Plate heat exchangers technology in comparison with the shell & tube

Matteo Danese

Agenda

1. Air Conditioning – EU Market Trends
2. Main Advatnages of BPHE compared to S&T
3. Main Advantages of S&T compared to BPHE
4. Chillers Overview: capacity, efficiency, technology
   - ❖ Heat Exchangers Portfolio

Air Conditioning - EU Market Trends

– Focus on Europe

EUROPE

- **A/C**: Push for Low GWP Refrigerants (F-gas) and higher efficiencies (ECO Design)
- **A/C**: Multi-scroll compressors ready for R32
- **A/C**: Replacement of S&T with BPHE for multi-scroll >600kW
- **A/C**: Replacement of S&T with BPHE for screw direct expansion (DX)

Main Advantages of BHE compared to S&T

1. Footprint
2. Efficiency
3. Refrigerant Charge
4. Heat Recovery Option
5. Logistic and Transport

EUROPE

- **A/C** : Push for Low GWP Refrigerants (F-gas) and higher efficiencies (ECO Design)
- **A/C** : Multi-scroll compressors ready for R32

Main Advantages of BHE compared to S&T

1. Footprint

Brazed Plates Heat Exchanges (BPHE)

- Parallelepiped shape
- Any orientation possible in the chiller
- Flexibility on piping arrangment and architecture
- Piping arrangement replicable for more sizes
- Room for additional components (hydraulic kit)

Shell and Tubes (S&T)

- Cilindrical shape
- Length is dominant: ‘parallel’ to the chiller lenght
- Piping layout determined by need to fit S&T
- Different piping arrangment for different sizes
- No space for additional components

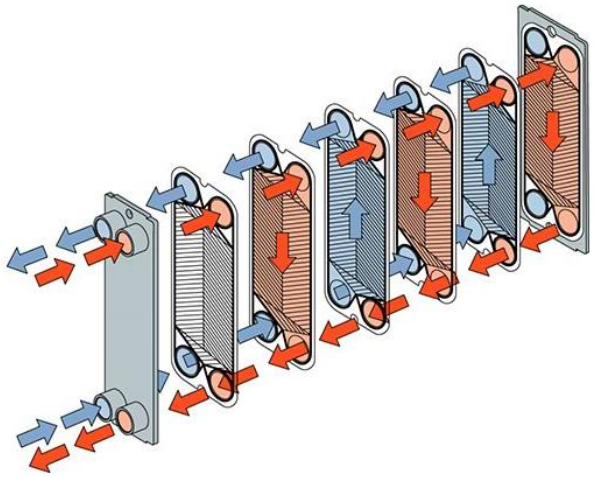
Main Advantages of BHE compared to S&T

2. Efficiency

* **A/C** : Push for Low GWP Refrigerants (F-gas) and higher efficiencies (**ECO Design**)

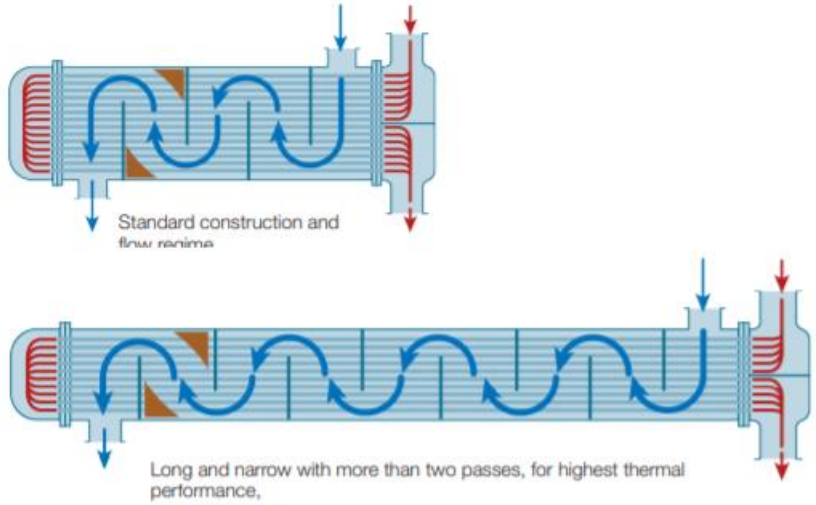
Brazed Plates Heat Exchanges (BPHE)

