



Information for technicians and users of refrigeration, air conditioning and heat pump equipment containing fluorinated greenhouse gases

(January 2015)

Summary

Regulation (EU) No 517/2014 on fluorinated gases ("the Regulation") includes a number of requirements for service technicians and for operators of equipment containing fluorinated greenhouse gases (F-gases) such as hydrofluorocarbons (HFCs).

Service technicians and operators of refrigeration, air-conditioning and heat pumps are required to ensure emission prevention and containment. In particular, they will need to know if and how often the equipment must be checked for leakage and keep records on these interventions. Automatic leakage detection systems may also be obligatory for some equipment. The specific requirements depend on the F-gas charge size of the equipment measured in CO₂ equivalents, a unit reflecting the potential impact on global warming.

Whenever the equipment's F-gas circuit is being checked or repaired, both the service companies and the operator must ensure that the technician entrusted with this task has the relevant F-gas certificate or training for that type of equipment. Furthermore, operators of all types of equipment must make arrangements for the proper recovery and/or destruction of the F-gases before the equipment is discarded.

The Regulation also puts into place the so-called 'HFC phase-down'. This HFC phase-down implies that the supply of the HFCs will become much scarcer in the future, in particular for those HFCs having a relatively high global warming potential (GWP). For this reason operators have a clear incentive to invest in equipment using gases with the lowest possible impact on global warming, including those using alternative gases such hydrocarbons, ammonia and carbon dioxide.

When buying new equipment, operators should further be aware of the bans related to the use of certain F-gases in new equipment. From 2020 onwards the serving of certain refrigeration equipment with new (virgin) F-gases having a very high impact on global warming will no longer be allowed.

The aim of this document is to provide guidance to equipment users and technicians without prejudice to the obligations contained in the Regulation. This guidance document focuses on all refrigeration, air conditioning and heat pump equipment relying on F-gases, mobile and stationary.

This document shall not be understood to have any legal status.

Acknowledgement

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1. General Information

1.1. What are Fluorinated gases (F-gases)?

F-gases are man-made chemicals used in several sectors and applications. They have become popular since the 1990s as substitutes for certain ozone-depleting substances used at that time in most of those applications, such as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), which have been phased-out under the Montreal Protocol. Although F-gases have no ozone-depleting properties they contribute significantly to climate change. The impact of F-gases from all applications in this context is comparable to that of the entire aviation sector.

Annex I of the Regulation lists 'Fluorinated greenhouse gases'. These are:

1. Hydrofluorocarbons (HFCs),
2. Perfluorocarbons (PFCs) and
3. Other perfluorinated compounds (sulphur hexafluoride (SF₆)).

A list of these gases and their Global Warming Potential (GWP) along with their typical applications is included in section 8 of this document.

1.2. What is GWP (Global warming potential)?

The GWP is used as a parameter to indicate the relevance of a gas for warming the atmosphere. It is calculated in terms of the 100-year warming potential of one kilogram of an F-gas relative to one kilogram of CO₂. In case of mixtures the GWP is calculated as outlined in section 9 of this document.

The GWP of F-gases usually ranks in the thousands. R404A (GWP 3,922) for example is a 3,922 times more potent greenhouse gas than CO₂. Preventing F-gases from entering into the atmosphere is therefore a very effective way of reducing climate-relevant emissions.

Table 1: Global warming potentials for common greenhouse gases, as compared to some typical F-gases (in orange)

Gas	GWP (AR4, 100yr)
CO ₂	1
Methane	25
Nitrous Oxide	298
HFC-134a	1,430
R-404A (HFC blend)	3,922
R-410A (HFC blend)	2,088
HFC-125	3,500
PFC-14	7,390
SF ₆	22,800

2. Who does this brochure address?

This brochure covers requirements laid down in the F-Gas Regulation for **equipment operators** as well as **technical personnel** working with refrigeration and air conditioning (RAC) equipment.

The operator who is legally responsible for complying with many containment obligations such as leak checks and proper decommissioning of equipment is defined as “the natural or legal person who exercises actual power over the technical functioning of the equipment and systems”¹. Under this definition, the owner of the equipment is not automatically the operator of the equipment unless the Member State designates the owner to be subject to the operator obligations².

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 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.

3. What is new?

For operators acquainted with the obligations of the old [F-gas Regulation \(EC\) No 842/2006](#), this section lists the most important changes under the new [F-gas Regulation \(EU\) No 517/2014](#) (“the Regulation”) that are relevant for operators of equipment.

Containment and recovery: Compared to the measures of the 2006 F-gas Regulation, some additional requirements apply for emission prevention, leak checks, end-of-life treatment and qualification of personnel which are discussed in detail below.

Phase down: The Regulation introduces a new mechanism which will reduce the supply of HFCs to the EU market. The quantities of HFCs (expressed in CO₂ equivalents) placed on the market will have to decrease by 79% in the period from 2015 to 2030. This will impact producers of HFCs, manufacturers of equipment, service personnel handling HFCs and equipment operators.

Bans: A number of new bans addressing mainly refrigeration and air conditioning applications have been added.

¹ Article 2 (8) of Regulation (EC) No 517/2014

4. What equipment is affected?

4.1. Types of equipment

The Regulation covers all equipment containing F-gases including stationary² and mobile³ refrigeration and air conditioning (AC) equipment.

5.1.1 Stationary refrigeration equipment

Refrigeration equipment is designed to cool products or storage spaces below ambient temperature. This includes domestic refrigerators and freezers, as well as commercial⁴ and industrial uses. Stationary equipment is therefore 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.

Dimensions within these various applications vary from single compartment domestic refrigerators to large cold stores.

5.1.2 Mobile refrigeration equipment

Mobile refrigeration equipment refers to refrigerated vehicles such as vans, trucks, trailers, ships etc. For most of these only general containment obligations such as the need to avoid emissions apply. Furthermore, recovery of gases at end of life is required if technically feasible and not prohibitively costly.

The Regulation does place however more stringent requirements on refrigeration units in trucks and trailers⁵. Refrigerated trucks and trailers are designed to transport perishable freight at a controlled temperature. The Regulation defines 'refrigerated trucks' as motor vehicles above 3.5 tonnes with a refrigeration unit. There is no weight limit on refrigerated trailers but they must be designed to be towed by a truck or a tractor.

Small trucks and trailers are predominantly used for distribution in urban and sub-urban areas while larger trucks and trailers are used for long haul transport. Especially the latter is available as multi-temperature equipment that can carry products at different temperatures in different compartments.

