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EC Regulation No 842/2006 on certain fluorinated greenhouse gases

Supplementary Guidance for Stationary Refrigeration Air-conditioning and Heat Pump Users

February 2007

Llywodraeth Cynulliad Cymru
Welsh Assembly Government

dti

SCOTTISH EXECUTIVE

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Published by the Department for Environment, Food and Rural Affairs and the Department of Trade and Industry February 2007

URN 06/1927

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1. Introduction

In June 2006 the EU Fluorinated Gases (F gases) Regulation came into force[1]. This Regulation places obligations on operators of refrigeration, air-conditioning and heat pump equipment to reduce emissions of fluorinated greenhouse gases used as refrigerants, through better containment and leakage prevention.

This Guidance Note is a supplement to Defra Guidance on the F gas Regulation[2]. In particular this Guidance is intended to:

- Help operators of refrigeration, air-conditioning and heat pump equipment identify whether they use refrigerants affected by the new Regulation.
- Help identify how much refrigerant they have in a system. This is important as it affects the way the Regulation will apply.
- For those that are affected, to provide an explanation of what actions they need to take to comply and the dates when the new rules come into force.

Fluorinated gases[3] (F gases) include HFCs, PFCs and SF_6. These are very powerful greenhouse gases which cause global warming. The objective of the F gas Regulation is to minimise emissions of these gases, mainly through reduced leakage and through gas recovery during servicing or when old equipment is being decommissioned.

This Guidance note is **only** aimed at stationary refrigeration, air-conditioning and heat pump users. Other sectors affected by the F gas Regulation[4] should refer to other Defra guidance (as referred to in footnote 2).

Please note that the term "refrigeration" used in this Guidance Note is intended to include air-conditioning and heat pump systems as well as refrigeration.

Background to the usage of refrigeration equipment in the UK

It is useful to note that there are over 30 million refrigeration systems used in the UK. They are used in almost all types of building including the home, offices, shops, factories, restaurants, pubs, hospitals, schools, etc.

A large proportion of these systems (well over 90%) are very small factory built systems that "plug in" to an ordinary 13 Amp electric socket - like domestic refrigerators or small retail units such as ice cream display

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[1] Regulation (EC) No 842/2006 of the European Parliament and of the Council of 17 May 2006 on certain fluorinated greenhouse gases.

[2] Defra Guidance "EC Regulation No 842/2006 on certain fluorinated greenhouse gases" available from http://www.defra.gov.uk/environment/climatechange/uk/fgas/index.htm

[3] HFCs: hydrofluorocarbons. PFCs: perfluorocarbons. SF_6: sulphur hexafluoride.

[4] The F-Gas Regulation also affects other users of HFCs (e.g. fire protection systems, solvents, foam blowing, aerosols), PFCs (e.g. semi-conductor manufacturers) and SF_6 (e.g. high voltage switchgear, magnesium smelting).

cabinets. This type of equipment typically only uses 50 to 250 grams of refrigerant and rarely suffers from leakage. The new Regulation affects these small systems primarily at end of life – when proper disposal of the refrigerant is required. However, if a leak is detected while such a small application is in use, it must be repaired as soon as possible by certified personnel, provided it is technically feasible and not disproportionately costly. The main impact of the Regulation is on systems containing at least 3 kg of refrigerant. Larger systems, especially those requiring long runs of refrigerant pipework, are prone to leakage. The Regulation is intended to reduce leakage of fluorinated greenhouse gas based refrigerants from such systems.

2. Types of equipment covered by the Regulation

The types of equipment that might use F gases as refrigerants include:

- **Refrigeration machinery** – equipment to cool products or storage spaces below ambient temperature, e.g. domestic refrigerators, industrial process cooling plant, retail refrigerated displays, cold stores etc.
- **Air-conditioning equipment** – equipment to cool buildings to a comfortable ambient temperature, ranging from small units to cool one room to large chillers that cool a whole office complex or factory space.
- **Heat pumps** – heating devices that use a refrigeration machine to extract energy from a waste heat source and deliver useful heat.

All these applications use a basically similar refrigeration process to provide cooling – the vast majority are powered by electric motors.

3. Main Obligations in the New Regulation

There are 6 main obligations in the F gas Regulation that will affect operators of refrigeration equipment. The obligations are summarised in Table 1. These are discussed in more detail in Section 9 of this Guidance Note and in other Defra Guidance.

