Application Note

Monitoring crude oil tanker gas hazards



Modern civilization is largely dependent on the products of oil and vast quantities are transported throughout the World.

Crude tankers move large quantities of unrefined crude oil from the point of extraction to refineries where the crude is refined into specific Hydrocarbon strings (dependent on the crude oil constituents).

The design of a tanker is largely dependent on its intended purpose and aspects like a high rate of loading/discharging is essential, as is pumping capacity and the size of the pipelines.

Due to the extreme flammability of the materials that are carried on these types of vessel, safety is a key concern and this includes the provision of a fire smothering installation and cofferdams (a water-tight space left open between bulkheads to give protection from fire, heat or collision), at the ends of cargo spaces, ventilating pipes and also tanks, etc.

As well as fire suppression, portable gas detection is also an essential component of tanker safety to protect against both flammable and toxic gas detection risks.

Constituents of crude oil

Crude oil is a complex mixture of thousands of different Hydrocarbons and varying amounts of other compounds containing Sulphur, Nitrogen, and Oxygen as well as salts, trace metals, and water. Crude oils can vary from a clear liquid, similar to gasoline, to a thick tar-like material that needs to be heated to flow through a pipeline. Crude can contain a mix of Hydrocarbon types including Aromatic Hydrocarbons (also known as Arenes/Aryl Hydrocarbons), like Benzene and Unsaturated Hydrocarbons (also known as Alkenes/Alkynes) like Ethylene.

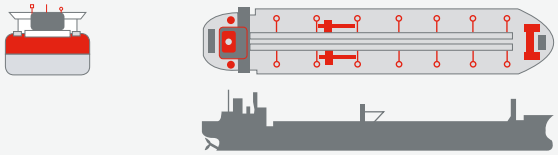
Crude is highly flammable and potentially toxic creating the need for enhanced safety onboard crude oil carrying tankers.

Tanker classification under International Maritime Organisation (IMO)

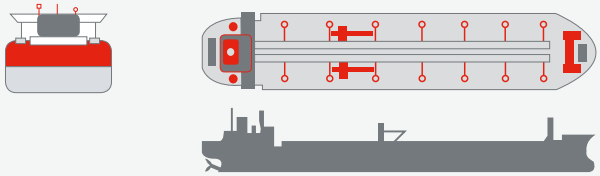
The International Maritime Organisation (IMO) categorises tanker ships in the following ways:

Category 1: oil tankers of 20,000 deadweight tonnes (DWT) and above carrying crude oil, fuel oil, heavy diesel oil or lubricating oil as cargo, and of 30,000 DWT and above carrying other oils, which do not comply with the requirements for protectively located segregated ballast tanks (commonly known as Pre-MARPOL tankers).

