

*Fredric Wenger  
Technical Category Manager Heatpumps and District cooling  
Process & Technical dep.  
Stockholm Exergi AB*

## **BREEAM-SE 20017 1.1** Pol 01 Impact of refrigerants - Leak detection

### **LEED** Enhanced Refrigerant Management

Systems that use refrigerants have either permanent installed automated systems for leak detection, OR built-in automated diagnostic procedures for leak detection. In all scenarios there must be a robust and tested system for leak detection installed, and the system must be able to withstand continuous leakage monitoring.

The system must be able to perform automatic shielding and containment of residual refrigerant if a leakage incident is detected (see Other information).

Stockholm Exergi AB mainly uses the refrigerant R134a (ODP = 0, GWP = 1430) in heat pumps and cooling machines for both district cooling and district heating production. Stockholm Exergi is not using any refrigerant with ODP as those are forbidden. No systems containing ammonia are used for district cooling or district heating production.

As Stockholm Exergi's operations are subject to a permit requirement, the supervisory authority sets requirements for how the company handles refrigerants at its facilities. Stockholm Exergi is moreover following the regulation EU / 517/2014 that complies with standard EN 378, among others.

#### Stockholm Exergi's facilities with refrigerants

Facilities	Refrigerant	Leakage warning system		Manual leak detection	Suction of refrigerant
		Refrigerant analyzer	Personal protection monitoring		
Ropsten1&2	R134a	x	x	8 times/year	Manual
Ropsten3	R134a	x	x	8 times/year	Manual
KC Nimrod	R134a	x	x	8 times/year	Manual
KVV6 RGK	R134a	x	x	8 times/year	Manual
KC Hornsberg	R134a	-	x	6 times/year	Manual
VP Hammarby	R134a	x	x	6 times/year	Manual
Kista Akalla	R134a	x	x	2 times/year	Manual
Vilunda	R134a	x	-	2 times/year	Manual
PC City	R134a	-	x	4 times/year	Manual
Skärholmen	R134a	-	x	2 times/year	Manual
Älvsjö	R134a	-	x	2 times/year	Manual
Farsta	R134a	-	x	2 times/year	Manual
Rosersberg	R1234ze	-	x	2 times/year	Manual
Fliir	R134a R410A	-	-	2 times/year	Manual

## Leakage detection

The regulations governing the use of refrigerants, the new revised regulation EU / 517/2014 which applies from 1 January 2015 stipulates that operators of equipment that contains fluorinated greenhouse gases in quantities of 500 tonnes of carbon dioxide equivalents or more (comment: 500 tonnes of CO<sub>2</sub>e corresponds to approximately 350 kg R134a) shall ensure that the equipment has a leakage warning system that warns the operator or a service company in the event of a leak.

## Leakage warning system

Stockholm Exergi uses various systems approved for automatic monitoring of refrigerant emissions within facilities containing refrigerants. The systems are referred to as:

- Refrigerant analyzer
- Personal protection monitoring

At the facilities, where required according to EU / 517/2014, at least one of these systems is installed.

### Refrigerant analyzer

The refrigerant analyzer is a permanently installed system for continuous monitoring and emission reporting of refrigerants in air and water with very good accuracy. Current and historical levels for individual measuring points are monitored by the operations technician from a control system. The equipment provides alarms locally and to the control system when the selected alarm limit is exceeded and controls the mechanical ventilation of the engine rooms.

The analysis performed in the refrigerant analyzer takes place with stripping technology. It handles all existing types of refrigerants and the determination is performed in gas phase with FTIR (Fourier Transform Infrared Spectroscopy). With this technology, the refrigerant analyzer manages both qualitative and quantitative analysis, ie determines the content of both refrigerants and any simultaneously occurring interferences such as carbon dioxide, methane and others, which potentially interfere with the analysis of individual components.

The practical detection limit is 1ppb, ie 1 part of one billion.

### Personal protection monitoring

The system for personal protection monitoring is a simpler system compared to the Refrigerant Analyzer. This system can only detect emissions to air and with less accuracy than a Refrigerant Analyzer. The equipment provides instantaneous values, ie no history or trends can be read. The equipment provides alarms locally and to a central control system when the selected alarm limit is exceeded.