5.1.3 Stationary AC-equipment and heat pumps

AC equipment is used in the residential, commercial, public and industrial sectors. The main function of stationary AC 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. This type of equipment also includes dehumidifiers.

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 comprised of an indirect system with a chilled water secondary circuit.

² Definition see Article 2 (23) of Regulation (EC) No 517/2014

³ Definition see Article 2 (24) of Regulation (EC) No 517/2014

⁴ Article 2(32) defines "commercial use" as follows: "used for the storage, display or dispensing of products, for sale to end users, in retail and food services".

⁵ Definition see Article 2 (26) and (27) of Regulation (EC) No 517/2014

Heat pumps are devices that use a refrigeration circuit to extract energy from an ambient or waste heat source and deliver heat to e.g. buildings. 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.

5.1.4 Mobile air conditioning equipment

Mobile air conditioning equipment is used in cars and light vans (these vehicles are covered by the EU MAC Directive⁶), larger road vehicles, trains, ships and aircraft. Its main purpose is to provide cooling inside the cabin of the vehicle.

In smaller vehicles the equipment is driven by the vehicle engine via a belt drive. In larger vehicles it can also be driven electrically or by a separate engine.

4.2. Hermetically sealed systems

A 'hermetically sealed system' means a system which has been factory-assembled and contains only permanent connections⁷. Examples include most types of equipment that are of the "plug-in" type such as domestic fridges and freezers or commercial stand-alone equipment such as supermarket display cabinets, as well as moveable room air-conditioners.

Hermetically sealed systems benefit from more lenient sets of requirements for example as regards leak checks⁸, always under the condition that the term "hermetically sealed system" is indicated on the label of the equipment.

4.3. Equipment charge

Equipment charge refers to the amount of F-gases contained in equipment. The main criterion to determine the charge is 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 if two refrigeration circuits are fully disconnected (i.e. without any permanent or temporary means to connect one refrigerant circuit to the other) these systems would be regarded as two separate applications, even if they are used for the same purpose (e.g. to maintain a low temperature in a cold store or warehouse).

It is further important to remember that the new F-gas Regulation refers to the charge in terms of CO₂ equivalents rather than kilograms of F-gases. As many requirements for operators of equipment depend on the charge size measured in CO₂ equivalents, it is important that operators know the GWP of the F-gas in their systems as well as how to calculate the charge in CO₂ equivalents. From 2017 on this will also have to be reflected on the label of the equipment.

⁶ Directive 2006/40/EC

⁷ Definition see Article 2 (11) of Regulation (EC) No 517/2014

⁸ Hermetically sealed equipment that is labelled as such and contains less than 6 kg of F-gases is not subject to leak checks until 31 December 2016 (Article 4(2) of Regulation 517/2014).

Determining the equipment charge in CO₂ equivalent

- To determine the F-gas charge, the operator should check the equipment label and the equipment manual or technical specifications. If in doubt the operator should contact the equipment supplier, manufacturer or the specialised service company.

- Once the charge in kilograms is known it is multiplied by the GWP of the F-gas used in the system to obtain the charge in CO₂ equivalents.

The need for leakage detection system and leak checks depends on whether the charge size is exceeding 5, 50 or 500 tonnes of CO₂ equivalent. In Table 2 below these limits are converted into the weight in kg for the most common refrigerants and blends.

Section 10 contains a more exhaustive list.

Table 2: Converting charge limits in CO₂ equivalent into kilograms for the most common refrigerants and blends

		Charge limits in t CO ₂ -equiv.				
		5	40	50	500	1,000
Refrigerant	GWP	Conversion of charge limits in kg				
R134a	1,430	3.50	27.97	34.97	349.65	699.30
R32	675	7.41	59.26	74.07	740.74	1,481.48
R404A	3,922	1.27	10.20	12.75	127.49	254.97
R407C	1,774	2.82	22.55	28.18	281.85	563.70
R410A	2,088	2.39	19.16	23.95	239.46	478.93
R422D	2,729	1.83	14.66	18.32	183.22	366.43
R507A	3,985	1.25	10.04	12.55	125.47	250.94

5. Obligations of emission prevention, containment and recovery

5.1. Overview of general obligations of operators and service personnel

Equipment operators and service personnel are generally obliged to avoid emissions of F-gases.⁹ They must take precautionary measures to prevent leakages.¹⁰ Once a leak is detected it has to be repaired without undue delay.¹¹

A number of requirements on training and certification will affect operators and service personnel for stationary RAC (refrigeration and AC) equipment, heat pumps, as well as refrigerated trucks and trailers:

- Service personnel must be certified to install, service and maintain, repair or decommission equipment as well as to perform leak checking and recovery of gas at end of life.
- Operators assigning a task such as installation, servicing, maintenance repair, decommissioning as well as leak checking and recovery of gas at end of life to another undertaking must make sure that the latter are certified.
- Only undertakings that are certified can acquire F-gases for the purpose of installing, servicing, maintaining or repairing.

For mobile AC and refrigerated vehicles excluding trucks and trailers the following applies:

- Recovery of gas at the end of life of mobile AC units in passenger cars and light vans requires personnel with a training attestation only. Recovery of F-gases from mobile AC units in other vehicles as well as from refrigerated vehicles other than refrigerated trucks and trailers requires appropriately qualified personnel without any specific attestation or certification.

The Regulation contains also more specific containment obligations for operators such as regular leak checks by certified personnel, the installation of leakage detection systems where appropriate and diligent record keeping as well as recovery of gases at end-of-life which are outlined below¹². These obligations depend on the type of equipment, either

- stationary refrigeration, air conditioning or heat pump equipment,
- mobile refrigeration systems, or
- mobile air conditioning systems,

and the charge of F-gas contained in the equipment. Note that the new F-gas Regulation refers to charges in terms of CO₂ equivalents rather than weight of any given refrigerant as was the case in the past. This is a bonus for operators of using equipment with lower GWP refrigerants, which needs e.g. to be checked only at longer intervals.

The decision tree in Figure 1 groups stationary equipment into equipment categories A-D, depending on their charge. Mobile refrigeration equipment can be grouped into categories MRX, MRA and MRB, depending on whether it is equipment in trucks and trailers or not and on charge size (Figure 2). Mobile air conditioning equipment falls into categories MAX or MAC depending on whether it is subject to Directive 2000/40/EC (MAC Directive; Figure 3).

Table 3 summarises relevant obligations for each of these nine categories.

