



# INFORMATION

for

## OPERATORS OF EQUIPMENT CONTAINING FLUORINATED GREENHOUSE GASES

STATIONARY REFRIGERATION,  
AIR-CONDITIONING AND  
HEAT PUMP EQUIPMENT

Regulation (EC) No 842/2006 on certain fluorinated greenhouse gases  
and implementing acts



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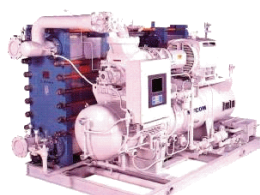
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## INTRODUCTION



Under the Kyoto Protocol, the European Union has committed itself to reducing its greenhouse gas emissions by 8% compared to the base year 1990 in the period 2008-2012. The Kyoto Protocol covers the major greenhouse gases: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O) and three groups of fluorinated gases, the so called 'F-Gases': hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF<sub>6</sub>).

To reduce emissions of these F-Gases in order to meet the EU climate change objectives and obligations under the Kyoto Protocol, the European Parliament and the Council adopted on 17 May 2006 the **Regulation (EC) No 842/2006 on certain fluorinated greenhouse gases (F-Gas Regulation)**. This Regulation which applies as of 4 July 2007<sup>1</sup>, lays down specific requirements for the different stages of the whole life cycle of F-Gases, from the production to end of life. Consequently, different actors along the life cycle of the F-Gases are affected by the Regulation including producers, importers and exporters of F-Gases, manufacturers and importers of certain F-Gas containing products and equipment and operators of the equipment.

The Regulation is supplemented by 10 Commission Regulations (implementing acts) defining technical aspects of certain of its provisions (see Annex I).

This brochure is for operators of **stationary refrigeration, air conditioning and heat pump equipment** in which F-Gases are used as **refrigerants**. Refrigeration and air conditioning systems contained in modes of transport are not covered.

The aim of this document is to provide information and guidance on the relevant provisions of Regulation (EC) No 842/2006 and its implementing acts and is not of a binding nature. Separate publications are available for operators of other equipment and relevant technical personnel and companies also covered by the Regulation. Requirements resulting from the F-Gas Regulation for producers, importers and exporters of F-Gases as well as manufacturers and importers of certain F-Gas containing products and equipment are summarised in a separate leaflet.

<sup>1</sup> Article 9 and Annex II of the Regulation came into application on 4 July 2006

## GENERAL INFORMATION ON F-GASES AND THE F-GAS REGULATION



### 2.1 Global warming

The terms “global warming” or “greenhouse effect” are commonly used to describe the increase in the average surface temperature of the Earth over time. It is estimated that the Earth’s climate has warmed between 0.6 and 0.9 degrees Celsius over the past century. Scientists concluded that “most of the observed increase in globally averaged temperatures since the mid-twentieth century is very likely due to the observed increase in anthropogenic (man-made) greenhouse gas concentrations”<sup>2</sup>. The major man-made greenhouse gases are those covered by the Kyoto Protocol: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O) and man-made F-Gases. Ozone-depleting substances controlled under the Montreal Protocol such as chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs) and halons are also significant greenhouse gases.

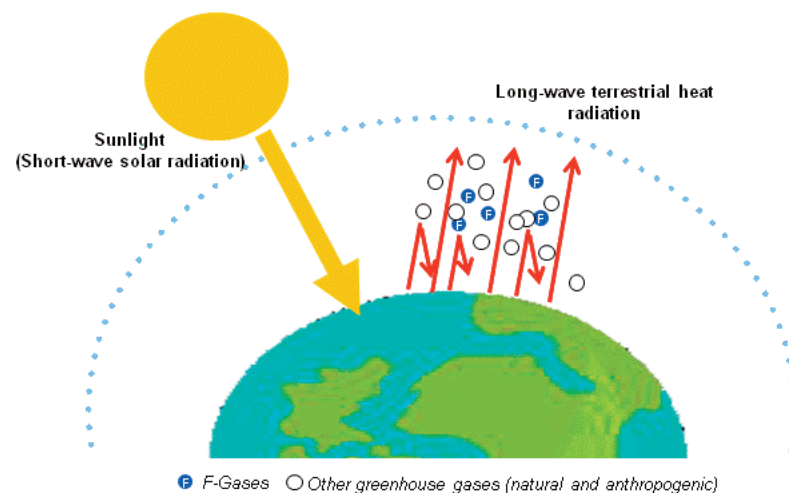


Figure 1 Simplified principle of global warming

#### Simplified principle of global warming

The Earth receives energy from the Sun in the form of sunlight (short-wave solar radiation) which penetrates the atmosphere relatively unhindered. About 30% of the incoming short-wave solar radiation is reflected by the atmosphere and the surface back into outer space. The remaining 70% is absorbed by the Earth’s surface (land, ocean) and the lower part of the atmosphere. When absorbed, it heats the Earth’s surface and is reradiated as long-wave (infrared) heat radiation. This infrared radiation is not able to penetrate the atmosphere as unhindered as the short-wave radiation but is reflected by clouds and absorbed by atmospheric greenhouse gases. Thus greenhouse gases trap heat within the surface-troposphere system

<sup>2</sup> 4<sup>th</sup> Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), <http://www.ipcc.ch/ipccreports/ar4-syr.htm>

Historically, the natural concentrations of greenhouse gases kept the Earth warm enough to support life as we know it. The more man-made greenhouse gases are in the atmosphere the more infrared radiation is reverberated to the Earth's surface. This leads to the so called "anthropogenic greenhouse gas effect" resulting in a global warming of the Earth.

## 2.2 What are fluorinated greenhouse gases?

F-Gases (HFCs, PFCs and SF<sub>6</sub>) are man-made chemicals used in several different sectors and applications.

They have become popular since the 1990s as substitutes for certain ozone-depleting substances<sup>3</sup> used at that time in most of those applications, such as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), and phased-out under the Montreal Protocol.

Although F-Gases have no ozone-depleting properties most of them have a high global warming potential (GWP).

The GWP used in the context of the F-Gas Regulation is calculated in terms of the 100-year warming potential of one kilogramme of an F-Gas relative to one kilogramme of CO<sub>2</sub>.<sup>4</sup>

**HFCs** are the most common group of F-Gases. They are used in various sectors and applications such as refrigerants in refrigeration, air conditioning and heat pump equipment, as blowing agents for foams, as fire extinguishants, aerosol propellants and solvents.

**PFCs** are typically used in the electronics sector (e.g. for plasma cleaning of silicon wafers) as well as in the cosmetic and pharmaceutical industry (extraction of natural products like nutraceuticals and flavours), but to a minor extent also in refrigeration as CFC replacements – often in combination with other gases. In the past PFCs were used as fire extinguishants and can still be found in older fire protection systems.

**SF<sub>6</sub>** is mainly used as an insulation gas and for extinguishing the switching arc in high-voltage switchgear and as a cover gas in magnesium and aluminium production.

Annex II of this brochure provides an overview of the substances addressed by the F-Gas Regulation, including their global warming potential and typical applications.

