SPECIAL INFORMATION

LIQUEFIED NATURAL GAS

SENSOR SOLUTIONS FOR THE LNG VALUE CHAIN

SICK
Sensor Intelligence.

TASKS IN THE OIL AND GAS INDUSTRY

The oil and gas industry needs to balance its efforts to meet the growing demand for energy with cost pressures and environmental sensitivity. Here, intelligent solutions are crucial for being successful in a highly competitive market. In many cases, the instruments at the core of these solutions are sensor-based technologies, which determine the volume and quality of hydrocarbons from wellhead to end customers, and from crude to final product. The data that modern sensors deliver lead to cleaner processes and greater efficiencies than ever imagined before. With a wide range of products and systems, SICK offers efficient sensor solutions to measure and perform even under the harshest operating conditions.

Metering

Due to the high monetary value of great volumes of gas being transported over long distances and even across country borders, highly accurate, real-time metering is crucial in any fiscal transaction between companies. Sensors and complete metering solutions from SICK are ideal for reliable and extremely robust gas flow measurements.

Measuring

Sensors from SICK provide plant operators with a reliable comprehensive data stream, allowing them to control and monitor anything from an individual industrial process to the overall surrounding installation, thereby ensuring confidence in the facility's environmental and regulatory compliance.

Quality control

The quality of the feedstock as well as of product streams have to be consistently checked along the entire value chain. By measuring the total stream composition, from the amount of by-products to simple residual impurities at trace levels, solutions from SICK ensure that the required quality level of feedstock, intermediate, and final products is achieved.

Emission monitoring

The regulatory requirements for emission monitoring are becoming more stringent worldwide. SICK solutions monitor and verify emission limits and the release of contaminant emissions and other substances into the environment. Trust the expertise of SICK when looking for appropriate solutions for particulate and gaseous emission monitoring.

Safety and protection

The safety and protection of industrial sites and their assets, as well as of personnel, is always the highest priority. SICK offers solutions to detect and prevent explosion hazards and to monitor toxic and/or corrosive substances in process streams and on emission stacks.

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SENSOR INTELLIGENCE. ALONG THE LNG VALUE CHAIN.

When being liquefied at temperatures below –162°C, the volume of natural gas reduces by a factor of about 600. Consequently, liquefied natural gas, or LNG, is very attractive for the transport and storage of large volumes of gas. SICK supports with best technical solutions from well to user.

FROM SHORE TO SHIP – FROM SHIP TO SHORE

Liquefied natural gas (LNG) can be supplied from point to point, from any export hub to any import terminal, just in time and at spot market prices. LNG increases the flexibility and lowers the costs and efforts of the world wide energy supply. Consequently, LNG is gaining market share in the midstream as well as downstream markets, where it is used, e.g., as the main fuel for vessel and vehicle fleets. And as the demand continues to grow, the infrastructure needed for production, transport, storage, and distribution of LNG is growing in parallel.

FOR YOUR SPECIFIC INDUSTRY

From the well to the end user markets, natural gas has to go through various processing steps including purification, fractionation, liquefaction, and regasification, and is traded between multiple entities. Consequently, process control, quality insurance, and fiscal metering for custody transfer have to happen many times along the value chain. Sensors and complete solutions from SICK provide information that is crucial for the gas industry for an efficient, safe, environmentally friendly and - last but not least - profitable business.

PERFORMING ACROSS THE BOARD

Natural gas in its gaseous or liquid form is a high quality product and represents a high value. Hence, any instrumentation must meet the highest standards in terms of precision, availability, durability, and low maintenance demands. SICK sensors are not only fulfilling their measuring tasks with outstanding performance. They also offer low operational costs and added value due to diagnostic functions that allow users to monitor the sensor and its environment at any time, anywhere.

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LNG PRODUCTION

Custody transfer – process control – gas flow metering

Feed gas metering

LNG is produced from purified dry natural gas supplied via a pipeline or by a nearby gas processing plant. Often, the gas is further processed in the liquefaction plant to minimize the content of components that are unfavorable for liquefaction like higher hydrocarbons, water, and CO_2. As a result, the measurement of the supplied gas volume and quality is crucial for the operation of the plant. Ultrasonic gas flow meters and metering solutions from SICK provide the reliable and precise data that is required.

