

CO_2 General system designs, and practical examples

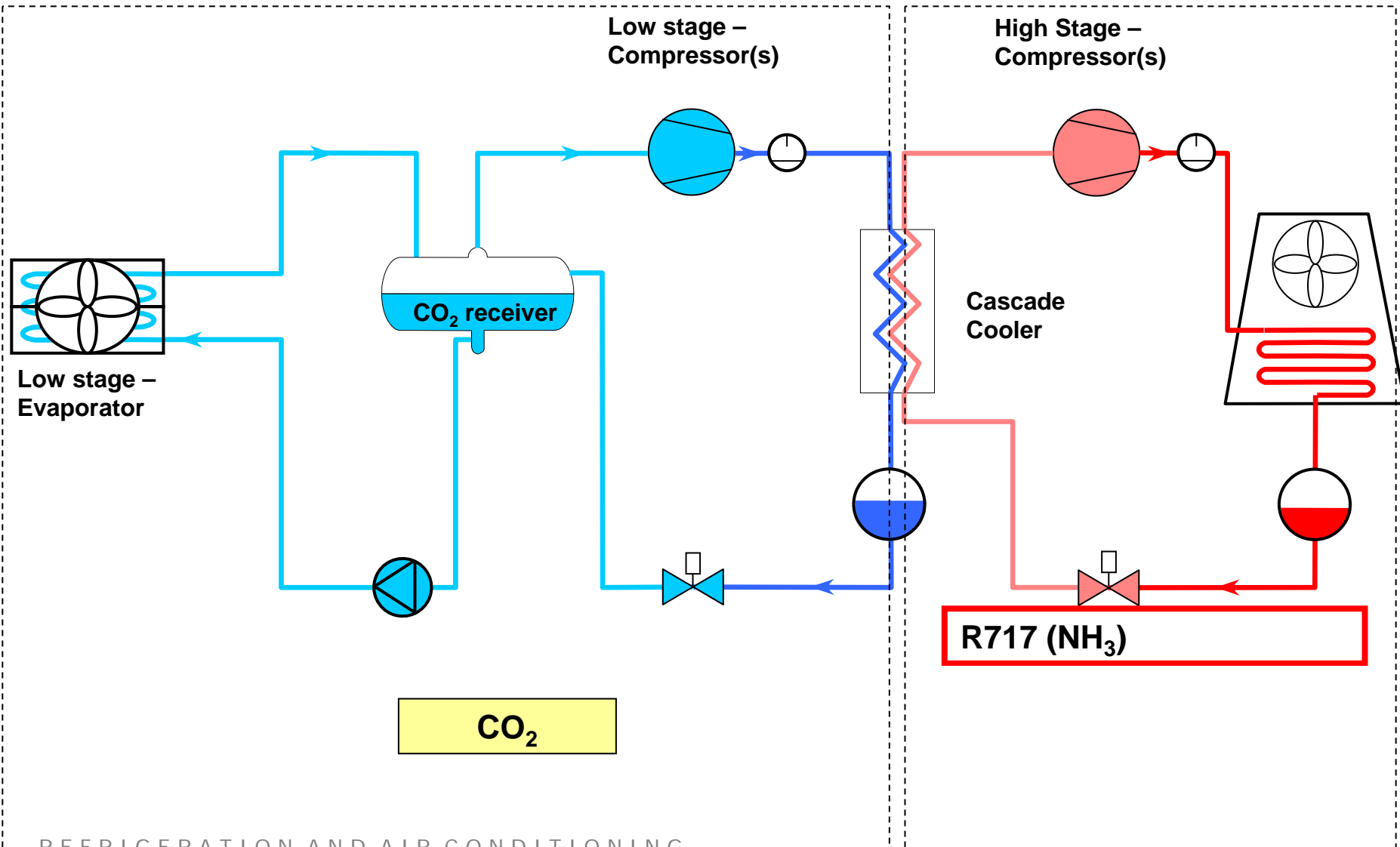
Prepared by:
Carsten E Petersen
2010-05

CO₂ – NH₃ cascade system

Danfoss

Low stage – CO₂

High stage - NH₃



CO₂ – NH₃ cascade system

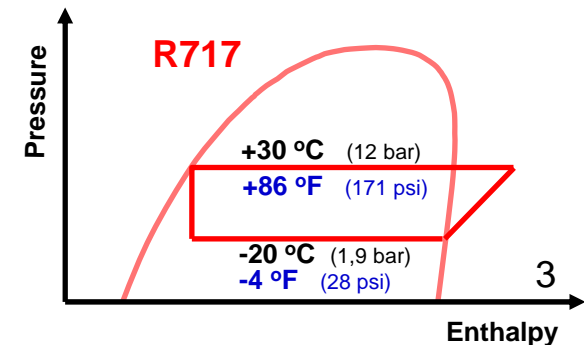
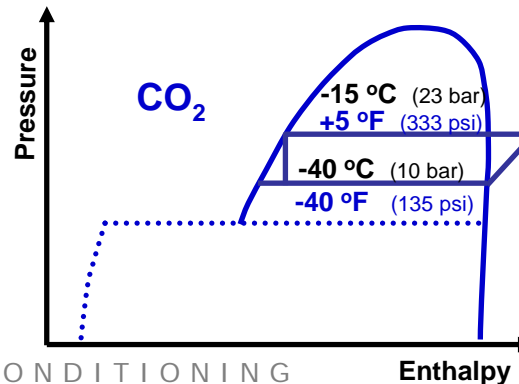
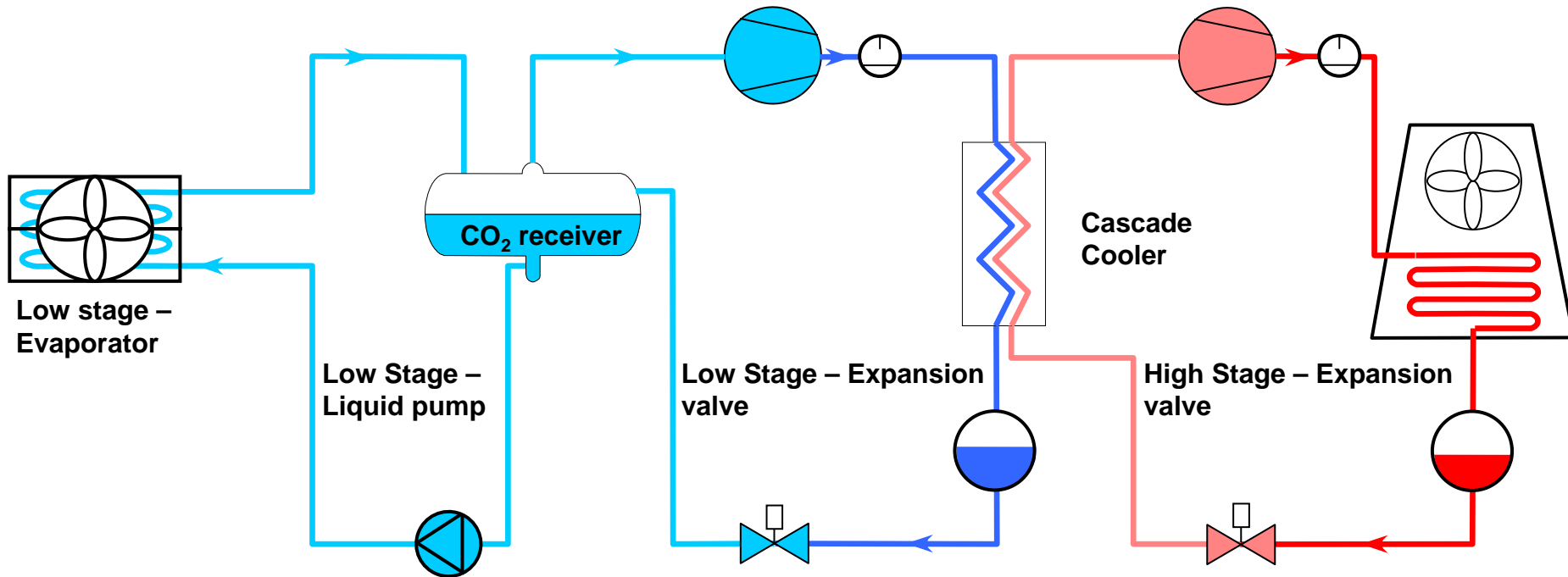
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Low stage – CO₂

High stage - NH₃

Low stage – Compressor(s)

High Stage – Compressor(s)



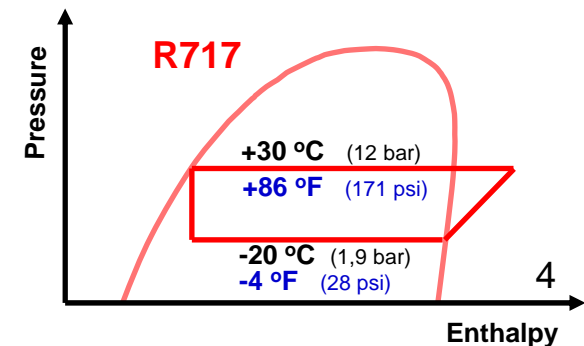
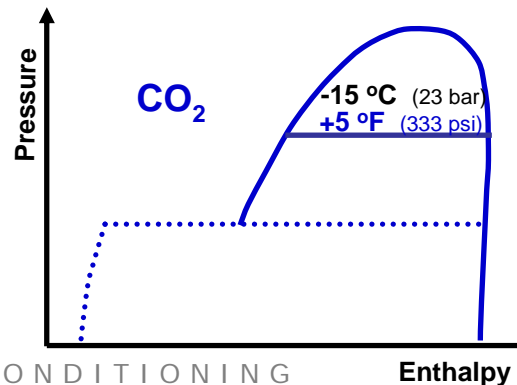
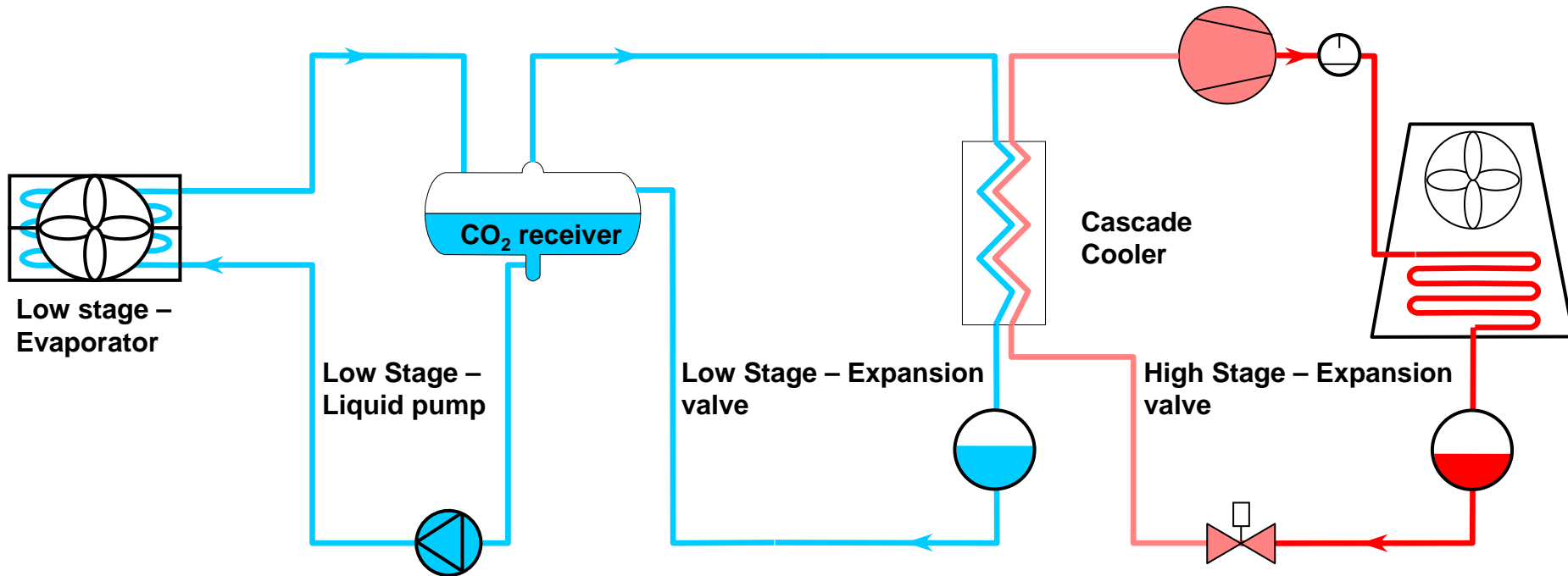
CO₂ – NH₃ “brine” system

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Low stage – CO₂

High stage - NH₃

High Stage – Compressor(s)

