNG tank management system (LMS): Rollover prediction software



The rollover prediction algorithms are based upon a lumped parameter model using energy and material balance equations. It allows the user to visualize the evolution of temperature, density and layer thickness of the stratified layers within a tank from an initial condition for temperature, layer depth and composition. The change in boil-off rate and vapour pressure can also be visualised with time. The model can be run for any profile available in the history by using the manual profile selection or automatic selection. The model can incorporate various tank operations such as tank filling (top or bottom), tank emptying (top or bottom) and external recirculation.

LNG tank skin temperature system (LMS): Cool down and leak detection software



The cool down and leak detection sensors, located around the base bottom, sides and roof of the LNG tank, are used to detect any abnormal in the shell insulation that may cause a leak of product. They are particularly used during the cool down and operation.

- View menu – skin temperatures
- List of cool down & leak temperatures
- Sensor configuration
- Visualisation
- Temperature maps
- Shell layer drop down selection
- Historical skin temperatures
- Thresholds / Trending / Alarms
- Set up communications



Inventory management – so much more than just a sensor

Reduce inventory costs and increase productivity with complete inventory visibility 24/7.

Monitoring and control of bulk liquids during processing, transportation and storage is challenging. You need to keep track of how much raw material you have on site and how much storage space you have available. Besides that the tank environment and relevant safety considerations are of high importance for your tank farm or terminal.

Precise data from the field are the baseline for inventory and supply chain management. Collection, consolidation and centralization of data becomes more and more important in the interconnected business world.

Our inventory management solutions support you:

- Highest transparency of product gain or loss balance by reconciliation of stock and in- and outflows in the plant or headquarters.
- Increase customer satisfaction by improving delivery performance and avoiding product run-outs or emergency deliveries.
- React fast and efficient to supply chain volatilities thanks to the optimization of the company's supply and value chain.
- Lower inventory management costs by integrating data in your systems, facilitating fast and effective data exchange with your partners and systems.
- Increase productivity with higher accuracy of your inventory monitoring and better planning capabilities.

40m vertical accuracy calibration facility

At Endress+Hauser Yamanashi in Japan, we are able to perform accuracy testing and highly precise calibration of level gauges for installation in large LNG tanks. This facility is the highest of its kind in the world.

This test facility is certified to conform OIML R85 standard:

- **Laser length measuring device:** minimum resolution 1µm or less.
- **NMI certification for test installation:** maximum uncertainty in the reference level reading of 0.02mm (at constant temperature).
- **Measuring range:** 40m (above ground 8m, underground 32m).



www.addresses.endress.com