

▶ Intelligent solutions
for tank monitoring



KROHNE
Marine

CARGOMASTER®

Product overview | Tank monitoring systems

CARGOMASTER®



▶ CARGOMASTER® The complete solution for tank monitoring and alarm

The CARGOMASTER® system is a complete solution for tank monitoring and alarm. The system can combine readings from all tanks onboard into modern and easy-to-use software.

Combined with our high precision cargo level radar OPTIWAVE 8300 C Marine, CARGOMASTER® offers unique benefits for tanker operators.

In addition to tank monitoring, the system may include monitoring of pumps and cargo lines and integration to other systems onboard.

Company facts

- The Marine Centre within the KROHNE Group, taking care of all business related to ship systems and solutions
- Delivering systems for ships since 1957
- Based in Brevik - Norway
- More than 850 cargo tank level systems delivered
- Active development of measurement technology and solutions
- Certified ISO 9001-2000
- Developed the world's first computerized level gauging system (1979)
- Acquired by KROHNE in 2004, after successful cooperation since 1992

KROHNE Marine A leading provider of advanced tailor made tank monitoring systems

Through more than 50 years in marine business, KROHNE Marine has gained extensive knowledge regarding what it takes to deliver high quality products to demanding ship operators and yards. Systems have been installed on all kinds of vessels, from the smallest product tankers to the most complex chemical tankers and VLCCs.

A network of service stations and sales agents are representing the company in main shipping hubs and shipbuilding countries around the globe.

KROHNE Marine offers a wide variety of solutions and instruments for monitoring liquids onboard ships (e.g. cargo, ballast, fuel, other consumables). Different instruments and measurement techniques may be combined in one system to obtain the highest versatility and redundancy.



Delivered to more than 850
ship installations world wide:

- **Tankers**
 - Chem. tankers (IMO I, II, III)
 - Product-, Oil-, and Juice tankers
 - VLCCs
 - Tank barges
 - FPSOs
- **Supply ships**
 - AHTS, PSV, DSV
- **Bulkers**
- **Container ships**
- **Reefers**
- **Cruise ships and ferries**
- **Heavy lift vessels**
- **Drilling rigs**
- **Production platforms**
- **LPGs, FSUs**

CARGOMASTER®

The complete solution

- 1 CARGOMASTER® Computer Unit (CCU)**
- Workstation with CARGOMASTER® monitoring and alarm software
 - For full redundancy on monitoring, the system may be set up in multiple configurations

- 2 CARGOMASTER® Signal Control Unit (SCU)**
- Main cabinet with electronics for handling all sensor signals and communication to other systems

- 3 Cargo level radar installation**
- Measurement of cargo ullage/level
 - Inert gas pressure (IGP) sensor mounted on radar flange

- 4 Stillwell installation with cargo level radar**
- Measurement of level in narrow tanks

- 5 Cargo temperature sensors installation**
- Measures average cargo temperature and cargo temperature from individual sensors
 - Installed in separate pipe or integrated in deep-well pump (2 or 3 sensors pr. cargo tank)

- 6 Cargo manifold and vapour return line pressure sensor installation**
- Measurement of pressure in cargo lines, manifolds, pumps and vapour recovery line
 - Instant response on pressure changes

- 7 Guided level radar installation**
- Alternative to cargo level radar for measurement of level in various tanks (e.g. slop, residual, LPG and ballast)
 - Measurement of oil/water interface

- 8 Pressure sensor installation**
- Measurement of cargo tank level, IGP and temperature
 - Robust and accurate pressure sensors with integrated temperature sensors
 - Inert gas pressure (IGP) sensor mounted in deck junction box

- 9 Submerged pressure sensor installation**
- Measurement of level in ballast tanks
 - Sensor clamped to fastening bracket close to tank bottom

