INFORMATION

for

OPERATORS AND TECHNICAL PERSONNEL WORKING WITH EQUIPMENT CONTAINING FLUORINATED GREENHOUSE GASES

HIGH VOLTAGE SWITCHGEAR

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

EUROPEAN COMMISSION

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1

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_2), methane (CH_4), nitrous oxide (N_2O) and three groups of fluorinated gases, the so called 'F-Gases': hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

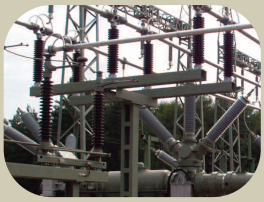
To reduce emissions of these F-Gases in order to meet the EU climate change objectives and obligations under the Kyoto Protocol, the European Parliament and the Council adopted on 17 May 2006 the **Regulation (EC) No 842/2006 on certain fluorinated greenhouse gases (F-Gas Regulation)**. This Regulation which applies as of 4 July 2007[1], 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 **high-voltage switchgear** containing sulphur hexafluoride **(SF_6)** and for technical personnel working with such equipment.

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.

[1] Article 9 and Annex II of the Regulation came into application on 4 July 2006



2

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"[2] . The major man-made greenhouse gases are those covered by the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) 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.

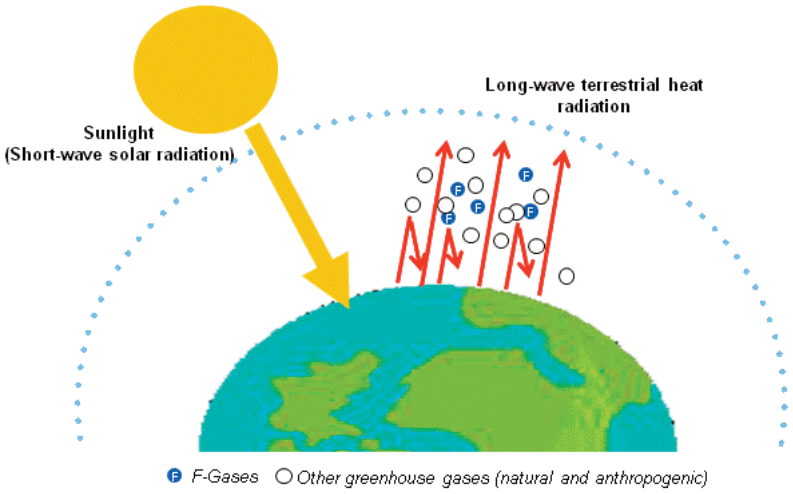


Figure 1: Simplified principle of global warming

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.

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[2] 4th 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_6) 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[3] 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_2.[4]

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.

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)

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_6 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.

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[3] **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.

[4] 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.

