

Leakage matters: for equipment owners and operators

REAL Zero builds on the F Gas Regulation requirements with good practice recommendations. Recently revised and updated, the programme provides free e-learning & downloads covering:

- 1: Good leak testing
- 2: 13 most common leaks
- 3: Designing out leaks
- 4: Leakage matters: for service and maintenance contractors
- 5: Leakage matters: for equipment owners

Now with optional Institute of Refrigeration CPD assessment and certification.

Leakage matters: The equipment owner's responsibilities



REAL Zero and REAL Skills Europe (Refrigerant Emissions and Leakage) are projects that offers practical assistance to everyone involved in purchasing, designing, installing, servicing, maintaining and owning refrigeration, air conditioning or heat pump equipment, to help them reduce leaks.

This Guidance Note is one of a series of publications developed by the project teams in the UK and Europe. Also available are a Carbon Emissions/ Cost Calculators and Refrigerant use and Emissions tracking spreadsheets. The five guidance notes support an e-learning and CPD certification programme available at www.realzero.org.uk

Leaking refrigeration and air conditioning systems cost you more to run, damage the environment and are less reliable.

On a national and international level, the combined environmental and financial impact of refrigerant leakage is significant. It is therefore no wonder that end users have changed the way they think about refrigerants. Until recently, refrigerants have been regarded as a consumable and regular expenditure item – a bit like topping up the oil in your car. However, end users are now starting to value their refrigerant stock as part of their asset base, which needs to be protected.

Table	Servicing and maintenance of your equipment – seven golden rules for refrigerant leakage reduction	Page 2
1	Refrigerants and the environment	Page 3
2	Your legal responsibilities	Page 3
3	Why leaks occur and how to reduce them	Page 5
4	Specifications for equipment design, installation, service and maintenance	Page 6
5	Your service and maintenance contract	Page 7
6	Criteria for selecting a contractor	Page 8
7	Leakage reduction skills	Page 9
8	Your obligation to manage refrigerant strategically	Page 9
9	References and sources of further information	Page 10



A leak of 1 kg of refrigerant can cause the same environmental damage as operating a domestic refrigerator from UK grid electricity for 43 years

This document is based on information and legislation current at date of publication. The Institute of Refrigeration and REAL Skills Europe partners accept no responsibility for any errors or omissions. Originally published in June 2011. Revised August 2015 © IOR all rights reserved

Servicing and maintenance of your equipment: Seven golden rules for refrigerant leakage reduction

1. Draw up a tender document which identifies what work is included and on what basis; if necessary employ an independent consultant to advise on this.
2. Interview as many potential contractors as possible (who have passed the pre-tender screening process).
3. If appropriate, include capital works related to leakage reduction in the service and maintenance contract to provide an incentive to carry out improvements which will reduce leakage. **Note** – high cost improvements or replacements should always be tendered separately.
4. For large sites or multi site organisations consider appointing more than one contractor (but ensure there is a clear division of work). This will give you greater flexibility if you need to re-allocate contracts and stop contractors becoming complacent.
5. Give potential contractors access to the refrigeration equipment to ensure they are able to tender to your exact requirements.
6. Include refrigerant leakage reduction as a key performance indicator and ask the contractor to demonstrate a strategy for leakage reduction.
7. Award a contract for more than one year's duration to provide an incentive to the contractor to invest in leakage reduction; this is especially important for comprehensive contracts.

Reducing leakage reduction helps to “future proof” systems. The availability of HFC refrigerants is now subject to phase down so it is likely that high GWP refrigerants, including R404A, the R407series and R410A, will soon become scarce. Their cost has already increased significantly. In addition, from 2020 the use of some HFCs such as R404A will be prohibited for servicing large systems.

1. Refrigerants and the environment

HFC refrigerants have a major impact on the environment and can leak from systems at an unacceptably high rate if left unchecked.

