



# Külmasüsteemi jääsoojuse kasutus ASi Selver näitel

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# Sissejuhatus

- Selver ASi valdusfirma Tallinna Kaubamaja AS on börsiettevõtte
- NG Investeeringud OÜle kuulub Tallinna Kaubamaja AS 67% osalus
- Kitman Thulema AS on Selver ASi külmatehnika alane partner



## Tehnoloogia valik, jääksoojuse kasutus

- Hinna ja töökindluse printsiip
- Rendipinna kitsendused
- Jääksoojusvahetid ja ventilatsiooni ettekütte kalorifeer
- Kütte, ventilatsiooni ja sooja tarbevee kütmine
- Kondenseerumise temperatuuri juhtimine (FHPC)

# MT ( $T_E = -10^\circ\text{C}$ ) kompressor valik

## System performance data

### Input Values

|                                     |                       |
|-------------------------------------|-----------------------|
| Compressor type                     | Recips, semi-hermetic |
| Refrigerant                         | R404A                 |
| Reference temperature               | Dew point temp.       |
| Cooling capacity                    | 140.0 kW              |
| subcooling method                   | Natural               |
| Power supply                        | 50 Hz / 400 V         |
| Liquid subcooling (after condenser) | 2.0K                  |
| Suction gas temperature             | 20.0°C                |
| Useful superheat                    | 100%                  |

### Output

|                                       | Operating point A | Operating point B |
|---------------------------------------|-------------------|-------------------|
| Evaporating SST:                      | -10.0°C           | -10.0°C           |
| Condensing SDT:                       | 45.0°C            | 40.0°C            |
| Cooling capacity                      | 148.6 kW          | 161.8 kW          |
| Evaporator capacity                   | 148.6 kW          | 161.8 kW          |
| Evaporator capacity relative to input | 106.2 %           | 115.6 %           |
| Condenser capacity                    | 216 kW            | 226 kW            |
| Power input                           | 67.4 kW           | 63.8 kW           |
| Current (400V)                        | 109.8 A           | 104.5 A           |
| COP/EER                               | 2.20              | 2.54              |
| Mass flow                             | 4331 kg/h         | 4416 kg/h         |
| Discharge gas temp. w/o cooling       | 94.4 °C           | 88.6 °C           |

# LT ( $T_E = -35^\circ\text{C}$ ) kompressori valik

## System performance data

### Input Values

|                                     |                       |
|-------------------------------------|-----------------------|
| Compressor type                     | Recips, semi-hermetic |
| Refrigerant                         | R404A                 |
| Reference temperature               | Dew point temp.       |
| Cooling capacity                    | 22.0 kW               |
| subcooling method                   | Natural               |
| Power supply                        | 50 Hz / 400 V         |
| Liquid subcooling (after condenser) | 2.0K                  |
| Suction gas temperature             | 20.0°C                |
| Useful superheat                    | 100%                  |