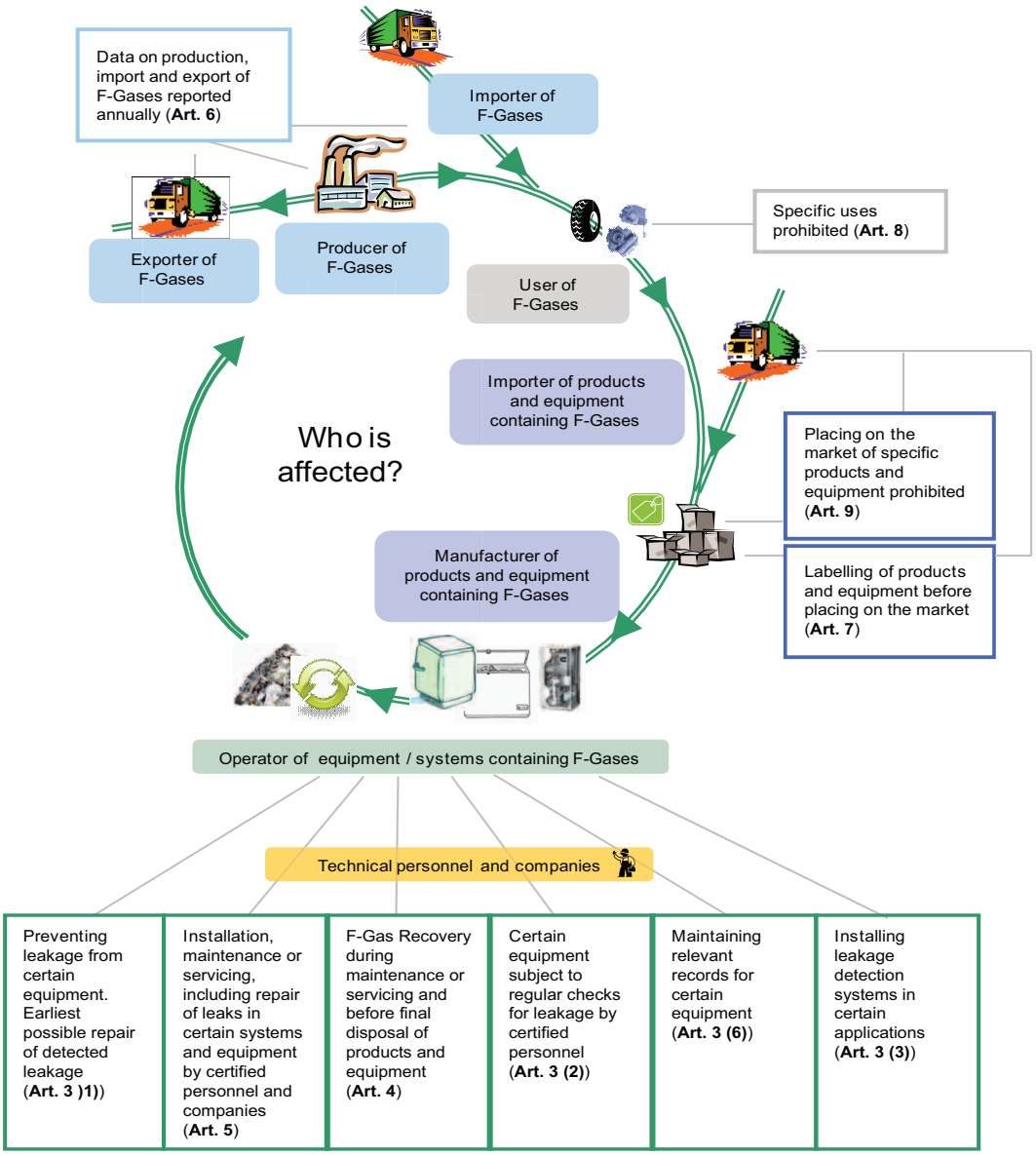

Figure 2 Overview of the main actors affected by the F-Gas Regulation and the related requirements

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_6 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.

3

WHO DOES THIS BROCHURE ADDRESS?

This brochure covers requirements laid down in the F-Gas Regulation for **operators** of **high-voltage switchgear** containing **SF_6**. 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.

Technical personnel working with high-voltage switchgear containing SF_6 are also addressed by this brochure (refer to section 5).

3.1 Which types of equipment are affected?

High-voltage switchgear means "switching devices and their combination with associated control, measuring, protective and regulating equipment, and assemblies of such devices and equipment with associated interconnections, accessories, enclosures and supporting structures, intended for use in connection with generation, transmission, distribution and conversion of electric energy at rated voltages above 1 000 V".[5]

High-voltage switchgear can be further divided into 'medium' high-voltage switchgear (>1 and ≤52kV), typically used in electrical distribution network, and 'high' high-voltage switchgear (>52kV), typically used in electrical transmission network. Both types as well as SF_6 containing instrument transformers, bushings and capacitors fall under the scope of the F-Gas Regulation.

Apart from equipment containing SF_6, used in various applications, containers in which SF_6 is delivered and stored are also affected by the Regulation.

