

Chillers

Commercial and Technical Data

- » Wide capacity range (120 kW - 570 kW)
- » Compact design
- » Indoor installations
- » Water supply down to -10°C (optional)
- » New MicroTech III controller



FCDFN12-41







Daikin Europe N.V.

About Daikin

Daikin has a worldwide reputation based on over 85 years' experience in the successful manufacture of high quality air conditioning equipment for industrial, commercial and residential use. Daikin's much envied quality quite simply stems from the close attention paid to design, production and testing, as well as aftersales support. To this end, every component is carefully selected and rigorously tested to verify its contribution to product quality and reliability.

New Daikin Compact line 'EWWD-J-' water cooled chiller range

In order to upgrade the water cooled chiller portfolio, Daikin enhances today the 'EWWD-J-' series, offering compact design, maximum efficiency and superior control logic.

The new range is composed of 16 sizes and available in standard efficiency version, with EER up to 4.41 and ESEER up to 5.37. Each unit is equipped with one or two R-134 refrigerant circuits, featuring shell & tube condenser, plate to plate evaporator and single screw compressor with stepless capacity control, allowing the chiller to modulate its capacity from 100% to 12.5%.

Moreover, the range features an extensive option list including the heat pump version, the energy meter and the sound proof system..



Table of Contents

CH	ILLER FEATURES	
TEC	CHNICAL DATA	5
1.	Features	5
2.	Technical & electrical specifications	6
3.	Features and advantages	11
4.	General Characteristics	13
5.	Nomenclature	17
6.	Capacity tables	18
7.	Pressure drops	24
8.	Dimensional Drawings	25
9.	Sound data	27
10.	Installation	28
11.	Operation range	31
12.	Specification text	34



Chiller features

Application flexibility

The EWWD-J- series is available in a wide range of capacities (120 - 570kW), allowing project solutions for an extensive range of applications. The most commonly serviced parts are easily accessible, simplifying maintenance and service. Moreover, the new chillers allow flexible integration into a wide range of control and building management systems.

Large operation range

With the 'brine' option the new range is able to provide water down to -10°C, making the units suitable also for some typical industrial applications.

Extensive option list

The base model includes several standard factory mounted options such as: electronic expansion valve, wye delta starter (y-d), main switch interlock, etc. Moreover, the new range features an extensive option list, including the sound proof system, the automatic circuit breakers, the fork-lift kit, etc.

Compact design for indoor installations

Water cooled units are typically intended for indoor installation and operation, resulting in acoustic isolation and also zero impact on the building layout. Thanks to the compact design, the EWWD-J- series allow easy indoor installations and retrofit operations.

Superior control logic

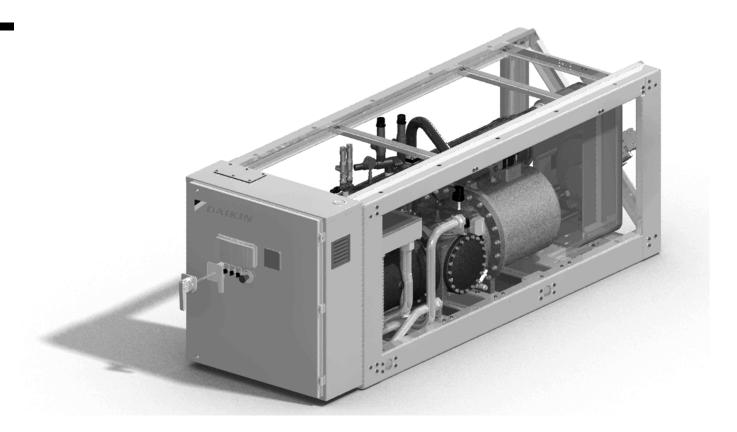
The new MicroTech III controller provides an easy to use control environmental. The control logic is designed to provide maximum efficiency, to continue operation in unusual operating conditions and to provide a history of unit operation. One of the greatest benefits is the easy interface with Lonwork, BACnet, Ethernet TCP/IP or Modbus communications.

1 Features

- Compact design to allow easy indoor installation or retrofit operations
- Daikin semi-hermetic single screw stepless compressor
- High efficiency at full and partial load

- Chilled water temperatures down to -10°C on standard unit
- Optimised for use with R-134a
- MicroTech III controller

1



2-1 Technica	I Specificatio	ns			EWWD120J-SS	EWWD140J-SS	EWWD150J-SS	EWWD180J-SS	EWWD210J-SS	EWWD250J-SS		
Cooling capacity	Nom.			kW	120 (1)	146 (1)	155 (1)	178 (1)	208 (1)	256 (1)		
Heating capacity	Nom.			kW	142 (2)	172 (2)	188 (2)	216 (2)	249 (2)	305 (2)		
Capacity control	Method			•			Step	oless		•		
	Minimum capaci	ty		%			2	15				
Power input	Cooling	Nom.		kW	27.3 (1)	33.3 (1)	38.5 (1)	44.2 (1)	49.3 (1)	58.7 (1)		
	Heating	Nom.		kW	32.9 (2)	40.1 (2)	46.4 (2)	53.5 (2)	59.57 (2)	71.68 (2)		
EER					4.40 (1)	4.38 (1)	4.03	3 (1)	4.22 (1)	4.37 (1)		
COP					4.32 (2)	4.29 (2)	4.05 (2)	4.04 (2)	4.18 (2)	4.26 (2)		
ESEER					5.01	4.	67	4.66	4.75	5.20		
Casing	Colour						lvory	white	l	I		
-	Material					G	alvanized and p	ainted steel she	eet			
Dimensions	Unit	Height		mm			1,0)20				
		Width		mm			9	13				
		Depth		mm			2,6	684				
Weight	Unit			kg	1,177	1,233	1,334	1,366	1,416	1,600		
· ·	Operation weigh	t		kg	1,211	1,276	1,378	1,415	1,473	1,663		
Water heat	Туре			, -		1	· ·	one per circuit	1	1		
exchanger												
Water heat	Water volume			I	14	18	14	17	20	26		
exchanger -	Water flow rate	Nom.		l/s	5.73	6.98	7.41	8.50	9.94	12.25		
evaporator	Nominal water pressure drop	Cooling	Heat exchanger	kPa	15	13	40	38	36	28		
	Insulation mater	ial				•	Close	ed cell				
Water heat	Туре				Double pass shell and tube							
exchanger -	Water flow rate	Nom.		l/s	7.04	8.57	9.25	10.62	12.30	15.06		
condenser	Nominal water	Cooling		kPa	20 12 11							
	pressure drop											
	Insulation mater	ial		Closed cell								
	Model	Quantity						1				
Sound pressure level	Cooling	Nom.		dBA			71.4 (3)			70.0 (3)		
Sound power level	Cooling	Nom.		dBA			88.6 (3)			87.2 (3)		
Compressor	Туре					Sem	ni-hermetic sing	e screw compre	essor			
	Quantity				1							
	Oil	Charged volume		I		1	3			_		
Operation range	Evaporator	Cooling	Min.	°CDB			-	10	•			
			Max.	°CDB			1	5				
	Condenser	Cooling	Min.	°CDB	23							
			Max.	°CDB			6	0				
Refrigerant	Туре	•	•	•			R-1	34a				
	Charge			kg	18	20	33	34	36	38		
	Circuits	Quantity		•		•		1	•	•		
Piping	Evaporator wate	r inlet/outlet		mm			76	6.2				
connections	Condenser water	r inlet/outlet (OD)		•	2" 1/2			4"				
Safety devices	Item	01				High	discharge press	sure (pressure s	witch)			
		02			High discharge pressure (pressure transducer)							
		03				Low s	uction pressure	(pressure trans	ducer)			
		04					Compressor m	notor protection				
		05			High discharge temperature							
		06			Low oil pressure							
		07			Low pressure ratio							
		08			High oil filter pressure drop							
		09			Phase monitor							
		10			Emergency stop button							
		11				\			er			
	<u> </u>	1			Water freeze protection controller							

