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Mitsubishi Electric Guide to Working with the F-Gas Regulations

Information Guide 63

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This is an independent guide produced by Mitsubishi Electric to enhance the knowledge of its customers and provide a view of the key issues facing our industry today.

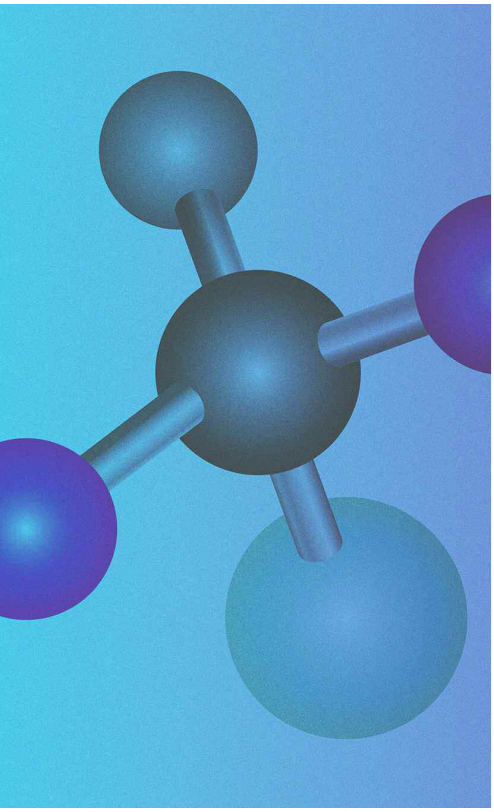
This guide accompanies a series of seminars, all of which are CPD certified.

Contents

Introduction

The aim of this Guide is to help readers understand how the F-Gas Regulations will affect them if they are installers, specifiers, owners and users of air conditioning equipment.

There are some actions that may need to be undertaken immediately, however there is also time to plan for future milestones in the F-Gas phase down process.



Background

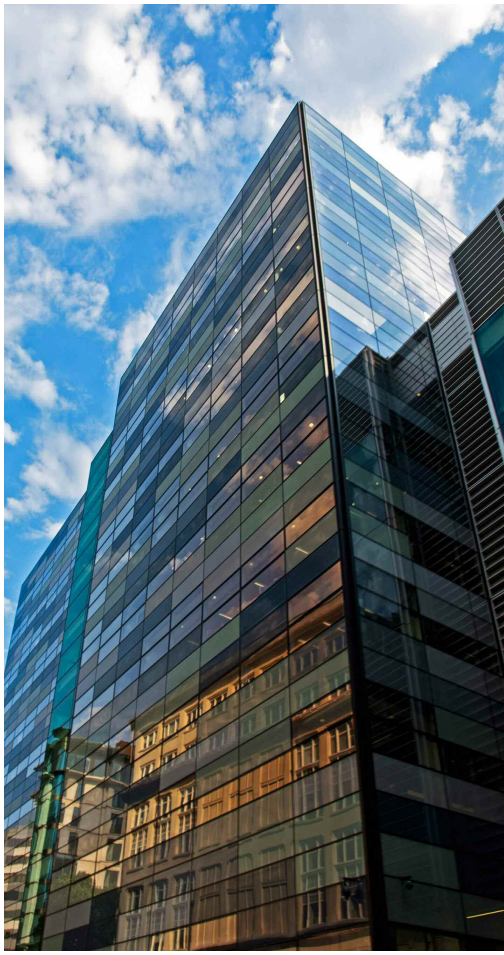
In March 2014, the European Parliament passed, by an overwhelming majority, a piece of legislation that has brought significant changes to the air conditioning industry.

This was the 2014 EU F-Gas Regulation (517/2014). This replaced, and strengthened an earlier version of the legislation introduced in 2006.

The recent Kigali agreement reinforces this change, however Europe will continue with the current, more stringent F-Gas legislation.

The F-Gas Regulation was a landmark ruling that has affected the air conditioning industry at all stages, from manufacture to installation and use.

From 1st January 2015, the phase down of hydrofluorocarbons (HFCs), and bans on use of the refrigerants in certain sectors of new equipment, began.



> The ultimate objective is to cut the availability of HFCs by **79%** between 2015 and 2030

Background

The overriding objective of the legislation is to reduce emissions of fluorinated greenhouse gases (F-Gases) used predominantly in the refrigeration and air conditioning sectors which make a significant contribution to climate change.

