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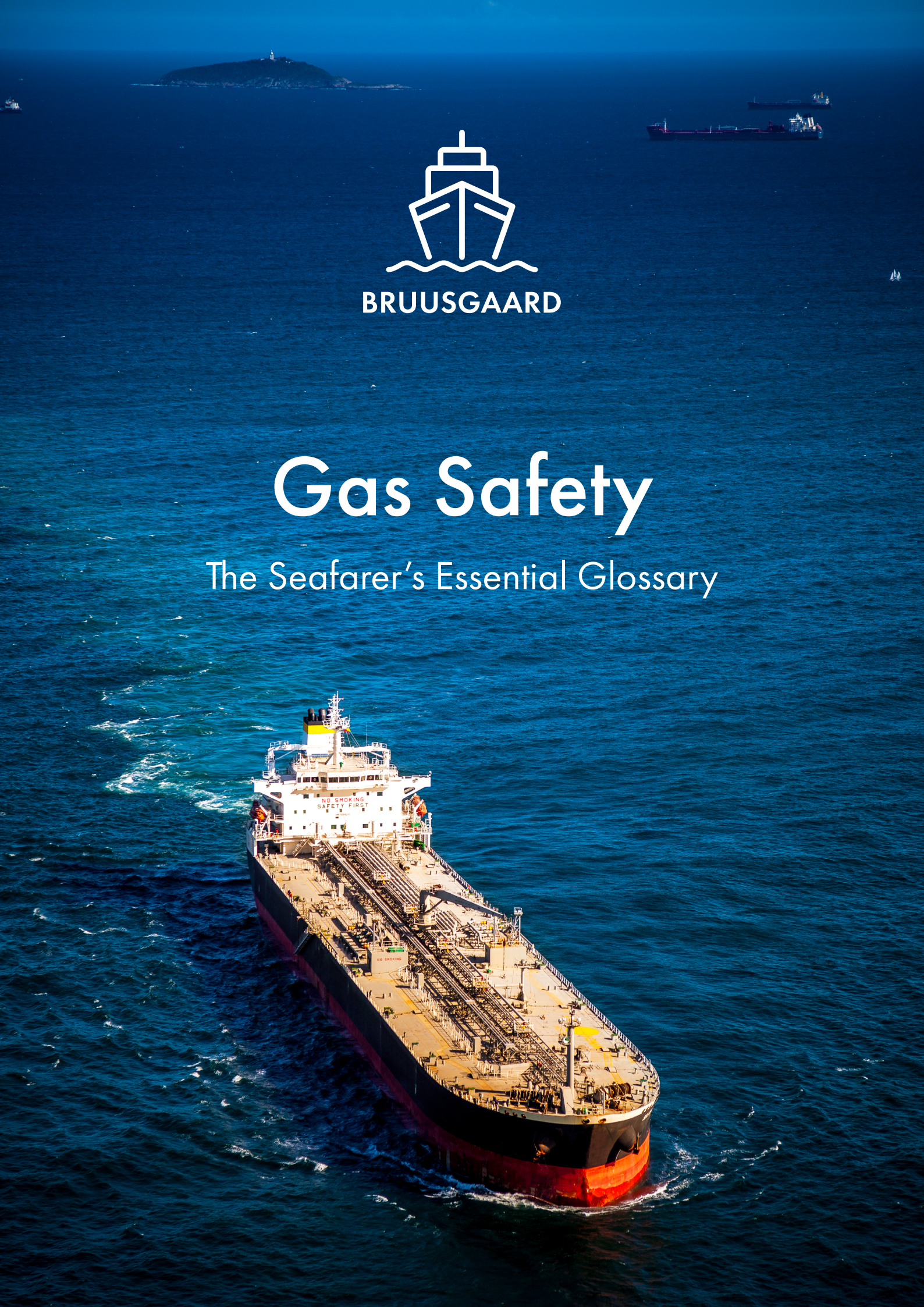
# Gas Safety

## The Seafarer's Essential Glossary



Dear seafarer,

This glossary contains the terms we regard as the bare minimum you should be familiar with for establishing basic gas safety on board. We've separated the terms in different categories, for your convenience.