⁹ Article 3 (1) of Regulation (EC) No 517/2014

¹⁰ Article 3 (2) and (4) of Regulation (EC) No 517/2014

¹¹ Article 3 (3) of Regulation (EC) No 517/2014

¹² Articles 4, 5, 6 and 8 of Regulation (EC) No 517/2014

Guidance for equipment operators

The specific requirements laid down in the F-gas Regulation for the various equipment categories are described in detail further below. In order to indicate the categories affected, the following symbols are used in the following.

Examples:

- Relevant for all equipment categories:

A	B	C	D	MRX	MRA	MRB	MAX	MAC
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- Relevant for stationary equipment category D only (≥ 500 t CO₂-equiv.):

A	B	C	D	MRX	MRA	MRB	MAX	MAC
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Figure 1: Decision tree for stationary equipment categories

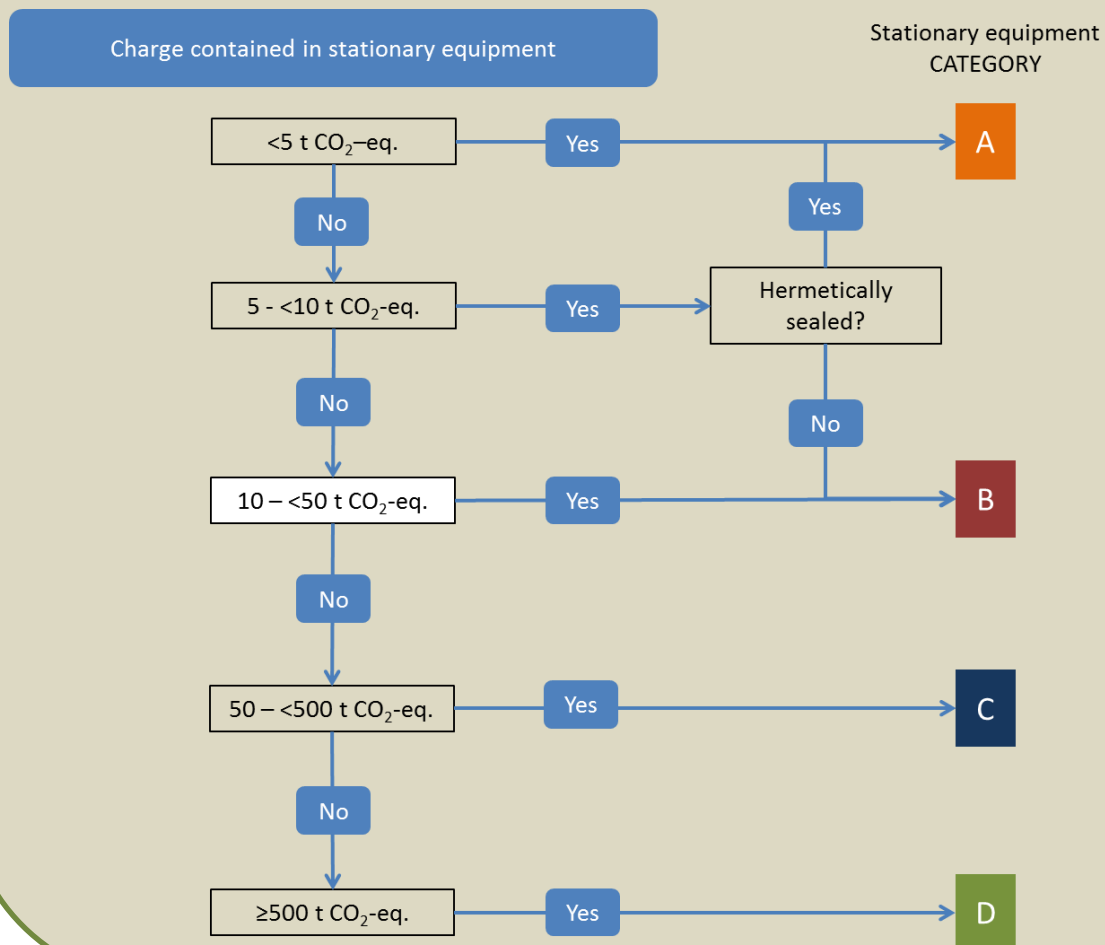


Figure 2: Decision tree for mobile refrigeration equipment

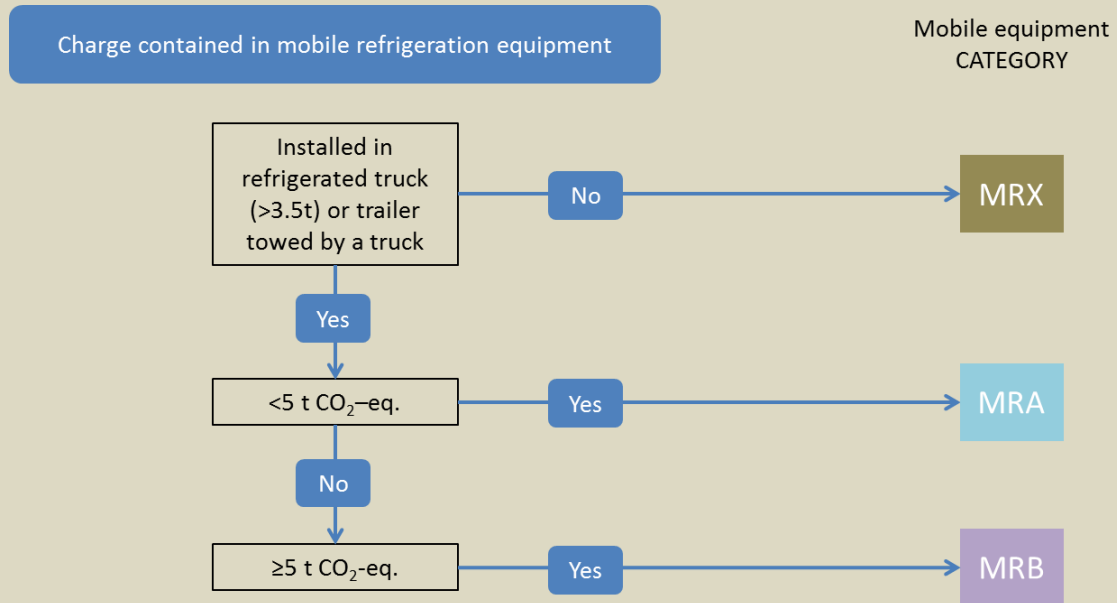


Figure 3: Decision tree for mobile AC equipment

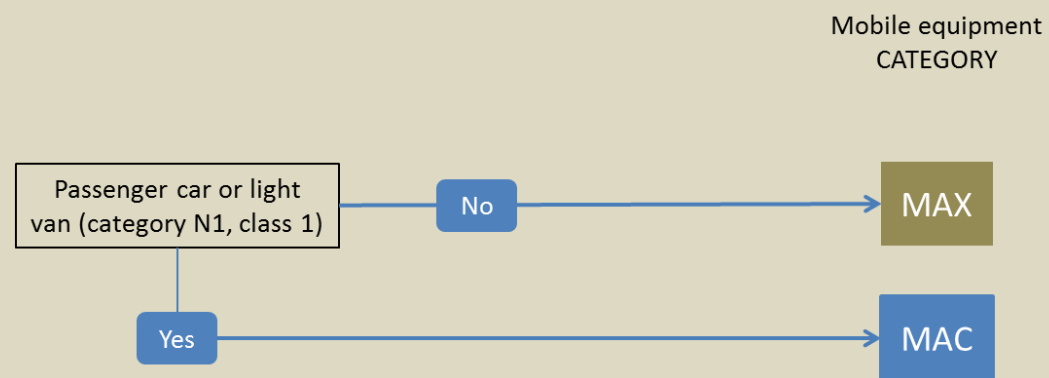


Table 3: Overview of requirements in stationary equipment categories

Measure	Stationary refrigeration and AC			
	A	B	C	D
Leakage prevention and repair as soon as possible (Art. 3)	✓	✓	✓	✓
Installation ¹³ , maintenance or servicing of the equipment by certified personnel and companies (Art. 3)	✓	✓	✓	✓
Minimum frequency of leak checks by certified personnel (Art. 4)		12 mo. (*)	6 mo. (*)	3 mo. (*)
Installation of leakage detection system which must be checked at least every 12 mo. (Art. 3)				✓
Record keeping (Art. 6)		✓	✓	✓
Recovery of F-gases before final disposal of the equipment, and when appropriate during maintenance or servicing, by certified personnel (Art. 8 and Art. 10)	✓	✓	✓	✓
Labelling of equipment (Art. 12)	✓	✓	✓	✓

(*) If the stationary refrigeration or air conditioning equipment is equipped with a leakage detection system the frequency of leak checks doubles to 24 months, 12 months and 6 months for classes B, C and D, respectively.

Table 4: Overview of requirements in mobile equipment categories

Measure	Mobile refrigeration			Mobile AC	
	MRX	MRA	MRB	MAX	MAC
Leakage prevention and repair as soon as possible (Art. 3)	✓	✓	✓	✓	✓
Installation, maintenance or servicing of the equipment by certified personnel and companies (Art. 3)		✓ (*)	✓ (*)		
Minimum frequency of leak checks by certified personnel (Art. 4)			12 mo. (**)		
Installation of leakage detection system which must be checked at least every 12 mo. (Art. 3)					
Record keeping (Art. 6)			✓		
Recovery of F-gases before final disposal of the equipment, and when appropriate during maintenance or servicing (Art. 8 and Art. 10)(***)	...by certified personnel	✓	✓		
	...by personnel with training attestation				✓
	...by appropriately qualified personnel	✓		✓	
Labelling of equipment (Art. 12)	✓	✓	✓	✓	✓

(*) Only servicing personnel must be certified, not servicing companies.

(**) If the stationary refrigeration or air conditioning equipment is equipped with a leakage detection system the frequency of leak checks doubles to 12 months for MRB.

(***) Only necessary if technically feasible and no disproportionate costs are incurred (Article 8 (3) Regulation (EU) No 517/2014).

¹³ as far as applicable, e.g. not relevant for plug-in systems

In the context of the new F-Gas Regulation	
