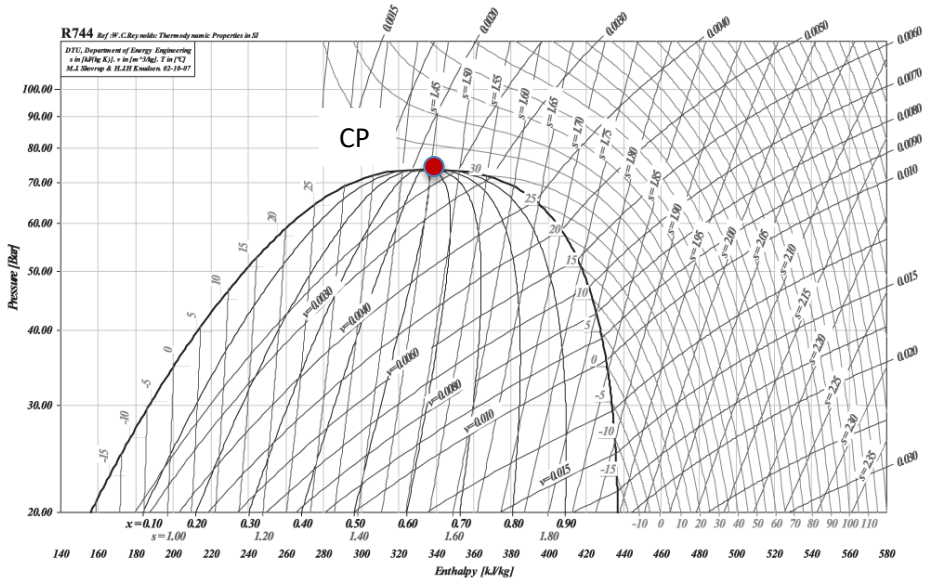


EXTREME TEMPERATURE EFFICIENCY

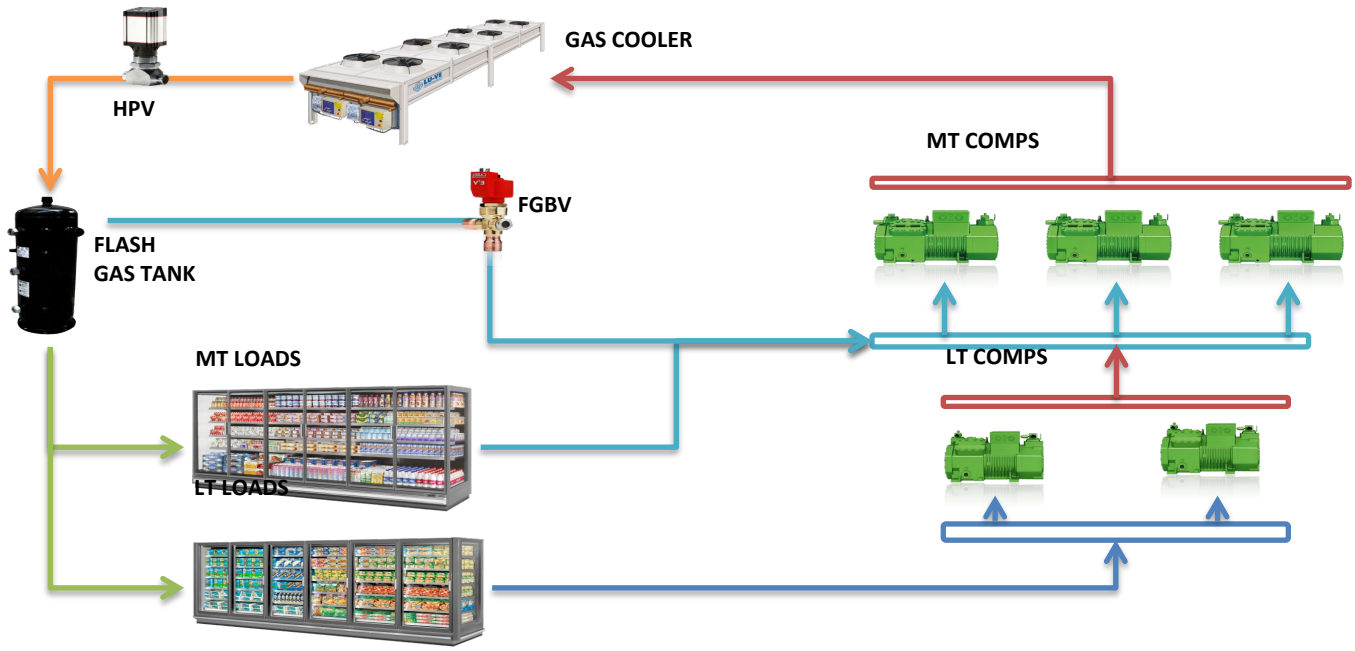
Rev.	Date	By	Purpose
0	05/05/2023	IVC	Initial Release

1. Overview

CO2 transcritical refrigeration is such system that at some point, the operation of the system runs above the refrigerant critical point (CP). In this case for CO2 which critical point refers to a temperature of 87.76F and 1070 psia.