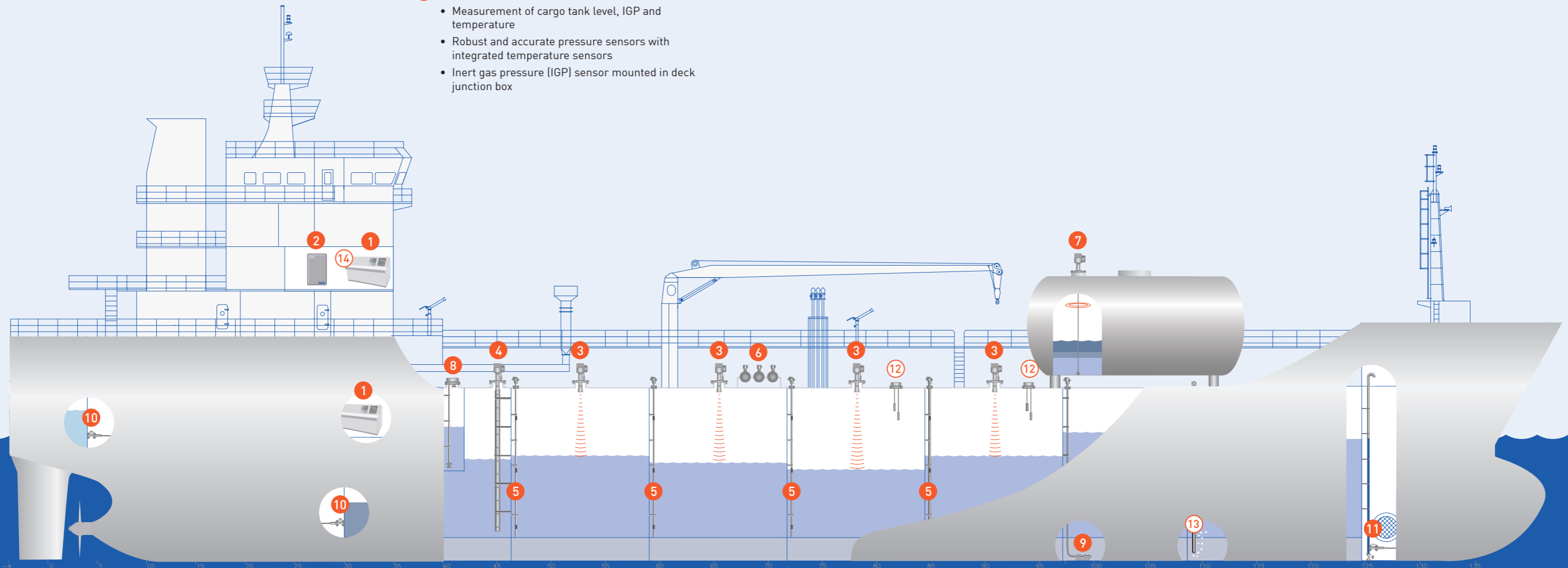
- 10 Sidemounted pressure sensor installation**
- Measurement of level in ballast, fuel, freshwater and similar tanks
 - Sensor mounted outside the tank, optionally with isolated valve

- 11 Draught pressure sensor installation**
- For draught measurement

Sub systems:

- 12 Independent high level system**
- For overfill (98%) and high level (95%) alarm
 - Magnetic float or solid state based
- 13 Air purge ballast system**
- Alternative system for measurement of ballast, fuel and draught levels

- 14 Loading calculator**





CARGOMASTER® Typical system layout

A CARGOMASTER® system is normally built up of these main parts:

CARGOMASTER® Signal Control Unit

The Signal Control Unit (SCU) is handling all sensor signals and communication to other systems and the CARGOMASTER® Computer Unit. The cabinet is normally placed in Cargo Control Room (CCR) or adjacent room for easy cabling and access. The SCU contains terminal blocks for deck cabling, interface modules and zener barriers for intrinsic safety.

CARGOMASTER® Computer Unit

The CARGOMASTER® Computer Unit (CCU) is a marine type approved (IACS approved) Microsoft Windows computer. The CARGOMASTER® monitoring and alarm software is an easy-to-use and powerful tool to obtain a full picture of tank contents and liquid cargo operations.

Uninterrupted Power Supply

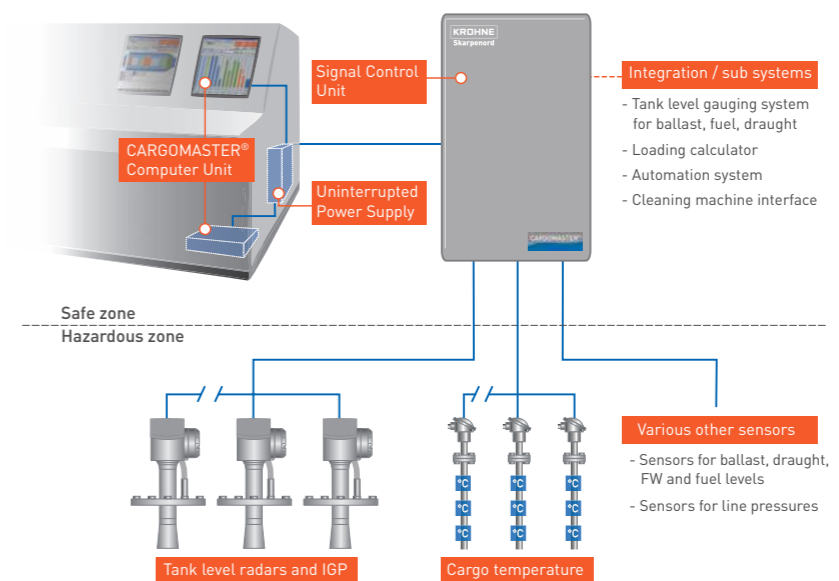
The Uninterrupted Power Supply (UPS) secures that the system will run for at least 30 minutes after a complete power loss in the ship.