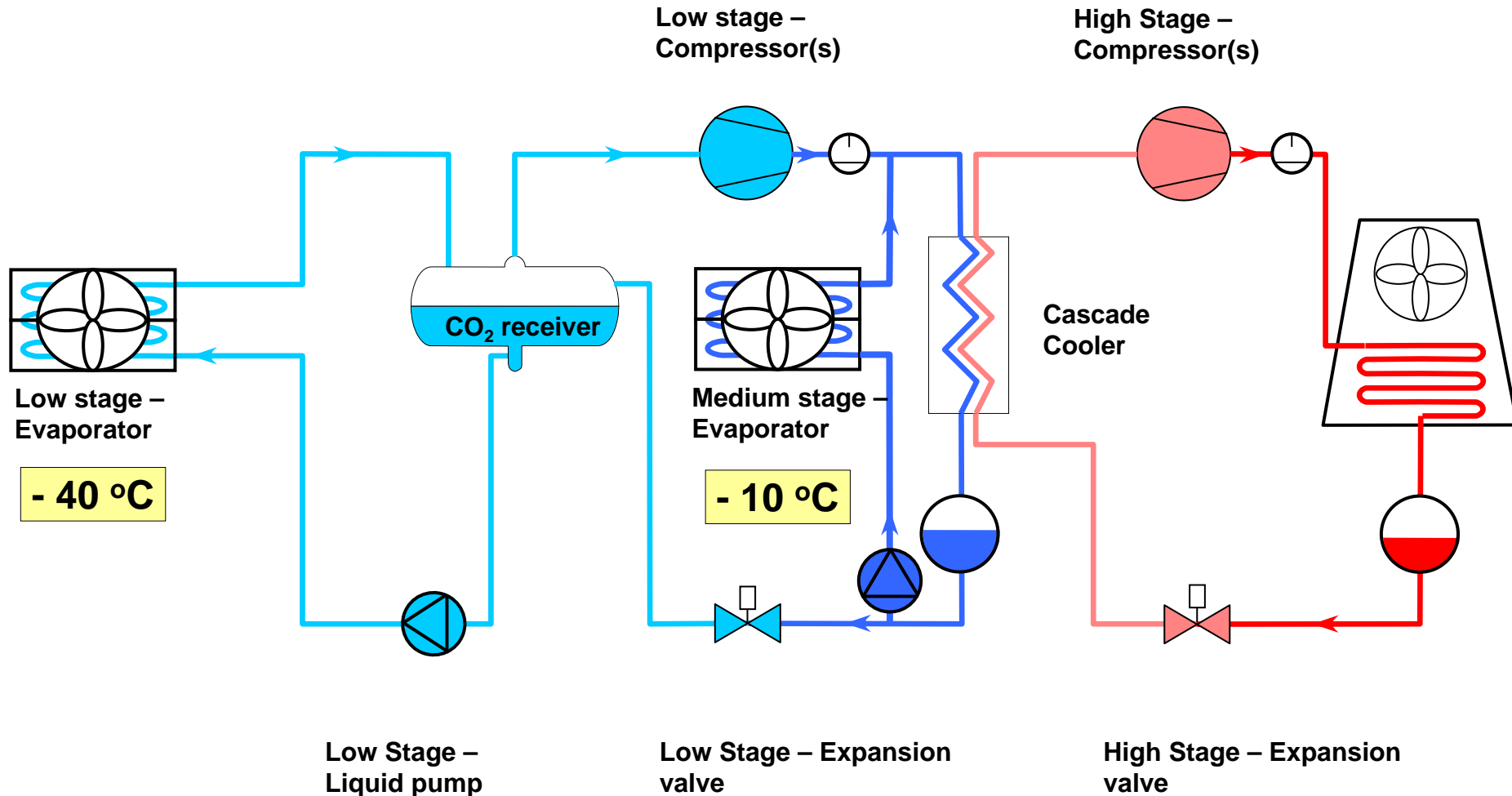


CO₂ – NH₃ cascade system

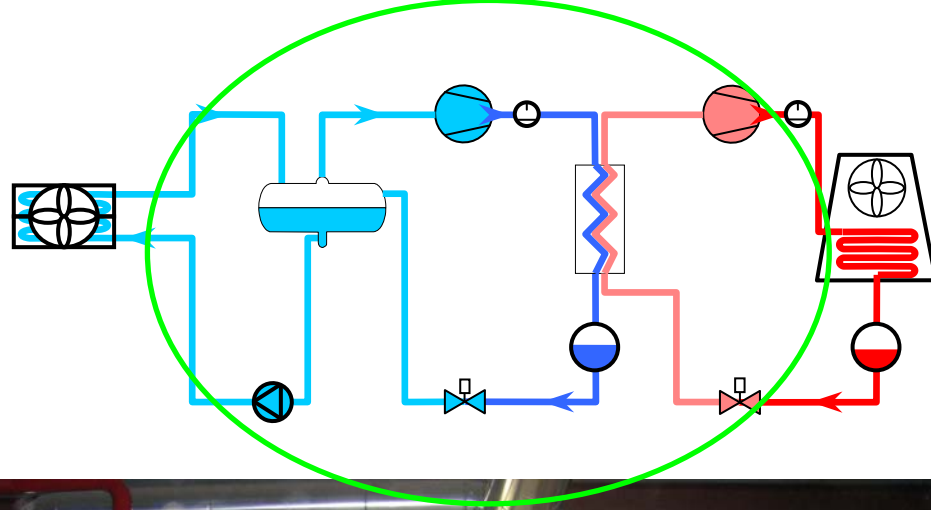
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Low stage – CO₂