The system described in this document refers to the ETE (Extreme Temperature Efficiency) technology that helps to improve the energy efficiency of regular CO2 Transcritical systems, which could be booster, medium temperature only configurations including some light industrial applications. The image below represents the concept of a CO2 transcritical basic booster system with its main components.

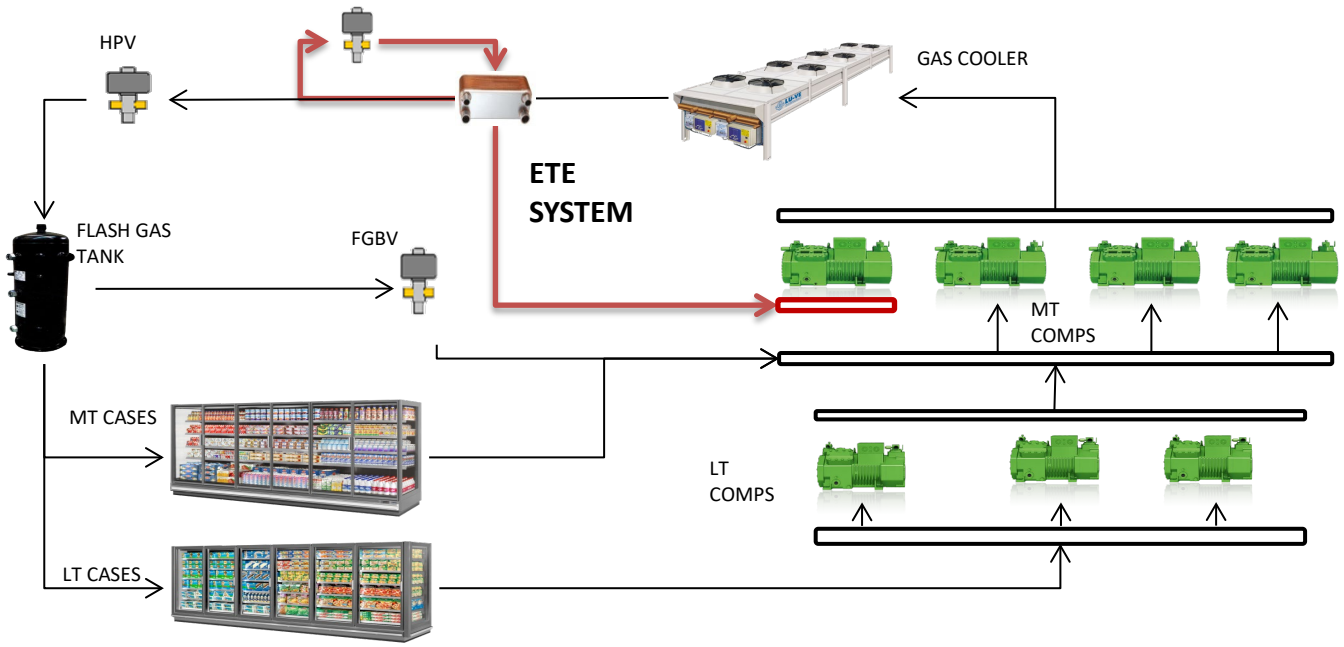


Standard CO2 transcritical systems are known for the low environmental impact they represent and for the energy consumption increase when they operate in high ambient conditions.

There are different technologies that have been developed to improve the energy efficiency of those systems during high ambient conditions operation and ETE (Extreme Temperature Efficiency) is one of those that is also patented technology by Epta Group.

ETE technology is designed to increase system efficiency during high ambient conditions by reducing flash gas formation after the high-pressure valve. This is possible due the use of embedded mechanical gas cooling system into the same CO2 transcritical booster system.