Fluorinated gases (F-Gases) are a family of man-made gases which, because they do not damage the atmospheric ozone layer, are often used as substitutes for ozone depleting substances such as chlorofluorocarbons (CFCs). However, F-Gases are powerful greenhouse gases, with a global warming effect of up to 23,000 times greater than Carbon Dioxide (CO_2).

Emissions occur through leakage during the manufacture, operation and disposal of products and because of this the EU introduced the original regulation in 2006 which focused on controlling emissions through improved quality of installations, F-Gas recovery and technician training.

Although this regulation did stabilise emissions it did not lead to the significant reduction which was originally expected and as a result this Regulation was invoked and replaced by the 2014 EU F-Gas Regulation(517/2014) which aims to achieve an 80% cut in emissions across the EU by 2030. ***This will be achieved by:***

Phasing down the amount of F-Gases that can be placed on the market through gradually reducing quotas for F-Gas producers and importers

Bans on certain F-Gases in some applications

Strengthening of obligations on leak checks, repairs, recovery and training

The F-Gas Regulations cover a number of products used in building services and refrigeration such as air conditioning, chillers, heat pumps and refrigeration, which will affect the industry for decades to come.

However, the phased approach taken by the legislation means that the following bans will take effect over the next few years:

- **Single split air-conditioning systems** containing less than 3kg of F-Gases with a GWP of 750 or more from 1st January 2025
- **Centralised refrigeration systems** for commercial use with a capacity of 40kW or more that use F-Gases with a Global Warming Potential (GWP) of 150 or more, from 1st January 2022
- **Stationary refrigeration equipment** running on HFCs with a GWP of 2500 or more from 1st January 2020
- **Movable room air-conditioning appliances** that contain HFCs with a GWP of 150 or more from 1st January 2020
- **Refrigerators and freezers for commercial use** containing HFCs with a GWP of 2500 or higher from 1st January 2020 and those containing HFCs with a GWP of 150 or more from 1st January 2022

F-Gases are powerful greenhouse gases, with a global warming effect of up to **23,000** times greater than Carbon Dioxide (CO_2)

How the phase down operates

The European Union (EU) is restricting the availability of HFCs through a quota system policed by the Environment Agency in the UK. Only companies with EU quotas will be able to supply HFCs to the EU market.

The baseline for these quotas is calculated from average HFC sales in the EU between 2009 and 2012. This amounted to 183 million tonnes of carbon dioxide (CO_2) equivalent per year.

What is important here is the way that the quantities are measured. In the 2006 Regulation, the quantity of F-Gas was measured in terms of the mass of fluid (in kg) however, under the 2014 Regulation this has changed and it is now measured as a CO_2 equivalent (CO_2-eq).

The CO_2 equivalent is calculated using the following formula:

Equivalent tonnes of CO_2 = weight of refrigerant x GWP divided by 1000

Example; For a system with 10kg of R410A:

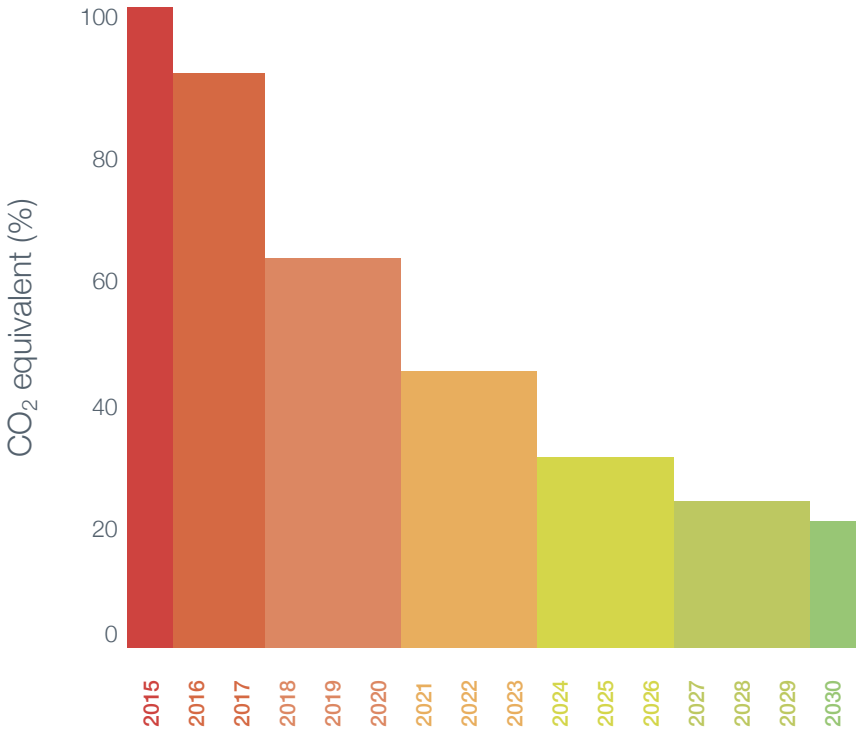
Equivalent tonnes of CO_2 = 10 x 2088 divided by 1000 **= 20.88 tonnes**

