**FAQ Refrigerants**
**May 2020**

The EU F-Gas regulation and the effects on environmental simulation often cause uncertainty of users and owners of test instruments. Here are some answers to the most common questions.

**Links and videos:**
https://youtu.be/OdZTCsjqfNI (EU refrigerant regulation and environmental simulation systems)
https://youtu.be/jS4YV_O9XGU (WT69)
https://www.weiss-technik.com/en/f-gase-faq/ (information about refrigerants)
https://www.german-innovation-award.de/en/winners/preis/gewinner/kaeltemittel-wt69-r469a-1/

**What is weisstechnik's position on the EU regulation of refrigerants?**
We recognized the effects of the F-Gas regulation (EU) No. 517/2014 early and acted accordingly. In 2016 we were the first supplier of environmental simulation systems to offer a product - ClimeEvent - with the more environmentally friendly refrigerant R449A (GWP 1397). Since 2018 all standard products have been converted to R449A. In the extended temperature range down to -70°C, we have developed an alternative to R23 with partners: WT69 / R469A.
The EU quota system applies to all refrigerants users in Europe. Weiss Technik has sufficient refrigerant quota for production and service. We have ensured the supply of refrigerants through long-term supply contracts, own stock and recycling.

**Will there be a replacement for R23?**
Yes. weisstechnik uses the new refrigerant WT69 / R469A for the temperature range down to -70°C. It replaces R23 in our systems without any restrictions in performance. All existing test profiles can be used. WT69 / R469A has 90 percent less global warming potential than R23 and a GWP of 1357. Up to a filling quantity of 3.6kg, the mandatory leakage test is therefore not required. Devices with WT69 / R469 can also be filled with R23 in an emergency. The components used in the refrigeration circuit are identical.

**What is the GWP and how is it calculated?**
In order to be able to classify the harmfulness of the refrigerants, they are compared to the greenhouse gas CO2. The resulting GWP value (Global Warming Potential) indicates the factor a substance adds to global warming more than CO2. This is called the CO2 equivalent. For example: R404A has a GWP value of ≈ 3900. One kilogram of released R404A corresponds to the influence of ≈ 3900 kg CO2 in the atmosphere.

**Why did the prices for refrigerants increase so much?**
The EU has adopted a quota system for the total amount of fluorinated greenhouse gases produced and imported in the EU. Since 2015 the allowable amount (in terms of CO2 equivalent) decreases every year. For 2019 only two thirds of the quantity available in 2015 are allowed. By 2030, the allowed amount will fall to 20%. This shortage is leading to increased prices, especially for high GWP refrigerants.

**Do I have to retrofit my equipment?**

All fluorinated or chlorinated refrigerants with an ODP (ozone-damaging) are no longer permitted and must be replaced. For refrigerants with a GWP >2500, stricter rules will apply from 2020. For example, in case of repair a quantity of more than 10kg R404A may only be replaced by recycled R404 (40t CO2 equivalent). From 2030 on, no refrigerant with GWP > 2500 may be refilled.

In the event of a repair we convert R404 in existing systems to R452A. There are only a few technical changes needed. The Weiss Technik Service advises in individual cases.

**What about CO2?**

CO2 is a very potent refrigerant for temperatures down to -45 °C. From -56 °C it becomes solid (snow).

For Weiss technology, CO2 is neither an alternative to R449A nor to R23, because cooling-circuit components for climatic cabinets is too costly and low temperatures cannot be reached or are not reached fast enough. For walk-in chambers, CO2 is an option because the technical effort is less significant.

At the moment there are almost no standardized, tested components for CO2. Often a standstill cooling is necessary because the pressure in the system at 30 °C ambient temperature would rise to over 70 bar. Alternatively, very large pressure-compensation tanks are needed. Heat compensation below -45 °C is very low when using CO2.

Weiss Technik offers the right refrigeration system for every chamber size and every performance requirement.

**Which other refrigerant alternatives are there?**

The temperature range down to -70°C is perfectly covered with R449A and R469A / WT69. Weisstechnik continues to conduct intensive research with partners to find alternatives to refrigerants for the temperature range down to -80°C and for conversions.

