

Fixed Gas Detection for Shipping



Fixed gas detection is safety technology - and safety technology on sea-going vessels is supervised by the so-called Classification Societies, sometimes called the “TUV of Shipping”.

Under the organizational roof of the IACS (International Association of Classification Societies) there are the following ten Classification Societies:

ABS		American Bureau Of Shipping Houston USA	KR		Korean Register of Shipping Daejeon Republic of Korea
BV		Bureau Veritas Paris-La-Defense France	LR		Lloyd's Register of Shipping London United Kingdom
CCS		China Classification Society Beijing People's Republic of China	NK		Nippon Kaiji Kyokai Tokyo Japan
DNV		Det Norske Veritas Hovik Norway	RINA		Registro Italiano Navale Genoa Italy
GL		Germanischer Lloyd Hamburg Germany	RS		Russian Maritime Register of Shipping St. Petersburg Russia

Ship owners or shipping companies authorize Classification Societies to keep the construction and building of ships under their surveillance and to check regularly their compliance with the regulations and safety requirements (e.g. SOLAS¹) issued by the IMO (International Maritime Organization).

These compliance tests are based on the “Rules for Classification and Construction” issued by the Classification Societies which comprise test specifications for any product, equipment or component related to the safety of shipping.

¹ International Convention for the Safety of Life at Sea

These is also mandatory for e.g. gas detection systems being used on chemical carriers or liquid gas carriers.

So, in respect to their designated site of operation, central control units and gas detection transmitters are tested whether they meet the requirements concerning specified mechanical, climatic, functional and EMC-based stress. Depending on the surveying Classification Society these testing specifications are more or less similar and valid for electrical/electronic equipment, computers and peripherals:

Mechanical requirements	Vibrations	IEC 60068-2-6
Climatic requirements	Cold, dry heat, damp heat, salt mist	IEC 60068-2-x
Functional requirements	Performance, power supply failure and power supply variations, inclination	IEC 60092-504
Electrical safety	Insulation resistance, high voltage, electrostatic discharge	IEC 60092-504
EMC - Immunity	Electromagnetic fields, conducted fast transients (bursts), conducted slow transients (surges) conducted high frequency interference, conducted low frequency interference (harmonics)	IEC 60945
EMC - Emission	Conducted emissions and radiated emissions from enclosure	IEC 60533

In the presence of the Classification Society's surveyor the relevant test procedures can be performed in any authorized testing laboratory, and especially also in the Dräger laboratories being approved and officially accredited for this purpose.

Gas detection transmitters and central control units which pass these tests, are suitable for shipping applications and are accordingly certified by the Classification Society.

Since ultimately Classification Societies approve and regularly check a ship's construction quality, this is not only relevant for the insurance (the higher the quality the lower is the insurance rate for ship and load), but also the relevant type approvals are considered as a high quality issue which play an increasingly observed big roll in non-offshore applications.

To carry dangerous goods on sea-going ships the persons in charge need to install precautionary measures according to the foreseeable risks in order to avoid cases of damage or to mitigate hazards. So, gas detection instruments are being used to detect leaking containments and to activate safety related measures as early as possible.

Transport of dangerous good on ships

Fixed gas detection systems are preferably used on dangerous goods transporting ships, chemical carriers and loading terminals and especially where safety is affected when handling dangerous goods of class 2 (gases), class 2.1 (flammable gases) and class 3 (flammable liquids) of the IMDG-code².

Installed in the proximate vicinity of product carrier tanks leaks can early be detected by means of gas detectors for the detection of flammable gases and vapors. Also, released aggressive acids (corrosive substances, class 8 of the IMDG-code), which produce hydrogen when in contact with metal, are possibly detectable by gas detection instruments.

Gas- or Liquid Gas Carriers are special ships falling under special safety regulations in respect to their construction and gas management (loading, transporting and unloading), listed in the so-called IGC-code³. For example, the load officer may only take over liquefied gases as long as the minimum requirements of chapter 19 of the IGC-code for the given gas are met. Although - according to these safety precautions - leaks are considered to be seldom, the potential risk is so high that a suitable gas detection systems is used in term of a "risk reducing system".

² The International Maritime Code for Dangerous Goods covers nine classes of dangerous goods

³ International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk

Dräger gas detection systems for the detection of flammable gases and vapors are performance approved and type-approved for shipping applications, and also the detection of toxic gases in very low concentrations by means of electrochemical sensors, is possible and shipping approved.

Chemical and oil fighting ships

If hazardous goods carriers or crude oil carriers come into an accident then chemical and oil fighting ships are used to mitigate the consequences. These special ships are constructed such that they can be operated in dangerous atmospheres without harming the personnel. Gas detectors, sometimes covering more than only one hazardous substance class, can protect the personnel and cause alarm when passing a released toxic gas or flammable gas cloud. Ships like this are preferably used by the Coast Guard and harbor fire brigades.

