Australian National University

Guideline: Gas sensor

Purpose

To establish the guidelines for the choice, installation and operation of gas sensors across the University.

Definitions

Lower Explosive Limit (LEL) is the lowest concentration (expressed as a percentage) of a gas or vapour in the air capable of producing a flash of fire in the presence of an ignition source.

Threshold Limit Value (TLV) is the airborne concentration of a substance below which all workers can be exposed to without adverse effects following repeated day to day exposure for 8 hour periods.

Short Term Exposure Limit (STEL) is the average airborne concentration of a substance permitted over a 15 minute period, which should not be exceeded at any time during an eight hour working day.

Guideline

Scope

1. This guideline provides information to assist Facilities and Services (F&S) and Local areas on the selection, installation and operation of fixed gas sensors and monitoring systems in University workplaces.

2. To ensure an effective gas monitoring system, it is a requirement to involve the Work Environment Group (WEG) during the system design stage.

Exemption

3. An exemption to this guideline is only available in writing after appropriate discussions and agreement with the WEG.

4. Portable gas monitors are not covered by this guideline. However, portable gas monitors/detectors are to be operated by trained and competent people. A portable monitor must be maintained in-line with the manufacturer's requirements.

Gas system design

5. A gas monitoring system aims to provide:

- (early) detection and warning of a gas leak;
- actions in the event of process or gas system failure; and/or
- warning of a hazardous work environment that may present a risk to health or safety.

6. The gas supply system and supporting gas monitoring system must be discussed and designed with input from the WEG (contact weg@anu.edu.au) and engaged external suppliers as appropriate. Shared processes, gas specificity, cross-sensitivities, sensor poisoning and contamination must be considered to ensure reliable gas monitoring and to minimise false alarms.

7. The presence of a gas monitoring system does not remove the requirement to have appropriate gas system shutdown devices and emergency procedures.

Gas monitoring options

8. Gas sensors are available for a variety of gases. Where a specific gas sensor is not available, a surrogate gas sensor (e.g. oxygen for inert gases) may be used. As per AS/NZS 60079.29.2 – Explosive atmospheres Gas detectors, oxygen deficiency measurement is not to be used for the detection of toxic gases as reliance on oxygen detectors to monitor the presence of carbon dioxide has led to fatalities.

9. Gas sensors shall be located and positioned such that they can quickly detect an abnormal gas or process situation. Possible sensor locations are:

- associated with the gas supply network (e.g. gas cage and protective ducting/housing);
- within the process equipment (e.g. gas control panel, point of consumption);
- within the habitable work environment;
- after a gas cleaning device (scrubber); and
- within the exhaust ventilation system (note: some sensors may not function correctly in high velocity exhaust systems).

10. One or several of these locations may be required for monitoring gas. The work environment must be monitored when a leak would pose a significant risk to life and health.

11. The height of the gas sensor will be dependent on the gas's relative density. Heavy or cold gases will be monitored at a lower level than lighter or hot gases. Additional detail can be found in the table below.

12. A gas monitoring display/panel should be provided for laboratory gas monitoring systems. Any gas display panel must be located outside the (potentially) hazardous zone/room.

13. A battery backup for the gas monitoring system must be considered, especially where the process may continue without power or ramp-up quickly after power is restored. This ensures that the gas sensor requires little or no time to stabilise and the system reliably operates.

Setting gas detector responses

14. The concentration of gas that triggers an alarm must be discussed and determined in consultation with the WEG and engaged external suppliers. Common examples are provided in Table 1 below.

15. Actions in the event of a high or dangerous gas concentration/situation are to be pre-determined and agreed with WEG, F&S and any engaged external suppliers. Options include:

- a link to the fire/emergency evacuation alarm system to initiate a building evacuation;
- interaction with the building management system to shut down the building's ventilation system or increase exhaust ventilation flow rates;
- activation of gas shut-off valves (including those outside the building if available);
- restricting facility, room or door access or operation; and
- simple audible and/or visible alarm signals.