<p>Installation</p> <p>means 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. 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>Maintenance or servicing</p> <p>comprise 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"> • supplying the system with fluorinated greenhouse gases, • removing one or more pieces of circuit or equipment, • reassembling two or more pieces of circuit or equipment, • repairing leaks.

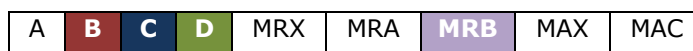


5.2. Emission prevention

All operators of refrigeration, air conditioning and heat pump applications, including refrigerated trucks and trailers and other refrigerated vehicles as well as mobile AC, irrespective of the quantity of refrigerant contained, must:

- prevent leakage through all measures technically feasible and not entailing disproportionate costs, and
- repair leakages as soon as possible after they have been detected.

Installation, servicing and maintenance of equipment should only be carried out by personnel and companies holding an appropriate certificate or attestation, as appropriate (see section 0).



5.3. Containment through leak checks

Stationary refrigeration and air conditioning equipment and refrigerated trucks and trailers containing F-gas refrigerant, in working order or just temporarily out of operation, have to be checked for leakage at regular intervals (Table 5).¹⁴ This does not apply if the charge is below 5 t CO₂-equiv. (or less than 10 t CO₂-equiv. for hermetically sealed equipment labelled as such). A crucial point determining the frequency of checks is also the existence or not of a leakage detection system¹⁵.

¹⁴ Until 31 December 2016 equipment that contains less than 3 kg F-gases (less than 6 kg if hermetically sealed) is exempt from leak checks.

¹⁵ A leakage detection system is defined as "a calibrated mechanical, electrical or electronic device for detecting leakage of fluorinated greenhouse gases which, on detection, alerts the operator" (Article 2(29) of Regulation No 517/2014).

The operator of the equipment is responsible for ensuring that this check is carried out by certified personnel only (see section 0).

Regular leak checks are not required for mobile AC equipment containing F-gas refrigerants or refrigerated vehicles that are neither trucks nor trailers (e.g. containers, vans etc.).

Table 5: Overview of minimum frequency of leakage checking

Equipment category	Stationary refrigeration and AC			Mobile refrigeration
	B	C	D	MRB
Without a properly functioning, appropriate leakage detection system in place	12 months	6 months	3 months*	12 months
With a properly functioning, appropriate leakage detection system in place	24 months	12 months	6 months	24 months

(*) A leakage detection system which on detection alerts the operator is mandatory for applications containing a charge of 500 t CO₂-equiv. or more

Newly commissioned equipment should be checked for leakage immediately after it has been put into service.

In cases where a leak has been detected, the operator is obliged to ensure that the repair is carried out as soon as possible by personnel certified to undertake the specific activity (see section 0). Prior to repair a pump-down or recovery shall be carried out, where necessary.

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. Prior to pressure testing with OFN or another suitable pressure testing gas, F-gases shall be recovered from the whole application, where necessary.