Table 1: Summary of Obligations for Refrigeration, Air-Conditioning and Heat Pump Operators

Obligation	Applicability (for systems using F gas Refrigerants)
Recovery of F gases during plant servicing and maintenance and at end of plant life.	All stationary systems
Use adequately trained staff to carry out installation, servicing and maintenance and leakage checking	All stationary systems
New equipment shall be labelled	All stationary systems

Take steps to prevent F gas leakage and repair detected leakage as soon as possible	All stationary systems
Regularly check for leakage	Stationary systems above 3kg or 6kg[5]
Keep certain records about refrigeration plant that uses F gases	Stationary systems above 3kg
Fit automatic leak detection system	Stationary systems above 300kg

Whether you need to comply with all the obligations listed in Table 1 depends on the size and type of plant that you operate. The requirements to check for leakage and to keep records only apply to plant containing 3 kg or more of refrigerant (the leak checking obligation has a threshold of 6 kg for hermetically sealed equipment). However, the requirements to recover refrigerant and to use adequately trained staff applies to equipment of all sizes.

Some parts of the F gas Regulation[6] refer to "stationary refrigeration, air-conditioning and heat pump equipment". This means that mobile systems used in cars (mobile air-conditioning) and in other forms of transport (e.g. refrigerated lorries or containers) are not subject to the regular leak testing and record keeping obligations.

4. Who will be affected by the new Regulation?

To establish whether you are affected by the F gas Regulation you will need to identify 2 pieces of technical information about each separate refrigeration system/application:

1) Does the system use a refrigerant containing F gases? If a system **does not** use an F gas refrigerant then F gas Regulation will not apply. In most cases F gas refrigerants are HFCs, although PFCs are also used in a few refrigerant blends. For simplicity we shall refer to HFCs in this document, but the rules also apply to PFCs.

2) How much HFC refrigerant is in the system? If a system contains less than 3 kg of HFC refrigerant then the obligations on leak checking and record keeping will not apply. A large proportion of refrigeration systems are small systems that fall well below this limit. For example a domestic refrigerator only contains around 0.1 kg of refrigerant.

[5] The threshold is 3 kg for most systems, but is increased to 6 kg for a "hermetically sealed system". This is defined as: "a system in which all refrigerant containing parts are made tight by welding, brazing or a similar permanent connection which may include capped valves and capped service ports that allow proper repair or disposal and which have a tested leakage rate of less than 3 grams per year under a pressure of at least a quarter of the maximum allowable pressure".

[6] Articles 3.1 and 4.1

Information about the type and quantity of refrigerant might be found on a "Name Plate" found on your equipment. If you cannot find a Name Plate, this Guidance Note provides advice about how to answer these 2 questions (see Section 7 and Section 8).

5. What is a "separate refrigeration system"?

The Regulation refers to size thresholds for each separate refrigeration system or application. Two plants are considered to be separate if there is no interconnection between their refrigerant circuits (i.e. refrigerant cannot flow from one to the other).

For example:

a) A site has 20 small systems, each with 0.25 kg of refrigerant. The systems are **not** interconnected between their refrigerant circuits. Although the total refrigerant charge for the site is 5 kg, each separate refrigeration system contains less than 3 kg, so annual leak tests are not required.

b) A site has 3 water chillers, each with 150 kg of refrigerant. They are interconnected on the chilled water side but are <u>not</u> interconnected between their refrigerant circuits. Each chiller is treated separately and will need to comply with the rules for systems between 30 and 300 kg (see Table 3 in Section 9). However, automatic leak detection equipment is not mandatory even though the total charge is 450 kg, because the 3 systems are treated separately.

6. Who is responsible for complying with the Regulation?

The main responsibilities are held by the "Operator" of the equipment. 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 … a Member State may, in defined, specific situations, designate the owner as being responsible for the operator's obligations*".

In many circumstances the identity of the operator will be obvious – the phrase "*exercising actual power"* is an important one and it usually places responsibility with the end user, even if there is a comprehensive maintenance contract in place.
An area of potential ambiguity is in landlord-tenant relationships e.g. in an air-conditioned office building. In these circumstances you may need to refer to the legal responsibilities set down in the lease – this would normally specify the party who is responsible for the operation and upkeep of the system.

