TOXIC GAS DETECTORS IN THE WORKPLACE – UK REGULATIONS AND STANDARDS

SUMMARY

In recent articles supplied by the Council of Gas Detection and Environmental Monitoring (CoGDEM) for inclusion in International Environmental Technology (IET), the subject matter has covered the selection, specification and use of toxic gas detectors, both portable and fixed. In this article, co-authored by Leigh Greenham of Crowcon Detection Instruments Limited and Dr Peter Walsh of the Health and Safety Laboratory, emphasis will be on guidance to both users and manufacturers of toxic gas detectors. The article discusses the regulatory context within which these items of equipment may be used.

INTRODUCTION

As witnessed by the wide array of toxic gas detection instruments and systems outlined in this publication, there are many manufacturers who can offer appropriate instrumentation to protect people at risk of exposure to toxic gas in the workplace. It is vital that all equipment on the market complies with appropriate legislation, that it is fit for purpose and is easy and safe to use.

UK manufacturers of such instrumentation benefit from a combination of the input from its trade association, CoGDEM (Council of Gas Detection and Environmental Monitoring); and the Health & Safety Executive (HSE), a government organisation, through its Health and Safety Laboratory (HSL). Each year, the HSE revises guidance on workplace exposure limits in EH40 “Occupational Exposure Limits” (HSE, 2002a) – available from HSE books (tel: 01787 881165). Any changes to exposure limits of toxic substances are highlighted and should be considered in the context of the workplace risk assessment and how this may influence adoption of appropriate procedures to ensure adequate control of exposure. Instrumentation may need to be upgraded to be capable of meeting reduced limits. In recent years we have witnessed the reduction of exposure limits of some relatively common substances. An example of this has been the reduction of the exposure limit of hydrogen sulphide over an eight-hour working day, from 10ppm to 5ppm as listed in EH40/2002.

LEGISLATIVE REQUIREMENTS

Within the UK, the principal regulations governing substances hazardous to health (which include toxic gases) are the Control of Substances Hazardous to Health (COSHH) Regulations (see HSE, 2002). However, other regulations impact on the risks of toxic gases, for example the Confined Space Regulations (HSE, 1997a), which will be covered in a future CoGDEM article to be published in IET.

COSHH Regulations

The central requirements of COSHH are:

- Reg 6(1) – the employer should carry out a suitable and sufficient assessment of the risks to the health of employees and any other person who may be affected by the work, if they are exposed to substances hazardous to health;
- Reg 7(1) – the employer should ensure that exposure is prevented or, when this is not reasonably practicable, adequately controlled.

Moreover, if COSHH regulation 6(1) is complied with then the duties under Reg 3 of the Management of Health and Safety at Work regs. 1999 (HSE, 1999a) have also been fulfilled.
The legal requirement for monitoring inhalation exposure is given in Reg 10 of the COSHH regulations. It requires monitoring to be carried out if:

- it is not immediately obvious whether there is a risk to the health of employees; and
- there is a suitable procedure which can be used to measure exposure.

Reg 10 is clarified in detail in the COSHH Approved Code Of Practice (HSE, 2002b) which states that monitoring is required when:

- failure or deterioration of the control measures could result in a serious health effect;
- measurement is necessary to ensure that an occupational exposure limit or any self-imposed working standard is not exceeded; or
- necessary as an additional check on the effectiveness of any control measures provided in accordance with Reg 7, and always in the case of substances or processes specified in Schedule 4 to the regulations (the only vapour mentioned here is vinyl chloride monomer).

**Exposure limits**

Under COSHH there are two types of Occupational Exposure Limit (OEL) for hazardous substances: the Maximum Exposure Limit (MEL) and the Occupational Exposure Standard (OES). A MEL is set for substances which may cause the most serious health effects such as cancer and occupational asthma, and for which safe levels of exposure cannot be determined. A MEL may also be set for substances for which, although a safe level of exposure may be determined, it is not always reasonably practicable to control to that level. MELs have been set for a number of gaseous substances and they are set out Table 1 of EH40. The key duty for a substance assigned a MEL is to “take all reasonable precautions and to exercise due diligence to ensure that exposure is kept as far below the MEL as is reasonably practicable.” The MEL should never be exceeded. An OES is set at a level at which (based on current scientific knowledge) there is no indication of risk to the health of workers exposed by inhalation day after day. OESs are specified for various substances in Table 2 of EH40. The details of how OESs and MELs are currently set are given in EH40.

The lists of OELs given in EH40, unless otherwise stated (eg vinyl chloride monomer), relate to personal exposure to substances hazardous to health in the air of the workplace. Personal monitoring is used to establish the time-weighted average (TWA) concentration of an airborne substance within the breathing zone of the worker. Both MELs and OESs are defined as concentrations of hazardous substances in the air, averaged over a specified reference period. Two time periods are used: long term (8 hours) and short term (15 minutes). Long term exposure limits should be applied as a means of assessing adequacy of control over a typical 8 hour working day. The 8-hour long-term exposure limit relates to any exposures within a 24-hour period and these are expressed as a single uniform exposure, as if received over 8 hours. Short term exposure limits (STELs) are applied to control effects which may occur following exposure for a few minutes. The total duration of short term exposures above the 8-hour time-weighted value should be limited to one hour in a 24-hour period, and the overall 8-hour limit still applies. For those substances for which no short-term limit is specified it is recommended that a figure of three times the long-term limit be used as a guideline for controlling short-term exposures.