2-1 Technica	I Specification	ns			EWWD280J-SS	EWWD310J-SS	EWWD330J-SS	EWWD360J-SS	EWWD380J-SS	EWWD400J-SS		
Cooling capacity	Nom.			kW	285 (1)	310 (1)	334 (1)	357 (1)	386 (1)	416 (1)		
Heating capacity	Nom.			kW	340 (2)	377 (2)	405 (2)	432 (2)	466 (2)	499 (2)		
Capacity control	Method						Ster	oless				
	Minimum capaci	ty		%	25		•	12.5				
Power input	Cooling	Nom.		kW	68.3 (1)	77 (1)	82.7 (1)	88.4 (1)	98.	6 (1)		
	Heating	Nom.		kW	80.75 (2)	92.88 (2)	99.9 (2)	107 (2)	113 (2)	119 (2)		
EER					4.18 (1)	4.03 (1)	4.04	1 (1)	3.91 (1)	4.22 (1)		
COP					4.21 (2) 4.06 (2) 4.05 (2) 4.04 (2) 4.12 (2) 4.15							
ESEER					4.46	4.80	4.84	5.00	4.79	5.17		
Casing	Colour					ı	lvory	white	l .	II.		
	Material					G	alvanized and p	ainted steel she	eet			
Dimensions	Unit	Height		mm	1,020			2,000				
		Width		mm		•	9	13				
		Depth		mm			2,6	684				
Weight	Unit	•		kg	1,607	2,668	2,700	2,732	2,782	2,832		
	Operation weigh	nt		kg	1,675	2,755	2,792	2,830	2,888	2,946		
Water heat exchanger	Туре						Brazed plate,	one per circuit				
Water heat	Water volume			I	26	29	31	33	37	41		
exchanger -	Water flow rate	Nom.		I/s	13.63	14.81	15.96	17.06	18.44	19.88		
evaporator	Nominal water pressure drop	Cooling	Heat exchanger	kPa	33	4	0	3	38	36		
	Insulation mater	ial	-I	1		l	Close	ed cell		ı		
Water heat	Туре					Double pass shell and tube						
exchanger -	Water flow rate	Nom.		I/s	16.89	18.49	19.91	21.28	23.15	24.59		
condenser	Nominal water pressure drop	Cooling	kPa	26		L	11	L	L			
	Insulation mater	ial		+	Closed cell							
	Model	Quantity			Ciosed ceil							
Sound pressure level	Cooling	Nom.		dBA	70.0 (3)			74.4 (3)				
Sound power level	Cooling	Nom.		dBA	87.2 (3) 92.4 (3)							
Compressor	Туре			L.		Sem	ni-hermetic singl	e screw compre	essor			
·	Quantity				1			2				
	Oil	Charged volume		I		-		2	26			
Operation range	Evaporator	Cooling	Min.	°CDB				10				
			Max.	°CDB	15							
	Condenser	Cooling	Min.	°CDB	23							
			Max.	°CDB	60							
Refrigerant	Туре						R-1	34a				
	Charge			kg	38	66	67	68	70	72		
	Circuits	Quantity		•	1		•	2	•			
Piping	Evaporator water	er inlet/outlet		mm			76	5.2				
connections	Condenser water	er inlet/outlet (OD)		•			4	."				
Safety devices	Item	01				High	discharge press	ure (pressure s	witch)			
		02				High dis	scharge pressur	e (pressure trar	nsducer)			
		03				Low s	uction pressure	(pressure trans	ducer)			
		04					Compressor m	notor protection				
		05			High discharge temperature							
		06			Low oil pressure							
		07			Low pressure ratio							
		08			High oil filter pressure drop							
		09			Phase monitor							
		10			Emergency stop button							
		11				V	Nater freeze pro	tection controlle	er			

2-1 Technica	I Specificatio	ns			EWWD450J-SS	EWWD500J-SS	EWWD530J-SS	EWWD560J-SS		
Cooling capacity	Nom.			kW	464 (1)	513 (1)	541 (1)	570 (1)		
Heating capacity	Nom.			kW	554 (2)	610 (2)	645 (2)	681 (2)		
Capacity control	Method					Ste	pless			
	Minimum capaci	ity		%		12	2.5			
Power input	Cooling	Nom.		kW	108 (1)	117 (1)	127 (1)	137 (1)		
	Heating	Nom.		kW	131 (2)	143 (2)	152 (2)	162 (2)		
EER					4.30 (1)	4.38 (1)	4.26 (1)	4.16 (1)		
COP					4.22 (2)	4.26 (2)	4.23 (2)	4.22 (2)		
ESEER					5.27	5.37	5.25	4.81		
Casing	Colour					lvory	white			
	Material					Galvanized and p	painted steel sheet			
Dimensions	Unit	Height		mm		2,0	000			
		Width		mm		9	13			
		Depth		mm		2,6	684			
Weight	Unit			kg	3,016	3,200	3,207	3,215		
	Operation weigh	nt		kg	3,136	3,327	3,338	3,350		
Water heat exchanger	Туре					Brazed plate,	one per circuit			
Water heat	Water volume			I	46		52			
exchanger -	Water flow rate	Nom.		I/s	22.17	24.51	25.85	27.23		
evaporator	Nominal water pressure drop	Cooling	Heat exchanger	kPa	36	2	28	33		
	Insulation mater	ial	I.			Close	ed cell	I.		
Water heat	Туре					Double pass	shell and tube			
exchanger -	Water flow rate	Nom.		I/s	27.33	30.10	31.92	33.78		
condenser	Nominal water pressure drop	Cooling		kPa	11	1	16			
	Insulation mater	ial		-	Closed cell					
	Model	Quantity					1			
Sound pressure level	Cooling	Nom.		dBA	73.8 (3)		73.0 (3)			
Sound power level	Cooling	Nom.		dBA	91.8 (3)		91.0 (3)			
Compressor	Туре				()	Semi-hermetic sing	le screw compressor			
•	Quantity						2			
	Oil	Charged volume		I	29		32			
Operation range	Evaporator	Cooling	Min.	°CDB			10			
, ,	·	, o	Max.	°CDB			15			
	Condenser	Cooling	Min.	°CDB			23			
			Max.	°CDB			60			
Refrigerant	Туре		I.			R-1	134a			
•	Charge			kg	74		76			
	Circuits	Quantity					2			
Piping	Evaporator water			mm		70	6.2			
connections		er inlet/outlet (OD)		1		4	4"			
Safety devices	Item	01				High discharge press	sure (pressure switch)			
•		02					re (pressure transducer)			
		03					(pressure transducer)			
		04					notor protection			
		05			High discharge temperature					
		06					pressure			
		07					ssure ratio			
					1		pressure drop			
		08				High oil filter	pressure drop			
		08					monitor			
						Phase				

2-2 Electric	al Specificatio	ns		EWWD120J-SS	EWWD140J-SS	EWWD150J-SS	EWWD180J-SS	EWWD210J-SS	EWWD250J-SS		
Compressor	Phase			3~							
	Voltage		V	400							
	Voltage range	Min.	%	-10							
		Max.	%	10							
	Maximum runnir	ng current	A	80	96	107	121	145	161		
	Starting method					Wye-	-delta	•	•		
Power supply	Phase					3	~				
	Frequency		Hz	50							
	Voltage				400						
	Voltage range	Min.	%	-10							
		Max.	%	10							
Unit	Maximum startir	ng current	A	1:	51		195		288		
	Nominal running current (RLA)	Cooling	A	47 (6)	57 (6)	68 (6)	75 (6)	85 (6)	99 (6)		
	Maximum running current		A	80	96	107	121	145	161		
	Max unit current	for wires sizing	A	88	106	118	133	160	177		

2-2 Electric	al Specificatio	ns		EWWD280J-SS	EWWD310J-SS	EWWD330J-SS	EWWD360J-SS	EWWD380J-SS	EWWD400J-SS			
Compressor	Phase			3~								
	Voltage		V	400								
	Voltage range	Min.	%	-10								
		Max.	%	10								
	Maximum runnir	ng current	А	182	1	07	1	21	145			
	Starting method		•		•	Wye	-delta		•			
Power supply	Phase					3	}~					
	Frequency		Hz	50								
	Voltage		V	400								
	Voltage range	Min.	%	-10								
		Max.	%		10							
Unit	Maximum startir	ng current	А	288	281	2	92	3	11			
	Nominal running current (RLA)	Cooling	A	113 (6)	135 (6)	143 (6)	150 (6)	160 (6)	169 (6)			
	Maximum running current		Α	182	214	228	242	266	290			
	Max unit current	for wires sizing	Α	200	235	251	266	293	319			