### Global warming potential (GWP)

An index, describing the radiative characteristics of well-mixed *greenhouse gases*, that represents the combined effect of the differing times these gases remain in the *atmosphere* and their relative effectiveness in absorbing outgoing *infrared radiation*. This index approximates the time-integrated warming effect of a unit mass of a given greenhouse gas in today's atmosphere, relative to that of *carbon dioxide*.

(Source: IPCC Third Assessment Report)

<sup>3</sup> **Ozone-depleting substances** are substances which destroy the ozone-layer of the earth. They typically contain chlorine or bromine. These substances are regulated under Regulation (EC) No 2037/2000 of the European Parliament and of the Council of 29 June 2000 on substances that deplete the ozone layer.

<sup>4</sup> The 100-year GWP figures listed in Annex II are those published in the third assessment report (TAR) adopted by the Intergovernmental Panel on Climate Change (IPCC). These range from 97 for fluoromethane (HFC-41) to 22 200 for sulphur hexafluoride.

## 2.3 General overview of the F-Gas Regulation

The **overall objective** of the F-Gas Regulation is to reduce emissions of F-Gases, through a series of measures or actions taken throughout their life cycle.

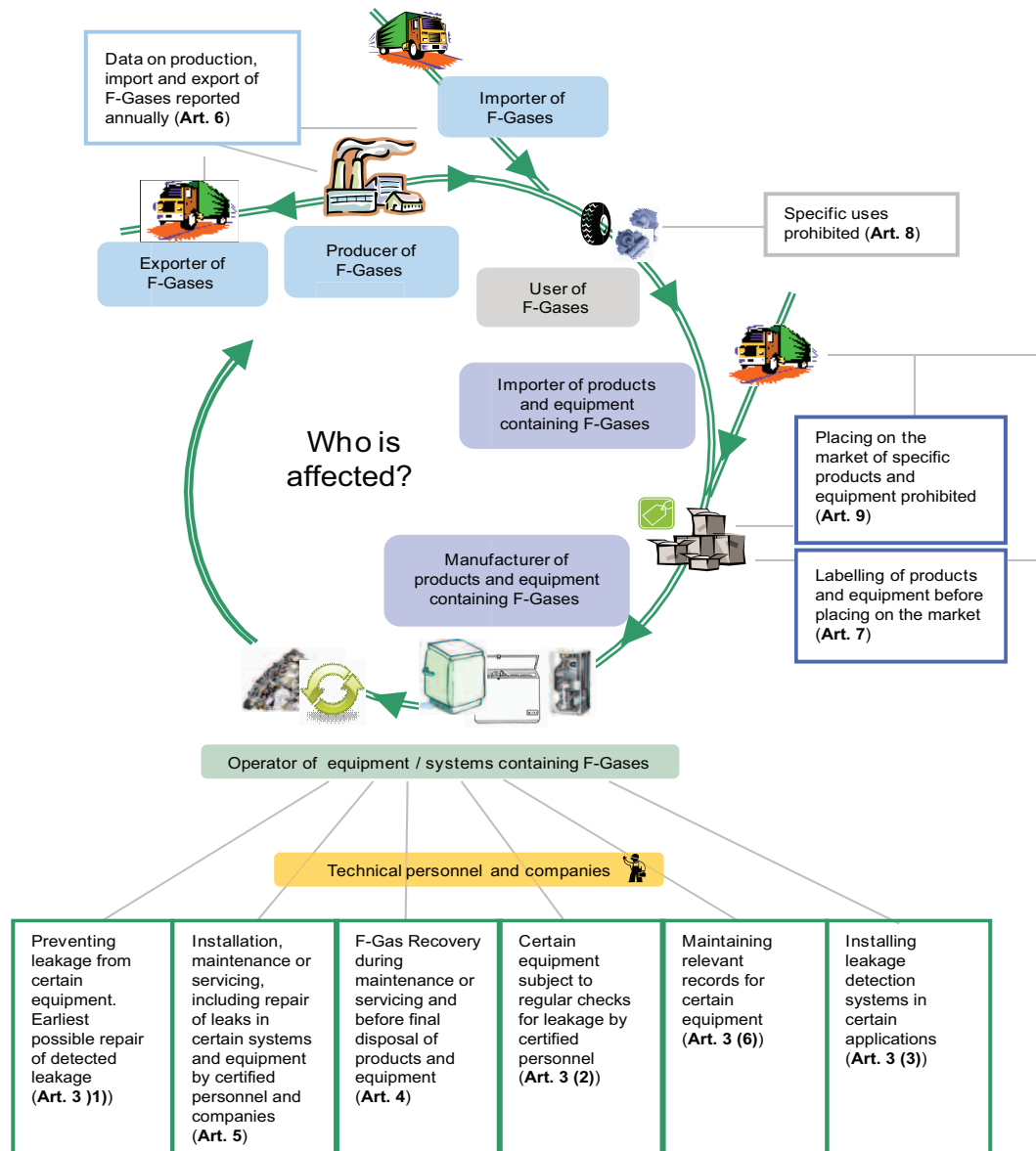


Figure 2 Overview of the main actors affected by the F-Gas Regulation and the related requirements



The requirements of the F-Gas Regulation are relevant to:

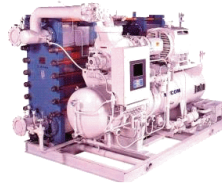
- Producers, importers and exporters of F-Gases
- Manufacturers and importers placing certain products and equipment containing F-Gases on the EU market
- Users of SF<sub>6</sub> in magnesium die-casting and for filling of vehicle tyres
- Operators of certain equipment and systems containing F-Gases
- Technical personnel and companies involved in certain activities relating to equipment containing F-Gases

As already described above, F-Gases are used in several areas of application. Within the F-Gas Regulation, specific obligations are defined for the **operators** of the following types of equipment:

- **Stationary refrigeration, air conditioning and heat pump equipment**
- Stationary fire protection systems and fire extinguishers
- High-voltage switchgear
- Equipment containing solvents

Other products and equipment, including mobile equipment, containing F-Gases are also addressed by the F-Gas Regulation.

## Who does this brochure address?



This brochure covers requirements laid down in the F-Gas Regulation for **operators of stationary refrigeration, air conditioning and heat pump equipment**, which contain F-Gases as refrigerants. Therefore, as a first step it has to be determined exactly who is addressed by the relevant requirements of the F-Gas Regulation and thus by this brochure.

### 3.1 Which types of equipment are affected?

Stationary equipment is defined as equipment which is normally not in transit during its operation. Consequently, refrigeration and air conditioning equipment contained in modes of transport are not covered by this brochure.

Stationary equipment is in use in various different configurations and in all types of buildings including households, offices, supermarkets, retail shops, factories, processing plants, cold stores, restaurants, bars, hospitals and schools.

#### Refrigeration circuit

The circuit in which the refrigerant circulates includes the compressor, condenser, expansion valve and evaporator

Refrigeration, air conditioning and heat pump equipment are based on the same thermodynamic process and are charged with similar refrigerants. There are direct and indirect systems to achieve cooling and heating: A direct system is characterised by one circuit containing the refrigerant. The heat exchange takes place where cooling or heating is required. An indirect system has two circuits with a first heat exchange between the fluids of the primary and the secondary circuit and a second heat exchange where cooling or heating is required. The first circuit contains the refrigerant.

