Pneurop PN14 - Air Treatment

8th February 2024

PN14 position paper on Compressed Air Refrigerated Dryers (CARD) categorisation as a function of system design according to ANNEX IV, Placing on the market prohibitions referred to in Article 11 (1) in F-Gas regulation

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1. About Pneurop

Pneurop is the European association of manufacturers of compressors, vacuum pumps, pneumatic tools and related equipment. Pneurop members are national associations, representing more than 200 manufacturers in 7 EU Member States, the United Kingdom and Turkey. The European market turnover of the represented company exceeds 20 billion euros.

The Pneurop Committee 14 (PN 14) leads the way for air treatment manufacturers in the compressor field in the expanding European Union.

2. Executive summary

This document provides interpretation for the product categorisation of compressed air refrigerated dryers (CARDs) regarding the prohibitions set out in Annex IV as per F-Gas Regulation .

CARDs are used for drying compressed air. The drying of compressed air is generally essential for its application. CARDs are by far the most widely used drying systems and are therefore currently an indispensable system component for a reliable and efficient supply of compressed air worldwide.

As the F-Gas Regulation does not explicitly define a category for CARDs, argumentation is suggested in sections 3 to 6 of this document to define the best matching product category using definitions and descriptions included in the regulation.

It is derived that, due to their different system designs, CARDs using a heat transfer fluid (e.g. a glycol-water mixture) that is actively circulated in an intermediate circuit have to be categorised as ´chiller´, while CARDS without such intermediate circuit have to be categorised as ‘other self-contained air-conditioning equipment (OSAC)´.

Section 7 points out that an analogous approach of product categorisation, as presented here, regarding the European F-gas Regulation and the Technology Transitions Program (TTP) of the EPA in the USA is preferable.

The interpretation refers to CARDs that are manufactured as series products, meaning that there are a limited number of custom designs that may differ from the following interpretation and product categorisation derived here.

3. Self-Contained Products

Generally, CARDs meet the definition of art. 3 (38) of being ´self-contained ‘systems:

'self-contained' means a complete factory-made system which is in a suitable frame or casing, is fabricated and transported complete or in two or more sections, can contain isolation valves and in which no gas-containing parts are connected on site.

CARDs are factory-made and not manufactured on-site. All of their components are enclosed in a suitable encasing. In open variants, e.g. for marine applications, suitable frames are used. They are transported complete or sometimes in sections (e.g. with compressed air piping components and air filters). However, their refrigerant circuit is always supplied complete. Therefore, no gas-containing parts are connected during their installation on site.

4. Primary function is dehumidification, not refrigeration

CARDs are used to dehumidify compressed air. Within their drying process, the temperature of the compressed air is reduced. This characteristic seems to meet the definition of refrigeration of art. 3 (43):

‘refrigeration’ means the process of maintaining or lowering the temperature of a product, substance, system or other item.

However, this is only done to condense the humidity contained in the air and finally to remove any condensate from the air flow. Consequently, the main function is not refrigeration or cooling, but dehumidifying. In other words, cooling the air is only the means to the purpose of dehumidification.

Furthermore, this should be seen as a valid statement that most CARDs use an air-to-air heat exchanger, in which the incoming humid warm air is directed in counterflow to the dried cold air. This is done to recover preferably most of the applied cooling capacity causing that the outlet temperature of the dried air is almost equal to the inlet temperature of the humid air. So again, the cooling of the air is only an internal process, as is the reheating. Both processes serve one purpose: dehumidifying.

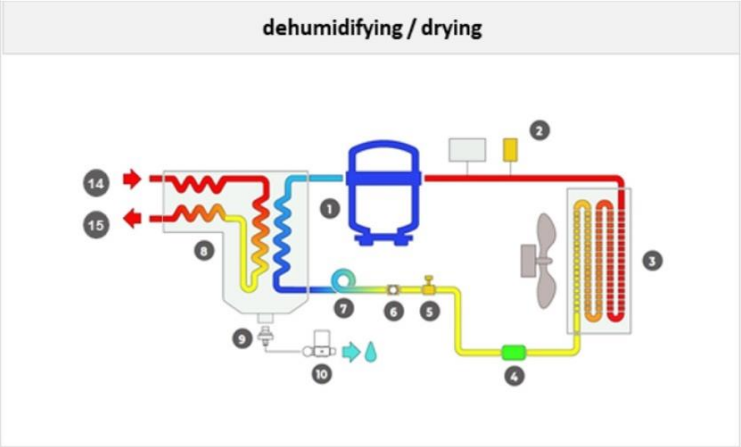
Consequently, it follows that the prohibitions set out in Annex IV for the whole paragraph of stationary refrigeration (i.e. section 2 up to and inclusive to 6), in particular also the group of "any self-contained refrigeration equipment, except chillers”, does not apply to CARDs.