2-2 Electric	al Specificatio	ns		EWWD450J-SS	EWWD500J-SS	EWWD530J-SS	EWWD560J-SS				
Compressor	Phase			3~							
	Voltage		V	400							
	Voltage range	Min.	%		-1	10					
		Max.	%		1	0					
	Maximum runnir	ng current	Α	145	16	61	182				
	Starting method				Wye-	-delta	•				
Power supply	Phase				3	~					
	Frequency		Hz	50							
	Voltage		V		40	00					
	Voltage range	Min.	%		-1	10					
		Max.	%		1	0					
Unit	Maximum startir	ng current	Α	404	417	4	34				
	Nominal running current (RLA)	Cooling	A	183 (6)	197 (6)	212 (6)	226 (6)				
	Maximum runnir	ng current	Α	306	322	343	364				
1	Max unit current	for wires sizing	Α	337	354	377	400.4				

Notes

- (1) Cooling: entering evaporator water temp. 12°C; leaving evaporator water temp. 7°C; entering condenser water temp. 30°C; leaving condenser water temp. 35°C; full load operation.
- (2) Heating: entering evaporator water temp. 12°C; leaving evaporator water temp. 7°C; entering condenser water temp. 40°C; leaving condenser water temp. 45°C; unit at full load operation
- (3) Sound level data are measured at entering evaporator water temp. 12°C; leaving evaporator water temp. 7°C; entering condenser water temp. 30°C; leaving condenser water temp. 35°C; full load operation; standard: ISO3744
- (4) Allowed voltage tolerance ± 10%. Voltage unbalance between phases must be within ± 3%.
- (5) Maximum starting current: starting current of biggest compressor + current of the other compressor at 75 % of maximum load
- (6) Nominal current in cooling mode: entering evaporator water temp. 12°C; leaving evaporator water temp. 7°C; entering condenser water temp. 30°C; leaving condenser water temp. 35°C; compressors.
- (7) Maximum running current is based on max compressor absorbed current in its envelope
- (8) Maximum unit current for wires sizing is based on minimum allowed voltage.
- (9) Maximum current for wires sizing: compressor full load ampere x 1.1
- (10) Maximum starting current: starting current of biggest compressor + current of the other compressor at 75 % of maximum load + fans current

3 Features and advantages

Features and advantages

The EWWD-J- water cooled chillers, featuring 1 or 2 single screw compressors, are manufactured to satisfy the requirements of the consultants and the end user. Units are designed to minimise energy costs while maximising the refrigeration capacities. Daikin's chiller design experience, combined with outstanding features makes the EWWD-J- chiller unmatched in the industry.

Seasonal quietness

The compressor design with a single screw and twin rotors allows a constant gas flow. This compression process completely eliminates gas pulsations. The oil injection also results in significant mechanical noise reduction.

The twin gas compressor discharge chambers are designed to act as attenuators, based on the harmonic wave principle with destructive interference, thus always resulting equal to zero. The extremely low noise compressor performance affords the use of EWWD-J- chiller for all applications.

The reduced number of vibrations produced from the EWWD-J- chiller offers a surprisingly quiet operation eliminating the noise transmission through the structure and the chilled water piping system.

Infinitely capacity control

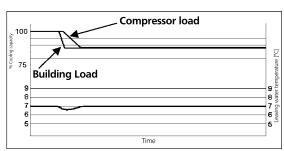
Cooling capacity control is infinitely variable by means of a screw compressor controlled by microprocessor system. Each unit has infinitely variable capacity control from 100% down to 25% (one compressor unit), down to 12,5% (two compressors units).

This modulation allows the compressor capacity to exactly match the building cooling load without any leaving evaporator water temperature fluctuation.

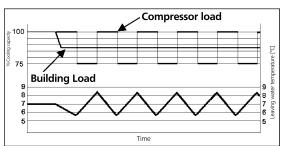
This chilled water temperature fluctuation is avoided only with a stepless control.

With a compressor load step control in fact, the compressor capacity, at partial loads, will be too high or too low compared to the building cooling load.

The result is an increase in chiller energy costs, particularly at the part-load conditions at which the chiller operates most of the time.



EWLT fluctuation with stepless capacity control



EWLT fluctuation with steps capacity control (4 steps)

Units with stepless regulation offer benefits that the units with step regulation are unable to match. The ability to follow the system energy demand at any time and the possibility to provide steady outlet water temperature without deviations from the set-point, are the two points that allow you to understand how the optimum operating conditions of a system can be met only through the use of a unit with step-less regulation.

Code requirements - Safety and observant of laws/directives

All water cooled units are designed and manufactured in accordance with applicable selections of the following:

Construction of pressure vessel	97/23/EC (PED)
Machinery Directive	2006/42/EC
Low Voltage	2006/95/EC
Electromagnetic Compatibility	2004/108/EC
Electrical & Safety Codes	EN 60204-1/EN 60335-2-40
Manufacturing Quality Stds	UNI - EN ISO 9001:2004

FTA_1-2_Rev.00_1

3 Features and advantages

Certifications

All units manufactured are CE marked, complying with European directives in force, concerning manufacturing and safety. On request units can be produced complying with laws in force in non European countries (ASME, GOST, etc.), and with other applications, such as naval (RINA, etc.).

Versions

EWWD-J- is available in standard efficiency version:

S: Standard Efficiency

16 sizes, covering a cooling capacity range from 121 up to 571 kW, EER up to 4.41 and ESEER up to 5.37.

The EER (Energy Efficiency Ratio) is the ratio of the Cooling Capacity to the Power Input of the unit. The Power Input includes: the power input for operation of the compressor, the power input of all control and safety devices.

The ESEER (European Seasonal Energy Efficiency Ratio) is a weighed formula enabling to take into account the variation of EER with the load rate and the variation of water inlet condenser temperature.

$$\mathsf{ESEER} = \mathsf{A} \; \mathsf{x} \; \mathsf{EER}_{\mathsf{100\%}} + \mathsf{B} \; \mathsf{x} \; \mathsf{EER}_{\mathsf{75\%}} + \mathsf{C} \; \mathsf{x} \; \mathsf{EER}_{\mathsf{50\%}} + \mathsf{D} \; \mathsf{x} \; \mathsf{EER}_{\mathsf{25\%}}$$

	А	В	С	D
Coefficient	0.03 (3%)	0.33 (33%)	0.41 (41%)	0.23 (23%)
Condenser water inlet temperature (°C)	30	26	22	18

Sound configuration

EWWD-J- is available in standard sound level configuration:

S: Standard Noise

FTA_1-2_Rev.00_2

General characteristics

Cabinet and structure

The cabinet is made of galvanized steel sheet and painted to provide a high resistance to corrosion. Colour Ivory White (Munsell code 5Y7.5/1) (±RAL7044). The base frame has eye-hook for lifting the unit with ropes for an easy installation. The weight is uniformly distributed along the profiles of the base and this facilitates the arrangement of the unit.

Screw compressors

The compressor is semi-hermetic, single-screw type with gate-rotors made of carbon impregnated engineered composite material. The compressor has one slide managed by the unit microprocessor for infinitely modulating the capacity between 100% to 25%. An integrated high efficiency oil separator maximizes the oil separation and standard start is Wye-delta $(Y-\Delta)$ type.

Ecological HFC 134a refrigerant

The compressors have been designed to operate with R-134a, ecological refrigerant with zero ODP (Ozone Depletion Potential) and very low GWP (Global Warming Potential) that means low TEWI (Total Equivalent Warming Impact).

Evaporator

The units are equipped with direct expansion plate to plate type evaporator, one per circuit. This heat exchanger is made of stainless steel brazed plates and is covered with a 10mm closed cell insulation material. The evaporator is manufactured in accordance to PED approval. The evaporator water outlet connections are provided with Victaulic Kit (as standard).