High stage - NH₃

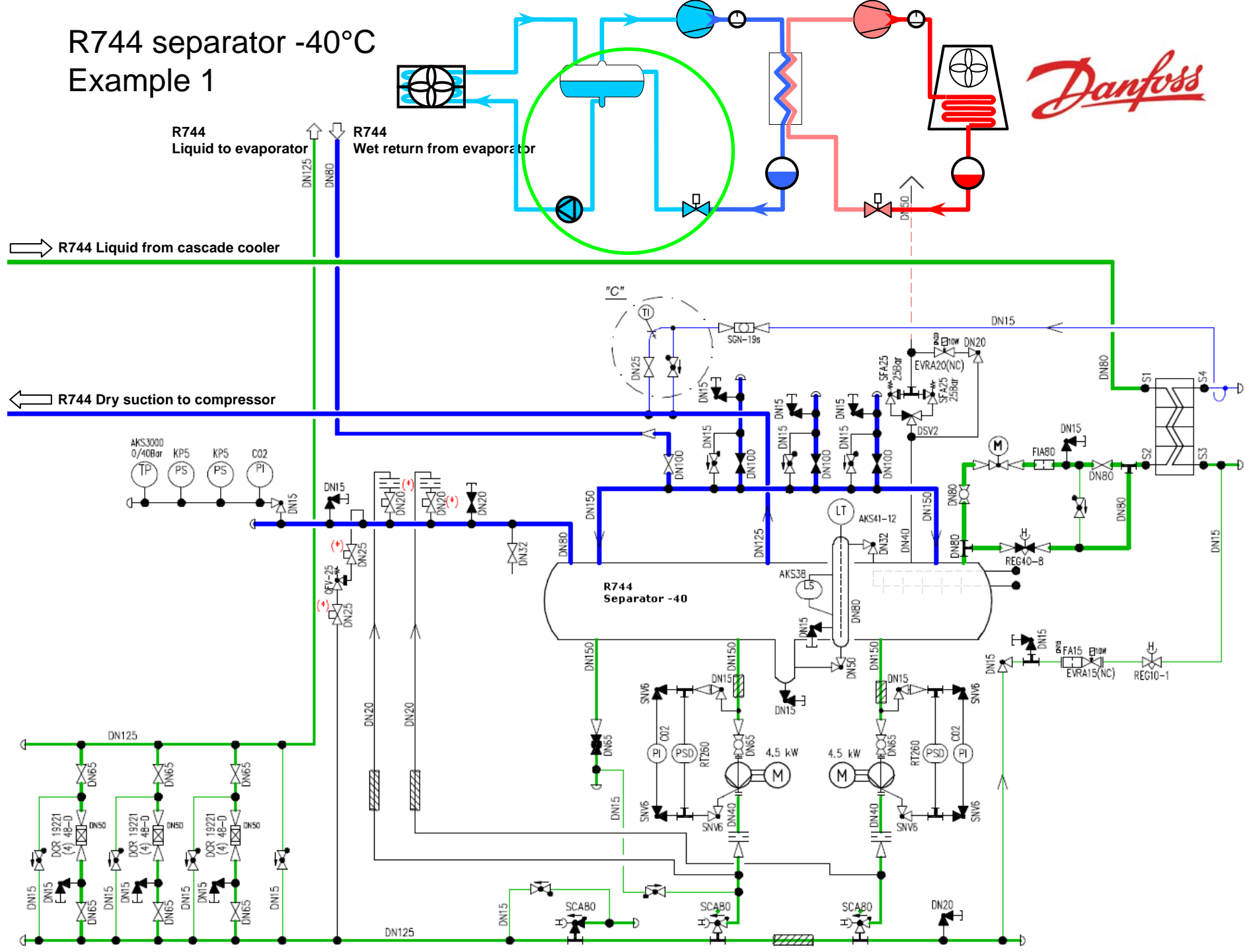


Machine room
Cascade system
R744 / R717

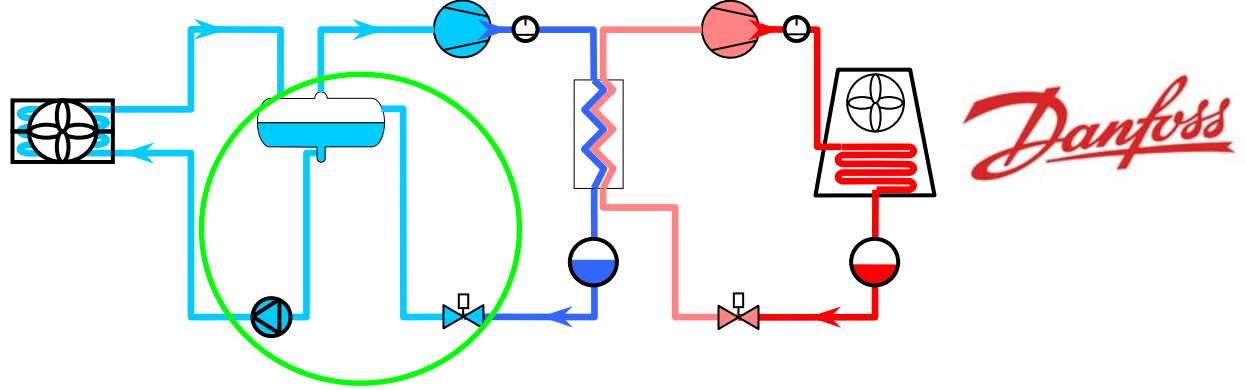


R744 separator -40°C

Example 1



R744 separator -40°C Example 2



R744 Dry suction to compressor

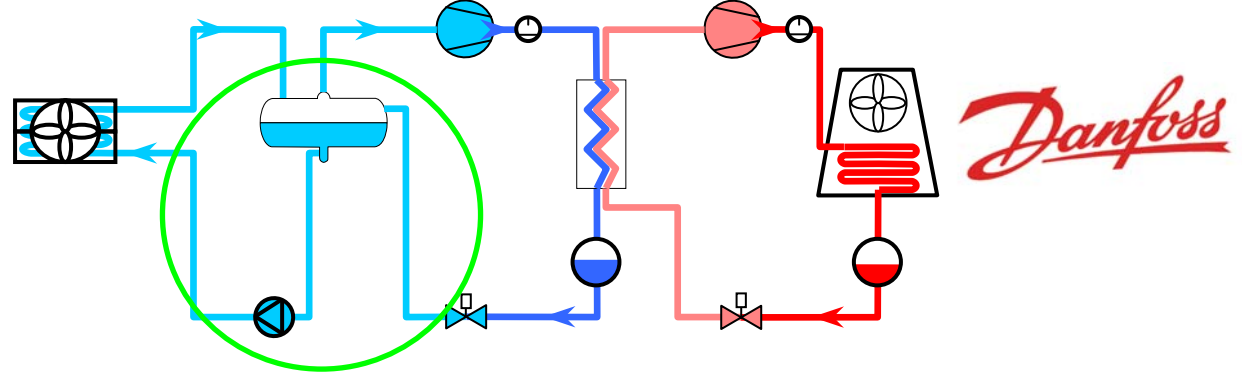
R744 Wet return from evaporators

R744 By-pass
Discharge from CO2 compressor

R744 Liquid from cascade cooler

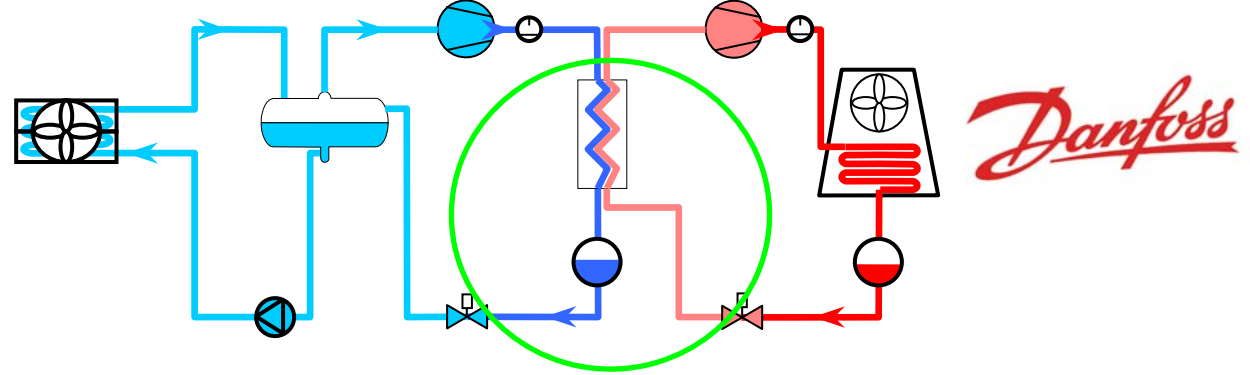
R744 Liquid to evaporators

R744 separator -40°C



Cascade cooler

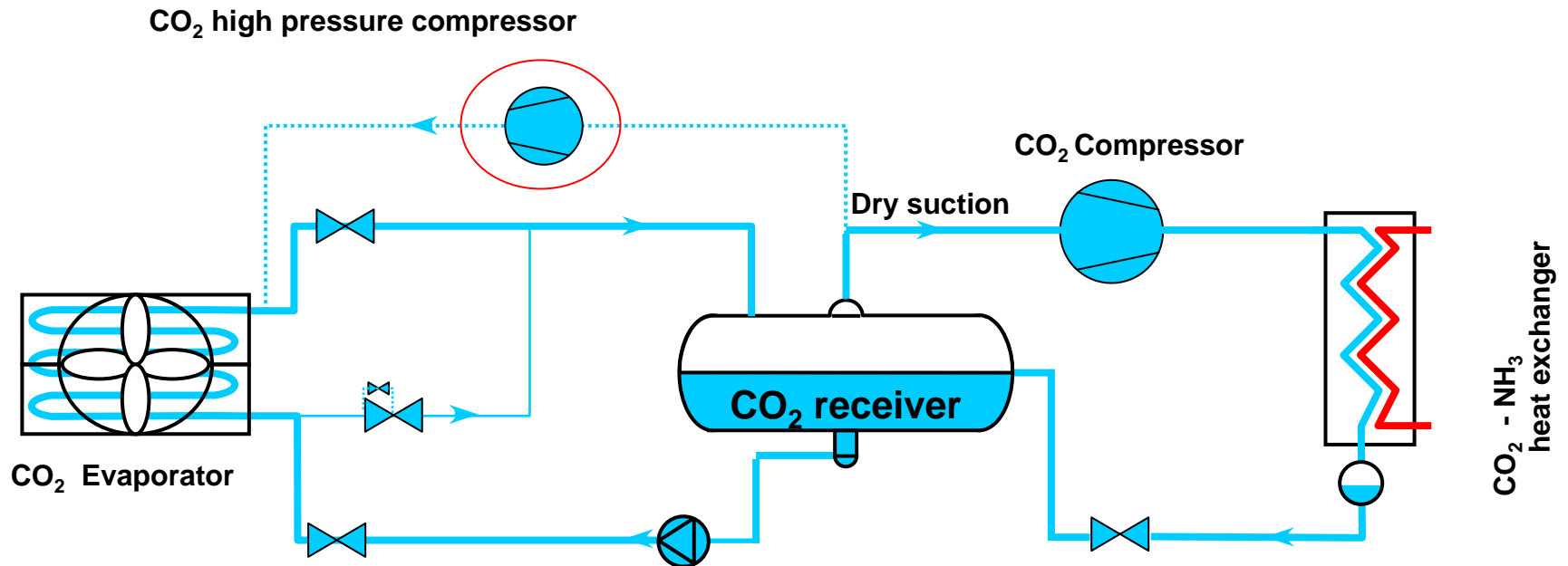
R744 / R717



Defrosting

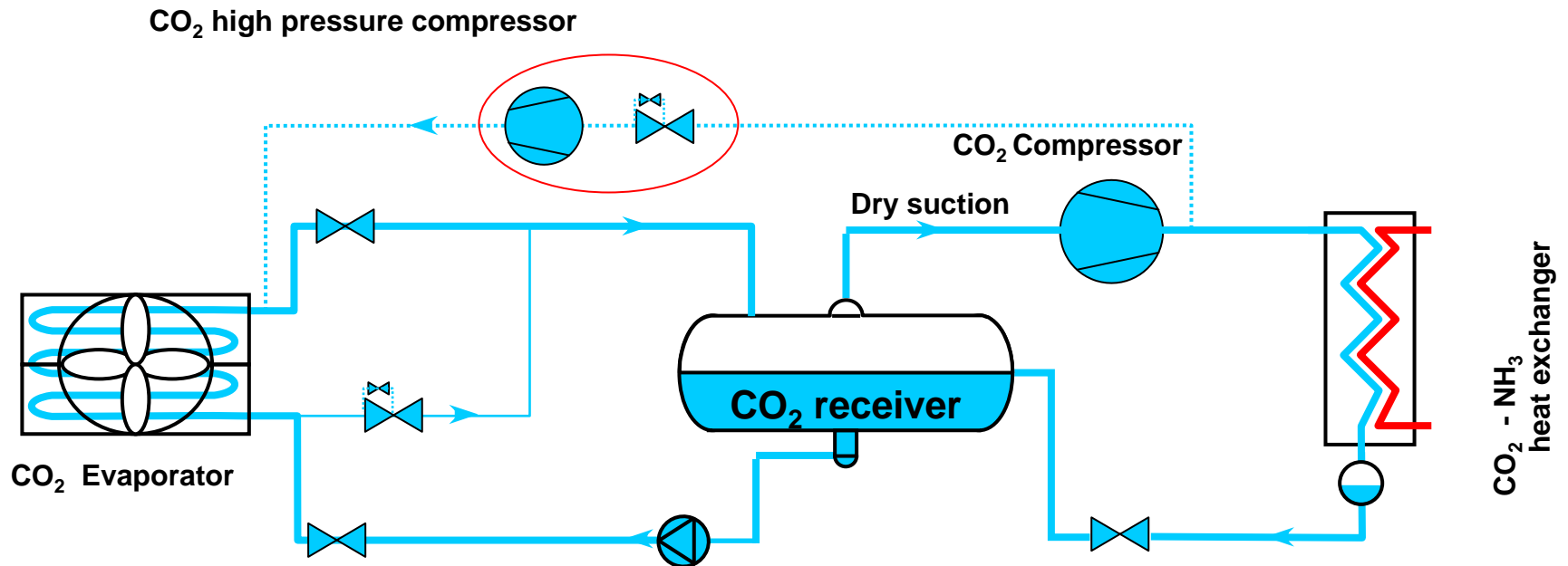
Principle diagram: CO₂-NH₃ cascade system

Hot gas defrosting – CO₂ high pressure compressor



Principle diagram: CO₂-NH₃ cascade system

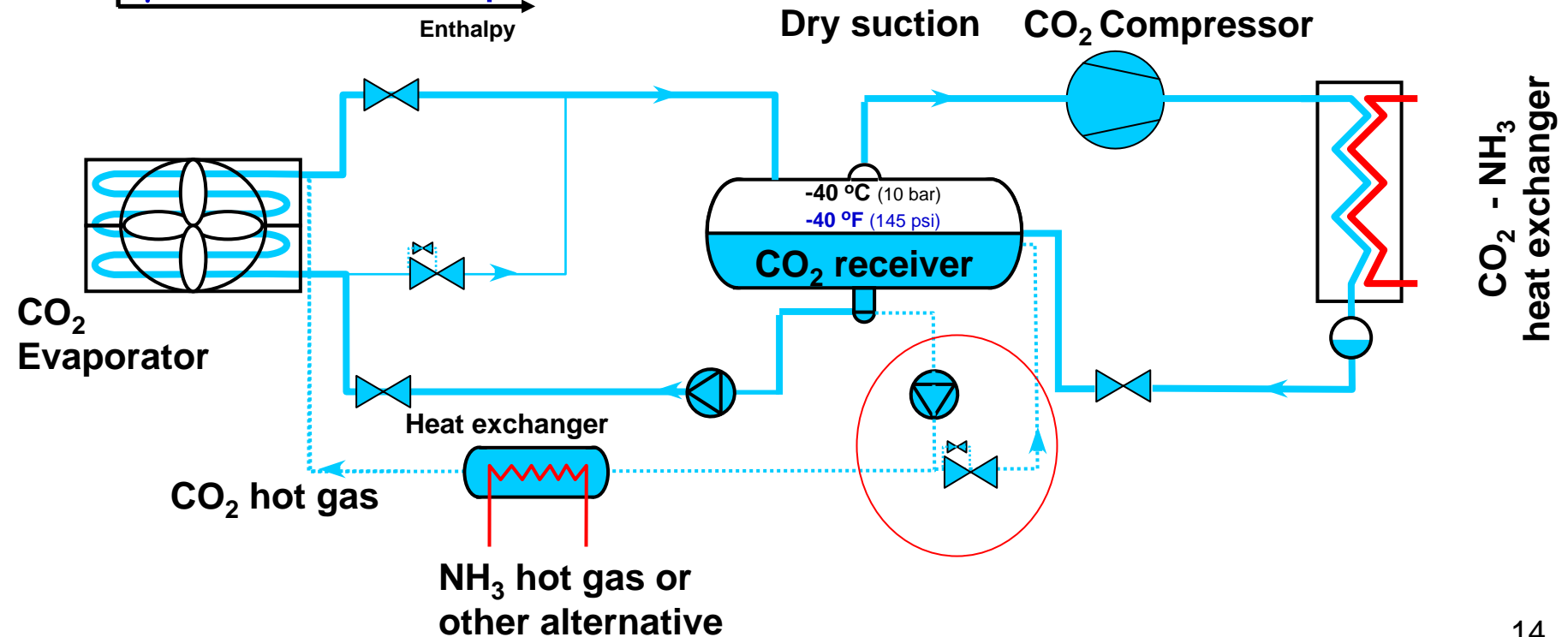
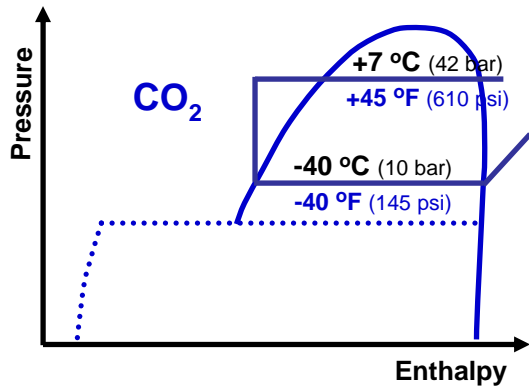
Hot gas defrosting – CO₂ high pressure compressor + suction pressure control (ICS+CVC-HP)



Principle diagram: CO₂-NH₃ cascade system

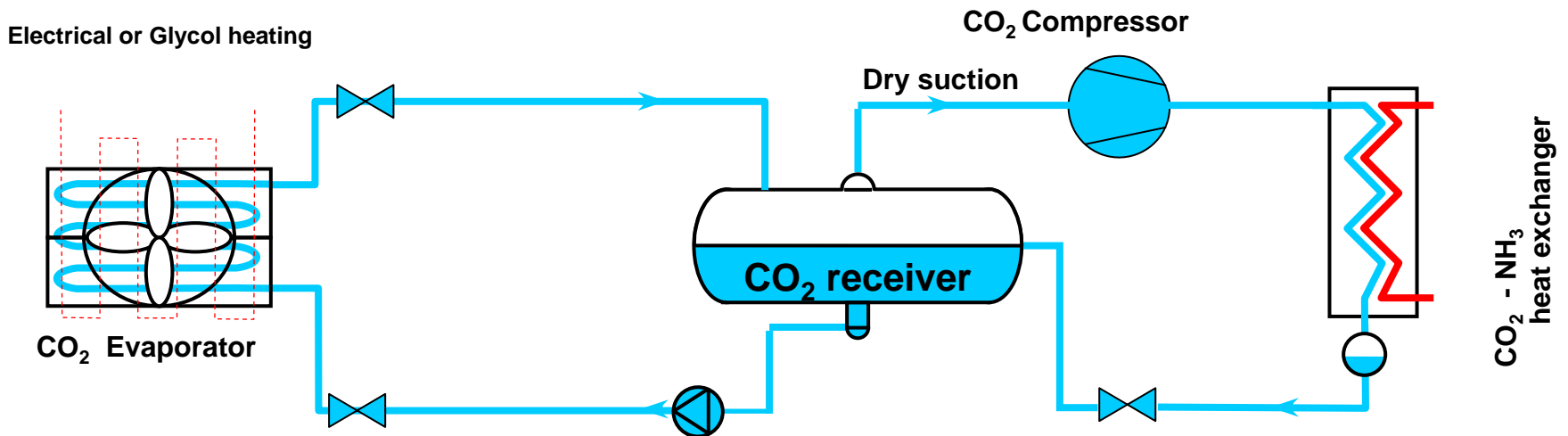
Hot gas defrosting – Liquid high pressure pump

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Principle diagram: CO₂-NH₃ cascade system