- **Refrigeration equipment**

Refrigeration equipment is designed to cool products or storage spaces below ambient temperature. This includes domestic refrigerators and freezers, ice cream displays, refrigerated warehouses, cold stores and industrial-process cooling plants.

Applications for refrigeration equipment are manifold: from domestic use, via retail, to industrial use. Dimensions within these various applications vary from single compartment domestic refrigerators to large cold stores with F-Gas charges ranging from below 0.1 kg (domestic refrigeration) up to several thousand kg (industrial refrigeration).

- **Air conditioning equipment**

The main function of air conditioning equipment is to cool and/or control temperature in rooms or buildings to a certain level. The size of the equipment ranges from small units (e.g. movable plug-in systems) to large fixed, installed equipment for cooling whole buildings such as offices or hospitals. Air conditioning equipment is used in the residential, commercial, public and industrial sectors.

Depending on the layout, a differentiation can be made between single packaged air conditioners (all essential components are built into a single casing) and so called "split systems" (essential components of the cooling / heating process are built into several casings). Office buildings, retail stores or hospitals will typically have different

systems such as small split systems and large, central systems, often using a chilled water secondary system.

The refrigerant charge of air conditioning equipment varies from below 0.5kg to over 100kg for large non-domestic installations.

- **Heat pumps**

Heat pumps are devices that use a refrigeration circuit to extract energy from an ambient or waste heat source and deliver useful heat. In addition, reversible systems are available which have a cooling as well as a heating function.

Stationary heat pumps are used in houses as well as in the commercial and industrial sectors for heating and cooling, for the production of process water, for heat recovery and other applications. Heat pumps are typically hermetically sealed systems with a refrigerant charge varying from 0.5kg for hot water heat pumps to about 100kg for industrial heat pumps.

## 3.2 How to identify refrigerants covered by the Regulation

The F-Gas Regulation concerns equipment containing **F-Gases** listed in Annex II as well as **preparations** (commonly called “blends”) containing F-Gases in their refrigeration circuits.

### Common types of refrigerants

Industry nomenclature<sup>5</sup> is often used for refrigerants, usually referred to by an “R” (abbreviation of “Refrigerant”) number e.g. R-134a for HFC-134a. Specific trade names are also used.

In Europe, hydrocarbons (not covered by the F-Gas Regulation) such as R-600a (isobutane) and R-290 (propane), are common refrigerants in domestic refrigerators and freezers as well as in small retail refrigeration equipment (e.g. plug-in cabinets). However, a number of units containing F-Gases (typically R-134a) are also in use.

In larger **refrigeration** equipment like those used in supermarkets (e.g. retail display cabinets with central refrigeration systems), F-Gases such as R-134a (HFC) and R-404A (blend of HFCs) are widely used as refrigerants. Apart from F-Gases, other types of refrigerants such as HCFCs<sup>6</sup>, R-744 (CO<sub>2</sub>), R-600a (isobutane), R-290 (propane), R-1270 (propylene) and R-717 (NH<sub>3</sub>) are also used in refrigeration of goods. These refrigerants are not covered by the F-Gas Regulation.

For **air conditioning** equipment, F-Gas refrigerants (e.g. R-410A or R-407C, both blends of HFCs) are widely used. Apart from HFCs, HCFCs such as R-22 are still used in older equipment. Other types of refrigerants such as R-744 (CO<sub>2</sub>), R-600a (isobutane), R-290 (propane), R-1270 (propylene) and R-717 (NH<sub>3</sub>) are increasingly being used.

F-Gases such as R-134a (HFC) and R-407C (a blend of HFCs) are mainly used as refrigerants in **heat pumps**, whereas alternative refrigerants, including R-744 (CO<sub>2</sub>), R-600a (isobutane), R-290 (propane), R-1270 (propylene) and R-717 (NH<sub>3</sub>), are increasingly being used.

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<sup>5</sup> Based on ISO 817

<sup>6</sup> Ozone depleting substances, regulated by the Regulation (EC) No 2037/2000

In the following table a non-exhaustive list of substances used as refrigerants is given.

Type	Common refrigerants	Less common refrigerants
<b>Covered by the F-Gas Regulation</b>		
<b>HFCs - pure fluids</b>	R-134a	R-23, R-32, R-125, R-143a
<b>HFC containing blends</b>	R-403 (A,B), R-404A, R-407C, R-408A, R-410A, R-413A, R-417A, R-419A, R-507A	R-401 (A,B,C), R-402 (A,B), R-405A, R-407 (A,B,D), R-411B, R-416A, R-422 (A,D), R-423A, R-508A
<b>Other refrigerants – not covered by the F-Gas Regulation but covered by the ODS Regulation<sup>7</sup></b>		
<b>HCFCs - pure fluids</b>	R-22	R-123, R-124
<b>HCFCs - blends</b>		R-406A, R-409 (A,B)
<b>CFCs - pure fluids and blends</b>	R-11, R-12, R-502	R-13
<b>Other refrigerants – not covered by the F-Gas Regulation or ODS Regulation</b>		
<b>Alternatives</b>	R-717 (ammonia), R-290 (propane), R-600a (isobutane), R-1270 (propylene), hydrocarbon (HC)-blends	R-744 (CO <sub>2</sub> )

Table 1 Refrigerants typically used in refrigeration, air conditioning and heat pump equipment

### How to identify the type of refrigerant in equipment

The easiest way to identify the type of refrigerant is to check the label on the equipment. Refrigeration, air conditioning and heat pump equipment containing F-Gases, placed on the EU market since 1 April 2008, must have a label with the text **“Contains fluorinated greenhouse gases covered by the Kyoto Protocol”<sup>8</sup>** and must also indicate the type and amount of the F-Gas. Section 7 provides an example of such a label. In many cases, relevant information is also available on equipment placed on the market earlier.

In cases where no relevant information is found on the label, the manual or the technical specifications of the equipment should provide information on the type of the refrigerant contained in the equipment. Alternatively, the supplier, manufacturer or company and personnel carrying out maintenance or servicing of this equipment should be asked to provide it.

### How to determine if a refrigerant blend (preparation) is covered by the Regulation

Apart from pure substances, preparations (blends) containing F-Gases are in use. Preparations under the F-Gas Regulation are defined as mixtures

- of two or more substances of which **at least one** is an F-Gas and
- where the **total** GWP is not less than 150.

<sup>7</sup> Regulation (EC) No 2037/2000

<sup>8</sup> Label requirements are set out in Commission Regulation (EC) No 1494/2007

For the first criterion, Annex II contains a list of the relevant F-Gases covered by the Regulation. Operators should refer to this list to check whether one of the components of the blend is included in the list.

For the calculation of the total GWP of the preparation, apart from the GWP of the F-Gases, the GWP of the other components performing the same function (refrigerant) have to be taken into consideration. To determine the GWP of non-F-Gases in preparations, the values published in the First IPCC Assessment<sup>9</sup> should be used.