### Output

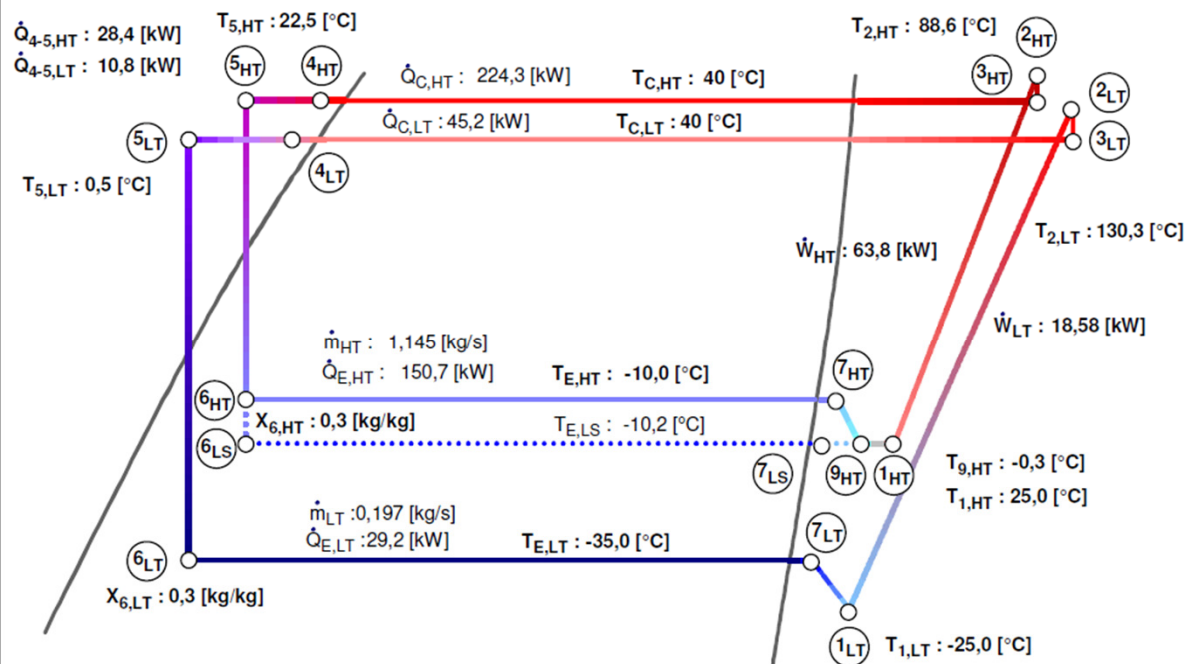
|                                       | Operating point A | Operating point B |
|---------------------------------------|-------------------|-------------------|
| Evaporating SST:                      | -35.0°C           | -35.0°C           |
| Condensing SDT:                       | 45.0°C            | 40.0°C            |
| Cooling capacity                      | 23.5 kW           | 26.9 kW           |
| Evaporator capacity                   | 23.5 kW           | 26.9 kW           |
| Evaporator capacity relative to input | 106.7 %           | 122.1 %           |
| Condenser capacity                    | 41.8 kW           | 45.4 kW           |
| Power input                           | 18.32 kW          | 18.58 kW          |
| Current (400V)                        | 37.1 A            | 37.4 A            |
| COP/EER                               | 1.28              | 1.45              |
| Mass flow                             | 660 kg/h          | 709 kg/h          |
| Discharge gas temp. w/o cooling       | 136.7 °C          | 130.3 °C          |