- HCFCs such as R22 deplete stratospheric ozone and have now been phased out and can no longer be used to service or maintain equipment.
- HFCs are powerful greenhouse gases and thus contribute to adverse climate change. The table below lists common HFCs and their global warming potentials

Refrigerant	R134a	R407A	R407C	R407F	R410A	R422D	R404A
GWP* relative to CO ₂	1430	2107	1774	1825	2088	2729	3922

*GWP (Global Warming Potential) means the climatic warming potential of a fluorinated greenhouse gas relative to that of carbon dioxide. The values listed in this table are taken from or calculated from EU 517/2014 (the F Gas Regulation).

In addition, systems with insufficient refrigerant charge use more power than necessary, thus increasing their indirect CO₂ emissions. Leaking systems also have a high cost of service and associated downtime.

2. Your legal responsibilities

As an end user of refrigeration, air conditioning or heat pump (RACHP) equipment, you are responsible for complying with the Fluorinated Gas (F Gas) Regulations because you are the operator of the system. The aim of the F Gas Regulations (EU517/2014) is to reduce leakage of HFC type refrigerants. In brief, the regulations require that you:

- Leak test systems (the frequency depends on the charge size and GWP of the refrigerant).
- Repair leaks found without undue delay.
- Fit permanent leak detection to large systems (dependent on charge size and the GWP of the refrigerant).
- Log leak tests and refrigerant usage.
- Use engineers qualified to the F Gas Regulations standard to carry out this work.

The updated ODS (Ozone Depleting Substances) Regulations (EC 1005/2009) cover the phase out of HCFC refrigerants and place broadly similar obligations on end users.

More detailed information about the F Gas Regulation can be found in the other Guidance Notes and in the Reference section at the end of this document.

The F Gas regulation has other requirements which you should be aware of:

- Placing on the market bans on the use of HFCs in some new equipment;
- Service bans on some refrigerants in some systems;
- A phase down in the availability of HFC refrigerants.

UK Environment Agency service F Gas Support has produced information sheets offering general guidance and practical information. Of particular relevance are IS2 (commercial refrigeration), IS3 (industrial refrigeration) and IS5 (stationary air conditioning and heat pumps). They are available from

<https://www.gov.uk/government/collections/eu-f-gas-regulation-guidance-for-users-producers-and-traders>

Additional more detailed guidance is also available from:

<http://www.gluckmanconsulting.com/f-gas-information-sheets/>

According to the F Gas Regulations the person having control of the equipment containing the refrigerant i.e. “the operator”, typically a company, is responsible for compliance. The Regulation defines the operator as follows:

“Operator means the natural or legal person exercising actual power over the technical functioning of the equipment and systems covered by this regulation”.

This includes:

- Free access to the system, and the possibility to grant access to third parties
- The control over the day-to-day functioning/running e.g. takes the decision to switch it on or off
- The power to decide on technical modifications e.g. to have checks and repairs carried out

Therefore the Regulation usually places responsibility with the owner, even if there is a comprehensive maintenance contract in place.

3. Why leaks occur and how to reduce them

Many factors affect leakage, for example:

- System design and the components used.
- The type of joint and the quality of brazing.
- How pipes are routed, supported and clipped.
- Vibration elimination.
- The quality of pressure and leak testing during commissioning.
- The age of equipment and the environment it works in.
- Standard and suitability of service and maintenance.

The Guide to 13 Most Common Leaks provides more information about the most common leakage points. It is a useful reference document to target actions to reduce leakage.

4. Specifications for equipment design, installation, service and maintenance



Leakage can be reduced over the operating life of a plant by detailed specification, design and installation as well as appropriate service and maintenance. So:

- Design systems in accordance with EN378: 2008+2012 (Refrigeration systems and heat pumps – safety and environmental requirements) and ensure they are compliant with the EU Pressure Equipment Directive (PED) and national legislation. REAL Skills Europe guidance notes GN3 “Designing out leaks: design standard and practices” and GN4 “Leakage matters; the service and maintenance contractor’s responsibility” have more details.
- Provide enough time for good quality installation and commissioning – this is vital to long-term refrigerant containment.
- Ensure brazers are competent – the industry standard brazing qualifications include a brazed test piece which is sectioned to examine filler penetration.
- Specify the pipe layout and routing accurately to ensure that pipe work is correctly supported and includes vibration elimination.
- Where possible, design in easy access to joints and components.
- Identify joints and components on scaled isometric pipe layouts.
- Ensure that major components such as compressors and packs are mounted so that vibration is isolated.
- Specify a maintenance regime that includes appropriate leak testing – see the next section for information about maintenance contracts and contractors.