Condenser

The units are equipped with Direct Expansion shell & tube condenser, with copper tubes rolled into steel tube sheets. The unit has independent condensers, one per circuit. The condenser is manufactured in accordance to PED approval.

Condensers are provided with liquid shut-off valve and spring loaded relief valve.

The condenser water outlet connections are provided with Victaulic Kit (as standard).

Electronic expansion valve

The unit is equipped with the most advanced electronic expansion valves to achieve precise control of refrigerant mass flow. As today's system requires improved energy efficiency, tighter temperature control, wider range of operating conditions and incorporate features like remote monitoring and diagnostics, the application of electronic expansion valves becomes mandatory.

Electronic expansion valve proposes features that makes it unique: short opening and closing time, high resolution, positive shut-off function to eliminate use of additional solenoid valve, highly linear flow capacity, continuous modulation of mass flow without stress in the refrigerant circuit and corrosion resistance stainless steel body.

EEV strength point is the capacity to work with lower $\triangle P$ between high and low pressure side, than a thermostatic expansion valve. The electronic expansion valve allows the system to work with low condenser pressure (winter time) without any refrigerant flow problems and with a perfect chilled water leaving temperature control.

Refrigerant circuit

Each unit has independent refrigerant circuits and each one includes:

- Single screw compressor with integrated oil separator
- Brazed plate evaporator
- Shell & tube condenser
- Oil pressure transducer
- High pressure switches
- High pressure transducer
- Low pressure transducerMoisture liquid indicator
- Replaceable core filter-drier
- Electronic expansion valve

Electrical control panel

Power and control are located in the main panel that is manufactured to ensure protection against all weather conditions. The electrical panel is IP54 and (when opening the doors) internally protected with Plexiglas panel against possible accidental contact with electrical components (IP20). The main panel is fitted with a main switch interlocked door.

The power section includes compressors fuses and control circuit transformer.

MicroTech III controller

MicroTech III controller is installed as standard; it can be used to modify unit set-points and check control parameters. A built-in display shows chiller operating status plus temperatures and pressures of water, refrigerant, programmable values, set-points. A sophisticated software with predictive logic, selects the most energy efficient combination of compressors and electronic expansion valve to keep stable operating conditions to maximise chiller energy efficiency and reliability. MicroTech III is able to protect critical components based on external signs from its system (such as motor temperatures, refrigerant gas and oil pressures, correct phase sequence, pressure switches and evaporator). The input coming from the high pressure switch cuts all digital output from the controller in less than 50ms, this is an additional security for the equipment.

Fast program cycle (200ms) for a precise monitoring of the system. Floating point calculations supported for increased accuracy in P/T conversions.

Control section - main features:

- Management of the compressor stepless capacity.
- Chiller enabled to work in partial failure condition.
- Full routine operation at condition of:
 - high ambient temperature value
 - High thermal load
 - High evaporator entering water temperature (start-up)
- Display of evaporator entering/leaving water temperature.
- Display of condensing-evaporating temperature and pressure, suction and discharge superheating temperature for each circuit.
- Leaving water evaporator temperature regulation. Temperature tolerance = 0,1°C.
- Compressor and evaporator pumps hour counters.
- Display of Status Safety Devices.
- Number of starts and compressor working hours.
- Optimized management of compressor load.

 Re-start in case of power failure (Automatic / Manual).
- Soft Load (optimized management of the compressor load during the start-up).
- Start at high evaporator water temperature.
- Return Reset (Set Point Reset based on return water temperature).
- Setpoint Reset (optional).
- Application and system upgrade with commercial SD cards.
- Ethernet port for remote or local servicing using standard web browsers.
- Two different sets of default parameters could be stored for easy restore.

Safety device / logic for each refrigerant circuit

- High pressure (pressure switch).
- High pressure (transducer).
- Low pressure (transducer).
- High compressor discharge temperature.
- High motor winding temperature.
- Phase monitor.
- Low pressure ratio.
- High oil pressure drop.
- Low oil pressure.
- No pressure change at start.

System security

- Phase monitor.
- Low Ambient temperature lock-out.
- Freeze protection.

Regulation type

Proportional + integral + derivative regulation on the evaporator leaving water output probe.

Microtech II

MicroTech III built-in terminal has the following features.

- 164x44 dots liquid crystal display with white back lighting. Supports Unicode fonts for multi-lingual.
- Key-pad consisting of 3 keys.
- Push'n'Roll control for an increased usability.
- Memory to protect the data.
- General faults alarm relays.
- Password access to modify the setting.
- Application security to prevent application tampering or hardware usability with third party applications.
- Service report displaying all running hours and general conditions.
- Alarm history memory to allow an easy fault analysis.

Supervising systems (on request)

MicroTech III remote control

MicroTech III is able to communicate to BMS (Building Management System) based on the most common protocols as:

- ModbusRTU
- LonWorks, now also based on the international 8040 Standard Chiller Profile and LonMark Technology.
- BacNet BTP certifief over IP and MS/TP (class 4) (Native).

Chiller Sequencing

MicroTech III controller allows an easy plug-in sequencing technology based on digital or serial panel

Digital Sequencing Panel

This panel is basically a step inserter that switches ON/OFF up to 11 units (chillers or heat pumps operating in the same cooling/heating mode) depending on the selected set point, the units are connected with the panel through standard cables and no serial card is requested.

Serial Sequencing Panel

Basically this panel sequences a chiller plant by switching on/off the units (up to 7 chillers) taking into account their running hours and the requested plant load, in order to optimise the number of working units for each condition; serial cards and shielded cables are requested to connect the panel with the units and, if installed, a BMS.

Standard accessories (supplied on basic unit)

Evaporator Victaulic Kit - Hydraulic joint with gasket for an easy and quick water connection.

20mm Evaporator Insulation

Condenser Victaulic kit

Condenser Water side design pressure 16 bar

Condenser 2 passes (\triangle t 4-8°C)

Suction line shut off valve - Suction shut-off valve installed on the suction of the compressor to facilitate maintenance operation. **Discharge line shut-off valves** - Discharge shut-off valve installed on the discharge of the compressor to facilitate maintenance operations.

Electronic expansion valve

High Pressure Side Manometers

Y-D starter - Star Delta starter is the standard type

Double set-point - Dual leaving water temperature set-points.

Phase monitor - The phase monitor controls that phases sequence is correct and controls phase loss.

Evaporator flow switch for the water piping.

Hour run meter - Digital compressors hour run meter.

General fault contactor - Contactor for alarm warning.

Main switch interlock

Emergency stop

Options (on request)

Heat pump version

Brine version - Allows the unit to operate down to -8°C leaving liquid temperature (antifreeze required).

Compressor thermal overload relays - Safety devices against compressor motor overloading in addition to the normal protection envisaged by the electrical windings.

Evaporator Water side design pressure 16 bar

20mm Condenser insulation

Condenser double flanges kit

Water pressure differential switch on evaporator

Sound Proof System - Compressor sound enclosure.

Rubber type antivibration mounts - Supplied separately, these are positioned under the base of the unit during installation. Ideal to reduce the vibrations when the unit is floor mounted.

Fork lift kit

Low pressure side manometers

Dual Pressure Relief Valve on evaporator

Under/Over Voltage - This device control the voltage value of power supply and stop the chiller if the value exceeds the allowed operating limits.

Energy Meter - This device allows to measure the energy absorbed by the chiller during its life.

It is installed inside the control box mounted on a DIN rail and show on a digital display: Line-to-Line Voltage, Phase and Average Current, Active and Reactive Power, Active Energy, Frequency.

Condenser power factor correction - Installed on the electrical control panel to ensure it complies with the plant rules. (Daikin advises maximum 0,9).

Current limit display

Witness test - Every unit is always tested at the test bench prior to the shipment. On request, a second test can be carried out, at customer's presence, in accordance with the procedures indicated on the test form. (Not available for units with glycol mixtures)

Acoustic test - On request, a test can be carried out, at customer's presence (please contact the factory) (This test is not available for units with glycol mixtures).

Set-point reset, demand limit and alarm from external device - The leaving water temperature set-point can be overwritten with the following options: 4-20mA from external source (by user), outside ambient temperature; evaporator water temperature △t. Moreover the device allow the user to limit the load of the unit by 4-20mA signal or by network system and the microprocessor is able to receive an alarm signal from an external device (pump etc... - user can decide if this alarm signal will stop or not the unit).

