

מחנה
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Let's talk about the new AXP82 for the CO2 commercial refrigeration



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CO₂ SYSTEM OVERVIEW TECHNICAL CHALLENGES

Transcritical CO₂ Comp rack: installation

- Supermarket



CO₂



Gas Cooler

- Controls CO₂ outlet temperature
- Min temp CO₂ outlet: 5-10°C

CO₂ Compressor Rack

- 1 liquid line
- 2 suction lines (booster):
 - Medium Temp (-10°C, 26 bar)
 - Low Temp (-30°C, 12 bar)

A compressor rack includes different types of brazed heat exchangers (BHEs) exposed to many different technical challenges:

- Very high pressure
- High temperature gradient
- Temperature cycling



MT cabinets

Air Temp
0÷4°C



Cold Rooms

MT and LT



LT freezers

Air Temp
-18÷-25°C

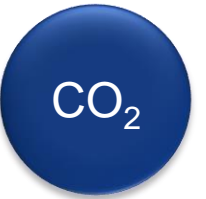
MT Suction line (26 bar)

LT Suction line (12 bar)

Liquid line (35-40 bar)

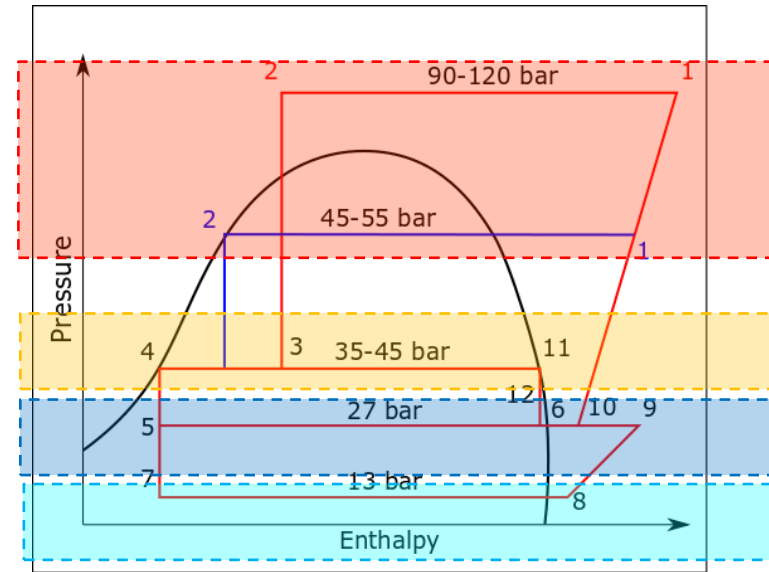
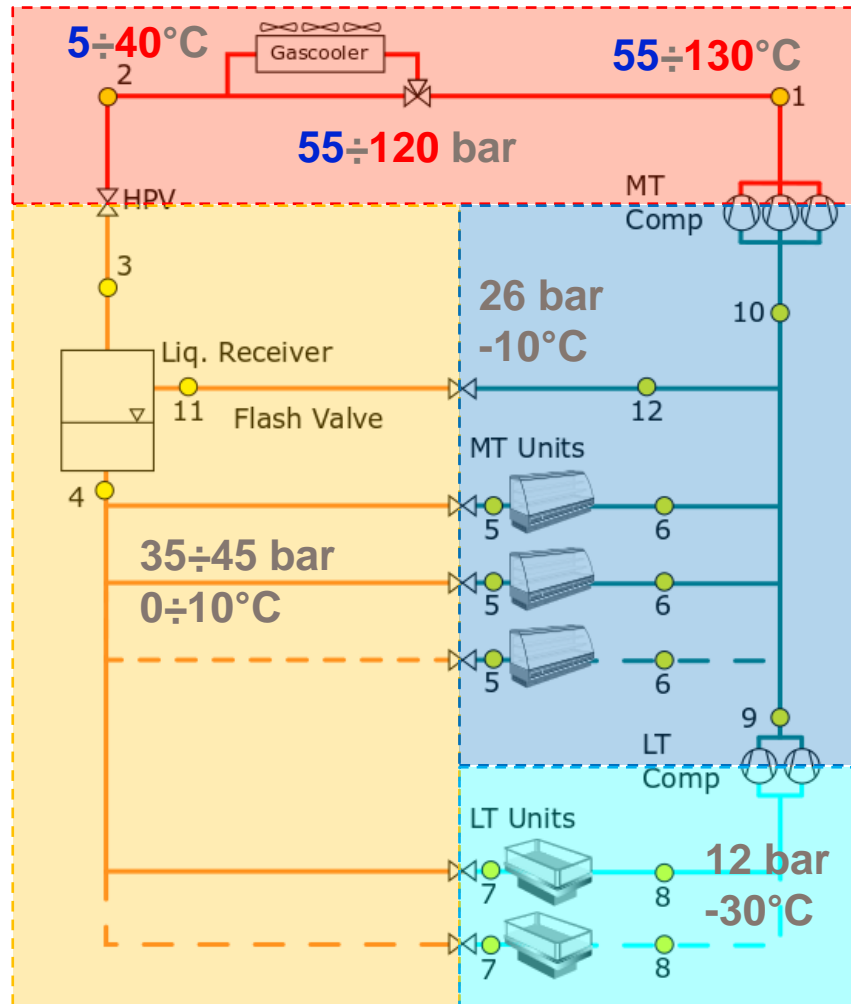
Transcritical CO2 Comp rack: pressures and temperatures

