


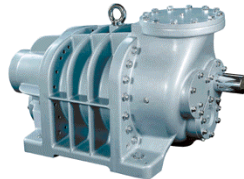


**Ammonia Liquid Chiller  
Series FX PP, LP, VP  
200 – 6000 kW**

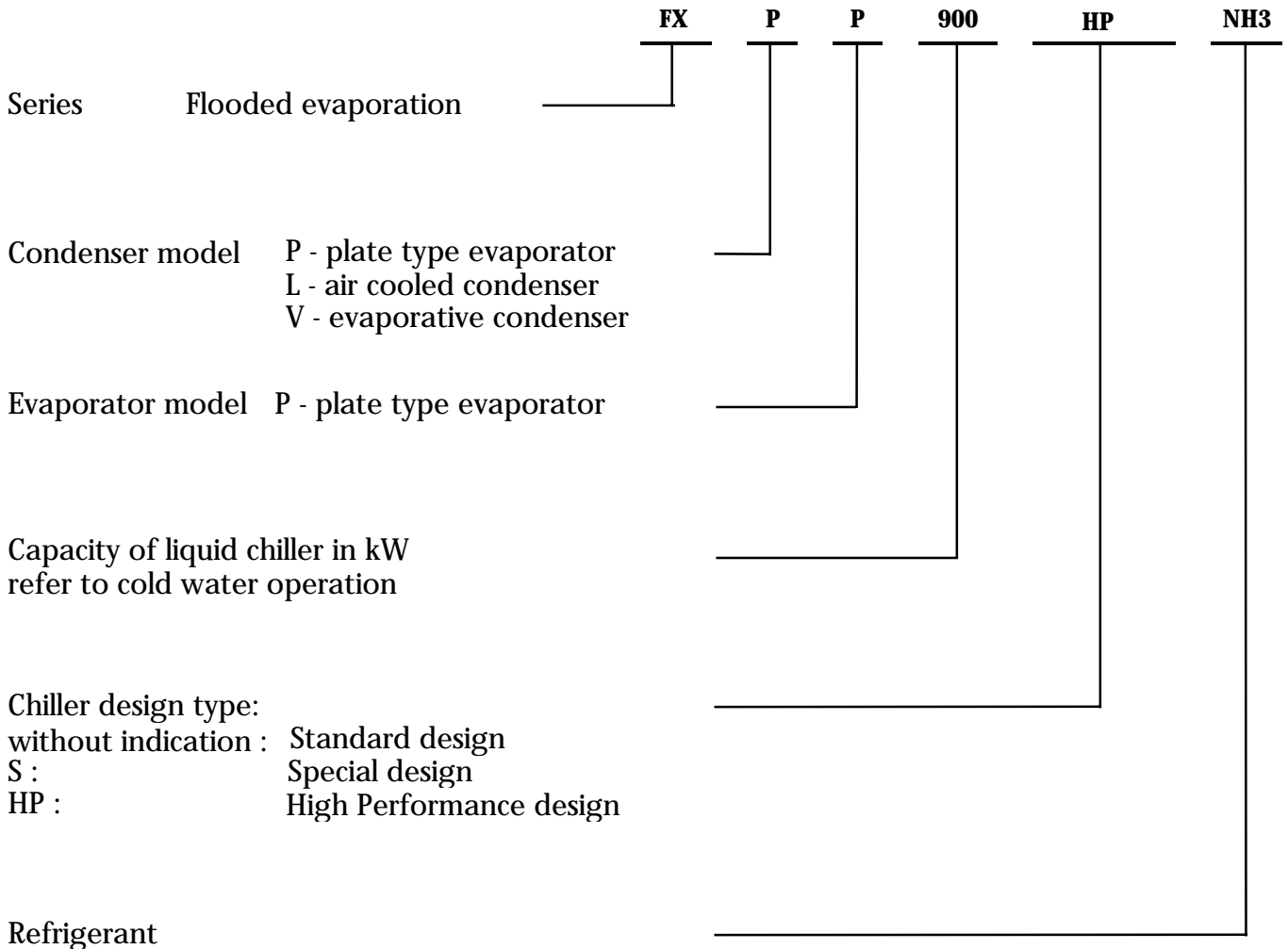
**Product Information**



Series overview		060 020e	2001.12
Designation Code		060 040e	2001.12
Description of Function and Design		060 100e	2001.12
Series FX PP	PP 200 ...350	Weights and Chargings	060 200e 2001.12
	PP 200 ... 350	P+I diagram	060 210e 2001.12
	PP 450 ... 900	Weights and Chargings	060 220e 2001.12
	PP 450 ... 900	P+I diagram	060 230e 2001.12
	PP 800 ... 3300	Weights and Chargings	060 240e 2001.12
	PP 4200 ... 5800	Weights and Chargings	060 250e 2001.12
	PP 800 ... 5800	P+I diagram	060 260e 2001.12
Series FX LP, VP	LP, VP 200 ... 350	Weights and Chargings	060 300e 2001.12
	LP, VP 200 ... 350	P+I diagram	060 310e 2001.12
	LP, VP 450 ... 900	Weights and Chargings	060 320e 2001.12
	LP, VP 450 ... 900	P+I diagram	060 330e 2001.12
	LP, VP 800 ... 3300	Weights and Chargings	060 340e 2001.12
	LP, VP 4200 ... 5800	Weights and Chargings	060 350e 2001.12
	LP, VP 800 ... 5800	P+I diagram	060 360e 2001.12
Performance parameters	Series PP 200...3300 - Standard	060 570e	2001.12
	Series PP 200...3300 - High Performance	060 571e	2001.12
	Series LP 200...3300 - Standard	060 572e	2001.12
	Series LP 200...3300 - High Performance	060 573e	2001.12
	Series VP 200...3300 - Standard	060 574e	2001.12
	Series VP 200...3300 - High Performance	060 575e	2001.12
	Series PP, LP, VP 4200 ... 5800 - Standard	060 576e	2001.12
External condensers		060 600e	2001.12
Oil pumps		060 610e	2001.12
Sound pressure level		060 620e	2001.12
Modular Control		060 700e	2001.12
Low voltage switchgear installation with integral control GSC		060 800e	2001.12

	<b>200 – 350 kW</b>	<b>450 – 900 kW</b>	<b>800 – 2800 kW</b>	<b>3300 – 5800 kW</b>
