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Summary Guide to the new Leak Checking Requirements

[The F-gas Regulations¹](#) came into force on 1st January 2015. These Regulations are concerned with the **phase down** of F-gases and **preventing their release** into the atmosphere.

One method of preventing F-gas release is through periodic leak checking of equipment containing F-gas. Several new requirements relating to leak checking were introduced in the F-gas Regulation and are outlined in this document.

1. What Equipment needs to be Leak Checked?

Equipment containing F-gases in quantities of **5 tonnes of Carbon Dioxide (CO₂) equivalent (t CO₂ eq) or more must be leak checked.**

The CO₂ equivalent (CO₂ eq) of an F-gas is calculated by multiplying the mass in tonnes by the **Global Warming Potential (GWP)** of that gas.

For example, the tonnes CO₂ equivalent of 10 kg of HFC 404A is calculated as follows:

$$\begin{aligned}\text{CO}_2 \text{ equivalent} &= \text{mass (in tonnes)} * \text{GWP} \\ &= (.01) * 3,922 \\ &= 39.2 \text{ t CO}_2 \text{ eq}\end{aligned}$$

GWP compares the global warming potential of a gas to that of CO₂. CO₂ has a GWP of 1 and F-gases have high GWPs. The GWP of a range of gases is provided in table 2 below.

As the thresholds for obligations in the new Regulation are given in CO₂ equivalents, the European Commission has made [a calculation tool](#) available to translate tonnes CO₂ equivalents into metric tonnes.

Since the 1st January 2015 the scope of equipment which required leak checking has increased. Equipment now requiring leak checks is,

1. Stationary equipment² (i.e. refrigeration, air conditioning, heat pumps and fire protection equipment),

¹ [Regulation EU No. 517/2014](#) which came into force on 1st January 2015 and repealed F-gas Regulation EC No. 842/2006

² Stationary means not normally in transit during operations

2. refrigeration units of refrigerated trucks and trailers³,
3. electrical switchgear⁴
4. organic Rankine cycles⁵.

There are exemptions for leak checking electrical switchgear and fire protection equipment, which apply **if certain conditions are met**. Please refer to Article 4 of the F-gas Regulation or the Guidance Document titled "[Guidance Note for Contractors of Equipment Containing F-gases and ODS](#)".

2. How often does Relevant Equipment need to be Leak Checked?

The thresholds for frequency of leak checking under the 2014 F-gas Regulation are given in t CO₂ eq, whereas the threshold in the 2006 F-gas Regulation were given in Kg of F-gas. This change means that equipment containing F-gases with a higher t CO₂ eq require more frequent leak checking because of their higher GWP. This change in leak checking thresholds is to encourage the use of lower GWP alternatives. Newly commissioned equipment should be checked for leakage immediately after it has been put into service.

Table 1: Leak Checking Frequencies under the current F-gas Regulations

Quantity of gas (t CO ₂ eq)	F- gas Leak Checking Frequency	
	No equipment fitted	Leak detection equipment fitted
≤ 5	None	None
5 - 50	12 monthly	24 monthly
50 - 500	6 monthly	12 monthly
≥ 500	3 monthly	6 monthly

The change from leak checking based on charge (in kg) to leak checking based on CO₂ equivalent is to encourage the use of lower GWP alternatives.

Hermetically sealed equipment containing less than 10 t CO₂ eq is not subject to leak checking provided the equipment is labeled as being hermetically sealed.

Automatic Leak Detection

Operators⁶ of stationary equipment (i.e. equipment not normally in transit during operations including refrigeration, moveable and fixed air conditioning, heat pumps and fire protection equipment) containing F-gas in quantities greater than **500 t CO₂ eq** must provide **automatic leakage detection systems**⁷ which alerts the operator or a service company of any leakage. Operators of

³ A motor vehicle with a mass of more than 3.5 tonnes that is designed and constructed primarily to carry goods and that is equipped with a refrigeration unit.

⁴ Electrical 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 usage in connection with the generation, transmission, distribution and conversion of electric energy.

⁵ A cycle containing condensable F- gas converting heat from a heat source into power for the generation of electric or mechanical energy.

⁶ The operator is defined in the F-gas Regulation as "*the natural or legal person exercising actual power over the technical functioning of products and equipment covered by this Regulation*". As a starting point the owner should assume responsibility for operator obligations under the F-gas Regulation unless it is confirmed that the operator obligations have been transferred to a third party.