The total GWP for a preparation is a weighted average, derived from the sum of the weight fractions of the individual substances multiplied by their GWPs.

$$\Sigma [( \text{Substance X\%} \times \text{GWP} ) + ( \text{Substance Y\%} \times \text{GWP} ) + \dots ( \text{Substance N\%} \times \text{GWP} )]$$
where % is the contribution by weight with a weight tolerance of +/- 1%.

Example 1 R-415B	Example 2 R-410A
25% HCFC-22 (GWP 1 500), 75% HFC-152a (GWP 120)	50% HFC-32 (GWP 550), 50% HFC-125 (GWP 3 400)
$\Sigma [(25\% \times 1\,500) + (75\% \times 120)] \rightarrow \text{Total GWP} = 465$	$\Sigma [(50\% \times 550) + (50\% \times 3\,400)] \rightarrow \text{Total GWP} = 1\,975$
→Preparation covered by the F-Gas Regulation (GWP≥ 150)	→Preparation covered by the F-Gas Regulation (GWP≥ 150)

Table 2     Examples of how to calculate the GWP of preparations

### 3.3 Who is the operator of the equipment?

The F-Gas Regulation lays down that the **operator** of the equipment is responsible for legal compliance. The operator is defined as "the natural or legal person who exercises actual power over the technical functioning of the equipment and systems". Under this definition, the owner of the F-Gas equipment is not automatically the operator of the equipment.

The "actual power over the technical functioning" of a piece of equipment or system would, in principle, include the following elements:

- Free access to the system, which entails the possibility to supervise its components and their functioning, and the possibility to grant access to third parties
- The control over the day-to-day functioning and running (e.g. taking the decision to switch it on or off)
- The power (including financial power) to decide on technical modifications (e.g. replacement of a component, installation of a permanent leak detector), modification of the quantities of F-Gases in the equipment or system, and to have checks (e.g. checks for leakage) or repairs carried out

<sup>9</sup> Climate Change, The IPCC Scientific Assessment, J.T. Houghton, G.J. Jenkins, J.J. Ephraums (ed.), Cambridge University Press, Cambridge (UK) 1990.

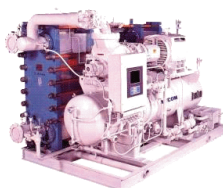
Typically, the operator of domestic or small commercial equipment is an individual, usually the owner of the equipment, whereas in commercial and industrial applications the operator in most cases is a legal person (typically a company) who is responsible for giving instructions to employees as to the day-to-day technical functioning of the equipment.

In some cases, in particular where large installations are involved, service companies are contracted to carry out maintenance or servicing. In these cases the determination of the operator depends on the contractual and practical arrangements between the parties.

Although ownership is not a criterion for identifying the "operator", Member States may designate the owner as being responsible for the operator's obligations in defined, specific situations, even though the owner does not have actual power over the technical functioning of the system or equipment. Therefore, specific Member State conditions on implementation should be taken into consideration.



## WHICH OBLIGATIONS APPLY TO THE OPERATOR?



Depending on the charge contained in the application, specific obligations have to be fulfilled. The following decision tree groups applications into categories<sup>10</sup> A-E and Table 3 summarises which obligations are relevant for each category.

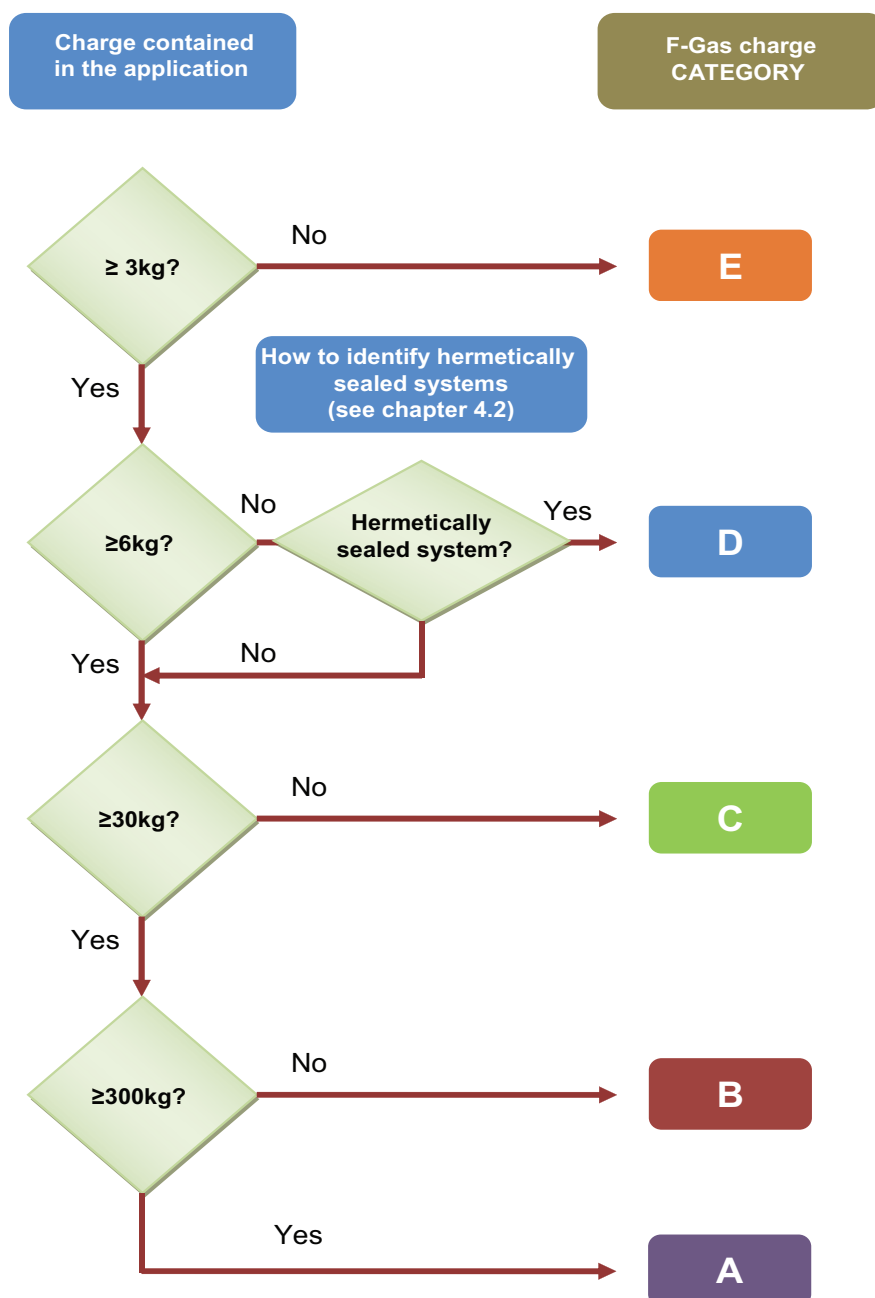


Figure 3 Decision tree to identify what has to be done

<sup>10</sup> F-Gas charge categories are used in this brochure for simplicity. They are not defined as such in the Regulation.