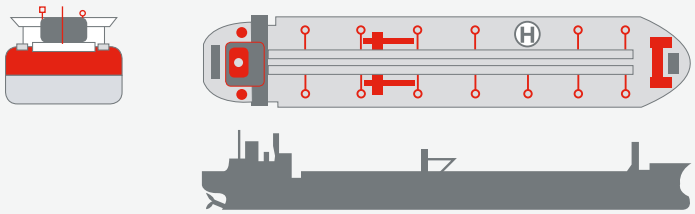
Panamax 55.000 - 80.000 DWT



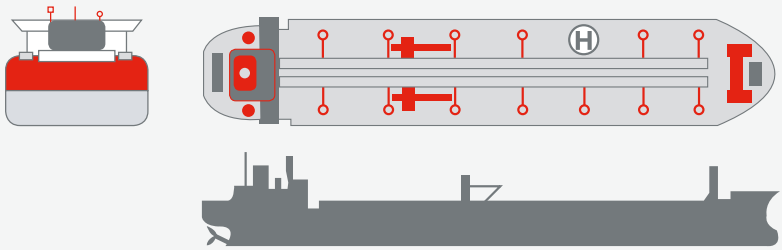
Aframax 75.000 - 120.000 DWT



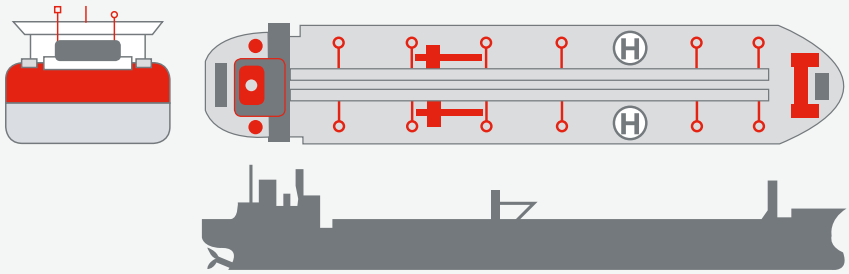
Suezmax 120.000 - 200.000 DWT



V.L.C.C. 200.000 - 320.000 DWT



U.L.C.C. 325.000 DWT



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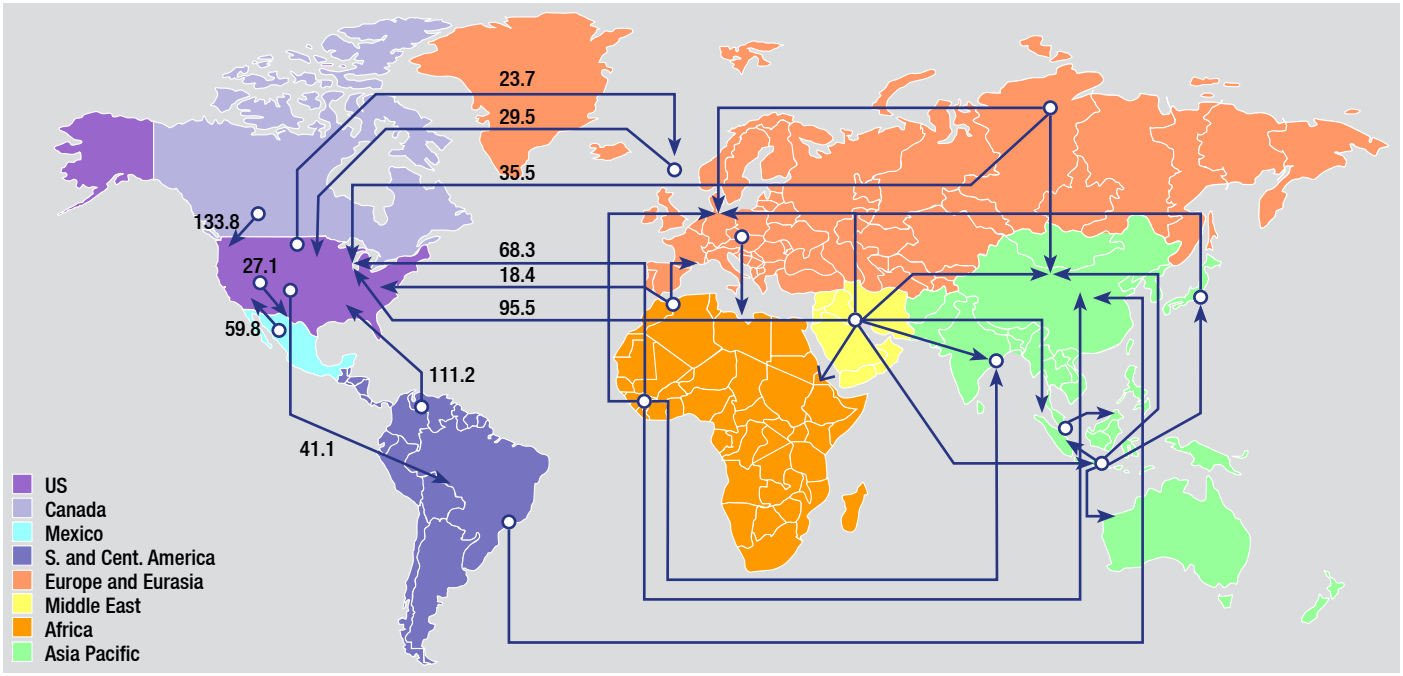


Major crude oil and refined products World trade movements

Category 2: as Category 1, but complying with protectively located segregated ballast tank requirements (MARPOL tankers).

Category 3: oil tankers of 5,000 DWT and above but less than the tonnage specified for Category 1 and 2 tanker.

Types of crude oil tankers

Tanker capacities are stated in terms of DWT cargo or barrels (BBL). DWT is measured in Long Tonne (LT) of 2,240 pounds. One BBL is equal to 42 US gallons.

Oil tankers can also be classified by types, based on their displacement.

Panamax: the largest oil tanker that can pass through the Panama Canal: 70,000 DWT.