The cause of a leakage should be identified as far as possible in order to avoid recurrence.

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. This check should focus on those areas where leakages have been found and repaired as well as on adjacent areas in cases where has been applied during the repair. 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 that point in time.

Requirements for leak checks of stationary equipment are specified in detail in a separate regulation¹⁶. The requirements for general systematic check are listed as well as the need for direct and indirect measuring methods of leakage checking.

¹⁶ Commission Regulation (EC) No 1516/2007

A	B	C	D	MRX	MRA	MRB	MAX	MAC
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5.4. Containment through leakage detection systems

A leakage detection system is defined as a calibrated mechanical, electrical or electronic device for detecting leakage of fluorinated greenhouse gases which, on detection, alerts the operator¹⁷.

Equipment containing 500 t CO₂-equiv. or more of F-gas refrigerant have to be equipped with such a leakage detection system. The proper functioning of the leakage detection system has to be checked **at least once every 12 months**¹⁸.

Leakage detection systems are not a requirement for refrigeration equipment in mobile equipment such as trucks and trailers or mobile AC systems.

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.

As general guidance, systems which detect leakage by monitoring the existence of F-gases in the air, where these are appropriate, should be installed in the machine room or, if no machine 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.

In particular, the standard EN 378, any other 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 500 t CO₂-equiv. of F-gas may also install a leakage detection system. Equipment with properly functioning appropriate leakage detection systems needs to be checked for leakage less frequently (see

Table 5).

¹⁷ Article 2(29) of Regulation (EC) No 517/2014

¹⁸ Article 5(3) of Regulation (EC) No 517/2014

A	B	C	D	MRX	MRA	MRB	MAX	MAC
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5.5. Recovery and reclamation of refrigerants

Operators of all types of equipment must make arrangements for the proper recovery, i.e. the collection and storage of the F-gas refrigerant from the cooling circuits of refrigeration, air conditioning and heat pump equipment, to ensure recycling, reclamation or destruction of the F-gases. This activity must take place before the final disposal of the equipment and, when appropriate, during maintenance or servicing work.

Certified personnel is required for stationary RAC as well as refrigerated trucks and trailers. Recovery of F-gases from air conditioning equipment in motor vehicles regulated by Directive 2006/40/EC (passenger cars, light trucks; i.e. MAC) must be accomplished by personnel holding at least a valid training attestation.

F-gas recovery from mobile AC equipment in other vehicles only (MAX) as well as from refrigerated vehicles other than trucks and trailers (MRX) requires appropriately qualified personnel without any specific attestation or certification. For all mobile AC equipment, recovery is only required if technically feasible or not disproportionately costly.

A	B	C	D	MRX	MRA	MRB	MAX	MAC
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5.6. Record keeping

Operators of stationary RAC applications as well as refrigerated trucks and trailers containing 5 t of CO₂-equiv. or more F-gas charge have to maintain records of the equipment and make them available to the national competent authority or the European Commission on request. In case the equipment is labelled as "hermetically sealed equipment", these records are only required if the charge is more than 10 t of CO₂-equiv.

The **operator** has to keep the records for 5 years, while the **contractor** must keep a copy of the records for 5 years. Equipment records must contain the following information:

- 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 during installation, maintenance or servicing due to leakage
- Quantities of installed F-gases that have been recycled or reclaimed, including the name and address of the recycling or reclamation facility and, where applicable, the certificate number
- The quantity of fluorinated greenhouse gases recovered
- The dates and results of the leakage checks including the cause of any detected leakage
- If the equipment was decommissioned, the measures taken to recover and dispose of the fluorinated greenhouse gases
- Identification of company / personnel who carried out the activities
- Dates and results of checks of the leakage detection system (if installed)
- Any other relevant information

No records have to be kept for mobile air conditioning equipment, or refrigerated vehicles other than trucks and trailers. Further guidance for equipment records is specified in a separate regulation¹⁹.

¹⁹ Commission Regulation (EC) No 1516/2007



5.7. Labelling

Refrigeration and air conditioning equipment, including mobile air conditioning equipment, needs to be labelled appropriately. The label needs to indicate that the equipment contains F-gases, information about which F-gas is contained and the charge size. It should further be clearly legible as well as easily accessible, for example by being located close to the service ports. If the equipment is hermetically sealed this also needs to be indicated on the label.

From 1 January 2017 onwards, the label needs to indicate the CO₂ equivalent of the charge as well as the GWP of the F-gas contained. Labels need to be put on the equipment when it is first placed on the market, i.e. when the EU equipment manufacturer first sells it to a distributor or other company, or when an importer releases the equipment for free circulation.

6. Obligations of technical personnel and company certification

The Regulation prohibits any intentional release of fluorinated gases into the atmosphere.²⁰ Service personnel are therefore required to ensure that this does not happen. They are further obliged to take pre-cautionary measures to minimise any leakage of F-gases.²¹

Certification is required for a number of activities as elaborated below. In addition to skills and knowledge that had been required under the old legislation, the new F-gas Regulation adds that **certification programmes and training must also cover information on relevant technologies to replace or reduce the use of F-gases and their safe handling.**

6.1. Stationary refrigeration and air conditioning and refrigerated trucks and trailers

Regarding stationary refrigeration and air conditioning equipment as well as equipment in refrigerated trucks and trailers (i.e. A, B, C, D, MRA and MRB), the activities indicated in Table 6 can only be undertaken by personnel and companies holding a certificate, issued by a certification body designated by a Member State. For other refrigerated vehicles (MRX), there is no requirement for certification.

Only certified personnel working for a certified company can do installation and maintenance or servicing activities on these types of equipment. Specifically for leak checking and the recovery of F-gases, personnel needs to be certified, but a company certification is not required explicitly.

Certificates issued under the old F-gas Regulation (2006) remain valid. Member States might establish specific requirements that should be taken into consideration.

The operator must make sure that the relevant personnel hold a valid certificate for the foreseen activity.

Table 6: Activities on stationary RAC and mobile refrigeration equipment in refrigerated trucks and trailers that need to be carried out by certified servicing personnel and companies

Activity	Certified personnel (*)	Certified company
Installation	✓	✓
Maintenance or servicing	✓	✓
Leak checks of charge categories B, C, D and MRB	✓	
Recovery of F-gases	✓	

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

Certificates must contain the following information:

- 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

²⁰ Article 3 (1) of Regulation (EC) No 517/2014

²¹ Article 3 (4) of Regulation (EC) No 517/2014

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 (more information at the National Contact points).