Make it your priority to maintain first-rate gas detection capabilities. It really can be a life-or-death matter. We strongly recommend that you build on the insights you gain from this glossary, and complete a thorough assessment with a competent partner.

Good luck, and safe travels!

Sincerely,

**Martin Bruusgaard AS**

# INDEX



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# GAS DETECTION

## Alarm set point

The selected gas concentration level where an alarm is activated/triggered.

## Bump test

Exposing a sensor to a known concentration of gas to verify accurate response.

## Calibration

Exposing and adjusting a sensor to a gas with a known concentration.

## Calibration gas

A reference gas/mixture with known or certified content. Used for verification and adjustment of analytical gas sensors.

## CBT

Short for Computer Based Training. Gas safety is part equipment, part training. An on-board computer-based training program allows all crew members to receive proper training, covering:

- operation of instruments
- evacuation procedures
- first-aid competence

## Consumables

Spares that need to be changed on a regular basis to maintain continuous operation.

## Diffusion

The flow of a substance (liquid or gas) from a region of high concentration to a region of low concentration. The movement is driven by the random motion of molecules. One example is the interaction between a drop of lemon juice and drinking water.

## Direct indicating tubes

Pre-calibrated detection tubes for gases based on a qualitative colour change and a readout scale for quantification.

## Expiry date

The date when a spare should be replenished.

## Gas cylinder

A canister that contains gas.

## Gas measuring instruments

Instruments with one or more sensors that will detect and quantify levels of gas.

# GAS DETECTION

## Instrument report

A vessel's set-up of gas detecting instruments and equipment.

## On-board calibration

Gas detection instruments need regular calibration. Some systems, like The Bruusgaard System, allow you to do this on board. The conventional approach is to send the gas detection equipment ashore for calibration. In that case, the vessel needs the double amount of sensors, as it is required to be equipped for gas detection at all times. On-board calibration eliminates surplus equipment and calibration detours.

## Personal gas detector

A gas detector for individuals. Crew members can carry these at all times.

## Portable gas detector

A portable gas detector is used for monitoring areas other than where you are located – which thus are beyond the reach of your personal gas detector and includes sampling means (pump and hose).

## Regulator

A regulator controls gas flow from cylinder to gas detector.

## Sampling

Method of bringing a sample to the detection device.

## Support agreement

A vessel's plan for delivery of consumables according to the contents of the instrument report.

## Standardised gas detection system

A standardised gas detection system provides you with everything you need to stay safe and in compliance. By outsourcing and standardising with a specialist supplier, you will receive a tailored service that consists of:

- Instruments
- Routines
- Training
- Procurement/logistics

With a standardised gas detection system, you'll only buy the equipment you need, and you'll stay compliant and safe at all times.

# HEALTH

## Oxygen deficiency

Dry air contains 20.9 percent oxygen (by volume). Different processes aboard ships, such as rust formation, create oxygen-deprived environments, threatening human health acutely or over the long-term.

Oxygen levels deviating from 20.9 percent should be considered oxygen deficient.

## ppm

ppm (parts per million) is a unit for denoting very small concentrations of a substance. It is analogous to percent (per hundred) and per mille/pro mille (per thousand).

## TLV-STEL (Threshold Limit Value – Short-Term Exposure Limit)

"A 15-minute TWA exposure that should not be exceeded at any time during a workday, even if the 8-hour TWA is within the TLV–TWA. The TLV–STEL is the concentration to which it is believed that nearly all workers can be exposed continuously for a short period of time without suffering from 1) irritation, 2) chronic or irreversible tissue damage, 3) dose-rate-dependent toxic effects, or 4) narcosis of sufficient degree to increase the likelihood of accidental injury, impaired self-rescue, or materially reduced work efficiency. (...)"

Fragment from: ACGIH®'s TLV® Chemical Substances Introduction

(The American Conference of Governmental Industrial Hygienists)

## TLV-TWA (Threshold Limit Value – Time-Weighted Average)

"The TWA concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, for a working lifetime without adverse effect. (...)"

