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CO_2 compressors overview

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INTRODUCTION

- The purpose of this overview is to present some of the commercially-available largest CO_2 compressors for subcritical and transcritical applications
- In this presentation, the compressors of three brands are shown:
  - **Dorin:** CD series for transcritical and CDS series for subcritical applications.
  - **GEA**: HG series for subcritical and transcritical applications
  - **Bitzer**: Octagon SL for subcritical and Ecoline for transcritical applications

DORIN models

Transcritical
CD series

The compressors are used in transcritical applications for industrial, civil, and commercial applications.

- Semi-hermetic compressor
- Operating pressures of up to 110 bar
- Displacement from 1.12 to up to 80 m³/h (50 Hz, single stage)

Subcritical
CDS Series

The compressors are used for typical cascade and booster installations.

- Semi-hermetic compressor
- Operating pressures of up to 55 bar
- Displacement from 1.9 to 100 m³/h (50 Hz)

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DORIN models

Dorin will present its new CO2 compressors platform, the largest available worldwide. Based on a 6 cylinders design, this platform includes models up to 100 hp and 98.58 m3/ h with utmost efficiency levels and premium reliability standards.
The New CD600 range will replace the CD500 range and it will feature same displacements as the CD500 as well as larger capacity models.

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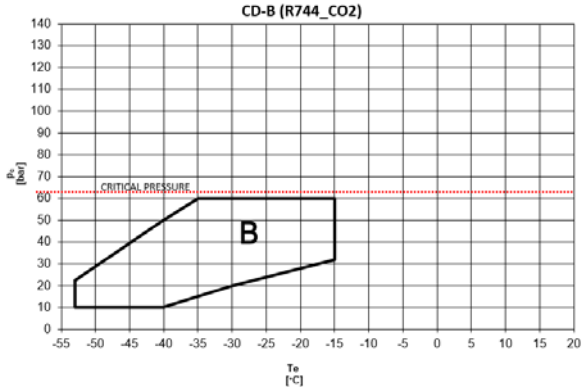
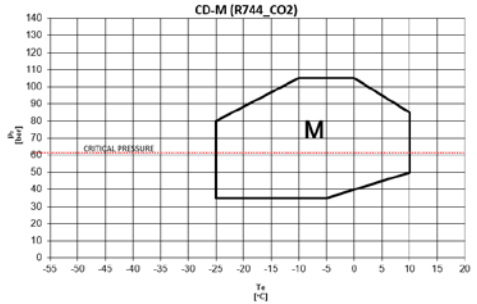
DORIN: largest subcritical

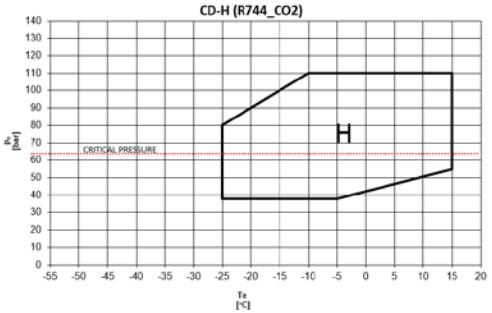
Model	m³/h	Weight	Pc min	Pc max	Pevap max	T evap min
CDS 3001B	48.82	160 kg	20 bar	51 bar	23 bar	-50 °C



DORIN: largest transcritical

Model	m³/h	Weight	Pc min	Pc max	Pevap max	T evap min
CD6 1600-82H	82	---	40 bar	110 bar	51 bar	-25 °C
CD6 901-59M	59.53	---	35 bar	105 bar	45 bar	-25 °C
CD6 801-53M	53.21	---	35 bar	105 bar	45 bar	-25 °C
CD6 801-45H	59.53	---	40 bar	110 bar	51 bar	-25 °C
CD6 701-45M	45.43	---	35 bar	105 bar	45 bar	-25 °C
CD6 701-40H	39.85	---	40 bar	110 bar	51 bar	-25 °C





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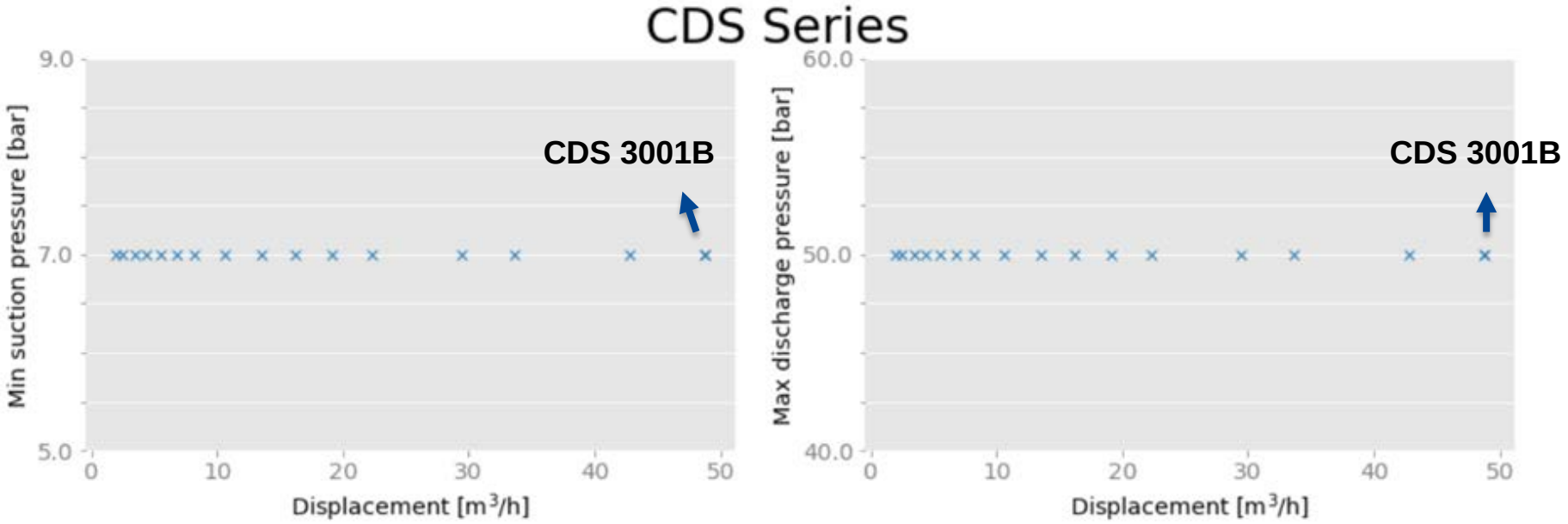
DORIN – CDS series

Standstill pressure max:

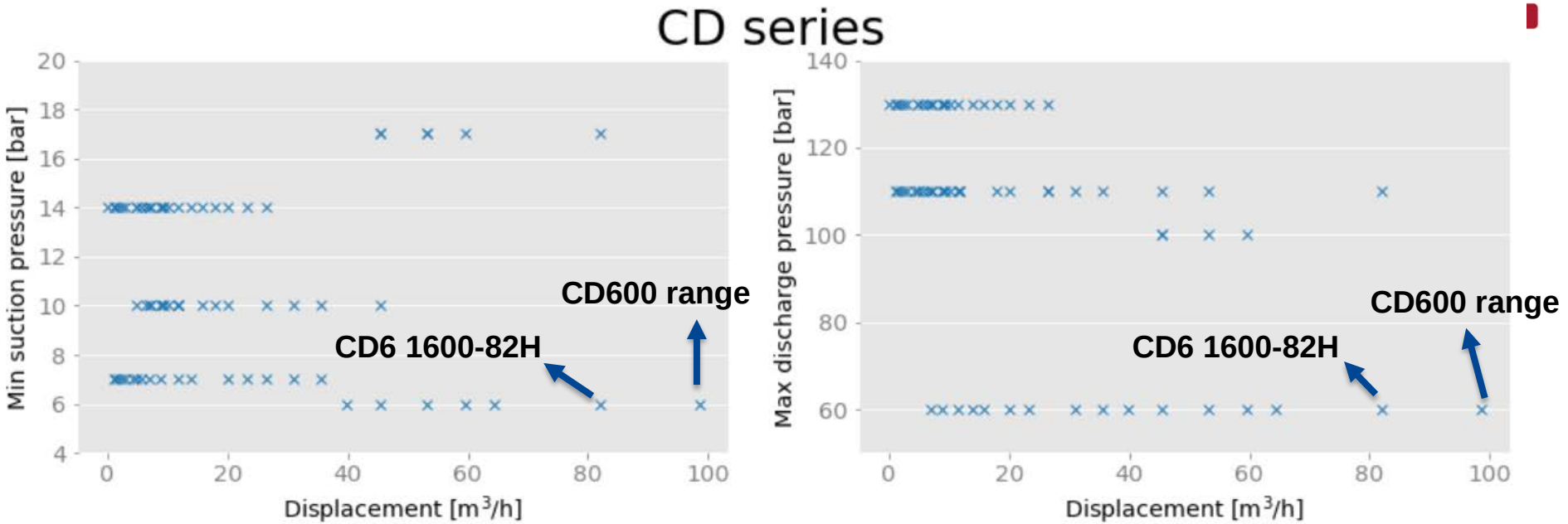
- LP -> 36 bar
- HP -> 55 bar



DORIN – CD series

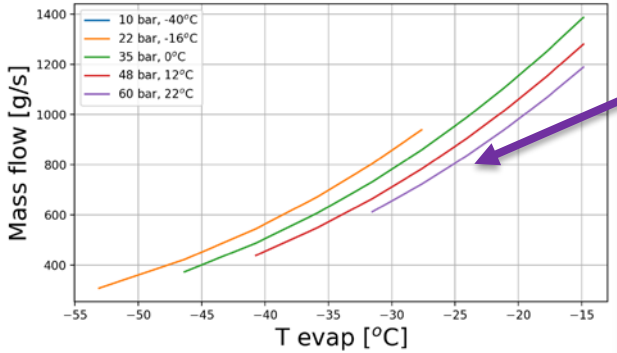
Standstill pressure max:

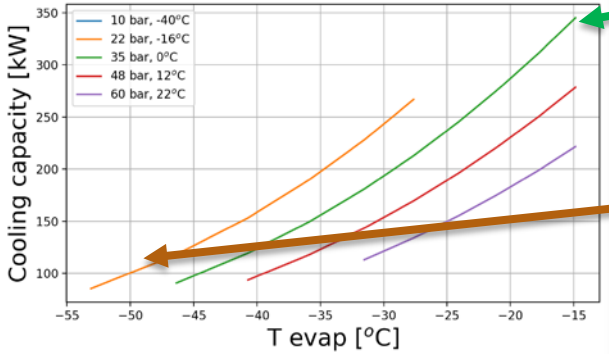
- LP -> 100 bar
- HP -> 150 bar



DORIN subcritical

99 m³/h





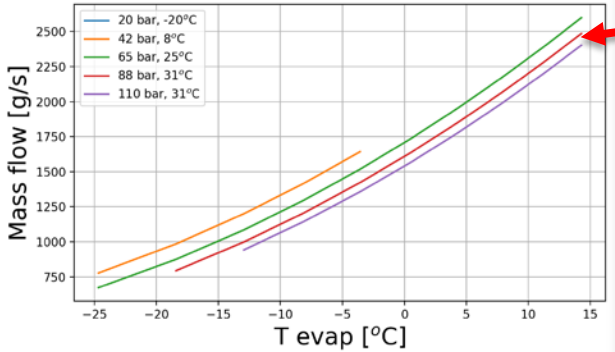
Max mass flow at +22 °C (60 bar)/-25 °C
= 800 g/s

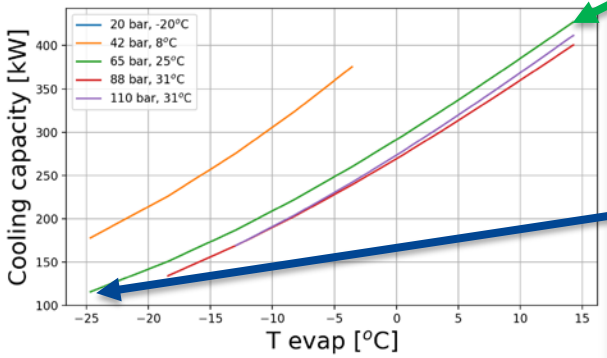
Max cooling capacity at 0 °C (35 bar)/ -15°C
= ~350 kW

Max cooling capacity at -16 °C (22 bar)/ -50°C
= 100 kW

DORIN transcritical

82 m³/h





Max mass flow at +31 °C (88 bar)/-25 °C
= ~2500 g/s

Max cooling capacity at 25 °C (65 bar)/ +15°C
= ~400 kW

Max cooling capacity at +25 °C (65 bar)/ -25°C = ~ 125 kW

GEA models

Transcritical

HG CO2 T compressors transcritical

Subcritical

HG CO2 T compressors subtranscritical

The compressors are used in transcritical and subcritical applications for supermarkets, commercial, industrial refrigeration and heat pumps.

- Gas-cooled semi-hermetic reciprocating compressor
- Operating pressures of up to 130 bar
- Displacement from 9.9 to 38.2 m³/h (50 Hz)
- Designed for transcritical CO_2: Standstill pressures LP 100 bar / HP 150 bar
- Highest efficiency in the market with EER/COP of more than 1.85 (50 Hz [1450 U/min], evaporating -10°C, gas cooler outlet 35°C/90 bar, superheat 10 K)

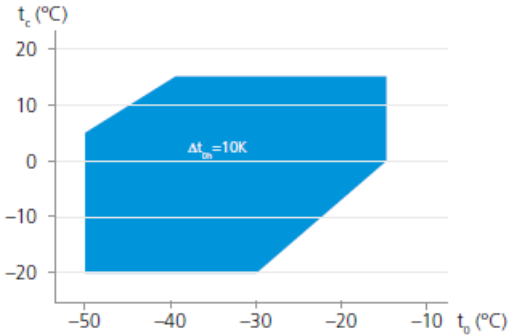
The compressors are used in cascade and booster systems in supermarket, commercial and industrial cooling applications.

