



Test laboratory for transcritical CO₂ booster system with Güntner gas cooler

Commercial refrigeration plant manufacturer Eletrofrío has set up an in-house laboratory for CO₂ commercial refrigeration to reliably fill this gap in the market, particularly with individually optimised transcritical CO₂ systems. The heat is dissipated on the high pressure side by a Güntner gas cooler.

The goal of the Eletrofrío test plant for supermarket refrigeration systems is to evaluate economic operating parameters for operation in a 100 % transcritical range. The scope of tasks performed at the new laboratory includes measurements, documentation and evaluations in line with the ISO standard for refrigerated display cases. Not only transcritical systems are evaluated on the 40 m² test area but also conventional subcritical CO₂ installations. The laboratory is also designed for training purposes.

Güntner manufactured the gas cooler for cooling the compressor in the normal cooling circuit, and the gas desuperheater for cooling the compressor in the low temperature circuit.

The refrigerated display cases from the manufacturer (Eletrofrío) serve as heat source for generating the system load for the normal and low temperature circuit. These refrigerated cabinets were produced specifically for the test run in the new high-pressure range.

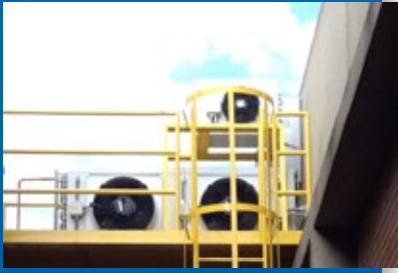


▲ Brazil

Overview

Business line:	Commercial
Application:	Supermarket Cooling
Country/Region:	Brazil/Curitiba
Fluid:	CO ₂
Product:	Güntner gas cooler S-GFH Güntner desuperheater S-GFH

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- ▲ The Güntner S-GFH gas cooler with EC motor dissipates the heat in the high-pressure circuit (operating pressure of 91 bar).
- ▲ A compressor is operated as cooling booster in the low temperature system; its heat is dissipated via an air-cooled Güntner S-GFH desuperheater with EC fans.

Transcritical operation

The normal refrigeration circuit is designed for five “consumers”, the low temperature circuit for three of them. Two CO₂ compressors connected in parallel are operated for normal cooling and another one runs as cooling booster in the low temperature system; its heat is dissipated via an air-cooled Güntner S-GFH desuperheater with EC motors.

A fourth compressor is integrated into a “parallel compression circuit”, a well-proven setup for tropical climate as it prevails in Brazil. This compressor is to decrease the energy consumption and to increase the plant’s efficiency. The Güntner S-GFH gas cooler with EC motor dissipates the heat in the high pressure circuit (91 bar of operating pressure).

Two-stage pressure reduction

The pressure of the CO₂ from the gas cooler operation is reduced by electronic expansion valves before the CO₂ is directed to an intermediate pressure vessel. This vessel directly supplies direct expansion evaporators with an evaporating temperature of -16 °C. Further, second-stage high-pressure CO₂ compressors achieve the low temperature stage with an evaporating temperature of -28 °C. A flash gas bypass valve and a separate flash gas compressor hold the pressure in the intermediate pressure vessel at 37 bar.

Waste heat from the compressors is transferred to a hot water circuit which, in a real-life installation in a shopping centre, would be used to supply kitchens, sanitary facilities etc.

The Güntner gas cooler complies with the project and safety regulations and is, in line with Pressure Equipment Directive PED 97/23/EC: Module A, designed for a maximum pressure of 120 bar. To achieve this pressure, the core tubes have a small diameter and are made of copper alloy that is characterised by high resistance to wear and tear. Compared to conventional models, the tube volume is decreased by about 40 %.

Güntner gas cooler – technical background

To ensure that transcritical operated CO₂ refrigeration systems achieve optimal COP ratings, there must be a control valve to regulate the pressure in the gas cooler to a constant value that is a function of its outlet temperature (typical values: about 90 bar to 100 bar).

Since the safety equipment – such as high-pressure switches or venting mechanisms – is subject to switching hysteresis, the Güntner gas cooler is designed for a maximum operating pressure of 120 bar. To enable it to withstand these high pressures, the construction uses small-diameter core tubes made of high-strength copper alloy.

This substantially reduces the necessary tube volume to about 40 % of that in conventional designs. On the one hand, this helps to significantly reduce the refrigerant charge needed in the plant but it also speeds up the process of switching between subcritical and transcritical operation because less CO₂ has to be displaced into the gas cooler. One positive side effect is that a smaller intermediate pressure vessel can be used because less refrigerant needs to be provided for this process.