7. What type of refrigerant is used?

The F gas Regulation will apply to any refrigeration system using an F gas refrigerant. This will include:

a) Pure F gas refrigerants, usually an HFC (e.g. R134a).

b) Blended refrigerants containing a number of F gas components (e.g. R404A which is a blend of 3 HFCs).

c) Blended refrigerants containing F gases **and** other components such as HCFCs (hydrochlorofluorocarbons) and hydrocarbons (e.g. R408A which is a blend of 2 HFCs and R22 which is an HCFC or R403A which is a blend of a PFC and 2 other components).

The Regulation's requirements would not apply to blends ("preparations") where the total global warming potential of the F gases is less than 150. All refrigeration systems should be labelled with the refrigerant type, usually on a Name Plate mounted on the equipment or in documentation provided when the system was purchased. If no information is available you should contact the equipment supplier or manufacturer and ask for their advice. There are numerous different refrigerant types, usually referred to by an "R" number or sometimes by a Trade Name. To help interpret the information you find on a Name Plate, see Table 2 to establish whether a refrigerant is an HFC.

Table 2 Identifying HFC Refrigerant Types

HFC Refrigerants Covered by the New F gas Regulation		
Type	**Commonly Used Refrigerants**	**Less Common Refrigerants**
HFCs – pure fluids	R134a	R23, R32, R125, R143a
HFCs – blends	R403A, R403B, R404A, R407C, R408A, R410A, R413A, R417A, R507	R401 (A,B,C) R402 (A, B) R407 (A, B, D), R411B, R 416A, R422A, R423A, R50
Trade Names for Refrigerants	Trade names are sometimes used with the relevant R number (e.g. Harp 134a) or with another number (e.g. R 401A is also Suva MP39) The following trade names are for refrigerants that contain F gases: AZ-20, AZ-50, Forane (FX56, FX80, FX100), Greencool 411B, Harp, Isceon (MO29, 39TC, MO49, 59, MO79, MO89), Klea, RS-24, RS-44 Suva (MP39, MP66, HP80, HP81)	

Other Refrigerants – **NOT** Covered by the New F gas Regulation		
Type	**Commonly Used Refrigerants**	**Less Common Refrigerants**

HCFCs - pure fluids	R22	R123, R124
HCFCs - blends		R406A, R409(A, B)
CFCs	R11, R12, R502	R13, R500
Other refrigerants	R717 (ammonia), R290 (propane) R600a (iso-butane), R1270 (propylene) Care (10,30, 40, 45, 50 –HC blends)	R744 (CO_2) Absorption plants: Ammonia / water Lithium Bromide / water

Notes to Table 2:
Some HFC refrigerant blends contain both HFCs and HCFCs (e.g. R401A and R408A). These are often referred to as "HCFC blends" to make it clear that the blend falls under the EU Ozone Regulation. It is important to recognise that they **are also covered** by the F gas Regulation as they contain some F gas components, provided the combined global warming potential of the F gases is 150 or more.
R22 is a very common HCFC refrigerant used in air-conditioning and industrial plant. As an HCFC it is **not covered** by the F gas Regulation, but does fall under the EU Ozone Regulation. Under the EU Ozone Regulations:

1) Use of HCFCs for new refrigeration systems is banned.
2) Use of virgin HCFCs for servicing existing systems will be banned after 2009.
3) Use of recycled HCFCs for servicing existing systems will be banned after 2014. This date is currently under review and might be brought forward. There is no guarantee that recycled supplies will be available at reasonable price between 2010 and 2014.

8. How much refrigerant is in the system?

If you have established that you are using an HFC refrigerant in a refrigeration system, the next step is to find out how much refrigerant is in the system. The key thresholds specified in the Regulation are as follows:

- All systems with less than 3 kg of HFC refrigerant are not covered by the obligation to carry out regular leakage checks and to keep records.
- Hermetically sealed systems with between 3 kg and 6 kg of HFC refrigerant are exempt from the obligation to carry out regular leakage checks. Examples of hermetically sealed systems include domestic refrigerators and small self-contained commercial systems such as bottle coolers, display cabinets and ice makers. Any system requiring on-site fabrication of refrigerant pipework is unlikely to fall in the hermetic category (even if it has a hermetic compressor).
- There are further thresholds at 30 kg and 300 kg which are used to define the regularity of leak testing required and the requirements for automatic leak detection. This is described in more detail in Section 9 of this Guidance Note.

