

REAL ZERO CASE STUDY 2 – Industrial

Industrial Refrigeration and Air Conditioning Systems

In the UK, leakage of HFC refrigerants from industrial refrigeration and air conditioning (RAC) systems is estimated to have been 359,000 kg in 2005¹. Under the F Gas Regulations, operators of RAC systems containing more than 3kg of HFC refrigerants are required to perform regular leak testing and must not add more refrigerant without first identifying and repairing the source of the leak. There are also strict requirements on recovery of refrigerant from systems, recording of refrigerant use and labelling of equipment. A REAL Zero site survey can help operators ensure that they comply with the F Gas Regulations and reduce potential and actual sources of refrigerant leakage.

Industrial Site Survey Case Study

The cooling systems in a large office building were surveyed using the REAL Zero methodology. The RAC systems comprised 5 water chillers, all around 10 years old and using R407C refrigerant. It was found that the systems using adiabatic cooling of the condensers had experienced lower levels of refrigerant leakage compared with other systems that used air cooling of the condensers. It was concluded that this was due to the higher discharge pressures, compared with the adiabatically cooled condensers for similar ambient conditions. It was also found that the access to condensers and high pressure receivers of some systems was difficult, impacting both leak testing and maintenance and that there were multiple Schrader valves (a common source of refrigerant leakage) on both high and low pressure sides of each system. The F Gas logs and site maintenance records indicated that sources of leaks had frequently not been identified or recorded. Several recommendations were made for improving leak testing and reducing the leakage potential.

Leak testing was carried out using hand held leak detectors that were capable of detecting leakage rates as low as 5g/ year. New leaks found during the site survey included leaky Schrader valves, a leaking Thermostatic Expansion Valve (TEV) and leakage from a compressor body. These results demonstrate the effectiveness of using appropriate leak testing methods and tools.



The analysis of refrigerant leakage and the associated carbon emissions and financial impact for this site are shown in the table below. The costs shown include only the cost of replacement refrigerant – in practice the costs associated with equipment downtime and repair can be much greater.

Pack Ref	Refrigerant Type	Leaks Recorded in Site Log	Refrigerant Additions (kg)	Record Period (Months)	New Leaks Detected at Site Survey	Refrigerant Cost Over Period Recorded (£)	Total CO ₂ Emissions Equivalent (tonnes)
A	R407C	2	68	12	1	1,564	112.2
B	R407C	1	44	12		1,012	72.6
C	R407C	2	53	12		1,219	87.5
D	R407C		0	12	2	0	0
E	R407C		0	12	1	0	0
TOT		5	165		4	3,795	272.3

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Conclusion

The site survey demonstrated to the client how improved leak testing regimes and recording of data could be used to identify and rectify faults at an early stage and the report provided recommendations on practical steps to reduce the potential for leakage in the future. Good design practice and effective maintenance regimes will minimise the financial cost and environmental damage caused by refrigerant leakage.

REAL Zero Site Survey Process

REAL Zero site surveys are undertaken by advisers who have received training and assessment in refrigeration leakage reduction skills. They are RAC professionals who are members of the UK Institute of Refrigeration and may operate within a service and maintenance company, or as consultants. A site survey comprises:

- A visual examination of the RAC plant
- A leak test of readily accessible joints using a hand held electronic leak detector
- An examination of the F Gas log and other service records
- Discussions with site personnel who have day to day experience of the operation and service of the RAC equipment



The client is provided with a comprehensive report that includes:

- Executive summary and analysis of the carbon and financial impact of refrigerant leakage, based on site records
- Benchmarking of refrigerant leakage (comparison with the average for the sector)
- A review of site compliance with F Gas Regulations, including logs and record keeping, with recommendations for improvements where appropriate
- Identification of leaks and potential leakage points found during the survey, together with design or installation issues that may affect leakage
- Recommendations for resolving leaks and other problems identified during the survey
- A review of the site service and maintenance strategy

Refrigeration and Air Conditioning systems are responsible for significant emissions of Global Greenhouse Gases, resulting from their energy consumption and leakage of HFC and HCFC refrigerants. In the UK the emissions due to leakage of HFC refrigerants from all types of stationary refrigeration and air conditioning systems was estimated to be equivalent to 3,555,000 tonnes of CO₂ in 2005¹. REAL Zero is a UK Institute of Refrigeration initiative to help RAC system owners and operators to identify sources of refrigerant leakage and to take practical steps to reduce it. For more information on REAL Zero visit the website at www.realzero.org.uk

¹ AEAT (2004), *Emissions and Projections of HFCs, PFCs and SF6 for the UK and Constituent Countries*, Report No. AEAT/ED50090/R02