3.2 How to identify whether the equipment is covered by the Regulation

SF_6 is used as an insulating and switching medium in high-voltage switchgear in public energy supply as well as in non-public supply. Although SF_6 is widely used in such equipment, alternative technologies – not using SF_6 – are also available. Sometimes both types of technology might be in place at the same location.

The easiest way to identify whether high-voltage switchgear contains SF_6 is to check the label on the equipment. High-voltage switchgear containing SF_6, 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"**[6] and must also indicate the type (i.e. SF_6) and amount of the gas. Section 6 provides an example of such a label on the nameplate of the equipment. In many cases, relevant information is also available on equipment placed on the market earlier.

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[5] Commission Regulation (EC) No 305/2008

[6] Label requirements are set out in Commission Regulation (EC) No 1494/2007

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 dielectric medium contained in the equipment. Alternatively, the supplier, manufacturer or a service company carrying out maintenance or servicing of this equipment should be asked to provide the relevant information.

Table 1 provides a non-exhaustive list of types of equipment in which SF_6 is used for insulation and /or switching.

Type of equipment	Typical application
Switchgear ≤ 52 kV	
Medium-voltage gas insulated switchgear and control gear (MV GIS)	Electrical distribution network
	Secondary distribution, mainly ring main units (RMUs) up to 36 kV
	Primary distribution with vacuum circuit breakers up to 52 kV
Medium-voltage SF_6 circuit breakers (*)	Primary distribution
Switchgear > 52 kV	
High-voltage gas insulated switchgear and control gear (HV GIS) 72 kV up to 420 kV	Electrical transmission network
High-voltage SF_6 circuit breakers 72 kV up to 420 kV	
High-voltage bushings 72 kV up to 420 kV	Interfaces of SF_6 HVS and overhead lines
Gas insulated instrument transformers 72 kV up to 420 kV	Electrical transmission network

*Mainly in France, Italy and Spain up to 36 kV, in other countries vacuum circuit breakers are typically used.

Table 1: Overview of the use of SF_6 in high-voltage switchgear

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 switchgear 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), modification of the quantities of F-Gases in the equipment or system, and to have checks or repairs carried out

Typically, the operator of high-voltage switchgear 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.

Service companies are usually contracted to carry out maintenance or servicing as well as recovery of the gas. 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.

4

WHAT IS THE OPERATOR RESPONSIBLE FOR?

Operators must make arrangements for the proper recovery, i.e. the collection and storage, by **certified personnel** of SF_6 from high-voltage switchgear to ensure its recycling, reclamation or destruction. In addition any residual SF_6 in storage containers must be properly recovered.

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

To avoid losses of SF_6 during recovery the use of a 'gas recovery unit' and of appropriate SF_6 handling equipment in accordance with industry standards is recommended.

5

INFORMATION ON TECHNICAL PERSONNEL CERTIFICATION

Only personnel holding the appropriate certificate can carry out the recovery of SF_6 from high-voltage switchgear.

To obtain a certificate personnel must pass a theoretical and practical examination organised by a designated evaluation body. **Commission Regulation (EC) No 305/2008** defines minimum requirements as to the skills and knowledge to be covered in the examination. Certificates are issued by certification bodies designated by Member States and must contain the following information[7]:

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

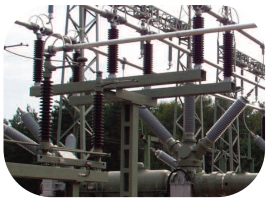
Certificates are valid in all Member States, but Member States may require a translation of the certificate.

While the operator is responsible for making arrangements so that the recovery of the SF_6 is carried out by certified personnel, the certified person is responsible for the proper execution of this activity.