At the larger plants, there are redundant systems and all plants have routines for how and when manual monitoring takes place if one or more automatic systems should stop working.

## Leakage detection

In addition to the requirements for the equipment for continuous monitoring of refrigerant emissions, there are requirements for the systems to be manually leak detected by certified personnel. The periodicity of leak detection is determined by the amount and type of refrigerant. Equipment containing fluorinated greenhouse gases in quantities of 500 tonnes of carbon dioxide equivalents or more must be leak detected at least every three months. If there is equipment for continuous monitoring of refrigerant emissions, the control frequency can be halved, ie every six months. Within Stockholm Exergi, the larger refrigerant-carrying equipment is leak detected every four to six weeks.

## Measures in case of Leakage

Refrigerant leakage at Stockholm Exergi's facilities is rectified immediately by personnel on site or by personnel on call 24 hours a day, for example by emptying the leaking part with specially installed systems to external containers. Furthermore, it is possible to remotely section off refrigerant circuits to seclude a leaking part.

### **Leakage measurement**

To measure how much refrigerant has leaked, a weighing is performed in connection with the maintenance of each heat pump. The entire amount of refrigerant is moved to an external tank with a built-in scale. In this way, you get information about how much refrigerant (in kilograms) has been lost since the previous weighing. An annual report is established and sent to the environmental authorities. The leakage used for BREEAM Pol 01 and Lr for LEED is calculated from the average yearly values over the last 10 years.

### **Refrigerant recycling system**

Manual shutdown and pumping of refrigerants takes place when high concentrations are detected in the engine room or in the building. Manual pumping to either a separate storage tank or to another secluded part of the system takes place if necessary, shut-off valves are fitted to retain the refrigerant after pumping. Pumping is performed by personnel who are available around the clock, or by emergency personnel on call 24 hours a day.

### **Explanations**

#### Fluorinated greenhouse gases

Fluorinated greenhouse gases or f-gases as they are usually abbreviated are as defined in EU / 517/2014: fluorocarbons, perfluorocarbons and sulfur hexafluoride and other greenhouse gases containing fluorine, as listed in Annex I in EU/517/2014, or mixtures containing any of those substances. So even if only a small proportion of the gas consists of one or more of the gases listed in Annex I in EU/517/2014, it is considered to be an f-gas. There is thus no limit in the form of GWP factor.

#### Carbon dioxide equivalent / CO<sub>2</sub>e

CO<sub>2</sub>e is a way of indicating how much greenhouse gas emissions a gas has in comparison with emissions of the same amount (kg) of carbon dioxide (CO<sub>2</sub>). By expressing greenhouse gas emissions in carbon dioxide equivalents, one can easily compare the contribution of individual gases to the greenhouse effect. The conversion takes place by multiplying the emission (kg) of a greenhouse gas by the gas's so-called GWP factor (Global Warming Potential).

#### GWP

The GWP factor (Global Warming Potential) for refrigerants indicates how large the greenhouse effect emissions of one kg of the refrigerant is in comparison with emissions of one kg of carbon dioxide (CO<sub>2</sub>). If you know the refrigerant's GWP factor, you can easily calculate how many kg of CO<sub>2</sub> this corresponds to in the event of a leak. This is achieved by multiplying the amount of refrigerant emitted in kg by the refrigerant's GWP factor.

#### ODP

The ODP factor (Ozone Depletion Potential) is a measure of the ability of a refrigerant to break down the ozone layer. Stockholm Exergi's is not using such refrigerants, their use is forbidden.

#### ppm

ppm, from English parts per million, "number per million" stands for one millionth. It is a measure of proportion, content or concentration.

ppm is an immeasurable quantity, which in addition to being described as one millionth can also be said to represent the number 10<sup>-6</sup>.

#### ppb

ppb, from English parts per billion, "number per billion" stands for one billionth. It is a measure of proportion, content or concentration.

ppb is a dimensionless quantity, which in addition to being described as a billionth can also be said to represent the number 10<sup>-9</sup>.

**Link to European f-gas regulation EU / 517/2014**

<https://eur-lex.europa.eu/legal-content/SV/TXT/HTML/?uri=CELEX:32014R0517&from=EN>