# Kombineeritud süsteemi analüüs

## CYCLE ANALYSIS : COMBINATION OF ONE-STAGE CYCLES

> TWO SEPARATE CYCLES, DX EVAPORATORS, SUBCOOLING OF LIQUID FOR LOW TEMPERATURE CYCLE

LOG(p),h-DIAGRAM



REFRIGERANT<sub>HT</sub> R404A

REFRIGERANT<sub>LT</sub> R404A

COP :2,183

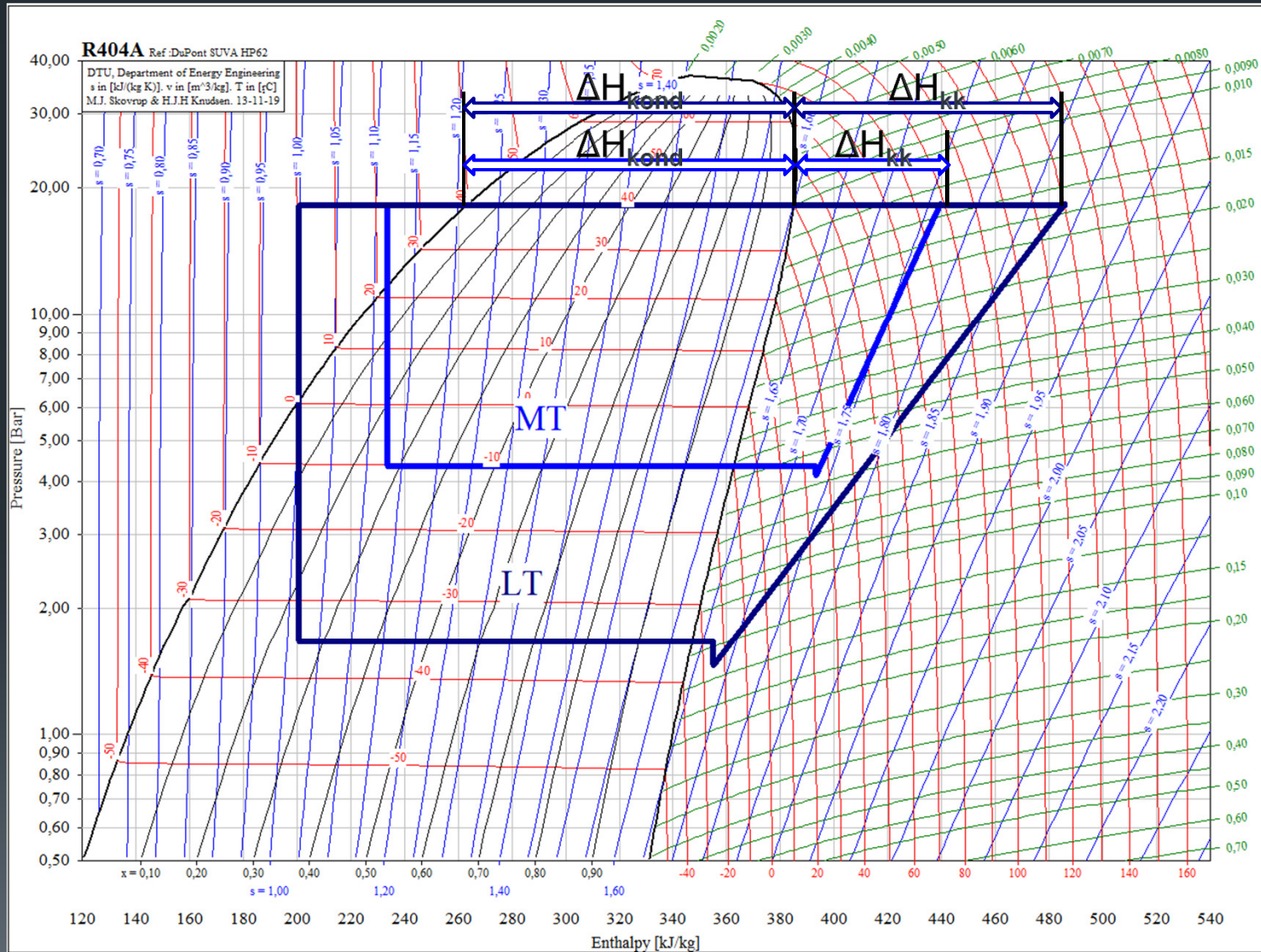
