
# New weisstechnik $CO_2$ refrigeration technology with GWP 1

## Fact sheet

According to the Paris Agreement of December 12, 2015, global warming should be limited to below 1.5 °C. The goal of the F-Gas Regulation is to primarily use alternatives with a lower impact on the climate or natural refrigerants with a very minimal effect.

Greenhouse gases have different levels of global warming potential (GWP). The climate impact of carbon dioxide (GWP of $CO_2$ equals 1) is used as a benchmark, i.e. the global warming potentials of other substances are measured relative to $CO_2$. The GWP value/ $CO_2$ equivalent indicates the greenhouse potential of a substance and, therefore, its contribution to the warming of the lower atmosphere.

As a result, F-gases significantly contribute to climate change. They are primarily used in air conditioning systems, refrigeration systems, heat pumps, foam production processes, and as propellants in aerosols. They are also used as refrigerants in many environmental simulation systems (for example the previously used R404A or R23).

A new revision of the European F-Gas Regulation came into force on March 11, 2024. The revision of the regulation has a major impact on environmental simulation systems. The transition period for the new regulation until January 1, 2025, is also quite short..

**Key Facts:**

- From 01.01.2025, a GWP <150 applies for most test chambers.
- Only R744 ($CO_2$) with a GWP = 1 can be used
- Our $CO_2$ systems provide powerful cooling down to -50 °C
- No changes to the infrastructure necessary
- Reduced power consumption & operating noise

## The F-Gas amendment and its consequences

The phase-down will reduce the availability of F-gases in the EU internal market. The new version from 2024 significantly tightens the phase-down. The amount of F-gases available will be reduced to a greater extent than originally specified. All F-gases are affected by the phase-down. In recent years, for example, we have seen how the phase-down of R23 has caused market prices to skyrocket.

At Weiss Technik, we aim to develop efficient and environmentally friendly test chambers. As a result, we are the first to supply our test chambers with R-449A refrigerant as of January 1, 2018, and R-469A for freezer refrigeration as of 2020, in order to reduce the GWP of the refrigerants used as much as possible. Now we are going one step further and completely replacing F-gases for many applications.

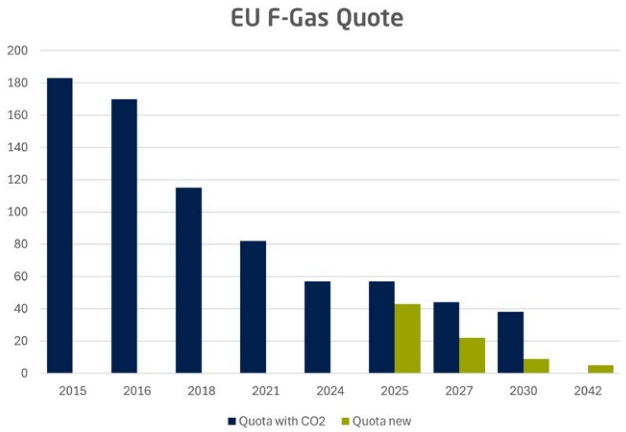



*Figure 1: Development of the EU F-gas quota since 2015*

## R744 ($CO_2$) is the future

In the natural refrigerant category, only flammable refrigerants and $CO_2$ (R744) have a GWP <150. Since the temperature and climatic test chambers contain heating elements in addition to a refrigeration machine, flammable refrigerants must be excluded for safety reasons. This is especially true for applications involving flammable materials or lithium-ion batteries.

In recent years, we have relied on $CO_2$ for large-scale systems. Advances in technology mean that we can now use $CO_2$ for small test chambers. Weiss Technik $CO_2$ refrigeration systems are certified in accordance with CE and the Pressure Equipment Directive.

Devices and systems for environmental simulation tests traditionally cool down to -40 °C (single-stage) or -70 °C (cascades). As of January 1, 2025, Weiss Technik will replace single-stage test chambers with $CO_2$ systems.

The existing single-stage cooling systems with R449A achieve a minimum temperature of -40 °C; however, their technology means that cooling performance slows down at around -25 °C, making them unsuitable for many applications down to -40 °C. Our $CO_2$ systems can cool down to -50 °C more efficiently with the same or improved heat compensation. Their performance is therefore between that of single stage test chambers and cascade systems.

For this reason, we are going to change the way the chambers are used. Test chambers with a cascade and F-gases are only used where they are absolutely necessary. In many applications, $CO_2$ test chambers from Weiss Technik will meet this requirement.

