

Meeting Ringsted DHU Emission Goals

ENGINEERING
TOMORROW



Topic	Minutes	Comment	Who
Welcome to webinar	2	Live	Drew
Intro to Ringsted district Heating company	10	Live	Ole
Ringsted Forsyning updated heat plant	5	Live	Ole
Danfoss and technology used in Ringsted heat pump	10	Live	Drew
Geoclima and their heat pumps used in Ringsted	10	Live	Fabian
Virtual tour of new Ringsted heat plant	10	Video	Ole
Roundtable discussion - System, equipment, learnings	10	Live	Ole, Drew, Fabian, Morten
Webinar participant questions	15	Live	Ole, Drew, Fabian, Morten
Thank you and next action	3	Live	Drew

Danfoss Oil-Free Solutions, Geoclima and Unicoool Meeting Ringsted DHU Emission Goals

DBDH Webinar | March 2021



The Evolution of Danfoss Turbocor® Compressors

The idea of using oil free magnetic bearing technology began with the 1st prototype built in 1995. Since then, over 80,000 Danfoss Turbocor® Compressors have been built, confirming the commercial success of oil free compressor technology.



1st oil free magnetic bearing compressor built



Full range of oil free, magnetic bearing centrifugal compressors up to 200 tons offered



VTT compressor up to 400 tons



TGS490 compressor, world's 1st oil free magnetic bearing compressor using low GWP, non-flammable R515B

1995

2001

2010

2013

2014

2019

2020

1st installation of oil free, magnetic bearing TT centrifugal compressor



TG compressor launched – 1st centrifugal compressor using ultra low GWP HFO1234ze



TTH / TGH compressor, world's 1st oil free magnetic bearing compressor optimized for higher lift applications



VTX compressor up to 450 tons for high efficiency, large capacity oil free chillers



Danfoss Turbocor TTH/TGH “High Lift” Compressor

The world’s **first oil-free compressor** for **higher lift** applications

Utilizes **oil-free magnetic bearings**, **permanent magnet motor**, and integrated **variable speed drive**