<b>Capacity range</b>				
Screw Compressor (SC)	Small highintegrated  4 Types : C, D, E, G swept volume $V_{th}$ $V_{th}= 231 \dots 375 \text{ m}^3/\text{h}$	Medium compact  4 Types : H, L, M, N swept volume $V_{th}$ $V_{th}= 450 \dots 860 \text{ m}^3/\text{h}$	Large traditional  6 Types : P, R, S, V, W, Y, Z swept volume $V_{th}$ $V_{th}= 805 \dots 2748 \text{ m}^3/\text{h}$	X-Large traditional  4 Types : XA, XB, XC, XD swept volume $V_{th}$ $V_{th}= 3250 \dots 5800 \text{ m}^3/\text{h}$
				
Screw Compressor Packages (SCP)	<b>SMALL</b>	<b>MEDIUM</b>	<b>LARGE</b>	<b>X-LARGE</b>
Liquid Chiller	<b>SMALL</b>	<b>MEDIUM</b>	<b>LARGE</b>	<b>X-LARGE</b>
Evaporator Type	Plate type evaporator	Plate type evaporator	Plate type evaporator	Plate type evaporator
Working principle	Flooded evaporation	Flooded evaporation	Flooded evaporation	Flooded evaporation
Liquid separator	horizontal	vertical	vertical	horizontal
Condenser Type P	Plate type condenser	Plate type condenser	Plate type condenser	Plate type condenser
Condenser Type L	Air-cooled condenser	Air-cooled condenser	Air-cooled condenser	Air-cooled condenser
Condenser Type V	Evaporative condenser	Evaporative condenser	Evaporative condenser	Evaporative condenser
For transportation divided into	1 fragment	1 fragment	3-4 fragments	4-5 fragments

**DESIGNATION CODE**



Screw Compressor	Nominal capacity in kW
C	200
D	250
E	300
G	350
H	450
L	550
M	650
N	900
P	800
R	1100

Screw Compressor	Nominal capacity in kW
S	1300
V	1700
W	2000
Y	2400
Z	2800
<b>XA</b>	3300
<b>XB</b>	4200
<b>XC</b>	5000
<b>XD</b>	5800

## INTRODUCTION

The standard ammonia liquid chiller programme comprises well-proven components which are assembled to form complete refrigerating systems both for medium and large refrigerating and air conditioning requirements.

