

ClimaCheck

Performance analysis and
Energy optimisation

**Manufacturing of Chillers/Heat Pumps
Development and testing**



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- Complete line-up for field and fixed performance analysis
- Based on patent from 1986.
- ClimaCheck was founded in 2004
- Distribution in 15 countries.
- Rapid increase in the global market.
- Customers today: over 30 Manufacturing Companies. Around 400 contractors from Europe to Asia :
 - **Carrier/Trane/Thermia**
 - **DuPont, Solvay**
 - **Copeland/Bitzer**
 - **Carrefour, Metro (Italien), ICA, Axfood, Tesco**

Winner 2009
"Refrigeration Product of the Year"
at RAC-exhibition in England



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Customer demands

- Performance according to specifications
- Correct amount of refrigerant in the system
- Components adjusted to specified operation ambient conditions.

Why so important?

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Customer demands:

- Customer should get "what he paid for"
- The Manufacturer wants to secure quality and lower risk of compressor failure
- Correct analysis and documentation increases the competence and trust in the market.

More Possibilities!

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Development of Chillers and Heat Pumps:

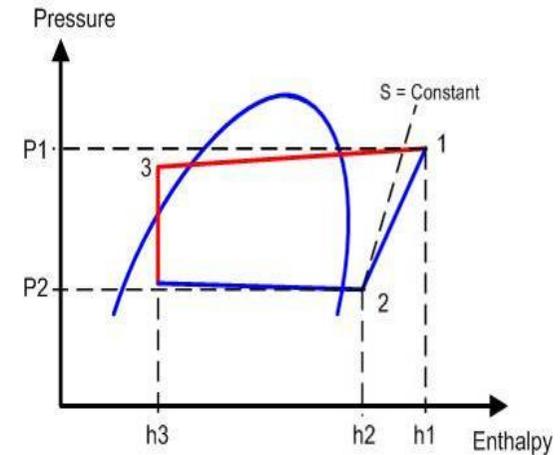
- Frequency modulation is more and more common-ClimaCheck gives the correct capacity and COP
- New compressor technologies-verification
- New technology should be tested inside the lab-not in field

The ClimaCheck Method!

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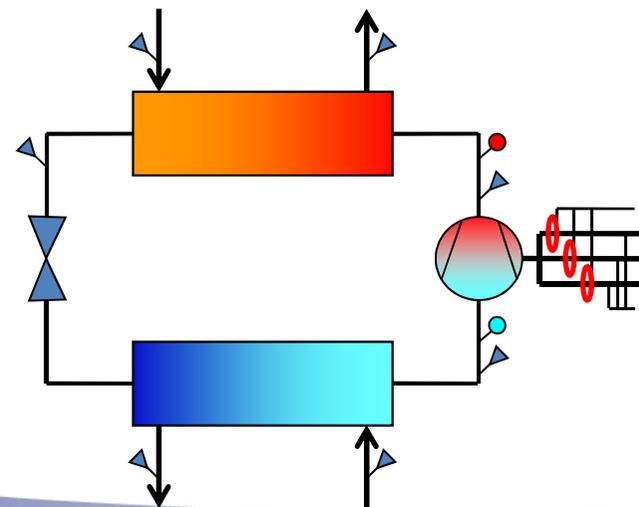
The ClimaCheck Method is based on the following principles

1. Pressure and temperature measurement around the compressor
 - Gives enthalpy difference
2. Temperature liquid refrigerant
 - Gives enthalpy out of the condenser and into the evaporator.
3. Energy balance over compressor gives mass flow
 - (Heat losses are known and Thermal efficiency is introduced in the calculation)
4. Mass flow gives heating- and cooling capacity



Additional information:

1. Brine and Coolant temperature
 - For accurate control of set values
2. Ambient temperature and humidity
 - For accurate control of aircooled condensers
3. Input power
 - Total input power including pumps etc.