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

Table 7: Personnel certification categories for all equipment categories

	Equipment categories A and MRA			Equipment categories B, C, D and MRB				
	R	I	M	L1	L2	R	I	M
Category I	✓	✓	✓	✓	✓	✓	✓	✓
Category II	✓	✓	✓		✓			
Category III	✓							
Category IV					✓			

Note: L1=Leak check including breaking into refrigeration circuit; L2=leak check without breaking into refrigeration circuit; R=Recovery; I=Installation; M=Maintenance or servicing

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 are specified in a separate regulation²².

6.2. Mobile air conditioning

The recovery of F-gases from motor vehicles covered by the EU MAC Directive²³ (passenger cars and light trucks; i.e. category MAC), requires that personnel holds valid training attestations. Such personnel must at least be trained in

- the functioning of the mobile air conditioning system,
- the environmental impact of the F-gas refrigerant,
- environmental regulations and
- refrigerant recovery.

Recovery of F-gases from motor vehicles not covered by the EU MAC Directive (i.e. category MAX) requires appropriately qualified personnel but no specific attestation or certification.

²² Commission Regulation (EC) 303/2008

²³ Directive 2006/40/EC

7. Novel measures

7.1. Phase-down²⁴

Under the phase-down, the quantities of HFCs (expressed in CO₂ equivalents) placed on the EU market are stepwise reduced by 79% in the period from 2015 to 2030. This mechanism does not ban the sale of any particular HFC. Nevertheless, given that less overall CO₂ equivalents will be available, the prices are expected to increase over time, in particular for HFCs with a high GWP (which use up a lot of CO₂ equivalents). Price increases become relevant to operators when future maintenance and servicing work of equipment and systems containing HFCs is planned.

Equipment operators can continue using their current refrigeration, air conditioning and heat pump equipment with existing refrigerant gases, with the exception of the service ban (see below). Price increases can however be significant especially in the years where the F-gas supply is further reduced (see Figure 3 and Table 9). It is important to realise that the initial slope is rather steep (i.e. that reductions of supply will happen quickly).

Figure 4: F-gas phase down under the new Regulation

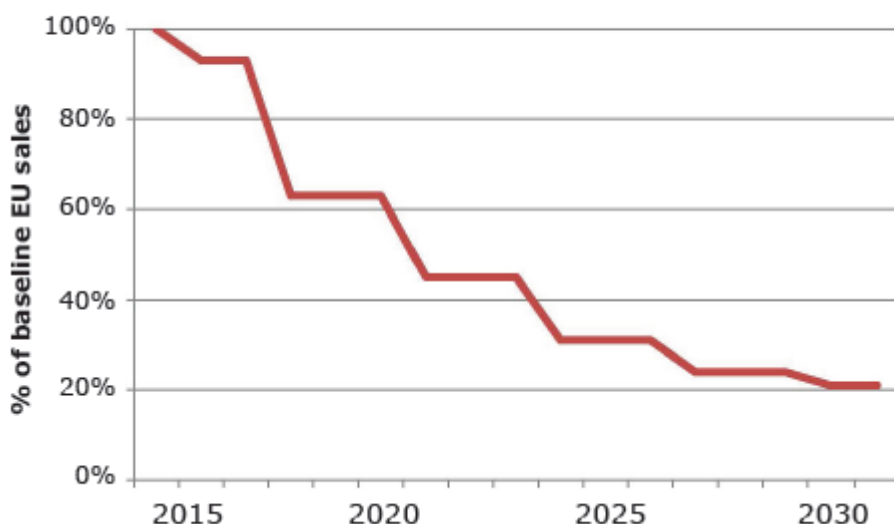


Table 8: Phase down steps until 2030

2009-12	2015	2016-17	2018-20	2021-23	2024-26	2027-29	2030
Baseline (100 %)	100 %	93 %	63 %	45 %	31 %	24 %	21 %

It is therefore important for operators who are considering buying new equipment to take these facts into account. It is not advisable to invest into equipment with HFC of high GWP at this point in time, in particular equipment where the service ban (see below) applies. Operators should seek good guidance on what equipment using low-GWP refrigerants or other technologies are available for their particular purpose.

²⁴ Articles 14 and 15 of Regulation (EC) No 517/2014

7.2. Bans

Bans relevant to equipment operators include both

- Product and equipment bans, and
- Service and maintenance bans.

7.2.1. Bans on certain F-gase in new equipment

The placing on the market of certain new products and equipment is prohibited from certain dates onwards²⁵. Table 9 provides an overview of the additional bans complementing those required by the 2006 Regulation.

Table 9: New equipment bans introduced in addition to those contained in Regulation 842/2006

Ban description		Date of prohibition
Domestic refrigerators and freezers that contain HFCs with GWP of 150 or more		1 January 2015
Refrigerators and freezers [...] for commercial use (hermetically sealed systems)	That contain HFCs with GWP of 2,500 or more	1 January 2020
	That contain HFCs with GWP of 150 or more	1 January 2022
Stationary refrigeration equipment, that contains, or whose functioning relies upon, HFCs with GWP of 2 500 or more except equipment intended for application designed to cool products to temperatures below – 50 °C		1 January 2020
Multipack centralised refrigeration systems for commercial use with a rated capacity of 40 kW or more that contain, or whose functioning relies upon, fluorinated greenhouse gases with GWP of 150 or more, except in the primary refrigerant circuit of cascade systems where fluorinated greenhouse gases with a GWP of less than 1 500 may be used		1 January 2022
Movable room air-conditioning equipment (hermetically sealed equipment which is movable between rooms by the end user) that contain HFCs with GWP of 150 or more		1 January 2020
Single split air-conditioning systems containing less than 3 kg of fluorinated greenhouse gases, that contain, or whose functioning relies upon, fluorinated greenhouse gases with GWP of 750 or more		1 January 2025

It would be mistake to assume that these bans mean that it is recommendable to use the affected refrigerants until banned. The phase-down will strongly affect the supply of these gases and drive price developments in advance of many of the ban end dates (see above). A continued use might therefore not be feasible economically. Instead, it is advised to see the bans as a sort of guidance in terms of which refrigerants are close to being fully replaceable by alternatives with low climate impact already ahead of the actual date of the ban.

For mobile AC systems in passenger cars, the MAC Directive already requires that a refrigerant with GWP<150 has to be introduced in new car models in the period 2011-2017. From 2017 this will apply for all new passenger cars and light trucks. The F-gas Regulation does not establish further bans for mobile AC systems.