A major cause of leakage is poor installation and inadequate commissioning due to insufficient time. Make sure you allow enough time so this essential aspect of the system can be carried out properly.

Life cycle costing is a useful tool for comparing options for new systems and checking the cost effectiveness of replacing old equipment. The latter is especially important – for many old systems it is impossible to totally eliminate leaks and therefore the environmental and financial costs associated with leakage.

5. Your service and maintenance contract

An essential element to leakage reduction is employing the right contractor on the most appropriate contract to maintain your equipment. Refrigerant leakage can occur at anytime throughout the lifetime of a plant so a diligent contractor is essential in advising on ways to avoid it.

Contracts typically fall into four categories and their impact on leakage reduction needs careful consideration. The below table separates refrigerant leakage from other requirements and needs to be a balanced with all the pros and cons:

Type of contract	What's included	Advantages	Disadvantages
Labour and maintenance (semi comprehensive)	Excludes all refrigerant	Possibly the best option as the contractor concentrates on maintenance and will make suggestions about your plant knowing that he does not have to pay for refrigerant.	You do not have total control over the budget and contractor management is essential
Fully comprehensive	Should include refrigerant though some contracts specifically exclude refrigerant due to its cost	Appears the highest cost option, but could be the most cost effective. If the contractor is paying for the refrigerant there is a high emphasis on leak reduction as this increases the contractor's profit	The older your equipment is the higher the cost will be to factor in the 'insurance' of high refrigerant leakage rates.
Maintenance only	Refrigerant chargeable	A good option on new plant where the emphasis is on maintenance and refrigerant leakage should be minimal	Careful consideration needs to be given to the control of refrigerant expenditure.
Pay as you go	Refrigerant chargeable	A good option on new plant where the emphasis is on maintenance and refrigerant leakage should be minimal	Careful management of the contractor is required. This looks like the cheapest option, but you pay for everything so the more the contractor supplies you, the more money he will make.

6. Criteria for selecting a contractor

Once you have decided the best option for your business, tender the work to a minimum of three contractors and ask for quotes based on more than one of the above options regardless of your preferred option. As part of the tender process ask them to pre qualify by sending you evidence of the issues below and if you do not receive it do not proceed any further with that contractor. The items in **bold** are considered essential, the others are desirable:

- **Companies employing personnel handling F gases and wishing to purchase F Gas refrigerant must be certified by a government appointed body as reported to the EU. The acceptable certification bodies for companies and individuals are shown on the European Commission F Gas Website: https://circabc.europa.eu/faces/jsp/extension/wai/navigation/container.jsp?FormPrincipal:idcl=FormPrincipal:libraryContainerList:pager&page=2&FormPrincipal_SUBMIT=1&org.apache.myfaces.trinidad.faces.STATE=DUMMY**
- **Evidence of company certification under F Gas in the UK is available from Refcom, Bureau Veritas or Quidos.**
- **Evidence of individual technician competence under F Gas is available with certificates issued by either** City and Guilds 2079-11 to -14, the relevant units of the NVQ Apprenticeship or CITB J11 to J14.
- Other relevant individual qualification standards:
 - ⇒ RAC craft person skills to prEN 13313:2010 (Refrigerating systems and heat pumps – competence of personnel). In the UK this corresponds to City and Guilds Level 2/ 3 NVQ)
 - ⇒ In the UK the BRA, City & Guilds or CITB offer Brazer certification. This is recommended for installation engineers.
- **Evidence of refrigerant management plans including F Gas-compliant refrigerant usage logs**
- Written environmental policy
- **Written health and safety policy**
- **Copies of risk assessments and task procedures**
- **Copies of COSHH assessments (UK)**
- Individual membership of a RAC professional body (e.g. in the UK: The Institute of Refrigeration, CIBSE or IMechE) for managers who are responsible for your refrigeration equipment
- Company membership of a trade association or body (e.g. in the UK: British Refrigeration Association, Building Environmental Services Association or REFCOM elite)
- Registration of engineers with registration schemes eg in the UK, ACRIB F gas SKILLcard (www.acrib.org.uk) so that you can verify their refrigerant handling qualifications.