Main fields of application:

- old water for air conditioning
- cold brine for air conditioning with combined ice storage operation
- cold water for industrial processes
- cold brine for industrial processes
- (cold) and warm water for heat pump operation

On principle, the refrigerant used in the refrigerating systems is ammonia which features a high specific refrigerating capacity, a low energy demand, an attractive price and an environmentally neutral behaviour.

Based on the screw compressor series, the ammonia liquid chiller programme covers a refrigerating capacity ranging from 200 to 5800 kW, related to the cold water range. The capacity ranges are determined by the 18 sizes of the Grasso screw compressors.

The liquid chiller programme consists of three series which comprise different condenser designs and are operated with flooded evaporator systems on the basis of gravity recirculation.

The ammonia liquid chillers are of modular design and consist of the following main modules:

- Standard Screw compressor unit
- heat exchanger assembly with low-pressure separator and oil return system
- low-voltage switchgear installation with control device

The modular design of the chillers is guided to the standard series of Grasso screw compressor packages, which are executed with horizontal oil separators within the SMALL series and vertical oil separators within the MEDIUM and LARGE series.

For chillers equipped with SMALL packages is the liquid separator with respect to the package design as well executed in horizontal design. For MEDIUM and LARGE series chillers vertical compact vessels are used for liquid separation. This ensures the compact design of ammonia liquid chillers.

For the new X-LARGE size of packages a horizontal liquid separator is used in difference to the vertical oil separator.

Solely plate-type evaporators are used as evaporators. Each series is optionally fitted with a standard evaporator, but can also be adapted to specific operating conditions and customer requests, if need be.

On the condenser side, the following versions are used:

- plate-type condenser PP
- evaporative condenser VP
- air cooled condenser LP

The ammonia chillers 200 – 550 will be delivered as a compact, complete pre-fabricated factory packaged and wired unit, ready for connection on site.

The modular design enables a divided delivery in different parts especially from the chiller size 800 up to 5800. The modules will be re-assembled on site under consideration of certain special machine room conditions.

The ammonia liquid chillers FX LP and FX VP are delivered completely so that solely the air cooled condenser (FX LP) or the evaporative condenser (FX VP) has to be connected on site.

The heat exchangers of the three series are designed for the parameters of a project on both the evaporator- and condenser side. In doing so, the temperature differences are chosen so that the customer requirements are met optimally. If the difference between the evaporating temperature and the temperature of the leaving secondary refrigerant is lower than 5K, the liquid chiller gets the addition HP (High Performance).

The standard version of the liquid chillers is equipped with a freely programmable standard logic controller PLC SIMATIC C7-633. All operating and fault signals as well as the process variables can be read from a LCD-display with background lighting. The display is operated via a robust foil keyboard having 6 function- and 24 system keys.

The liquid chillers are delivered without refrigerant and oil; they are filled with dry nitrogen (0.5 bar gauge pressure).

Each liquid chiller consignment is accompanied by the respective User Documentation which comprises a description of the refrigeration circuit, assembly and commissioning instructions as well as operating and maintenance instructions.

For detailed information about the screw compressors and standard screw compressor units specific Product Documentation is available.

**AMMONIA LIQUID CHILLER  
SERIES FX P**

**FUNCTION**

The screw compressor sucks refrigerant gas out of the liquid separator and brought up to condensation pressure. The refrigerant turns to liquid as its cooled in the condenser. Afterwards the liquid is injected back to the liquid separator via a high pressure float valve as expansion device. Inside the liquid separator takes place the separation of the liquid and gaseous phases. The liquid passes in a gravity driven circuit the evaporator. By taking up heat (delivered by the secondary refrigerant) it evaporates and a mixture of gas and liquid is coming back to the liquid separator.

During the operation of the screw compressor, oil is injected into the working chamber and then separated again from the refrigerant in the discharge side oil separator. The oil which has heated up in the compressor is cooled in an oil cooler to reach the entry temperature and passes a fine filter.

Despite of the highly effective oil separation system, oil penetrates to the low pressure side of the Chiller. A special automatic and maintenance-free oil returning system developed by Grasso returns the oil from the liquid separator back into the screw compressor. This is a basic precondition for a flawless operation of the evaporator system.