8.1 Doing it the easy way!

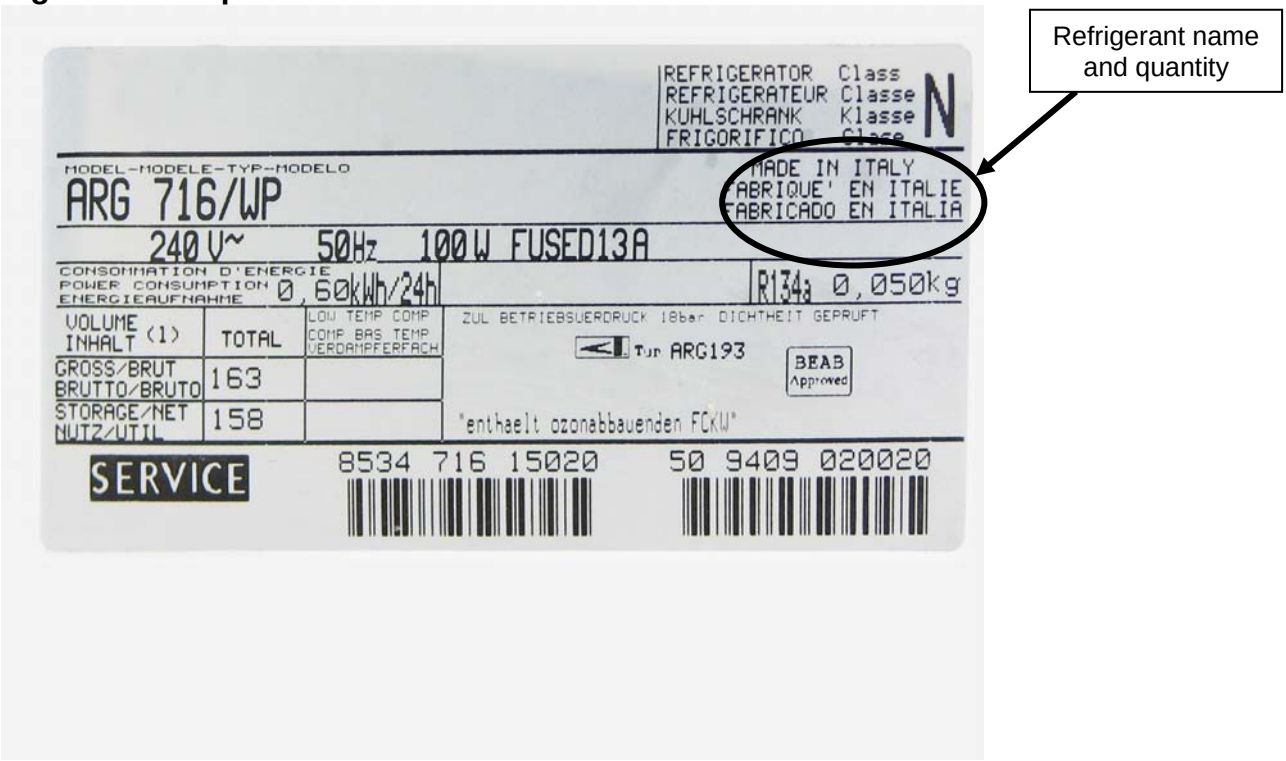
The easiest way to establish the amount of refrigerant in the system is to use data supplied by the manufacturer:

- Many refrigeration systems, especially small ones, have a Name Plate showing the amount of refrigerant.

- Alternatively, you may have a record of the amount of refrigerant in the documentation supplied when the system was installed.

On a Name Plate there will be a refrigerant name (which will enable you to establish whether the refrigerant is an HFC, using the lists in Table 2) and also a refrigerant charge, shown in grams or kilograms. The name plate shown in Figure 1 shows the type of data you are likely to find. Half way down the right side of the label (inside the oval) it shows the refrigerant used is R134a and the quantity is 0.05 kg.