<i>F-Gas charge category</i> <i>Obligations for the operator</i>	<b>A</b> (≥300kg)	<b>B</b> (≥30kg and <300kg)	<b>C</b> (≥3kg and <30kg; hermetically sealed ≥6kg and <30kg)	<b>D</b> (hermetically sealed ≥3kg and <6kg)	<b>E</b> (<3kg)
Installation <sup>11</sup> , maintenance or servicing of the equipment by certified personnel and companies, Art. 5 (3) <sup>12</sup>	✓	✓	✓	✓	✓
Leakage prevention and repair of detected leakage as soon as possible, Art. 3 (1) <sup>12</sup>	✓	✓	✓	✓	✓
Regular leakage checks by certified personnel, Art. 3 (2) <sup>12</sup>	✓	✓	✓		
Installation of a leakage detection system which must be checked at least every 12 months, Art. 3 (3) <sup>12</sup>	✓				
Record keeping, Art. 3 (6) <sup>12</sup>	✓	✓	✓	✓	
Recovery of F-Gases before final disposal of the equipment, and when appropriate during maintenance or servicing, by certified personnel, Art. 4 (1), (4) <sup>12</sup>	✓	✓	✓	✓	✓

Table 3 Overview of obligations for the operator depending on the F-Gas charge of the application

The difference between the requirements of the categories B and C is the frequency of leakage checks (see Table 5).

## 4.1 How to determine the F-Gas charge of an application

In identifying an application the Commission considers as the main criterion the technical structure (refrigerant circuit), and not the location or function. An application should be understood as a set of components and pipes which form one continuous structure through which F-Gases can flow. If a molecule of F-Gas can flow through the structure from one location to another, it means that these two locations are parts of one single application.

With regard to refrigeration, air conditioning and heat pump equipment, this means that even if two disconnected refrigeration circuits (i.e. without any permanent or temporary means to connect one refrigerant circuit to the other) are used for the same purpose (e.g. to maintain a low temperature in a cold store or warehouse), these systems would be regarded as two separate applications.

<sup>11</sup> as far as applicable, e.g. not relevant for plug-in systems

<sup>12</sup> Regulation (EC) No 842/2006



Example	
A site has 5 water chillers, each containing 100kg of F-Gas refrigerant. They are interconnected on the chilled water side but their refrigerant circuits are not interconnected.	
Although the total refrigerant charge is 500kg, each of the chillers is considered as a separate application as their refrigeration circuits are not interconnected.	
→	<b>the requirements for F-Gas charge category B (equipment <math>\geq 30</math> and <math>&lt; 300</math>kg) have to be fulfilled for each chiller</b>
→	<b>the installation of a fixed leakage detection system (obligatory for F-Gas charge category A <math>\geq 300</math>kg) is not required</b>

Table 4 Example of how to determine the F-Gas charge of an application

To determine the F-Gas charge, the operator should check the label (see also section 7) and the equipment manual or technical specifications.

**Where the F-Gas charge in the application is not indicated in the manufacturer's technical specifications or on the label but could belong to one of categories A, B, or C, it must be determined by certified personnel** (see section 6).

If in doubt the operator should contact the equipment supplier, manufacturer or the service company.

#### Rules-of-thumb

Typically, small hermetically sealed refrigeration applications fitted with a "domestic" plug would be below the 6kg limit of F-Gas charge. Almost all domestic refrigerators and freezers (apart from some very old systems) fall into this category. For example, a common domestic refrigerator typically contains around 0.1kg of refrigerant.

Refrigeration applications used in small shops (e.g. ice cream display cabinets, bottle coolers, small chilled or frozen food cabinets), in pubs and restaurants (e.g. "in-line" drink coolers or ice makers), in offices (e.g. vending machines) and in other types of buildings typically contain 0.05 to 0.25kg of refrigerant.

Single-split domestic air conditioning applications typically contain 0.5 to 4kg of refrigerant (on average 0.31 – 0.34kg per kW of cooling capacity).

Heat pumps only used for hot water preparation usually have F-Gas charges below 3kg. In small heat pump equipment (in the domestic sector with a refrigerant charge of up to 6kg) the refrigerant is normally contained in a hermetically sealed circuit. Heat pumps used in industry typically have F-Gas charges above 30kg.

## 4.2 How to identify hermetically sealed systems

Hermetically sealed systems may benefit from a less strict set of requirements provided that the sentence **“hermetically sealed system”** is indicated in the label of the equipment (see also section 7).

A ‘hermetically sealed system’ means 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<sup>13</sup>.

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<sup>13</sup> Article 2 of Regulation (EC) No 842/2006

## WHAT IS THE OPERATOR RESPONSIBLE FOR?



Based on the information provided in the previous section, an allocation of applications to the different F-Gas charge categories and the resulting requirements should be possible (see Table 3 in section 4).



National specific requirements for systems with less than 3kg (or < 6kg for hermetically sealed ones labelled as such) might apply and should be taken into consideration.

In this section, the specific requirements laid down in the F-Gas Regulation for the various charge categories are described in detail. In order to indicate the categories affected, the following symbols are used:

### Examples:



Relevant for all F-Gas charge categories



Only relevant for F-Gas charge category A (≥ 300kg)

## 5.1 Ensuring proper installation, maintenance or servicing of the equipment



Installation and maintenance or servicing of equipment should be carried out by personnel and companies holding an appropriate certificate (see section 6).

In the context of the F-Gas Regulation	
<p><b>Installation means</b></p> <p>joining two or more pieces of equipment or circuits containing or designed to contain fluorinated greenhouse gas refrigerant, with a view to assembling a system in the location where it will be operated.</p> <p>It also includes joining a system's refrigerant conductors together to complete a refrigerant circuit, irrespective of the need to charge the system after assembly.</p>	<p><b>Maintenance or servicing comprises</b></p> <p>all activities that entail breaking into the circuits containing or designed to contain fluorinated greenhouse gases, excluding recovery and checks for leakage. This includes in particular:</p> <ul style="list-style-type: none"> <li>• supplying the system with fluorinated greenhouse gases</li> <li>• removing one or more pieces of circuit or equipment</li> <li>• reassembling two or more pieces of circuit or equipment</li> <li>• repairing leakages</li> </ul>

## 5.2 Preventing and repairing leakages



All operators of stationary refrigeration, air conditioning and heat pump applications, irrespective of the quantity of refrigerant contained, must:

- prevent leakage and
- repair leakages as soon as possible after they have been detected,

through **all measures technically feasible and not entailing disproportionate costs**.<sup>14</sup>

## 5.3 Checking for leakage



### 5.3.1 Standard leakage checks

If an appropriate, properly functioning leakage detection system is installed, the frequency for leakage checking will be halved but never >12 months (see section 5.4).

Working and temporarily out of operation applications containing 3kg or more (6kg or more in case of hermetically sealed systems labelled as such) of F-Gas refrigerant, have to be checked for leakage at regular intervals. The operator of the application is responsible for ensuring that this check is carried out by **certified personnel** (see section 6).