²⁵ Article 11 (1) of Regulation (EC) No 517/2014

7.2.2. Bans on servicing and maintenance of refrigeration equipment with certain F-gases

Certain bans apply to the servicing and maintenance of equipment.

As of 2020, refrigeration equipment with a charge of 40 tonnes CO₂ equivalents or more will no longer be able to be serviced or maintained with virgin HFCs with a GWP > 2,500. Equipment intended for low-temperature refrigeration below -50°C are exempted from this ban.²⁶

Recycled and reclaimed HFCs with a GWP > 2,500 can still be used for service or maintenance purposes until 2030 if these gases are labelled accordingly.

No restrictions apply for the service and maintenance with HFCs with a GWP < 2,500.

When relying on recycled and reclaimed refrigerants it is important to remember that one also relies on their availability. Retrofit gases with intermediate GWP on the other hand might not provide the necessary CO₂ equivalent savings to meet the challenges of later phase-down steps. It can therefore make long-term economic sense to replace equipment and switch to low-GWP alternatives directly.

Table 10: Charge size limits above which service and maintenance bans will apply with regard to the 40 t CO₂ equivalent threshold

Refrigerant	Charge size threshold (40 t CO ₂ -equiv.)
R23	2.72 kg
R404A	10.20 kg
R507	10.04 kg
R422D	14.66 kg

²⁶ Article 13 (3) of Regulation (EC) No 517/2014

8. F-gases listed in Annex I of the Regulation

Fluorinated Greenhouse Gases listed in Annex I of Regulation No 517/2014, along with their CAS number and typical applications

Industrial designation	Chemical name (Common name)	Chemical formula	GWP ²⁷	CAS number	Typical Applications
Section 1: Hydrofluorocarbons (HFCs)					
HFC-23	trifluoromethane (fluoroform)	CHF ₃	14800	75-46-7	Low temperature refrigerant Fire extinguishant
HFC-32	difluoromethane	CH ₂ F ₂	675	75-10-5	Blend component for refrigerants
HFC-41	fluoromethane (methyl fluoride)	CH ₃ F	92	593-53-3	Semiconductor manufacturing
HFC-125	pentafluoroethane	CHF ₂ CF ₃	3500	354-33-6	Blend component for refrigerants Fire extinguishant
HFC-134	1,1,2,2-tetrafluoroethane	CHF ₂ CHF ₂	1100	359-35-3	No typical applications at present
HFC-134a	1,1,1,2-tetrafluoroethane	CH ₂ FCF ₃	1430	811-97-2	Refrigerant Blend component for refrigerants Extraction solvent Propellant for medical and technical aerosols Blowing agent component for extruded polystyrene (XPS), polyurethane (PU) foams
HFC-143	1,1,2-trifluoroethane	CH ₂ FCHF ₂	353	430-66-0	No typical applications at present
HFC-143a	1,1,1-trifluoroethane	CH ₃ CF ₃	4470	420-46-2	Blend component for refrigerants
HFC-152	1,2-difluoroethane	CH ₂ FCH ₂ F	53	624-72-6	Not commonly used
HFC-152a	1,1-difluoroethane	CH ₃ CHF ₂	124	75-37-6	Propellant for specialised technical aerosols Blowing agent component for extruded

²⁷ Based on the Fourth Assessment Report adopted by the Intergovernmental Panel on Climate Change, unless otherwise indicated.

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Industrial designation	Chemical name (Common name)	Chemical formula	GWP ²⁷	CAS number	Typical Applications
					polystyrene (XPS) foams Refrigerant
HFC-161	fluoroethane(ethyl fluoride)	CH ₃ CH ₂ F	12	353-36-6	Not commonly used. Tested as alternative to R22, not used at commercial scale.
HFC-227ea	1,1,1,2,3,3,3-heptafluoropropane	CF ₃ CHFCF ₃	3220	431-89-0	Refrigerant Propellant for medical aerosols Fire extinguishant Blowing agent for foams
HFC-236cb	1,1,1,2,2,3-hexafluoropropane	CH ₂ FCF ₂ CF ₃	1340	677-56-5	Refrigerant Blowing agent
HFC-236ea	1,1,1,2,3,3-hexafluoropropane	CHF ₂ CHFCF ₃	1370	431-63-0	Refrigerant Blowing agent
HFC-236fa	1,1,1,3,3,3-hexafluoropropane	CF ₃ CH ₂ CF ₃	9810	690-39-1	Fire extinguishant Refrigerant
HFC-245ca	1,1,2,2,3-pentafluoropropane	CH ₂ FCF ₂ CHF ₂	693	679-86-7	Refrigerant Blowing agent
HFC-245fa	1,1,1,3,3-pentafluoropropane	CHF ₂ CH ₂ CF ₃	1030	460-73-1	Foam blowing agent for polyurethane (PUR) Solvent for specialised applications
HFC-365mfc	1,1,1,3,3-pentafluorobutane	CF ₃ CH ₂ CF ₂ CH ₃	794	406-58-6	Foam blowing agent for polyurethane (PUR) and phenolic foams Blend component for solvents
HFC-43-10mee	1,1,1,2,2,3,4,5,5,5-decafluoropentane	CF ₃ CHFCHFCF ₂ CF ₃	1640	138495-42-8	Solvent for specialised applications Blowing agent for foams
Section 2: Perfluorocarbons (PFCs)					
PFC-14	tetrafluoromethane (perfluoromethane, carbon tetrafluoride)	CF ₄	7390	75-73-0	Semiconductor manufacturing Fire extinguishant

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Industrial designation	Chemical name (Common name)	Chemical formula	GWP ²⁷	CAS number	Typical Applications
PFC-116	hexafluoroethane (perfluoroethane)	C ₂ F ₆	12200	76-16-4	Semiconductor manufacturing
PFC-218	octafluoropropane (perfluoropropane)	C ₃ F ₈	8830	76-19-7	Semiconductor manufacturing
PFC-3-1-10 (R31-10)	decafluorobutane (perfluorobutane)	C ₄ F ₁₀	8860	355-25-9	Physics research Fire extinguishant
PFC-4-1-12 (R41-12)	dodecafluoropentane (perfluoropentane)	C ₅ F ₁₂	9160	678-26-2	Precision cleaning solvent Low-use refrigerant
PFC-5-1-14 (R51-14)	tetradecafluorohexane (perfluorohexane)	C ₆ F ₁₄	9300	355-42-0	Coolant fluid in specialised applications Solvent
PFC-c-318	octafluorocyclobutane (perfluorocyclobutane)	c-C ₄ F ₈	10300	115-25-3	Semiconductor manufacturing
Section 3: Other perfluorinated compounds					
	sulphur hexafluoride	SF ₆	22800	2551-62-4	Insulating gas in high-voltage switchgear Blanket gas for magnesium production Etching and cleaning in the semiconductors industry

9. Method of calculating the total GWP of a mixture

From, Annex IV - Method of calculating the total GWP of a mixture [of Regulation No 517/2014]

The GWP of a mixture is calculated as a weighted average, derived from the sum of the weight fractions of the individual substances multiplied by their GWP, unless otherwise specified, including substances that are not fluorinated greenhouse gases.

$$\Sigma [(Substance\ X\% \times GWP) + (Substance\ Y\% \times GWP) + \dots (Substance\ N\% \times GWP)]$$

where % is the contribution by weight with a weight tolerance of +/- 1%.