- Supermarket



■ Subcr.
■ Transcr.

Operating Pressures and temperatures



Design pressure

High pressure side

DP ≥ 120 bar, due to transcritical operation

When the unit is OFF, pressure can rise up to 50-70 bar

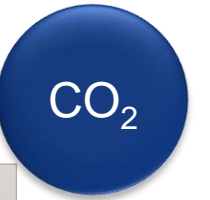


Medium and Low pressure side

DP = 60-90 bar, due to standstill operation

Transcritical CO₂ comp rack

- BHEs



External subcooler

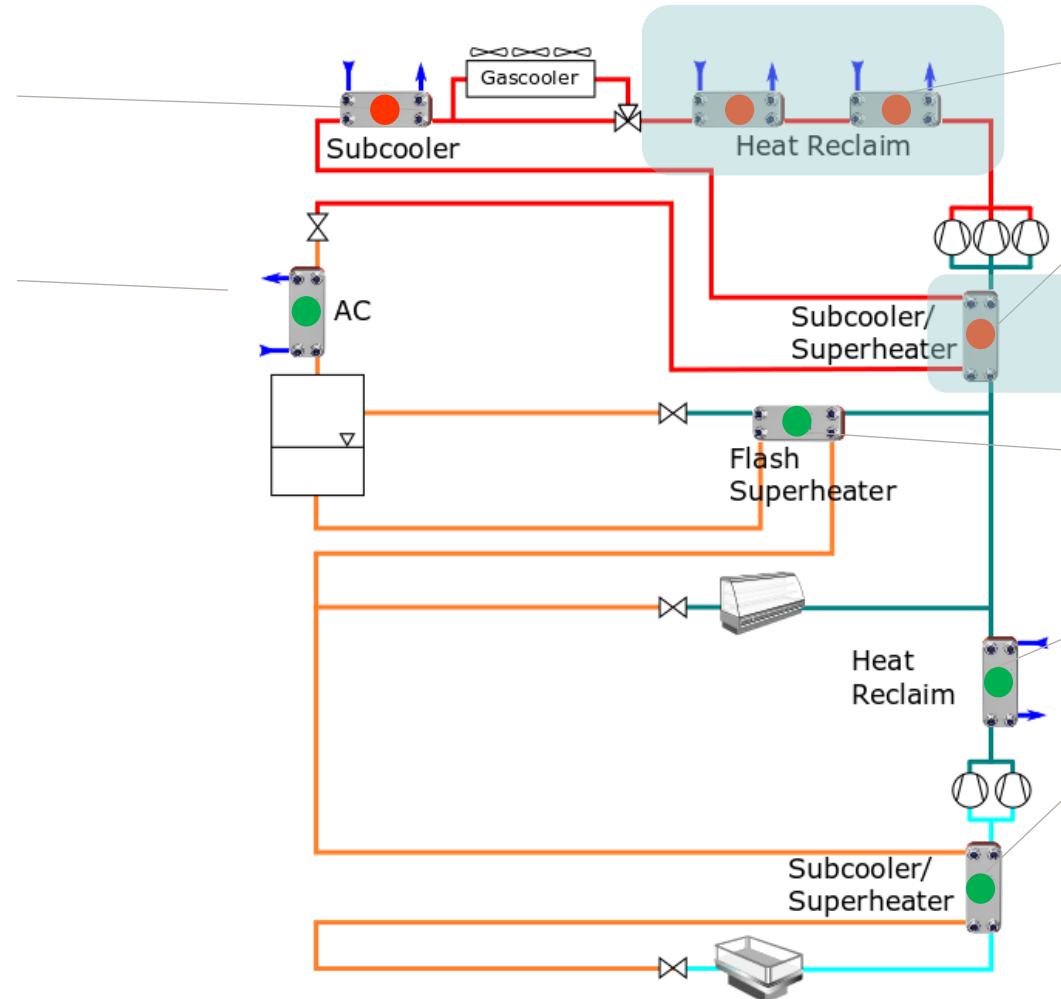
External ref unit
Geothermal

Air Conditioning

Requires parallel comps

● DP ≥ 120 bar

● DP ≤ 90 bar



Heat Reclaim

Tap water (high ΔT)
Space Heating (low ΔT)

Internal Heat Exchanger (IHX)