- Gas-cooled semi-hermetic reciprocating compressor
- Subcritical CO_2 operating conditions (low temperature application)
- Displacement from 1.6 to 49.2 m³/h (50 Hz)
- Operating pressures of up to 51 bar (t_c =15°C)
- Designed for subcritical CO_2:
  - Standstill pressure LP 40 bar (30 bar)* / HP 55 bar
  - High efficiency at low temperature applications (t_o < -15°C)

GEA: largest subcritical

HGX44e CO2 compressors subcritical

Model	m³/h	Weight	Pc min	Pc max	Pevap max	T evap min
HGX44e-565-4-S	49.2	201 Kg	20 bar	51 bar	23 bar	-50 °C
HGX44e-475-4-S	41.3	200 Kg	20 bar	51 bar	23 bar	-50 °C
HGX44e-390-4-S	34.2	203 Kg	20 bar	51 bar	23 bar	-50 °C
HGX44e-320-4-S	27.7	197 Kg	20 bar	51 bar	23 bar	-50 °C
HGX34e-255-4-S	22.3	104 Kg	20 bar	51 bar	23 bar	-50 °C
HGX34e-210-4-S	18.4	102 Kg	20 bar	51 bar	23 bar	-50 °C



Max. permissible operating pressure (LP/HP):
HGX12e CO_2/HGX22e CO_2/HGX34e CO_2: 40/55 bar
HGX44e CO_2: 30/55 bar

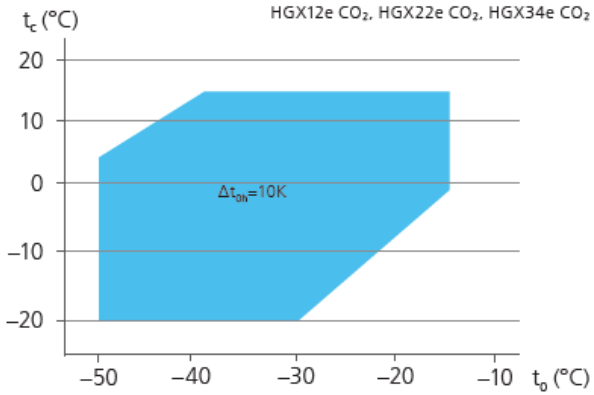
GEA: largest transcritical

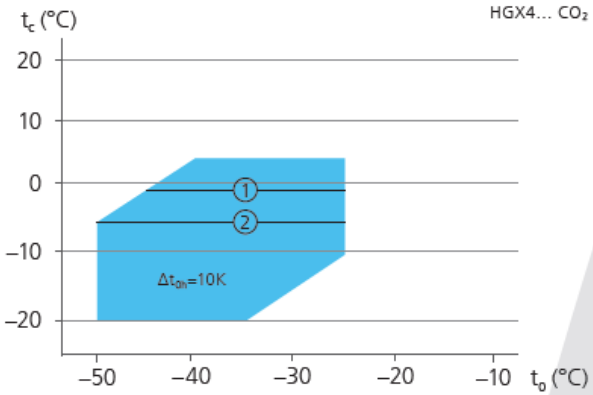
HG46 CO2 T compressor transcritical

Model	m³/h	Weight	Pc min	Pc max	Pevap max	Tevap min
HGX46/440-4 ML	38.2	201 Kg	40 bar	110 bar	35 bar	-40 °C
HGX46/345-4 S/SH/ML	30.2	242 Kg	40/47/40 bar	130/130/110 bar	45/65/35 bar	-40 °C
HGX46/310-4 S/SH/ML	27.2	240 Kg	40/47/40 bar	130/130/110 bar	45/65/35 bar	-40 °C
HGX46/290-4 S/SH/ML	25.5	218 Kg	40/47/40 bar	130/130/110 bar	45/65/35 bar	-40 °C
HGX46/280-4 S/SH/ML	24.4	240 Kg	40/47/40 bar	130/130/110 bar	45/65/35 bar	-40 °C
HGX34/280-4 S/SH/ML	20.1	213 Kg	40/47/40 bar	130/130/110 bar	45/65/35 bar	-40 °C

GEA: largest transcritical

HG46 CO2 T compressor transcritical





t_o Evaporating temperature (°C)
Δt_{oh} Suction gas superheat (K)
t_c Condensing temperature (°C)

Max. permissible operating pressure (LP/HP) [1] for HGX12e, HGX22e and HGX34e: 40/55 bar
Max. permissible operating pressure (LP/HP) [1] for HGX4: 27/55 bar, HGX4 CO_2

[1] LP = low pressure, HP = high pressure

● Unlimited application range

① HGX4/385-4 CO_2, HGX4/465-4 CO_2
Max. condensing temperature
t_c = 0 °C

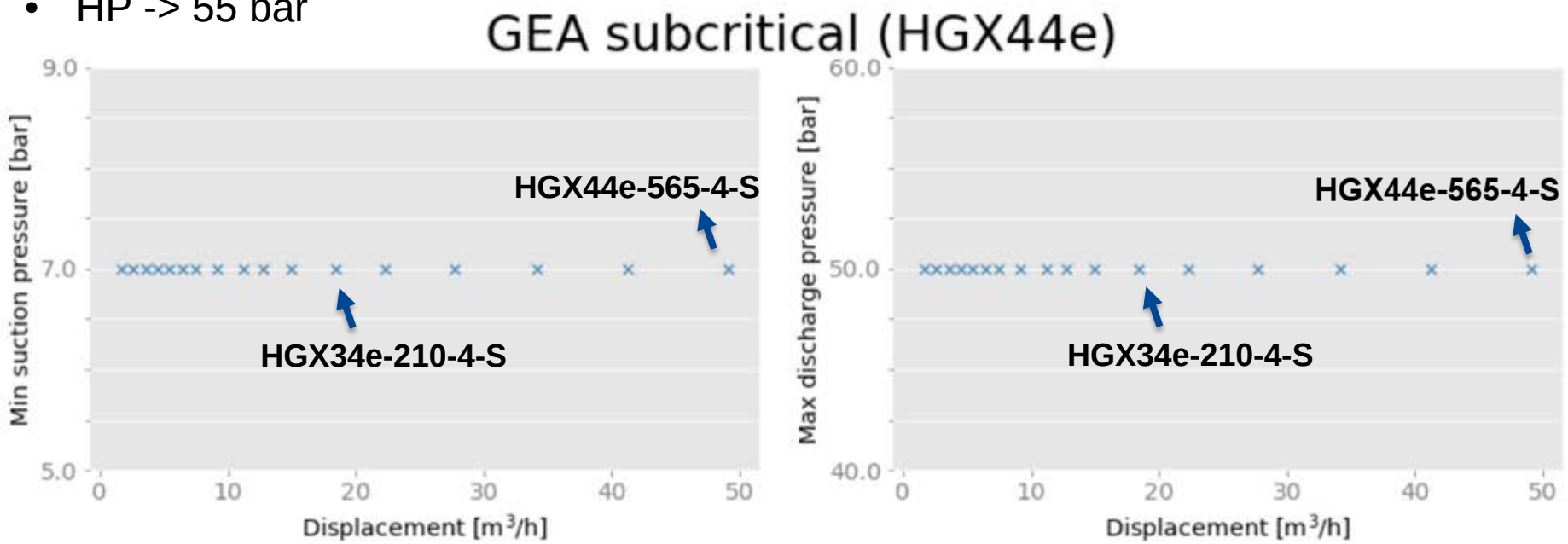
② HGX4/555-4 CO_2
Max. condensing temperature
t_c = –5 °C

GEA – HGX44e series

Standstill pressure max:

- LP -> 40 bar
- HP -> 55 bar


HGX44e CO2 compressors subcritical

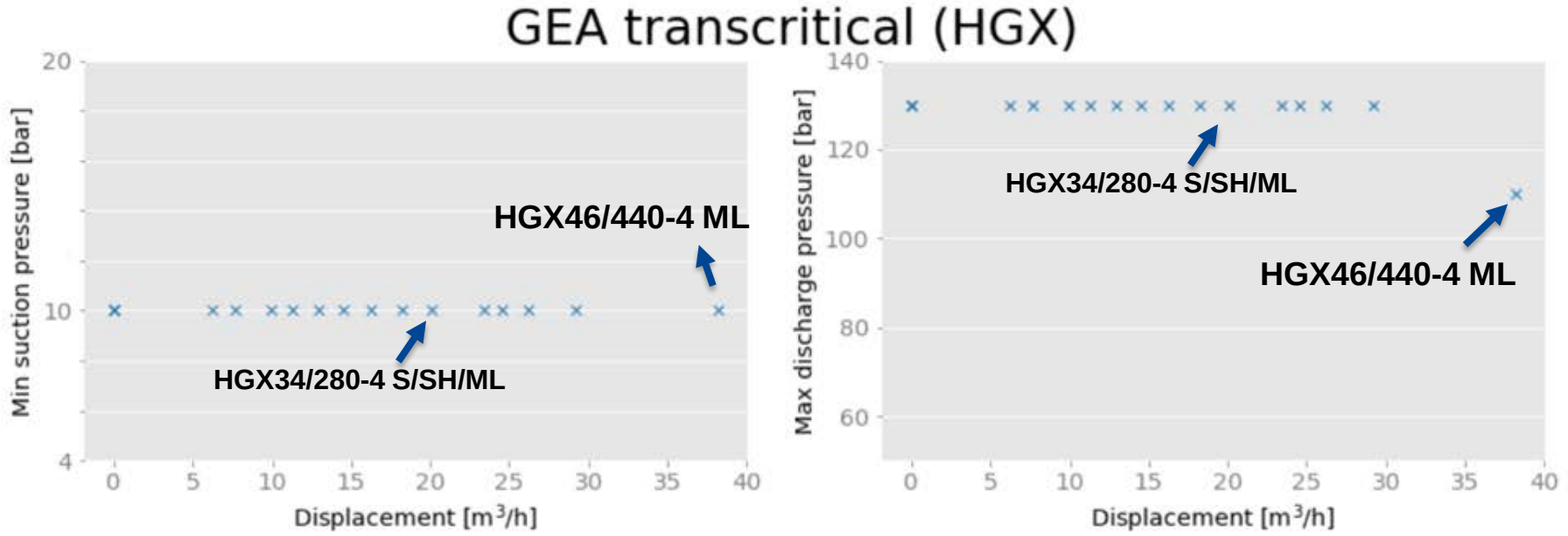


GEA – HG series

Standstill pressure max:

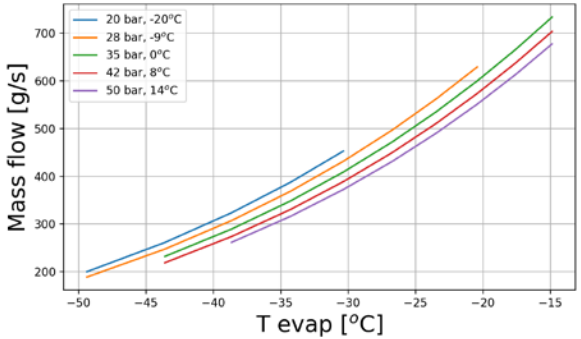
- LP -> 100 bar
- HP -> 150 bar

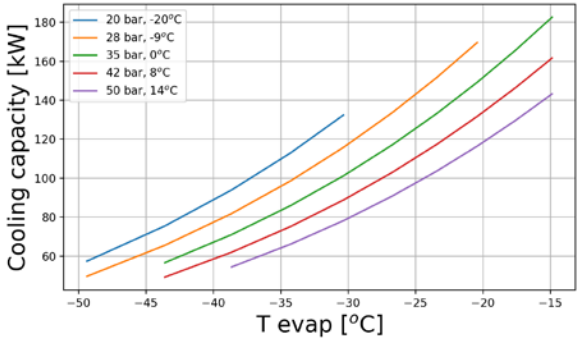

HG46 CO2 T compressor transcritical



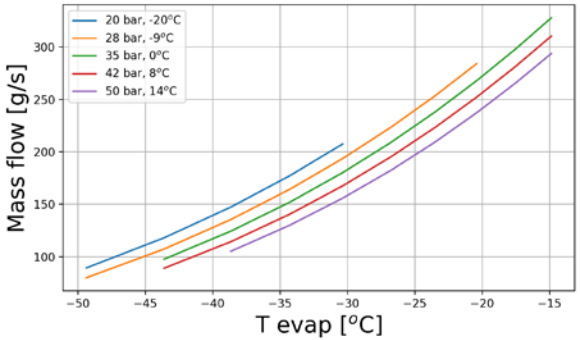
GEA subcritical

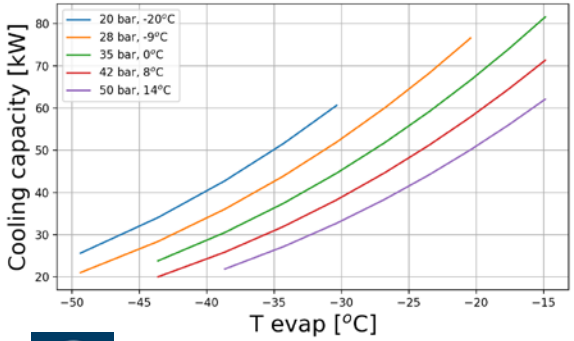
49 m³/h



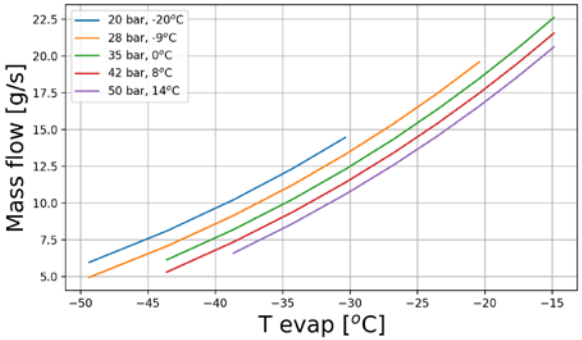


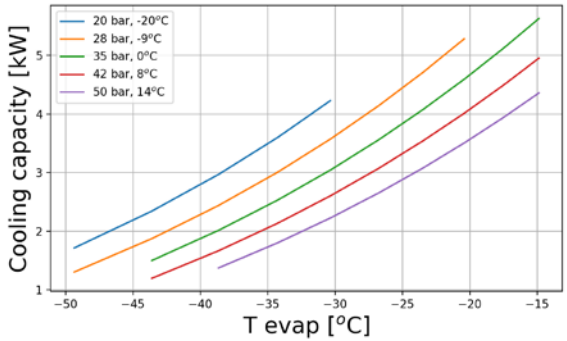
22 m³/h





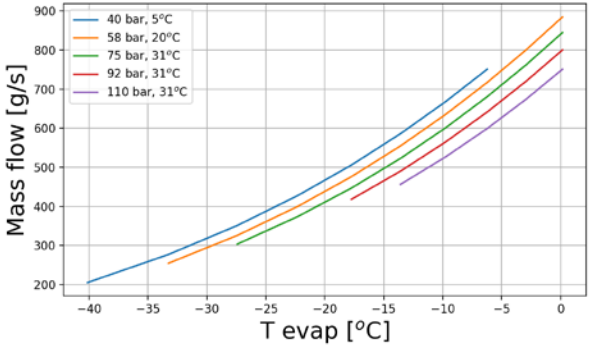
1.6 m³/h

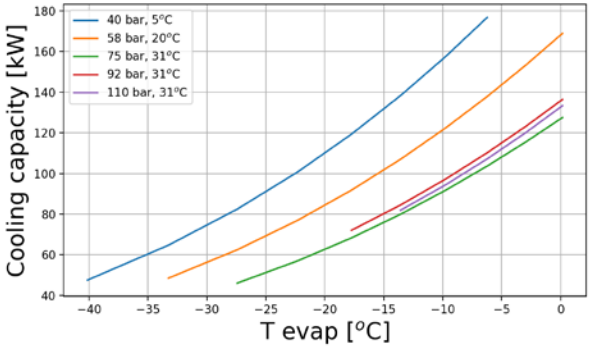




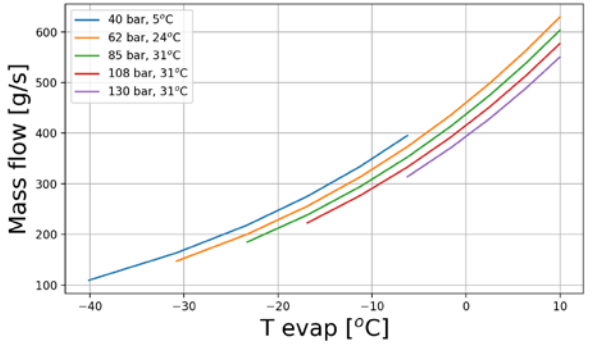
GEA transcritical

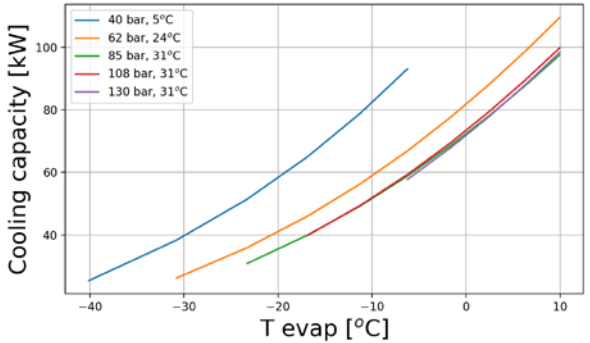
38 m³/h



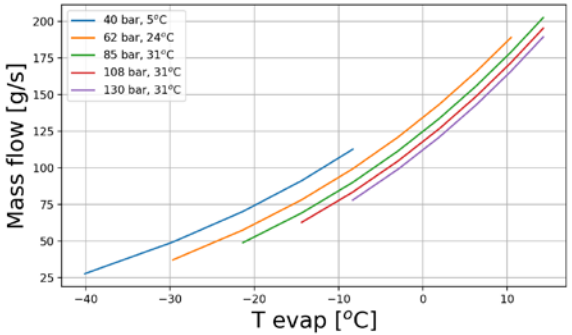


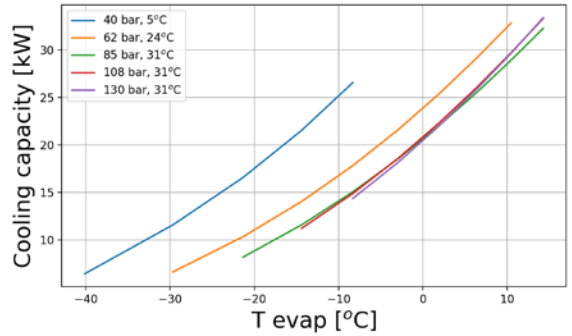
20 m³/h



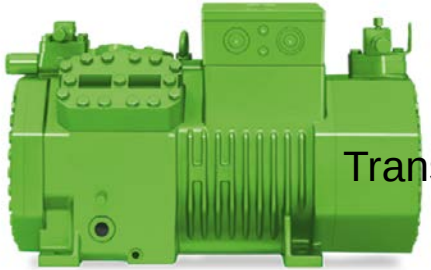


6 m³/h



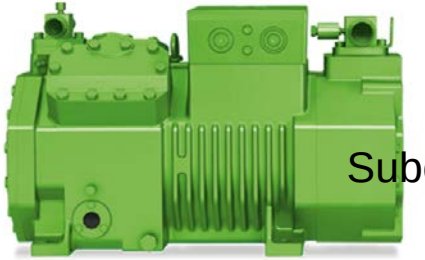


Bitzer models



Transcritical

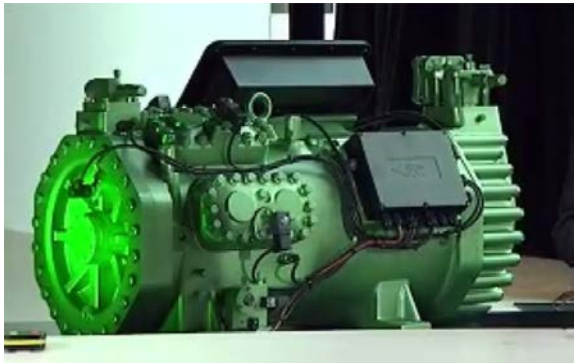
BITZER's CO_2 compressors have been setting benchmarks in transcritical CO_2 applications for many years. The series was revised to increase its efficiency once again, and optimise the suction gas flow control and the valve plates. The ECOLINE TE compressors also boast tailored motors for a wide range of applications with the natural refrigerant CO_2. But what hasn't changed is one tried-and-tested characteristic: its high reliability makes the ECOLINE TE series a natural addition to BITZER's selection of CO_2 compressors.
Ecoline transcritical



Subcritical

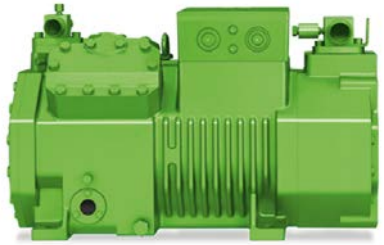
BITZER CO_2 compressors have been proving their worth in subcritical CO_2 applications since 1998. The OCTAGON SL series is a closely stepped range of models with a cooling capacity ranging between 2.7 and 80 kW (–35° C/–5° C) for subcritical CO_2 applications. Alongside its well-known attributes, this SL compressor series also offers improved energy efficiency. In addition, the application limits were pushed to a higher condensing temperature (53/30 bar).
Octogan SL subcritical

Bitzer models



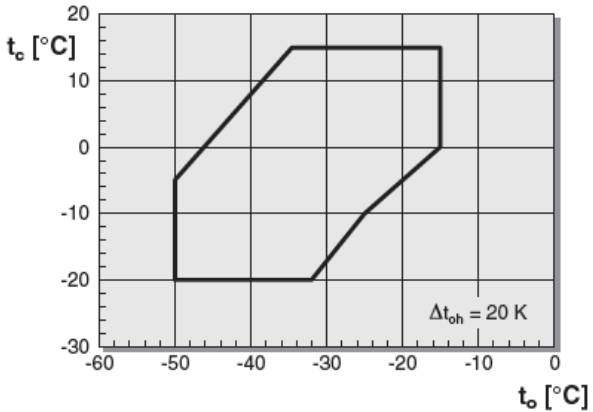
Bitzer is to introduce a 140hp eight-cylinder compressor – its largest compressor for transcritical CO2 applications.
Announced today at the Chillventa eSpecial online exhibition, the new CKHE7 compressor has a displacement of 99.2m^3/hr, which is around 2.5x larger than currently available models.
Designed for large commercial and light industrial applications, as well as heat pumps, the compressor is equipped with mechanical capacity unloading and offers a wide speed range for inverter drives. Like similar products, it is equipped with Bitzer's IQ control system.
The compressor will be available from 2021.