→ www.sick.com/FLOWSIC600-XT

- FLOWSIC600-XT gas flow meter

CO_2 removal

Since it will freeze out at the low temperatures that occur during the liquefaction process, any excess of CO_2 might cause damage or blockage of downstream equipment like turbo expanders or heat exchangers. Therefore, the control of the residual CO_2 levels after removal is crucial for a safe plant operation. Gas analyzers from SICK are a proven solution to measure low ppm levels of CO_2 in gas streams.

→ www.sick.com/GMS800

- GMS820P UNOR/GMS840P UNOR gas analyzer

LNG boil-off recycling

Natural gas is liquefied at temperatures of about –162 °C at normal pressure. The unavoidable boil-off of gas from the liquid phase during LNG production, storage, and offloading is gathered and recycled for reliquefaction. Ultrasonic gas flow meters from SICK allow a precise and reliable fiscal metering of any boil-off losses inside a liquefaction plant even at cryogenic gas temperatures.

→ www.sick.com/FLOWSIC600-XT

- FLOWSIC600-XT gas flow meter

Flare metering

Flare stacks can be found on almost any oil and gas installation as part of the waste gas system and as a controlled vent for high volumes of combustible gases during an upset. By its nature, the pressure, the volume flow and the gas composition in a flare stack can differ significantly within short periods of time. Ultrasonic gas flow measuring devices are well suited for reliable process control of flares through accurate measurement, from almost zero flow to gas velocities up to 120 m/s.

→ www.sick.com/FLOWSIC100 Flare

- FLOWSIC100 Flare mass flow measuring device

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LNG TRANSPORT AND REGASIFICATION

Gas flow metering – emission monitoring – custody transfer

Measuring gas consumption in engines

LNG carrier are using their payload also as a fuel for the on-board gas engines. The internal gas consumption lowers the total value of the cargo shipped. Therefore, a high-precision flow measurement in the fuel gas preparation unit upstream of the engines is often required for fiscal purposes. The FLOWSIC600-XT ultrasonic gas flow meter from SICK does not feature any mechanically operated parts and is therefore well suited for the use on vessels or any other floating unit.

→ www.sick.com/FLOWSIC600-XT

- FLOWSIC600 gas flow meter

Emission monitoring on regasification boiler stacks

LNG is transported by vessels to any point in the world where an import terminal is available for receiving the LNG load. Here, the LNG is stored and distributed in liquid or gaseous form for further downstream use. The regasification can be performed, e.g., by means of gas-fired water bath boilers. In most regions of the world, local legislations are asking for continuous monitoring of gaseous emissions on the stacks of the regasification boilers. Here, SICK offers very cost-efficient solutions.

→ www.sick.com/POWERCEMS

- PowerCEMS50/100 emission monitoring system

Floating storage and regasification units (FSRUs)

Where an onshore LNG import terminal is not an option, e.g., due to the lack of space, an FSRU can be an alternative. The FSRU bunkers LNG delivered alongside by carrier vessels and regasifies it for further use onshore. As an FSRU can be considered a stationary source of gaseous emission by the harbor authorities, a continuous emission monitoring system (CEMS) might be required onboard. SICK's MARSIC analyzer solution was specifically developed and approved for the use on vessels.

→ www.sick.com/MARSIC

- MARSIC200/300 ship emissions measuring device

Sales gas metering

After regasification, the gas is sold to transport companies who bring the product to the market. Measurements must be carried out at custody transfer points in accordance with mutually agreed standards. Such large volumes translate to enormous amounts of money and even a small error can mean huge losses in revenue. The FLOWSIC600-XT gas flow meter from SICK, available with up to eight measurement paths, is certified to deliver the highest rated fiscal gas metering accuracy.

→ www.sick.com/FLOWSIC600-XT

- FLOWSIC600-XT gas flow meter

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DISTRIBUTION

Custody transfer

Small-scale LNG

LNG is also gaining more and more market share in downstream distribution and in the use of natural gas. Small-scale LNG liquefaction and regasification is seen as a suitable way to gain flexibility and to increase gas market coverage. Ultrasonic gas flow meters from SICK can be found at any point of custody transfer of gas and in the handling of boil-off losses from LNG storage and on-off-loading even at low pressures and flow rates.