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

[7] Article 4 (2) of Commission Regulation (EC) No 305/2008

6 INFORMATION ON LABELS

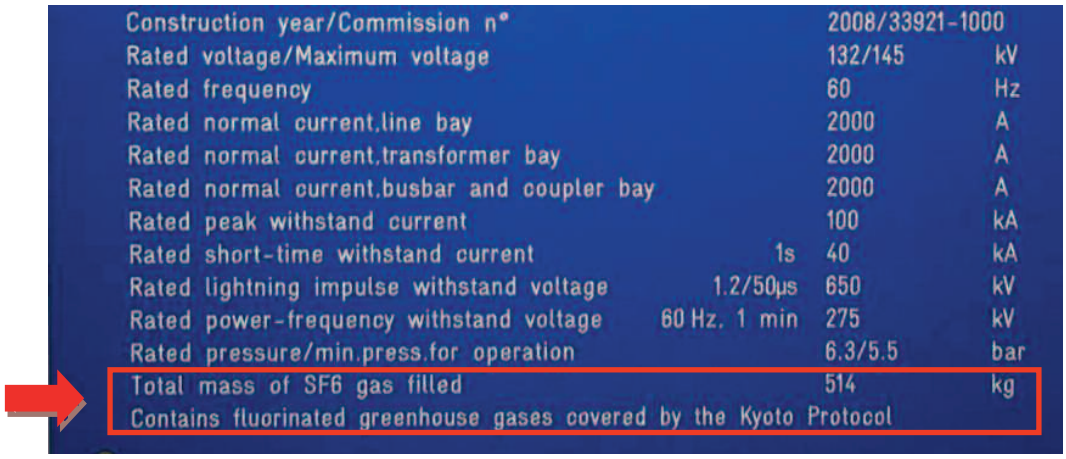


Since 1 April 2008[8], a manufacturer or importer who places SF_6 containing switchgear and SF_6 containers on the EU market is obliged to label them.

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:



7 PENALTIES FOR NON COMPLIANCE

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

[8] 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_6	Sulphur hexafluoride	SF_6	2551-62-4	22 200	- Insulating gas in high voltage switchgear - Blanket gas for magnesium production - Etching and cleaning gas in the semiconductors industry
Hydrofluorocarbons (HFCs)					
HFC-23	Trifluoromethane	CHF_3	75-46-7	12 000	- Low temperature refrigerant - Fire extinguishant
HFC-32	Difluoromethane	CH_2F_2	75-10-5	550	- Blend component for refrigerants
HFC-41	Fluoromethane	CH_3F	593-53-3	97	- Semiconductor manufacturing
HFC-43-10mee	1,1,1,2,2,3,4,5,5,5-Decafluoropentane	$C_5H_2F_{10}$ ($CF_3CHFCHFCF_2CF_3$)	138495-42-8	1 500	- Solvent for specialised applications - Blowing agent for foams
HFC-125	1,1,1,2,2-Pentafluoroethane	C_2HF_5 (CHF_2CF_3)	354-33-6	3 400	- Blend component for refrigerants - Fire extinguishant
HFC-134	1,1,2,2-Tetrafluoroethane	$C_2H_2F_4$ (CHF_2CHF_2)	359-35-3	1 100	No typical applications at present
HFC-134a	1,1,1,2-Tetrafluoroethane	$C_2H_2F_4$ (CH_2FCF_3)	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	$C_2H_4F_2$ (CH_3CHF_2)	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_2FCHF_2)	430-66-0	330	No typical applications at present
HFC-143a	1,1,1-Trifluoroethane	$C_2H_3F_3$ (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_3CHFCF_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_2CHFCF_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
Perfluorocarbons (PFCs)					
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_3F_8 ($CF_3CF_2CF_3$)	76-19-7	8 600	- Semiconductor manufacturing
Perfluorobutane (PFC-31-10)	1,1,1,2,2,3,3,4,4,4-Decafluorobutane	C_4F_{10}	355-25-9	8 600	- Physics research - Fire extinguishant
Perfluoropentane	1,1,1,2,2,3,3,4,4,5,5,5-Dodecafluoropentane	C_5F_{12}	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_6F_{14}	355-42-0	9 000	- Coolant fluid in specialised applications - Solvent
Perfluorocyclobutane	1,1,2,2,3,3,4,4-Octafluorocyclobutane	c-C_4F_8	115-25-3	10 000	- Semiconductor manufacturing

Annex III: Further information

European Commission

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

National Contact Points for F-Gases

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