

# Guidance on Gas Detection for Inert Entry into Nitrogen Purged Vessels



## Introduction

In some industries, particularly the petroleum or oil/ gas industry, reactor vessels are intentionally flooded with an inert gas such as Nitrogen, to ensure the vapour space is too low to support combustion. Nitrogen is not itself a toxic gas, but it displaces the Oxygen. So, a purged gas environment, although it eliminates the chance of fire or explosion, produces a very real threat to human life.

Specialist breathing protection, communications, training, and working and rescue procedures are all part of safe working in inert vessels - we are however covering only the issue of gas detection in this document.

The table below shows how the balance of air changes in a purged reactor.



	Normal Atmosphere	Purged gas reactor
Oxygen level	20.9% volume	Must be reduced to below 4 or 5% volume
Nitrogen level	78% volume	95% or higher

A standard gas detector for confined spaces will monitor for the essential gases - Oxygen, Flammables – normally calibrated to Methane, Hydrogen Sulphide and Carbon Monoxide. However, a standard gas detector *may not* be suitable.



A typical 4 gas personal monitor

## **The following are considerations when selecting a suitable gas detector for this work:**

### **1. Oxygen Sensor**

Normally the alarm levels are set to 19 or 19.5%vol falling oxygen and 23% rising. As the gas concentration is under 4% normally in a purged reactor the unit will be in alarm constantly. The danger in a purged reactor is a rising level of oxygen which will increase chances of ignition of vapour or pyrophoric material in the reactor. There should be no falling oxygen alarm – only rising and this should be set to 4 or 5% vol, as this indicates a dangerous level of oxygen. Not all gas detectors will allow for the alarm levels to be reset to such a low level – this depends on the manufacturer. It should be verified with the manufacturer also that the detector will accurately measure at low levels as typically sensors are designed for an operating range and this is outside what some manufacturers will recommend using their sensors. The sole purpose of the Oxygen measurement for this application is to protect from ignition and not to indicate if air is safe to breathe.



## **2. Flammable Sensor**

The technology used in a flammable gas sensor is normally a catalytic pellistor. This essentially burns a sample of the atmosphere which it is exposed to but relies on the presence of Oxygen to do this accurately. Whilst an indication is still sometimes reflected on the detector, it is not accurate enough to be relied on. Accuracy will vary from one manufacturer to another. The most suitable type of sensor is Infra-red, where the infra-red beam will be broken by intruding gas and It is not affected by a lack of oxygen.

## **3. Gas detectors with pump.**

Gas detectors with a pump built in are suitable but not essential for inert entry work. They allow for easy sampling of the vessel prior to entry, and if used during work in the vessel they will result in quicker response.

## **4. Fixed or semi-fixed gas systems**

Portable, personal detectors are often used which give worker visibility of the gas concentrations. The advantage of a fixed detection system is that it allows control panel operator the visibility of the gas mixture inside the reactor.

## **5. Temperature monitoring**

It is usually important to monitor the temperature inside a purged reactor, as an increase will be an indication of a potentially dangerous situation arising with any flammable material in the vessel.

## **6. Marking Detectors clearly**

There is a danger that a detector for Inert Entry work is used in normal atmosphere – they should be clearly marked for Inert Entry work only. It is often necessary to also monitor the air outside the vessel – where purged air is exhausted to atmosphere.

## **7. Calibration**

Generally, gas detection instrument sensors will drift over time – a full calibration is recommended at least every 6 months. In addition to this bump testing prior to work will give the confidence that the detector is reading correctly.



## 8. Reliability and Proof testing

Reliability is key with equipment for inert entry, since consequences are likely to be more serious when something goes wrong. It is best to seek advice from other users or from suppliers who have experience with equipment which is proven as reliable.

Inert entry is specialist task and there may not be information readily available on the most suitable equipment or manufacturers may not wish to guarantee the effectiveness of their equipment in this application.

It is a good idea to prove equipment before use and see that it accurately responds and alarms prior to commissioning. Different from calibration or bump testing, a field trial is set up to test the equipment in a in the actual work environment.

## Summary

Although selecting a suitable detector can be challenging, proven reliable units are available which can be used for inert entry.

Further support on selection of instruments is available [sales@lunosystems.com](mailto:sales@lunosystems.com)