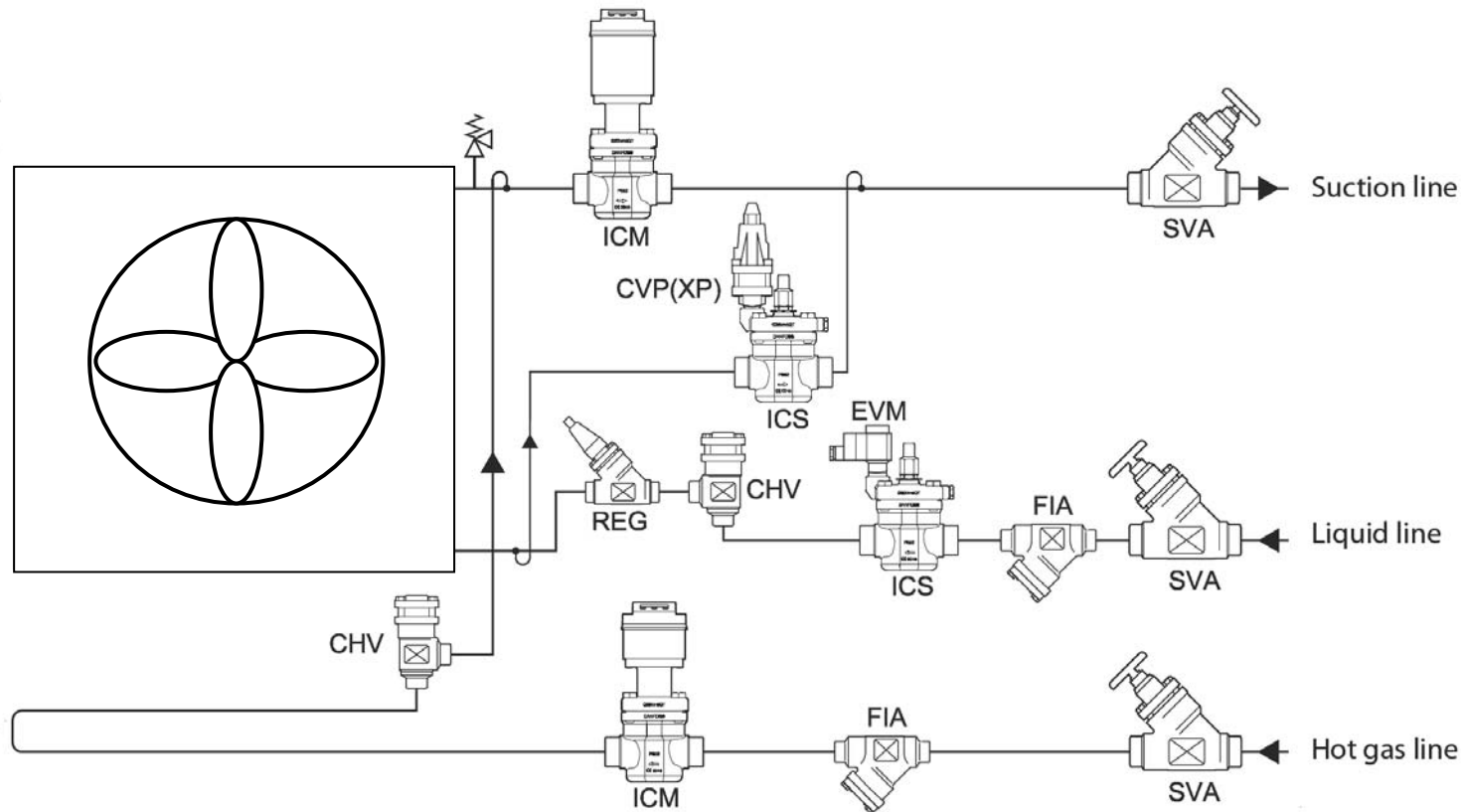
“Other” defrosting methods



Danfoss components application example 1

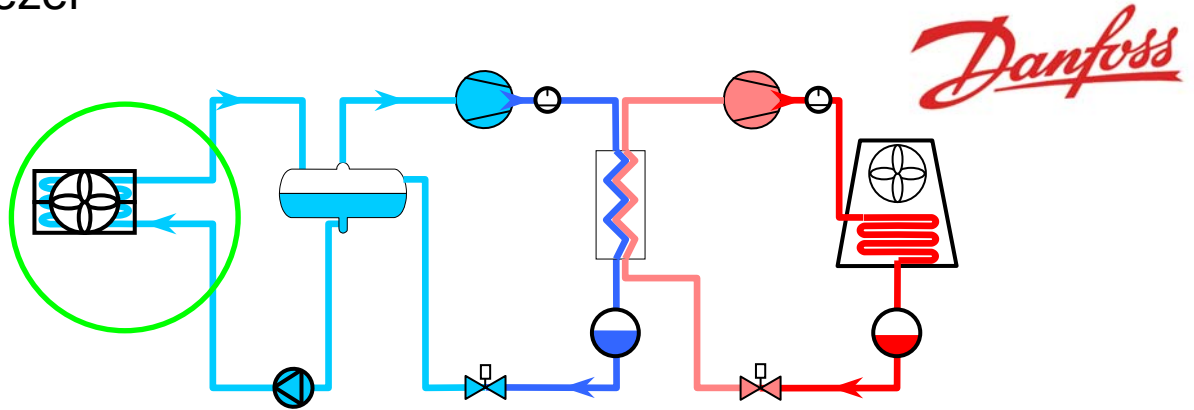
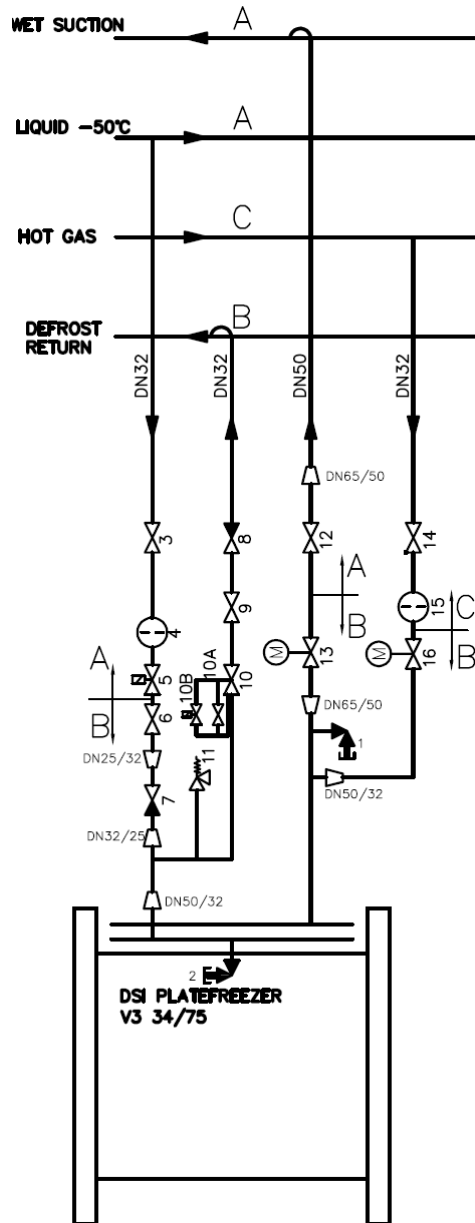


CO2 system with hot gas defrosting (52 bar)



All valve direct coupled (welded)
Design pressure 52 bar (750 psi)

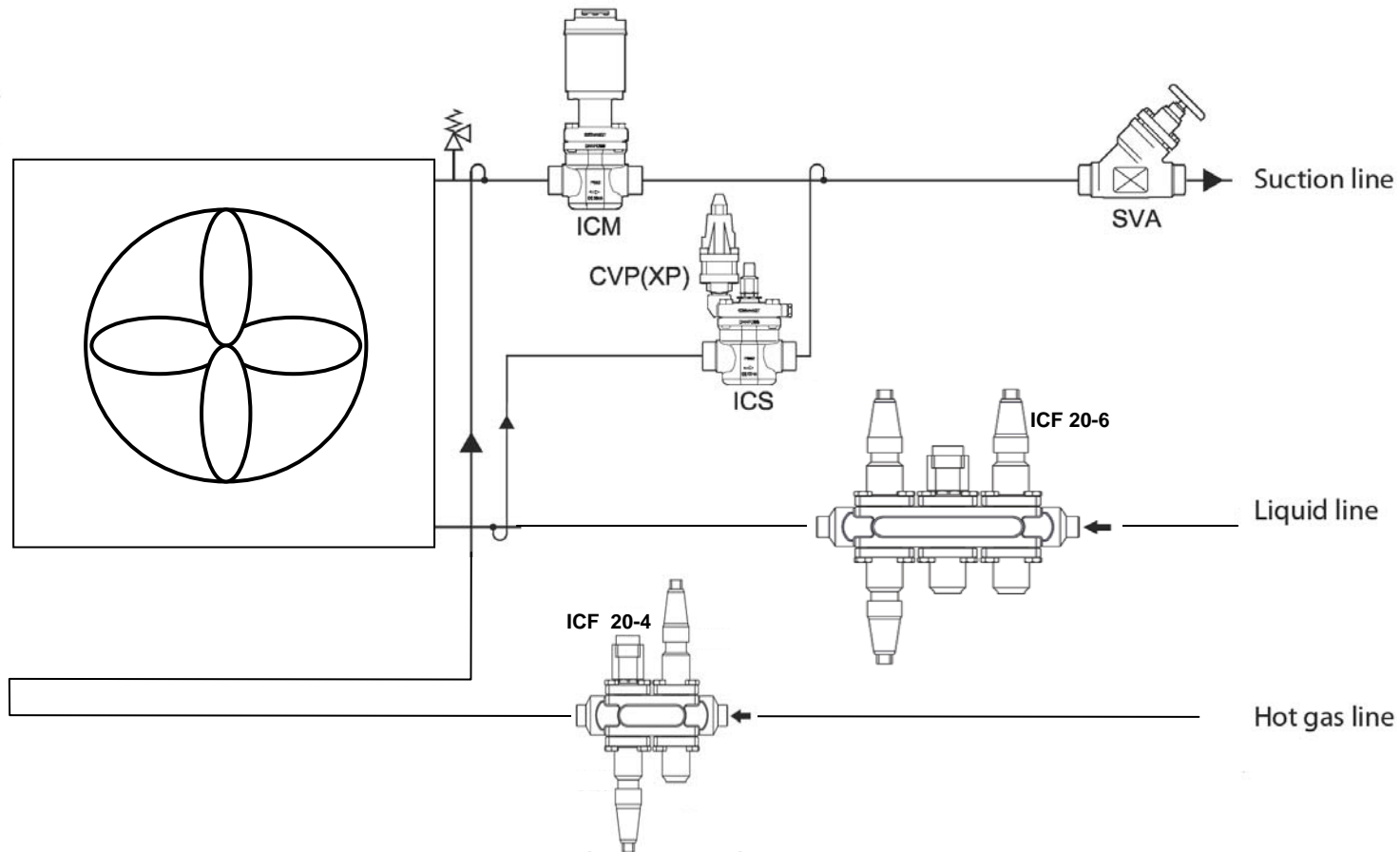
Valve station for plate freezer



Danfoss components application example 2

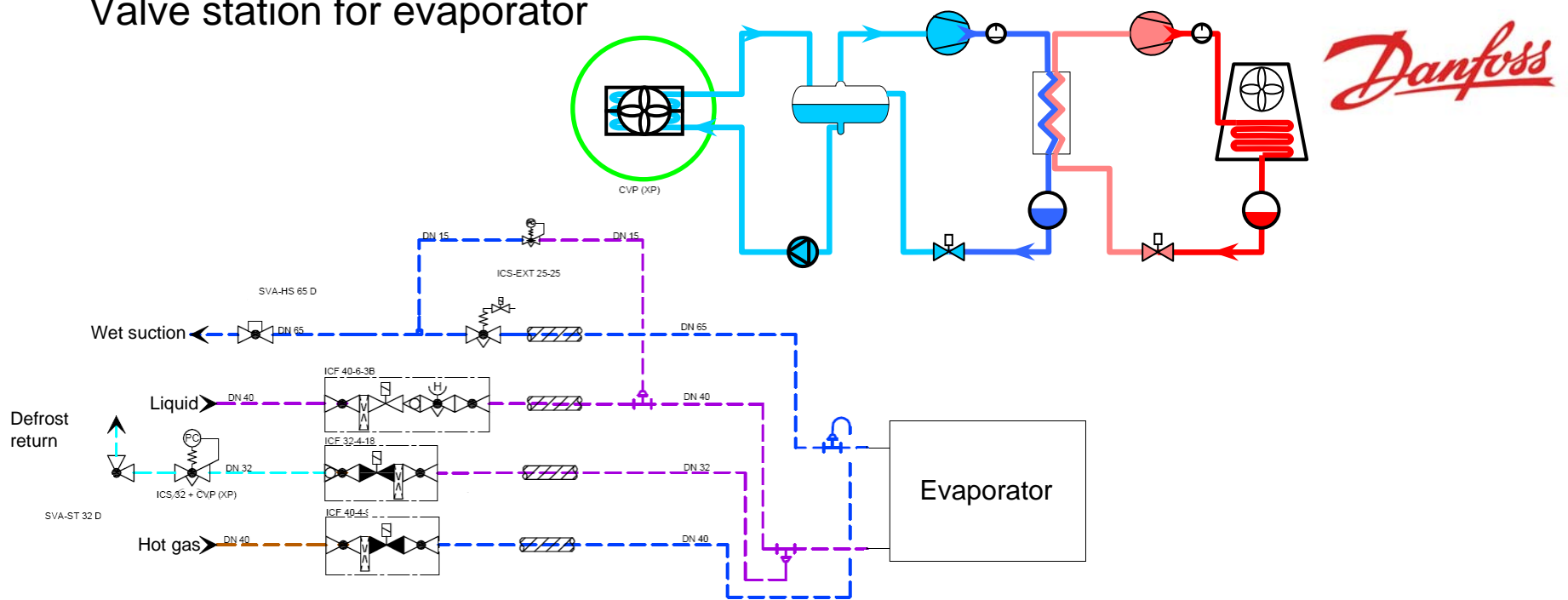


CO₂ system with hot gas defrosting (ICF – 52 bar)