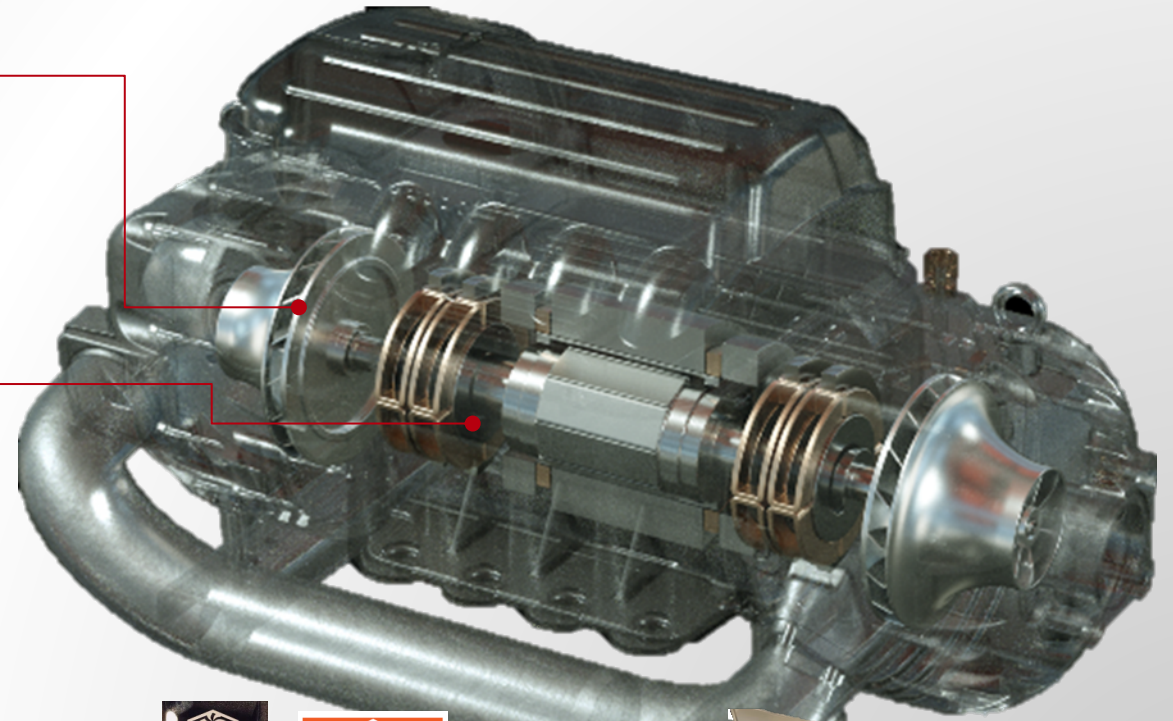
Heating capacities

R-134a, R-513A: 379-440kW

HFO-1234ze, R515B (in-development): 296-360kW

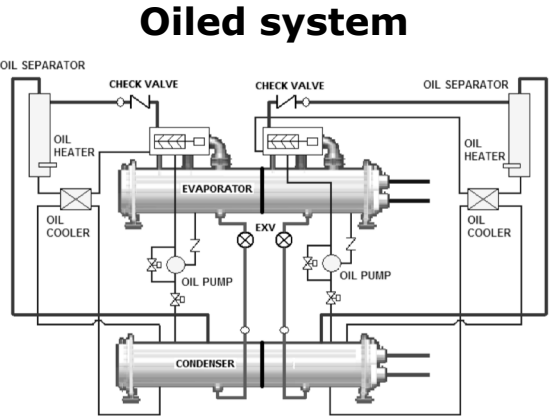
Industry recognition - awards

- 2018 AHR Product of the Year
- 2018 AHR Innovation - Green Building
- 2018 Innovation, Mostra Convegno
- 2018 Innovation, China Refrigeration

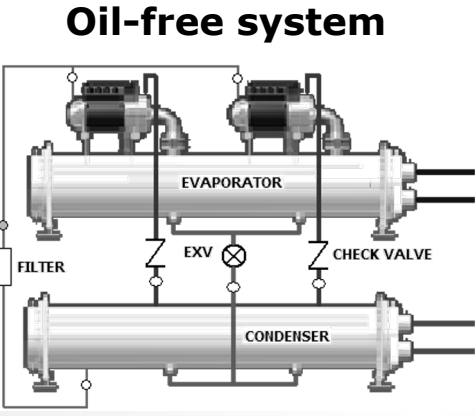


The benefits of Oil-Free Compressor Technology vs Oiled Compressors

Reduced Complexity



vs



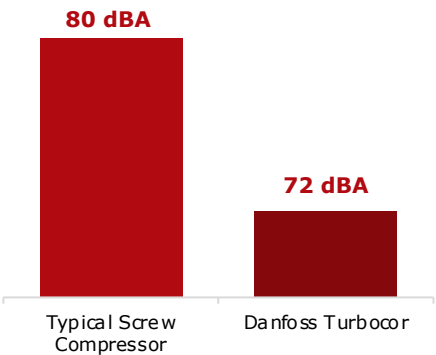
High Efficiency vs Screws

Up to 40% improvement in part load efficiency (IPLV) vs traditional fixed speed screws



Quiet Operation vs Screws

- Up to 8 dBA quieter vs typical screw compressor
- No expensive sound attenuation required
- No pure tone noise effect in 1/3 octave bands



Less Maintenance

Required Maintenance

- Check Oil Pressure
- Check Oil Level
- Oil Filter Change
- Conduct Oil Analysis and Submit to OEM
- Inspect and Confirm Oil Pump Operation
- Inspect Oil Sump Heaters
- Oil Change
- Inspect Oil Sump Strainers
- Acidity Test on Oil

Frequency

- Daily
- Daily
- Twice/year
- Quarterly
- Every Week
- Every Week
- Annual
- Every 5 years
- Annual