Aframax: an oil tanker smaller than 120,000 metric tonnes, with a breadth above 32.31 m/106 ft. It takes its name from the Average Freight Rate Assessment (AFRA) tanker rate system (a system devised to calculate freight charges for AFRA-affiliated companies). Due to their size, they can serve most ports in the World: 70,000 – 120,000 DWT.

Suezmax: the largest oil tanker that can pass through the Suez Canal: 120,000 - 200,000 DWT.

The shuttle tanker: a tanker that has emerged since oil exploration went offshore and into deeper and more remote waters; where pipelines to shore are neither feasible nor economical. They are largely conventional tankers which are equipped to station themselves on an offshore loading buoy, far out at sea. The cargo load comes directly from the oil field where it has been kept in a reservoir (often with Sulphur removed).

In most respects the shuttle tanker looks similar to any other crude carrier, but the most noticeable difference is the extra equipment at the bow of the vessel for single point mooring/unloading.

Shuttle tankers need enhanced manoeuvrability compared to other tanker types and they are also faster with 16 knot capabilities: 120,000 DWT.

Very Large Crude Carrier (VLCC): a large oil tanker: 200,000 - 325,000 DWT.

Ultra Large Crude Carrier (ULCC): the largest oil tanker (these are no longer being built): 325,000 DWT.

Design of crude oil tankers

Tank configuration

The International Convention for the Prevention of Pollution from Ships (MARPOL 73/78 – which is an abbreviation for Marine Pollution), is the international convention that governs the prevention of marine pollution resulting from ships (both operational and accidental release), and Annex I deals with oil pollution. Tanker hull design is strongly influenced by MARPOL regulations.

Oil tankers usually feature eight to twelve tanks. Each of the vessel's tanks are split into independent compartments by fore and aft bulkheads. The tanks are assigned numbers with tank one being the forward-most (towards the bow). Individual compartments are referred to by their tank number and position, i.e. "one port" or "three starboard".

Cofferdams

Tankers usually have cofferdams forward and aft of the cargo tanks and in some cases between tanks.

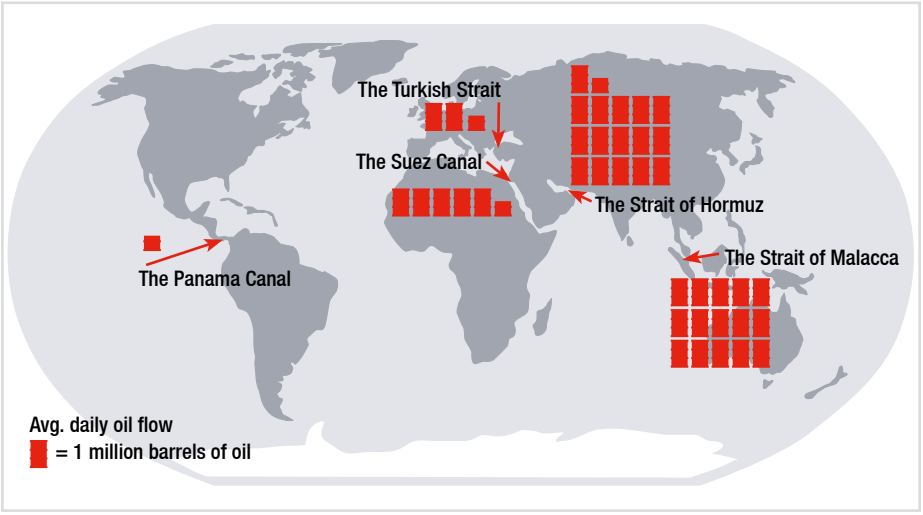
Pump rooms

A pump room is a space that houses all the pumps connected to the ship's cargo lines. Pump rooms are often located aft (aft port), so that power may easily be supplied to the pumps from the engine room, but ships designed to carry many grades of oil simultaneously may be fitted with two pump rooms located in such a way that they divide the cargo space into three sections.

Application Note

Monitoring crude oil tanker gas hazards





Daily crude oil flow

The system of pipelines used in a tanker is such that great flexibility is possible in the method of loading or discharging and different parcels of cargo may be completely isolated from one another during loading and subsequent discharging. In some cases a small, separate line is used for stripping the last few inches of oil from each tank.

Portable gas detection requirements for crude oil tankers

The use of portable gas detectors is regulated and mandatory:

SOLAS Reg II-2/ 4.5.7.1 (May 1999, Rev.1Nov2005 and Rev2 Feb2012)

SOLAS requires that oil tankers shall be equipped with at least one portable instrument for measuring Oxygen and one for measuring flammable vapour concentrations, together with a sufficient set of spares. Suitable means shall be provided for the calibration of such instruments.