All valve direct coupled (welded)
Design pressure 52 bar (750 psi)

Valve station for evaporator



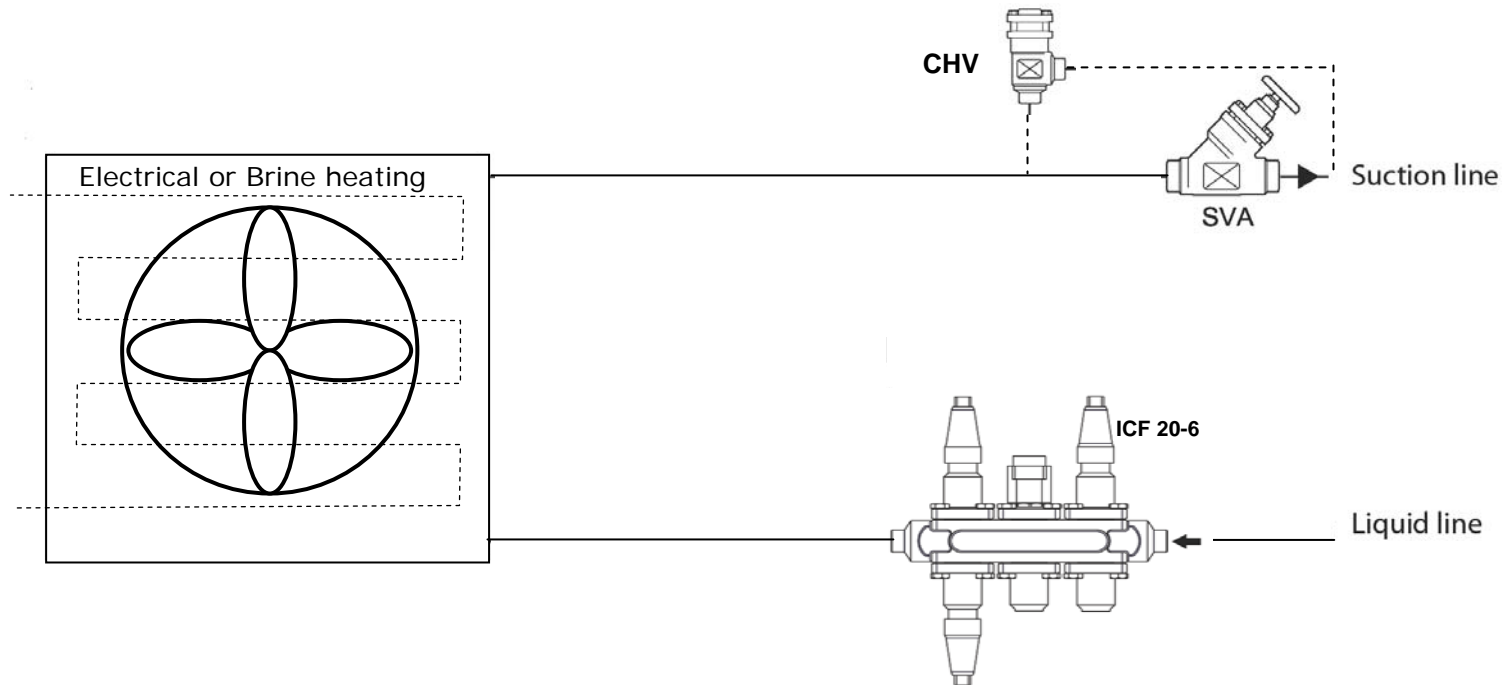
G



Danfoss components application example 3

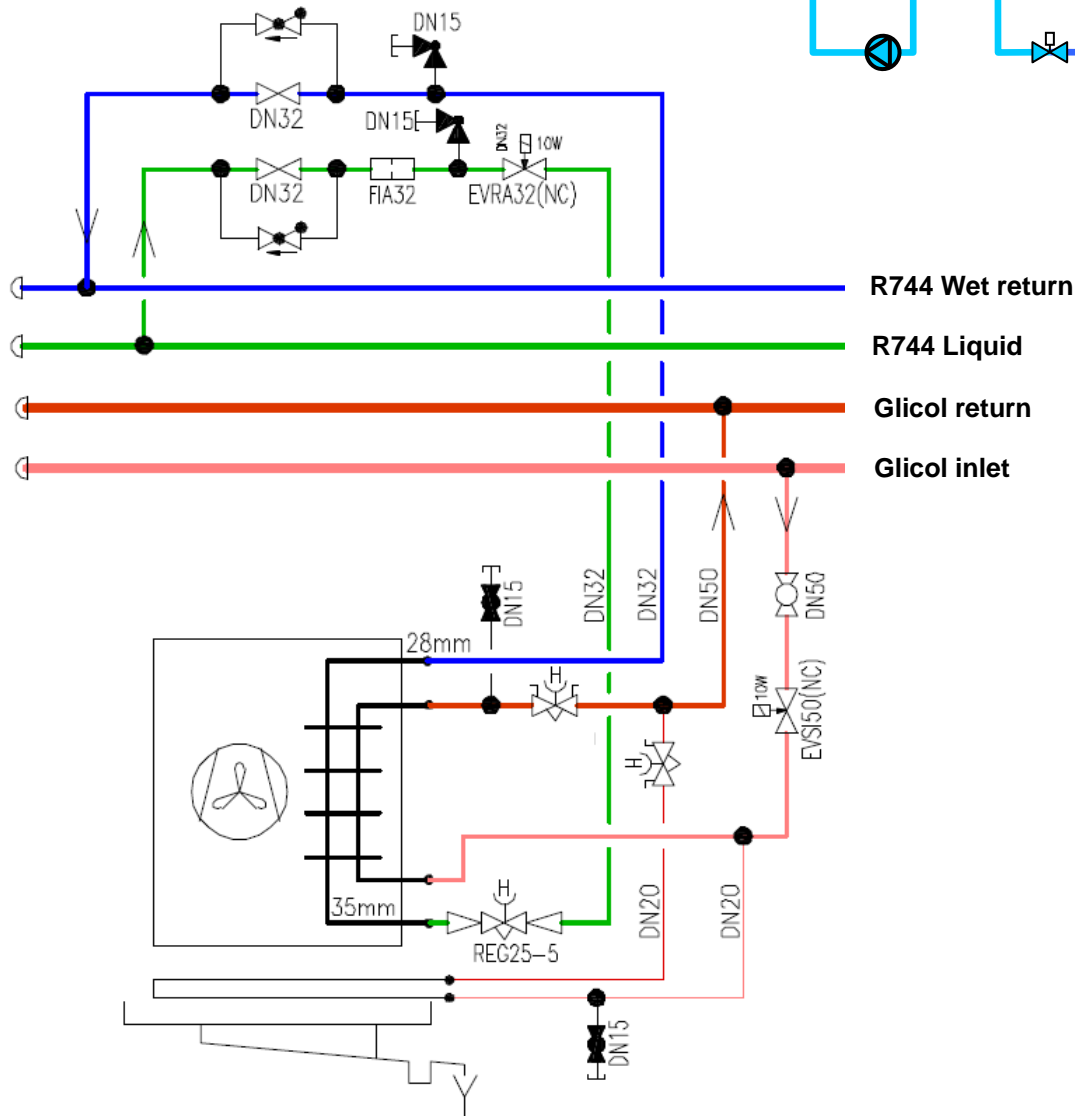
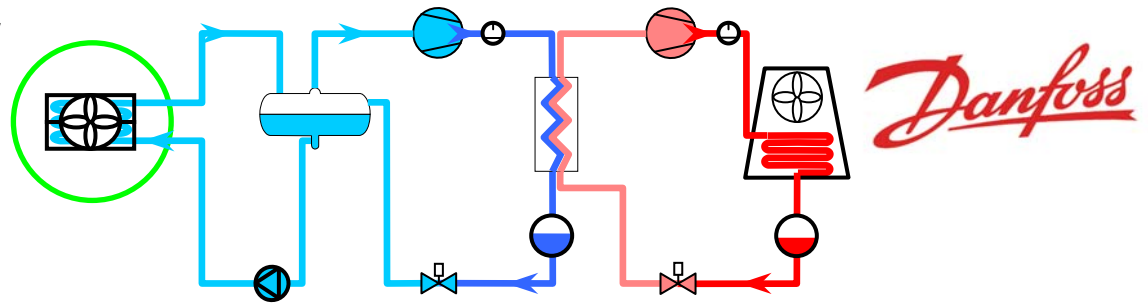


CO2 system with Electrical or Glycol defrosting
(without drained liquid (remaining CO2 need to evaporate))



All valve direct coupled (welded)
Design pressure 40 bar (580 psi)

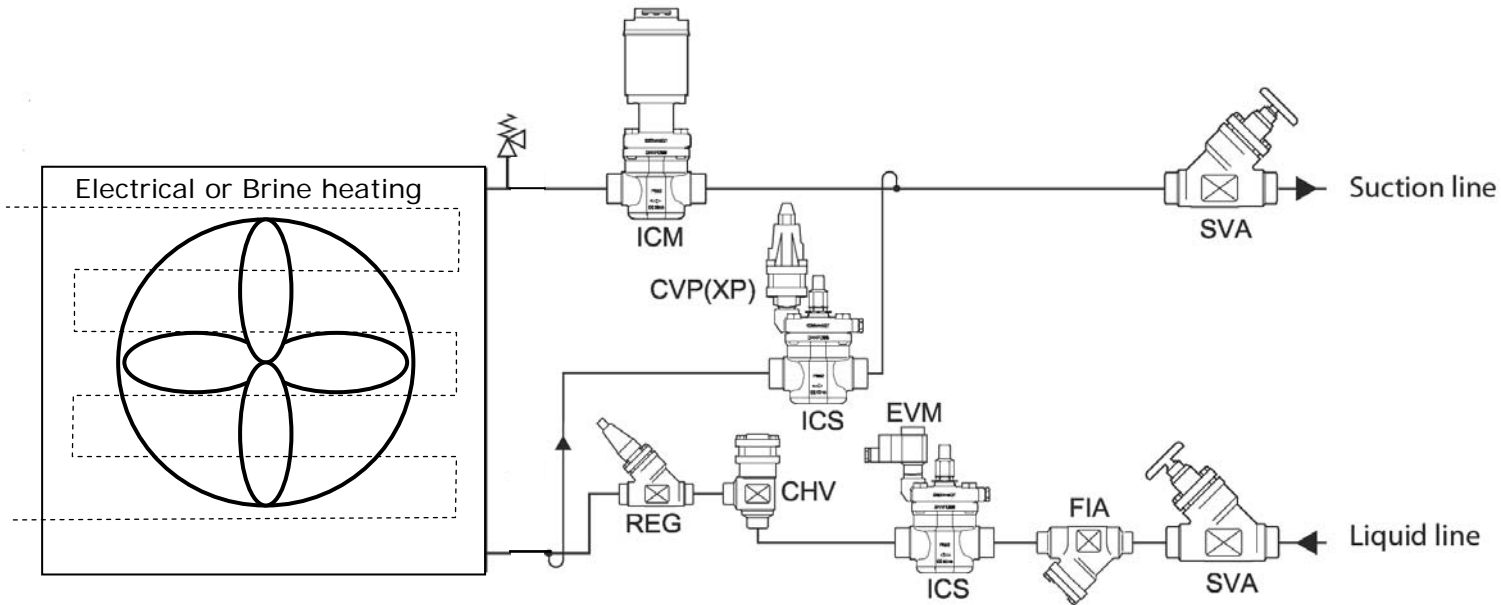
Valve station for evaporator with hot glycol defrost



Danfoss components application example 4



CO2 system with Electrical or Brine defrosting (52 bar)