<i>F-Gas charge category</i>	<b>A</b> (≥300kg)	<b>B</b> (≥30kg and <300kg)	<b>C</b> (≥3kg and <30kg; ≥6kg and <30kg hermetically sealed)
<i>Minimum frequency of leakage checks</i>			
Without a properly functioning appropriate leakage detection system in place	every 3 months (*)	every 6 months	every 12 months
With a properly functioning appropriate leakage detection system in place	every 6 months	every 12 months	every 12 months

(\*) A leakage detection system which on detection alerts the operator is mandatory for applications containing a charge of 300kg or more

Table 5 Overview of minimum frequency of leakage checking

### 5.3.2 Checks following a repair

In cases where a leak has been detected, the operator must ensure that the repair is carried out as soon as possible by personnel certified to undertake the specific activity (see section 6). Furthermore, the operator has to ensure that, after the repair, a leakage test with Oxygen Free Nitrogen (OFN) or another suitable pressure testing and drying gas is carried out where necessary (based on the judgment of the certified member of personnel). The test should be followed by removing the drying gas used for pressure testing, recharging the refrigerant and a new leakage-test.

<sup>14</sup> Article 3 (1) of Regulation (EC) No 842/2006

A follow-up check must be carried out at any time within 1 month depending on the situation and based on the judgment of the certified person. As the follow-up check must be carried out according to the standard leakage checking requirements, the time interval for the next regular leakage check starts from this point.

### 5.3.3 Newly commissioned equipment

In the case of newly installed equipment, a check according to the standard leakage checking requirements has to be carried out, by certified personnel, immediately after it has been put into service.

## 5.4 Installing leakage detection systems

A	B	C	D	E
---	---	---	---	---

Applications containing **300kg or more** of F-Gas refrigerant have to be equipped with a fixed leakage detection system which on detection of leakage alerts the operator. The proper functioning of the leakage detection system has to be checked **at least once every 12 months**.

In the selection of appropriate technology and the installation location of such a detection system, the operator should take into consideration all parameters which may affect its effectiveness to ensure that the system installed will detect a leakage and alert the operator. Such parameters may include the type of equipment, the space in which it is installed and the potential presence of other contaminants in the room.

“Leakage detection system” means a calibrated mechanical, electrical or electronic device for detecting leakage of fluorinated greenhouse gases which, on detection, alerts the operator.

As a guide, systems which detect leakage by monitoring the existence of F-Gases in the air, where these are appropriate, should be installed in the machinery room or, if no machinery room exists, as close as possible to the compressor or to the relief valves, and should have a sensitivity which allows effective detection of leakage.

Other systems, including those which detect leakage through electronic analysis of liquid level or other data may also be used, as appropriate.

EN 378 standard and the standards referred to therein as well as national Regulations should be taken into consideration.

Any presumption of F-Gas leakage indicated by the fixed leakage detection system has to be followed by a check of the system (section 5.3) to identify and, if appropriate, to repair the leak.

**Operators of applications containing less than 300kg of F-Gas may also install a leakage detection system. Equipment with properly functioning appropriate leakage detection systems which on detection alert the operator are subject to less frequent checks (see Table 5).**

## 5.5 Maintaining records

Operators of applications containing 3kg or more of F-Gas charge – irrespective of whether the system is hermetically sealed or not – have to maintain records of the equipment and make them available to the national competent authority or the European Commission on request.

### 5.5.1 Contents of equipment records - categories A, B, C

A	B	C	D	E
---	---	---	---	---

Equipment records (for a sample template, see Annex III) must contain the following information<sup>15</sup>:

- Name, postal address, telephone number of the operator
- Information on quantity and type of F-Gas installed (if not indicated in the manufacturer's technical specifications or label it has to be determined by **certified personnel**)
- Quantities of F-Gases added
- F-Gas quantities recovered during maintenance or servicing and final disposal
- Identified cause of detected leakage
- Identification of company / personnel who carried out the relevant activities
- Dates and results of the regular leakage checks
- Dates and results of checks of the leakage detection system (if installed)
- Any other relevant information

### 5.5.2 Contents of equipment records - category D

A	B	C	D	E
---	---	---	---	---

Equipment records must contain the following information<sup>16</sup>:

- Information on quantity and type of F-Gases installed
- Quantities of F-Gases added
- F-Gas quantities recovered during maintenance or servicing and final disposal
- Identification of company / personnel who carried out the activities
- Any other relevant information

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<sup>15</sup> Article 3 (6) of Regulation (EC) No 842/2006 and Article 2 of Commission Regulation (EC) No 1516/2007

<sup>16</sup> Article 3 (6) of Regulation (EC) No 842/2006

## 5.6 Recovering the refrigerant



Operators must make arrangements for the proper recovery, i.e. the collection and storage, by **certified personnel** of F-Gas refrigerants from the cooling circuits of stationary refrigeration, air conditioning and heat pump equipment to ensure their recycling, reclamation or destruction.

**This activity must take place before the final disposal of the equipment and when appropriate during maintenance or servicing work.**

## INFORMATION ON TECHNICAL PERSONNEL AND COMPANY CERTIFICATION

The activities indicated in Table 6, unless undertaken at the sites of manufacturers during manufacture or repair, can only be undertaken by personnel and companies holding a certificate, issued by a certification body designated by a Member State. The operator should make sure that the personnel hold a valid certificate for the foreseen activity.

Requirements specific to individual Member States should be taken into consideration.



Activity	Certified personnel (*)	Certified companies
Installation	✓	✓
Maintenance or servicing	✓	✓
Leakage checking of applications containing $\geq 3\text{kg}$ of F-Gases ( $\geq 6\text{kg}$ if hermetically sealed and labelled as such)	✓	
Recovery of F-Gases	✓	

(\*) Certain exemptions are listed in article 4 (3) of Commission Regulation (EC) No 303/2008.

Table 6 Activities carried out by certified personnel and companies

Certificates must contain the following information<sup>17</sup>:

- Name of certification body, full name of holder, certificate number, date of expiry (if any)
- Category of certificate (only for personnel)
- Activities which the holder of the certificate is entitled to perform
- Issuing date and issuer's signature

For an interim period not exceeding 4 July 2011, interim certification systems may be in place in some Member States. Member States can decide on the content of the certification, the category of personnel and the expiry date. It is therefore important that the operator is aware of the Member State's specific conditions (National Contact points, see Annex IV).

<sup>17</sup> Article 5 (2) of Commission Regulation (EC) No 303/2008



An overview of **personnel** certification categories and the corresponding activities that can be undertaken on the basis of the EU requirements<sup>18</sup> is provided in Table 7.

Activity Certificate	Charge categories D, E			Charge categories A, B, C				
	R	I	M	L1	L2	R	I	M
Category I	✓	✓	✓	✓	✓	✓	✓	✓
Category II	✓	✓	✓		✓			
Category III	✓							
Category IV					✓			

L1 = Leakage check including breaking into refrigeration circuit

L2 = Leakage check without breaking into refrigeration circuit

R = Recovery    I = Installation    M = Maintenance or servicing

Table 7    Personnel certification categories

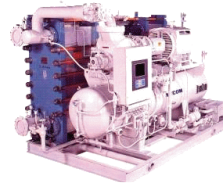
**Company certificates** correspond to activities (not categories), either installation or maintenance / servicing or both.

Certificates (excluding interim certificates) are valid in all Member States, but Member States may require a translation of the certificate. The certification requirements for personnel and companies can be found in **Commission Regulation (EC) 303/2008**.