In addition, tankers fitted with inert gas systems should use at least two portable gas detectors that are capable of measuring concentrations of flammable vapours in inerted atmosphere.

The requirement of Reg.II-2/4.5.7.1 for one portable instrument measuring Oxygen and one measuring flammable vapour concentrations and spares for both is met when a minimum of two instruments - each capable of measuring both Oxygen and flammable vapour concentrations are used onboard. Alternatively, two portable instruments for measuring Oxygen and two portable instruments for measuring flammable vapour concentration can also be used.

Revised MARPOL Annex VI, Reg 15 VOCs

Volatile Organic Compounds (VOCs) are to be controlled by a vapour emission control system (VECS) onboard any oil tanker flying the flag of a MARPOL Signatory State, which is in compliance with the safety standards laid down in MSC/Circ.585.

The following sensors are recommended for use:

- Photo Ionisation Detector (PID)
- Oxygen sensor
- Combustible/flammable sensor (catalytic bead/IR)

Revised MARPOL Annex VI, Reg 14 Sulphur Content

The Sulphur content of any oil fuel intended for use on board ships flying the flag of a MARPOL Annex VI Signatory State should not exceed 3 ppm/4.5 mg/m^3 except in designated SOx (the family of Sulphur Oxides) Emission Control Areas (SECAs), where the maximum Sulphur content of any fuel oil used will be further limited to 0.5 ppm/1.5mg/m^3 or, where post combustion treatment is utilised, the emission rate is limited to a maximum of 6.0 g SOx/kWh.

The Sulphur content of each parcel of oil fuel intended for use onboard a ship will also require documentation by means of a Bunker Delivery Note, which must be kept on board for a period of three years after delivery of the fuel.

Revised MARPOL VI/13 NOx (the family of Nitrogen Oxides) Emissions MEPC.176(58) - Marine Environment Protection Committee. This regulation shall apply to:

- Each marine diesel engine with a power output of more than 130 kW installed on a ship
- Each marine diesel engine with a power output of more than 130 kW which undergoes a major conversion on or after 1st January 2000, except when demonstrated to the satisfaction of the Administration that the engine is an identical replacement to the one being replaced

The operation of a marine diesel engine installed on a ship constructed on or after 1st January 2000 and prior to 1st January 2011 is prohibited, except when the emission of Nitrogen Oxides (NOx) calculated as the total weighted emission of NOx from the engine is within the following limits, where n = rated engine speed (crankshaft revolutions per minute):

- 17.0 g/kWh when n is less than 130 rpm;
- 45. $n^{(-0.2)}$ g/kWh when n is 130 rpm or more (but less than 2,000 rpm);
- 9.8 g/kWh when n is 2,000 rpm or more.

The operation of a marine diesel engine installed on a ship constructed on or after 1st January 2011 is prohibited, except when the emission of NOx (calculated as the total weighted emission of NOx) from the engine is within the following limits, where n = rated engine speed (crankshaft revolutions per minute):

- 14.4 g/kWh when n is less than 130 rpm
- 44. $n^{(-0.23)}$ g/kWh when n is 130 rpm or more (but less than 2,000 rpm)
- 7.7 g/kWh when n is 2,000 rpm or more

The following sensors are recommended for use:

- Oxygen sensor
- Combustible/flammable sensor
- Carbon Monoxide sensor
- Sulphur Dioxide sensor
- Nitrogen Dioxide sensor

MARPOL Annex IV Sewage

Compliance with Annex IV became mandatory on 1st August 2005 for ships flying the flag of a Signatory State of MARPOL Annex IV. Ships to be provided with a sewage treatment plant approved by the Administration as compliant with resolution MEPC.2(VI) and be provided with a standard discharge connection per regulation 11. Ships built before 2nd October 1983 should comply with Annex IV, as far as is practicable.

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Monitoring crude oil tanker gas hazards



The following sensors are recommended for use:

- Oxygen sensor
- Combustible/flammable sensor
- Carbon Monoxide sensor
- Hydrogen Sulphide sensor

Crude oil tanker applications requiring monitoring

Portable gas detectors are an essential part of Personal Protective Equipment (PPE). They keep personnel safe from a myriad of potential hazards including chemicals, fire and explosions from flammable materials and dangerous atmospheres from confined spaces. The following aspects of a crude oil tanker require monitoring with portable gas detectors:

- Air emissions in the tanker environment
- Wastewater monitoring
- Hazardous materials and oil being stored
- Any other waste materials on the vessel

Air emissions

During loading, storage and transportation of crude oil on tankers, VOCs are emitted to the atmosphere. Evidently, the emission represents a loss of considerable monetary value. But any potential adverse effect they could have on the environment is considered of greater importance than lost revenue.