Fragment from: ACGIH®'s TLV® Chemical Substances Introduction

(The American Conference of Governmental Industrial Hygienists)

# SENSORS

## EC

Electrochemical sensor, primarily used for toxic gases such as $H_2S$ and CO in the PPM range.

## IR

Infrared Sensor, used for combustible gases in the % VOL range, in air and in inert gases.

## LEL

Catalytic combustion, used for detection of combustibles in the Lower Explosive Limit (LEL) range in air.

## OS

Oxygen Sensor, galvanic cell sensor, used for detection of $O_2$ in % VOL levels.

## PID

Photo Ionization Detector, normally used for toxic gases in the PPM range, in air and in inert gases.

## TCD

Thermal Conductivity Detector, typically used for combustible gases in the % VOL range, in air and in inert gases.

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# TECHNICAL

## Asphyxiant gases

Gases that are heavier than, and displaces, air. Asphyxiant gases cause suffocation.

## Combustible gases (EX gases)

Gases that combust or explode when exposed to heat and oxygen. The widely used "fire triangle" consists of fuel, oxygen and heat. The combustible gas represents the "fuel".

## Dew point

Hot air can hold more water than cold air. As hot air is cooled, its ability to hold water is gradually reduced. When the air is saturated with water vapor (100 percent relative humidity), dew starts to form. This is why clouds can appear out of thin (actually saturated) air.

## Explosive gases

See **Combustible gases**. Explosive gases are combustible and highly reactive. These reactions create lots of heat, which in turn causes the surroundings to expand rapidly, or to "blow up".

## HC

Hydrocarbons is the common denominator for any gas in the HC family. All fossil fuels and fossil (natural) gases are composed by some configuration of carbon and hydrogen atoms. Methane is $CH_4$. Paraffins are $C_nH_{2n+2}$. Unrefined (crude) oil consists of 82-87 percent carbon and 12-15 percent hydrogen.

## IGS

Inert Gas System. A system that fills an enclosed space with an inert gas, preventing an explosive atmosphere.

## Inert gas

A non-reactive gas. Remember the fire triangle? An inert gas hinders a fuel gas from reacting with oxygen. Even if heat is present, combustion will not occur in a tank filled with e.g. propane ($C_3H_8$) and nitrogen ($N_2$). Even if some oxygen (O) is present, an inert gas may dilute it enough to prevent combustion (see LEL).

## Inerting (see Inert gas)

The introduction of an inert gas to ensure safe, non-reactive conditions.

# TECHNICAL

## LEL

Lower Explosive Limit. The lower gas/air concentration that enables combustion. If the concentration of gas (fuel) drops below this, relative to the air, combustion can not occur.

## UEL

Upper Explosive Limit. The highest gas/air concentration that enables combustion. If the concentration of gas (fuel) exceeds this level, relative to the air, combustion can not occur.