We always select the best available refrigerant for customized systems. We pay close attention to the safety and practicability of the substances. In our opinion, refrigerants must not be flammable (not even when leaking), non-toxic and non-corrosive. At the same time, plant safety must be guaranteed. High pressure, de-oiled compressors, special lubricants etc. are not an option for our standard systems.

Thus, many organic substances (ethane, etc.) are no alternative for us. The same applies to mixtures such as R1234yf, which becomes flammable in the event of leakages. Nitrous oxide (N2O) is not an alternative because of the corrosive effect and the need for special compressor oils.

Weiss Technik relies on R449A and WT69 / R469A R23 (for -70 °C) for standard cabinets.

For large systems and walk-in chambers, more and more cascades with R134a and CO2 are being used. The more complex technology for the CO2 cascade often pays off because of the reduced energy requirement. Ammonia can be an alternative too.

**Which rules apply to leakage tests?**

Since 2017, leakage tests are mandatory and dependent on the CO2 equivalent. From 5t CO2 equivalent, an annual test is required (e.g. 1.25 kg R404A). The period to the next leakage test can be extended by installing an automatic leak monitoring system.

The leakage test is also recommended by DIN EN 378-4. In this standard, the amount of refrigerant is relevant. From 3 kg of any refrigerant an annual test is required, from 30kg half-yearly, from 300kg quarterly.

The "permitted" leakage rate depends on the amount of refrigerant and the production date of the system. Example: A system with up to 10 kg of refrigerant and construction after June 2008 may still lose 3% of refrigerant per year. Our systems are leak-tight.

# GENERAL POINTS

## 1. What is the F-gas Regulation?

"The objective of this Regulations is to protect the environment by reducing emissions of fluorinated greenhouse gases (including refrigerants). Accordingly, this Regulation:
a) establishes rules on containment, use, recovery and destruction of fluorinated greenhouse gases, and on related ancillary measures;
b) imposes conditions on the placing on the market of specific products and equipment that contain, or whose functioning relies upon, fluorinated greenhouse gases,
c) imposes conditions on specific uses of fluorinated greenhouse gases, and
d) establishes quantitative limits for the placing on the market of hydrofluorocarbons."[1]

## 2. Why are climate chamber operators affected?

Climate chambers are cooled by refrigerants which consist of hydrofluorocarbons and are thus subject to the F-gas Regulation. As an operator of such a system, you are legally obliged to implement the Regulation in a technically correct manner.

## 3. Which refrigerants are affected?

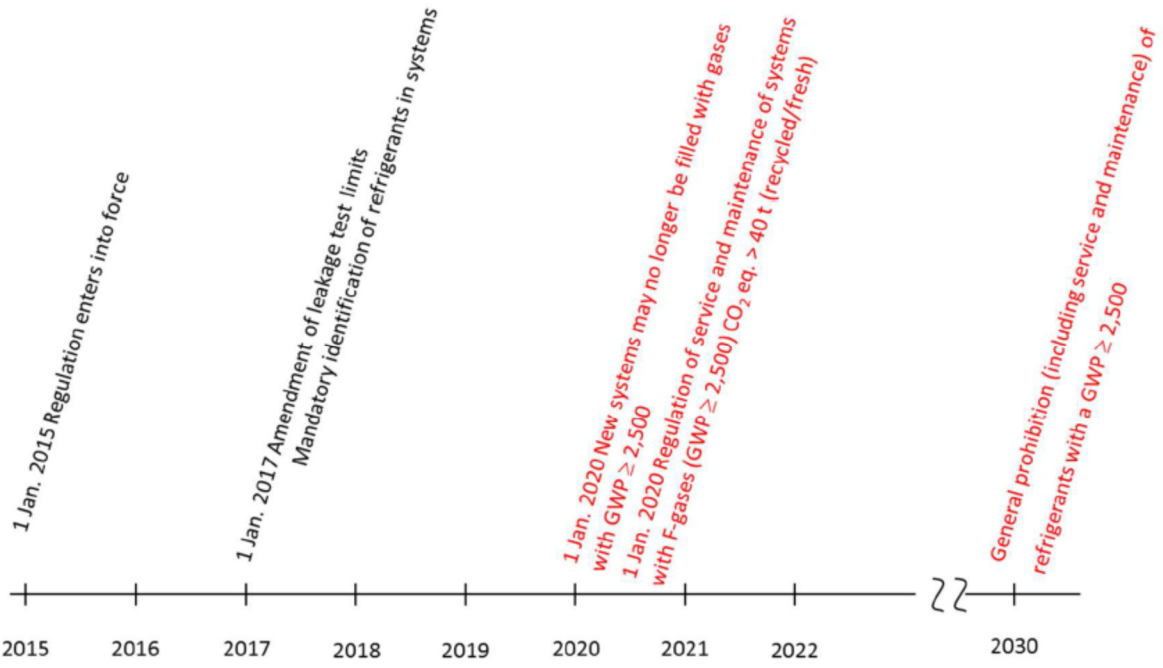
The Regulation contains a classification system that specifies which refrigerants must be replaced due to their potentially detrimental properties. In the case of environmental simulation systems, this predominantly refers to R404A and R507.
Thanks to an exemption in the field of environmental simulation, R23, which is also used, is not affected (see 4.). R134a, which is used to some extent, is also exempted from the Regulation.