The VOC emission process happens during loading of cargo, carriage of cargo and also crude oil washing.

The VOC emission is determined by various parameters including:

- The composition and temperature of the loaded cargo
- The vessel motion
- Operational parameters such as loading time for each cargo tank, cargo tank pressure and amount of crude oil washing

The following sensors are recommended for use:

- Photo Ionisation Detector (PID) sensor
- Oxygen sensor
- Combustible/flammable sensor (catalytic bead/IR)

Hydrogen Sulphide (H_2S)

Personnel working in the oil tanker industry are generally familiar with the hazards associated with the presence of Hydrogen Sulphide (H_2S) in Hydrocarbon products (crude) carried as cargo.

However, it is less widely known that marine bunkers may also be a source of H_2S gas.

With this in mind, the SOLAS Regulation VI/5-1 requires a vessel to carry a Material Safety Data Sheet (MSDS) – a mandatory requirement since 1st January 2011. The MSDS should feature information regarding the composition of the fuel including the concentration of H_2S, the effects of exposure to the gas and the first aid measures to be taken in the event of an exposure.

It is important to recognise that there is no direct correlation between the concentration of H_2S produced and the oil in the bunker. These issues cannot be predicted with accuracy as they depend on many factors including the chemical properties of the oil, temperature, viscosity, heating, storage time, agitation, tank shape and ventilation. This means that gas monitoring is essential for optimal safety.

When H_2S is present in a bunker fuel, the concentration of gas inside a bunker compartment will often exceed the declared H_2S content of the bunker by a significant margin because the H_2S is recorded in its liquid phase concentration; particularly in tanks with limited natural ventilation or within closed systems.

Although the toxicity of H_2S gas remains the primary hazard, lesser long-term risks include corrosion within bunker tanks and pipelines (known as Sulphide stress cracking), and damage to other system components.

If the amount of H_2S gas inside a tank exceeds the Oxygen content, further risks are created. H_2S may react with Iron Oxide (rust) to form pyrophoric Iron Sulphide. Pyrophoric Iron Sulphide deposits may emit considerable heat when in contact with air and can act as a source of ignition. As a by-product of this reaction, Hydrogen and water are produced.

The International Standards Organisation (ISO) Fuel Standard ISO 8217:2010 limits the H_2S content of residual and distillate marine fuels to 2 ppm (mg/kg by weight in the liquid - not as a vapour/gas concentration). The H_2S limit has applied since 1st July 2012.

Other recommendations include adding suitable guidance on the dangers of H_2S in marine bunkers to the Safety Management System (SMS), providing vessels with a correctly calibrated H_2S portable gas detector and training appropriate personnel in their use. In fact, any personnel on deck should always be protected with an H_2S monitoring portable device.

The following sensors are recommended for use:

- Hydrogen Sulphide sensor
- Carbon Monoxide sensor
- Oxygen sensor
- Combustible/flammable sensor (catalytic bead/IR)

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Tank cleaning

Tank cleaning and degassing can generate significant quantities of VOCs and tank degassing vapours should be routed to an appropriate emissions control device.

Other practices include restricting cleaning activities to a season when the potential for atmospheric Ozone formation is reduced or a time of the day when the potential for Ozone formation is less (VOCs react with Nitric Oxide and sunlight in the atmosphere to form “smog”, which is also known as “low-level Ozone”, causing an environmental hazard).

The internal area of tanks should be periodically inspected. Subsequent frequency of inspections should be governed by the results of the previous inspection.

The following sensors are recommended for use:

- Photo Ionisation Detector (PID)
- Hydrogen Sulphide sensor
- Carbon Monoxide sensor
- Oxygen sensor
- Combustible/flammable sensor (IR)

Ideal monitoring solutions for this application include:

- Impact Pro IR (to check Oxygen and flammable levels in inert atmospheres)
- PHD6™
- GasAlertMicro 5 PID
- GasAlertMicroClip XT (port area)
- GasAlertQuattro (attendant)

Full product details are provided later in this application note.