Automatic circuit breakers

5 Nomenclature

E W W D 1 2 0 J - S S 0 0 1 1 2 13 14 Machine type EWA = Air-cooled chiller, Cooling only EWY = Air-cooled chiller, Heat pump EWL = Remote condenser chiller ERA = Air Cooled Condensing Unit EWW = Water-cooled chiller, Cooling only EWC = Air-cooled chiller, cooling only with centrifugal fan EWT = Air-cooled chiller, cooling only with heat recovery Refrigerant = R-134a= R-407c= R-410aCapacity class in kW (Cooling) Always 3-digit code Idem as previous **Model series** Letter A, B, . . . : major modification =Non inverter =Inverter Efficiency level =Standard Efficiency (N.A. for this range) = High Efficiency (N.A. for this range) = Premium efficiency Sound level =Standard Noise (N.A. for this range) (N.A. for this range) (N.A. for this range) =Low noise = Reduced noise =Extra low noise =Cabinet (N.A. for this range) Warranty = 1 year of warranty = 2 years of warranty =3 years of warranty =... years of warranty Sequential number 000 = Base model 001 = First order for this model (1 or more units) 002 = Second order for this model (1 or more units)
... = ...order for this model B01 = First order for this model + 1 year of warranty B02 = Second order for this model (1 or more units) =...order for this model NMC_1_Rev.00_1

5

Capacity tables 6

6 - 1 **Cooling Capacity Tables**

EWWD120~250J-SS

		ı				Ent	erina condense	er water temp.	(°C)				\neg
	EWLT		15			20			25			30	
Unit	(°C)	Cc(kW)	Pi (kW)	Hc (kW)	Cc (kW)	Pi (kW)	Hc (kW)	Cc (kW)	Pi (kW)	Hc (kW)	Cc (kW)	Pi (kW)	Hc (kW)
	4				118	21.7	139	113	23.9	137	108	26.4	135
	5				122	22.0	144	117	24.2	141	112	26.7	139
	6				126	22.3	148	121	24.5	145	116	27.0	143
	7 8				130 134	22.6 22.9	152 157	125 129	24.8 25.1	150 154	120 124	27.3 27.6	147 152
	9				138	23.2	161	133	25.1	154	128	27.9	156
120	10				100	20.2	101	137	25.8	163	132	28.2	160
	11							142	26.1	168	136	28.6	165
	12							146	26.4	172	140	28.9	169
	13							150	26.7	177	145	29.2	174
	14							155	27.1	182	149	29.6	179
	15							159	27.4	186	153	29.9	183
	4				143	26.5	169	137	29.2	166	131	32.2	163
	5				148	26.8	174	142	29.6	172	136	32.6	168
	6				153	27.2	180	147	29.9	177	141	32.9	174
	7 8				158 163	27.5 27.9	185 191	152 157	30.3 30.6	182 188	146 151	33.3 33.6	179 184
	9				168	28.2	197	162	31.0	193	156	34.0	190
140	10				100	20.2	101	168	31.4	199	161	34.4	195
	11							173	31.8	205	166	34.8	201
	12							178	32.1	210	171	35.2	207
	13							184	32.5	216	177	35.6	212
	14							189	32.9	222	182	36.0	218
	15							195	33.3	228	188	36.4	224
	4				153	30.8	183	147	34.1	181	141	37.5	179
	5 6				157	31.1 31.4	188 193	152	34.4	186 191	146	37.9 38.2	184 189
	7				162 167	31.7	193	156 161	34.7 35.0	196	151 155	38.5	194
	8				171	32.1	203	166	35.4	201	160	38.9	199
	9				176	32.4	209	171	35.7	206	165	39.3	204
150	10							176	36.1	212	169	39.6	209
	11							180	36.5	217	174	40.0	214
	12							186	36.8	222	179	40.4	220
	13							191	37.2	228	184	40.8	225
	14							196	37.6	233	189	41.1	230
	15				475	05.0	040	201	38.0	239	194	41.6	236
	5				175 181	35.2 35.6	210 216	169 174	38.9 39.4	208 214	162 167	43.0 43.4	205 211
	6				186	36.0	222	180	39.8	220	173	43.4	217
	7				192	36.4	228	185	40.2	225	178	44.2	222
	8				198	36.8	234	191	40.6	231	184	44.7	229
180	9				203	37.3	241	197	41.0	238	190	45.1	235
100	10							202	41.4	244	195	45.5	241
	11							208	41.9	250	201	46.0	247
	12							214	42.3	257	207	46.5	253
	13 14							221 227	42.8 43.3	263 270	213 219	46.9 47.4	260 266
	15							233	43.7	277	225	47.9	273
	4				205	39.2	244	197	43.5	240	189	47.9	237
	5				211	39.6	251	203	43.9	247	195	48.4	244
	6				217	40.0	257	209	44.4	254	202	48.9	250
	7				224	40.5	264	216	44.8	260	208	49.3	257
	8				230	40.9	271	222	45.3	267	214	49.8	264
210	9				237	41.4	278	229	45.7	274	221	50.2	271
	10 11							235 242	46.2 46.7	281 289	227 234	50.7 51.2	278 285
	12							242	47.2	296	240	51.7	292
	13							256	47.7	303	247	52.2	299
	14							263	48.2	311	254	52.7	307
	15							270	48.7	319	261	53.2	314
	4				252	46.4	299	242	51.5	294	233	57.2	290
	5				261	46.9	308	250	52.0	302	239	57.6	297
	6				270	47.4	317	259	52.6	312	248	58.2	306
	7 8				279 287	47.8 48.3	327 335	268 277	53.1 53.6	321 331	256 265	58.7 59.3	315 325
	9				294	48.3	335	285	53.6	331	265	59.3	325
250	10				234	70.7	543	293	54.1	347	282	60.4	343
	11							300	55.0	355	290	60.9	351
	12							308	55.5	364	298	61.4	359
	13							317	56.0	373	306	62.0	368
	14							325	56.5	381	314	62.5	376
	15							333	57.0	390	322	63.0	385

NOTES

Cc (cooling capacity) - Pi (unit power input) - ELWT (Evaporator leaving water temperature - \triangle t 5°C) - Condenser Water temperature \triangle t 5°C Data refers to 0,0176m² °C/kW evaporator fouling factor Data refers to 0,0440m² °C/kW condenser fouling factor CAPCOOL 1-2-3-4-5-6 Reference of the condenser fouling factor

