



where

Carrefour Aosta,
Italy

what

CO₂ system

- ENEX compressor rack
- CAREL electronics
- CAREL remote management

why

Full green solution

- natural refrigerant
- energy saving
- double heat recovery control

when

September 2013

CAREL full green, transcritical CO₂ system.
Double heat recovery and three suction lines in
Carrefour Aosta.

Thanks to the partnership between Carel, Carrefour and Enex, a new supermarket situated in Aosta has become fully green. Starting this September, the refrigeration system now uses carbon dioxide as the sole refrigerant for cold food storage.

Carrefour, which has been committed to replacing its HFC systems, first with hybrid CO₂/R134a solutions, and then with refrigeration systems that only use CO₂, inaugurates this new hypermarket that stands out for its size and the specific configuration with 3 suction lines - MT1, MT2 and LT.

The main partner in this project is Enex, a designer and manufacturer of advanced CO₂ refrigeration system operating in the field of environmentally-friendly and energy saving ventilation, refrigeration, air-conditioning and heat pump systems.

The implementation of this solution has proven that

- the Italian market is ready to accept this type of technology from a viewpoint of return on investment
- Carel control technology is both advanced and versatile, placing the focus on system integration and heat recovery
- this type of system is reliable and efficient even in milder climates than northern Europe
- Carel solutions can assist less experienced users in interacting with these types of systems.



Description of the system

The compressor rack is a transcritical CO₂ booster system, specifically the low temperature (-35°C) compressor discharge is first cooled by an intercooler, featuring two ON/OFF fans, and then delivered to the first medium temperature suction line (-8°C).

Independently from the booster system, a second medium temperature suction line provides a third level of evaporation (-10°C). The pRack controller manages three suction lines, comprising: 4 compressors (LT), 4 compressors (MT1) and 2 compressors (MT2), where LT stands for low temperature and MT medium temperature.

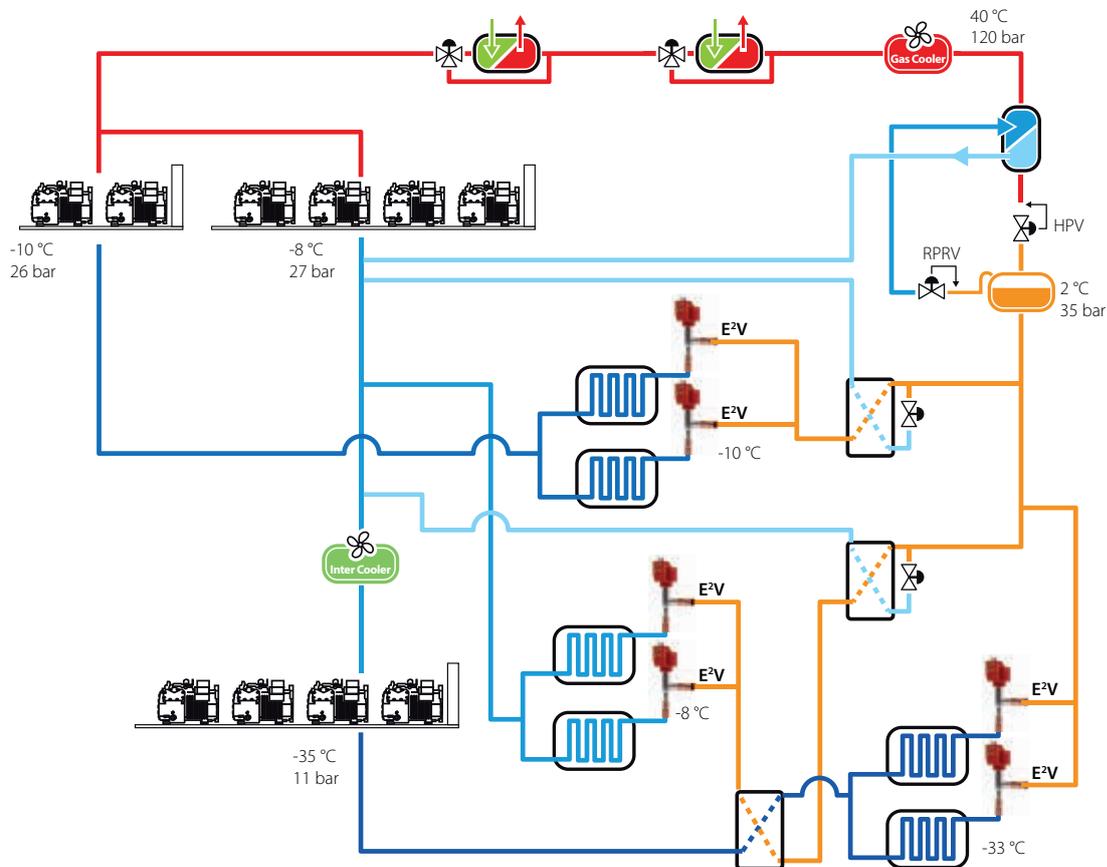
The compressor discharge on the two medium temperature lines flows into the condenser line, where a system of three heat exchangers provides for heat recovery in two stages, firstly for domestic hot water and secondly as room heating; both are managed directly by the Carel pRack board and the Carel IR33 universal controllers. The third heat exchanger is placed in series with the first two, and can be used manually for system safety.

pRack provides temperature control of the gas cooler, featuring EC fans, based directly on the heat exchanger outlet temperature, with the possibility to adjust the control set point based on variations in outside temperature (floating condensing pressure function). Between the gas cooler and the HPV valve is a subcooler, which exploits the colder fluid from the flash valve to further cool the CO₂ at the high pressure valve inlet.