Danfoss Turbocor® Advantages

Consistent Performance over the Lifetime

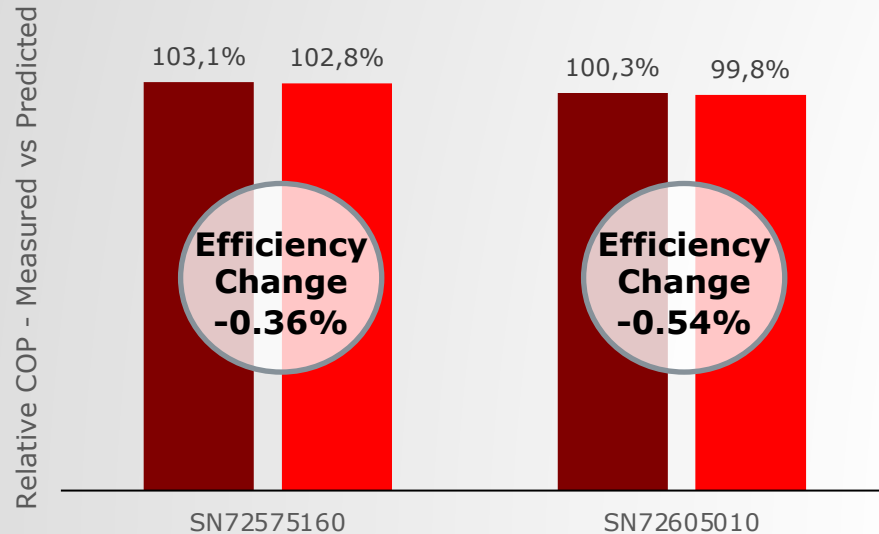


- <-0,6% variation in energy efficiency over 11 years
- No Variation Above Any Measurement Uncertainty!!!
- Turbocor® Magnetic Bearing Compressors Means No Wear In & No Wear Out



Compressor Performance after
11 Years of Operations

■ 2007 ■ 2018



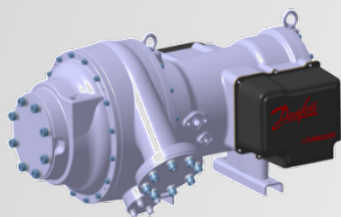
TT300 Compressor Performance over Time				
Serial Number	72575160		72605010	
Year Tested	2007	2018	2007	2018
Age (years)	0yrs	11yrs	0yrs	11yrs
SST	5.8	6.0	5.3	5.4
SDT	36.3	36.3	36.0	36.1
Input Power Measured	46.8	48.0	48.7	49.0
Massflow Measured	101.1	103.2	100.2	100.3
Massflow Target	98.0	100.4	99.9	100.1
vs Target Change	103.1%	102.8%	100.3%	100.2%
	(0.36%)		(0.09%)	
COP Measured	5.68	5.66	5.41	5.39
COP Target	5.51	5.51	5.40	5.40
vs Predicted Performance Change	103.1%	102.8%	100.3%	99.8%
	(0.36%)		(0.54%)	

Danfoss Oil-Free Compressor Technology

Dynamic Compression 'Lift' Defined



- Lift – Temperature difference between Saturated Suction (SST) and Saturated Discharge (SDT)
- Three main groups with application overlap



Standard

Applications:

- Water-cooled chillers
- Evap-cooled chillers

Compressors:

- TTS400, TTS700
- TGS390, TGS520
- VTT1200
- VTX1600

Up to 50°C

~32 K design
(~57F)

~42 K max
(~76F)

Down to ~4°C



Medium

Applications:

- Air-cooled chillers
- Water-cooled chillers
- Evap-cooled chillers
- W-W heat pumps
- High-temp process

Compressors:

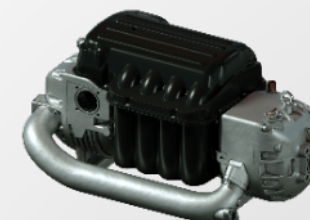
- TTS300, TTS350
- TGS230, TGS310, TGS490

Up to 63°C

~42 K design
(~76F)

~57 K max
(~103F)

Down to -10°C



High

Applications:

- Air-cooled chillers
- W-W heat pumps
- A-W heat pumps
- Med-temp process
- Thermal storage

Compressors:

- TTH375
- TGH285

Up to 69°C

~55 K design
(~99F)

~65 K max
(~117F)

Down to -18°C

Danfoss Oil-Free Compressor Technology

Ringsted Heat Plant heat pumps utilize two optimized versions



Ringsted Heatpump system 2020

Outdoor temperature	-5° C
Forward temperature from HP*	60° C
kW	
Heat cap, HP01 (outdoor air)	6,829
Heat cap, HP02 (waste heat straw boiler)	962
Heat cap, straw boilers (waste heat)	850
Heat cap, HP03 (waste heat from HP 01)	310
Total heat capacity	8,951
Power consumption HP01	2,262
Power consumption HP02	136
Power consumption HP03	50
Power consumption scrubber	22
Total power consumption	2,448
COP HP01	3.0
COP HP02	7.1
COP scrubber	38.6
COP HP03	6.2
Total COP for energy system	3.7

2-HP02



Medium

Applications:

- Air-cooled chillers
- Water-cooled chillers
- Evap-cooled chillers
- **W-W heat pumps**
- High-temp process

Compressors:

- TT300, TT350
- TG230, **TG310**, TG490

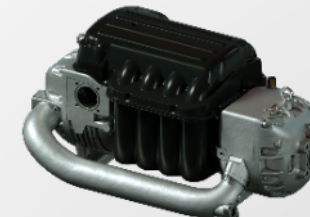
Up to 63°C

~42 K design
(~76F)

~57 K max
(~103F)

Down to -10°C

1-HP03



High

Applications:

- Air-cooled chillers
- **W-W heat pumps**
- A-W heat pumps
- Med-temp process
- Thermal storage

Compressors:

- TTH375
- **TGH285**

Up to 69°C

~55 K design
(~99F)

~65 K max
(~117F)

Down to -18°C

Oil-Free Compressor Technology

Optimized Performance for Various Applications and Requirements



Two different compressor designs required for Ringsted performance



Different temperature capabilities & optimization (closer to center = more efficient)



Portfolio flexibility is critical



Alternative (5th Generation of District Heating) system concept, utilizing low-lift & high-lift combination



Medium-lift compressor design



VP02 design point

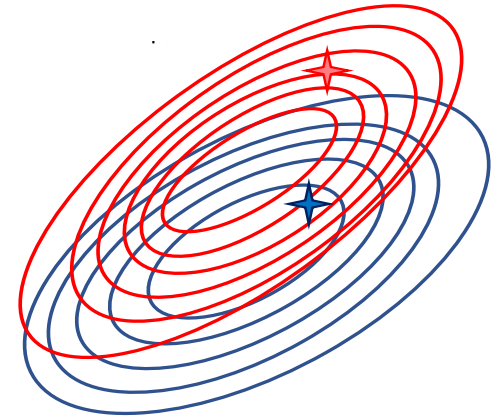


Optimized for heat pump application



VP03 design point

Head Factor
(Lift/differential temp.)



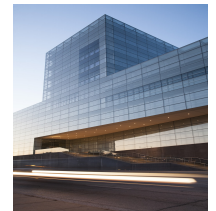
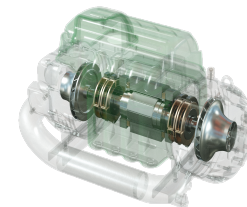
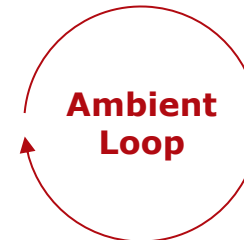
Flow Factor (capacity)