5. Different designs of CARDs

With regard to the F-Gas Regulation, market available designs of CARDs differ in whether they contain an intermediate circuit or not.

5.1. CARDs without an intermediate circuit (Direct Expansion)

CARDs using the principle of direct expansion transfer heat directly from the compressed air to the refrigerant in the evaporator (see Fig. 1).



1	Refrigerant scroll compressor
2	Pressure switches
3	Refrigerant condenser
4	Filter drier
5	Solenoid valve
6	Moisture indicator
7	Capillary tube
8	Heat exchanger
9	Noloss level sensor
10	Solenoid drain valve
14	Inlet compressd air
15	Outlet compressd air

Fig.1: CARD without an intermediate circuit (Direct Expansion)

Removing moisture from humid compressed air means that air is conditioned. This function meets the definition of ‘air-conditioning’ as per art. 3 (40):

‘air-conditioning’ means the process of treating air to meet the requirements of a conditioned space by controlling its temperature, humidity, cleanliness or distribution.

In detail, CARDs are treating air by controlling its humidity, thereby meeting the requirement of a specified pressure dew point inside the compressed air pipework towards the point of its use. The above definition includes air at all pressures, i.e. also compressed air.

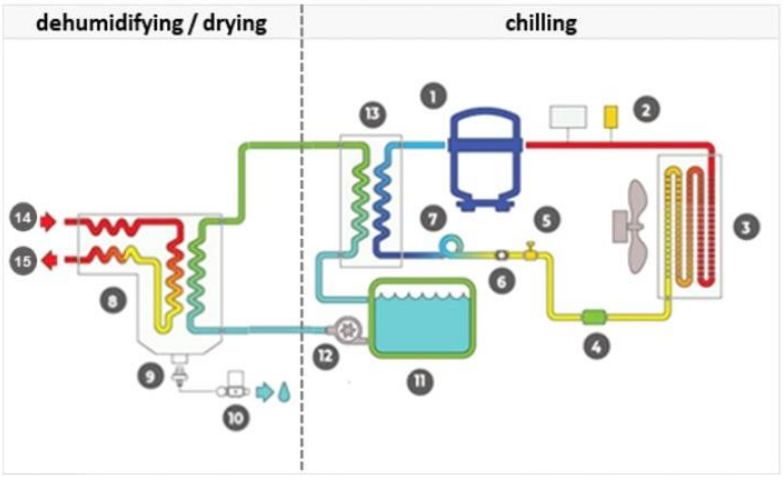
As CARDs described above are also stationary equipment (i.e. not in transit during operation; see art. 3 (20)), Annex IV section 8 “stationary air-conditioning equipment and heat pumps" provides the best fit for this category.

Further on, as they do not meet the technical structures and/or end uses of plug-in room air-conditioning equipment, monoblock air-conditioning equipment and heat pumps, they fit into the category ‘other self-contained air-conditioning equipment (OSAC)´.

Consequently, prohibitions set out in Annex IV for OSAC, i.e. in section 8b) up to and including 8e), apply to CARDs.

5.2. CARDs with an intermediate circuit

An alternative design of CARDs uses a heat transfer fluid (e.g. glycol-water mixture) that is actively circulated in an intermediate circuit (see Fig. 2.).



1	Refrigerant scroll compressor
2	Pressure switches
3	Refrigerant condenser
4	Filter drier
5	Solenoid valve
6	Moisture indicator
7	Capillary tube
8	Heat exchanger
9	Noloss level sensor
10	Solenoid drain valve
11	Tank
12	Circulator
13	Gas to glycol heat exchanger
14	Inlet compressd air
15	Outlet compressd air

Fig. 2: CARD with an intermediate circuit

The primary function of this design (i.e. dehumidification) is identical to CARDs without an intermediate circuit. However, the refrigeration part of this equipment complies with the definition of ´chiller´ as per art. 3 (44):

'chiller' means a single system whose primary function is to cool a heat transfer fluid (such as water, glycol, brine or CO2) for refrigeration, process, preservation or comfort purposes.

In contrast to the type of CARDs that we categorise as OSAC in 5.1, there is no direct heat transfer from the compressed air to the refrigerant.

Instead, heat is transferred from the compressed air to the evaporator via an intermediate circuit, i.e. CARDs with an intermediate circuit can be divided up into two sections: a first one that provides a chilled heat transfer fluid and a second one that uses the chilled heat transfer fluid to cool and to dehumidify compressed air.

