

LGCNCOE Study Guide: Fixed Gas Detection

References

Regulatory

International Gas Carrier Code (IGC) regulation 13.6

Gas Carrier Code (GC) regulation 13.6

Existing Gas Carrier Code regulation 13.6

46 CFR 154.1345 & 154.1350

Other Industry

Manufacturer's Fixed Gas Detection Manual

Ship's Cargo Operations Manual

FGCE PQS (*this is a placeholder reference to PQS revisions currently in draft form)

Task # 17 – Examine fixed gas detection system

17.1 – Witness a satisfactory calibration of the fixed gas detection system

17.2 – Verify that sampling points are installed in the required spaces

17.3 – Verify the location of sampling points relative to authorized cargo types

17.4 – Verify the integrity of gas detection sampling pipe system



What type of system is represented in this photograph?

Pictured above is the inside view of a LGC's fixed gas detection systems control cabinet. Gas carriers are fitted with fixed gas detection systems to monitor the spaces (required in IGC 13.6/GC 13.6.7) for the presence of gas vapors.

As part of a liquefied gas carrier's certificate of compliance examination, Foreign Gas Carrier Examiners (FGCEs) should conduct examinations of the vessel's fixed gas detection system. These systems are required in accordance with regulation 13.6 of the IGC & GC codes.

The regulations require that the gas detection system be capable of gas sampling and analyzing at each required sampling head location, sequentially at intervals not exceeding 30 minutes, with the exception of gas detection found in the ventilation hoods and engine room gas supply pipelines (LNG ships only) where sampling must be continuous. A visual and audible alarm is required to actuate if the gas concentration levels reach 30% of the lower explosive limit (LEL). Alarms should be observed while onboard, IAW the manufacturer's fixed gas detection manual. Continuous gas detection for LNG ships must be provided to indicate leaks and to shut down the gas fuel supply to the machinery space if gas concentration levels have reached 60% LEL.

Sampling points must be provided in the following areas (IAW IGC 13.6.7/GC 13.6.7):

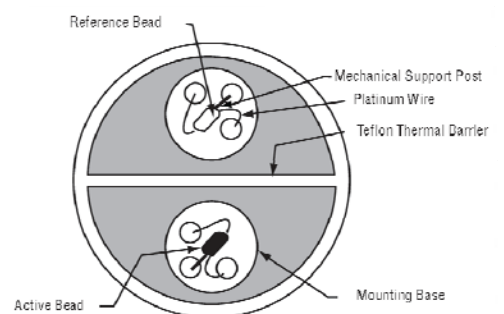
- Cargo compressor rooms
- Electric motor rooms
- Cargo control rooms unless classified as gas safe
- Enclosed spaces such as hold spaces and inter barrier spaces
- Air locks
- Ventilation hoods and engine room gas supply pipelines (LNG ships only)

There are two types of gas detection systems used to meet the regulations:

1. **Gas Sampling:** The first is a system that consists of one gas detection cabinet, usually located in the cargo control room with a vacuum pump, one gas analyzer, solenoid valves, and individual piping. This system draws a sample of air from a particular location and then transports it back to the analyzing unit, within the gas detection cabinet. Sampling and analyzing from each detector is done sequentially and is automatically controlled by the solenoid selection valves. This process is repeated at intervals not to exceed 30 minutes for all detector locations.
2. **Gas Detection Sensor/Transmitter:** The second system has individual gas detection analyzers inside the required areas which monitor the atmosphere continuously and will detect the presence of any gas should it accumulate. These analyzers then convert the presence of gas into an electrical signal and send it back to the gas detection panel.

There are two types of gas detectors (analyzers) used in the gas detection systems above:

1. **Catalytic:** Catalytic detectors are based upon the principle that when gas oxidizes it produces heat, and a sensor converts the temperature change via a standard Wheatstone Bridge-type circuit to a sensor signal that is proportional to the gas concentration. The sensor components consist of a pair of heating coils (reference and active). The catalytic sensor reacts exothermically to



the present combustible gases, resulting in a change of resistance.

This analyzer is used to monitor flammable gases within the following spaces:

- Accommodation Spaces
- Engine Room
- Cargo Machinery Room

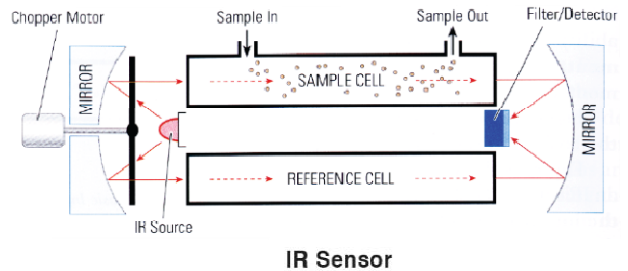
2. **Infrared:** The Infrared (IR) detection method is based upon the absorption of infrared radiation at specific wavelengths as it passes through a volume of gas. Typically, two infrared light sources and an infrared light detector measures the intensity of two

different wavelengths, one at the absorption wavelength and one outside the absorption wavelength. If a gas intervenes between the source and the detector, the level of radiation falling on the detector is reduced. Gas concentration is determined by comparing the relative values between the two

wavelengths. Infrared sensors can only detect

hydrocarbons, thus making them ineffective on an LPG ships carrying chemical gases such as Vinyl Chloride and Anhydrous Ammonia. These analyzers will be located in the following locations:

- Cargo Holds and Inter Barrier Spaces
- Vent Masts
- Double Bottom and Under Deck Pipe Passages



hydrocarbons, thus making them ineffective on an LPG ships carrying chemical gases such as Vinyl Chloride and Anhydrous Ammonia. These analyzers will be located in the following locations:

Note: The infrared system is used in locations that may be oxygen deficient and the catalytic sensors require at least 10% oxygen to oxidize the gas.