CAPCOOL_1-2-3-4-5-6_Rev.00_1

Cooling Capacity Tables 6 - 1

EWWD120~250J-SS

	EWLT						ering condense	r water temp. (
Unit	(°C)	Cellana	35 D://////	11-7340	C-(1460	40	11-7346	C-/1140	45	11-/1100	C-(lan)	50 p://ato	11-7000
	4	Cc (kW) 103	Pi (kW) 29.0	Hc (kW) 132	Cc (kW) 98.1	Pi (kW) 31.9	Hc (kW) 130	Cc (kW) 92.5	Pi (kW) 35.1	Hc (kW) 128	Cc (kW) 86.7	Pi (kW) 38.6	Hc (kW) 125
	5	107	29.3	136	102	32.3	134	95.9	35.4	131	90.0	38.9	129
	6	111	29.6	140	105	32.6	138	99.5	35.7	135	93.3	39.2	133
	7	115	30.0	145	109	32.9	142	103	36.1	139	96.7	39.5	136
	8	119	30.3	149	113	33.2	146	107	36.4	143	100	39.9	140
120	9	123	30.6	153	117	33.6	150	111	36.8	147	104	40.2	144
	10	127	31.0	158	121	33.9	155	114	37.1	152	108	40.6	148
	11	131	31.3	162	125	34.2	159	118	37.5	156	112	40.9	152
	12	135	31.6	166	129	34.6	163	122	37.8	160	115	41.3	157
	13	139	32.0	171	133	35.0	168	126	38.2	165	119	41.7	161
	14	143	32.3	175	137	35.3	172	131	38.6	169	123	42.0	165
	15 4	147 125	32.7 35.5	180 161	141 118	35.7 39.0	177 157	135 111	38.9 42.9	173 154	127 104	42.4 47.1	170 151
	5	130	35.8	165	123	39.4	162	116	43.2	159	104	47.1	156
	6	134	36.2	170	127	39.7	167	120	43.6	164	112	47.8	160
	7	139	36.5	175	132	40.1	172	125	44.0	169	117	48.2	165
	8	144	36.9	181	137	40.5	177	129	44.3	173	121	48.6	170
	9	149	37.3	186	142	40.8	182	134	44.7	178	126	48.9	175
140	10	154	37.7	192	146	41.2	188	139	45.1	184	130	49.3	180
	11	159	38.1	197	152	41.6	193	143	45.5	189	135	49.8	185
	12	164	38.5	203	157	42.1	199	148	45.9	194	140	50.2	190
	13	170	38.9	209	162	42.5	204	154	46.4	200	145	50.6	195
	14	175	39.3	214	167	42.9	210	159	46.8	206	150	51.0	201
	15	180	39.7	220	172	43.3	216	164	47.3	211	155	51.5	206
	4	135	41.2	176	128	45.3	174	122	49.9	172	114	54.9	169
	5	140	41.6	181	133	45.7	178	126	50.3	176	118	55.3	174
	6	144	42.0	186	137	46.1	183	130	50.6	181	123	55.7	178
	7	149	42.3	191	142	46.4	188	135	51.0	186	127	56.1	183
	8	154	42.7	196	147	46.8	194	139	51.4	191	131	56.5	188
150	9 10	158 163	43.1 43.4	201	151 156	47.2 47.6	199 204	144 149	51.8 52.2	196 201	136 140	56.9 57.3	193 198
	11	168	43.4	211	161	48.0	209	153	52.6	206	145	57.8	203
	12	173	44.2	217	165	48.4	214	158	53.0	211	150	58.2	208
	13	177	44.6	222	170	48.8	219	163	53.4	216	155	58.6	213
	14												
	14	182	45.0	227	175	49.2	224	167	53.9	221	159	59.1	218
	15	182 187	45.0 45.4	227	175 180	49.2 49.6	224	167 172	53.9 54.3	221	159 164	59.1 59.5	218
	15	187 155 160	45.4	233	180 147 152	49.6	230	172	54.3	227	164	59.5	223 194 199
	15 4 5 6	187 155 160 165	45.4 47.4 47.8 48.2	233 202 208 214	180 147 152 157	49.6 52.2 52.6 53.0	230 199 205 210	172 140 144 149	54.3 57.5 57.9 58.3	227 197 202 207	164 131 136 141	59.5 63.1 63.6 64.1	223 194 199 205
	15 4 5 6 7	187 155 160 165 171	45.4 47.4 47.8 48.2 48.7	233 202 208 214 220	180 147 152 157 163	49.6 52.2 52.6 53.0 53.5	230 199 205 210 216	172 140 144 149 154	54.3 57.5 57.9 58.3 58.7	227 197 202 207 213	164 131 136 141 146	59.5 63.1 63.6 64.1 64.5	223 194 199 205 210
	15 4 5 6 7 8	187 155 160 165 171 176	45.4 47.4 47.8 48.2 48.7 49.1	233 202 208 214 220 225	180 147 152 157 163 168	49.6 52.2 52.6 53.0 53.5 54.0	230 199 205 210 216 222	172 140 144 149 154 159	54.3 57.5 57.9 58.3 58.7 59.2	227 197 202 207 213 219	164 131 136 141 146 150	59.5 63.1 63.6 64.1 64.5 64.9	223 194 199 205 210 215
180	15 4 5 6 7 8 9	187 155 160 165 171 176 182	45.4 47.4 47.8 48.2 48.7 49.1 49.6	233 202 208 214 220 225 231	180 147 152 157 163 168 174	49.6 52.2 52.6 53.0 53.5 54.0 54.4	230 199 205 210 216 222 228	172 140 144 149 154 159 165	54.3 57.5 57.9 58.3 58.7 59.2 59.7	227 197 202 207 213 219 225	164 131 136 141 146 150 155	59.5 63.1 63.6 64.1 64.5 64.9 65.4	223 194 199 205 210 215 221
180	15 4 5 6 7 8 9	187 155 160 165 171 176 182 187	45.4 47.4 47.8 48.2 48.7 49.1 49.6 50.0	233 202 208 214 220 225 231 237	180 147 152 157 163 168 174	49.6 52.2 52.6 53.0 53.5 54.0 54.4 54.9	230 199 205 210 216 222 228 234	172 140 144 149 154 159 165	54.3 57.5 57.9 58.3 58.7 59.2 59.7 60.2	227 197 202 207 213 219 225 231	164 131 136 141 146 150 155	59.5 63.1 63.6 64.1 64.5 64.9 65.4 65.9	223 194 199 205 210 215 221 227
180	15 4 5 6 7 8 9	187 155 160 165 171 176 182 187	45.4 47.4 47.8 48.2 48.7 49.1 49.6 50.0 50.5	233 202 208 214 220 225 231 237 244	180 147 152 157 163 168 174 179	49.6 52.2 52.6 53.0 53.5 54.0 54.4 54.9 55.3	230 199 205 210 216 222 228 234 240	172 140 144 149 154 159 165 170	54.3 57.5 57.9 58.3 58.7 59.2 59.7 60.2 60.7	227 197 202 207 213 219 225 231 237	164 131 136 141 146 150 155 161	59.5 63.1 63.6 64.1 64.5 64.9 65.4 65.9 66.4	223 194 199 205 210 215 221 227 233
180	15 4 5 6 7 8 9 10	187 155 160 165 171 176 182 187 193	45.4 47.4 47.8 48.2 48.7 49.1 49.6 50.0 50.5 50.9	233 202 208 214 220 225 231 237 244 250	180 147 152 157 163 168 174 179 185	49.6 52.2 52.6 53.0 53.5 54.0 54.4 54.9 55.3 55.8	230 199 205 210 216 222 228 234 240 246	172 140 144 149 154 159 165 170 176	54.3 57.5 57.9 58.3 58.7 59.2 59.7 60.2 60.7 61.1	227 197 202 207 213 219 225 231 237 243	164 131 136 141 146 150 155 161 166	59.5 63.1 63.6 64.1 64.5 64.9 65.4 65.9 66.4 66.9	223 194 199 205 210 215 221 227 233 239
180	15 4 5 6 7 8 9 10 11 12	187 155 160 165 171 176 182 187 193 199 205	45.4 47.4 47.8 48.2 48.7 49.1 49.6 50.0 50.5 50.9 51.4	233 202 208 214 220 225 231 237 244 250 256	180 147 152 157 163 168 174 179 185 191	49.6 52.2 52.6 53.0 53.5 54.0 54.4 54.9 55.3 55.8 56.3	230 199 205 210 216 222 228 234 240 246 253	172 140 144 149 154 159 165 170 176 182	54.3 57.5 57.9 58.3 58.7 59.2 59.7 60.2 60.7 61.1 61.6	227 197 202 207 213 219 225 231 237 243 249	164 131 136 141 146 150 155 161 166 172	59.5 63.1 63.6 64.1 64.5 64.9 65.4 65.9 66.4 66.9	223 194 199 205 210 215 221 227 233 239 245