The use of CO_2 equivalent as a measurement means that a significantly lower quantity of F-Gases with a high GWP will be available. In addition, the gases which have the highest CO_2-eq are scheduled for earlier and more rapid phase down.

The table below gives a good overview of what percentage of the baseline 183 million tonnes CO_2-eq will be available to the EU market up to 2030.

It should be noted that the quotas are issued EU-wide, rather than set for each country. Although the table below shows dates to 2030, there are plans to go beyond that year with further phase downs.

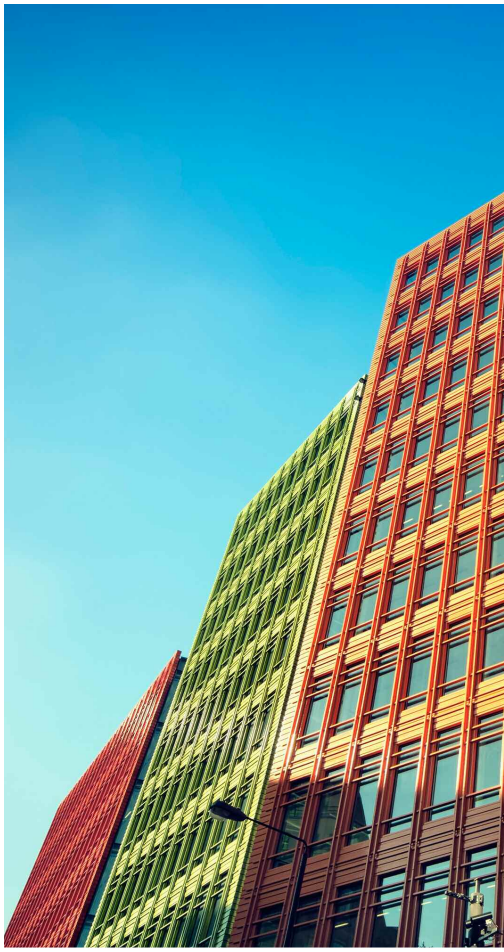
The HFC phase down programme to 2030*



It is important to note the first major drop in market availability is between 2017 and 2018.

This is by far the largest reduction in the phase down process, and one that air conditioning contractors and users should be prepared for in advance.

* Table from Department, Food and Rural Affairs (DEFRA) HFC phase down guideline.



What does this mean for air conditioning systems and owners?

As already noted, HFCs are being measured as CO_2 equivalent, and the weight of refrigerant permitted in a quota is set in these terms. Most F-Gases are between 1,000 and 20,000 times more powerful than CO_2 in terms of GWP, therefore the way GWP is calculated has been revised to reflect the equivalent tonnes of CO_2 - changing the GWP of HFCs and HFC blends.

As a result, HFCs with a higher global warming potential (GWP) are likely to be dropped first as they are 'heavier' in terms of their CO_2 equivalence. ***The table below illustrates this for some common HFC refrigerants:***

HFCs and their CO_2-eq weights**

HFC	GWP	Quantity of HFC equivalent to 10 tonnes CO_2-eq
404A	3,922	2.5kg
410A	2,088	4.7kg
407C	1,824	5.4kg
32	675	14.8kg

Typical Air Conditioning and Heating Systems

System	Capacity (kW)	Refrigerant	Charge (kg)	CO_2e (tonne)
Split Air Conditioning	10	R410A	5	10.4
Split Air Conditioning	10	R32	4.5	3.4
VRF Air Conditioning	25	R410A	20	41.8
Air To Water Heat Pump	4	R744 (CO_2)	1.15	0.01

So we can see that if a quota of 10 tonnes CO_2-eq of HFC is set, then only 4.7kg of R410A would be enough to fill the quota. However, this quota would allow for 14.8kg of R32. What this example demonstrates is that the use of a quota system, which covers all HFCs, will have a higher impact on some refrigerants and air conditioning systems than others.