→ www.sick.com/FLOWSIC600-XT

- FLOWSIC600-XT gas flow meter

City gates

Natural gas is delivered to consumers via pipelines or through LNG import terminals to local distributors at entry points known as city gates. Here, the gas is odorized and pressures are reduced. SICK's FLOWSIC500 ultrasonic gas flow measuring device is perfect for fiscal metering in distribution networks from city gates to industrial burners. Its unique design means virtually no maintenance and allows for installation in almost any piping configuration.

→ www.sick.com/FLOWSIC500

- FLOWSIC500 gas flow meter

Industry gates

Industrial users such as gas-fired power stations or cement plants have a high demand for natural gas and are very often directly supplied from a nearby pipeline, an LNG regasification plant, or an FSRU via so-called industry gates. As the most crucial part of the industry gate, SICK's ultrasonic gas flow meters offer the highest rated fiscal gas metering accuracy for both, the gas supplier and the end customer.

→ www.sick.com/FLOWSIC600-XT

- FLOWSIC600-XT gas flow meter

CNG/NGV fuel stations

Compressed or vehicle natural gas (CNG or VNG) is often regarded as an attractive alternative fuel for car, truck, and omnibus fleets because it is less expensive and has a lower environmental impact than liquid fuels. Ultrasonic gas flow meters from SICK overcome many of the problems associated with mechanical flow meters with regard to custody transfer of CNG/VNG delivered to the fuel stations.

→ www.sick.com/FLOWSIC500

- FLOWSIC500 gas flow meter

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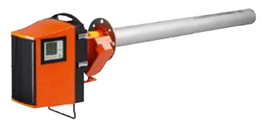
OFF-SITE AND UTILITIES

Environmental monitoring – flow metering – safety

Emission monitoring

Process units, utility boilers and ovens, thermal oxidizers or flare stacks for waste gas treatment, compressor stations and other ancillary installations have to be considered in a comprehensive environmental impact assessment. The selection of a continuous emission monitoring system depends on many parameters including fuel type and the kind of process. With an exceptional CEMS portfolio on the market, SICK offers solutions at the lowest possible cost of ownership.



→ www.sick.com/cems

- CEMS from SICK

Storage tanks

Huge tanks are used to build up a buffer stock for LNG or natural gas in order to manage supply and demand in terms of prices and volumes. Due to its bidirectional operation (filling and withdrawal) of gas tanks and the ability to measure gas flows with high precision even at cryogenic temperatures, ultrasonic gas flow meters are extremely suitable.

→ www.sick.com/FLOWSIC600-XT

- FLOWSIC600-XT gas flow meter

Surveillance of inertization or blanketing processes

Most oil and gas feedstock and products are flammable by nature. In order to prevent explosion hazards, the formation of explosive atmospheres must be avoided at all times. This task is accomplished by inertization or blanketing of the pipes and storage tanks with an inert gas like nitrogen. Laser oxygen transmitters from SICK minimize the consumption of the inert gases by monitoring the residual oxygen content in an inertization loop, with limited gas sampling and low maintenance required.

→ www.sick.com/TRANSIC100LP

- TRANSIC100LP laser oxygen transmitter

Organic residues in process water or waste water

In the oil and gas industry, the contamination of process water, surface, and waste water with hydrocarbon compounds is a constant risk. Therefore, the concentration of organic compounds in water from cooling and heating systems, steam boilers, and in water treatment plants is continuously monitored using TOC analyzers. SICK offers solutions for real-time, low-maintenance TOC measurement based on UV or thermal oxidation, which can be used in hazardous areas.

→ www.sick.com/TOCOR700

- TOCOR700 total organic carbon customized analyzer system

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PROVEN SENSOR TECHNOLOGIES . . .