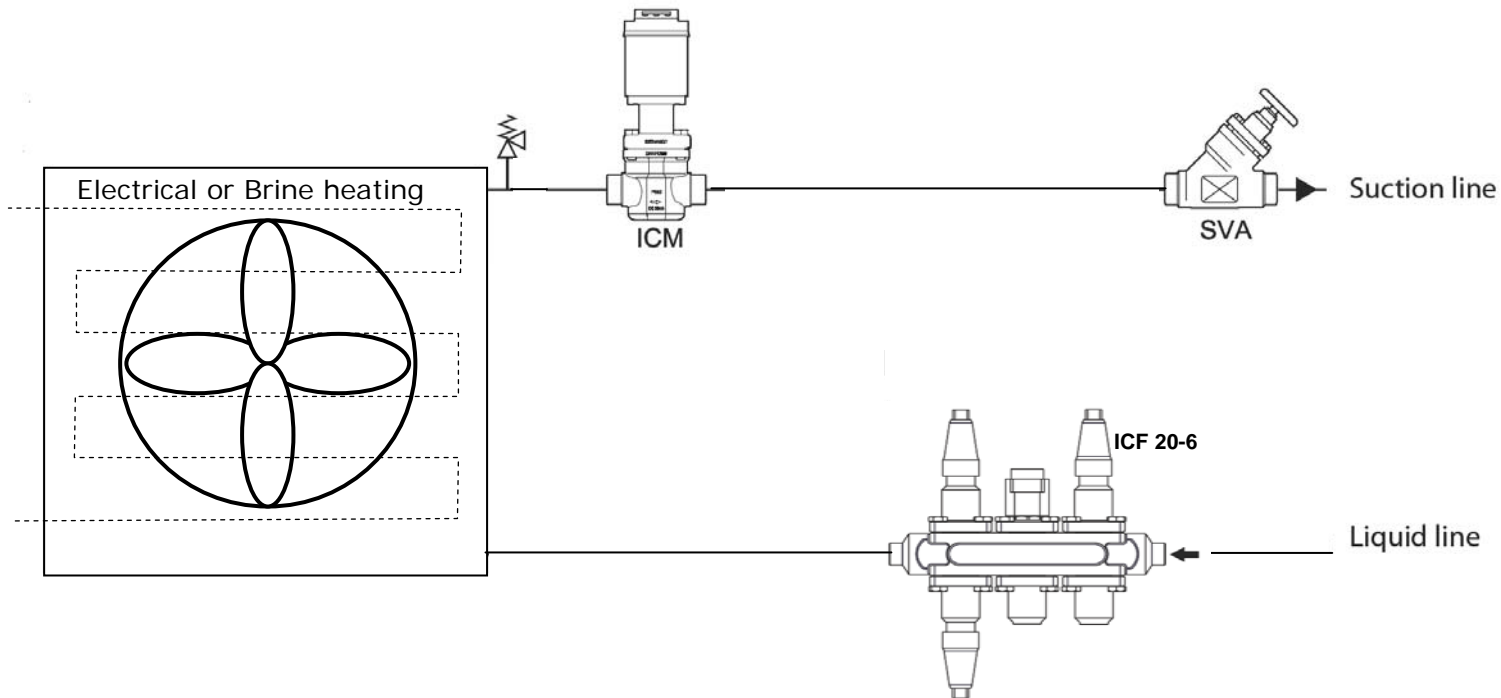


All valve direct coupled (welded)
Design pressure 52 bar (750 psi)

Danfoss components application example 7



CO2 system with Electrical or Brine defrosting
(without drained liquid (remaining CO2 need to evaporate))

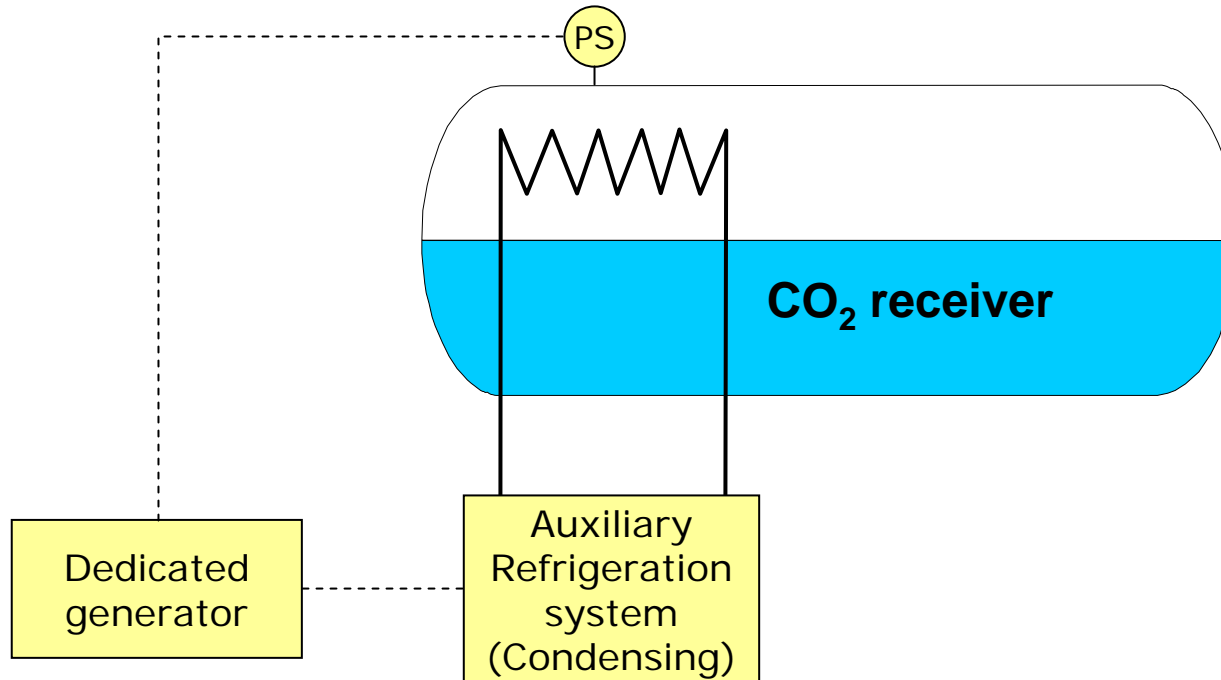


All valve direct coupled (welded)
Design pressure 40 bar (580 psi)

Auxiliary Refrigeration system

Auxiliary Refrigeration system

Example 1



Auxiliary cooling system - in case of power failure

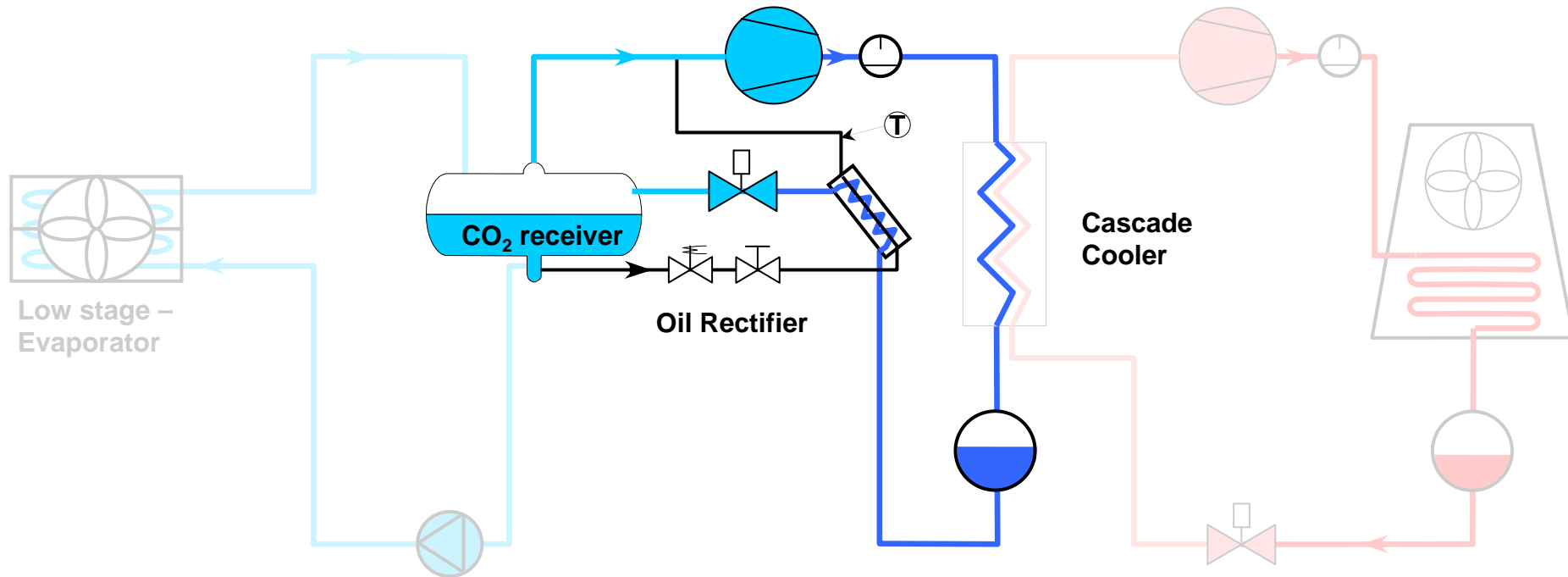
Capacity dependent of system design and ambient temperature (~ 4kW / 1000 kW)

Oil recovery

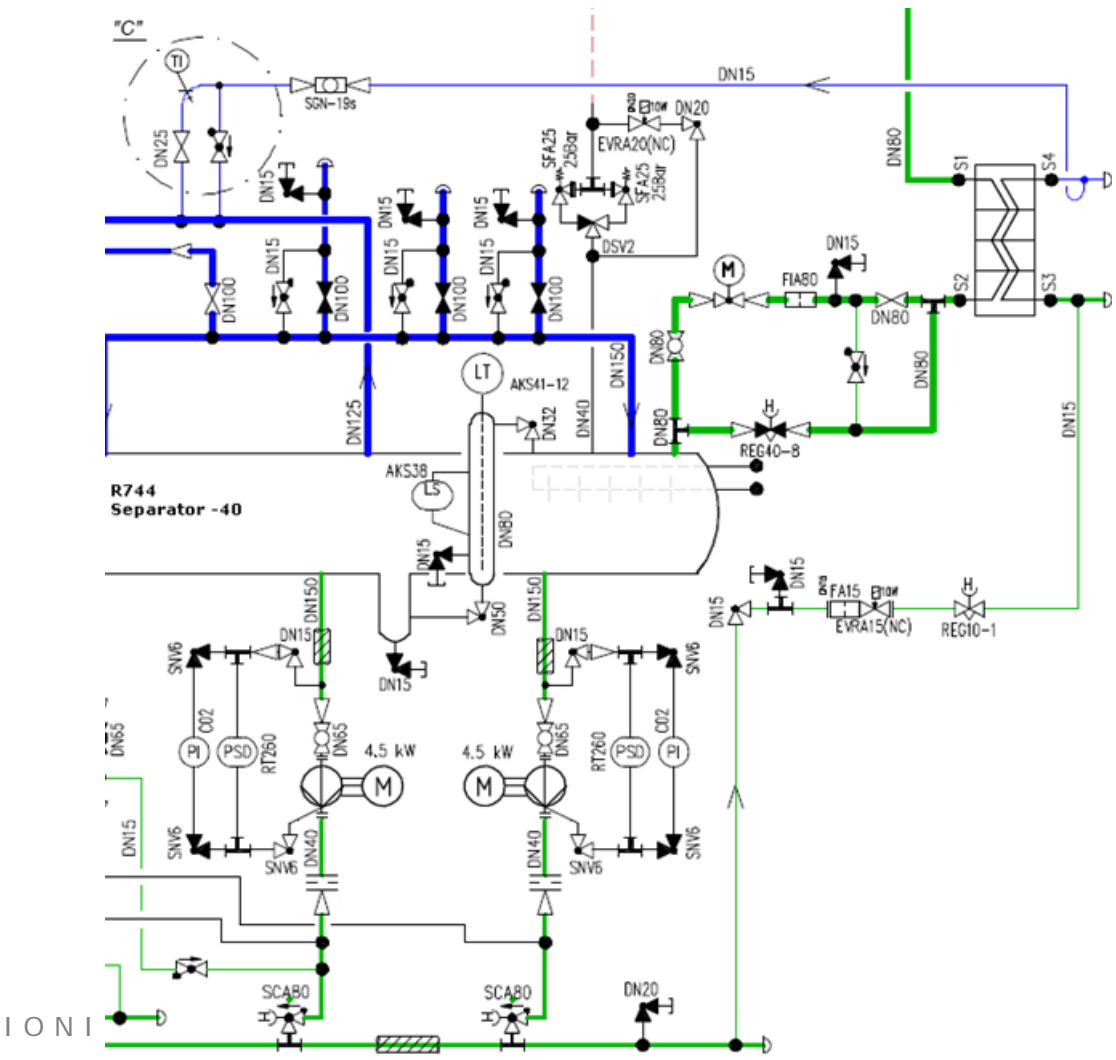
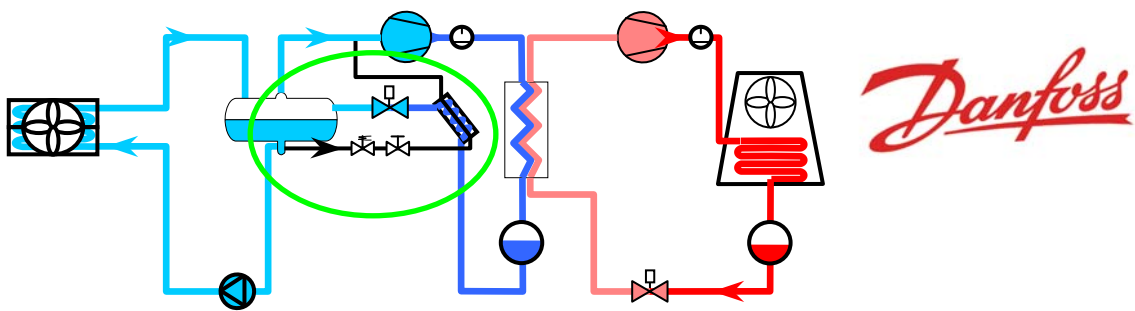
CO₂ – NH₃ cascade system