- Modularity: add plates to increase efficiency
- High turbolence: manage variable flow at part load
- Asymmetric design: lower dp_w



Shell and Tubes (S&T)

- Increase length for higher efficiency
- Lower turbolence in S&T



Every % efficiency increase is more costly in S&T rather than BPHE.
BPHE: easier to comply with ECO Design rules

Main Advantages of BHE compared to S&T

3. Refrigerant charge ; 4. Heat Recovery Option ; 5. Logistic and Transport

3. Refrigerant Charge

BPHE comes with lower ref. volume, reducing the refrigerant charge.

4. Heat Recovery Option

BPHEs, thanks to the smaller footprint, allow room for heat recovery option (DSPH)

5. Logistic and Trasport

BPHEs are cheaper and easier to trasport and stock (lower space usage)

Main Advantages of S&T compared to BPHE

S&T can be inspected, differently than BPHE. How to overcome this in BPHE?

- **Maximum allowed particle size provided**
- **Technical water and closed loops used in most chillers**
- **Minimum flowrate**
  - Avoids fouling
  - Avoids local corrosion
  - Avoids low performance

Reynolds Number (Re)

Shear Stress (tau)

Channel flow data			
Re (in, mid, out)	751.9	657.6	605.6

Hot Side Water
tau(wall)= 51.21 Pa

Main Advantages of S&T compared to BPHE

S&T have a more resistant design to ice formation (freezing).
How to overcome this in BPHE?