Inert gas system monitoring

L.S Regulation 30 and SOLAS Ch II-2 Regulation 4.5.5 requires that tankers of 20,000 DWT or over carrying flammable bulk liquid cargoes, i.e. crude oil and petroleum products with a flash point that does not exceed 60°C/82.4°F, require an inert gas system complying with the requirement contained in Schedule 9 of MSN 1666(M) or the FSS code, dependent on date of tanker build.

An Inert Condition (IC) is defined as a cargo atmosphere with 8% or less Oxygen concentration through the addition of inert gas, which displaces the Oxygen. The system can be fed by the exhaust gases, by an inert gas generator or by Nitrogen.

Crude oil tankers use two key processes to generate inert atmospheres:

- Ships with main or auxiliary boilers normally use the flue gas, which contains typically only 2- 4% vv of Oxygen. This gas is scrubbed with sea water to cool it and to remove Sulphur Dioxide and particulates, and it is then blown into the tanks through a fixed pipe distribution system
- On diesel engine ships the engine exhaust gas contains too much Oxygen to be used for inerting. An inert gas generating plant is often used to produce gas by burning diesel or light fuel oil. The gas is scrubbed and used in the same way as boiler flue gas

Non-return barriers in the form of a deck water seal and non-return valves are maintained between the machinery space and deck distribution system to ensure no petroleum gas or liquid petroleum passes back through the system to the machinery space.

The double hull and double bottom spaces of tankers that require an inert gas system have connections for the supply of inert gas.

The following sensors are recommended for use:

- Photo Ionisation Detector (PID)
- Hydrogen Sulphide sensor
- Carbon Monoxide sensor
- Oxygen sensor
- Combustible/flammable sensor (IR)

Ideal monitoring solutions for this application include:

- Impact Pro IR (to check Oxygen and flammable levels in inert atmospheres)
- PHD6™

Full product details are provided later in this application note.

Hot Work (HW)

As with all hot work being carried out in any environment, monitoring with gas detection is essential.

The following sensors are recommended for use:

- Photo Ionisation Detector (PID) sensor
- Hydrogen Sulphide sensor
- Carbon Monoxide sensor
- Oxygen sensor
- Combustible/flammable sensor (catalytic bead/IR)

Ideal monitoring solutions for this application include:

- Impact Pro IR
- PHD6™
- GasAlertMicro 5
- GasAlertMax XT II
- GasAlertQuattro
- GasAlertMicroClip XT
- MultiPro™

Full product details are provided later in this application note.

Crude oil tank washing

To satisfy the control measures for tank washing in inert atmospheres, measures must be taken to verify that the atmosphere in the tank is non-flammable (Oxygen content must not exceed 8% vv), and that the atmosphere is also at a positive pressure.

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Considerations before tank washing

The tank bottom should be flushed with water, so that all parts are covered. The water is then stripped.

This flush should be undertaken using the main cargo pumps and lines. Alternatively, permanent pipe work extending the full depth of the tank can be used. This flush should not be undertaken using the tank washing machines.

The piping system, including cargo pumps, crossovers and discharge lines, should also be flushed with water. The flushing water should be drained to the tank designed or designated to receive slops.

The tank should be ventilated to reduce the gas concentration of the atmosphere to 10% or less of the Lower Explosive Limit (LEL) (a pre-wash with cold water can also be considered). Gas tests must be made at various levels and due consideration should be given to the possible existence of pockets of flammable gas, in particular in the vicinity of potential sources of ignition such as mechanical equipment that might generate hot spots, e.g. moving parts such as those found in intake (submerged) cargo pump impellors.

Tank washing with heated wash water may only commence once the tank atmosphere reaches 10%LEL or less.

Considerations when washing with heated wash water

Stratified atmosphere testing of the whole tank should be frequently carried out to monitor any change in LEL percentage.

Consideration should be given to the possible effects of water on the efficiency of the gas measuring equipment (an IP 66/67 rating will prevent issues resulting from water ingress).

Mechanical ventilation should, whenever possible, be continued during washing. The ability to mechanically ventilate concurrently with tank washing is recommended but, where mechanical ventilation is not possible, the monitoring of the tank atmosphere should be more frequent as the likelihood of rapid gas build-up is increased. If a gas monitor produces a high alarm, tank washing MUST cease immediately.

Washing may be resumed when continued ventilation or a cold pre-wash reduces the concentration at or below at 10% LEL.