Figure 1 Example Name Plate



8.2 Some Useful Rules of Thumb

In the absence of manufacturer's data you will need to make an estimate of the refrigerant quantity. There are five simple rules of thumb that can help:

Rule 1: Small hermetically sealed systems fitted with a "domestic" 240 Volt 13 Amp plug will be well below the 6 kg limit. This is a very important rule as it applies to millions of small systems. All domestic refrigerators and

freezers fall into this category. So do many systems used in small shops (e.g. ice cream display cabinets, bottle coolers, small chilled or frozen food cabinets etc,) in pubs / restaurants (e.g. “in-line” drink coolers, ice makers etc.), in offices (e.g. vending machines) and in other types of building.

Rule 2: Most “split systems” will be above the 3 kg limit. A split system is one with at least 2 major components located in different locations, connected by refrigerant pipework that is fitted by an installation contractor. For example, an air-conditioning system with a cooling unit inside a room and a “condensing unit” (consisting of various components including a compressor and a condenser) that is located remotely, usually outside the building. The components are interconnected by 2 refrigerant pipes, often made of copper. One or both of the pipes will be covered in insulation. Split systems are used for many refrigeration applications (e.g. cold stores, larger retail systems for supermarkets and large shops, industrial applications and air-conditioning in many types of building). The majority of split systems will use at least 3 kg of refrigerant.
Exceptions to Rule 2: Very small split systems that are “close coupled” e.g. an air-conditioning system serving a small room where the indoor and outdoor units are less than 5 metres apart could be below 3 kg. If a small split system is operated via a 240 Volt 13 Amp plug (see Rule 1), then it is more likely that the system has less than 3 kg – but only if the indoor and outdoor units are close coupled.

Rule 3: Most air-conditioning water chillers will be above the 3 kg limit. Water chillers for air-conditioning are factory built units where the components are located together in a fairly compact layout. They usually provide quite a large cooling duty and will be well over the 3 kg limit.
Exceptions to Rule 3: Very small water chillers, e.g. with a cooling duty below 15 kW might be below the 3 kg limit. Also, small units could be hermetically sealed, in which case the 6 kg threshold applies – a hermetically sealed water chiller providing less than 30 kW cooling might be below the 6 kg limit.

Rule 4: A crude approximation is that the compressor motor kW equals the kg of refrigerant. For example, a system with a 5 kW compressor motor might contain about 5 kg. This is only an approximation – the actual refrigerant charge depends on many different factors. However, it can be a useful screening test – e.g. a system with a 1 kW compressor motor is less likely to be above the 3 kg limit.

Rule 5: Any system with a liquid storage vessel will contain more than 3 kg. Some systems are fitted with a “high pressure liquid receiver” which is located under the condenser. They are usually quite large cylindrical vessels containing well over 3 kg. Other types of storage vessel are also used in other locations e.g. an evaporator surge drum or an intercooler for a 2-stage plant. Again these will almost always contain well over 3 kg.

8.3 Doing a proper estimate of refrigerant charge

To more accurately estimate the amount of refrigerant in a system you need to collect data about key components in the system and build a "refrigerant inventory". DTI/Defra have developed a spreadsheet tool that can be used to help with this process. The tool can be accessed at http://www.defra.gov.uk/environment/climatechange/uk/fgas/

Refrigerant in a system is either in the form of liquid or vapour. The liquid is about 50 times denser than the vapour – so to estimate the refrigerant charge we need to find out how much liquid is in the system (the extra for vapour will only add 1 or 2% to the total). The refrigerant liquid can be found in the following places:

a) In the evaporator – the heat exchanger providing the cooling.
b) In the condenser – the heat exchanger where heat is rejected.
c) In the liquid line – the pipe connecting the condenser to the expansion valve.
d) In any storage vessels – e.g. a liquid receiver under the condenser or a surge drum linked to the evaporator.
e) In the compressor – a small amount of liquid is often dissolved in the compressor lubricating oil.

Figure 2 shows a very simple refrigeration system without any storage vessels. The red shading shows where liquid is located.

Figure 3 shows a slightly more complex system with a high pressure liquid receiver.

Figure 4 shows a complex industrial plant with multiple heat exchangers, a high pressure liquid receivers and a low pressure surge drum.

The amount of liquid in the liquid line and in storage vessels is specific to the actual layout of pipework and the size of vessels installed. The only way of establishing the refrigerant charge is to do calculations based on pipe and vessel dimensions.