IceSafe

Controlled, non-destructive freezing

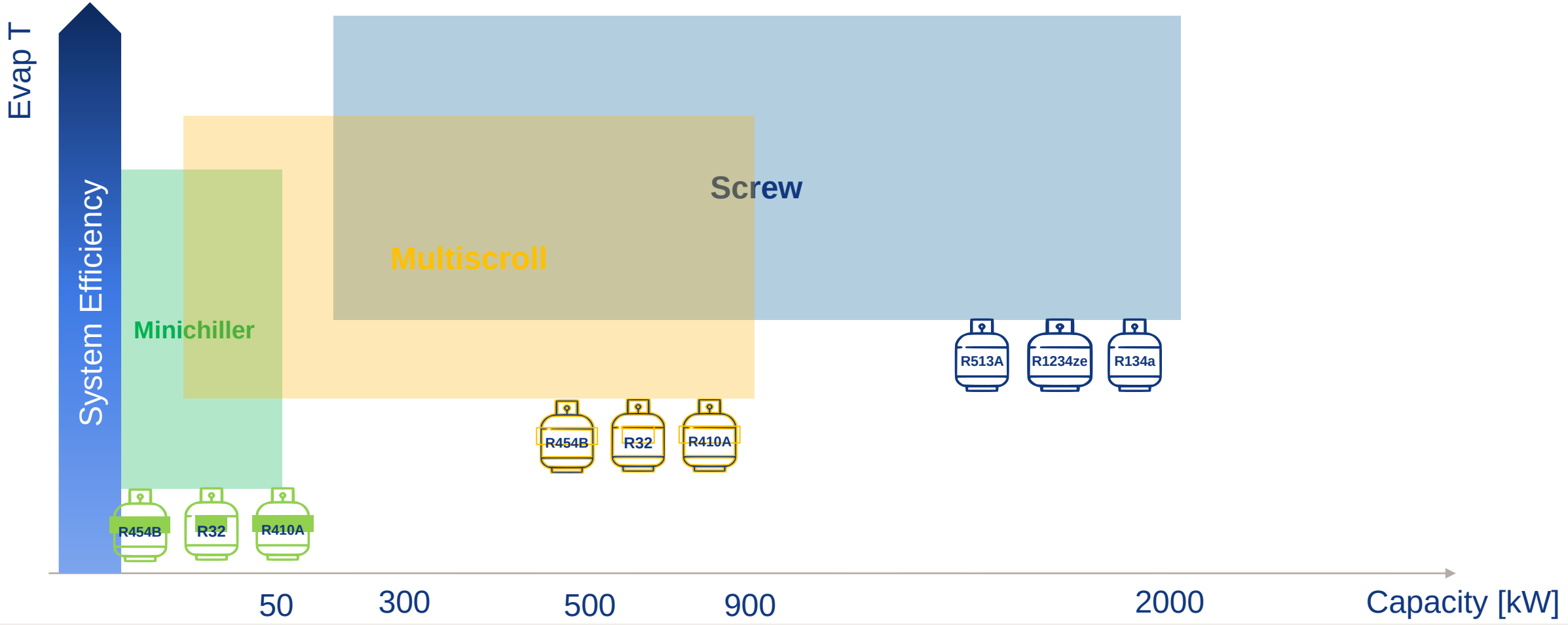
Ice safe design

- Freezing can start locally in low flowrate/velocity zones in the water channel
- Channel plate design can be optimized to eliminate these low velocity zones

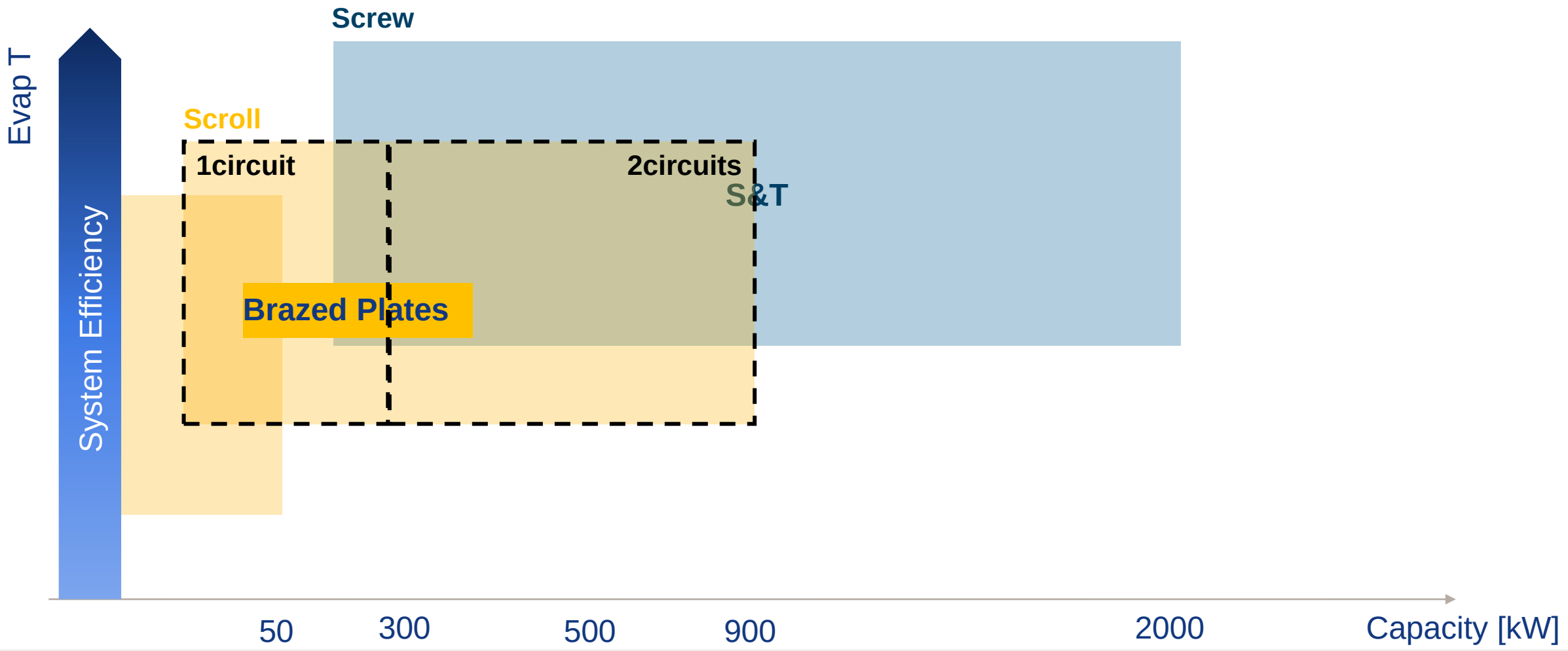
Anti freezing guidelines

- General guidelines on water flow and Wall Temperature must be considered in case of **continuous** low temperature level operations