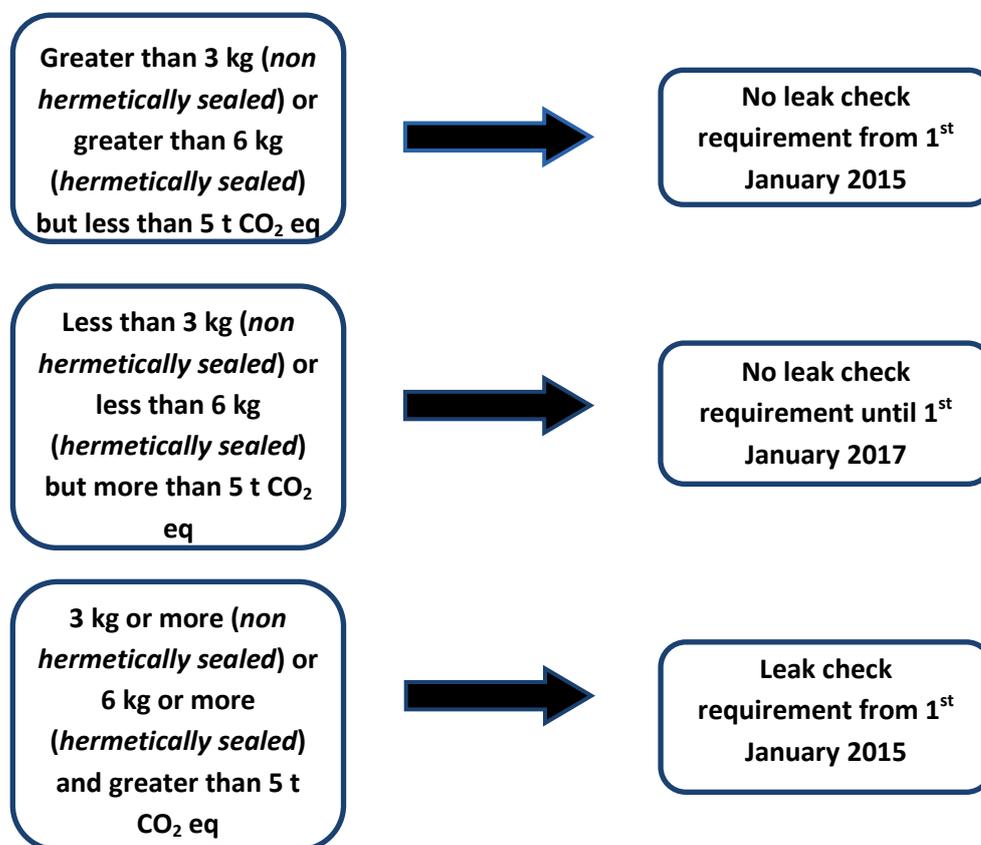
⁷ Leakage detection system means a calibrated mechanical, electrical or electronic device for detecting leakage of fluorinated greenhouse gases which, on detection, alerts the operator.

electrical switchgear and organic Rankine cycles containing F-gas in quantities greater than **500 t of CO₂ eq** and installed from 1st January 2017, must also provide automatic **leak detection**. Leakage detection systems installed on stationary equipment and organic Rankine cycles must be **checked** at least **once every 12 months** to ensure their proper functioning. Leakage detection systems installed on electrical switchgear must be **checked** at least **once every 6 years** to ensure their proper functioning. It is recommended that leak detection systems are installed in plant rooms where possible to ensure that operators are alerted of leaks once detected.

There is an **exemption** in relation to small charge equipment, as follows:

The repealed F-gas Regulation ([EC Regulation 842/2006](#)) leak checking regime for **small charge equipment** continues until 31st December 2016, i.e. leak checking is not required for non-hermetically sealed⁸ equipment containing less than 3 kg and hermetically sealed equipment containing less than 6 kg - regardless of the GWP. From 1st January 2017 relevant small charge equipment must be leak checked in accordance with Table 1.

In Summary, this means:



The change from leak checking based on charge (in kg) to leak checking based on GWP (in CO₂ eq) means that some equipment containing F-gas, which would previously have been exempt, is now subject to leak checking. For example:

- Equipment containing just 1.27 kg of R410A will now need to be leak checked (1.27 kg of R404A is equal to 5 tonnes of CO₂ equivalent) - but as it is less than 3 kg leak checking will not be required until 1st January 2017.

⁸Equipment with an airtight seal.

On the other hand equipment currently liable to regular leak checks may fall below the minimum threshold. For example:

- The minimum R32 charge, subject to leak checking, increases from 3 kg to 7.41 kg.

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. The cause of a leakage should be identified in order to avoid recurrence. A follow-up check must be carried out any time within **1 month** of the repair to verify that the repair has been effective.