The amount of liquid in the evaporators and condensers depends on the type of heat exchanger used and the size of the cooling load.

8.4 Using the DTI Refrigerant Charge Calculator Spreadsheet

Research with equipment suppliers has identified the amount of refrigerant used in different components – these have been used to develop the DTI Refrigerant Charge Calculator spreadsheet.

To use the spreadsheet tool you must supply the following information:

- The type of evaporators (e.g. finned air cooler) and condensers (e.g. evaporative).
- The length and diameter of the main liquid line.
- The dimensions of liquid storage vessels.
- The type of compressors (e.g. reciprocating).
- The overall system size (either in terms of cooling duty or compressor power) and the cooling temperature level.

- The type of refrigerant used.

The spreadsheet then calculates an estimate of the refrigerant charge for a system. The outputs include:

a) The total charge of the system, in kg.

b) The amount of F gas in the system, in kg. Note, in many cases this will be equal to the total charge, but some refrigerant blends include components that are not F gases. This could affect your assessment of size threshold e.g. a plant with a total charge of 5 kg of R403B only contains about 2 kg of F gases, which is below the important 3 kg threshold.

c) A summary of the obligations that apply from the F gas and Ozone Regulations.

Figure 2 Simple Refrigeration System

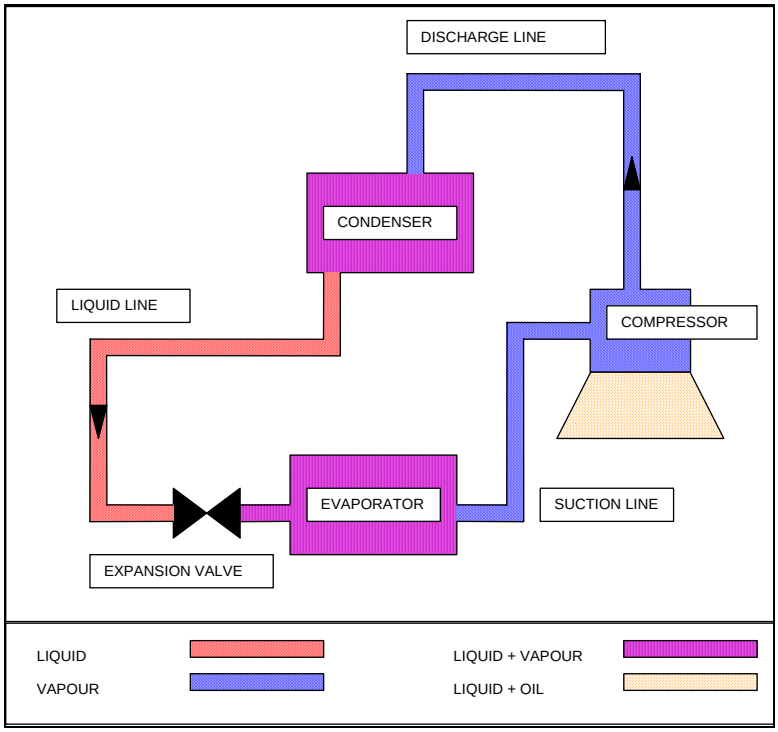


Figure 3 Simple Refrigeration System with HP Liquid Receiver

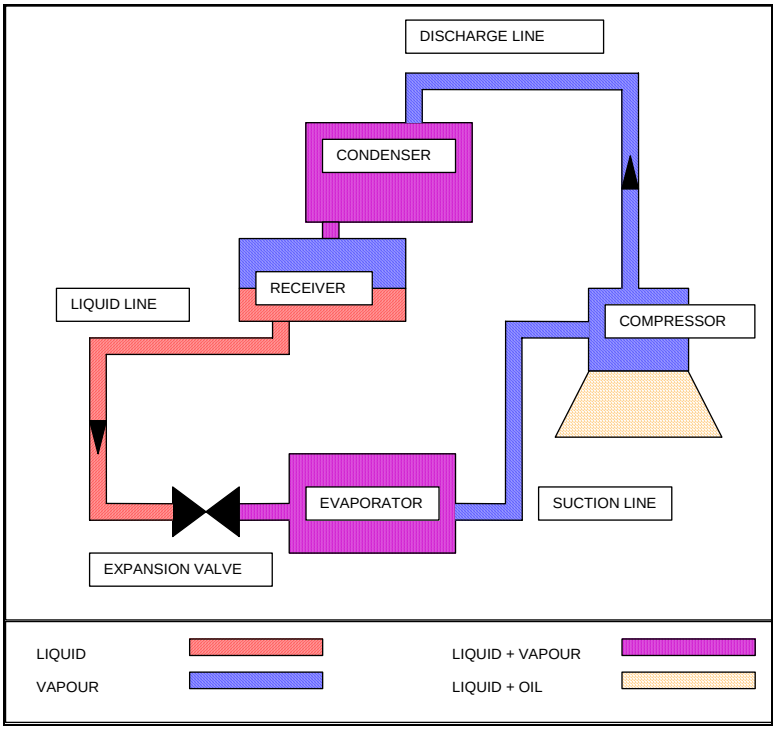
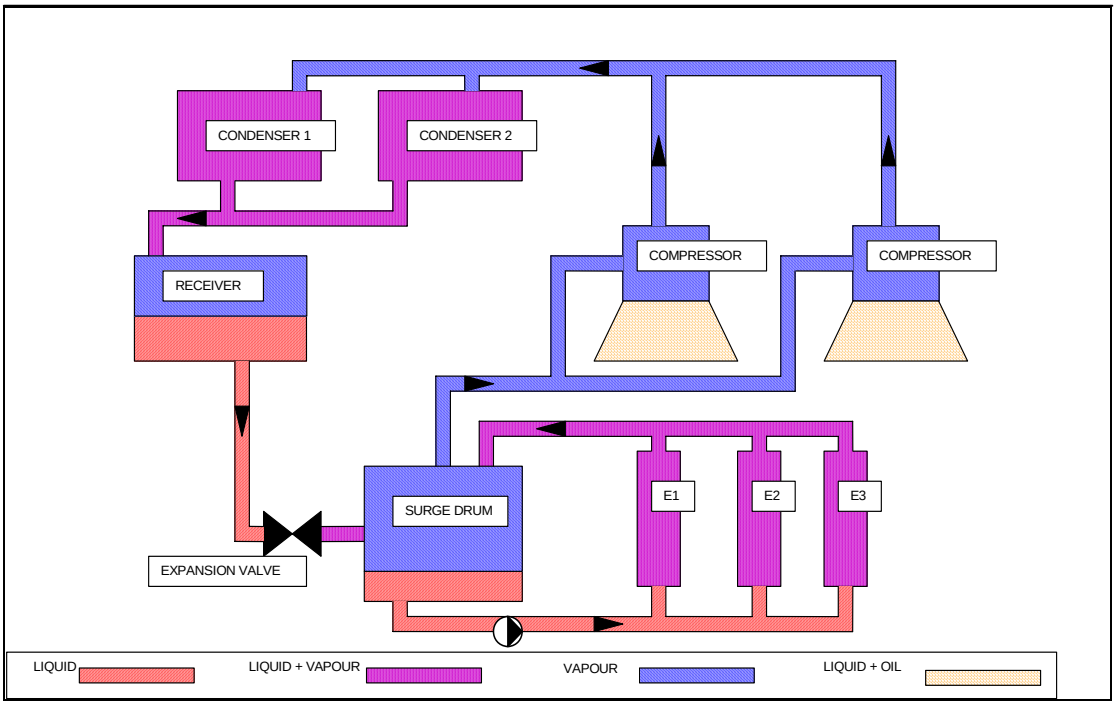


Figure 4 Complex Industrial Plant



9. Details of the Obligations in the New Regulation

Details about all aspects of the F gas Regulation can be found in Defra Guidance available on http://www.defra.gov.uk/environment/climatechange/uk/fgas/index.htm .

The key obligations related to refrigeration systems are summarised in this section. However it is advisable to check the Defra Guidance as this will be kept up to date as certain aspects of the Regulation evolve (some aspects are still under discussion by the EU F gas Regulatory Committee).