Chillers Overview: capacity, efficiency, technology

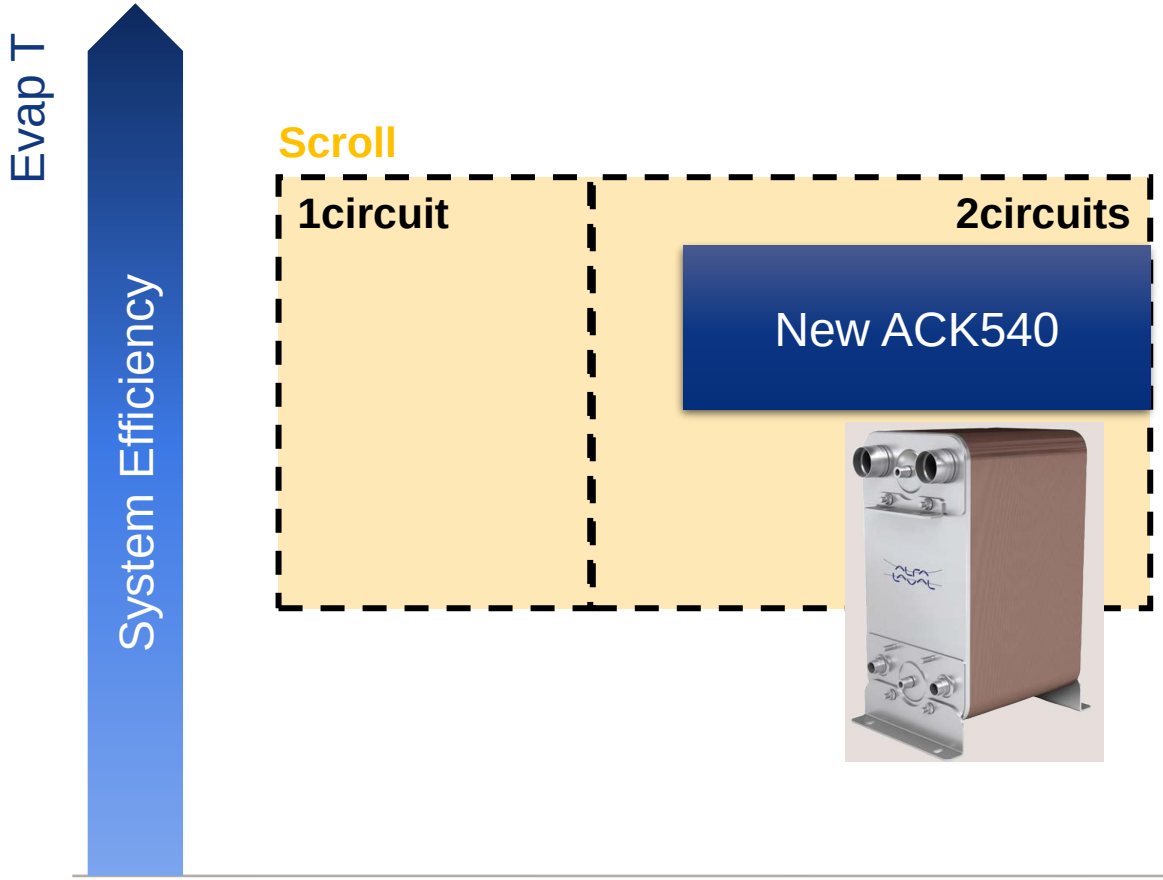


Chillers Overview: capacity, efficiency, technology



Chillers Overview: capacity, efficiency, technology

– Heat Exchangers Portolio: Scroll



- Full Load Design: Te > 4°C @ **Dp_w < 35kPa** up to 900kW
- Part Load with Te > 5°C
- Same item can be used with multiple refrigerants: standardization