COP\*<sub>HT</sub> :2,614

COP\*<sub>LT</sub> :1,035

$\eta_{\text{CARNOT,HS}}$  : 0,50

$\eta_{\text{CARNOT,LS}}$  : 0,33

# LOG(p), h diagramm



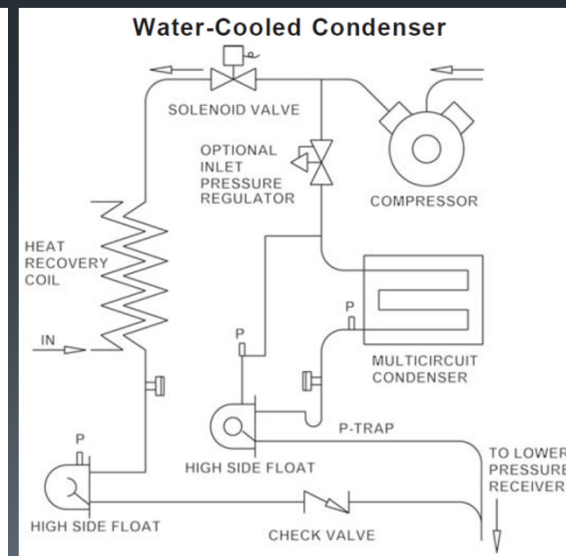
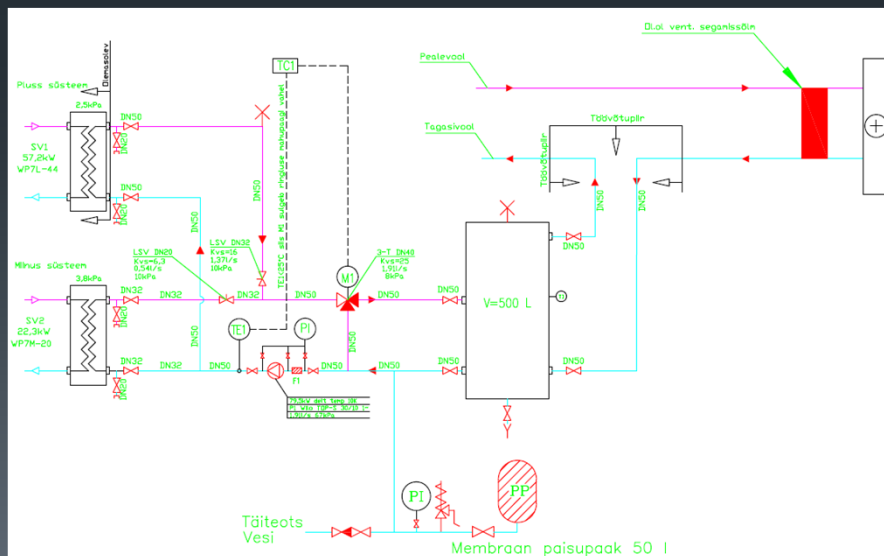
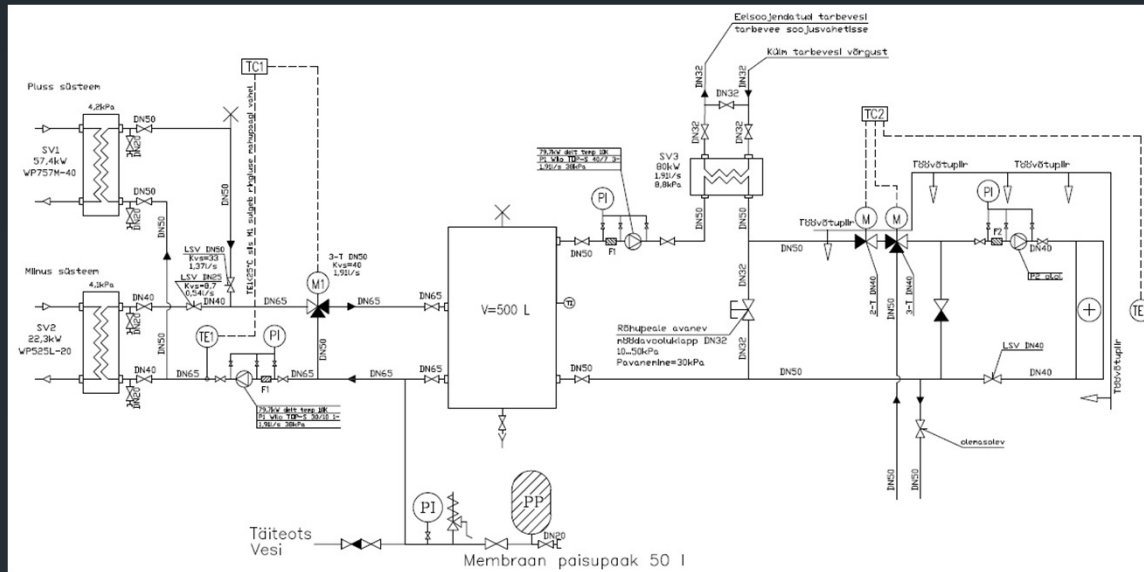