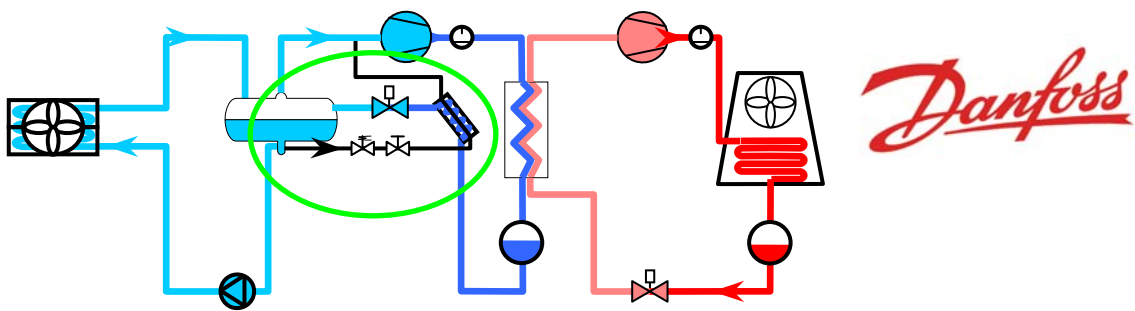
Oil management system for systems with soluble (miscible) oils