Chillers Overview: capacity, efficiency, technology

– Heat Exchangers Portfolio: Scroll ACK540DQ

- PressureSecure ➔ ACK540 Version: 49bar @150°C
- REFuture ➔ Multi-refrigerant Platform (R32, R410A, R454B, etc)
- DynaStatic™ ➔ Flexible distr. system suitable for low GWP ref.
- IceSafe ➔ Controlled freezing design, Antifreezing Guidelines
- FlexFlow™ ➔ Asymmetric channel plates, best in class water PD

Chillers Overview: capacity, efficiency, technology

– Heat Exchangers Portfolio: Screw

Evap T

System Efficiency

Screw

Single Circuit

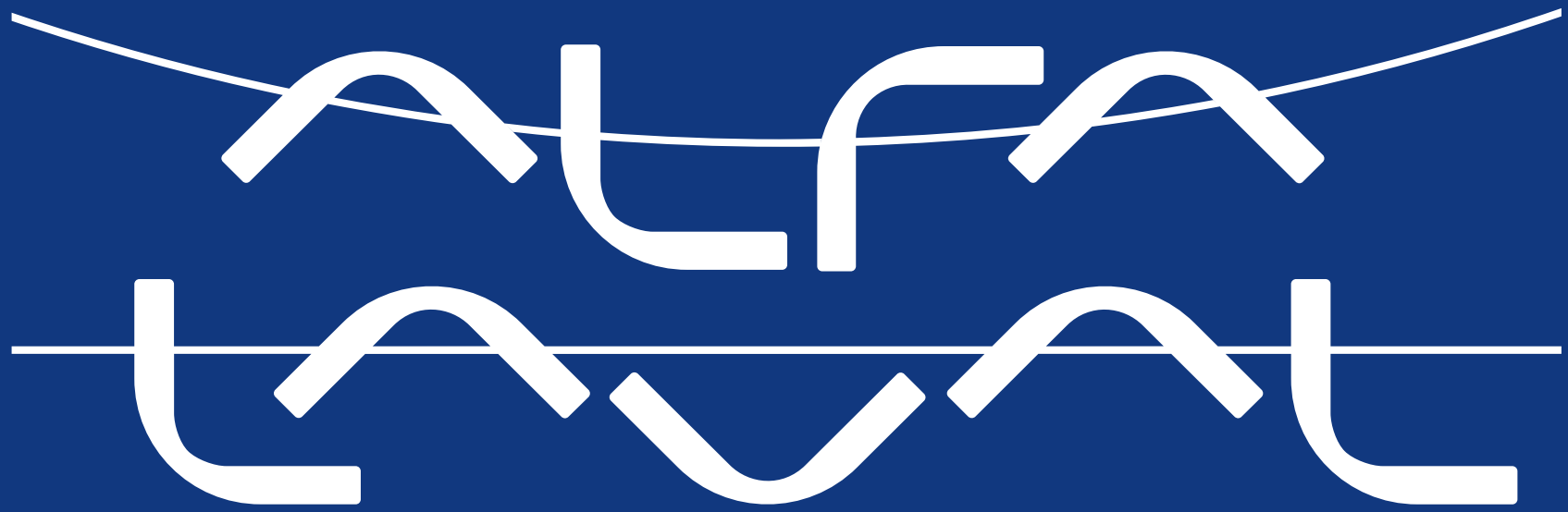
Double Circuit

AC500EQ

AC540DQ & AC1000DQ

- Dedicated Distribution System
- AC500EQ: Te 3,5÷4°C @ Dp_w < 25kPa up to 300kW
- AC1000DQ: Te 3,5÷4°C @ Dp_w < 20kPa up to 700kW

50 300 500 700 2000 Capacity [kW]


ALFA
LAVAL