Tank sensors

In cargo tanks, various sensors are installed to measure relevant physical values:

- Cargo level radars for measuring ullage
- Pressure sensors for measuring tank pressure / inert gas pressure
- Temperature sensors for measuring tank temperature

Other sensors (e.g. sensors for ballast, draught, FW, fuel and lines) can be integrated to obtain complete monitoring.



▶ Intelligent solutions for tank monitoring



CARGOMASTER® Monitoring and alarm software

The CARGOMASTER® system provides measurement of all relevant tank data:

- Ullage/level
- Volume (based on volume tables)
- Loading/discharging rate
- Weight and cargo density
- Inert gas pressure
- Tank temperature
- Cargo manifold pressure

Alarms may be configured for all values, securing the highest degree of safety in operations.

Flexible and easy-to-use software

With selectable screen setup, the operator may choose to show only the tanks of interest (manually or automatically), leaving unwanted information in the background. Should something unexpected happen, automatic warnings will give notice to the operator and consequently alarms will occur. With extensive functions for reporting, you can make printouts covering your needs.

Maintenance friendly

Based on MS Windows, which is well known to people onboard, potential service and maintenance can normally be performed by crew. With experts on line, a problem may be corrected quickly and easily, saving time and money. The CARGOMASTER® software has been approved and is certified for onboard use by all major classification societies.

Redundancy

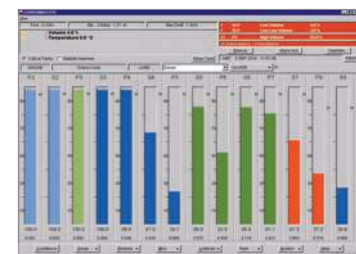
The CARGOMASTER® system can be set up in multiple configurations for full redundancy and distribution of information. Doubling of computers in CCR will also give a better overview of operations.

Integration

The CARGOMASTER® system is normally interfaced to several other systems, such as ship's automation system, vessel management system and loading calculator. Also, sub systems may be integrated to provide full overview to the operator.



Tank plan view



Bar graph view



OPTIWAVE 8300 C Marine Cargo Level Radar (FMCW)

The OPTIWAVE Cargo Level Radar is a highly accurate and reliable instrument for measuring the ullage/level. With its heavy duty stainless steel housing, it is designed to withstand the roughest conditions on deck.

Well protected by a stainless steel cover, it carries a backup display for redundant indication. Loading may continue with a man on deck, if level information is lost on the main monitoring station.

State of the art technology

The OPTIWAVE 8300 C Marine introduces well tested and proven state of the art radar technology in the marine sector. First of all the KROHNE 24GHz technology (FMCW principle with 2GHz sweep) represents a giant leap forward in signal to noise ratio. In more spoken words; the radar's ability to see actual tank contents under the most difficult situations is well secured.

By minimizing the effect of fog, foam, movements, sloshing, disturbances and low reflection, the OPTIWAVE gives you the ullage under the worst conditions.



▶ Bring easiness to your daily work

OPTIWAVE 8300 C Marine, is unique when it comes to redundant indication, closed tank cleaning and closed tank service. With these three operational benefits, the OPTIWAVE will save operational costs in various critical situations as well as save hassle during daily routines.



The OPTIWAVE grants redundancy on tank monitoring

Even in a worst case scenario where a central component in the monitoring system fails, ullage will always be obtainable on the OPTIWAVE level radar display on deck. The OPTIWAVE calculates and displays all level data locally before transmitting to CCR.



Thorough cleaning of the radar antenna without opening the tank

All level radars may require cleaning of antenna if contaminated by cargo. Opening the cargo tank in a safe and approved way requires cleaning and venting of the tank. The OPTIWAVE radar antenna may be cleaned with closed tank, which saves time and efforts and protects ship's crew from being exposed to cargo vapours.

