

Naturally Cool

New line of natural refrigerant gases



CO₂

Refrigeration technology for commercial and industrial applications

The natural gas for new commercial and industrial refrigeration systems

The recent F-gas Regulation (EU) 2024/573 has introduced very strict limits on the use of fluorinated gases in new systems, especially for commercial refrigeration.

In this context, a significant transition towards the use of low GWP natural refrigerants based on CO₂ technology is expected. These refrigerants represent an alternative to fluorinated gases across a wide range of applications. The choice of technology depends on the specific requirements of the system and the intended application.

The technology used depends on the application and the location of the plant. CO₂ is already widely used in several applications, where it proves a valuable solution.

CO₂ as an alternative refrigerant to traditional fluorinated gases

CO₂ R-744 GWP = 1

R-404A GWP = 3,922

R-134a GWP = 1,430

R-448A GWP = 1,350



Regulatory framework

The new rules on fluorinated gases, Regulation (EU) 2024/573, confirmed the use of refrigerant gases with GWP<150 in newly constructed refrigeration systems for commercial use, as already required as of 1 January 2022 in centralised systems with nominal capacity ≥40 kW.

Accordingly, commercial refrigeration systems using transcritical and subcritical CO₂ technology have led to more efficient systems.



CO₂

Properties and applications

Properties

CO₂ is a natural gas and an excellent refrigerant with outstanding thermophysical properties:

- excellent heat transfer coefficient
- extremely low viscosity
- high cooling capacity in both storage and freezing cold rooms

Having a low critical temperature, CO₂ is a high-pressure refrigerant requiring a high operating pressure (a transcritical pressure of over 100 bar) for efficient operation.

Moreover, CO₂ has a low compression ratio (20 to 50% lower than HFCs and ammonia), which improves its volumetric efficiency and allows the use of compressors producing smaller volumes.

Nippon Sanso believes that CO₂ will become the dominant refrigerant in commercial refrigeration systems. The F-gas Regulation is a clear push in this direction.

Main applications

Unlike the majority of refrigerants, in actual practice, CO₂ is used in three different refrigeration cycles:

- **subcritical**, cascade systems with Freon in the primary circuit and CO₂ in the secondary circuit
- **transcritical**, CO₂ only systems
- **secondary fluid**, CO₂ used as a heat transfer fluid

Other applications

- Industrial refrigeration. CO₂ used in combination with ammonia, both in cascade systems and as a heat transfer fluid
- Heat pumps (with production of DHW)
- Refrigerated transport



CO₂ A high quality product

Thanks to its natural CO₂ storage facilities, Nippon Sanso is the only company in Italy that is able to place on the market CO₂ certified as having a Carbon Footprint 80% lower than a conventional product, based on the methodology and system boundaries defined in the certification.

CO₂ for refrigeration applications, R-744 according to the ASHRAE designation, must meet certain purity requirements for safe and optimal use in refrigeration systems.

Nippon Sanso brings to the market a high quality, high purity product:
CO₂ 4.0 (99.99% grade) -
Max H₂O content <20 ppm



CO₂ is available in the following formats



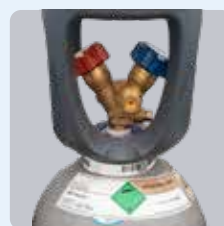
Cylinder

Gas or liquid phase
40 L = 30 kg



Bundles

Gas or liquid phase
12 cylinders
40 L each = 360 kg



CO₂ is a high-pressure gas and requires 200 bar cylinders.

To meet customer requirements, all Nippon Sanso cylinders and bundles are fitted with a double tap that makes it possible to dispense both the liquid and the gaseous phase.

Know-how at the service of our customers to meet individual system requirements

An efficient, practical and economical solution

Through practical packaging options and diversified solutions according to individual needs, R-744 is an optimal, widely available solution with high cooling capacity. From Nippon Sanso cylinders R-744 CO₂ can be dispensed in either gaseous or liquid phase, whichever is required.

The advantages of R-744

- It is cheaper than HFCs/HFOs
- It has a GWP of 1, making for an extremely low greenhouse effect
- Excellent cooling capacity especially in cascade and transcritical systems

A wide, innovative range for circuits of all sizes

1. Low GWP and Zero ODP

Non-toxic, non-flammable natural gas with ODP (Ozone Depletion Potential) = 0 and GWP = 1, suitable for a wide range of refrigeration applications.

