Fixed gas detection systems – are you sure the correct gas concentration is displayed?

During routine port state control inspections, the USCG found that fixed gas detection system sensors on a few LNG carriers were outside the tolerances established by the manufacturer and failed subsequent calibration checks.

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Introduction

Over the years there have been many incidents in the shipping industry involving leakage of flammable and toxic gases into pump rooms, void spaces, engine rooms and other compartments. A mixture of gas in the air beyond certain concentration levels can be life threatening for crew entering these spaces and pose a serious fire risk. The International Gas Carrier Code (IGC Code) states that gas detection equipment shall be installed to monitor the integrity of the cargo containment, cargo handling and ancillary systems, and should be tested in accordance with recognized standards. To ensure that the fixed gas detection system operates effectively, timely and accurate calibration of the sensors is critical.

On 3 February 2020 the United States Coast Guard (USCG) in their marine safety alert 02-20 highlighted issues with the fixed flammable gas detection system found by Port State Control Officers on a few LNG vessels. The marine safety alert states that *"during exams on three separate Liquefied Natural Gas (LNG) carriers in Boston, Port State Control Officers (PSCOs) discovered issues with the fixed flammable gas detection system that resulted in the issuance of deficiencies and delay of cargo operations. While witnessing tests, multiple sensors measured outside the tolerances established by the manufacturer and subsequent calibration checks failed"*.

In this article, we discuss the two main reasons highlighted by the USCG for these deficiencies, both of which are related to the calibration of fixed gas detection sensors. These are:

- Using inappropriate span gas on the sensors, and

- Not following proper calibration procedures.

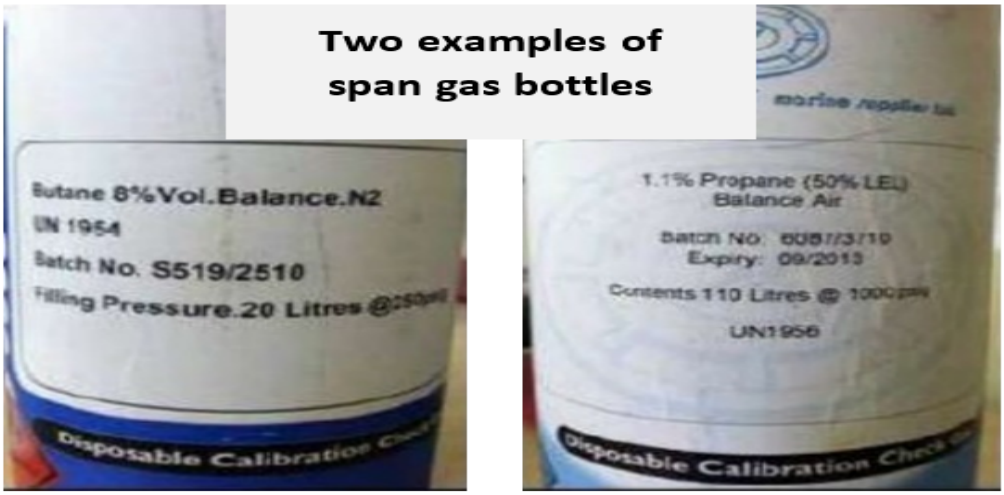
Using appropriate span gas

The type of span gas, or calibration gas, used depends on the type of sensor. There are three main types of sensors: infrared, electrotechnical and catalytic sensors. The PSC deficiencies issued by the USCG for the fixed gas detection systems, related to the *improper calibration of catalytic sensors*.

The catalytic sensors are the only sensors which rely on oxygen to function correctly. When used in systems which are sampling from an inert atmosphere, the sample will have to be diluted with fresh air, i.e. minimum 10% oxygen, in accordance with IEC 60079-29-1, to support catalytic oxidation. If the oxygen concentration is below the specified limit, the crew cannot rely on the catalytic bead combustible sensor reading. It is therefore important that crew members understand the type of sensor used in the equipment and its limitations. Crew members must also ensure that the span gas used for calibration of catalytic sensors is balanced with fresh air and not inert gas. Crew members are recommended to refer to the manufacturer's instructions for the type of span gas to be used. Tests or calibrations conducted with the incorrect span gas can lead to the sensor operating outside established tolerances and causing it to show inaccurate readings.

When a sensor is calibrated using a specific gas, it would show a different reading for

other flammable gasses. For example, if a sensor is calibrated using methane and is then exposed to pentane, then measurement of Pentane gas would be lower than the actual content of pentane in the space. The span gas selected should therefore reflect the target gas which the crew is trying to measure in a space.



8% Butane by volume, balance Nitrogen

1.1% Propane by volume, balance Air (oxygen)

Following proper testing procedures

Ship's crew should fully understand the manufacturer's testing procedures and permissible tolerances for maintaining and testing fixed gas detection systems. If during testing, a sensor shows a reading outside the tolerances specified, the manufacturer's instructions on correcting this should be followed. The USCG highlights in their safety alert *that "sensors operating outside of established tolerances pose a significant safety threat and could be grounds for vessel control actions, such as delayed departure from port, delayed cargo operations, or detention"* . It is important that regular training is carried out to ensure that crew members are familiar with these instructions. It is also recommended that the calibration and maintenance instructions are included in the vessel's planned maintenance system (PMS) and are posted near the gas detection display panel as good practice. Finally, it should be highlighted that catalytic and combustible type gas sensors usually have a limited operating life, at the end of which they must be changed. Crew should therefore also be aware of the lifespan of the sensors.

Recommendations

To ensure that fixed gas detection systems continue to provide safety assurance, Members and clients and their crew can consider the following recommendations:

• Crew should know the **type and limitations** of the sensors used.

• Labels can be put on the equipment itself to note
key dates, such as when a sensor is to be changed.

• There should be procedures onboard covering at least the following:
Risks of improper calibration
Testing and calibration frequency
The type of span gas to be used
Testing, calibration and maintenance procedures
Training of crew in not only using the equipment but also testing, calibrating and maintaining it

• A proper inventory should be maintained of spare sensors and span gas bottles.

• Audits and inspections by shore management should include an assessment of the gas detection systems covering areas like crew awareness and calibration.