The capacity control of the screw compressor operates infinitely variable by volume flow control (internal bypass) and thus adapts optimally to the refrigeration capacity being effectively required and ranging from 100% to approx. 15%. The capacity slide is hydraulic driven and activated by 4 solenoid valves. The position of the slide is displayed on the compressor control.

**SAFETY DEVICES**

The ammonia chillers are equipped with a comprehensive software safety chain preventing higher pressures, temperatures and freezing of secondary refrigerant. A suction- and discharge pressure control and a motor current control is dominating the normal capacity control in the way if a limit value is exceeded then the capacity slide is activated into minimum position.

Several organizations in different countries require in due to laws and rules extensive additional safety equipment independent from software.

Following additional safety equipment is required by German TÜV:

**Series FX PP**

- Overflow valve from discharge- to suction side
- Safety pressure limiter (2 independent switches with internal and external reset)
- a safety relief valve (with blow off line) is not necessary, because there is a defined refrigerant charge and no vessel can be filled up with more than 90% of liquid refrigerant

**Series FX LP, VP**

- Safety relief valve (with blow off line, to be connected to the outside by contractor)
- Overflow valve from discharge- to suction side
- Overflow valve from HP-receiver of thermosyphon oil cooler to LP side
- Safety pressure limiter (2 independent switches with internal and external reset)

Following additional safety equipment is required if the chiller is delivered according to **EN 378 CE marked**:

**Series FX PP, LP, VP**

- a pressure relief device for every vessel, which might be contain liquid refrigerant, within stop valves and a diameter > 152mm. This is not valid for oil separators and oil filters. The pressure relief device is executed as overflow valve.
- Safety pressure limiter (2 independent switches with internal and external reset)
- a double safety valve with change over valve, (with blow off line, to be connected to the outside by contractor)

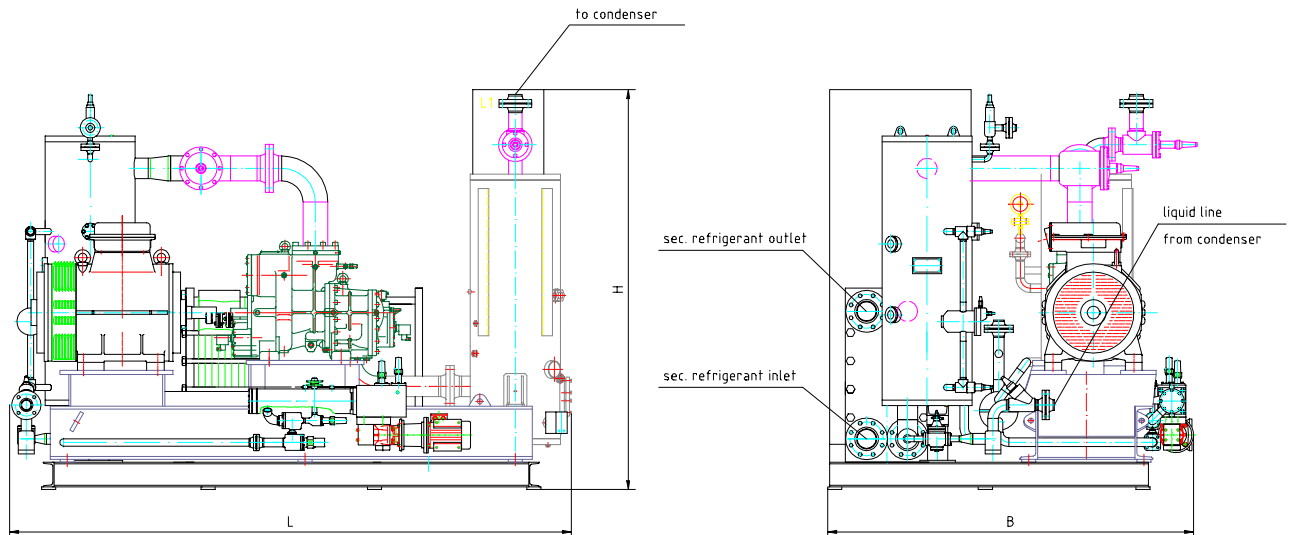
If delivery is according to EN 378 then all in this rule definitely mentioned documentations will be delivered in the national language where the chiller is erected.

All other approvals have to agreed separately.

Below mentioned data are valid for following standard conditions:

**Secondary refrigerant temperature +12°C/+6°C and condensation temperatures of +35°C (VP) and +45°C (LP)**

For other conditions there might be divergent data.