Those systems which use a refrigerant with a higher GWP are likely to be impacted first as it is generally accepted that availability of refrigerants with a high GWP is likely to reduce substantially well before the date of the ban.

** Table from Environmental Investigation Agency report on HFCs.

In addressing the issue, the air conditioning industry has to take into account the need to meet the requirements of the F-Gas Regulation whilst still providing products which deliver the required cooling capacity in the occupied space.

The industry is unable to exceed their quota which means that there are essentially two main options; move towards using less of the same refrigerant; and/or reduce the GWP of the refrigerant being used.

There is clear commercial logic in producing lower GWP refrigerants and it is inevitable that over the next few years there will be options to consider around refrigerants and perhaps even changes to air conditioning systems. For example, A2L refrigerants, such as R32, are becoming more widely used. As with all refrigerants, these alternatives come with their own challenges.

For example, A2L refrigerants, are described as 'mildly flammable' but this is something which is common for most low GWP HFCs. What is important is that they are still a safe refrigerant and an F-Gas Certificate qualifies a contractor to use A2L refrigerants including R32.

The benefits to the industry however are significant, because as far as the quota is concerned R32 has a GWP of 675 compared with R410A's GWP of 2,088. In general terms A2L gases also produce better system efficiency, better low ambient heating performance, have a greater cooling capacity and a higher cooling efficiency which overall points towards increased performance over refrigerants such as R410A.

Other issues to consider when looking at alternative refrigerants include pressure requirements in the system as well as energy efficiency performance. The organisation for F-Gas certification, REFCOM, has already issued a warning over the misuse of refrigerants to minimise the incorrect use of alternative gases in air conditioning and refrigeration systems.

Before proceeding with any sort of replacement programme it is vital to ensure that a reputable and qualified air conditioning installer is overseeing the project.

Leak detection

Another major change is that of leak detection, and while it featured in the 2006 Regulation, and is therefore something which contractors are already very familiar with, the rules have been significantly tightened in the 2014 Regulation.

The main change is to the measurement terms. In the 2006 Regulation the thresholds for leak detection were based on the quantity of F-Gas measured in kg and mandatory leak checks were required on all systems containing more than 3kg of HFC refrigerant. Under the 2014 Regulation the thresholds have been changed to CO_2 equivalent which means that the 3kg threshold has been replaced with a threshold of 5 tonnes CO_2-eq. These new CO_2-eq size thresholds mean that the kg threshold for each refrigerant is different and refrigerants with a high GWP will have a lower size threshold than refrigerants with a low GWP.

This is a significant step that has an impact on a number of commonly-used refrigerants, including the popular R410A. ***The weights for R410A in kilogrammes compared to CO_2 - eq are as follows:***

R410A weights***

CO_2 - equivalent (R410A)	Weight in kg
5 tonnes CO_2 - eq	2.39kg
10 tonnes CO_2 - eq	4.78kg
50 tonnes CO_2 - eq	23.95kg
500 tonnes CO_2 - eq	239.46kg

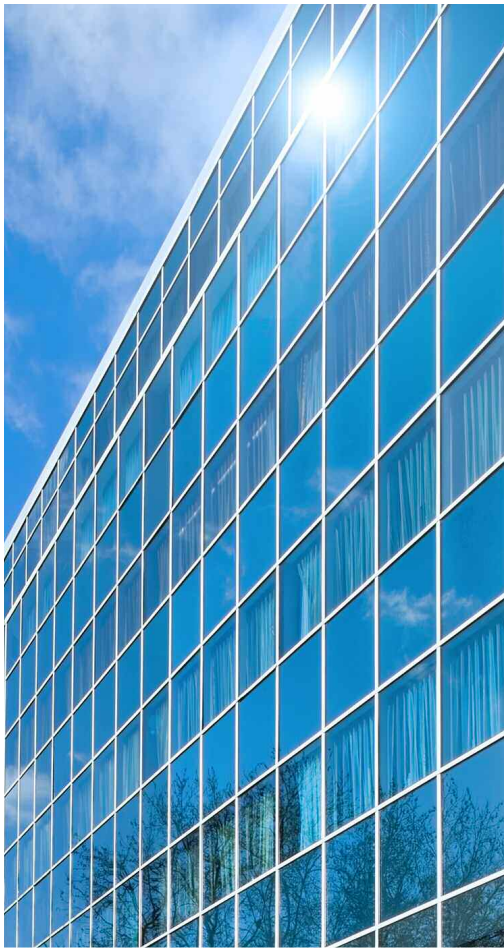
*** Area F-Gas Guide.