## 4. What relevance does the GWP value have?

To determine the harmfulness of refrigerants, they are compared to the greenhouse gas $CO_2$. The resulting value, which is referred to as GWP (Global Warming Potential), indicates the factor by which the substance's potential effect on global warming is higher than that of $CO_2$. This is referred to as the $CO_2$ equivalent.
For example: R404A has a GWP of ≈ 3,900, i.e. one kilogram of R404A that is released into the atmosphere has the equivalent harmful effect of ≈ 3,900 kg $CO_2$.

[1] Article 1 Chapter 1 of Regulation (EU) No 517/2014 of the European Parliament and the Council of 16 April 2014.

## 5. From which date onwards will the Regulation affect operators?




As of 1 January 2017:

All new and existing systems are subject to the amended regulations for leakage tests. Depending on the CO2 equivalent of the respective refrigerant, leakage tests may be mandatory with immediate effect – even in the case of smaller fill quantities. The following table shows the limits above which leakage tests will be mandatory in the future:

| Refrigerant | GWP | Maximum amount of refrigerant in the system without mandatory leakage test |
|---|---|---|
| R134a | 1430 | 3,5 kg |
| R449A | 1397 | 3,58 kg |
| R452A | 2141 | 2,34 kg |
| R404A | 3920 | 1,28 kg |
| R507 | 3990 | 1,25 kg |
| R23 | 14800 | 0,34 kg |
| R469A | 1357 | 3,6 kg |

All new and existing systems with refrigerant volumes above the forenamed limits must be tested for leak tightness at regular intervals.

As of 1 January 2020:
Refrigerants in **new systems** may not exceed a GWP of 2,500. Regulation (EU) No 517/2014 does not specify any limits regarding the fill quantity. Devices and systems that generate test chamber temperatures below -50 °C are exempted; these systems generally use the refrigerant R23 which is not covered by the Regulation.
**Existing systems** may continue to operate after 2020, irrespective of the refrigerant used. The exception are systems that use R404A in a fill quantity above 10 kg: When serviced, they must be refilled with recycled R404A.

Until 31 Dec. 2030:
**Existing systems,** using 10 kg or less of refrigerant R404A may be refilled with fresh, i.e. new R404A when they are serviced.

As of 1 January 2030:
**Existing systems** must be changed over to an alternative refrigerant when they are serviced.

## 6. Does the operator have to pass additional leakage tests?

As explained under 5, all systems that exceed a certain fill quantity are affected. Operators are responsible for commissioning and/or performing the leakage test. Depending on the refrigerant quantity, the test cycle may range between 3 and 12 months. Where automatic leakage systems are used, the intervals are twice as long.
Leak tightness tests must be carried out at or above the following refrigerant quantities:

| Fill quantity ($CO_2$ equivalent) | Without automated leakage detection | With automated leakage detection |
|---|---|---|
| **5 t to 50 t**<br>(R404A 1.25 kg to 12.5 kg)<br>(R23 0.33 kg to 3.3 kg) | every 12 months | every 24 months |
| **50 t to 500 t**<br>(R404A 1.25 kg to 12.5 kg)<br>(R23 0.33 kg to 3.3 kg) | every 6 months | every 12 months |
| **> 500 t**<br>(R404A > 125 kg)<br>(R23 > 33 kg) | every 3 months | every 6 months |

## 7. Can automatic leakage monitoring help?
Leakage monitoring of cooling devices prevents undetected effluence of refrigerants and indicates leakages at an early stage. On principle, the installation of leakage monitoring systems does not replace leakage tests. However, the prescribed test cycle can be extended to twice its length.