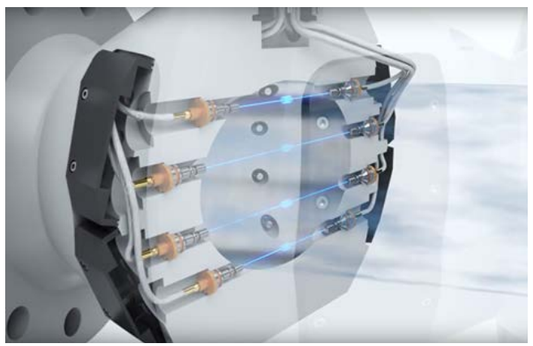
Ultrasonic sensors from SICK

All FLOWSIC products are equipped with high-performance ultrasonic sensors developed by SICK. A hermetically sealed titanium housing contains ultrasonic transducers that operate at a selectable ultrasonic frequency of 80 kHz, 135 kHz, 200 kHz, or 300 kHz to match the operating conditions. The sensors can also be deployed at very high or very low temperatures (from –194 °C to +280 °C), at high pressures (up to 450 barg), under corrosive conditions, and with heavy background noise. They exhibit unrivaled reliability in sound-absorbing gases that are high in carbon dioxide. The FLOWSIC devices feature an efficient sensor for performing measurements at atmospheric pressure, allowing calibration using air. The high parameter quality of the sensors provides the basis for precise transit time measurement that is stable in the long term and accurate to within a few nanoseconds. The ultrasonic sensors are electrically intrinsically safe (“ia”, with device protection level Ga).

Measurement principle: Direct path layout

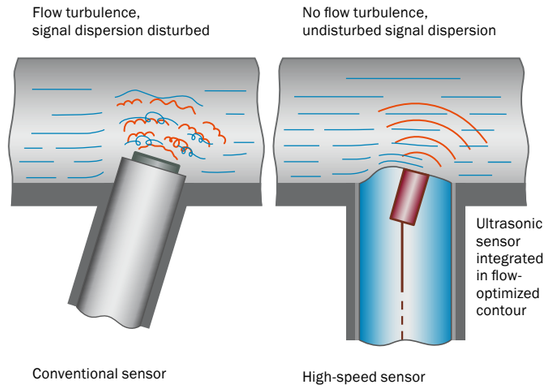
The transit time difference principle is used for performing ultrasonic gas flow measurement. This measurement principle uses ultrasonic transit time to determine the gas flow rate. The direct path layout minimizes the influence of turbulence, contamination, moisture, and background noise. Two ultrasonic sensors are installed opposite each other at a specific angle to the gas flow and operate alternately as a transmitter and receiver.

If no gas is flowing, the pulses spread out at the same speed (speed of sound) in both directions. In a flowing gas, the pulse in the direction of flow moves faster and the pulse against the direction of flow is slower. This means that the transit time in the direction of flow (tAB) is shorter and the transit time against the direction of flow (tBA) is longer. The transit time differences of the acoustic signals are thus an indication of the flow rate of the gas in the measuring volume.



High-speed sensor design

An innovative sensor design has been developed for the challenging measurement of flare gas. The ultrasonic sensors are embedded in a flow-optimized contour that has been specially designed for high gas flows – for example for flare gas. The unique sensor design reduces flow noise and signal drift to a minimum and provides stable and reliable measured values. The optimized two-stage signal algorithm offers optimum signal processing across the entire measuring range. The innovative design is implemented in the FLOWSIC100 Flare and enables measurement of gas velocities of up to 120 m/s.



Advantages: the big five

High level of measurement certainty and self-diagnosis
The FLOWSIC devices are self-monitoring. In the event of an issue, such as change in electronics performance or contamination, the meter will generate an alarm. This means that there is no need for maintenance on a timed basis – resulting in a reduced cost of ownership.

Power supply: no problem
Due to PowerIn Technology™, both FLOWSIC500 and FLOWSIC600-XT measure fail-safe in intrinsically safe line-powered operation with battery backup. This allows to continue operating even when the main power supply fails.

Insensitive to overload
Ultrasonic gas flow meters from SICK do not get harmed by overloading. They process dynamic load changes without any loss in accuracy. Measuring ranges of more than 100:1 can be realized.

Approved worldwide
FLOWSIC devices comply with all relevant standards and regulations for natural gas distribution. This also includes the international requirements for explosion-proof areas.

Increased measurement reliability
The ultrasonic technology ensures the highest level of availability. It operates with no mechanical moving parts, and is not liable to wear. This provides stable measurement certainty in the long term.