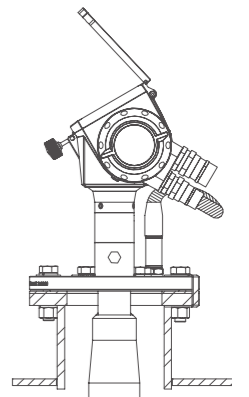


Replacement of radar can be done by ship's crew

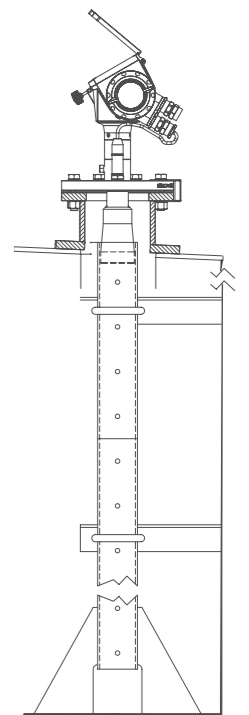
The OPTIWAVE radar is a robust piece of equipment, but even with state of the art equipment things may go wrong and most certainly at the most unwanted time. It is good to know that the complete calibrated part (including transmitting/receiving antenna) can be replaced with closed tank.

Joint development

Together with KROHNE's radar research and development expert centres in Germany and France, The OPTIWAVE is developed to be one of the most modern and cost saving radar gauges in the market. Including unbeaten operational benefits, time and money may be saved on daily routines and unwanted situations.



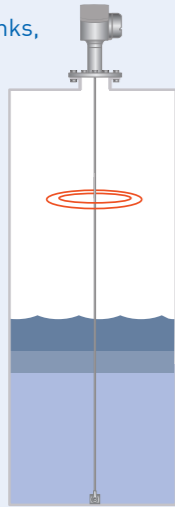
Standard installation
Mounted on a small deck socket / trunk



Stillwell installation
Radar waves guided to tank bottom, avoiding unwanted reflections

Highlights OPTIFLEX

- Measures level and oil/water interface
- Measures low reflecting cargoes
- Not affected by clogging
- Ideal for narrow tanks, needs only 60 cm radius free space
- Types of applications:
 - Slop tank levels
 - Ballast tanks
 - Curved tanks
 - LPG
 - Liquid CO2



OPTIFLEX 4300 C Marine Guided Level Radar (TDR)

The OPTIFLEX 4300 C Marine offers accurate and reliable level gauging in various applications not fully covered by standard cargo level radars. Based on Time Domain Reflectometry (TDR) measuring principle, the instrument signal is guided by a stainless steel wire, reducing the requirement for free space.

Measurement of level and oil/water interface

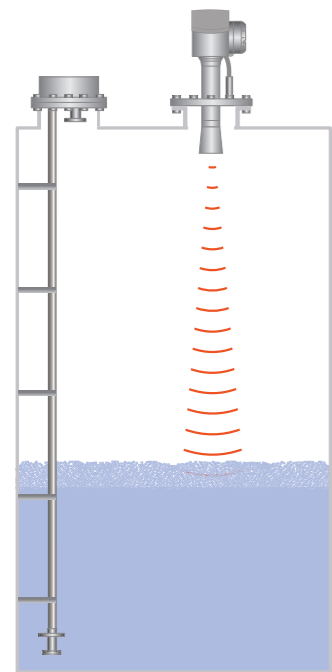
The OPTIFLEX measures level and can detect two levels from the same wire installation. Consequently both oil and water level can be measured in a tank using only one instrument.

▶ World leading in sensor technology

For more than 30 years we have been working closely with our sensor manufacturers for development of sensor technology. All our sensors are carefully tested to withstand demanding environments onboard ships.



Hybrid Level Gauging



By combining two measurement technologies in the same tank, you are secured reliable measurements for all tanks and conditions

KROHNE Skarpenord offers highly accurate OPTI-WAVE Cargo Level Radars for measuring level in cargo tanks. However, it is a known problem that in some tanks radar wave propagation may be disturbed or blocked by tank shape, steel constructions or piping. In such difficult tank level measuring applications, a standard level radar installation may not fully cover the needs for monitoring.

We have developed our Hybrid Level Gauging concept to provide tanker operators reliable level gauging in all types of applications. Combining the OPTI-WAVE Cargo Level Radar and P-105 Precision Pressure Sensor in the same tank will secure accurate and reliable level indications at all tank levels. In the CARGOMASTER® software a switch point between the two different measurement technologies is set. The system will use the level radar as primary instrument and the pressure sensor will be used below the switch point. Together, the level radar and pressure sensor will also calculate the cargo density.

As a supplier of both level radar and pressure sensors for cargo monitoring applications, we can offer hybrid solutions unaffected by any disturbance.