Consequently and as already mentioned that CARDs are also stationary equipment, Annex IV section 7 "stationary chillers" applies.

In detail, as CARDs are not used to cool products to temperatures below – 50 °C, only prohibitions set out in Annex IV section 7b up to and including 7d apply to CARDs with an intermediate circuit.

6. Prohibitions set out in Annex IV

Summing up the above interpretation and considering that CARDs due to their technical structures and/or end uses are obviously not in the scope of equipment covered in Annex IV section 9 and sections 10 up to 21 , the following prohibitions are seen to provide the best fit for CARDs (see Table 1):

CARD design	Product category Annex IV	Date of prohibition		
		January 2027	**January 2030**	**January 2032**
CARD with an intermediate circuit	(7) chiller	P_{cool}* ≤ 12 kW + GWP ≥ 150 **) Annex IV (7b)	/	P_{cool}* ≤ 12 kW + all GHG **) Annex IV (7c)
		P_{cool}* > 12 kW + GWP ≥ 750 **) Annex IV (7d)	/	/
CARD without an intermediate circuit	(8) other self-contained air-conditioning equipment	P_{cool}* ≤ 50 kW +GWP ≥ 150 ***) Annex IV (8b + 8d)	P_{cool}* > 50 kW +GWP≥150 ***) Annex IV (8e)	P_{cool}* ≤ 12 kW + all GHG ***) Annex IV (8c)

) P_{cool} is the nominal cooling capacity of a CARD at manufacturer specified rated conditions, which is achieved in terms of operating conditions according to ISO 7183 Option A1 at specified power supply and pressure dew point.;
****)*** If safety requirements at the site of operation would not allow using fluorinated greenhouse gases with GWP of less than150, the GWP limit is 750;
*****)*** except if required to meet safety requirements at the site of operation;

Table 1: Prohibitions set out in Annex IV for CARD

7. Relationship to the Technology Transitions Program (TTP)

The EPA published the TTP to restrict the use of certain HFCs, particularly also their use in specified product sectors.

The categorisation of CARDs with intermediate transfer circuit as Chillers and CARDs without intermediate transfer circuit as within Light Commercial Air Conditioning respectively, is according to our interpretation also matching the definitions as put forward by EPA. This alignment would be beneficial for both authorities and industry.

This categorisation is in line with the proposed categorisation under the EU F-Gas Regulation and can be justified as follows:

7.1 Residential and Light Commercial Air Conditioning and Heat Pumps

Chapter VI.F.1.k defines the category ´Residential and Light Commercial Air Conditioning and Heat Pumps´ as follows:

The residential and light commercial air conditioning and heat pump subsector includes equipment for cooling air in individual rooms, single-family homes, and small commercial buildings.

It is further said:

In addition, this subsector includes non-residential dehumidifiers, which are used for commercial and other purposes and are typically of a higher capacity than residential dehumidifiers.

As CARDs are dehumidifiers which are used in a commercial or industrial area and typically have a higher capacity than residential dehumidifiers they fall into this section.

Such reasoning is in line with the suggested categorisation CARDs without intermediate circuit (e.g. with direct expansion) as being OSACs as per F-gas Regulation.

However, for the argumentation already provided, it would be consequent if for CARDs with an intermediate circuit the category chiller is also applied as per TTP.

7.2 Chillers

Chapter VI.F.1.j defines the category ´chiller´ as follows:

A chiller is a type of equipment using refrigerant to typically cool water or a brine solution that is then pumped to fan coil units or other air handlers to cool the air that is supplied to occupied spaces.

The above mentioned ´water or brine solution´ can be understood as ´heat transfer fluid´ of a chiller as per art. 3 (44) of the F-gas Regulation.

Following that, CARDs with an intermediate circuit in which a heat transfer fluid (e.g. glycol-water mixture) is actively circulated also have to be categorised as chillers following the above definition of the TTP.

On behalf of PN14
Tim Preece (Secretary)
Janez Jakop (Chair)

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8. Additional references

[1]European Parliament (16.01.2024): Fluorinated gases regulation. URL: https://www.europarl.europa.eu/doceo/document/TA-9-2024-0002_EN.pdf (call date: 29.01.2024)

EPA (2024): Phasedown of Hydrofluorocarbons: Restrictions on the Use of Certain Hydrofluorocarbons Under the American Innovation and Manufacturing Act of 2020. URL: https://www.federalregister.gov/documents/2023/10/24/2023-22529/phasedown-of-hydrofluorocarbons-restrictions-on-the-use-of-certain-hydrofluorocarbons-under-the#p-873 (call date: 29.01.2024)