<sup>18</sup> Article 4 (2) of Commission Regulation (EC) No 303/2008

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## INFORMATION ON LABELS



Since 1 April 2008<sup>19</sup>, a manufacturer or importer who places refrigeration, air conditioning and heat pump equipment containing F-Gases as well as F-Gas containers on the EU market is obliged to label them.

The label is an important source of information to find out if the equipment is covered by the F-Gas Regulation and which requirements apply. Specific requirements for Member States may entail labelling in a Member State's language.

The label must contain at least the type and quantity of the F-Gas contained and the sentence: "Contains fluorinated greenhouse gases covered by the Kyoto Protocol".

### Example

Maschinentyp type / type de la machine:		VMK 90/1-S
Maschinennummer: no. / numéro de la machine		08120109
Kälteleistung bei: T.umbeg. / T.medium cooling capacity with: t.amb. / t.fluid capacité frigorifique lors de t.amb. / t.de fluide:	Q <sub>0</sub> [W]	11200/42°C
Umgebungstemperatur max.: ambient temperature max. / température ambiante max.:	T <sub>a,max</sub> [°C]	+ 42
zulässiger Betriebsüberdruck: admissible operating pressure / Supression autorisée:	P <sub>max</sub> [bar]	29,50
Kältemittel: Refrigerant / Fluide frigorifique:		R407C
Kältemittelmenge: quantity of refrigerant / quantité fluide frigorifique:	m <sub>1</sub> [kg]	2,20
Spannung: voltage / tension:	U [V]	3/PE ~ 400
Frequenz: frequency / fréquence:	f [Hz]	50
Betriebsstrom max.: operating current / intensité maximale:	I <sub>max</sub> [A]	11,30
Anschlußleistung: connected load / puissance électrique connectée:	P [kW]	6,30
Vorsicherung max.: preliminary fuse max. / fusible auxiliaire max.:	[A]	16
Gewicht: weight / poids:	m <sub>2</sub> [kg]	250
Gewicht mit Wasserfüllung: weight with water filling / poids, circuit hydraulique plein:	m <sub>3</sub> [kg]	360
Baujahr: year built / année de fabrication		2008

Kältekreislauf gefüllt mit:  
Refrigerant circuit is filled with:  
Le circuit réfrigérant est rempli avec:

- R134a (CF<sub>3</sub>CH<sub>2</sub>F)
- R404a (CF<sub>3</sub>CH<sub>2</sub>+CF<sub>3</sub>CH<sub>3</sub>+CF<sub>3</sub>CH<sub>2</sub>F)
- R407c (CH<sub>2</sub>F<sub>2</sub>+CF<sub>3</sub>CH<sub>3</sub>+CF<sub>3</sub>CHF<sub>2</sub>F)
- R410a (CH<sub>2</sub>F<sub>2</sub>-CF<sub>3</sub>CHF<sub>2</sub>)

Enthält vom Kyoto-Protokoll erfasste fluorierte Treibhausgase.  
Contains fluorinated greenhouse gases covered by the Kyoto Protocol.  
Contient des gaz à effet de serre fluorés relevant du protocole de Kyoto.

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## PENALTIES FOR NON COMPLIANCE



Penalties for infringements of any of the F-Gas Regulation provisions are laid down by each Member State individually.

<sup>19</sup> Commission Regulation (EC) No 1494/2007

## Annex I: List of implementing acts of Regulation (EC) No 842/2006

- **Commission Regulation (EC) No 1493/2007** of 17 December 2007 establishing, pursuant to Regulation (EC) No 842/2006 of the European Parliament and of the Council, the format for the report to be submitted by producers, importers and exporters of certain fluorinated greenhouse gases
- **Commission Regulation (EC) No 1494/2007** of 17 December 2007 establishing, pursuant to Regulation (EC) No 842/2006 of the European Parliament and of the Council, the form of labels and additional labelling requirements as regards products and equipment containing certain fluorinated greenhouse gases
- **Commission Regulation (EC) No 1497/2007** of 18 December 2007 establishing, pursuant to Regulation (EC) No 842/2006 of the European Parliament and of the Council, standard leakage checking requirements for stationary fire protection systems containing certain fluorinated greenhouse gases
- **Commission Regulation (EC) No 1516/2007** of 19 December 2007 establishing, pursuant to Regulation (EC) No 842/2006 of the European Parliament and of the Council, standard leakage checking requirements for stationary refrigeration, air conditioning and heat pump equipment containing certain fluorinated greenhouse gases
- **Commission Regulation (EC) No 303/2008** of 2 April 2008 establishing, pursuant to Regulation (EC) No 842/2006 of the European Parliament and of the Council, minimum requirements and the conditions for mutual recognition for the certification of companies and personnel as regards stationary refrigeration, air conditioning and heat pump equipment containing certain fluorinated greenhouse gases
- **Commission Regulation (EC) No 304/2008** of 2 April 2008 establishing, pursuant to Regulation (EC) No 842/2006 of the European Parliament and of the Council, minimum requirements and the conditions for mutual recognition for the certification of companies and personnel as regards stationary fire protection systems and fire extinguishers containing certain fluorinated greenhouse gases
- **Commission Regulation (EC) No 305/2008** of 2 April 2008 establishing, pursuant to Regulation (EC) No 842/2006 of the European Parliament and of the Council, minimum requirements and the conditions for mutual recognition for the certification of personnel recovering certain fluorinated greenhouse gases from high-voltage switchgear
- **Commission Regulation (EC) No 306/2008** of 2 April 2008 establishing, pursuant to Regulation (EC) No 842/2006 of the European Parliament and of the Council, minimum requirements and the conditions for mutual recognition for the certification of personnel recovering certain fluorinated greenhouse gas-based solvents from equipment
- **Commission Regulation (EC) No 307/2008** of 2 April 2008 establishing, pursuant to Regulation (EC) No 842/2006 of the European Parliament and of the Council, minimum requirements for training programmes and the conditions for mutual recognition of training attestations for personnel as regards air-conditioning systems in certain motor vehicles containing certain fluorinated greenhouse gases
- **Commission Regulation (EC) No 308/2008** of 2 April 2008 establishing, pursuant to Regulation (EC) No 842/2006 of the European Parliament and of the Council, the format for notification of the training and certification programmes of the Member States