180	15 4 5 6 7 8 9 10	187 155 160 165 171 176 182 187 193	45.4 47.4 47.8 48.2 48.7 49.1 49.6 50.0 50.5 50.9	233 202 208 214 220 225 231 237 244 250	180 147 152 157 163 168 174 179 185	49.6 52.2 52.6 53.0 53.5 54.0 54.4 54.9 55.3 55.8	230 199 205 210 216 222 228 234 240 246	172 140 144 149 154 159 165 170 176	54.3 57.5 57.9 58.3 58.7 59.2 59.7 60.2 60.7 61.1	227 197 202 207 213 219 225 231 237 243	164 131 136 141 146 150 155 161 166	59.5 63.1 63.6 64.1 64.5 64.9 65.4 65.9 66.4 66.9	223 194 199 205 210 215 221 227 233 239
180	15 4 5 6 7 8 9 10 11 12 13	187 155 160 165 171 176 182 187 193 199 205 211	45.4 47.4 47.8 48.2 48.7 49.1 49.6 50.0 50.5 50.9 51.4 51.9	233 202 208 214 220 225 231 237 244 250 256 263	180 147 152 157 163 168 174 179 185 191 196 202	49.6 52.2 52.6 53.0 53.5 54.0 54.4 54.9 55.3 56.8	230 199 205 210 216 222 228 234 240 246 253 259	172 140 144 149 154 159 165 170 176 182 187	54.3 57.5 57.9 58.3 58.7 59.2 59.7 60.2 60.7 61.1 61.6 62.1	227 197 202 207 213 219 225 231 237 243 249 255	164 131 136 141 146 150 155 161 166 172 177	59.5 63.1 63.6 64.1 64.5 64.9 65.4 65.9 66.4 66.9 67.4	223 194 199 205 210 215 221 227 233 239 245 251
180	15 4 5 6 7 8 9 10 11 12 13 14	187 155 160 165 171 176 182 187 193 199 205 211 217	45.4 47.4 47.8 48.2 48.7 49.1 49.6 50.0 50.5 50.9 51.4 51.9	233 202 208 214 220 225 231 237 244 250 256 263	180 147 152 157 163 168 174 179 185 191 196 202 208	49.6 52.2 52.6 53.0 53.5 54.0 54.4 54.9 55.3 56.8 56.3 56.8	230 199 205 210 216 222 228 234 240 246 253 259 265	172 140 144 149 154 159 165 170 176 182 187 193	54.3 57.5 57.9 58.3 58.7 59.2 59.7 60.2 60.7 61.1 61.6 62.1 62.7	227 197 202 207 213 219 225 231 237 243 249 255 261	164 131 136 141 146 150 155 161 166 172 177 183 189	59.5 63.1 63.6 64.1 64.5 64.9 65.4 65.9 66.4 66.9 67.4 67.9 68.5	223 194 199 205 210 215 221 227 233 239 245 251 257
180	15 4 5 6 7 8 9 10 11 12 13 14 15 4 6	187 155 160 165 171 176 182 187 193 199 205 211 217 181 187	45.4 47.4 47.8 48.2 48.7 49.1 49.6 50.0 50.5 50.9 51.4 51.9 52.4	233 202 208 214 220 225 231 237 244 250 269 263	180 147 152 157 163 168 174 179 185 191 196 202 208 172 178	49.6 52.2 52.6 53.0 53.5 54.0 54.4 54.9 55.3 55.8 56.8 57.3	230 199 205 210 216 222 228 234 240 246 253 259 265 230	172 140 144 149 154 159 165 170 176 182 187 193 199 161 167 173	54.3 57.5 57.9 58.3 58.7 59.2 59.7 60.2 60.7 61.1 61.6 62.1 62.7 64.8 65.3	227 197 202 207 213 219 225 231 237 249 255 261 225 231 249 255 261 225 232 238	164 131 136 141 148 150 155 161 166 172 177 183 189 148 153 159	59.5 63.1 63.6 64.1 64.5 64.9 65.4 65.9 66.4 66.9 67.4 67.9 68.5 71.5 72.0	223 194 199 205 210 215 221 227 233 239 245 251 257 219 225 232
180	15 4 5 6 7 7 8 9 10 11 12 13 14 15 4 5 6 7	187 155 160 165 171 176 182 187 193 199 205 211 217 181 187 193	45.4 47.4 47.8 48.2 48.7 49.1 49.6 50.0 50.5 50.9 51.4 51.9 52.4 52.7 53.2 53.7 54.2	233 202 208 214 220 225 231 244 250 268 269 233 240 247 254	180 147 152 157 163 168 174 179 185 191 196 202 208 172 178 184	49.6 52.2 52.6 53.0 53.5 54.0 54.4 54.9 55.3 56.8 56.3 56.8 57.3 58.2 58.6 59.1 59.6	230 199 205 210 216 222 228 234 240 246 253 259 265 230 248 249	172 140 144 149 154 159 165 170 176 182 187 193 199 161 167 173 178	54.3 57.5 57.9 58.3 58.7 59.2 59.7 60.2 60.7 61.1 61.6 62.1 62.7 64.3 64.8 65.3 65.8	227 197 202 207 213 219 225 231 237 243 249 255 261 225 261 225 232 238 244	164 131 136 141 148 150 155 161 166 172 177 183 189 148 153 159	59.5 63.1 63.6 64.1 64.5 64.9 65.4 65.9 66.4 66.9 67.4 67.9 68.5 71.5 72.0 72.5	223 194 199 205 210 215 221 227 233 239 245 261 267 219 225 232 238
180	15 4 5 6 7 8 9 10 11 12 13 14 15 4 5 6	187 155 160 165 171 176 182 187 193 199 205 217 181 187 193 200 206	45.4 47.4 47.8 48.2 48.7 49.1 49.6 50.0 50.5 50.9 51.4 52.7 53.2 53.7 54.2 54.6	233 202 208 214 220 225 231 237 244 250 268 269 233 240 247 254 260	180 147 152 157 163 168 174 179 185 191 196 202 208 172 178 184 190	49.6 52.2 52.6 53.0 53.5 54.0 54.4 54.9 55.3 56.8 56.3 56.8 57.3 58.2 58.6 59.6 60.1	230 199 205 210 216 222 228 234 240 246 253 259 265 230 236 243 249 256	172 140 144 149 154 159 165 170 176 182 187 193 199 161 167 173 178	54.3 57.5 57.9 58.3 58.7 59.2 59.7 60.2 60.7 61.1 61.6 62.1 62.7 64.3 64.8 65.3	227 197 202 207 213 219 225 231 237 243 249 245 255 261 225 225 232 238 244 251	164 131 136 141 146 150 155 161 166 172 177 183 189 148 153 159	59.5 63.1 63.6 64.1 64.5 64.9 65.4 66.9 67.4 66.9 77.4 68.5 71.5 72.0 72.5 73.0	223 194 199 205 210 215 221 227 233 239 245 257 219 225 238 245
180	15 4 5 6 7 8 9 10 11 12 13 14 15 4 5 6 7 7	187 155 160 160 165 171 176 182 187 193 199 205 211 217 187 193 200 206 206 212	45.4 47.4 47.8 48.2 48.7 49.1 49.6 50.0 50.5 50.9 51.4 51.9 52.4 52.7 53.2 53.7 54.2 54.6 55.1	233 202 208 214 220 225 231 237 244 250 263 269 233 240 247 254 260 267	180 147 152 157 163 168 174 179 185 191 196 202 208 177 178 184 190	49.6 52.2 52.6 53.0 53.5 54.0 54.4 54.9 55.3 56.8 57.3 56.8 57.3 58.6 59.1 59.6 60.1 60.6	230 199 205 210 216 222 228 234 240 246 253 259 265 230 243 249 249 258 268 263	172 140 144 149 154 159 165 170 176 182 187 193 199 161 167 173 178 187 178 187 178 187 178	54.3 57.5 57.9 58.3 58.7 59.2 59.7 60.2 60.7 61.1 62.1 62.1 62.7 64.8 66.3 66.8	227 197 202 207 213 219 225 231 237 249 255 261 255 261 252 232 238 249 255 251 251 252 252 253 254 255 255 255 257	164 131 136 141 146 150 155 161 166 172 177 183 189 148 153 159 165 171	59.5 63.1 63.6 64.1 64.5 64.9 65.9 66.4 66.9 67.4 67.9 68.5 71.5 72.0 72.5 73.0 73.6 74.1	223 194 199 205 210 215 221 227 233 239 245 251 267 219 225 232 238 239 245