If the tank has a venting system that is common to other tanks on the vessel, the tank must be isolated to prevent ingress of gas from other tanks.

The following sensors are recommended for use:

- Photo Ionisation Detector (PID)
- Hydrogen Sulphide sensor
- Carbon Monoxide sensor
- Oxygen sensor
- Combustible/flammable sensor (IR during sampling)
- Combustible/flammable sensor (in diffusion mode for continuous tank monitoring)

Ideal monitoring solutions for this application include:

- Impact Pro IR
- PHD6™
- GasAlertMicro 5
- GasAlertMax XT II
- GasAlertQuattro
- GasAlertMicroClip XT
- MultiPro™

Full product details are provided later in this application note.

Cargo Heating System

The cargo tanks and the slop tanks are equipped with a cargo heating system. The purpose of the system is to heat the crude up to a temperature where its viscosity will allow transportation via the cargo pumping system.

The following sensors are recommended for use:

- Photo Ionisation Detector (PID)
- Hydrogen Sulphide sensor
- Carbon Monoxide sensor
- Oxygen sensor
- Combustible/flammable sensor (catalytic bead/IR)

Ideal monitoring solutions for this application include:

- Impact Pro IR
- PHD6™
- GasAlertMicro 5
- GasAlertMax XT II
- GasAlertQuattro
- GasAlertMicroClip XT
- MultiPro™

Full product details are provided later in this application note.

Inspection of oil tanker cargo tanks

On oil tankers, regular internal inspection of cargo tanks is essential to monitor the effectiveness of anti-corrosion measures. Initial corrosion is caused by the acids inherent in crude oil, but the flexing of the ships structure along with the mandatory double hull design can cause further stress.

The following sections examine the safety precautions that are to be observed by crew members and officers before and during tank inspection.

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Tank Inspection Safety Precautions

A Permit to Enter Cargo Tanks Certificate (PTEC) will be issued once the following checks have been carried out:

- **Tanks must be certified gas-free:** Gas-freeing is the responsibility of the Chief Officer who uses the ship's inert gas system, from a dedicated plant or from the ship's engines or boiler exhaust fumes. A gas detector is used to confirm this condition (monitoring is required for: Oxygen, combustible/flammable catalytic bead/IR and PID)
- **Ventilation:** Vent fans must be run in extraction mode during tank inspection and regular samples should be taken to ensure the air within the tank contains 20.9% Oxygen, less than 1% explosive gases and 0% toxic gases, i.e. Oxygen, Nitrogen Dioxide, Sulphur Dioxide and VOCs depending on the area)
- **Gas monitoring:** Tanks under inspection must be continuously monitored to ensure levels do not exceed recommended values, carried out by the Chief Officer on watch.
- **Portable gas monitors:** These must be worn at all times during tank inspection; any alarm must be followed by immediate exit from the tank
- **Radio contact:** Radio contact with personnel must be maintained at all times during tank inspection
- **Rescue equipment:** All rescue equipment must be readily available in case emergency evacuation of personnel from the tank is required

Ideal monitoring solutions for this application include:

- Impact Pro IR
- PHD6™
- GasAlertMicro 5
- GasAlertMax XT II
- GasAlertQuattro
- GasAlertMicroClip XT
- MultiPro™

Full product details are provided later in this application note.

Confined space entry

The main confined spaces in a crude oil tanker are the tanks (including ballast tanks, cargo tanks and fuel tanks).

The following sensors are recommended for use:

- Photo Ionisation Detector (PID) sensor
- Hydrogen Sulphide sensor
- Carbon Monoxide sensor
- Oxygen sensor
- Sulphur Dioxide sensor
- Nitrogen Dioxide sensor
- Combustible/flammable sensor (catalytic bead/IR)

Ideal monitoring solutions for this application include:

- Impact Pro IR
- PHD6™
- GasAlertMicro 5
- GasAlertMax XT II
- GasAlertQuattro
- GasAlertMicroClip XT
- MultiPro™

Full product details are provided later in this application note.

Honeywell Gas Detection: meeting the requirements of crude oil tankers

Honeywell Gas Detection, which comprises the brands BW Technologies by Honeywell and Honeywell Analytics, offers a range of high-performance multi-gas portable monitoring solutions optimised to meet the needs of marine applications.

Portable multi-gas detectors

Impact Pro IR

High specification, 4-gas simultaneous monitoring solution designed to meet the needs of the most challenging marine applications with MED approval and ATEX Ex ia certifications. Impact Pro also features an integrated automatic pump, making it a highly flexible solution.