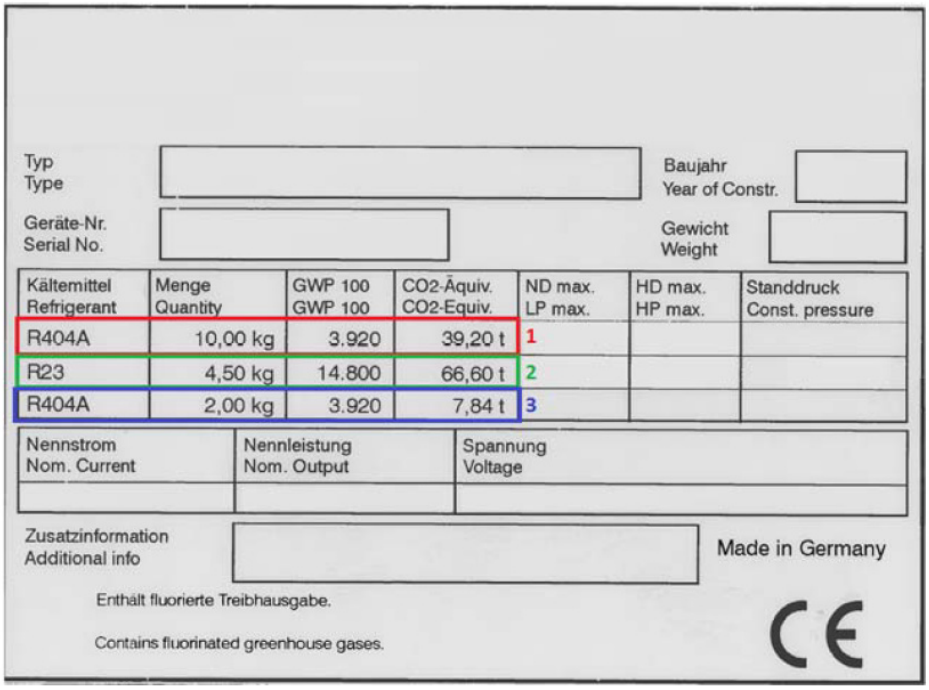
### 8. What other formal consequences are there for operators?

Operators of refrigeration systems are required to have a comprehensive chain of evidence for the quantity of purchased refrigerant and its use. This comprises the duty to hold evidence and documentation regarding the entire life cycle of the system. One way of ensuring such documentation is the **weiss**technik® log book which we provide free of charge.

## REFRIGERANTS BY WEISSTECHNIK®

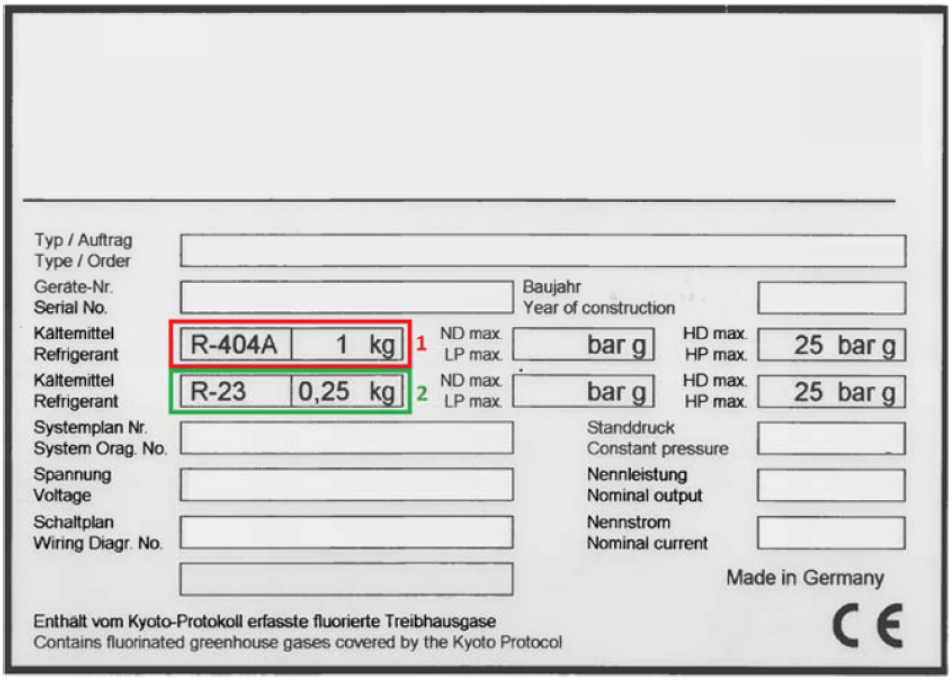
### 1. How much refrigerant is used in **weiss**technik® systems?