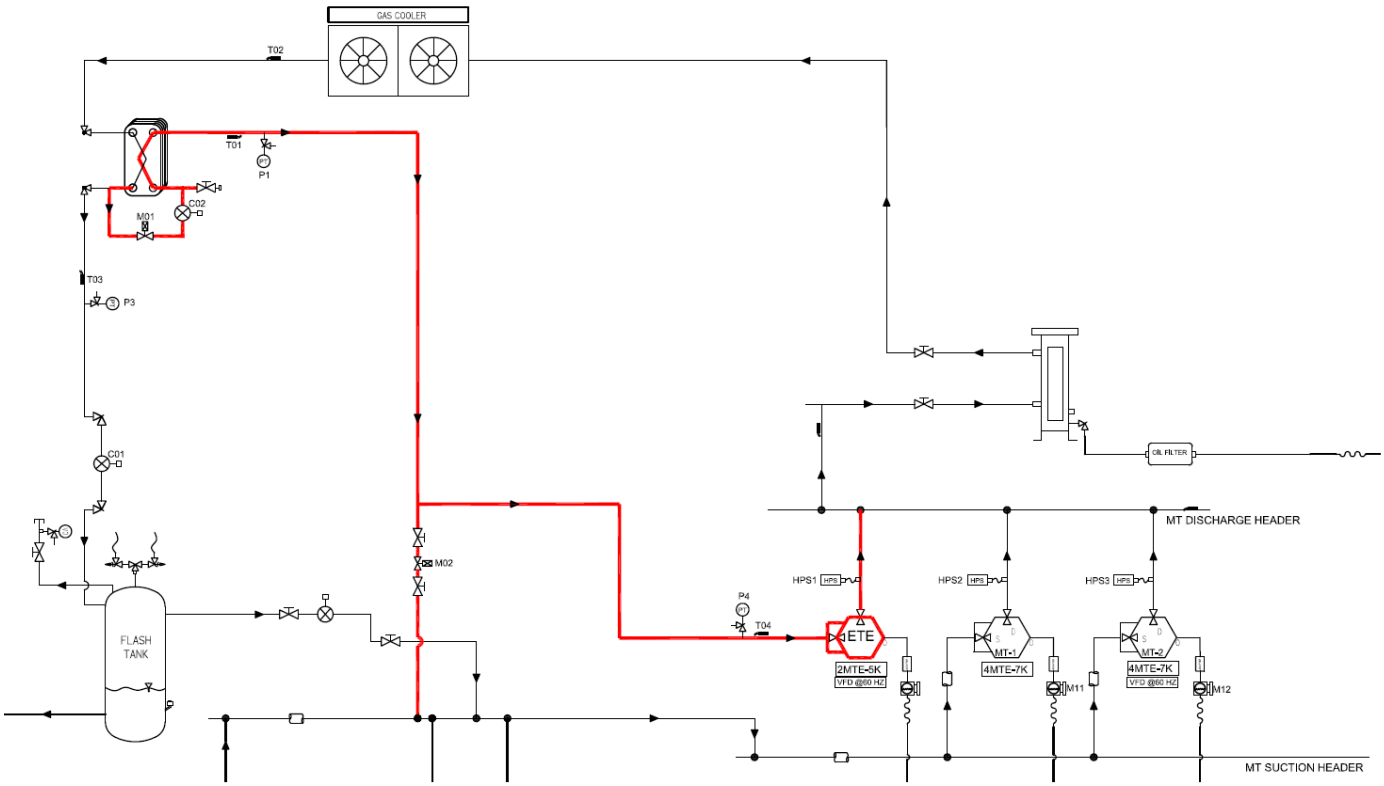
ETE has a dedicated compressor and a heat exchanger that is installed after the main gas cooler, this heat exchanger helps to produce the cooling in the gas leaving the gas cooler and the dedicated ETE compressor is the one driving the cooling capacity of this portion, the image below illustrates this technology.



2. ETE System Piping Schematic and components

The piping schematic below represents ETE configuration at compressor rack system which is compossed of the main following components:

a) Compressor, Variable Frequency Drive and compressor controller
b) Heat exchanger
c) Electronic Expansion Valve and valve driver
d) Motorized valves
e) Solenoid valve
f) Temperature Sensors
g) Pressure tranducers



3. ETE System Operation

ETE system will be enabled since the startup of the rack, however it will run only during high ambient conditions that will be predefined on a project-by-project basis.

Once the conditions are acceptable for the system to run on ETE mode the sequence will follow as below; refer to piping schematic for component naming and the below description.

When gas cooler outlet temperature (T02) is above the predefined set point the ETE compressor controller will send a signal to motorized valve M01 to start opening and that will allow flow through it reaching the electronic expansion valve C02 which will operate and start allowing flow going to the heat exchanger. This expansion valve will be controlled on superheat mode by temperature sensor T and pressure transducer P, the operation of this in consequence will increase the pressure at compressor suction line and it will then activate the compressor and VFD to run. The compressor will be controlled with a variable frequency drive which will driving ETE suction pressure at pre-stablished setpoint.
The operation of this part of the system will provide cooling to gas coming out of the main gas cooler lowering the temperature of the gas entering the high pressure valve which will expand this cooler gas resulting in a liquid-vapor mix with less amount of vapor (less quality) and higher amount of liquid that will be used to feed the display cases.

The valve M02 can be activated and function as an overpressure safety valve to vent from ETE circuit to the medium temperature suction group header.

4. Revision History

R0 – First Release