# Soojusvaheti arvutuslehed

| Design Calculation -- WP7L- 60            |                         |         |        |
|---|-------------------------|---------|--------|
| Input Data :                              |                         |         |        |
| Design Duty : MT jääsoojus täis koormusel |                         |         |        |
|   |                         | Side 1  | Side 2 |
| Fluid Name                                | :                       | R-404a  | Water  |
| Inlet Temperature                         | °C :                    | 90      | 30     |
| Outlet Temperature                        | °C :                    | 40      | 40     |
| Mass Flow Rate                            | kg/h :                  | 4416    | 7005,6 |
| Pressure                                  | bar :                   | 18      | -      |
| Max. Acceptable Pressure Drop             | kPa :                   | 15      | 50     |
| Physical Properties of Fluid :            |                         |         |        |
| Reference Temperature                     | °C :                    | 62,5    | 35     |
| Viscosity                                 | mPas :                  | 0,014   | 0,721  |
| Viscosity Wall                            | mPas :                  | 0,014   | 0,672  |
| Density                                   | kg/m <sup>3</sup> :     | 63      | 992,7  |
| Specific Heat Capacity                    | kJ/kg,°C :              | 1,205   | 4,179  |
| Thermal Conductivity                      | W/m,°C :                | 0,0159  | 0,624  |
| Designed Plate Heat Exchanger :           |                         |         |        |
| Heat Load                                 | kW :                    | 81,3    |        |
| Total Heat Transfer Area                  | m <sup>2</sup> :        | 7,83    |        |
| Log Mean Temperature Difference           | °C :                    | 19,54   |        |
| Overall H.T.C.                            | W/m <sup>2</sup> ,°C :  | 699/531 |        |
| Calculated Pressure Drop                  | kPa :                   | 15,7    | 3      |
| Number of Channels                        | :                       | 1*29L   | 1*30L  |
| Connection Diameter                       | mm :                    | 47,7    | 47,7   |
| Number of Heat Transfer Units             | NTU :                   | 2,814   | 0,512  |
| Total Number of Plates                    | :                       |         | 60     |
| Oversurfacing                             | % :                     |         | 32     |
| Fouling Factor                            | m <sup>2</sup> ,°C/kW : |         | 0,452  |

| Design Calculation -- WP7M- 20            |                         |         |        |
|---|-------------------------|---------|--------|
| Input Data :                              |                         |         |        |
| Design Duty : LT jääsoojus täis koormusel |                         |         |        |
|   |                         | Side 1  | Side 2 |
| Fluid Name                                | :                       | R-404a  | Water  |
| Inlet Temperature                         | °C :                    | 130     | 30     |
| Outlet Temperature                        | °C :                    | 40      | 40     |
| Mass Flow Rate                            | kg/h :                  | 710     | 1663,2 |
| Pressure                                  | bar :                   | 18      | -      |
| Max. Acceptable Pressure Drop             | kPa :                   | 15      | 50     |
| Physical Properties of Fluid :            |                         |         |        |
| Reference Temperature                     | °C :                    | 82,5    | 35     |
| Viscosity                                 | mPas :                  | 0,014   | 0,721  |
| Viscosity Wall                            | mPas :                  | 0,014   | 0,654  |
| Density                                   | kg/m <sup>3</sup> :     | 59,4    | 992,7  |
| Specific Heat Capacity                    | kJ/kg,°C :              | 1,031   | 4,179  |
| Thermal Conductivity                      | W/m,°C :                | 0,0171  | 0,624  |
| Designed Plate Heat Exchanger :           |                         |         |        |
| Heat Load                                 | kW :                    | 19,3    |        |
| Total Heat Transfer Area                  | m <sup>2</sup> :        | 2,43    |        |
| Log Mean Temperature Difference           | °C :                    | 29,41   |        |
| Overall H.T.C.                            | W/m <sup>2</sup> ,°C :  | 652/270 |        |
| Calculated Pressure Drop                  | kPa :                   | 8       | 2,9    |
| Number of Channels                        | :                       | 1*9M    | 1*10M  |
| Connection Diameter                       | mm :                    | 47,7    | 47,7   |
| Number of Heat Transfer Units             | NTU :                   | 3,23    | 0,34   |
| Total Number of Plates                    | :                       |         | 20     |
| Oversurfacing                             | % :                     |         | 141    |
| Fouling Factor                            | m <sup>2</sup> ,°C/kW : |         | 2,169  |

# Jääsoojuse kasutuse näited



# Pildid





Täna tähelepanu eest !