

## INTRODUCTION

When it comes to Refrigerants, you can distinguish between two main groups: naturals and synthetics. Naturals are Ammonia (NH<sub>3</sub>), Carbon Dioxide (CO<sub>2</sub>) & water (H<sub>2</sub>O), Propane (C<sub>3</sub>H<sub>8</sub>) while synthetics are fluorocarbons, especially chlorofluorocarbons. Synthetics become more and more phased out due to their GWP worth. Therefore, other refrigerants are Ammonia (NH<sub>3</sub>), Carbon Dioxide (CO<sub>2</sub>) and non-halogenated hydrocarbons such as Propane (C<sub>3</sub>H<sub>8</sub>). Those are used in applications like air-conditioning systems for buildings, in sport and leisure facilities, in the automotive industry, in the chemical/pharmaceutical industry and most of all in the food industry production, storage, marine shipping, and retailing).

This Application note focuses on using the AirWatch for Refrigeration purpose. Therefore, the main focus is on Ammonia and Carbon Dioxide as refrigerant and other gases, which are used as refrigerants, depending on the application itself. Currently there is no sensor for fluorocarbons available for the AirWatch.



Figure 1: Refrigeration Machine room

## REASONS FOR GAS DETECTION IN REFRIGERATION APPLICATIONS

There are several reasons for the need of gas detection in refrigeration applications. Regulations are obvious a

very important reason, but also:

- Reduced energy costs through avoidance of refrigerant shortage.
- Risk of damage to products through bigger leaks. (food safety)
- Safety for your Personal.
- Eventually reduced insurance costs.

In addition, various refrigeration applications require gas detection for various reasons.

**Ammonia (NH<sub>3</sub>) (R717)** is a toxic substance. Since there is often no staff present in machine rooms, which could take the necessary actions, gas detectors are very useful, even if you consider that ammonia has a very characteristic smell. In higher levels off ammonia present it can become an explosive gas. In addition, ammonia is the only common refrigerant that is lighter than air.

**Hydrocarbons** are flammable. Therefore, it is very important to ensure that the gas concentration around the cooling system does not exceed the explosion limit.

**Carbon Dioxide (CO<sub>2</sub>) (R744)** is directly involved on the respiratory process and must be treated accordingly. The standard proportion of CO<sub>2</sub> in the air is about 0.04%. At a CO<sub>2</sub>-concentration of 3% the respiratory rate doubles followed by loss of consciousness and death at a concentration of 10% and above.

## LEGISLATION

The requirements for gas detection are designed differently for each country. Hereinafter the rules and regulations for Europe:

The F-Gas Regulation (EC) No. 842/2006. The aim of the EU-regulation is the containment, prevention and thus the reduction of gas emissions by the Kyoto Protocol covered fluorinated gases. The F-gas regulation is mandatory in all member states of the EU and EFTA (European Free Trade Association).

This regulation determines the use of HCFC, HFC, CFC and FC substances in nearly all applications. This is the reason for the substitution of those substances for more environment-friendly substances like NH<sub>3</sub>, CO<sub>2</sub> and some exceptions from the HCs.

Further on describes the European regulation EN378 how to set up a refrigeration system and what to look for, including needs for the gas detection system. This regulation determines amongst other things that the ventilation system must have an emergency control and that the refrigeration system needs to have an alarm device and detectors.

### ASSIGNMENT OF REFRIGERANTS

Ammonia is commonly used in Cold Stores, slaughterhouses, breweries, central refrigeration in chemistry and skating rinks. As mentioned, ammonia has a very characteristic smell, which can be noted at a concentration of 5 ppm. The work exposure limit (WEL) for ammonia according to EH40 is LTEL at 25 ppm and the STEL at 35 ppm, but NH<sub>3</sub> is also explosive at 25.000 ppm.

Carbon Dioxide (CO<sub>2</sub>) is often used in two-stage refrigeration systems in combination with ammonia. CO<sub>2</sub> is used for the primary circulation, while NH<sub>3</sub> is used in the secondary circulation. Because CO<sub>2</sub> is no harm for the products, which are cooled, it has big advantages in the food and pharmaceutical industry.

### GAS DETECTION FOR REFRIGERATION SYSTEMS

According to the EU regulation on fluorinated gases, refrigeration systems must be checked regularly for refrigerant leaks. The test intervals depend on the size of the system and thus on the filling quantity with climate-damaging refrigerants. The larger the system, the shorter the intervals. Not only does the environment benefit from the early detection of escaping refrigerants. The timely detection of leaks also protects against dry running of the system, extends the maintenance intervals and increases the general system availability.