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. . . AND MEASUREMENT PRINCIPLES

In-situ gas analysis

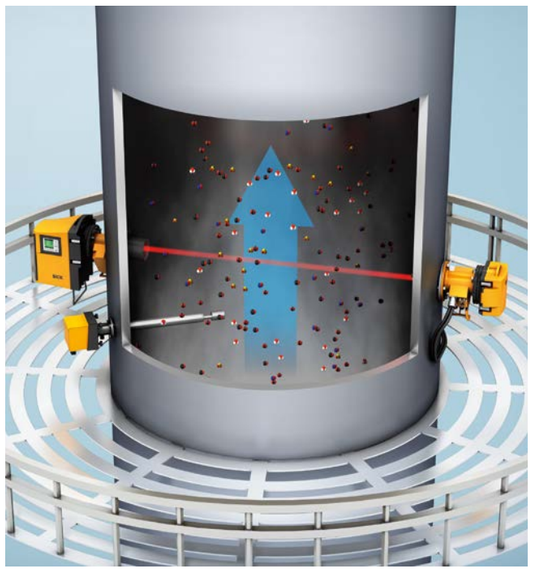
Thanks to SICK´s innovative in-situ measurement technology, the measuring devices can be mounted at the measurement location directly in the duct through which the gas flows. This solution features minimal maintenance requirements and very short response times.

SICK provides two in-situ versions

- Cross-duct: for measurement results across the entire duct cross-section
- Measuring probe: optimized for single-sided installation allowing simple integration into an extremely varied range of system conditions. For example, overpressure, wet gases, or very high test gas concentrations and dust loads

Advantages

- Continuous and direct measurement, no sampling
- Cross-duct version for representative measurement results or measuring probe version for simple installation
- GMP measuring probe with open measuring gap or GPP gas diffusion probe



Extractive gas analysis

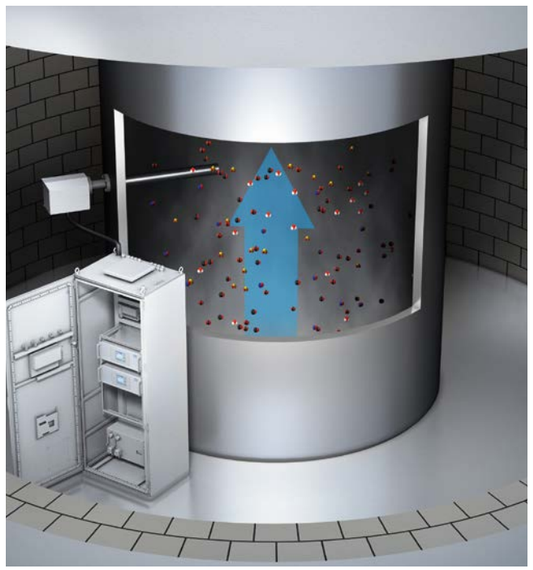
If the process do not permit a direct measurement, the measured medium must be extracted from the process. A partial gas flow is extracted from the gas duct, prepared and fed to the analyzer module under constant conditions. Depending on the process requirements and the gas components, SICK offers complete solutions: from the sample probe, to the optimized gas conditioning, to the right analyzer modules.

Two variants of measurement technology are available

- Hot-extractive measurement technology: All components that come into contact with the test gas are heated and kept above the dew point. The analysis is done under constantly hot measurement conditions and yields accurate results, even with very narrow measuring ranges. Ideal for detection of multiple gas components as well as water-soluble components such as HCl, HF or NH_3.
- Cold-extractive measurement technology: The gas sampling is optionally designed with a heated or unheated test gas line. Gas drying is achieved with a high-performance gas cooler. The “cold” measurement is handled by the analyzer.

Advantages

- Configurable analyzer modules for a wide range of applications
- Customized solutions designed for numerous possible measuring components
- Accurate and reliable measurement results
- Detection of aggressive, corrosive, or combustible gases



Effective monitoring of dust concentration in explosion-hazardous areas

Dust measuring devices from SICK have proved themselves for many decades in various industries and applications. Due to the ongoing development of their technical features, they can now detect even very low concentrations of dust. This high precision is based on forward-oriented scattered light principle which is independent from gas velocity and particle charges. With their customized and approved design, dust measuring devices from SICK can even be used in explosion-hazardous areas.