3. How to Calculate GWP and CO₂ Equivalent in Tonnes for your F-Gas Equipment

Table 2 provides the conversion from CO₂ eq to kg for the most commonly used F-gases (both pure and blends). This table provides the charge in F-gas equipment (in kg) which equates to 5, 50 and 500 t CO₂ eq and should be used to determine the frequency at which equipment requires leak checking. Alternatively [a calculation tool](#) to translate tonnes CO₂ equivalents into metric tonnes can also be used. F-gases marked **Red** in Table 2 are subject to the leak checking exemption (i.e. for small charge equipment leak checking is not required until 1st January 2017).

Table 2: Conversion from CO₂ eq to weights by threshold for the most commonly used F-gases (both pure and blends) - rounded to one decimal place

F-gas	GWP	5 t CO ₂ eq (in kg)	50 t CO ₂ eq (in kg)	500 t CO ₂ eq (in kg)
SF ₆	22,800	0.2	2.2	22
R23	14,800	0.3	3.4	33.8
R32	675	7.4	74.1	740.8
R41	92	54.4	543.5	5,434.8
R125	3,500	1.4	14.3	142.9
R134	1,100	4.6	45.5	454.5
R134a	1,430	3.5	35.0	349.7
R143	353	14.2	141.6	1,416.4
R143a	4,470	1.1	11.2	111.9
R152	53	94.3	943.4	9,434.0
R152a	124	40.3	403.2	4,032.3
R161	12	416.7	4,166.7	41,666.7
R227ea	3,220	1.6	15.5	155.3
R236cb	1,340	3.7	37.3	373.1
R236ea	1,370	3.7	36.5	365.0
R236fa	9,810	0.5	5.1	50.1
R245ca	693	7.2	72.2	722.0
R245fa	1,030	4.9	48.5	485.4
R365mfc	794	6.3	63.0	630.0
R43-10mee	1,640	3.0	30.5	304.9
R404a	3,922	1.3	12.7	127.5
R407a	2,107	2.4	23.7	237.3
R407c	1,774	2.8	28.2	281.9
R407d	1,627	3.1	30.7	307.3
R407f	1,825	2.7	27.4	274.0
R410a	2,088	2.4	24.0	239.5
R417a	2,346	2.1	21.3	213.1
R422a	3,143	1.6	15.9	159.0
R422d	2,729	1.8	18.3	183.2
R423a	2,280	2.2	21.9	219.3
R424a	2,440	2.0	20.5	204.9

F-gas	GWP	5 t CO ₂ eq (in kg)	50 t CO ₂ eq (in kg)	500 t CO ₂ eq (in kg)
R426a	1,508	3.3	33.2	331.6
R427a	2,138	2.3	23.4	233.9
R428a	3,607	1.4	13.9	138.6
R434a	3,245	1.5	15.4	154.0
R437a	1,805	2.8	27.7	277.0
R438a	2,265	2.2	22.0	220.8
R442a	1,888	2.7	26.5	264.8
R449a	1,397	3.6	35.8	357.9
R507	3,985	1.3	12.5	125.5
R508a	12,214	0.4	3.8	37.8
R508b (Suva 95)	13,396	0.4	3.7	37.3
R508b ISCEON MO89	3,805	1.3	13.1	131.4

 Pure F-gases  Blends

Example GWP Calculation

GWPs for common F-gases are included in Table 2. If equipment contains an F-gas which is not included in Table 2 then the GWP can be calculated using the formula provided below.

Example:

F-gas blend: HFC 404a

Comprised of:

- 44% HFC 125
- 52% HFC 143a
- 4% HFC 134a

The percentage of each gas in an F-gas blend can usually be found online in the Safety Data Sheet for the F-gas in question (see below an extract from a Safety Data Sheet for HFC 404a).

Table 3: Composition of R404a

<u>INGREDIENT NAME</u>	<u>CAS NUMBER</u>	<u>WEIGHT %</u>
Pentafluoroethane (HFC-125)	354-33-6	44
1,1,1-Trifluoroethane (HFC-143a)	420-46-2	52
1,1,1,2-Tetrafluoroethane (HFC-134a)	811-97-2	4

Formula

$$[(\text{Gas 1 \%} \times \text{GWP of Gas 1}) + (\text{Gas 2 \%} \times \text{GWP of Gas 2}) + (\text{Gas 3 \%} \times \text{GWP of Gas 3}) + \dots] \div 100$$

So for HFC 404a the GWP is calculated as follows:

$$[(44 \times 3,500) + (52 \times 4,470) + (4 \times 1,430)] \div 100$$

$$= [154,000 + 232,440 + 5,720] \div 100$$

$$= \text{GWP of } \underline{\underline{3,922}}$$

Example CO₂ Equivalent Calculation

Once the GWP has been calculated the weight (in kg) of the F-gas equating to 5, 50 and 500 tonnes of CO₂ equivalent can be calculated.