Early detection of smolder and fire

Smoldering fires are always conducted by high concentrations of carbon monoxide (CO), and thus CO-monitoring on ships is designated to detect and localize these fires. Just a small increase of CO-concentration might be a hint of smolder. This might induce an early and effective fire fighting.

Crude oil carriers

Depending of its origin crude oil contains solved flammable gases in different amounts (methane, ethane, propane, butane and higher alkanes) and many toxic organic sulfur compounds, especially hydrogen sulfide (H₂S).

This is the reason why crude oil carriers are equipped with gas detection systems.

Battery charging and fuel cells

When charging batteries (especially on submarines) and with the handling of hydrogen-operated fuel cells explosive hydrogen concentrations can be released. Hydrogen can be early detected by means of catalytic bead sensors so that effective countermeasures can be induced.

Liquid gas carriers

Commonly the installation of electrical measuring instruments in the tank area of liquefied gas carriers is prohibited. This is why gas detection systems for this application comprise of long bundles of tubes for sampling, which within a given time (mostly 30 minutes) activates all sampling points discontinuously. The gas detection controller (including one sampling point in the cabinet) with sampling control and alarm facilities is centrally installed in a cabinet in the *Cargo Control Room*. Catalytic bead sensing heads as well as infrared detectors can be used.

Type 1G-carrier: Chlorine, ethylene oxide, methyl bromide

Type 2G-carrier: Ethane, ethylene, methane (see LNG)

Type 2G/2PG-carrier: Acetic aldehyde, ammonia, butadiene, butylene, dimethyl amine, ethyl amine, ethyl chloride, methyl chloride, propylene, vinyl chloride and propane, butane (see LPG)

Type 3G-carrier: Nitrogen

Also the so-called **LPG- and LNG-carriers** are ranked among liquid gas carriers

LPG (Liquid Petrol Gas) is a mixture of propane, butane and propylene, liquefied by only pressure, while LNG (Liquid Natural Gas) is liquefied by cryogenic (approx. - 162 °C) consisting of about 90 % of methane.

Possible releases of refrigerants from the cryogenics may - depending on the kind of refrigerant - also be detectable by Dräger gas detection instruments.

For safety reasons the spaces around the tanks (so-called "void spaces") shall be inert, mostly this is done by using the exhaust gas from the ship's Diesel engine to displace the oxygen containing air.

Cargo ships for perishable goods and special atmospheres

Certain food and especially exotic fruit are transported under special atmospheres and/or reduced oxygen atmospheres or at lower temperatures to stop the process of ripening. The concentration of the ingredients (e.g. ethylene, carbon dioxide, nitrogen) of these atmospheres can be controlled by means of gas sensors (CA = "controlled atmospheres"). To protect the personnel, and if not regulated otherwise, it is necessary to use oxygen measuring instruments when entering the cargo area or when loading/unloading the goods. Mostly for CA-technology there are special analysis instruments being used, but sometimes gas detection instruments have proven to be more robust.

Passenger Ferries

Although high safety requirements are to be met, gas detection on passenger ferries can scarcely be found. Sometimes CO-monitoring is performed in the parking areas for automobiles. But CO-concentrations are not really a problem because of the natural ventilation (high air exchange rates).

The following GDS-products are type-approved for the shipping application:

Product	Classification Society	Certificate
Gas detection system for flammable gases and vapors, comprising Transmitter Polytron Ex, Ex-R Sensing head Polytron SE Ex PR M Polytron central control unit with 4-20-mA-channel modules and/or SE Ex channel modules	Germanischer Lloyd	89 722 - 93 HH 89 723 - 93 HH valid until 28.04.2010
	Bureau Veritas	05649/C0 BV valid until 18.01.2011
	Det Norske Veritas	A-10417 valid until 31.12.2009
Transmitter Polytron 3000 (toxic gases and O ₂) Transmitter Polytron 7000 (toxic gases and O ₂) Transmitter PEX 3000 (flammable gases) Transmitter Polytron IR Ex (flammable gases) Transmitter Polytron IR CO ₂ (carbon dioxide)	Det Norske Veritas	A-10766 valid until 31.12.2010
Transmitter Polytron 2 IR, type 334 and type 340 (flammable gases)	Det Norske Veritas	A-10767 valid until 31.12.2010
REGARD central control unit with channel modules 4-20 mA, SE Ex, master card, relay module and display module, 8-channel-display, 8-channel module and Modbus	Det Norske Veritas	A-10954 valid until 31.12.2010
Dräger PIR 7000 and Dräger PIR 7200	Det Norske Veritas	A-11327 und A-11328 valid until 30.06.2011
Dräger PIR 7000 and Dräger PIR 7200	Germanischer Lloyd	75 381-09 HH valid until 23.07.2014
Central control unit REGARD with sensing head Polytron SE Ex PR M and transmitter Polytron 3000	China Classification Society	HB06T00003_01 HB06T00003_02 HB06T00003_03 valid until 14.06.2010

MED - the European Shipping Equipment Directive 96/98/EC

In order to improve wider product compatibility and to promote safety and environmental protection, the European Union, in working towards the unification of product technology and test standards, develops EC directives for technological standardization in various fields, which are then adopted as domestic law by the member nations.