The HPV valve is controlled by pressure, the set point is calculated based on the saturated temperature at the gas cooler, with the aim of ensuring the optimum pressure for compressor rack COP in transcritical conditions, or the ideal level of subcooling in subcritical conditions.

The liquid receiver normally works at around 35 barg (2°C) and the flash valve controls the pressure inside the receiver (safety valves calibrated at 45 bars). From the CO₂ liquid receiver, the lines branch off to the medium temperature (2 levels) and low temperature (1 level) units.

Liquid refrigerant is delivered from the receiver directly to the low temperature units, where it is expanded to cool the cabinets and cold rooms, while the medium temperature units receive superheated refrigerant via a series of heat exchangers controlled based on superheat, using the Carel EVD DRIVER controllers. From the three temperature levels at the refrigeration units, the CO₂ is then injected into the 3 separate suction lines and the flash valve.



Compressor rack

The Enex compressor rack is designed to ensure efficiency and reliability, combining low energy consumption with the use of a natural refrigerant (CO₂).

The Elba family of systems includes booster units that combine MT (medium temperature, in this case with 2 evaporation temperature levels) and LT (low temperature) refrigeration. In this specific installation, the evaporation temperatures are -7°C (MT), -10°C (MT) and -33°C (LT)

- High efficiency, ensured by optimum development of the booster cycle, through the addition of an intercooler and regenerative heat exchanger
- Robust design and extremely reliable operation
- Stainless steel piping, completely TIG welded
- Low noise
- Completely automatic backup of critical components to ensure stable and continuous service
- Simplified maintenance, guaranteed by easy accessibility of all the components. Plug & play units.
- Continuous capacity control by inverter on MT and LT lines
- Standard version with 45 bar design pressure on LP / IP side - 120 bar on HP side
- Large volume liquid receiver to contain the refrigerant charge during all operating conditions
- Complete protection against the risk of liquid intake by compressor
- Safety valves all discharged to common drain
- Heat recovery for room heating and domestic hot water
- Safety system against excess pressure in heat recovery water circuit
- Pressure maintenance device when system off



Enex compressor rack

Control system



pRack pR300T

The compact CAREL solution for complete control and management the CO₂ refrigerant systems is the ideal solution to meet the considerable market demand for:

- integrated management of low and medium temperature compressors (two suction lines) and transcritical valves
- innovative energy saving management algorithms;
- algorithms dedicated to the management of CO₂ systems;
- management of heat recovery in two separate stages (domestic hot water and room heating)
- ample possibility for integration/supervision



MPXPRO

This is the CAREL offering for innovative refrigerant systems, featuring:

- built-in driver for managing E²V proportional electronic expansion valves;
- evolved algorithms for energy saving and optimisation of evaporator efficiency;
- commissioning tools to assist operations for installers and maintenance personnel



Plantvisor PRO

Complete and reliable solution for the management, monitoring and optimisation of refrigeration and air-conditioning systems with up to 300 units. Main features:

- management of large and complex systems using an intuitive web interface;
- HVAC-ECO optimisation package;
- fast installation onsite;
- alarm management using a powerful engine of rules, conditions and notification channels;
- complete series of reports and documents, such as HACCP and SYSTEM REPORT.



ir33

In this installation, the IR33 universal controls the two heat recovery pumps, based on the difference between water inlet and outlet temperature. The main features are:

- range: able to satisfy all control requirements (several programmable inputs/outputs);
- flexibility: models are available with different power supplies
- serial connection: all controllers are configured for network connection to supervisory and remote maintenance systems.
- certification: quality and safety are guaranteed by the ISO 9001 certified design and manufacturing system, as well as the CE mark.

Conclusions

Carel has implemented the control of a new refrigeration system using CO₂, only, for both the low temperature cabinets (frozen food) and fresh produce.

The project is centred around environmental sustainability thanks to the use of completely natural refrigeration technology.

The CAREL pRack PRK300T electronic controller, by adopting innovative control algorithms to manage at the same time the compressor, heat recovery and transcritical section, can achieve the maximum in terms of efficiency and savings in energy consumption.

Carel has once again proven to be a sustainable innovator, applying its technology to provide cooling using carbon dioxide, while ensuring the lowest possible energy consumption.

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