### THE AIRWATCH FOR REFRIGERATION SYSTEMS

We provide a solution to monitor various gases that occur or are used in cold storage rooms: The Refrigeration AirWatch for protection of personnel, goods and environment. The AirWatch is a fixed gas detection solution suitable to detect several different gases in one device.

Refrigeration detectors based on diffusion have the problem of being unstable due to temperature deviations. Furthermore, they are usable in a certain temperature ranges and can have major problems with moist and condensation, during taking a probe. This is a big problem with all refrigerants, which face customers worldwide often. The Refrigeration AirWatch offers a solution as being a pump model with a special water trap filter available. This allows to take samples from -40 °C, since the sample line warms up sample while being in the hose. Conventional fixed systems offer only solutions up to -20 °C.

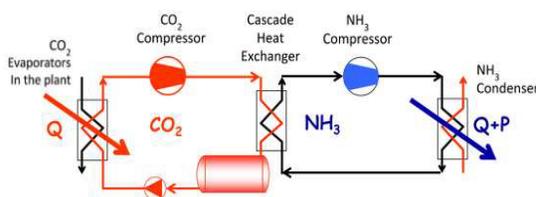


Figure 2: Two-stage Refrigeration system

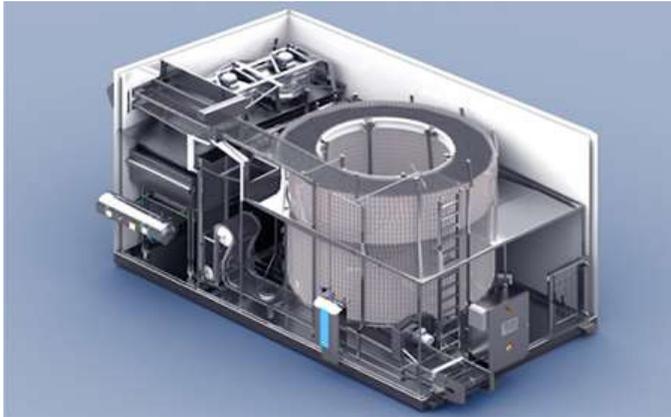


Figure 3: Spiral Freezer

Additionally, Spiral freezers are normally set to -50 °C and very windy combined with high humidity. This application offers big obstacles for common refrigeration gas detectors, but it is a perfect application for the AirWatch, because of heated and dehumidified sample systems available.

The AirWatch can provide an Infrared CO<sub>2</sub> Sensor, a NH<sub>3</sub> Sensor and a LEL sensor simultaneously, depending on the refrigerant you use. Just place the AirWatch with Beacon Sounder on the front of the cold storage room and lead the extension hose through openings inside. With a T-piece for the hose you are even able to measure on multiple spots with the same AirWatch. No hard-wiring needed or electrician. That way the AirWatch functions as a controller unit, measuring head, alarming device all at the same time and is a significant cost-saver. You can read the gas-concentrations on the display outside from the storage room and as soon as the concentrations get to a dangerous level, the optional s Sounder provides an audible alarm of 107 dB and a visual alarm, which is hard to ignore. To ensure its role as a cost-saver, the pump of the AirWatch comes with a 2-year-warranty.

The optional AirWatch Beacon Sounder has 38 multi-colour LEDs, showing green when on, orange when there is a technical issue (e.g. pump blocked), and in case of an alarm the Beacon Sounder will turn into a flashing yellow with a penetrating sound/noticeable alarm. Also, the Beacon Sounder is fully programmable, so that you can configure it to your demands.

Thanks to the built-in digital Modbus RTU interface, the AirWatch is also able to communicate with the refrigeration controls or the ventilation system, whatever you prefer. This has the advantage that the AirWatch can pass information directly to the refrigeration system itself, whereby no own alarm chain for these systems are required. The AirWatch offers extremely versatile programming possibilities.

The optional Datalog saves those gas concentrations in on a SD-card. Together with the optional Wifi-function and the AirWatch Receiver the AirWatch is even able to visualize them in real time in a mesh network, up to 300 meters. You could even let it send mails in case of an event to the responsible persons.



Figure 4: The AirWatch with Beacon Sounder

## ADVANTAGES OF THE AIRWATCH

- Internal pump with extension hose allows monitoring in the inside of the refrigeration storage from the outside.
- Watertrap filter available
- Easy to use & install
- Turns off the refrigeration system in emergencies
- Activates ventilation system
- Helps find leaks
- No own power supply needed/adapter included
- 60 minutes back-up battery available
- Beacon Sounder available