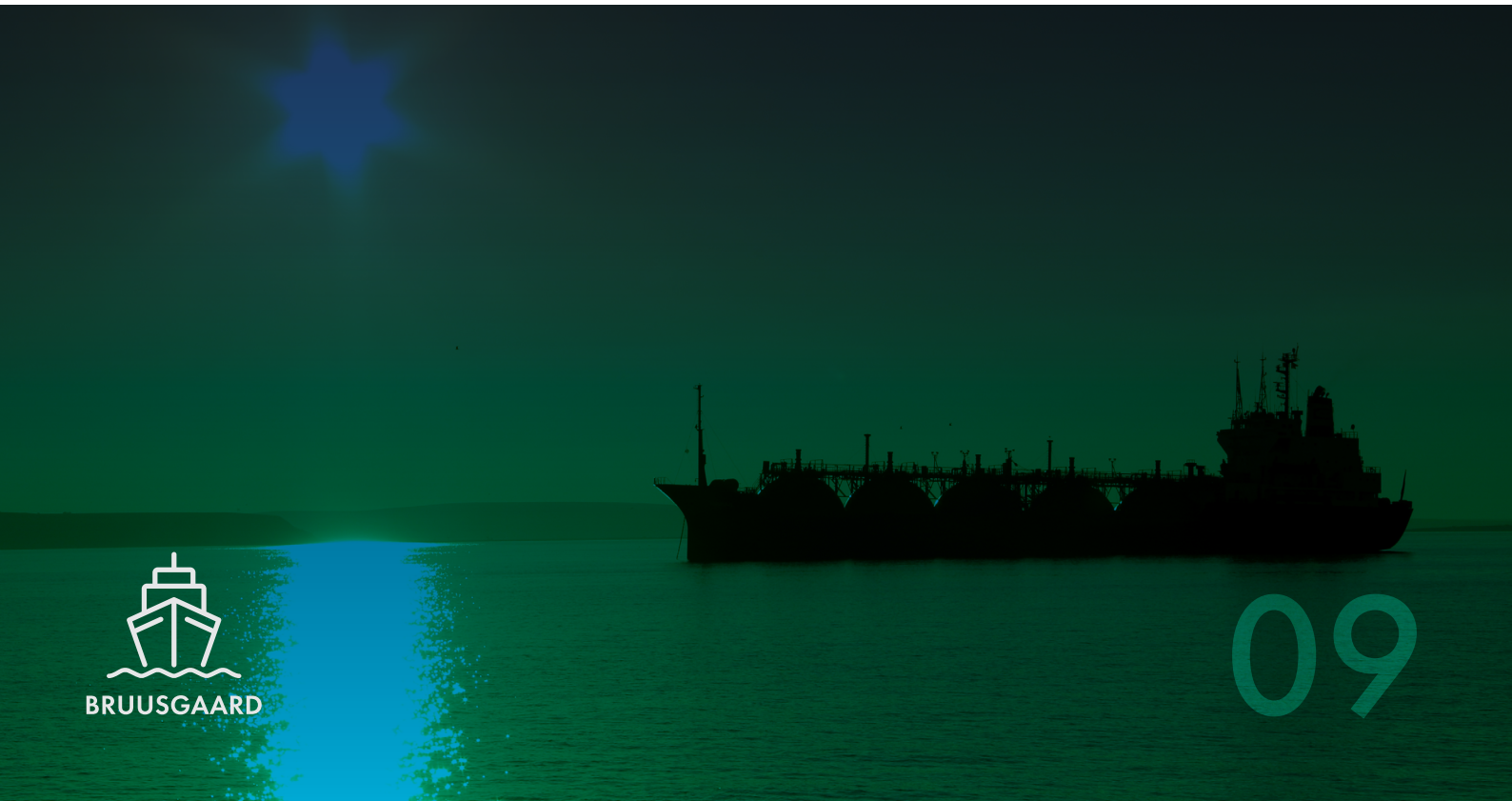
## Toxic gases

Gas poisoning occurs through inhalation, ingestion, or absorption through the skin. Time is a key factor: Toxicity is a function of concentration and exposure period. The specific thresholds are unique to each gas.

The most common toxic gases at sea are Hydrogen Sulphide ($H_2S$), Carbon Monoxide (CO) and gases from the cargo carried.

## VOC

Volatile Organic Compounds. Substances that evaporate very rapidly at room temperatures. Many VOCs are toxic, for example benzene.



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# VESSEL

## Enclosed space

Any space that is not open or ventilated to the atmosphere. Note that even a top-open space can in effect be enclosed – if it contains an asphyxiant gas. Such gases are heavier than air and won't escape through a roof hatch or manhole. Asphyxiant gases should be ventilated through ground-level valves.

## Head space (ullage)

In a tank or container, the unfilled space between the liquid and the roof of the tank is referred to as head space or ullage. Depending on the chemistry of the liquid, this compartment may require careful attention. For instance, a crude oil carrier will have a gap between the top level of the cargo and the roof of the tank. Oil evaporates until equilibrium is reached, filling the head space with explosive and/or toxic gas.