This means that R410A systems with a 24kg weight of refrigerant will fall into the 50 tonnes CO_2-eq bracket. So if such a system does not have fixed leak detection installed, it will have to be checked every six months. If leak detection is installed the checks must be carried out once a year.

For any type of equipment with 3kg of refrigerant or more, the new thresholds applied from 1st January 2015. There are some exceptions to this rule, for example, equipment with more than 3kg but less than 5 tonnes CO_2 - eq of refrigerant no longer had to be leak checked from 1st January 2015.

Equipment that contains less than 3kg but more than 5 tonnes CO_2 - eq of refrigerant will not be subject to leakage checking requirements until 1st January 2017.

AREA (Air Conditioning and Refrigeration European Association) has published a helpful table outlining the refrigerants that will be impacted by this change in terms of the frequency with which they must be checked:
www.area-eur.be



Planning ahead

Over the past few years, building owners have dealt with a lot of changes required by the F-Gas Regulation. For some this has been an opportunity to install new air conditioning systems; others have opted for replacement refrigerants.

Faced with further changes to the rules on HFCs, it may be a little overwhelming to consider yet more investment of time and money. However, it may be best at this point to review your air conditioning systems (in existing buildings) and take time to plan ahead. ***Mitsubishi Electric suggests the following steps, aimed at gathering information before making a decision:***

1

For new building projects this is a time to ensure that the designers have taken into account the F-Gas Regulation when specifying air conditioning or heat pump systems. It is important to consider if systems with the next generation of refrigerants or ones which use less refrigerant could be used.

It may be an opportunity to adopt a system such as the increasingly popular Hybrid VRF (HVRF) which typically uses 30-40% less refrigerant than a traditional VRF system as it employs water to carry heating and cooling around the building.

Under the new quota system, although HVRF technology utilises R410A which has a relatively high GWP, it still provides a significantly better alternative as a result of the requirement for less refrigerant and thus a lower CO_2 equivalent.

Alternatively, there is an opportunity to adopt a system which uses a very low GWP refrigerant such as an R32 split system. The benefit here is that R32 has a GWP of just 675 which is just one third of the GWP of R410A (2,088) and as a result these systems will also produce a significantly lower CO_2 equivalent.

2

For existing buildings, a review of air conditioning systems is vital if you do not already have the information to hand. In older buildings it's not uncommon to find a number of different systems and managers of multiple properties may find themselves with the same challenge.

Points to look out for are:

- What information do I have on my air conditioning system? For example, are there good service records (as required by law)?
- Am I sure I know what refrigerant is being used in all systems? For example, R22 was completely banned in 2015 (including refrigerant top-ups) so immediate action will have to be taken if this is found, and the system may need replacing. On the other hand, it is important to note that there is no planned phase out of R410A and therefore if you already have equipment installed, or in the process of being installed, you can be confident that it will be unaffected by the phase down in terms of maintenance, spares and system re-charge. Even after 2030 it will still be possible to use R410A although it is possible that supplies of this refrigerant will become limited.

3

Make a plan, working with your air conditioning service and maintenance contractor. The contractor will understand your obligations and help organise a planned approach to changes required by F-Gas Regulations.

It will be important to consider issues such as:

- What is happening to any reclaimed refrigerant from your systems? Refrigerants have a re-sale value that is rising, so make sure that this is clear on any contracts, or you may find it is no longer yours to use.
- Leakage of refrigerant is now covered by installation standards, and in some buildings you may need to fit leak detection (see the Mitsubishi Electric Guide on this topic). This is also a good strategy to reduce the amount of HFC you are using as lost refrigerant will be increasingly costly to replace.
- Energy efficiency is not specifically dealt with by the F-Gas Regulations, but a good survey of your equipment should include this factor. Older systems that are using unnecessary amounts of electricity will add to building operation costs, and also be more likely to break down. A review that highlights inefficiency could tip the balance towards a system replacement.

To receive a CPD seminar on Working with the F-Gas Regulations, you can call your Mitsubishi Electric Regional Sales Office to arrange an in-house presentation of this information.

If you would like to receive invitations to future CPD events, please email **livingenvironmentalsystems@meuk.mee.com**

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Effective as of January 2017