**Dimensions and Weights**

Chiller Type	L (mm)	B (mm)	H (mm)	Weight without charging (kg)		Operating weight (kg)	
				ST	HP	ST	HP
LP, VP 450	2800	2000	2300	3650	3700	3850	3950
LP, VP 550	2800	2000	2300	3950	3950	4200	4250
LP, VP 650	3200	2200	2800	5400	5500	5650	5770
LP, VP 900	3400	2200	2800	6300	6500	6560	6800

**Chargings, Ports, Sound pressure level**

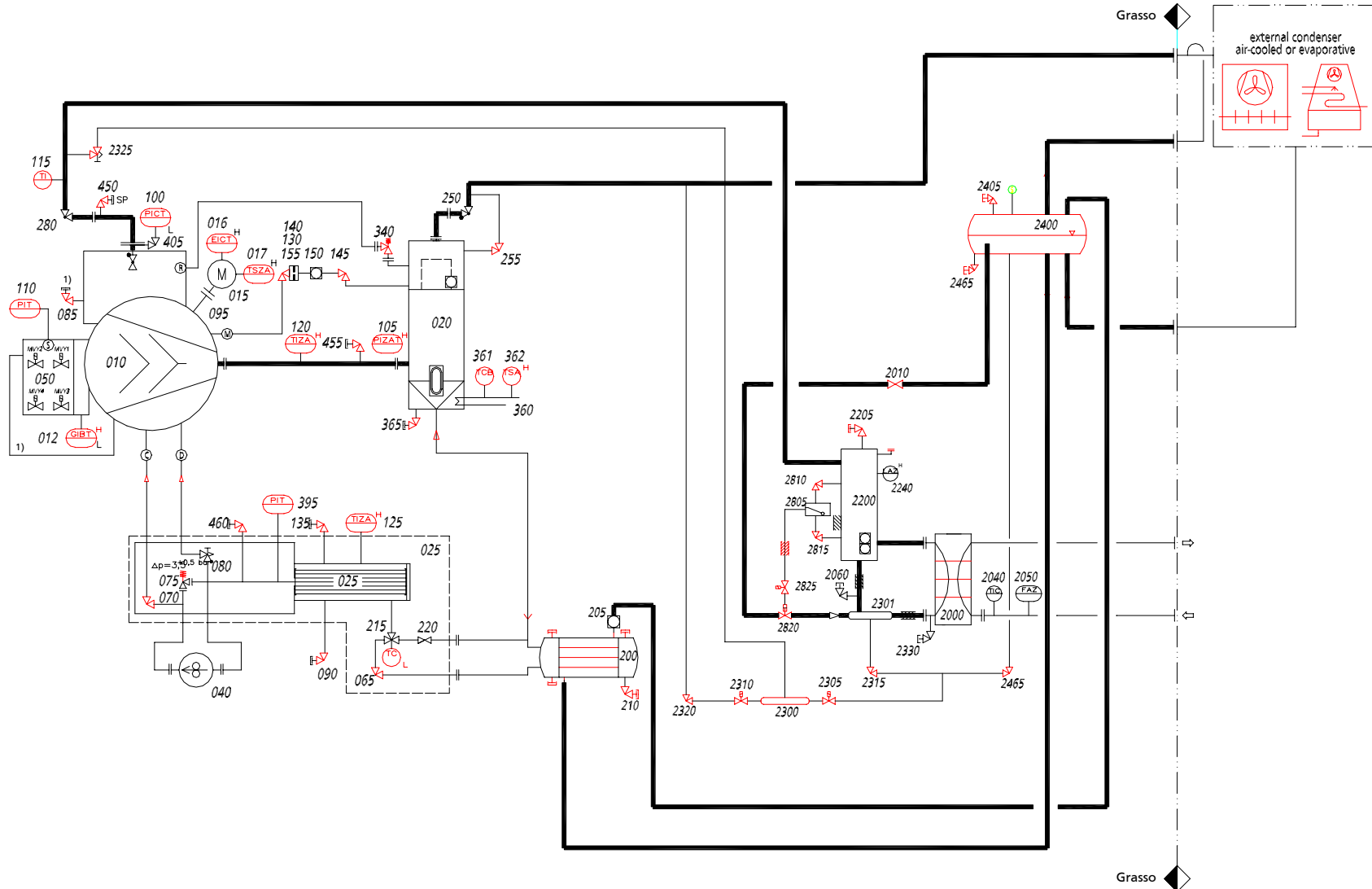
Chiller Type	Oil charging (dm <sup>3</sup> )	Refrigerant charging (kg)	Connections NB				Power supply (kW)		Sound press. level dB(A) 1m LP <sup>*</sup> )
			Cold water	discharge line	liquid line	return line	LP	VP	
LP, VP 450	110	95	100	50	50	40	132	110	81
LP, VP 550	110	98	100	50	50	40	160	132	83
LP, VP 650	120	103	100/150	65	50	50	200	160	84
LP, VP 900	120	110	100/150	65	50	50	250	200	85