The obligations in the new Regulation for stationary refrigeration equipment containing HFC refrigerant apply from July 4th 2007 and are as follows:

a) **General obligation to prevent leakage.** Using all measures which are technically feasible and do not entail disproportionate cost operators must: (a) prevent leakage of HFC refrigerants and (b) as soon as possible repair any detected leakage.

b) **Regular leakage checking.** Equipment containing 3kg or more of F gas refrigerant must be checked for leakage by certified personnel on a regular basis. "Checked for leakage" means that the equipment or system is examined for leakage using direct or indirect measuring methods, focusing on those parts of the equipment or system most likely to leak. The frequency of testing depends on refrigerant charge and system type. Table 3 summarises the leakage checking frequencies.

Table 3: Leak Testing Frequencies

Frequency	Normal systems	Hermetically sealed systems
None	<3 kg	<6 kg
Annual	3 kg to 30 kg	6 kg to 30 kg
6-monthly*	30 kg to 300 kg	30 kg to 300 kg
Quarterly*	>300 kg	>300 kg

* Half this frequency if fitted with automatic leak detection
Plants must be rechecked within one month after a leak has been repaired to ensure that the repair has been effective.

c) **Automatic leak detection systems.** Plants with more than 300 kg **must** be fitted with a leakage detection system, which is defined as: "a calibrated mechanical, electrical or electronic device for detecting leakage of refrigerants which, on detection, alerts the operator". The detection system must be checked at least once a year to ensure proper functioning.
For any plant fitted with a leakage detection system (including those below the mandatory 300 kg threshold), the frequency of leak checking can be halved, although an annual check remains the minimum frequency.

d) **Maintaining records.** Records must be kept about each system with more than 3 kg of HFC refrigerant. The obligation will apply from 4 July 2007. The records must include:

- The quantity and type of F gas refrigerants installed in each system
- Any quantities of refrigerant added
- The quantity of refrigerant recovered during servicing, maintenance and final disposal.
- Other relevant information including the identification of the company or technician who performed the servicing or maintenance, as well as the dates and results of leakage checks and leakage detection system checks.
- Relevant information specifically identifying the separate stationary equipment containing 30kg or more of refrigerant
- These records shall be made available on request to the competent authority and to the Commission.

Appendix 1 shows an example log sheet. The form of the record does not have to be prescribed at EC level although the Commission may make some suggestions about a useful common format.

e) Gas recovery. If refrigerant needs to be removed from a system (e.g. to gain access to part of a system for maintenance or during system decommissioning at the end of life) it must be properly recovered by certified personnel. After recovery the refrigerant can be reused or sent for reclamation or destruction.

f) Use of adequately trained and certified staff. Personnel carrying out leak checking, gas recovery or other refrigerant handling activities such as plant installation and maintenance must have a suitable refrigerant handling qualification. The minimum qualifications are still being discussed by the EU Regulatory Committee. It is expected that refrigerant handling qualifications such as City & Guilds 2078 or the CITB refrigerant handling certificate will be suitable.

g) Labelling. Any new system placed on the market must be fitted with a label clearly stating the type and quantity of HFC refrigerant used. The form of the label first has to be established at EU level.

Stationary HFC refrigeration systems with less than 3 kg of refrigerant do not need to comply with (b), (c) and (d) above. However, all the other items i.e. (a), (e), (f) and (g) apply to all types of stationary HFC refrigeration system.

Annex 1
Sample Log Sheet for Record Keeping Obligation

The table below shows an example record sheet for compliance with the F gas Regulation. Records of this type must be kept for **each** refrigerant plant that contains more than 3 kg of HFC refrigerant.

General Information			
Plant Name		Reference No.	
Location of plant			
Plant Operator[7]			
Operator Contact[8]			
Cooling loads served			
Refrigerant Type		Refrigerant Quantity installed (kg)	
Plant manufacturer		Year of installation	
Refrigerant Additions			
Date	Engineer[9]	Amount Added, kg	Reason for addition
Refrigerant Removals			
Date	Engineer	Amount Removed, kg	Reason for removal. What was done with recovered refrigerant
Leak Tests			
Date	Engineer	Test Result	Follow up actions required
Follow-up Actions			
Date	Engineer	Related to test on	Actions Taken
Testing of Automatic Leak Detection System (if fitted)			
Date	Engineer	Test Result	Comments

[7] Name and address of company operating the plant
[8] Contact details for Operator's nominated person responsible for F-Gas compliance
[9] Identify both the Company and the actual Technician carrying out the work, with contact details – to provide evidence of competence.