PHD6™

Simultaneous monitoring of up to six gas hazards with 18 sensor choices, including PID for the low-level detection of CO_2 and CH_4. PHD6™ features an integrated blackbox data recorder and event logger that records gas hazards experienced during operation. (Compatible with the Biosystems IQ6™ Multi-Gas Docking Station). Certifications include ATEX Ex ia.

GasAlertMicro 5 Series

Compact and lightweight, GasAlertMicro 5 Series instruments are available in diffusion or pumped formats. These portable gas detectors simultaneously monitor and display up to five gas hazards. Model variants include the GasAlertMicro 5 PID model for the low level detection of VOCs and GasAlertMicro 5 IR for CO_2 monitoring. Certifications include ABS approval and ATEX Ex ia.

GasAlertMicroClip XT

The slim and compact GasAlertMicroClip XT provides affordable protection from up to four gas hazards. With simple one-button operation, this device offers ultimate ease of use and significantly reduces the time spent training the user. Certifications include ABS approval and ATEX Ex ia.

GasAlertQuattro

Rugged and reliable, the GasAlertQuattro four-gas detector combines a comprehensive range of features with simple one-button operation. The graphic LCD displays easy to identify icons that indicate operational information, such as bump test and calibration status for simplified onsite auditing. With ABS, MED and ATEX Ex ia certifications, GasAlertQuattro is the ideal marine monitoring solution.

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Monitoring crude oil tanker gas hazards



GasAlertMax XT II

The rugged GasAlertMax XT II monitors up to four gas hazards and combines straightforward one-button field operation with an integrated sampling pump. Tamper-proof, user-adjustable options enable the instrument to be customised to suit application needs. Certifications include ABS approval and ATEX Ex ia.

MultiPro™

4-gas device with real-time simultaneous readings, simple one-button operation and a large easy-to-read LCD display. MultiPro™ features an integrated blackbox data recorder and event logger as standard. An optional screw-on pump with automatic leak test and low flow alarm is also available. (Compatible with the Biosystems IQ Express™ Multi-Gas Docking Station). Certifications include ATEX Ex ia.

Automatic portable device testing solutions

It's essential to ensure optimal device operation by carrying out regular maintenance including bump testing. A bump test, which exposes a portable gas detector to a known concentration of gas to check it alarms and responds in the presence of gas correctly, should be carried out daily (best practice guidance). Automatic test solutions from Honeywell Gas Detection provide quick, simplified, minimal training solutions to daily bump testing.

MicroDock II

The MicroDock II is an easy, cost-effective way to bump-test, calibrate and charge a device as well as manage records. Fully compatible with the complete BW Technologies by Honeywell product range, its accompanying Fleet Manager II software allows the user to download information faster than ever from the MicroDock II. Improved functionality allows the creation of accurate and user-friendly reports, print receipts of calibration, sort and graph data and archive information, helping to dramatically simplify fleet management activities.

Enforcer

Designed for use with the Impact range of portable gas detectors, Enforcer is a small, lightweight test and calibration station that is fully portable. With no batteries or mains power required, Enforcer permits quick testing on the move and helps to reduce the ongoing cost of portable device maintenance.

ToxiPro® IQ Express Docking Station

A fully automated bump test, calibration and datalogging station for use with the ToxiPro® portable range, allowing four devices to be linked to a single gas supply. Connects to a PC via USB port or Ethernet (optional).

Multi-Pro™ IQ Express Docking Station

A fully automated bump test, calibration and datalogging station for use with the MultiPro™ range of portable gas detectors. Connects to a PC via USB port or Ethernet (optional).

IQ6™ Docking Station

A fully automated bump test, calibration and datalogging station for use with the PHD6™ range of portable gas detectors. Connects to a PC via USB port or Ethernet (optional).

References:

Oil tanker types (source Los buques tanque y su clasificación. Petrotecnia. April 2004)

International Maritime Organization IMO: RESOLUTION MEPC.176(58):MEPC 58/23/ Add.1 ANNEX 13

International Safety Guide for Inland Navigation Tank-barges and Terminals: Chapter 33 Types of gas carriers

International Safety Guide for Inland Navigation Tank-barges and Terminals: Chapter 11 Shipboard operations

INTERNATIONAL MARITIME ORGANIZATION: FORMAL SAFETY ASSESSMENT FSA – Crude Oil Tankers

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