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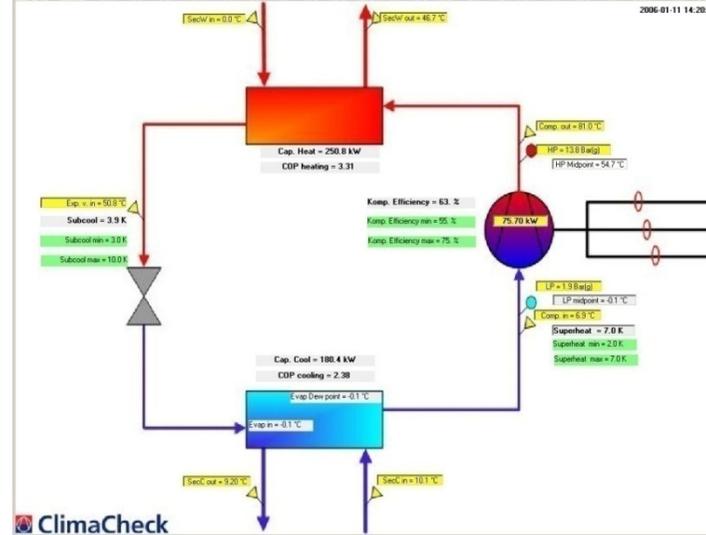
Protocol

Testat system:							
Datum:	2006-01-11						
Driftfall	Mätta värden		Nominella värden	Avvikelse från nominell			Kommentar
DatumDatum	2006-01-11						
Tid för mätning	14:26:00						
Kyleffekt	185.1	kW				%	
Värmeeffekt	256.1	kW				%	
COP Kyla	2.44					%	
COP Värme	3.37					%	
Elektrisk effekt	75.9	kW				%	
Cirkulationsflöde värmekrets	37.7	l/s				%	
Frostkyddsmedel typ	Water						
Frostkyddsmedel koncentration	100	Volym-%					
Cirkulationsflöde kylkrets	129.5	l/s				%	
Frostkyddsmedel typ	Water						
Frostkyddsmedel koncentration	100	Volym-%					
Sekundär kall in (Köldb./luft)	10.6	°C					
Sekundär kall ut (Köldb./luft)	9.5	°C					
Överhettning Kompressor	7.3	K					
Sekundär varm in (Kylmedel/luft)	40.6	°C					
Sekundär varm ut (Kylmedel/luft)	46.4	°C					
Köldmedium	R134A						
Kompressor tryckrörstemperatur	80.9	°C					

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Tested Equipment		Performance Inspection with ClimaCheck															Term. Elec.	Stab	Accept	Auto	Annual Electrical	Annual		
Participant	R13AA																0.93	1.00	Red	0.10	1.00	500000	700000	
Min	No of Scans																2.0	3.0	66	55	0.1	1.0	1.8	
Max	SE																7.0	10.0	120	75	1000	4.0	8	
																	4.7	3.6	58.78	0.8-7.0	1.8-8.0			
																	Exp. Sec.	Low Pres. Ref.	Cond. Sec.	High Pressure Ref.	Compressor	Operating cost		
Mean		10.1	9.2	1.82	0.0	6.9	6.8	0.0	47.1	13.94	55.1	4.0	81.2	63.5	75.8	237	179.7	3.30	250.2	2763	42188	2798	42418	
Max		10.2	9.3	1.94	0.2	7.0	7.0	0.0	47.8	14.26	56.0	4.1	81.5	64.4	76.5	239	180.7	3.32	251.3	2847	42557	2860	42686	
Min		10.1	9.2	1.91	-0.1	6.6	6.7	0.0	46.7	13.79	54.7	3.9	81.0	63.2	74.5	235	175.6	3.26	244.7	2767	41997	2705	42209	



Report from Performance inspection:

Tested Equipment:

Date: 2006-01-11

	Uppmätt värde	Nominella Data	Avvikelse	Kommentarer
Time for measurement	14:21:10			
Secondary Cold in	19.1 °C	12.0 °C	-1.89 K	
Secondary Cold out	9.2 °C	7.0 °C	-2.19 K	
Evaporation	0.6 °C	2.0 °C	-1.99 K	
Super heat Comp.	6.5 K	5.0 °C	1.69 K	
Secondary Warm in	6.6 °C	40.0 °C	-46.00 K	
Secondary Warm out	49.3 °C	45.0 °C	1.69 K	
Compressor discharge	61.0 °C	60.0 °C	1.00 K	
Condensing	56.7 °C	50.0 °C	4.68 K	
Sub cool before exp.	3.5 K	5.0 °C	-1.05 K	
Power Input	75.7 kW	70.0 kW	5.70 kW	8.1 %
Comp.heat_w	63.1 %	64.0 %	0.90	
Cooling Capacity	160.2 kW	190.0 kW	-9.88 kW	-5.2 %
COP cooling	2.39	2.60	-0.22	-8.4 %
Heating Capacity	250.5 kW	250.0 kW	-0.40 kW	-0.6 %
COP Heating	3.31	3.80	-0.19	-5.4 %
Stability*	0.03	0.10	0.09	