7. Leakage reduction skills

The UK REAL Zero research highlighted the need for refrigeration technicians to have additional skills to advise equipment owners on ways to reduce refrigerant leakage. These additional skills would allow technicians to:

- Advise how to minimise leakage in new and existing plant through appropriate design, installation and maintenance.
- Survey and leak test existing plant and identify areas where improvements can be made to reduce leak potential, for example by replacing certain components and specifying an appropriate leak test regime.
- Outline legal requirements and responsibilities such as those under the F Gas and ODS Regulations, and provide information on effective and practical compliance.
- Audit compliance and maintenance on a site-by-site basis.

The training in these additional skills is provided by the REAL Skills Europe e-learning programme which offers assessment and accredited CPD (Continuing Professional Development) certification. Students who successfully complete the full training course and satisfy other criteria can gain a CPD Certificate on successful completion of an assessment. See www.realskillseurope.eu for details.



Free e-learning for technicians is available at www.realskillseurope.eu

8. Your obligation to manage refrigerant strategically

A system that is well specified, designed, installed and maintained should not suffer any significant leakage during its lifetime.

Employ a contractor who firmly believes in the need to reduce all refrigerant leakage and understands the impact of leakage on system efficiency and energy costs. Ensure through accurate refrigerant reporting that your contractor identifies and repairs all leaks and use this knowledge and experience to correct the potential for leakage on other systems. Play a key part in monitoring and discussing refrigerant leakage with your contractor and be willing to invest in improvements where necessary.



**Remember:
If you don't
measure it you
can't manage it!**

If your contractor is providing refrigerant usage records to comply with the F Gas Regulations, make sure you analyse the reports and take appropriate action where necessary. This type of reporting can easily identify systems that have a high leakage rate over a period and be used to benchmark for improvement. Sample reports and calculator tools are available from the REAL Skills Europe website.

Refrigerant containment should be a priority for everyone who designs, builds, uses or maintains refrigeration or air conditioning systems. If we want to continue to have the best choice of refrigerants in the future, we must ensure that refrigerant is contained within the system. **If the refrigerant is contained within a system its environmental impact is negligible.**

9. References and sources of further information

- F Gas Regulations – EU 517/2014 Regulation of the European Parliament and of the Council on Certain Fluorinated Greenhouse Gases
- EC Regulation 1005/2009 (replacing 2037/2000) on substances that deplete the ozone layer. Referred to as the Ozone Depleting Substances (ODS) Regulations
- EC 303/2008 Certification of companies and personnel (under revision)
- UK Environment Agency F Gas Support RAC Guidance
<https://www.gov.uk/guidance/certification-for-companies-working-on-equipment-containing-f-gas>
- More detailed guidance to print off at <http://www.gluckmanconsulting.com/f-gas-information-sheets/>
- EN378:2008+2012 Refrigerating systems and heat pumps – Safety and environmental requirements available from www.bsigroup.com (under revision)
- EU Pressure Equipment Directive 97/23/EC
- Pressure Equipment Regulations 1999 (SI 1999/2001) and The Pressure Equipment (Amendment) Regulations 2002 (SI 2002/1267)
- Guidance Note 21 on Practical issues relating to pressure systems available from www.ior.org.uk
- The British Refrigeration Association Joining of Copper Pipework for Refrigeration Systems – www.feta.co.uk
- Good practice guide for the detection of refrigerant leaks available from <http://www.cetim.fr/cetim/fr/Boutique/Librairie/Publications/Good-practice-guide-for-the-detection-of-refrigerant-leaks>

This document is based on information and legislation current at date of publication. The Institute of Refrigeration and REAL Skills Europe partners accept no responsibility for any errors or omissions. Originally published in June 2011. Revised August 2015 © IOR all rights reserved