Before evaluating these systems, what is the first thing you should witness?

As part of the fixed gas detection system examination, examiners should always witness a calibration of the system. This is usually performed by the Chief Officer or the Gas Engineer, and demonstrates the system's ability to function properly, as well as, the ability of the ship's crew to properly calibrate and operate the equipment. The calibration should always be done in accordance with the manufacturer's fixed gas detection manual. Suitable equipment and span gas are required to be onboard for the calibration and usually located in the gas detection cabinet.

Note: A ship's gas detection system will be calibrated using span gas IAW manufacturer's fixed gas detection manual and then the calibration setting will be adjusted using a calibration curve depending upon the cargo being carried.

How do you ensure that the sampling points of this system are located in the required spaces?

An integral part of this examination is to ensure the sampling points are located in the required spaces. Each FGCE should review the ship's cargo operations manual prior to performing the cargo portion of the exam in order to familiarize themselves with the specifics of the onboard cargo system. Each cargo operations manual will have a section that identifies the locations of the gas sampling points onboard. FGCE's should use the cargo operations manual to cross reference the locations of the installed gas sampling points with the locations that are required to have gas detection in accordance with regulations 13.6.7 & 13.6.11 of the IGC & GC codes.

When this is complete, the FGCE can spot check those locations while conducting the cargo exam.

Would you find the sampling points located at the top or at the bottom of a particular space?

The location of the fixed gas detection sampling points within a space depends on the products the ship is authorized to carry and their relative density. Relative density is the ratio of the density of one substance to another. For gases, the relative density is the ratio of the density of the gas to that of air. For gas cargoes that have a relative density of less than 1.0, the gas will rise if a leak occurs. For gases that have a relative density of more than 1.0, the gas will fall. IGC & GC regulation 13.6.2 requires that the relative density of the cargoes be taken into account when locating the gas detection sampling points within a space. On some LPG ships, sampling points are located at both the top and bottom of a space, dependent upon the density of the cargoes authorized to be carried aboard the vessel.

To determine where the gas sampling points are required to be located on a particular ship prior to attending the ship, compare the list of authorized cargoes on the Subchapter "O" Endorsement to cargo information contained in Material Safety Data Sheets (MSDS) or the International Chamber of Shipping Tanker Safety Guide (Liquefied Gas).

How do you ensure that the sampling pipe system is in satisfactory condition?

In each space that is required to have gas detection installed, the sampling points are connected to the analyzing unit with a small steel piping system. If the integrity of the piping system is breached, then the atmosphere inside of a particular space will not be able to be analyzed. The procedure for testing the integrity of the piping system should be completed in accordance with the manufacture's fixed gas detection manual.

Note: FGCE's are to witness and observe the testing of the system and not become an active participant.

Two common methods for testing are:

1. Low flow alarm: Select a sampling point and have the Chief Mate or Gas Engineer ensure the analyzing unit is switched on manual and selected to the desired sampling point. A crewmember and if possible the other CG examiner will proceed to the selected location, and the crewmember will block the sampling point. If the piping system is in good condition, a low flow alarm will be activated. If there is a breach in the sampling piping system, air will be drawn in from the location of the breach, resulting in the failure of alarm activation.
2. Span gas: Integrity of the piping system can be verified by supplying span gas to the sample point. The % LEL displayed on the gas detection cabinet should be equal to what is stated on the span gas bottle +/- 5%. Span gas being utilized should be IAW manufacture's fixed gas detection manual.

Note: The farther the sampling point is located from the analyzing unit, the longer it will take for the reading or low flow alarm to activate. When in doubt as to the effectiveness of any test on a specific system, refer to the manufacture's fixed gas detection manual.

In summary: the steps for testing of the fixed gas detection system:

1. Witness a satisfactory calibration.
2. Verify sampling points are installed in the required spaces.
3. Verify location within a space of the sampling points relative to the cargoes authorized (i.e., top or bottom).
4. Verify the integrity of the sampling pipe system.

Please keep in mind that the gas detection system is a vital piece of equipment that ensures the safety of the ship's personnel, environment, and to the ship itself. An inoperative gas detection system may be grounds for denial of entry to port, expulsion from port or detention in accordance with Navigation and Vessel Inspection Circular (NVIC) 06-03, CH-2. The specific course of action will be at the discretion of the local OCMI.