BITZER: largest subcritical



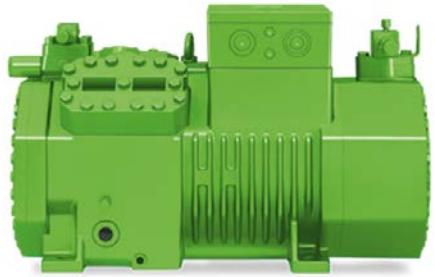
Model	m^3/h	Weight	Pc min	Pc max	Pevap max	T evap min
6PME-40K	55	---	---	---	---	-50 °C
4NSL-30K	46.9	171 Kg	20 bar	51 bar	23 bar	-50 °C
4PSL-25K	40.4	171 Kg	20 bar	51 bar	23 bar	-50 °C
4TSL-20K	34.4	154 Kg	20 bar	51 bar	23 bar	-50 °C
4VSL-15K	28.9	154 Kg	20 bar	51 bar	23 bar	-50 °C

Based on 20 K suction superheat



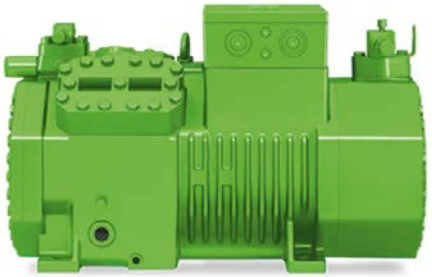
t_o Evaporating temperature (°C)
t_c Condensing temperature (°C)
Δt_{oh} Suction gas superheat (K)

BITZER: largest transcritical



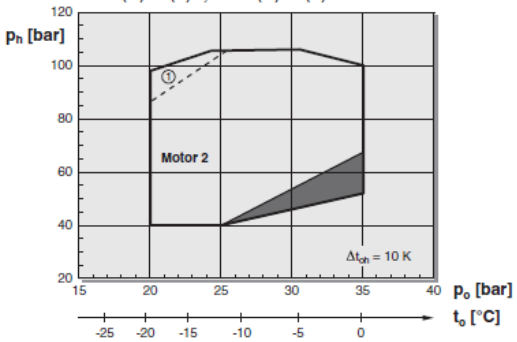
Model	m^3/h	Weight	Pc min	Pc max	Pevap max	Tevap min
6CTE-50K	38.2	241 Kg	40 bar	105 bar	35 bar	-20 °C
6DTE-50K	30.3	242 Kg	40 bar	130 bar	55 bar	-40 °C
6DTE-40K	30.3	238 Kg	40 bar	105 bar	35 bar	-20 °C
6FTE-50K	26.1	243 Kg	40 bar	140 bar	55 bar	-20 °C
6FTE-35K	26.1	233 Kg	40 bar	105 bar	35 bar	-20 °C

BITZER: largest transcritical

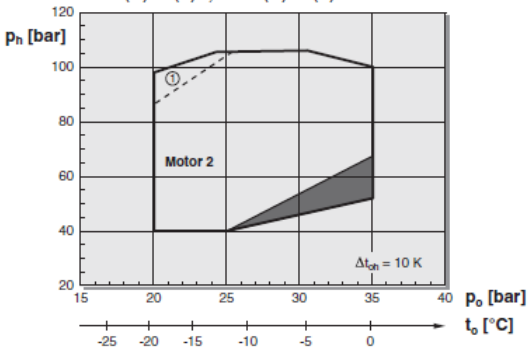


Based on 10 K suction superheat

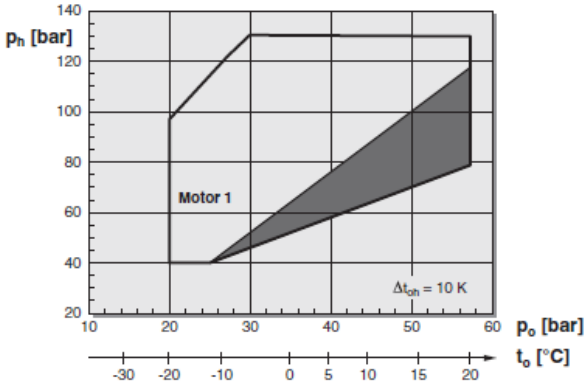
2MTE(U)-4(L)K, 2KTE(U)-5(L)K, 4PTE(U)-6(L)K, 4MTE(U)-7(L)K, 4KTE(U)-10(L)K, 4JTE(U)-10(L)K, 4HTE(U)-15(L)K, 4GTE(U)-20(L)K, 4FTE(U)-20(L)K, 6DTE(U)-25(L)K, 4CTE(U)-30(L)K, 6FTE(U)-35(L)K, 6DTE(U)-40(L)K, 6CTE(U)-50(L)K



2MTE(U)-4(L)K, 2KTE(U)-5(L)K, 4PTE(U)-6(L)K, 4MTE(U)-7(L)K, 4KTE(U)-10(L)K, 4JTE(U)-10(L)K, 4HTE(U)-15(L)K, 4GTE(U)-20(L)K, 4FTE(U)-20(L)K, 6DTE(U)-25(L)K, 4CTE(U)-30(L)K, 6FTE(U)-35(L)K, 6DTE(U)-40(L)K, 6CTE(U)-50(L)K