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BEST PERFORMANCE UNDER ANY CIRCUMSTANCES

Ultrasonic gas flow measuring devices, analyzers, and dust measuring devices from SICK are build for the same purposes: highest precision and measurement performance where needed, reliable operation even under harshest conditions, compliance to safety requirements, industry standards, and environmental legislation. Whatever the task is, sensor solutions from SICK will do the job, every day, for many years.

Ultrasonic gas flow meters from SICK – quality that pays for itself

Every day, large quantities of natural gas flow from production facilities to municipal utilities and industrial consumers via large pipelines. Ownership of the gas often changes hands and must be precisely measured for billing purposes. SICK´s product range comprises custody and non-custody ultrasonic gas flow meters for the oil and gas industry. SICK provides the right solution for various applications, from gas delivery to gas distribution. All devices feature high measurement accuracy and reliability.

Gas mass flow measurement from SICK – reliable under all conditions

Mass flow measuring devices from SICK are used for flow measurement of gas in the natural gas and petrochemical industries. The devices are specifically designed to the challenging requirements of these industries and provide reliable measurement of various gases. These devices are approved for use in explosion-proof areas and use integrated algorithms to calculate mass flow in a system.

Reliable gas analysis – even under harsh process conditions

SICK´s extractive gas analyzers can be used in a large number of applications. The extractive measurement technology extracts a partial gas flow from the gas duct, conditions the extracted gas and feeds it to an analyzer module under constant conditions. All the measurement technology that SICK offers – from gas sampling and conditioning right through to the numerous analyzer modules – is perfectly tailored to the measurement task concerned.

Real-time gas analysis directly within the process

Innovative measurement technology that allows the devices to be mounted directly at the measurement site: In-situ gas analyzers take measurements directly within the process under system conditions. These analyzers are primarily characterized by their minimal maintenance requirements and extremely short response times. SICK´s in-situ gas analyzers are available in two different versions:

- The cross-duct version for representative measurement results across the entire duct diameter
- The measuring probe version, optimized for single-sided gas duct installation

Simple, fast, and low maintenance

When it comes to creating gas analyzers that can serve as field instruments, gas transmitters are the next logical step. A gas transmitter requires barely any additional technical aids to perform the measurement task. In many cases, there is no need for costly sampling and gas conditioning either.

The reliable way to detect low dust concentrations

Light scattering by dust particles is a measurement principle that allows even very low concentrations of dust to be detected. Depending on the system-specific requirements, either forward scattering or backward scattering can be used in this context. Both measurement principles return stable and reproducible measurement results, regardless of the gas velocity, humidity, or dust particle charges.

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EVERYTHING FROM METERING RUNS TO CHALLENGING METERING SKIDS

Flow metering systems from SICK incorporate leading ultrasonic metering technology and are delivered as customized, turnkey solutions in the form of metering skids or metering runs. The FLOWSIC gas flow meter, as the heart of the system, ensures precise measurement. Due to their high precision level, flow metering systems from SICK are also perfect for LNG applications with lowest measurement uncertainty.

Custody transfer metering systems

Incorporate the leading ultrasonic metering technology from SICK into your custody transfer metering system. Customized solutions from SICK comprise complete metering systems including gas analyzers and monitoring systems.

Multiple solutions from SICK have already proven themselves in onshore and offshore applications in the LNG industry, e. g., metering systems for LNG import and export terminals as well as FSRUs, FLNGs, and LNG bunkering facilities.

From concept to beyond completion: SICK stands for extensive project experience with regard to metering systems.

Analyzer systems

SICK offers analyzer systems starting from a simple rack-mounted gas-chromatograph to complete analyzer houses including air-conditioning, fire and gas detection, and extinguishing systems to provide a controlled environment for your specific metering application.

The planning, engineering and manufacturing the final product in house at SICK is always combined with experience and knowledge for customized requirements. All is carefully integrated into metering systems, ensuring their required accuracy. Optimized solutions from SICK help customers increase their flexibility and lower their operating costs.

Monitoring systems

Measurement performance data can be monitored by a metering monitoring computer. Connected to the flow computers and the associated instruments, the monitoring computer generates reports of the performance of your metering system. Additionally, it includes features such as flow balancing and automatic line switching. All our solutions can be integrated into the operators DCS/SCADA/PCDA systems.