Example:

F-gas blend: HFC 404a

GWP = 3,922

$$\begin{aligned} 5 \text{ Tonne CO}_2 \text{ equivalent} &= \text{No. of tonnes} \times \frac{1}{GWP} \times 1,000 \\ &= 5 \times \frac{1}{3,922} \times 1,000 = 1.27 \text{ kg} \end{aligned}$$

To get the 50 tonne equivalent simply multiply the 5 tonne equivalent by 10 (i.e. 1.27 x 10 = 12.75 kg).

To get the 500 tonne equivalent multiply the 5 tonne equivalent by 100 (i.e. 1.27 x 100 = 127 kg).

Once the GWP has been calculated the weight (in kg) of the F-gas equating to 5, 50 and 500 tonnes of CO₂ equivalent can be calculated.

[Annex I](#) of the F-gas Regulation contains the GWP for common pure F-gases. [Annex IV](#) contains GWPs for common non F-gas substances which are commonly used in F-gas blends.

As mentioned in Section 1, the thresholds for obligations in the new Regulation are given in CO₂ equivalents, [a calculation tool](#) is being made available to translate tonnes CO₂ equivalents into metric tonnes

4. What Records are Required?

Operators of F-gas equipment which requires leak checking must establish and maintain records for each piece of equipment.

The records must include:

- The name, postal address and telephone number of the operator.
- The quantity and type of F-gas refrigerants installed in each system.
- Any quantities of refrigerant added during installation, maintenance or servicing or due to leakage).
- Whether the quantities of installed fluorinated greenhouse gases have been recycled or reclaimed: If so, must also be recorded:
 - The name and address of the recycling or reclamation facility
 - If applicable, the certificate number
- The quantity of refrigerant recovered during servicing, maintenance and final disposal
- The identity of the company or personnel who installed, serviced, maintained and where applicable repaired or decommissioned the equipment, including, where applicable, the number of its certificate.
- Dates and results of leak checks and rechecks after repairs.
- If the equipment is decommissioned, the measures taken to recover and dispose of the F-gas refrigerant.
- Details of automatic leak detection systems, including results of annual/6 yearly checks for effectiveness.

For equipment containing F-gas operators must retain the applicable records for at least **five years**. The company or personnel, who installed, serviced, maintained and where applicable repaired or

decommissioned the F-gas equipment must also retain the applicable records (see above) for at least **five years**.

An example record sheet is included in Appendix 7 of the Guidance Note titled "[Guidance Note for Operators of Equipment Containing F-gases and ODS](#)"

5. Who Can Perform Leak Checking?

Only appropriately certified persons can conduct leak checking. This means that the appropriate City and Guilds certification or the appropriate FETAC (now QQI) course is required. Detailed information on training requirements for equipment covered by the F-gas Regulation is included in Guidance Notes titled "[Guidance Note for Operators of Equipment Containing F-gases and ODS](#)" and "[Guidance Note for Contractors of Equipment Containing F-gases and ODS](#)".

Further information is available as follows:

Environmental Protection Agency

Guidance on the F-gas regulation, key changes, seminar presentations on the new F-gas regulations and the EU F-Gas Regulation 517/2014 are available from the EPA website (www.epa.ie) at the following link:

<http://www.epa.ie/air/airenforcement/ozone/reviewofthef-gasregulation/>

or from:

Resource Use Unit, *Environmental Protection Agency, Regional Inspectorate, McCumiskey House, Richview, Clonskeagh Road, Dublin 14*, www.fgases.ie Lo Call 1890 33 55 99

QQI/FETAC

The Further Education and Training Awards Council in Ireland (FETAC) developed national standards equivalent to the City and Guilds F-gas qualifications that have been developed in the UK. These courses have been assessed as Level 5 FETAC Award courses and the FETAC course developed for the refrigeration and air conditioning sector is the Special Purpose Certificate in Handling F-gas Refrigerants 5S0108. The functions of FETAC were taken over by Quality and Qualifications Ireland (QQI).

For more information on FETAC courses see: www.qqi.ie

European Commission

Information for technicians and users of refrigeration, air conditioning and heat pump equipment containing fluorinated greenhouse gases http://ec.europa.eu/clima/policies/f-gas/docs/f-gas_equipment_operators_en.pdf

UK Government

Guidance on the F-gas Regulations for users, producers and traders

<https://www.gov.uk/government/collections/eu-f-gas-regulation-guidance-for-users-producers-and-traders>

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