Same flow on both sides
Provides SH to MT comps

Flash gas superheater

Different flowrates
Superheats flash gas

Heat Reclaim LT

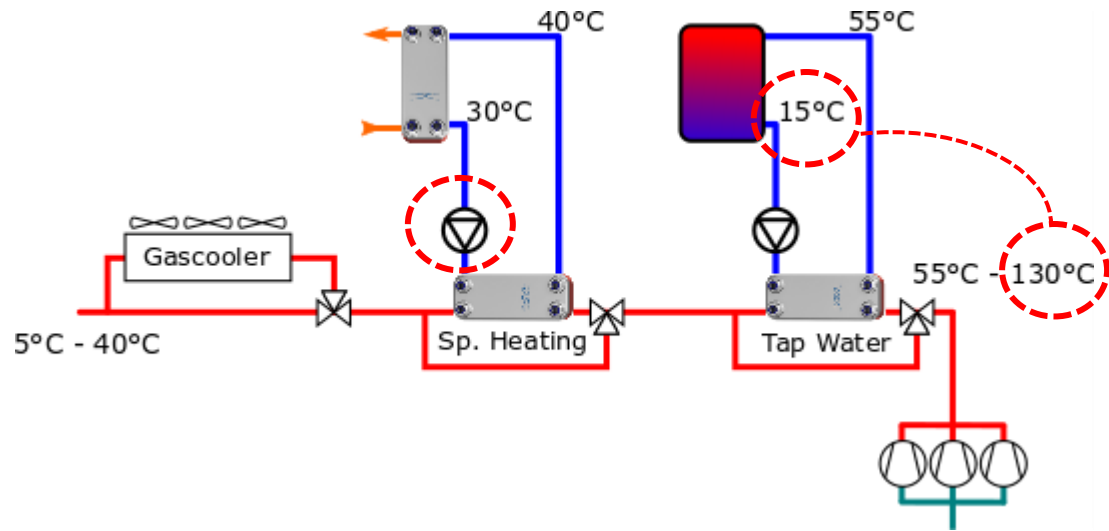
Small capacity

IHX LT

Same flow on both sides
Provides SH to LT comps

Heat Reclaim

- Transcritical CO₂ comp rack



Heat Reclaim or Heat Recovery

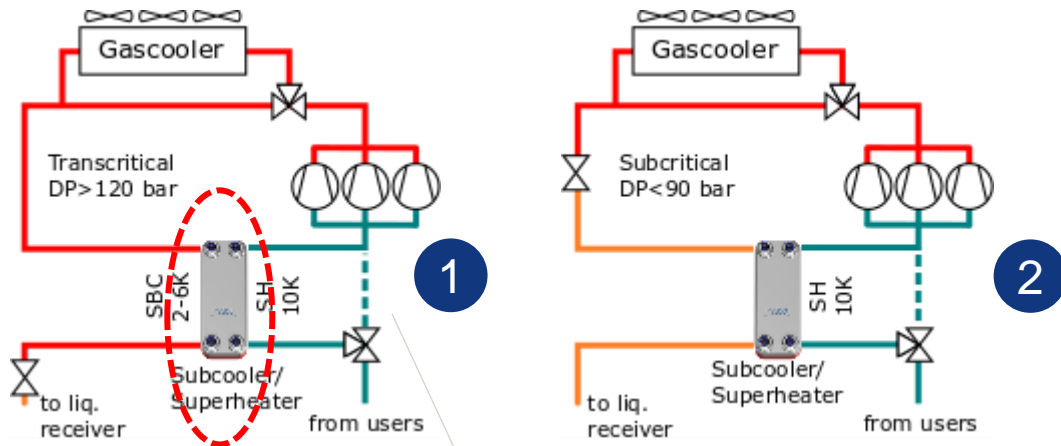
- The heat rejected by the rack, is not wasted in the air, but it is **recovered** to produce **Hot Tap Water** or to **heat the building**
- When they are not used, the BHE are **bypassed** and the pumps are stopped
- Gas cooler can be bypassed to recover all the heat from compressor