6DTE(U)-50(L)K

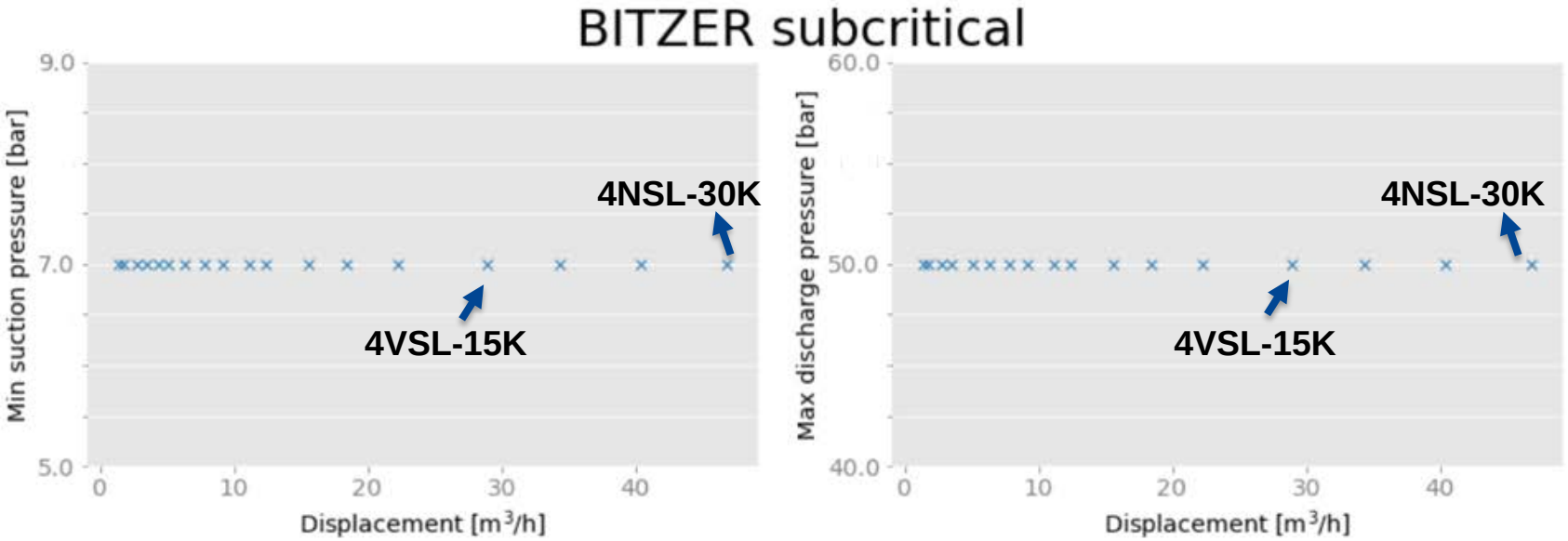


t_o	Evaporating temperature (°C)
Δt_{oh}	Suction superheat (K)
p_o	Suction pressure abs. (bar)
p_h	High pressure abs. (bar)
①	Range with limitations for the compressors 4PTEU

BITZER - subcritical

Standstill pressure max:

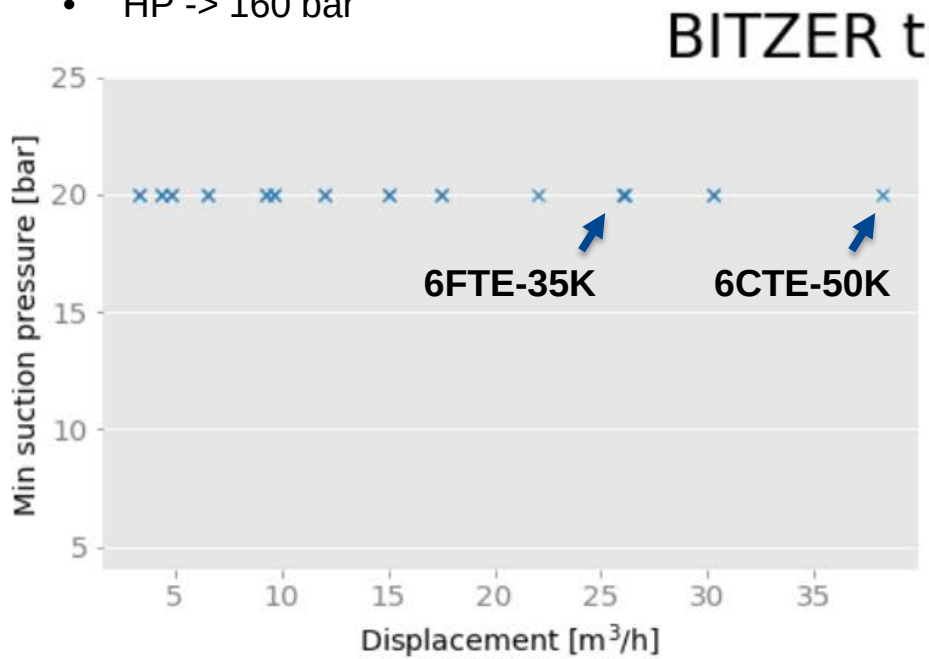
- LP -> 30 bar
- HP -> 53 bar

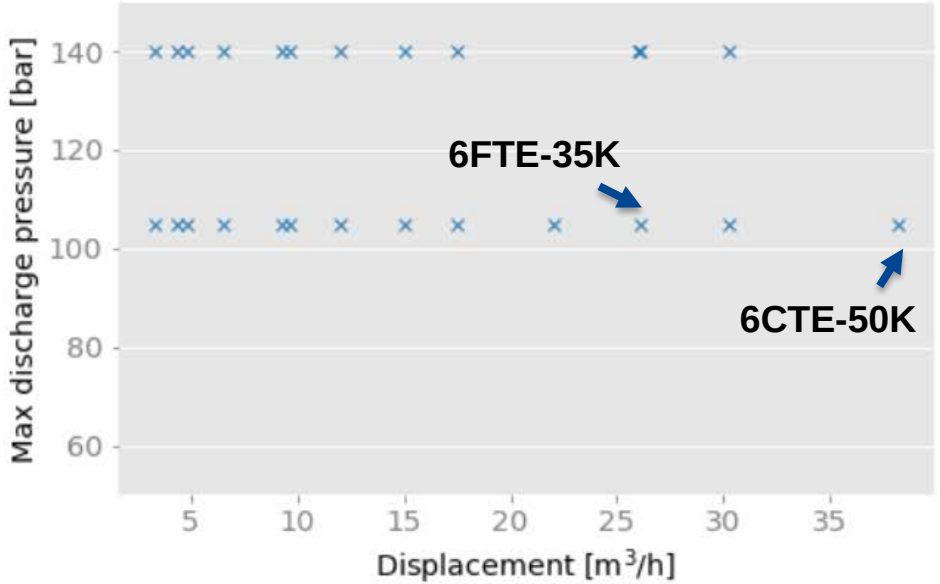


BITZER - transcritical

Standstill pressure max:

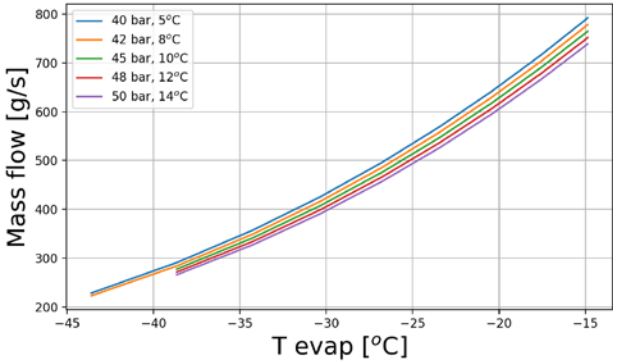
- LP -> 100 bar
- HP -> 160 bar

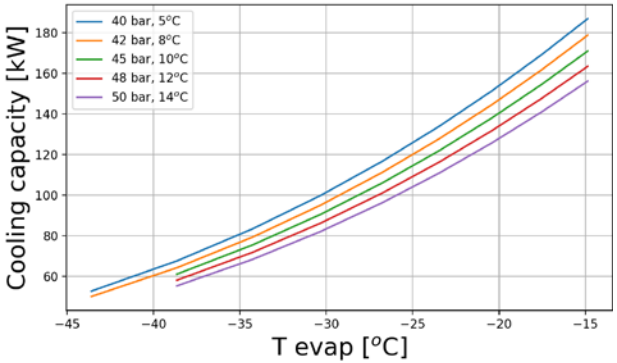




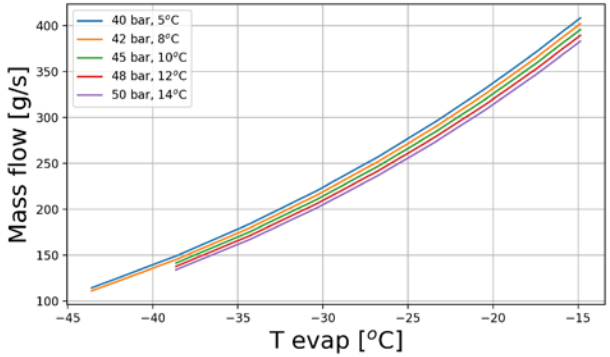
BITZER subcritical

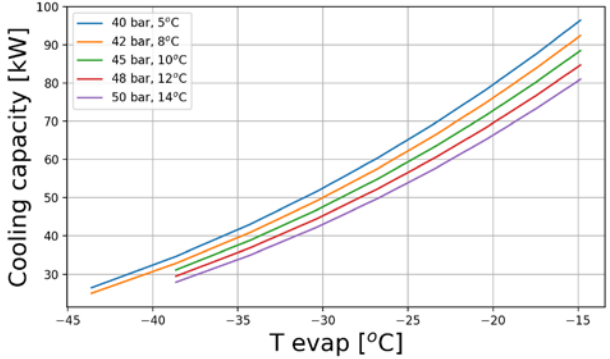
55 m³/h



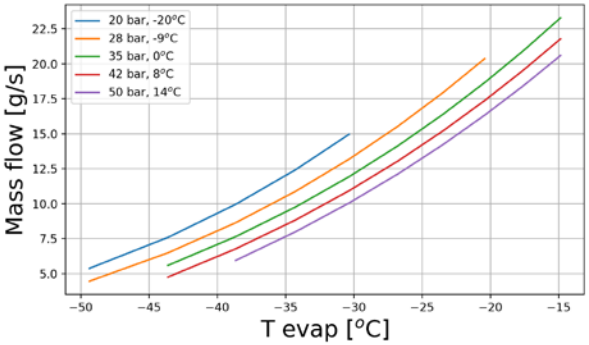


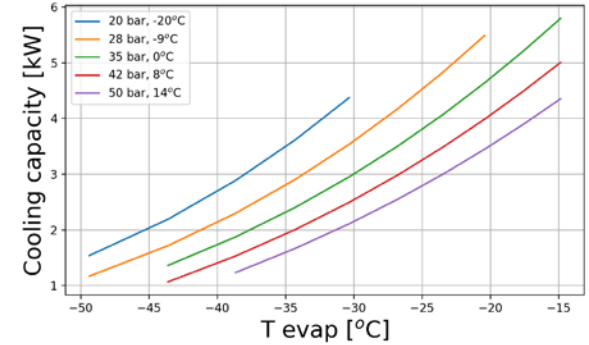
29 m³/h





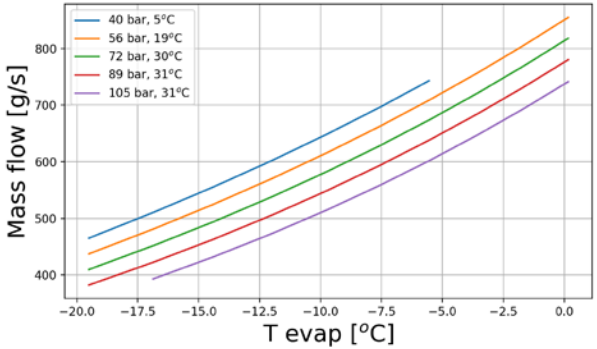
1.7 m³/h

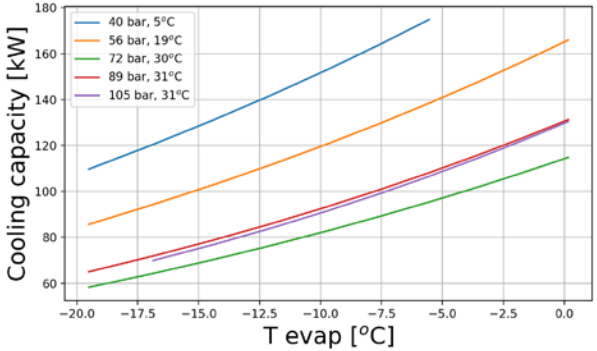




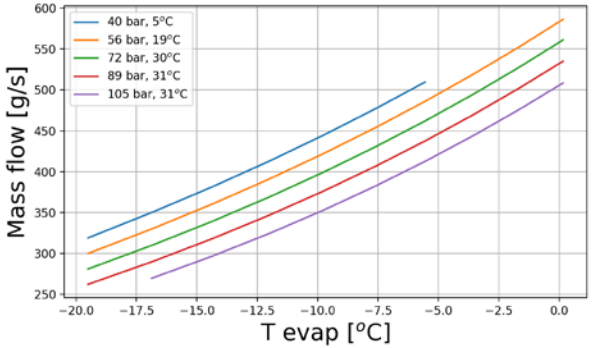
BITZER transcritical

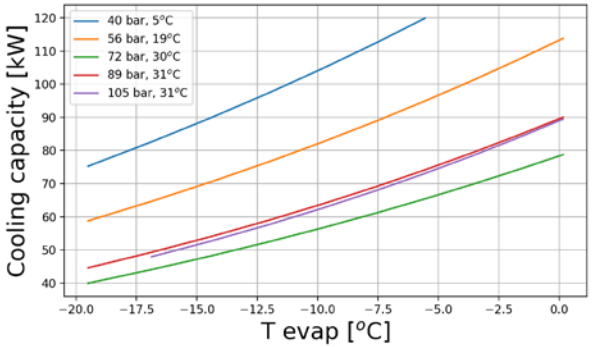
38 m³/h



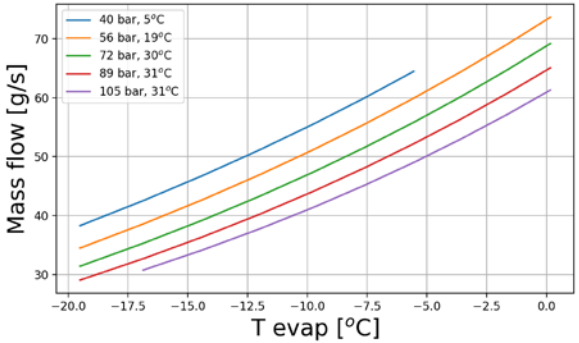


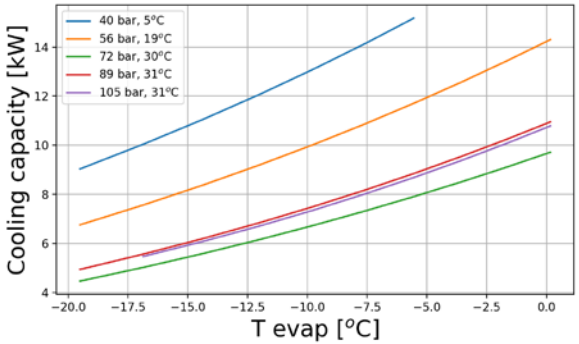
26 m³/h





3 m³/h





Summary

- Max capacities, an overview

Brand	Type	Mass flow [m^3/h]	Max pressure [bar]	Max cooling capacity [kW]
Dorin	*Transcritical*	82	110	400
	Subcritical	99	60	350
GEA	*Transcritical*	38.2	130	180
	Subcritical	49	51	180
Bitzer	*Transcritical*	99.2	130	180
	Subcritical	55	23	180

Thanks for listening