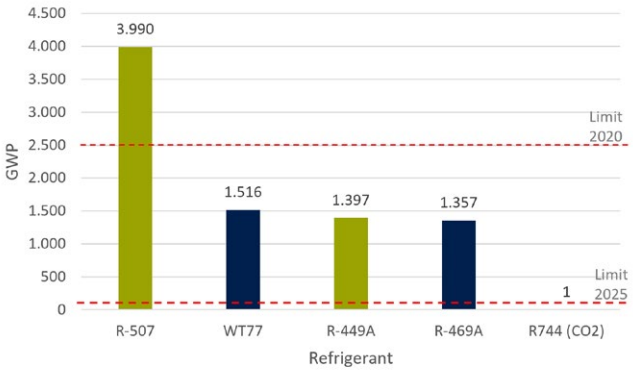



*Figure 2: GWP value of the relevant refrigerants and future limits*

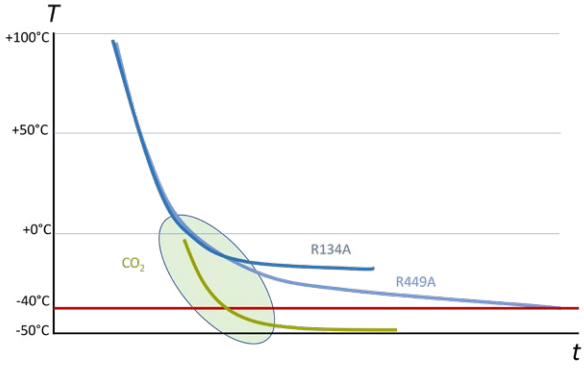
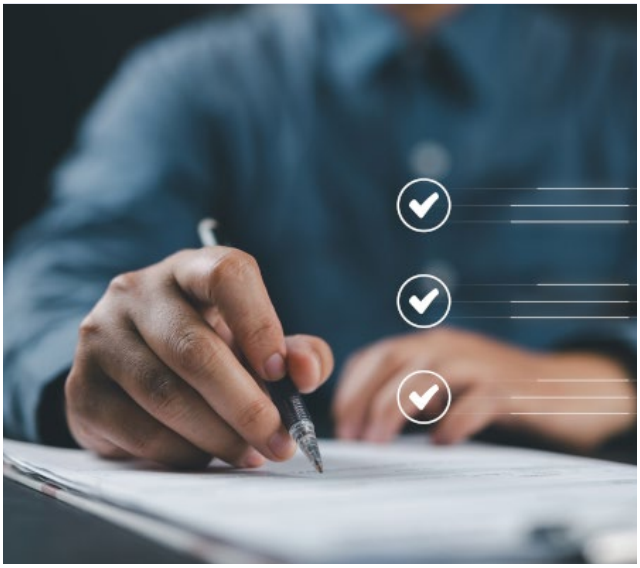



*Figure 3: Temperature change rate of refrigerant*

## New refrigerant technology - few changes to the installation site.

The $CO_2$ test chambers require almost no changes to the installation location. Like your existing Weiss Technik test chambers, the $CO_2$ test chambers are developed for a maximum ambient temperature of 10 °C to 35 °C. Standstill cooling, cold water brine or a water-glycol auxiliary circuit are not required. Water-cooled systems can continue to utilize cooling water in the temperature range of 12 °C to 28 °C as before. The only change is the use of an RCD residual current circuit breaker (RCD). It should be noted here that a connection to an RCD residual current circuit breaker < 300 mA cannot be made.



## Documentation requirements and security.

In most cases, $CO_2$ test cabinets do not require any additional safety equipment. Leak detection as part of the F-Gas Regulation is not required, as $CO_2$ is not classified as an F-gas. However, the DIN EN 378-4 Industrial Safety Regulation requires an annual leak test to be carried out for filling quantities of 3 kg or more. However, most of our test chambers have a filling quantity of less than 3 kg. According to DIN EN 378-4, the limit value for refrigeration systems is 0.07 kg/m$^3$ $CO_2$. For a room measuring (LxWxH) 10x10x2.5 m, 17.5 kg of refrigerant may be present in the test chambers in order to exceed the limit value. For the majority of our test chambers, they are below the limit value of 3 kg.


## What does this mean for your existing equipment that uses F-gases?

There is no time limit on the use of your existing test chambers.

However, for test chambers with a minimum temperature > -50 °C, no new refrigerant with a GWP >2500 may be used for service and maintenance work from 2025 (e.g. R404A). Alternatively, we can only offer recycled refrigerant. From 2030, the use of recycled refrigerants (GWP>2500) will also be prohibited. We offer R452A as a drop-in solution for this. From 2032, the GWP limits will be tightened again. A further change that has been in force since March 2024: a further leak test is required at least 24 hours to a maximum of 30 days after a leak has been repaired for systems with >5 tonnes of $CO_2$ equivalent.

## The Weiss Technik CO2 equipment - the future of safe environmental simulation!

Both with the minimum test temperature of -50 °C and in terms of performance, Weiss Technik test chambers with $CO_2$ are positioned between the previously common single-stage system (down to -40 °C) and cascades (down to -70 °C).