The Marine Equipment Directive, better known as MED, is a European directive which constitutes harmonized requirements to be met for safety equipment on ships. The MED is the legal basis for the conformity assessment of shipping equipment parts complying to the standards listed in the annex A1. Several times however the Annex A1 has been corrected or upgraded by the directives 98/85/EC, 2001/53/EC, 2002/75/EC, 2002/84/EC, 2008/67/EC and 2009/26/EC. With the 2nd alteration (2001/53/EC) firstly „oxygen analysis and gas detection equipment“ became listed as a „new item“. This gas detection equipment needed to comply with the well-known European performance standards EN 50104 (oxygen) and EN 50054 and EN 50057, which were harmonized under the ATEX-directive (94/9/EC).

The following GDS gas detection instruments have been approved by the German Notified Body “See-Berufsgenossenschaft” with the identification number 0736:

Product	Category	EC-Type examination certificate (Module B)	Valid until
Central control unit Polytron 4-20 mA	II (2) G	213.021	31.01.2011
Central control unit Polytron SE Ex with sensing head SE Ex PR M	II (2) G	213.023	31.01.2011
Central control unit Polytron SE Ex with DrägerSensor IR	II (2) G	213.023 NI	31.01.2011
REGARD-1	II (2) G	213.027	31.01.2011
Central control unit REGARD 4-20 mA	II (2) G	213.029	28.02.2011
Central control unit REGARD Ex with DrägerSensor IR	II (2) G	213.029 NI	28.02.2011
Central control unit REGARD 3900	II (2) G	213.035	31.05.2012
Transmitter Polytron 2 IR type 334 and type 340	II 2GD	213.022	31.01.2011
Polytron 7000 with sensor O2	II 1G	213.024	31.01.2011
Transmitter Polytron Ex with Ex-Sensor PR M	II 2G	213.025	31.01.2011
PEX 3000 (XTR 000x and XTR 009x)	II 2 GD	213.026	31.01.2011
Transmitter Polytron IR Ex and IR Ex IL	II 2G	213.030	28.02.2011
Dräger PIR 3000	II 2 GD	213.033	31.12.2011

With the fourth alteration (2008/67/EC) a difference was made between portable and fixed gas detection instruments, but unfortunately there were some misprints in the cited standards listed under A.1/3.54 „Fixed oxygen analysis and gas detection equipment“. Since in this list fixed gas detection instruments are indicated as “new items”, GDS instrument would have to meet the standards by July 2011.

But just before coming into force the 4th alteration (July 2009) a fifth alteration 2009/26/EC was issued correcting the misprints of the standards. In this directive, which will come into force in April 2010, the indication „new item“ for fixed installed gas detection equipment is missing, meaning that the listed standards need to be met by April 2010 to get the MED-approval:

EN 60945 (2002), IEC 60092-504 (2001), IEC 60533 (1999) and also the Performance standards EN 50104 (Oxygen) and EN 60079-29-1 (flammable gases and vapors).

So, besides the performance standards the relevant requirements of the following three standards need to be observed:

EN 60945 (2002): Maritime navigation and radio communication equipment and systems - General requirements - Methods of testing and required test results

IEC 60092-504 (2001): Electrical installations on ships - Special features - Control and instrumentation

IEC 60533 (1999): Electrical and electronic installations in ships - Electromagnetic compatibility

In the scope of the mentioned type approvals for shipping however the relevant tests have already been based on these standards.

While the target of the MED is to ensure free trading of shipping equipment by keeping a high safety level within in the European Community, type approvals for shipping are also valid world-wide and also accepted by the states not belonging to the European Community (so-called non-European Flag States).

Conclusion

If no further alteration of the MED will be issued, GDS products for monitoring flammable gases and vapors and oxygen need to comply with the listed standards by April 2010 if they are meant to be installed on sea-going ships of European Flag States.

Just as known from the European ATEX-directive a Notified Body issues a EC-type examination certificate and permits the manufacturer to confirm the product's compliance with the requirements of the MED by applying the so-called „wheel-mark“ on his product.

As the Annex A.1/3.54 reads explicitly, the MED is not applicable for gas detection instruments for the detection of toxic gases, in other words: Polytron 3000 and 7000, and also IR CO₂-transmitters can be used for on ships without a MED-approval. But this might change in future.



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