## Annex II: F-Gases listed in Annex I of Regulation (EC) No 842/2006

Designation	Complete name	Chemical formula	CAS number	GWP	Main Application
SF <sub>6</sub>	Sulphur hexafluoride	SF <sub>6</sub>	2551-62-4	22 200	- Insulating gas in high voltage switchgear - Blanket gas for magnesium production - Etching and cleaning gas in the semiconductor industry
<b>Hydrofluorocarbons (HFCs)</b>					
HFC-23	Trifluoromethane	CHF <sub>3</sub>	75-46-7	12 000	- Low temperature refrigerant - Fire extinguishant
HFC-32	Difluoromethane	CH <sub>2</sub> F <sub>2</sub>	75-10-5	550	- Blend component for refrigerants
HFC-41	Fluoromethane	CH <sub>3</sub> F	593-53-3	97	- Semiconductor manufacturing
HFC-43-10mee	1,1,1,2,2,3,4,5,5,5-Decafluoropentane	C <sub>5</sub> H <sub>2</sub> F <sub>10</sub> (CF <sub>3</sub> CHFCF <sub>2</sub> CF <sub>3</sub> )	138495-42-8	1 500	- Solvent for specialised applications - Blowing agent for foams
HFC-125	1,1,1,2,2-Pentafluoroethane	C <sub>2</sub> H <sub>2</sub> F <sub>5</sub> (CHF <sub>2</sub> CF <sub>3</sub> )	354-33-6	3 400	- Blend component for refrigerants - Fire extinguishant
HFC-134	1,1,2,2-Tetrafluoroethane	C <sub>2</sub> H <sub>2</sub> F <sub>4</sub> (CHF <sub>2</sub> CHF <sub>2</sub> )	359-35-3	1 100	No typical applications at present
HFC-134a	1,1,1,2-Tetrafluoroethane	C <sub>2</sub> H <sub>2</sub> F <sub>4</sub> (CH <sub>2</sub> FCF <sub>3</sub> )	811-97-2	1 300	- Refrigerant - Blend component for refrigerants - Extraction solvent - Propellant for medical and technical aerosols - Blowing agent component for extruded polystyrene (XPS) and polyurethane (PUR) foams
HFC-152a	1,1-Difluoroethane	C <sub>2</sub> H <sub>4</sub> F <sub>2</sub> (CH <sub>3</sub> CHF <sub>2</sub> )	75-37-6	120	- Propellant for specialised technical aerosols - Blowing agent component for extruded polystyrene (XPS) foams - Refrigerant

Designation	Complete name	Chemical formula	CAS number	GWP	Main Application
HFC-143	1,1,2-Trifluoroethane	$C_2H_3F_3$ ( $CH_2FCH_2F$ )	430-66-0	330	No typical applications at present
HFC-143a	1,1,1-Trifluoroethane	$C_2H_2F_3$ ( $CH_3CF_3$ )	420-46-2	4 300	- Blend component for refrigerants
HFC-227ea	1,1,1,2,3,3,3-Heptafluoropropane	$C_3HF_7$ ( $CF_3CH_2CF_3$ )	431-89-0	3 500	- Refrigerant - Propellant for medical aerosols - Fire extinguishant - Blowing agent for foams
HFC-236cb	1,1,1,2,2,3-Hexafluoropropane	$C_3H_2F_6$ ( $CH_2FCF_2CF_3$ )	677-56-5	1 300	- Refrigerant - Blowing agent
HFC-236ea	1,1,1,2,3,3-Hexafluoropropane	$C_3H_2F_6$ ( $CHF_2CH_2CF_3$ )	431-63-0	1 200	- Refrigerant - Blowing agent
HFC-236fa	1,1,1,3,3,3-Hexafluoropropane	$C_3H_2F_6$ ( $CF_3CH_2CF_3$ )	690-39-1	9 400	- Fire extinguishant - Refrigerant
HFC-245ca	1,1,2,2,3-Pentafluoropropane	$C_3H_3F_5$ ( $CH_2FCF_2CHF_2$ )	679-86-7	640	- Refrigerant - Blowing agent
HFC-245fa	1,1,1,3,3-Pentafluoropropane	$C_3H_3F_5$ ( $CHF_2CH_2CF_3$ )	460-73-1	950	- Foam blowing agent for polyurethane (PUR) foams - Solvent for specialised applications
HFC-365mfc	1,1,1,3,3-Pentafluorobutane	$C_4H_5F_5$ ( $CF_3CH_2CF_2CH_3$ )	406-58-6	890	- Foam blowing agent for polyurethane (PUR) and phenolic foams - Blend component for solvents
<b>Perfluorocarbons (PFCs)</b>					
Perfluoromethane (PFC-14)	Tetrafluoromethane	$CF_4$	75-73-0	5 700	- Semiconductor manufacturing - Fire extinguishant
Perfluoroethane (PFC-116)	1,1,1,2,2,2-Hexafluoroethane	$C_2F_6$ ( $CF_3CF_3$ )	76-16-4	11 900	- Semiconductor manufacturing

Designation	Complete name	Chemical formula	CAS number	GWP	Main Application
Perfluoropropane (PFC-218)	1,1,1,2,2,3,3,3-Octafluoropropane	C <sub>3</sub> F <sub>8</sub> (CF <sub>3</sub> CF <sub>2</sub> CF <sub>3</sub> )	76-19-7	8 600	- Semiconductor manufacturing
Perfluorobutane (PFC-31-10)	1,1,1,2,2,3,3,4,4,4-Decafluorobutane	C <sub>4</sub> F <sub>10</sub>	355-25-9	8 600	- Physics research - Fire extinguishant
Perfluoropentane	1,1,1,2,2,3,3,4,4,5,5,5-Dodecafluoropentane	C <sub>5</sub> F <sub>12</sub>	678-26-2	8 900	- Precision cleaning solvent - Low-use refrigerant
Perfluorohexane (PFC-51-14)	1,1,1,2,2,3,3,4,4,5,5,6,6,6-Tetradecafluoro-hexane	C <sub>6</sub> F <sub>14</sub>	355-42-0	9 000	- Coolant fluid in specialised applications - Solvent
Perfluorocyclobutane	1,1,2,2,3,3,4,4-Octafluorocyclobutane	c-C <sub>4</sub> F <sub>8</sub>	115-25-3	10 000	- Semiconductor manufacturing

## Annex III: Sample of an equipment record

Equipment record					
Name of equipment operator					
Postal address					
Telephone number					
Equipment designation <sup>1</sup>		Reference N°			
Description		Hermetically sealed?		Yes / No	
Location		Date of installation			
Type of refrigerant		Refrigerant charge [kg]			
Refrigerant Addition					
Date	Service engineer / company <sup>2</sup> (incl. certificate N°)	Type of refrigerant	Amount added [kg]	Reason for addition	
Refrigerant Recovery / Removal					
Date	Service engineer / company <sup>2</sup> (incl. certificate N°)	Type of refrigerant	Amount removed [kg]	Reason for recovery / removal	
Leakage checks (including follow-up checks)					
Date	Service engineer / company <sup>2</sup> (incl. certificate N°)	Areas checked	Result	Actions taken	Follow-up check required?
Maintenance or servicing activities					
Date	Service engineer / company <sup>2</sup> (incl. certificate N°)	Areas concerned	Maintenance or servicing work done	Comments	
Testing of automatic leak detection system (if any)					
Date	Service engineer / company <sup>2</sup> (incl. certificate N°)	Result	Comments		
Other relevant information					
Date					

<sup>1</sup> Technical identification

<sup>2</sup> Including name of engineer and of company, postal address, telephone number

## Annex IV: Further information

### European Commission

<http://ec.europa.eu/environment/climat/fluor>

### National Contact Points for F-Gases



Federal Ministry of Agriculture,  
Forestry Environment and  
Water Management  
Division V/2 – Chemicals Policy  
Stubenbastei 5  
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[www.umweltbundesamt.de/proudukte/fckw/index.htm](http://www.umweltbundesamt.de/proudukte/fckw/index.htm)

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