Cascades with a minimum temperature of -70 °C are used for many tests, e.g. in the electronics industry or in the automotive sector. This is not because the final temperature is required, but because power reserves must be available at classic test temperatures of around -40 °C (e.g. heat-emitting test material).

If a final temperature of < -50 °C is not required and the heat compensation of the $CO_2$ system is sufficient, these will be able to fulfil the testing tasks of the cascades in future, often at lower investment and operating costs.

In IEC 60068-2-14 Nb (LV124 L-03), for example, change rates of 5 K/min are often required. The 1000 litre test chamber with $CO_2$ and 10 K/min (C2/1000/50/10) can be used for this without any problems and still has performance reserves for future test requirements.

The new $CO_2$ test chambers consume significantly less energy in some cases. For ramp programmes between 120 °C and -40 °C, for example, a $CO_2$ test chamber consumes up to 30 % less energy than the cascade (example 340 litres). The test chamber still has power reserves to compensate for heat at -40 °C.

The $CO_2$ systems also reduce operating costs. The water-cooled systems have a pressure loss of 0.5 bar. Where you could previously connect 1 chamber with a pressure loss of 2 bar, you can now connect 4 systems without increasing the pressure.

In addition, Weiss Technik test chambers with $CO_2$ refrigeration technology have a significantly lower sound pressure level than comparable products in the portfolio. This can be clearly seen in the example of the test chamber with a test chamber volume of 180 litres: while 57 db(A) is measured on the cascade test chamber and 56 db(A) on the single-stage test chamber, the $CO_2$ test chamber is significantly quieter at 49 db(A).

The investment costs are up to 30% lower compared to the equivalent cascade system (example C2/1000/70/10).

The differences are illustrated using the example of the test chamber with a test chamber volume of 1000 litres (Table 1).

| ClimeEvent | | C2/1000/40/5 | C2/1000/50/CM[5] | C2/1000/50/10 | C2/1000/70/5 | C2/1000/70/10 |
|---|---|---|---|---|---|---|
| **Refrigerant** | | R449A | $CO_2$ | $CO_2$ | R449A; R469A (R23) | R449A; R469A (R23) |
| **Test space volume** | **Liter** | 1000 | 1000 | 1000 | 1000 | 1000 |
| **External Housing Dimensions (H x W x D)** | **mm** | 2040 x 1420 x 2075 | 2040 x 1420 x 2075 | 2040 x 1420 x 2075 | 2040 x 1420 x 2075 | 2040 x 1420 x 2489 |
| **Temperature change rate: -40 °C to 180 °C[1]** | **K/min** | 6.7 | n.a | 12 | n.a. | n.a. |
| **Temperature change rate: -50 °C to 180 °C[1]** | **K/min** | - | 2.5-3 | 10 | n.a. | n.a. |
| **Temperature change rate: -70 °C to 180 °C[1]** | **K/min** | - | - | - | 6 | 10 |
| **Heat Compensation at +20°C** | **Watt** | 5000 | 2000-2500 | 5000 | 5000 | 7000 |
| **Heat Compensation at - 20 °C** | **Watt** | 2000 | n.a | 3500 | 5000 | 7000 |
| **Heat Compensation at - 40 °C** | **Watt** | 500 | n.a | 1400 | 3200 | TBA |
| **Nominal Power** | **kW** | 16 | 9 | 18 | 23 | 26 |
| **Nominal Current** | **A** | 29 | 20 | 33 | 37 | 45 |
| **CEE-Plug** | **A** | 63 | 32 | 63 | 63 | 63 |
| **RCD (Residual Current Device) Circuit Breaker** | **mA** | 30 | 300 | 300 | 30 | 30 |
| **Cooling Water Consumption[2]** | **$m^3/h$** | 1.14 | 0.7 | 2.2 | 1.3 | 1.9 |
| **Max. Heat dissipation to the Installation Room[3]** | **kW** | 1.3 | 9.1/1[4] | 2.1 | 2.2 | 2.6 |
| **Max. Heat dissipation to the Cooling Water[3]** | **kW** | 23.9 | 7.7 | 27 | 29 | 41.6 |
| **Permissible Cooling Water Temperature[3]** | **°C** | 12-28 | 12-28 | 12-28 | 12-28 | 12-28 |
| **Permissible Ambient Temperature[3]** | **°C** | 10-35 | 10-35 | 10-35 | 10-35 | 10-35 |
| **Pressure Differential of the System[6]** | **bar** | 2 | 0.5 | 0.5 | 2 | 2 |

[1] in accordance with IEC 60068-3-5 [2] at Δt 10 K at Tmin +18°C [3] water-cooled [4] air-cooled/water-cooled [5] all values provisional; subject to deviations [6] no standby cooling required

### Weiss Technik Solution:

- Significantly reduced noise level (up to 9 dB(A) lower compared to devices rated down to -70 °C)
- Substantially lower energy consumption than previous models
- Infrastructure energy savings
- No changes required at the installation site for ambient temperature or cooling water