Calibration

16. Calibration of gas sensors must occur:

- prior to the University accepting the monitoring system;
- after replacement of the gas sensor/detector cell; and
- annually, as a minimum; or
- at a calibration frequency determined by the manufacturer/supplier.

17. In some monitoring systems (e.g. for oxygen), a simple air challenge can be used to determine proper function. Monthly detector challenges and six monthly service intervals should also be considered.

Maintenance

18. A gas monitoring system must be maintained in line with the manufacturer's requirements.

Documentation

19. The installation of a gas monitoring system must be accompanied by:

- design specifications and objectives;
- operating instructions;
- maintenance instructions and schedule (and any previous maintenance records if applicable);
- standard gas system alarm response procedure(s);
- documented actions in the event of another building emergency (e.g. nearby fire);
- a list of local contact personnel;
- details of people/companies able to conduct calibration; and
- signage near/on the gas sensor units, display panel, audible/visual alarms (etc. as appropriate).

20. Information and awareness training about the monitoring system is required for all users of the gas/process system.

Table 1: Typical gas sensor requirements

Gas type (Dangerous Goods Class)	**Gas** system example	**Monitoring**	**Sensor** location	**Alarm set** points **(LA - low** alarm, UA - upper alarm)	**Alarm action**
2.1 - Flammable (or explosive) gases	Acetylene LPG	Process Work Environment	Exhaust stream 1.5 m of floor	LA - 10% LEL UA - 30% LEL	• Warning • Increase exhaust ventilation • Shut-off supply gas • Evacuate area at UA
	Hydrogen	Process Work Environment	Exhaust stream At least 1.5m off	LA - 10% LEL UA - 20% LEL	• Warning • Increase exhaust ventilation • Shut-off

			the floor to ceiling		• supply gas • Evacuate area at UA
	LPG	Work Environment - gas water or gas heaters	0.4 m off floor for LPG detection. Alternate locations are possible when hot gases may be involved.	LA - 10% LEL UA - 30% LEL	• Warning • Increase exhaust ventilation • Shut-off supply gas • Evacuate area at UA
2.2 - Non-toxic, non-flammable gases	Nitrogen, Argon	Work Environment - Oxygen depletion in the work environment. Oxygen monitoring.	1.5 m off floor	LA - 19.5% O_2 UA - 23% O_2	• Warning • Increase exhaust ventilation • Shut-off supply gas • Evacuate area at LA or UA
	liquid nitrogen, cryogenic liquids	Work Environment - Oxygen depletion in the work environment. Oxygen monitoring.	0.4 m off floor	LA - 19.5% O_2 UA - 23% O_2	• Warning • Increase exhaust ventilation • Evacuate area at LA or UA
2.3 - Toxic gases	Arsine, ammonia	Process Work Environment	Gas storage cabinet Exhaust stream [1] Workspace	Depends on the gas, exposure limits (TLV) and biological responses. LA - 10-30% of TLV, 8hr TLV or 10% peak TLV UA - 50-80%	• Warning • Increase exhaust ventilation • Shut-off supply gas • Evacuate area at UA • Evacuate the building

				of TLV, or STEL, 20% peak	
					Also consider - • Links to fire/evacuation system • Gas shut-off valves • Dual level warnings/alarms • Restricting room/door access

21. This table provides possible gas system structures. These must be confirmed with the WEG and other associated parties for each individual gas monitoring installation.

Document information

Title	Gas sensor
Document Type	Guideline
Document Number	ANUP_000743
Version	7
Purpose	To establish the guidelines for the choice, installation, and operation of gas sensors across the University.
Audience	Staff
Category	Administrative
Topic	Health, Safety & Environment
Subtopic	Occupational Health & Safety
Effective Date	19 Feb 2018
Review Date	19 Feb 2024
Responsible Officer	Chief People Officer
Approved By	Director, Human Resources (err)
Contact Area	Human Resources Division (director.hr@anu.edu.au)
Authority	Work Health and Safety Regulations 2011 Work Health & Safety Act 2011
Printed On	9 Jun 2023