ST – Standard :  $\Delta T=5K$  at heat exchangers

HP – High Performance:  $\Delta T<5K$  at heat exchangers

\*) - Sound pressure level for VP see at PP

**STANDARD LIQUID CHILLER  
TYPE FX LP, VP 450 ... 900**





**AMMONIA LIQUID CHILLER  
SERIES FX VP - STANDARD**

Chiller type	Performance parameters in kW	Cold water inlet- / Cold water outlet temperatures (°C)				
		11/5	12/6	14/8	16/10	18/12
VP 200	Q <sub>o</sub>	206	213	220	228	243
	P <sub>e</sub>	39	40	40	41	42
	Q <sub>c</sub>	245	253	260	269	285
VP 250	Q <sub>o</sub>	241	249	257	266	284
	P <sub>e</sub>	46	47	48	49	50
	Q <sub>c</sub>	287	296	305	315	334
VP 300	Q <sub>o</sub>	289	299	309	320	341
	P <sub>e</sub>	54	55	55	57	58
	Q <sub>c</sub>	343	354	364	376	399
VP 350	Q <sub>o</sub>	343	355	367	380	405
	P <sub>e</sub>	63	64	65	66	68
	Q <sub>c</sub>	406	419	432	446	473
VP 450	Q <sub>o</sub>	438	453	468	484	516
	P <sub>e</sub>	77	79	80	81	84
	Q <sub>c</sub>	515	532	547	565	600
VP 550	Q <sub>o</sub>	517	535	552	572	610
	P <sub>e</sub>	90	92	93	94	98
	Q <sub>c</sub>	607	627	645	666	708
VP 650	Q <sub>o</sub>	649	673	695	723	767
	P <sub>e</sub>	119	121	123	124	129
	Q <sub>c</sub>	769	794	817	844	896
VP 800	Q <sub>o</sub>	779	807	833	862	920
	P <sub>e</sub>	139	141	143	145	150
	Q <sub>c</sub>	917	948	976	1007	1070
VP 900	Q <sub>o</sub>	833	863	891	928	984
	P <sub>e</sub>	152	155	157	159	165
	Q <sub>c</sub>	985	1018	1048	1082	1149
VP 1100	Q <sub>o</sub>	1004	1041	1074	1112	1186
	P <sub>e</sub>	181	184	187	190	196
	Q <sub>c</sub>	1185	1224	1261	1302	1382
VP 1300	Q <sub>o</sub>	1244	1289	1331	1378	1470
	P <sub>e</sub>	225	229	232	236	244
	Q <sub>c</sub>	1469	1518	1563	1614	1714
VP 1700	Q <sub>o</sub>	1617	1676	1730	1791	1910
	P <sub>e</sub>	276	280	283	288	297
	Q <sub>c</sub>	1893	1955	2013	2079	2207
VP 2400	Q <sub>o</sub>	2267	2350	2425	2511	2678
	P <sub>e</sub>	383	388	394	400	413
	Q <sub>c</sub>	2650	2738	2819	2911	3091
VP 2800	Q <sub>o</sub>	2707	2805	2895	2998	3197
	P <sub>e</sub>	465	471	478	486	502
	Q <sub>c</sub>	3172	3276	3373	3484	3699
VP 3300	Q <sub>o</sub>	3185	3300	3406	3548	3762
	P <sub>e</sub>	567	577	586	591	614
	Q <sub>c</sub>	3752	3876	3990	4120	4373

Q<sub>o</sub> - Refrigerating capacity  
 Q<sub>c</sub> - Condensing capacity at wet bulb temperature = 21°C  
 P<sub>e</sub> - Power consumption