2. Excellent performance

High purity dry gas with minimised moisture content (H₂O < 20 ppm). Lot traceability through barcode.

3. Safe

Via a dual valve tap, the product can be dispensed in either gaseous or liquid phase.

4. Practical

Identical outlet connection for all cylinder sizes, for both liquid and gas phase applications.



Propane R-290



In keeping with the provisions of the F-gas regulation concerning the use of natural gases and low GWP gases, Propane is one of the leading refrigerant options for new refrigeration, air-conditioning and heat pump applications (RACHP).

Classified as a hydrocarbon and a natural gas, and first used as a refrigerant more than a century ago, Propane is now back at the forefront as one of the main candidates for use as a refrigerant gas in newly designed air conditioning systems.

Propane, in fact, does not harm the ozone layer, has a negligible impact on global warming and has very good thermodynamic properties that make it suitable for use in a wide variety of HVAC-R appliances.

With a GWP of 3, Propane has a low global warming potential. Since it is a pure gas and not a blend, it has none of the glide problems associated with some synthetic coolants. Its low density and intrinsic properties provide for a reduced charge and relatively low working pressures.

It also offers a very wide range of applications so that it can be used in both refrigeration and air conditioning systems.

Pursuant to the updated version of standard EN 60335-2-89:2022, European manufacturers can sell stand-alone appliances with a Propane R-290 charge of up to 500 g. According to the new EN standard, it is no longer necessary to conduct a separate risk assessment as per EN 378.

Properties	Propane (R-290)
Physical state	Liquefied gas
Molecular weight	44.1 g/mol
Boiling point at 1.013 bar	-42.1 °C
Critical temperature	96.7 °C
Critical pressure	42.5 bar
Density of saturated liquid at 25 °C	492 kg/m ³
Density of saturated vapour at 1.013 bar	20.6 kg/m ³
Vapour pressure at 25 °C	9.5 bar a
Vapour pressure at 50 °C	17.1 bar a
Appearance/colour	Colourless gas
Odour	Faint characteristic odour
ODP	0
GWP	3
Flammability limits in air*	1.7 to 10.8% by vol
Safety Class (ASHRAE 34)	A3

*25°C and 1 atm

Propane is available in the following formats



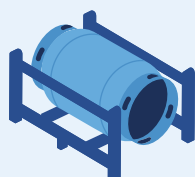
Cylinder

Gas or liquid phase
12.5 L= 5 kg



Cylinder

Gas or liquid phase
40 L= 16 kg



Drum

Gas or liquid phase
930 L= 400 kg

The thermodynamic properties of this product make it very suitable for use in plug-in systems at low and medium temperatures.

Ammonia

R-717



Ammonia (R-717) is a high-performance refrigerant with excellent thermodynamic efficiency, exceeding that of R-134a or Propane.

R-717 is a natural refrigerant gas, with a wealth of applications in industrial refrigeration.

It ensures optimal thermodynamic performance, especially in R-744 cascade systems or in systems using a secondary fluid, such as glycol water.

Ammonia (NH₃) systems are highly versatile and provide for different refrigeration levels, ranging from 4°C to -45°C, for both storage and freezing cold rooms.

In addition, it provides higher thermodynamic efficiency than other fluids, which translates, for the same cooling capacity, into lower energy expenditure especially for large systems.

The operating pressure of ammonia is comparable to that of the other refrigerants. With its high volumetric capacity, ammonia is able to absorb greater quantities of heat in a smaller volume.

On account of its toxicity and flammability, one way to address the safety issues associated with the use of ammonia as a refrigerant consists of using it in combination with CO₂, at medium or high temperatures, or in cascade systems at low temperatures.

At any rate, special care must always be taken when handling and storing this refrigerant since it is a toxic gas regulated by R.D.147/27.

Properties

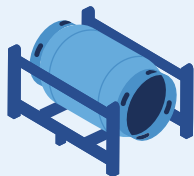
- High cooling capacity
- GWP - Global Warming Potential = 0
- ODP - Ozone Depletion Potential = 0

Ammonia is available in the following formats



Cylinder

Gas or liquid phase
60 L= 30 kg



Drum

Gas or liquid phase
920 L= 400 kg



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Making life better through gas technology

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