**New systems and system produced after January 1st 2016**: The refrigerant quantity, the GWP and the CO2 equivalent are all specified in the technical documentation of the respective system. Please do not hesitate to ask your contact at **weiss**technik for further information regarding the refrigerant quantity.
Information regarding the refrigerant values is also specified on the system's identification plate:




The system shown here has a refrigeration system which is composed of 3 parts. Since no CO2 equivalent smaller than 5 tons has been installed in any of the circuits, all 3 circuits must be tested for leaks. Due to the capacity of the ultra-low temperature circuit (R23) and the resulting CO2 equivalent of >50 t, a leakage test needs be carried out for this circuit every 6-months. The other two circuits fall below the 50 t limit and must therefore only be checked annually.

**Existing systems and systems produced before January 1st 2016:** Information regarding the refrigerant quantity is specified on the system's identification plate:




The cooling circuits are listed separately here. In this example, there are two circuits, one for pre-cooling (R404A) and one for deep-temperature cooling (R23). The CO2-equivalents are calculated:

Pre-cooling (R404A): $m_{CO2,VK} = GWP_{R404A} \times m_{R404A} = 3920 \times 1\ kg = 3920\ kg$

Low-temp-cooling (R23): $m_{CO2,TK} = GWP_{R23} \times m_{R23} = 14800 \times 0{,}25\ kg = 3700\ kg$

In the above example, therefore, both refrigeration circuits would be below the 5 t limit set out in Regulation (EU) No 517/2014. The device would thus be subjected to no cyclic leakage test. However, since both refrigeration circuits are considered separately, it may happen that, although the pre-cooling stage is below the limit of 5 t, the deep-freezing stage is not. In this case, a cyclic leakage test for the deep-freeze cycle according to the pattern described above is required.

The refrigerant amounts are also listed in the system's technical documentation which was included at the time of delivery. If the technical documentation is not available anymore, please request a copy from your contact at weisstechnik.

2. Our alternatives to R404A:
   a. Existing systems: R452A (GWP of 2,141):

R452A was developed as an alternative for low temperature applications and is below the required GWP limit. Its thermodynamic properties largely correspond to R404A. For all weisstechnik® systems, R452A is suitable as a direct replacement (so-called drop-in).

Similar to R404A, R452A is neither flammable nor toxic. Changes in the safety assessment are thus not necessary either for existing or for new systems.

### b. New systems including and after ClimeEvent: R449A (GWP 1,397):

Its very low GWP makes R449A the first choice as substitute refrigerant in weisstechnik®'s forward-looking strategy. However, since the thermodynamic performance figures deviate from R404A, adjustments of the refrigeration technology are necessary to guarantee the systems' extensive performance range. The use of R449A is thus expedient in new systems only.
Again, R449A is neither flammable nor toxic. Changes in the safety review are thus not necessary either for existing or for new systems.

## 3. Do the alternative refrigerants have any disadvantages?

Due to their low market spread, alternative refrigerants currently have a higher purchase price. However, in the course of the Europe-wide conversion to the new refrigerants, prices will assimilate.
The performance parameters of the new alternative refrigerants are different from R404A. To meet the high performance requirements of our systems, adjustments of the refrigeration technology are necessary. These adjustments have been tested in great detail over the last few years, both in internal and in field tests. There will be no loss of performance.
The new alternative refrigerants meet the published performance parameters of the weisstechnik® systems.