Low stage

High stage



Waste water

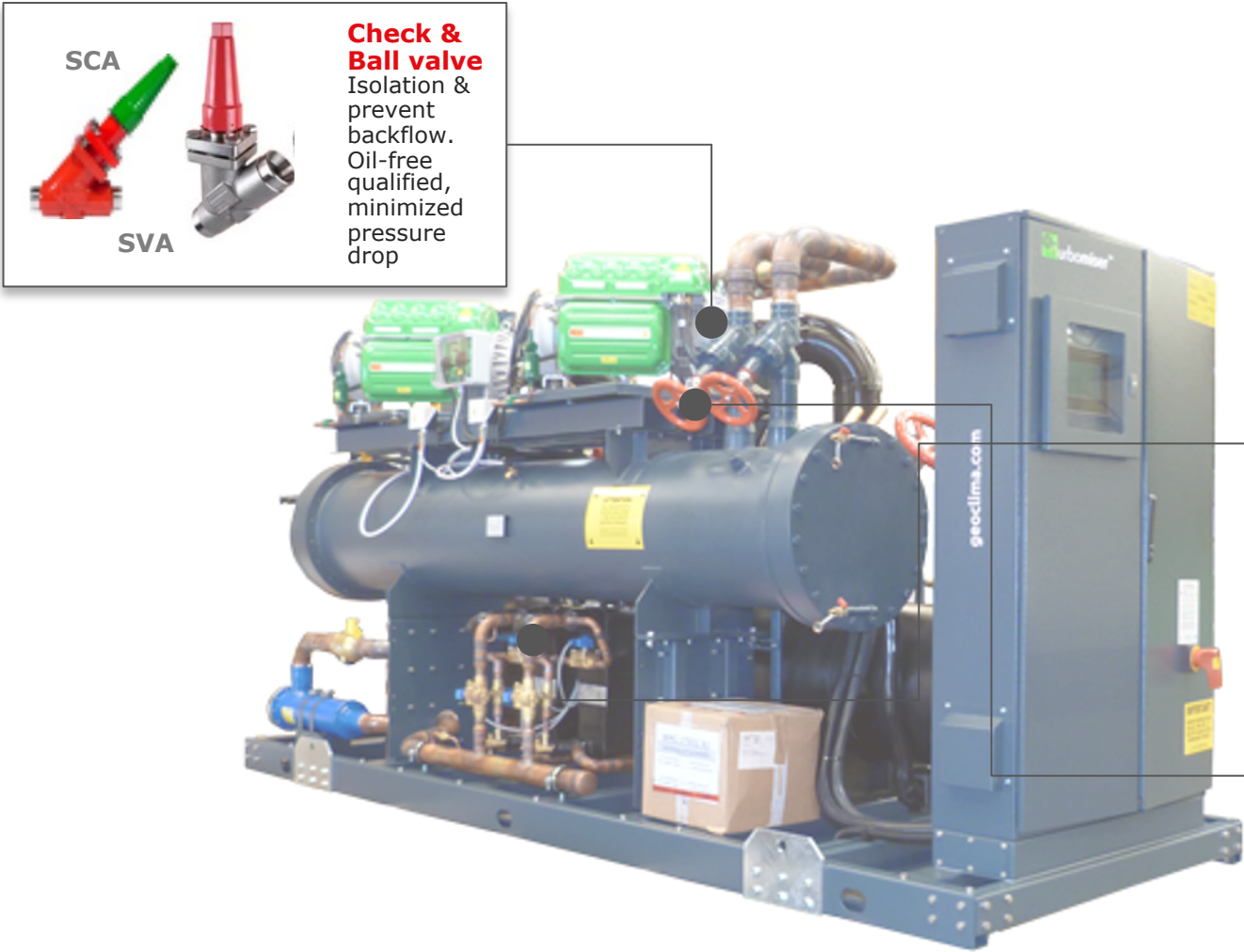


Low - Lift

High - Lift

Oil-Free Heat Pump Component Technology

A broad and expanding Portfolio



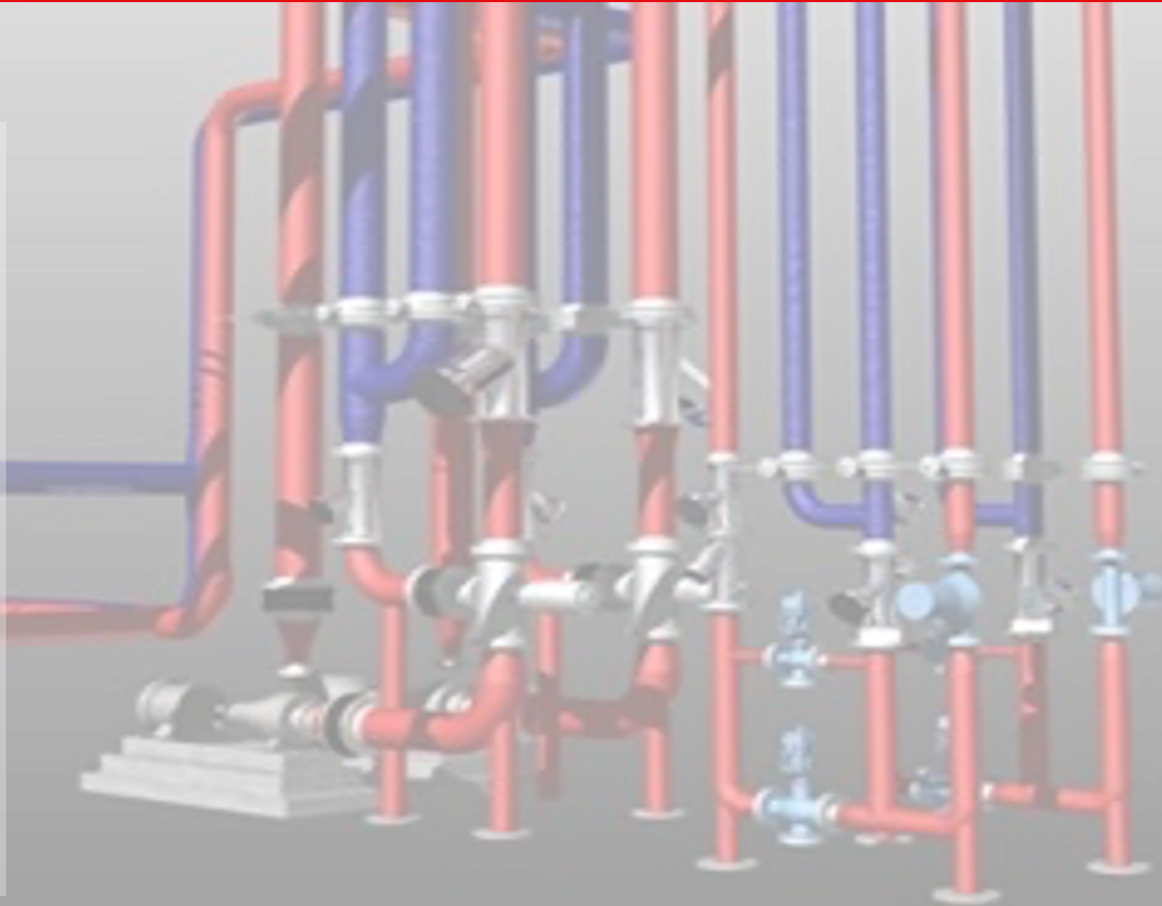
RIC20001A (2 units)		TMH1Z415 DC-ZE
Part	Model	
Check valve	CSA-X 80 D ANG	
Reinforced spring kit	SCA 80	
Valve	SVA-ST 100D STRH-CAP	
HP saftey pressostat	KP 6B (60-519166)	
Cover IP55	060-033066	
Therm Exp Valve	ETS-250	
Therm Exp Valve	COLIBRI 12C 22	

RIC20001B (1 unit)		TMH1K290 DC-ZE SP
Part	Model	
Check valve	CSA-X 100 D ANG	
Reinforced spring kit	SCA 100	
Valve	SVA-ST 125D STRH-CAP	
HP saftey pressostat	KP 6B (60-519166)	
Cover IP55	060-033066	
Therm Exp Valve	ETS-250	
Therm Exp Valve	COLIBRI 25C	

Danfoss Heat Plant Component Technology

The Driving Factor

Steel Ball Valves Type JiP, Butterfly Valves and Nonreturn Valves from DN65 - DN200





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