The GWP of the following non-fluorinated substances (under heading 10 below) are used to calculate the GWP of mixtures. For other substances not listed in the Annexes a default value of 0 applies.

10. Charge size limits in kilograms for common refrigerants and blends corresponding to CO₂ equivalent charge limits

Charge size limit in t CO ₂ -equiv				
5	40	50	500	1,000

Refrigerant	GWP	Converted charge size limit in kg				
		5	40	50	500	1,000
R134a	1,430	3.50	27.97	34.97	349.65	699.30
R23	14,800	0.34	2.70	3.38	33.78	67.57
R32	675	7.41	59.26	74.07	740.74	1,481.48
R404A	3,922	1.27	10.20	12.75	127.49	254.97
R407A	2,107	2.37	18.98	23.73	237.30	474.61
R407C	1,774	2.82	22.55	28.18	281.85	563.70
R407F	1,825	2.74	21.92	27.40	273.97	547.95
R410A	2,088	2.39	19.16	23.95	239.46	478.93
R413A	2,053	2.44	19.48	24.35	243.55	487.09
R417A	2,346	2.13	17.05	21.31	213.13	426.26
R422A	3,143	1.59	12.73	15.91	159.08	318.17
R422D	2,729	1.83	14.66	18.32	183.22	366.43
R423A	2,280	2.19	17.54	21.93	219.30	438.60
R424A	2,440	2.05	16.39	20.49	204.92	409.84
R427A	2,138	2.34	18.71	23.39	233.86	467.73
R428A	3,607	1.39	11.09	13.86	138.62	277.24
R434A	3,246	1.54	12.32	15.40	154.04	308.07
R438A	2,265	2.21	17.66	22.08	220.75	441.50
R442A	1,888	2.65	21.19	26.48	264.83	529.66
R449A	1,397	3.58	28.63	35.79	357.91	715.82
R507A	3,985	1.25	10.04	12.55	125.47	250.94
R508B	13,214	0.38	3.03	3.78	37.84	75.68

11. GWP of non-fluorinated gases in Annex IV of the Regulation

From, Annex IV - Method of calculating the total GWP of a mixture [of Regulation No 517/2014]:

Common name	Industrial designation	Chemical formula	GWP ²⁸
Methane		CH ₄	25
Nitrous oxide		N ₂ O	298
Dimethyl ether	E-170	CH ₃ OCH ₃	1
Methylene chloride		CH ₂ Cl ₂	9
Methyl chloride		CH ₃ Cl	13
Chloroform		CHCl ₃	31
Ethane	R-170	CH ₃ CH ₃	6
Propane	R-290	CH ₃ CH ₂ CH ₃	3
Butane	R-600	CH ₃ CH ₂ CH ₂ CH ₃	4
Isobutane	R-600a	CH(CH ₃) ₂ CH ₃	3
Pentane	R-601	CH ₃ CH ₂ CH ₂ CH ₂ CH ₃	5 ²⁹
Isopentane	R-601a	(CH ₃) ₂ CHCH ₂ CH ₃	5 ²⁹
Ethoxyethane (Diethyl ether)	R-610	CH ₃ CH ₂ OCH ₂ CH ₃	4
Methyl formate	R-611	HCOOCH ₃	25
Hydrogen	R-702	H ₂	6
Ammonia	R-717	NH ₃	0
Ethylene	R-1150	C ₂ H ₄	4
Propylene	R-1270	C ₃ H ₆	2
Cyclopentane		C ₅ H ₁₀	5 ²⁹

²⁸ Based on the Fourth Assessment Report adopted by the Intergovernmental Panel on Climate Change, unless otherwise indicated.

²⁹ Substance not listed in the Fourth Assessment Report adopted by the Intergovernmental Panel on Climate Change, default value on the basis of the GWPs of other hydrocarbons.

12. List of Implementing Acts

Below is a list of implementing acts that set out in more detail some of the provisions in the Regulation. It should be noted that some of these acts will be updated in the near future in light of changes and new requirements under the new Regulation compared to the repealed F-gas Regulation.

- 31/10/2014 - [Commission Implementing Decision determining, pursuant to Regulation \(EU\) No 517/2014 of the European Parliament and of the Council on fluorinated greenhouse gases, reference values for the period 1 January 2015 to 31 December 2017 for each producer or importer who has reported placing on the market hydrofluorocarbons under Regulation \(EC\) No 842/2006 of the European Parliament and the Council](#)
- 30/10/2014 - [Commission Implementing Regulation \(EU\) No 1191/2014 determining the format and means for submitting the report referred to in Article 19 of Regulation \(EU\) No 517/2014 of the European Parliament and of the Council on fluorinated greenhouse gases](#)

To ensure a smooth transition from the old regime to the new regime, Commission Regulations (EC) No 1494/2007, (EC) No 1497/2007, (EC) No 1516/2007, (EC) No 303/2008, (EC) No 304/2008, (EC) No 305/2008, (EC) No 306/2008, (EC) No 307/2008 and (EC) No 308/2008 remain in force and continue to apply unless and until repealed by delegated or implementing acts adopted by the Commission pursuant to the 2014 F-gas Regulation.

- 02/04/2008 - [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](#)
- 02/04/2008 - [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](#)
- 02/04/2008 - [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](#)
- 02/04/2008 - [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](#)
- 02/04/2008 - [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](#)

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- 02/04/2008 - [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](#)
- 18/12/2007 - [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](#)
- 17/12/2007 - [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](#)
- 17/12/2007 - [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](#)

13. Where to get more information?

National Contact Points for F-gases:

http://ec.europa.eu/clima/policies/f-gas/documentation_en.htm

European Commission, Directorate General Climate Action (DG Clima):

http://ec.europa.eu/clima/policies/f-gas/index_en.htm