



## Working in HFC and HCFC Machinery Rooms – Safety Alert

### Workers asphyxiated in refrigeration plant rooms

It has recently been reported that an incident took place in a shopping centre basement plant room where four workers were asphyxiated. The atmosphere was thought to have had a high concentration of refrigerant following a leak from the refrigeration plant. The plant was reported to have been a centrifugal chiller containing refrigerant R123. Any non-toxic, non-flammable HFC or HCFC might have had the same effect, because these refrigerants are heavier than air and if they leak into an unventilated area such as a basement they can accumulate and create an oxygen deficient atmosphere. It is unclear what ventilation, if any, the basement plant room had in this instance.

A similar incident occurred in 1991 in Alaska where there was a serious leak of R22 in the refrigeration plant room. The plant room was located in a leisure centre which included an R22 ice rink and a swimming pool. A manager died after entering the plant room wearing a cartridge-type respirator. Two other personnel were injured and two members of the public had to be rescued from the swimming pool.

### Why don't people notice they are in danger and flee to a safe place?

People die in oxygen deficient atmospheres (where there is less than the normal 21% Oxygen in air) because the body and brain naturally protects itself by shutting down rather than invoking a fight or flee response. Therefore, typically, a person will be quite unaware that their behaviour is abnormal or that they are in danger. There will be defects in their judgement and reasoning with a feeling of confidence, hilarity, belligerence, reduction in vision, weakness of arms and legs leading imperceptibly to unconsciousness. If the oxygen level is low enough death can follow rapidly.

### The key lessons are:

Large HCFC and HFC systems need to have fixed refrigerant gas detectors for safety purposes (as specified by EN378). In this context large is defined as a charge of more than 25kg or a system where the concentration in the air of the room would rise above a dangerous level if the total refrigerant charge leaked into the room. The dangerous level is related to the "practical limit" depending on the toxicity or flammability of the refrigerant. The practical limit is listed in Annex E of part I of the refrigeration safety standard EN378:2008.

The gas detector needs to be connected to a method of ensuring safety. This would usually mean emergency ventilation in the case of HCFC and HFC refrigerants – there is no need for a power trip as with ammonia.

Ensure that any machinery rooms for large HFC or HCFC plant have gas detection for personnel protection fitted and that it is fully functioning. The gas detection required under

the F-gas Regulations may not be sufficient to ensure personnel safety, especially if there are pits or other low lying areas where heavy refrigerant gas could accumulate.

All refrigerant gas detectors and alarm systems should be regularly tested and recalibrated according to the manufacturers instructions and at least annually for fixed systems and every 3 months for portable devices.

A canister respirator (as used for relatively low ammonia concentrations) offers no protection against a lack of oxygen. Only Self Contained Breathing Apparatus or Airline Breathing Apparatus used by personnel with specific training in its use would be appropriate for entering such an atmosphere.

Before opening up a large HFC or HCFC system for programmed maintenance make sure that the area is well ventilated and the gas detection system is working and its calibration up-to-date.

If a technician enters a machinery room and sees someone collapsed on the floor they must assume that the cause of the problem could be oxygen starvation. Therefore, they should only approach the person if they are certain there is adequate ventilation, otherwise, they are advised to remain in a ventilated area and call the Fire and Ambulance services.

It is possible in such accidents that one person dies because they were present when the plant leaked and several more die when they go to investigate, because they don't appreciate the risk.

It is a legal requirement to carry out a risk assessment prior to commencing work on site. This should include an evaluation of the task to be carried out and any risks associated with the local environment eg a confined space of the machinery room where large concentrations of refrigerant might occur.

## References and sources of further information

- Guidance on carrying out Risk Assessments is available at <http://www.hse.gov.uk/risk/fivesteps.htm>
- EN378:2008 Refrigerating systems and heat pumps — Safety and environmental requirement can be purchased from the BSI Bookshop on +44 (0)20 8996 7858, or on line at [www.bsi-global.com](http://www.bsi-global.com)
- The US National Institute for Occupational Safety and Health report on the Alaskan shopping centre incident is available on line at: <http://www.cdc.gov/niosh/face/stateface/ak/91ak013.html>
- system ISO/DIS 5149-3 (This standard is about to be published and replaces the 1993 version. It contains specific guidance relative to refrigeration plant machinery rooms.)
- Institute of Refrigeration Guidance Note N0. 20: "Fixed Refrigerant Detection Systems" discusses detection systems fully, including calibration and maintenance.

Issued by the Institute of Refrigeration Technical Committee.  
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