## Purge (gas freeing)

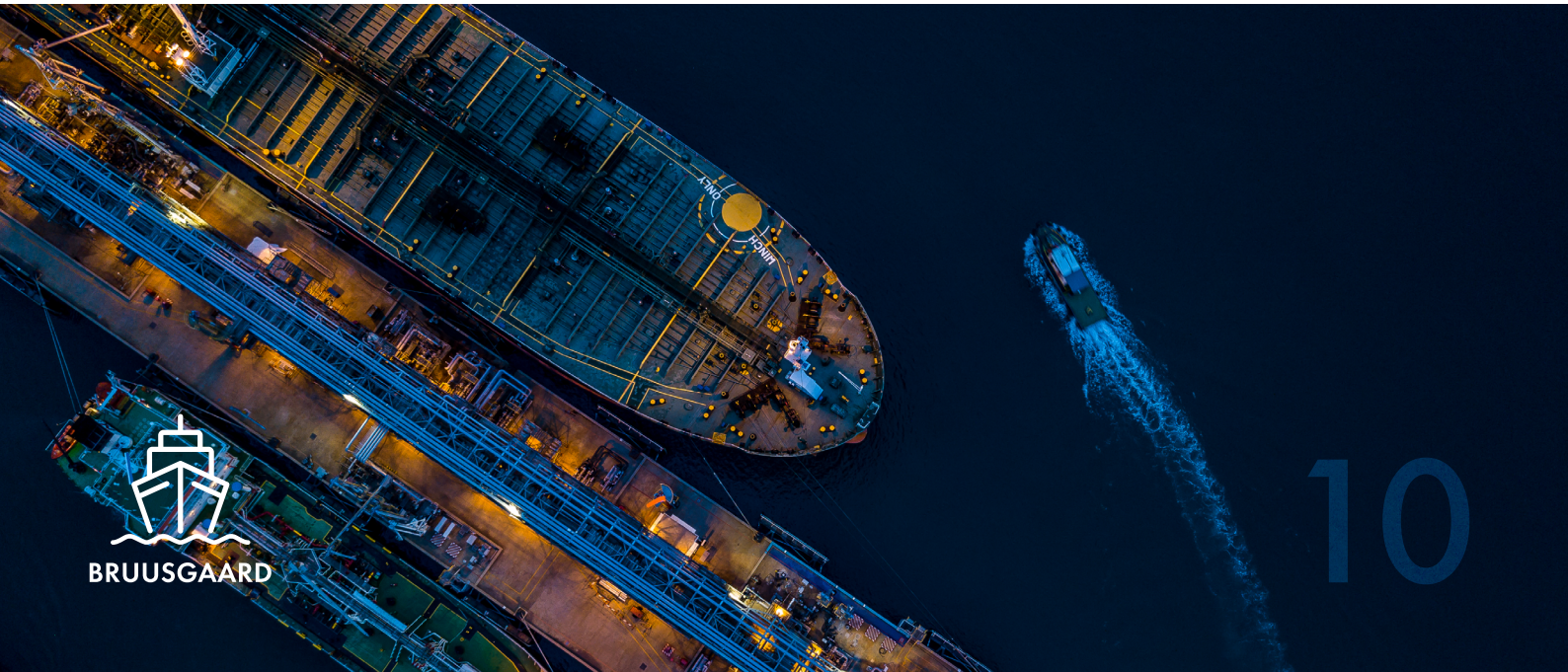
The act of removing gas from a confined space. This is done by natural and/or mechanical ventilation.

## Tank entry

Tank entry is associated with gas exposure risks. Enter only after a strict safety routine has been completed:

1. Activate and monitor the gas detector(s).
2. Purge the space (see: Purge)
3. Displace explosive gases with an inert gas (e.g. $N_2$) until a non-explosive level is reached (<LEL).
4. Ventilate with ambient/atmospheric air.
5. Enter

**Remember to monitor the gas levels throughout!**



# On Board with Safety

Our portable gas detection solutions give shipowners standardised instruments, routines, training and procurement. The result? Increased safety and substantial cost savings.

## Let us take care of the portable gas detection for you!

Please go to our webpage and subscribe to our newsletter for more information or contact us at: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