* If unstable this must be taken into account when evaluation

External measurement > small temperature differences

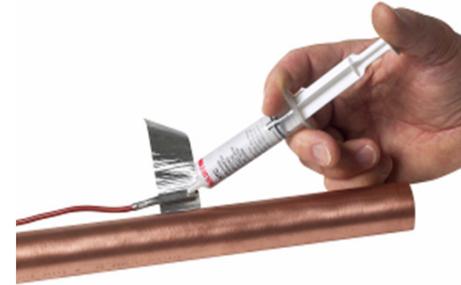
> inaccurate measurement has big impact on performance calculation

- System 12°C/ 7°C Brine temperature
 - Inaccuracy of 0.25 K gives 10% error in cooling capacity
- System 40°C/ 45°C Coolant temp
 - Inaccuracy of 0.25 K gives 10% error in cooling capacity
- Control at "0-load" is important and simple
- Perception of time constants increases knowledge

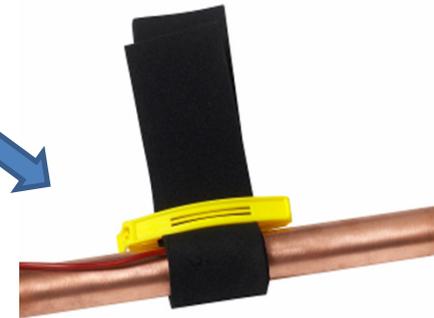
Internal method for refrigeration processes

- Gives detailed and accurate information
 - COP (5%), Cooling- and Heating capacity (7%)
 - Gives more information than performance
 - All components are evaluated
 - Compressor efficiency
 - Heat Exchanger analysis (Medium temp. difference, KA)
 - Correct amount of refrigerant charge
 - Expansion valve control and capacity control
 - etc
 - Faster and more complete analysis
 - Less demand of stability – less sensitive towards measuring error
 - 1% on pressure probes
 - Cost efficient

Easy to apply

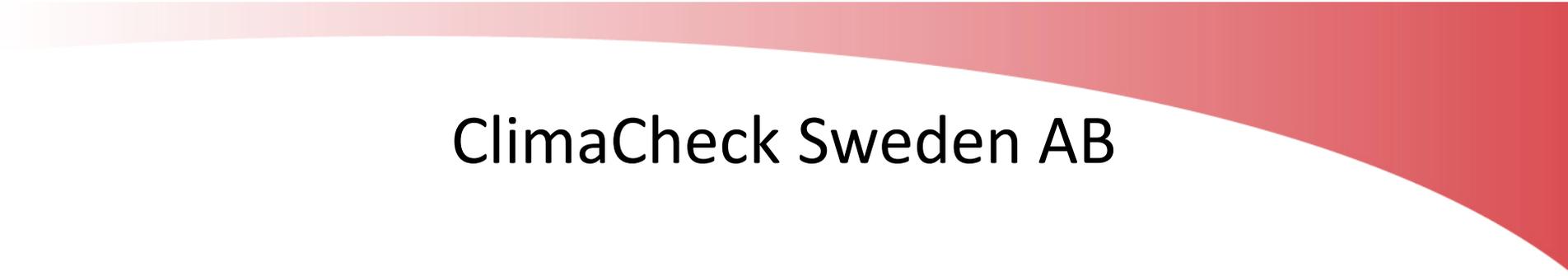


20
minutes



Analysis

- Components
 - Refrigerant charge
 - Subcooling
 - Expansion valve
 - Superheat
 - Compressor
 - Efficiency
 - Condensor
 - Temperature difference
 - Evaporator
 - Temperature difference
- System
 - Temperature levels
 - Stability
 - Control
 - Usage of capacity
 - Heat recovery
 - Free cooling



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Manufacturing and testing

Optimisation

Control of COP-Heating/cooling capacity

Refrigerant charge

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