P-105 Precision Pressure Sensor

Cargo level monitoring

With integrated temperature sensor and self calibration functionality, the P-105 offers reliable tank readings. As the pressure sensor is submerged, it is unaffected by foaming and heavy condensation. Made in Inconel, the sensor is suitable for installation in tanks carrying acids. P-105 is also used in combination with level radars as a hybrid installation.

Typical applications P-105:

- Precision measurement of level in tanks with special chemicals, small tanks and tanks that are not suited for a level radar installation
- Secondary system in Hybrid Solution, in combination with OPTI-WAVE 8300 C



P-130 Titanium Pressure Sensor

Tank level monitoring

The P-130 has successfully been installed in all kinds of tanks. Made in high grade Titanium, it is highly resistive to corrosive warm ballast water. The P-130 offers high repeatability, providing good level readings in the long run. We offer various installation methods, allowing the sensor to be installed in all liquids but acids and corrosive chemicals.

Typical applications P-130:

- Measurement of level in various tanks (e.g. ballast, FW, fuel, lub oil and sludge)
- Draught measurement



P-140 Cargo Manifold and Pump Pressure Transmitter

Manifold and pump pressure monitoring

The P-140 has a robust design suitable for deck mounting. Mounted on cargo lines, the sensor will monitor pressure during cargo operations. The sensor installation is designed for easy maintenance.

Typical applications P-140:

- Cargo lines, manifolds and pump pressure
- Vapour recovery line pressure

Need urgent assistance? Service engineers are only a phone-call away

To support you and your operations, our world wide network of service stations is trimmed to provide you high quality and right support at any time. Our first priority is always to try to solve problems remotely, guiding your own crew. Should our attendance be necessary, we are only a call away. We have spares available world wide.

Our team of service engineers receives regular training, both in the newest technology and sailing installations. By contacting KROHNE Marine, we ensure you that our skilled engineers and application technicians will follow any case until a successful result has been achieved.



Upgrades

KROHNE Marine has supplied level gauging products for more than 30 years and we take pride in maintaining our installations onboard for the lifetime of your ship. At a certain point, an overhaul or exchange of old computers or electronics may be necessary. In such cases we can offer tailored upgrading kits that will prolong the lifetime of the system, at a minimum cost.

Most of our CARGOMASTER® v.1 systems have been upgraded after 20 years of service and have got a new life. The ships are now sailing with new top end electronics and monitoring computers. Original sensor installations may be kept as installed in tanks.

Retrofits

KROHNE Marine have long experience in complete retrofit jobs. We are able to offer complete solutions including all necessary work

To save costs, we work closely with the ship's crew to find the most effective solutions for installation and work. We have successfully upgraded and retrofitted numerous vessels.

For upgrades and retrofits KROHNE Marine can offer from all our Service Stations:

- Onboard survey, to make a good plan for all work
- Supervision during installation
- Installation work
- Commissioning of the new system



► KROHNE Innovation combined with knowledge

KROHNE ranks among the world's leading companies involved in the development and production of innovative and reliable process measuring technology, providing solutions for all sectors around the globe.

KROHNE was founded in 1921 in Duisburg. It has more than 2.500 employees, 15 production facilities and owns 43 companies and joint ventures.

KROHNE is always a fair and reliable partner to its customers, business partners and employees. Customers are provided optimal products and solutions which always meet or exceed their expectations in terms of quality, performance capability, service and design.



KROHNE has continuously invested significantly in new technologies, facilities, human resources and quality procedures. Calibration is carried out on the world's most accurate calibration systems.

Over 50 years of experience:

1955
Production of mechanical level meters for measuring liquids in tanks and containers.

1989
KROHNE introduced the first FMCW radar level meter for process tanks, which made us pioneers in using radar level measurement technology in process applications.

1995
KROHNE launched the first TDR guided radar meter. It was able to reliably determine the level of liquids & solids as well as liquid interface.

2000
KROHNE developed the first FMCW radar device in 2-wire design.

2004
The next quantum leap in level measurement came with the OPTIWAVE and OPTIFLEX series, a generation of contactless and guided radar devices with a unique wizard-driven operating concept.

2009
Introduction of the innovative Drop antenna for OPTIWAVE. Its ellipsoidal shape makes it ideal for corrosive liquids or dust-laden atmospheres where product build-up is likely to occur. With the Drop antenna, purging systems become obsolete.

▶ KROHNE Marine's world wide network of support



For more information and offers/quotes,
do not hesitate to contact us

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Service Stations and Sales Agents

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