The MELs and OESs are approved only for use where the atmospheric pressure is between 900 and 1100 mbar. This covers the normal range of meteorological variations in the UK and slightly pressurised workplaces such as clean rooms, but not the hyperbaric conditions which may be encountered, in for example, tunnelling or diving. To enable MELs and OESs to be applied in hyperbaric conditions the limits should be expressed as a partial pressure or mass/volume concentration at atmospheric pressure (HSE EH75/2).
Exposure limits listed in the current version of EH40 are all British limits assigned under COSHH. However some substances also have a limit set by the European Union (EU). Indicative Occupational Exposure Limit Values (IOELVs) were introduced by the EU Chemical Agents Directive in 1998 and are intended to be health-based. Britain is now required to set a national limit which must take into account the IOELV and be in place by the implementation date (given in the relevant IOELV Directive). European limits are currently implemented in Britain as MELs or OESs. Further information is given in EH40.

The majority of substances used in industry have not been assigned OELs. For these substances it may be possible to use limits produced by other bodies such as Threshold Limit Values (TLVs) from the American Conference of Governmental Industrial Hygienists (ACGIH, 2002), or to set company in-house standards from available hazard information.

HSE has recently issued a discussion document on a possible new scheme for exposure limits with a view to eventually changing the COSHH regulations. The document (HSE, 2002c) suggests three options for a new approach:

- maintain the present system with minor modifications to the criteria for setting limits;
- good practice control advice (eg that given in COSHH Essentials, (HSE, 1999)) supported by a single type of limit
- good practice control advice (eg that given in COSHH Essentials) supported by a two tier system which flags carcinogens.

PERSONAL AND FIXED MONITORING

Personal monitors are usually powered by rechargeable batteries. The instrumentation is light and the mobility of the worker is not greatly affected. Instrumental methods may be useful for assessing personal exposure if they have the capability to log exposure data. This is normally achieved in one of two ways. Firstly, the time-weighted average exposures can be calculated in accordance with the calculations listed in EH40. A user-friendly method of digital communication from instruments to a printer or PC allows the second method of exposure assessment to be performed: this entails a regular download of memorised exposure data held within the instrument. Typically, with modern gas detection instruments, these data are either available as a table of exposures against time or as a "log of events", where an event is a defined activity or gas exposure recorded by the instrument. The time-weighted exposure is determined through integration of the area beneath the curve.

Fixed (static) monitoring can be used to obtain information on background contributions to exposure. However, fixed monitoring does not accurately reflect the amount that could be inhaled by workers. For this reason fixed monitoring equipment cannot be used to help calculate time-weighted average exposures.

Fixed monitoring can be of use:

- to check the effectiveness of control measures;
- to identify sources of emission;
- to determine background workplace contaminant concentrations;
- where there are no suitable personal monitoring methods available;
- when the wearing of personal monitoring equipment may introduce additional hazards;
- when continuous monitoring alarm systems are installed; and
- in the case of vinyl chloride

Further information on monitoring strategies can be found in HSE guidance (1997b).
CARBON MONOXIDE

Carbon monoxide is a commonly occurring colourless and odourless toxic gas, often arising through incomplete combustion. Specific guidance on its health hazards and the precautions required to prevent or control exposure in the workplace, as required by COSHH, including monitoring, are given in HSE guidance note EH43 (HSE, 1998).

USE OF TOXIC GAS DETECTORS IN EXPLOSIVE ATMOSPHERES

Some toxic gases are flammable if concentrations in air reach appropriate levels. The concentrations that cause concern over health effects will usually be orders of magnitude below those that create a risk of explosion. However all instruments for the detection of toxic gases, even for those which are not flammable, could be used in areas of the workplace where flammable substances may be present. Therefore it is sensible, and often essential, to use electronic instruments that are certified as being safe for use in atmospheres that may be explosive. The Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) implements the requirements of two European Union Directives: the safety requirements of the Chemical Agents Directive - CAD; and the requirements of the Explosive Atmospheres Directive - ATEX 137. DSEAR (HSE, 2002d) will apply to all dangerous substances at nearly every business in the UK. It sets minimum requirements for the protection of workers from fire and explosion risks related to dangerous substances and potentially explosive atmospheres. DSEAR will compliment the requirement to manage risks under the Management of Health and Safety at Work Regulations 1999.

PERFORMANCE AND GUIDANCE FOR USE STANDARDS FOR TOXIC GAS DETECTORS

In recent years the harmonisation of standards throughout Europe has led to the publication of many new standards covering performance and use of gas detecting instruments and systems. The committees who set these standards comprise members from instrument manufacturers, CoGDEM, HSE, BSI, end-users, academics and others.

A series of standards has been published recently as BS EN 45544 (BSI, 2000), entitled “Workplace atmospheres – electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours”. Part 2 of the standard (“Performance requirements for apparatus used for measuring concentrations in the region of limit values”) provides toxic gas detection equipment manufacturers with an agreed and harmonised standard to aid design and to allow third party certification. Part 4 of the standard (“Guide for selection, installation, use and maintenance”) provides guidance for end-users, prior to the purchase of equipment.

REFERENCES

ACGIH (2002) TLVs and BEIs: Threshold limit values for chemical substances and physical agents and biological exposure indices 2002. American Conference of Governmental Industrial Hygienists, Cincinnati, USA.

BSI (2000). BS EN 45544-1 Workplace atmospheres – electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours. Part 1: General requirements and test methods. BS EN 45544-2 Workplace atmospheres - Electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours. Part 2: Performance requirements for apparatus used for measuring concentrations in the region of limit values. BS EN 45544-3 Workplace atmospheres - Electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours. Part 3: Performance requirements for apparatus used for
measuring concentrations well above limit values.

BS EN 45544-4 Workplace atmospheres - Electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours. Part 4: Guide for selection, installation, use and maintenance.


HSE (1999b) COSHH essentials. Easy steps to control chemicals. Control of substances hazardous to health Regulations. HSG 193. HSE Books, Sudbury, UK.


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