Oil recovery system
with soluble (miscible) oils
Example 1



Oil recovery system
with soluble (miscible) oils
Example 2

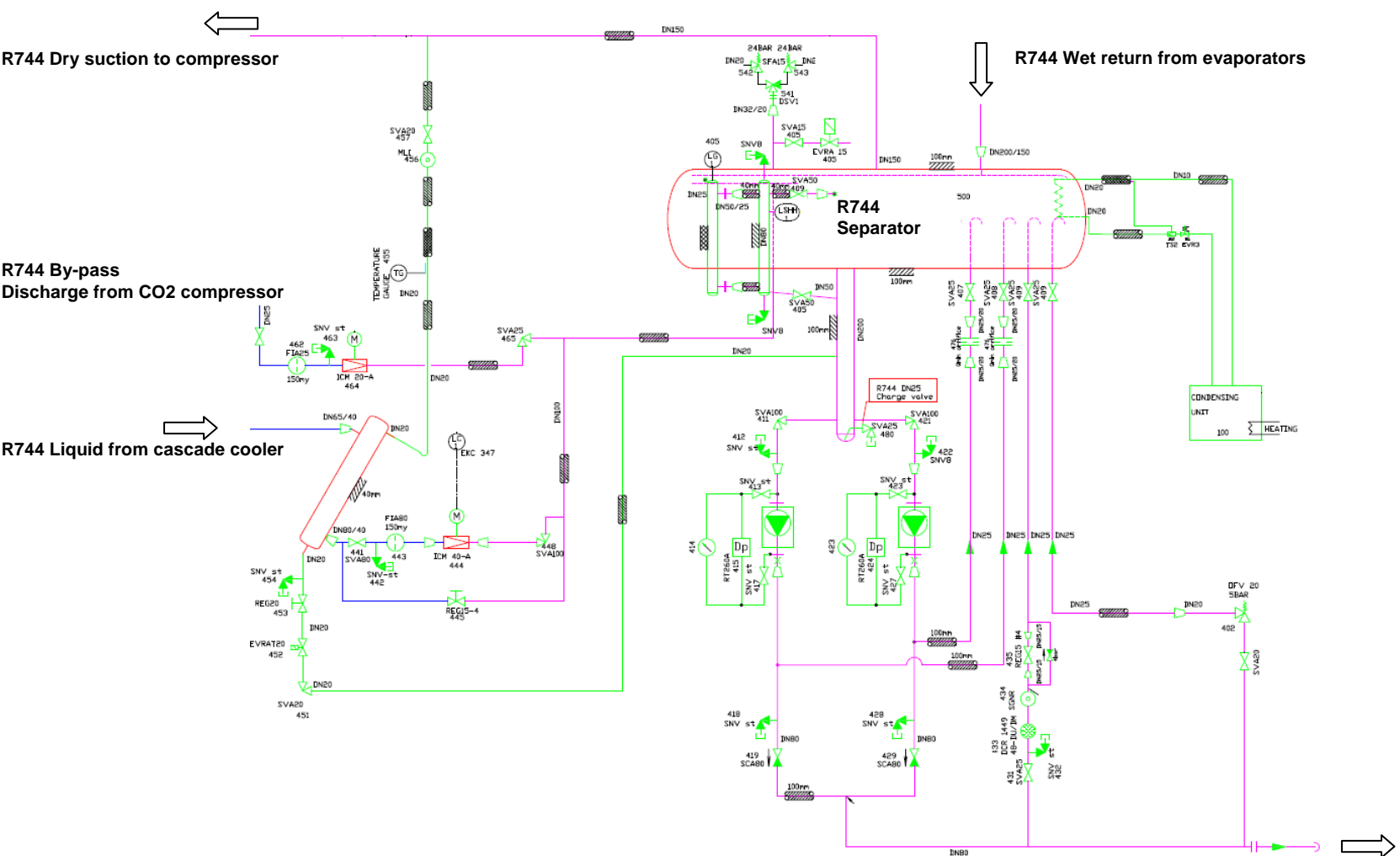


R744 Dry suction to compressor

R744 Wet return from evaporators

R744 By-pass
Discharge from CO2 compressor

R744 Liquid from cascade cooler



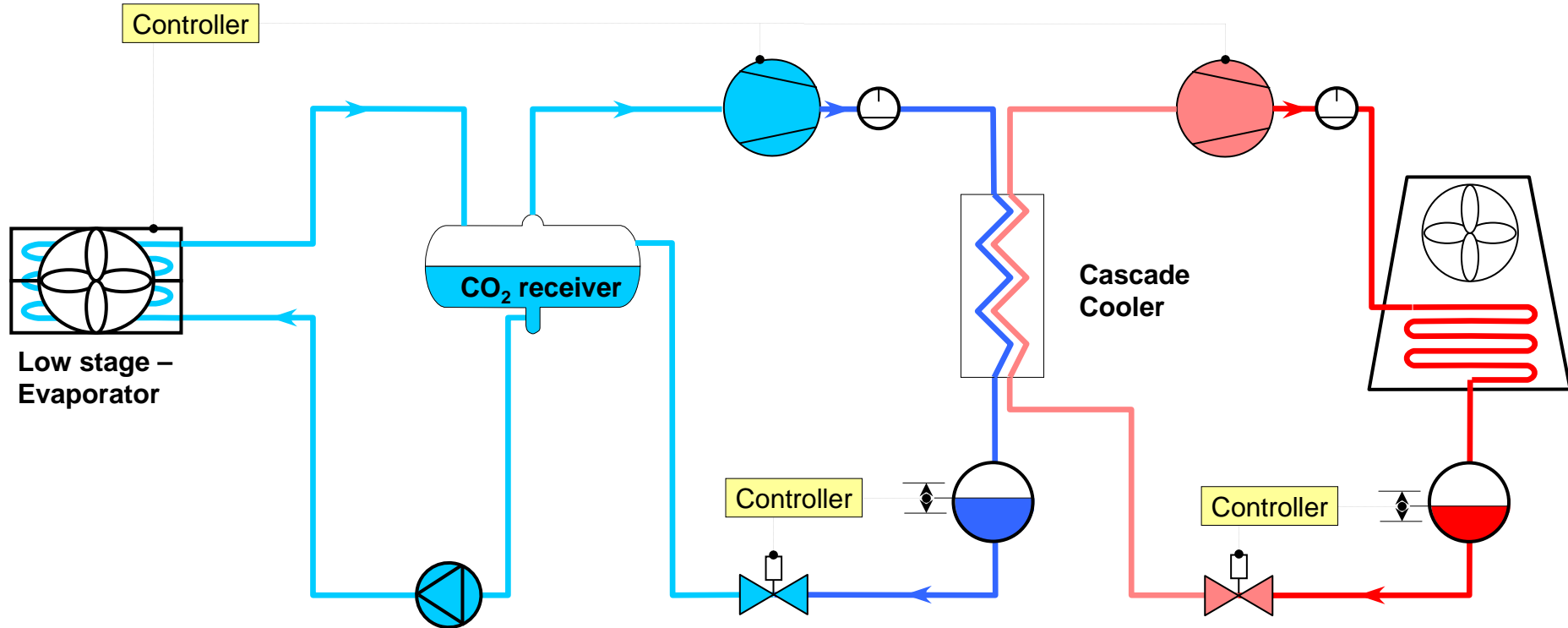
R744 Liquid to evaporators

System control methods

CO₂ – NH₃ cascade system

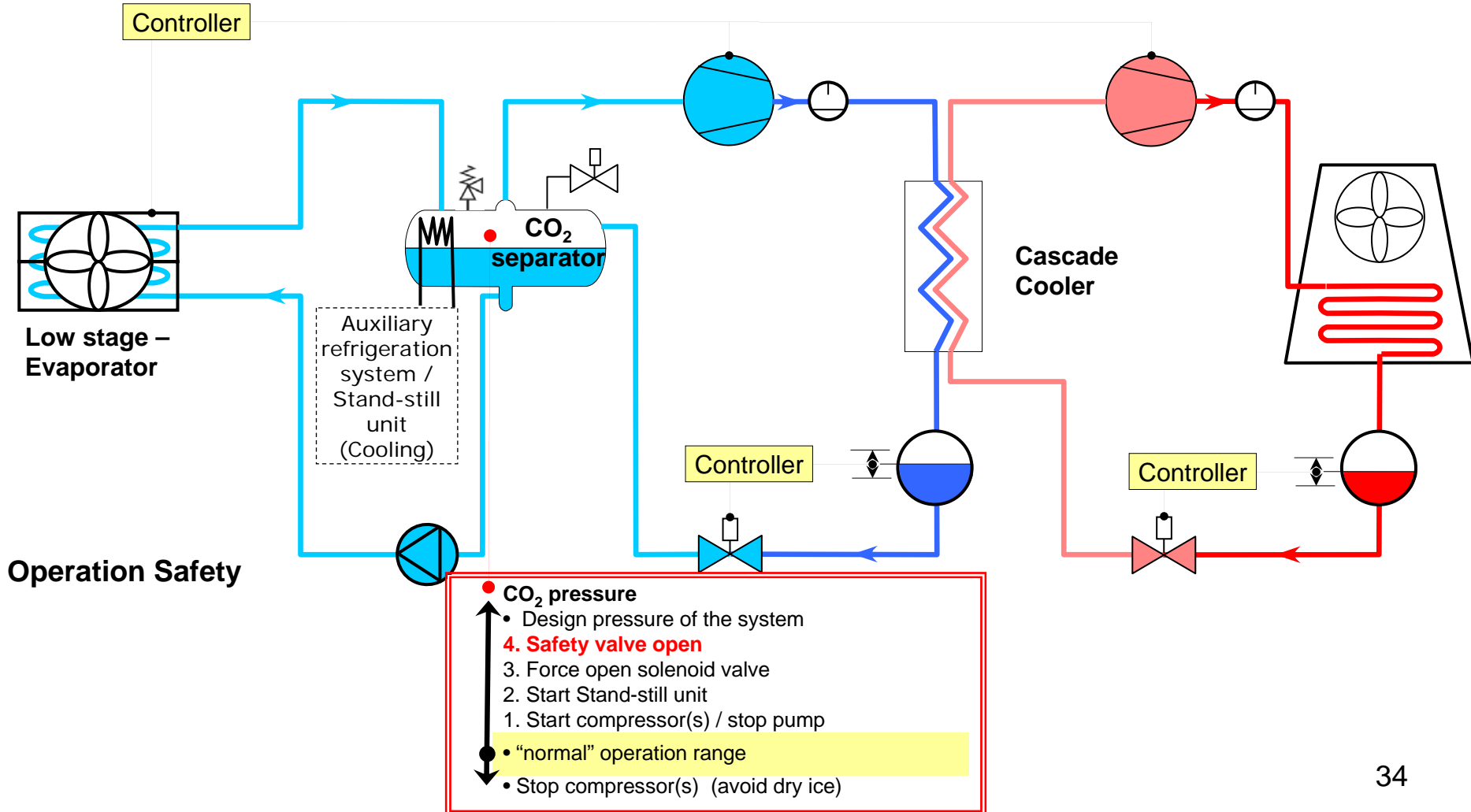


Examples on control methods



CO₂ – NH₃ cascade system

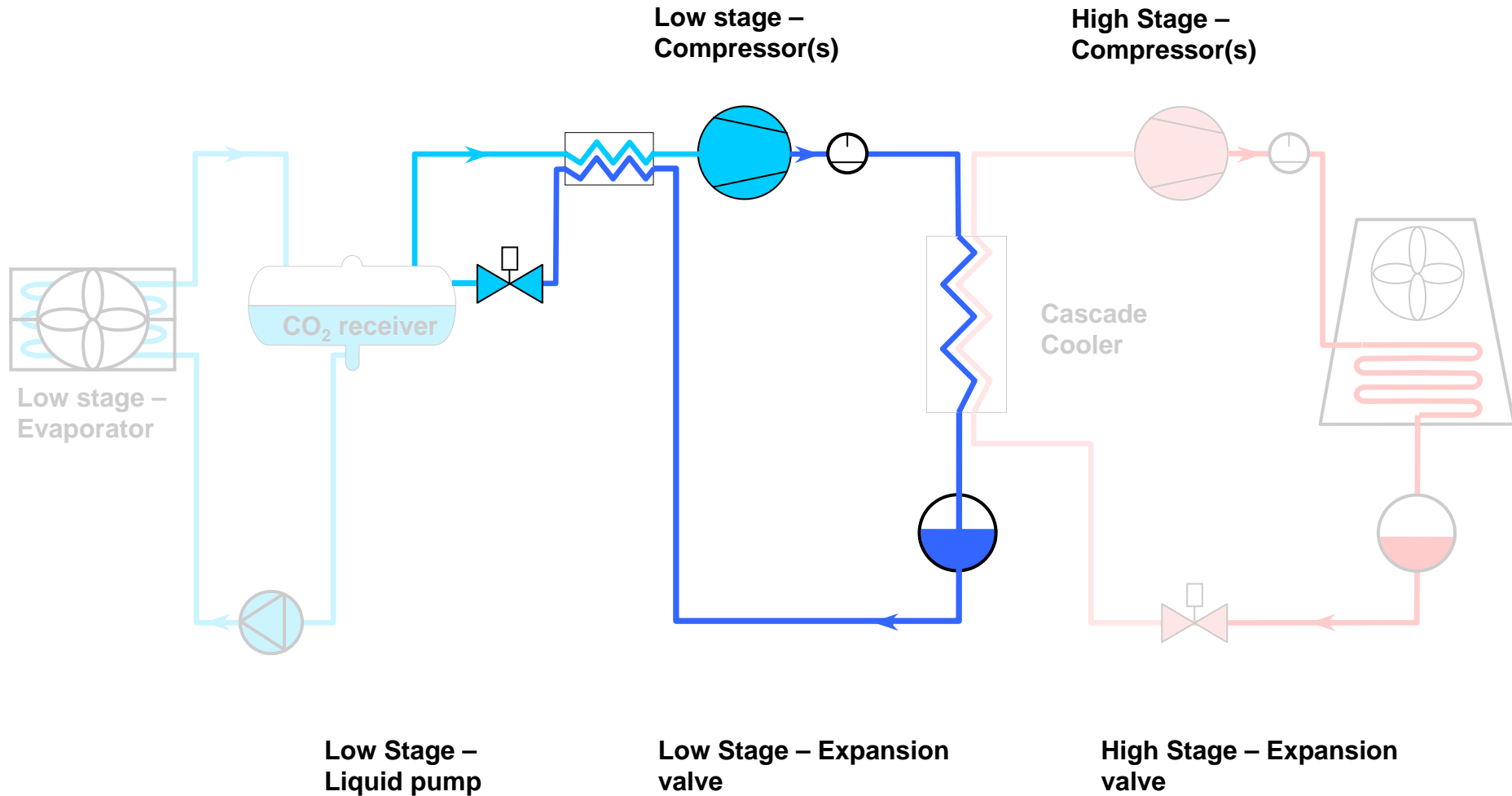
Examples on control methods



Other

CO₂ – NH₃ cascade system

Suction Heat Exchanger

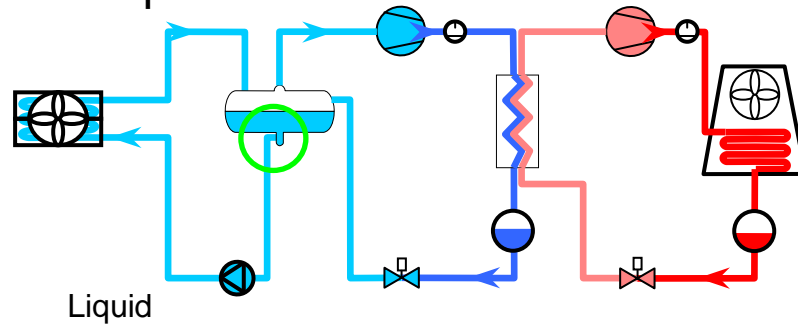


Water test samples

Vapour



Liquid



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NIP: 881-010-93-26

MESSER
Messer Polska

(CERTIFICATE)
ŚWIADECTWO ANALIZY

Dwutlenek węgla skroplony
(CARBON DIOXIDE LIQUID)

Próba nr 5148 pobrana w dniu 18.10.2007r. u klienta P.H.U. Gąsiorek.

Wyniki analiz:

Parametr	Zawartość (CONCENTRATION)
Tlen (OXYGEN)	1,5 ppm v/v
Amoniak (AMMONIA)	<2,5 ppm v/v
Wilgoć (MOISTURE)	3,2 ppm v/v



KU

upoważniona do. Konrad Jankowski

Silona
mgr inż. Krzysztof Biliński

Data 23.10.2007r.

Podpis

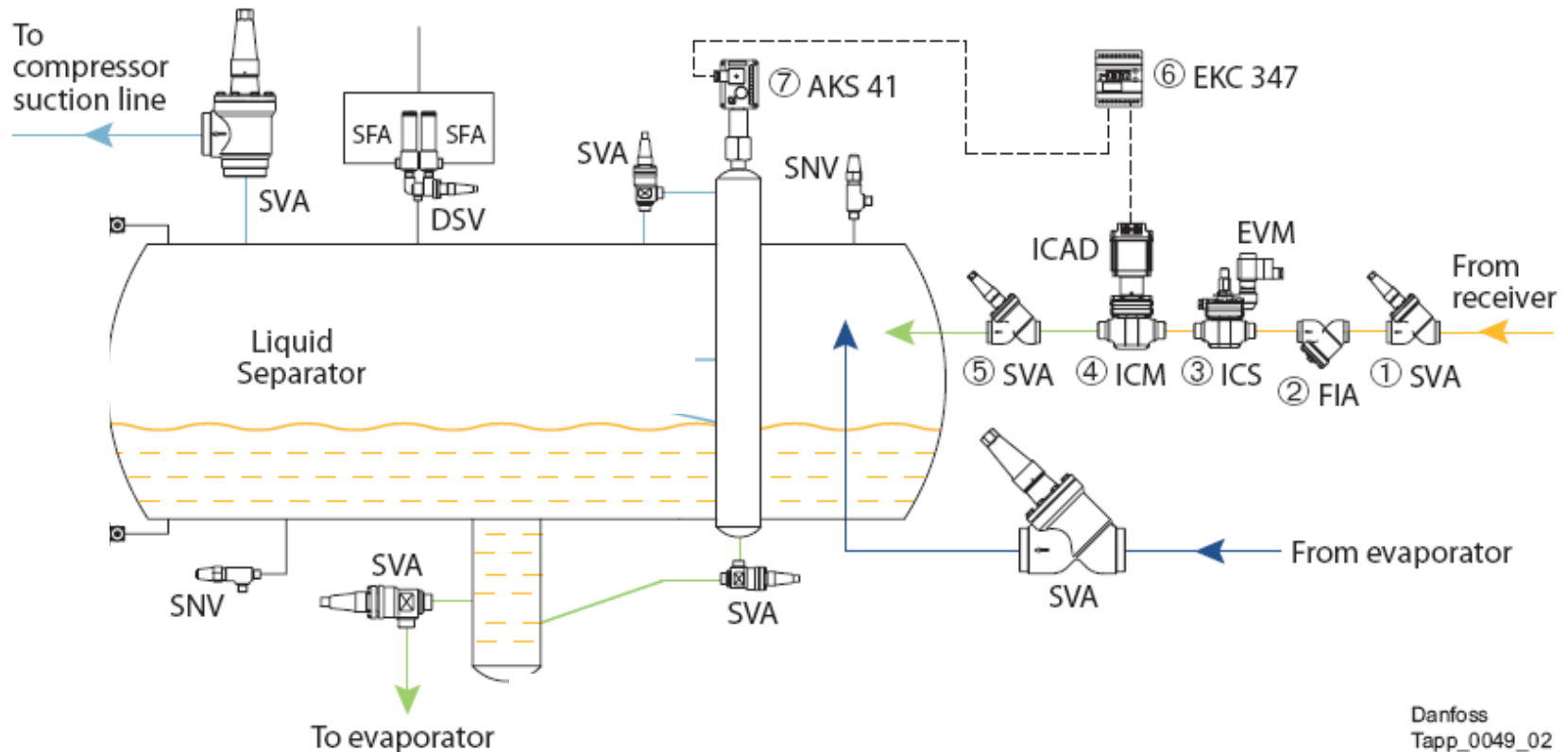
AIR CONDITIONING

Danfoss CO₂ solution
52 bar
“direct weld”

Danfoss components application example 1



CO2 system low pressure vessel make up

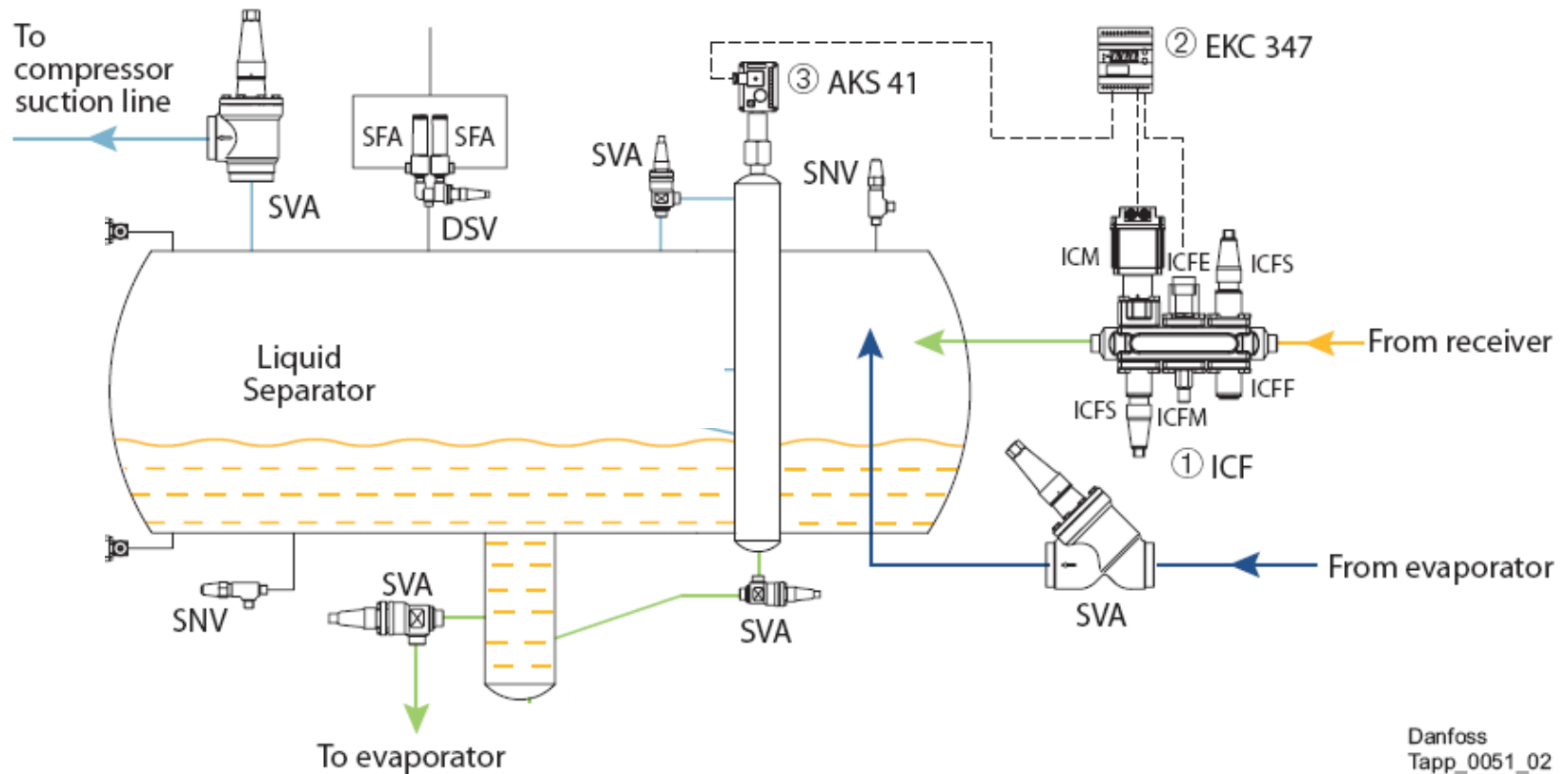


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Danfoss components application example 2



CO2 system low pressure vessel make up



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