Technology from SICK enables you to specifically adapt your monitoring system to the metering system. SICK provides monitoring systems that meet individual customer requirements. Thereby, customers can rely on the comprehensive experience of SICK with all the major monitoring software on the market.

Station control systems

SICK designs, engineers, builds, tests, and installs complete control systems. Such a system is usually integrated into the metering system, but can also work separately, serving for monitoring, automation, and verification as well as the communication between metering station and main control system of the plant.

From simple stand-alone flow computers to sophisticated panels incorporating redundancy and the latest monitoring and HMI systems: The system will be completely engineered, integrated, wired, and tested by experienced SICK engineering teams according to international standards and regulations.

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EVERYTHING FROM STAND-ALONE DEVICES TO COMPLETE ANALYZER SYSTEMS

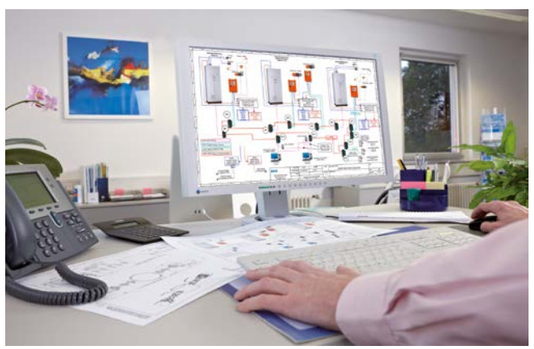
SICK provides standard solutions as well as customized system solutions for the oil and gas industry – both designed to withstand the harsh ambient conditions often found at installation sites.

Project management according to internationally recognized methods

SICK ensures globally consistent and effective project management. No matter in which country our customers award a project contract to SICK, our experienced international project teams provide consistent project results based on the same high standards of quality. These teams support the projects by helping with the contract award, controlling scheduled project delivery deadlines, increasing the on-site system acceptance, and updating the project documentation in consultation with the customer. The responsible project team remains available even after the conclusion of the project. Since it begins supporting complex projects as early as in the bidding phase, it is ensured that all project requirements are understood correctly and included in the bid.

Custom planning and engineering

Planning and engineering at SICK is based on decades of practise in emissions and process monitoring. SICK's engineers use the latest CAD/CAE systems to plan and design solutions for meeting the plant requirements. Latest analyzer and sample conditioning technology as well as current communications interfaces ensure rapid data transfer. Systems are designed in accordance with national and international standards. Implemented solutions are extensively and clearly documented. The system documentation thus forms the basis for a comprehensive project documentation and thus supports the fast supply of spare parts. Customers can rely on an experienced project team and a worldwide service organization during commissioning and afterwards so that a reliable and sustainable system operation is ensured.



Ready-to-use analyzer containers

Whether used for emissions or process measurements, the analyzers should be installed in the immediate vicinity of the measurement points. Analyzer containers have the important function to protect the highly precise measuring systems and signal processing devices from the harsh ambient conditions at the installation site.

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SICK AT A GLANCE

SICK is a leading manufacturer of intelligent sensors and sensor solutions for industrial applications. With more than 8,000 employees and over 50 subsidiaries and equity investments as well as numerous agencies worldwide, we are always close to our customers. A unique range of products and services creates the perfect basis for controlling processes securely and efficiently, protecting individuals from accidents and preventing damage to the environment.

We have extensive experience in various industries and understand their processes and requirements. With intelligent sensors, we can deliver exactly what our customers need. In application centers in Europe, Asia and North America, system solutions are tested and optimized in accordance with customer specifications. All this makes us a reliable supplier and development partner.

Comprehensive services round out our offering: SICK LifeTime Services provide support throughout the machine life cycle and ensure safety and productivity.

For us, that is "Sensor Intelligence."

Worldwide presence:

Australia, Austria, Belgium, Brazil, Canada, Chile, China, Czech Republic, Denmark, Finland, France, Germany, Great Britain, Hungary, Hong Kong, India, Israel, Italy, Japan, Malaysia, Mexico, Netherlands, New Zealand, Norway, Poland, Romania, Russia, Singapore, Slovakia, Slovenia, South Africa, South Korea, Spain, Sweden, Switzerland, Taiwan, Thailand, Turkey, United Arab Emirates, USA, Vietnam.

Detailed addresses and further locations → www.sick.com

SICK
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