	Tap Water	Space Heating
Capacity	Lower	Full load (>500 kW)
Temp.	15-55°C (W)	30-40°C (W)
Load	All year	Winter
Design P	≥120 bar	≥120 bar
2 nd fluid	Water/Brine	Water/Brine

- **Pressure Fatigue cycling depending on capacity control and ambient temperature.**
- **Temperature Fatigue cycling depending on the water pump regulation and bypass valve.**

Internal HX: Superheater/Subcooler

- Transcritical CO₂ comp rack



Superheater/Subcooler

- Internal Heat Exchanger, provides **extra superheat** to the suction line, and extra **liquid** in the receiver
- Two different installations:
 - 1 Transcritical: Installation after Gas Cooler outlet. The single-phase transcritical gas is cooled down
 - 2 Subcritical: after HP Valve In subcritical conditions. The hot side is a condenser

 **ΔP can be critical on gas side. Possible solutions partial bypass**

	Superheater/Subcooler	
Source	Subcritical CO ₂	Transcritical CO ₂
Capacity	<100 kW	<100 kW
Temp.	HP: 15÷40°C – 10÷35°C LP: 0°C – 10°C	HP: 15÷40°C – 10÷35°C LP: 0°C – 10°C
DeltaT	SH = 10 K	SBC = 2÷6K SH = 10 K
Design P	≤90 bar	≥120 bar
2 nd fluid	CO ₂	CO ₂

HIGH PRESSURE & HIGH TEMPERATURE FATIGUE

High pressure CO₂ Portfolio

- AXP & CBXP range



CBXP27	CBXP52	CBXP112	AXP27	AXP52	AXP112
70 kW (20 ton)	100 kW (28 ton)	250 kW (70 ton)	100 kW (28 ton)	150 kW (40 ton)	300 kW (85 ton)
111x310 mm	111x526 mm	191x616 mm	160x362 mm	160x582 mm	252x685mm
PS: 90 bar 1300 psi	PS: 90 bar 1300 psi	PS: 85 bar 1230 psi	PS: 130 bar 1880 psi	PS: 130 bar 1880 psi	PS: 140 bar 2030 psi

Ready for Natural Refrigerant: CO₂

High pressure CO₂ Portfolio

- How is it possible?



High pressure CO₂ Portfolio

- AXP & CBXP range



AXP10	AXP14	CBXP27	CBXP52	CBXP112	AXP27	AXP52	AXP112
15 kW (4 ton)	35kW (10ton)	70 kW (20 ton)	100 kW (28 ton)	250 kW (70 ton)	100 kW (28 ton)	150 kW (40 ton)	300 kW (85 ton)
76x190 mm	76x190 mm	111x310 mm	111x526 mm	191x616 mm	160x362 mm	160x582 mm	252x685mm
PS: 154 bar 2200 psi	PS: 140 bar 2030 psi	PS: 90 bar 1300 psi	PS: 90 bar 1300 psi	PS: 85 bar 1230 psi	PS: 130 bar 1880 psi	PS: 130 bar 1880 psi	PS: 140 bar 2030 psi

Is possible to reach higher pressure design w/o external reinforcement for bigger plate format?

AXP82

AXP82

– New design standards for CO2



- Bigger plate format vs AXP52
- Larger water ports
- **NO external reinforcements**

- **Scope**
 - HEAT RECLAIM
 - INTERNAL HEX
 - CASCADE
 - EVAPORATOR



AXP82

- New design standards for CO2



- Removed external reinforcements
- Increased the plate width **111mm → 160mm**
- Increased the port size **35 → 40mm**
- Increased the plate thickness
- Novel design around the CO2 ports

AXP82

- New design standards for CO2



- Pressure Design **140**bar (+10bar!)
- Pressure Fatigue **x2**
- Thermal Fatigue **x3**

AXP82

- New design standard for CO2



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THANK YOU Q&A