	15 4 5 6 7 8 9 10 11 12 13 14 15 4 5 6	187 155 160 165 171 176 182 187 199 205 211 217 181 187 193 200 206 212 212 213 220 206	45.4 47.4 47.8 48.2 48.7 49.1 49.1 50.0 50.5 50.9 51.4 51.9 52.4 52.7 53.2 53.7 54.2 54.6 55.6	233 202 208 214 220 225 231 237 244 250 269 233 240 247 254 260 267 274	180 1447 152 157 163 168 174 179 185 191 196 202 208 172 178 184 190 196 202 202 208 208 208 208 208 208 208 208	49.6 52.2 52.6 53.0 53.5 54.0 54.4 54.9 55.3 55.8 56.3 56.8 57.3 58.2 59.6 60.1 60.6 61.1	230 199 205 210 216 222 228 240 240 246 253 259 265 230 243 249 266 236 243 249 256 263 270	172 140 144 149 154 159 165 170 176 182 187 193 199 161 167 173 178 184 191 197	54.3 57.5 57.9 58.3 58.7 59.7 60.2 59.7 61.1 61.6 62.1 62.7 64.3 64.8 65.3 66.8 66.3	227 197 202 207 213 219 225 231 237 243 249 255 261 225 232 238 244 244 255 257 264	164 131 136 141 146 150 155 161 166 172 177 183 189 148 153 165 171 177 177 182	59.5 63.1 63.6 64.1 64.5 64.9 65.9 66.4 66.9 67.4 67.9 68.5 71.5 72.0 72.5 73.0 73.6	223 194 199 205 210 215 221 227 233 245 251 257 219 225 238 245 251 257
	15 4 5 6 7 8 9 10 11 12 13 14 15 4 5 6 7 7 8	187 155 160 165 171 176 182 187 193 199 205 211 217 181 187 193 200 206 212 218 200 206	45.4 47.4 47.8 48.2 48.7 49.1 49.6 50.0 50.5 50.9 51.4 51.9 52.7 53.2 53.2 53.7 54.2 54.6 55.1 55.6 56.1	233 202 208 214 220 225 231 237 244 250 256 263 263 240 247 254 260 267 274 281	180 147 152 152 157 163 168 174 179 185 191 196 202 202 202 178 184 190 196 202 202 202 202	49.6 52.2 52.6 53.0 53.5 54.4 54.9 55.3 56.3 56.8 56.3 56.8 57.3 58.2 58.6 60.1 60.6 60.1	230 199 205 210 218 222 228 234 240 246 253 259 265 265 230 238 249 249 256 257 277	172 140 144 149 154 159 165 170 176 182 187 193 199 161 167 173 178 184 191 197 203	54.3 57.5 57.9 58.3 58.7 59.2 60.2 60.7 61.1 61.6 62.1 64.3 64.8 65.3 66.3 66.3 66.3	227 197 202 207 213 219 225 231 237 243 249 255 261 225 232 232 238 249 255 251 255 251 275 275 275 275 275 275 275 275 275 275	164 131 136 141 148 150 155 161 166 172 177 183 189 148 153 159 165 171 177 177	59.5 63.1 63.6 64.1 64.5 64.9 65.4 66.9 67.4 67.9 67.9 72.0 72.5 73.0 73.6 74.1 74.6 75.2	223 194 199 205 210 215 221 227 233 245 251 252 228 245 251 257 264
	15 4 4 5 6 7 8 9 10 11 12 13 14 15 6 6 7 7 8 9	187 155 160 165 171 178 182 187 199 205 211 217 181 187 193 200 205 212 218 225 218 220 218 221 218 222 231	45.4 47.4 47.4 47.8 48.2 48.7 49.1 49.6 50.0 50.5 50.5 51.4 51.9 52.4 52.7 53.2 53.7 54.6 55.1 56.6	233 202 208 214 220 225 231 237 244 250 263 269 233 240 247 254 260 267 274 281	180 1447 152 157 163 168 174 179 185 191 196 202 208 172 178 184 190 202 202 203 203 204 205 205 205 205 205 205 205 205 205 205	49.6 52.2 52.6 53.0 53.5 54.0 54.4 54.9 55.3 56.8 57.3 56.8 57.3 56.8 57.3 60.1 60.6 61.1 61.6 62.1	230 199 205 210 218 222 228 234 240 245 253 259 265 230 236 243 249 259 259 265 230 236 243 249 259 259 259 259 259 259 259 259 259 25	172 140 144 149 154 159 165 170 176 182 187 193 199 161 167 173 178 184 191 191 197 203 209	54.3 57.5 57.9 58.3 58.7 59.2 59.7 60.2 60.7 61.1 61.6 62.1 62.7 64.3 64.8 65.3 66.8 67.4 67.4 67.4 67.4 67.9 68.4	227 197 202 207 213 219 225 231 237 243 255 261 225 232 238 249 255 261 225 232 238 249 255 261 277 278	164 131 138 141 148 150 155 161 168 172 177 177 183 189 148 153 159 165 171 177 187 187 187 187 188 189	59.5 63.1 63.6 64.1 64.5 64.9 65.4 66.9 67.4 66.9 67.4 67.9 68.5 71.5 72.0 72.5 73.0 74.1 74.6 75.8	223 194 199 205 210 215 221 227 233 239 245 251 267 219 225 232 238 245 251 257 219 225 232 238 245 251 257 27 27 27 28
	15 4 5 6 7 8 9 10 11 12 13 14 15 4 5 6 7 7 8 9	187 155 160 165 171 176 182 187 199 205 211 217 181 187 200 206 212 217 218 200 206 212 218 225 231	45.4 47.7 47.8 48.2 48.7 49.1 49.6 50.0 50.0 50.9 51.4 51.9 52.4 52.7 53.2 53.7 54.2 56.6 56.1 56.6 56.1	233 202 208 214 220 225 231 237 244 250 269 233 240 247 254 260 267 274 281 288 295	180 147 152 157 163 168 174 179 185 202 208 172 178 190 190 202 208 209 215 221 228	49.6 52.2 52.6 53.0 53.5 54.4 54.9 55.8 56.3 56.8 57.3 58.2 58.6 60.1 60.6 61.1 61.6 62.1 62.6	230 199 205 210 216 222 228 234 240 253 259 265 230 265 243 249 256 243 249 256 270 277 283 290	172 140 144 149 154 159 165 170 176 182 187 193 199 161 167 173 178 184 191 197 203 209 216	54.3 57.5 57.9 58.3 58.7 59.7 60.2 59.7 61.1 61.6 62.1 62.7 64.3 64.8 65.3 66.8 66.3 66.3 66.8 67.4 67.9 68.4 69.0	227 197 202 207 213 219 225 231 237 249 255 261 225 225 232 244 255 257 264 271 271 285	164 131 138 141 146 150 155 161 161 168 172 177 183 148 153 159 165 171 177 182 188 195 201	59.5 63.1 63.6 64.1 64.5 64.9 65.4 66.9 67.4 67.4 67.2 72.0 72.5 73.0 73.6 74.1 74.6 75.2 75.2	223 194 199 205 210 215 221 227 233 245 251 267 219 225 238 245 251 257 264 271 278
	15 4 5 6 7 8 9 10 11 12 13 14 5 6 7 8 9 10 11 12 13 14 15 15 16 17 18 19 10 11 12 13 14 14 15 16 17 18 18	187 155 160 165 171 176 182 187 193 199 205 211 217 181 187 200 208 212 218 225 231 238 245	45.4 47.4 47.8 48.2 48.7 49.6 50.0 50.5 50.9 51.4 51.9 52.4 52.7 53.2 53.2 54.2 54.6 55.1 55.6 56.1 56.6 57.1 57.6	233 202 208 214 220 225 231 237 244 250 256 263 269 233 240 247 254 260 267 274 281 288 295 302	180 147 152 157 163 168 174 179 185 191 196 202 208 172 178 184 199 202 209 215 221	49.6 52.2 52.6 53.0 53.5 54.0 54.4 54.9 55.3 56.8 56.3 56.8 57.3 58.2 58.6 60.1 60.6 61.1 61.6 62.1 62.6 62.6 63.2	230 199 205 210 218 222 228 234 240 246 253 259 265 230 236 243 249 256 257 277 277 283 290 298	172 140 144 149 154 159 165 170 176 182 187 193 199 161 167 173 178 184 191 197 203 209 218 222	54.3 57.5 57.9 58.3 58.7 59.2 60.2 60.7 61.1 61.6 62.1 62.1 62.7 64.3 64.8 65.3 66.8 66.3 66.8 66.3 66.8 67.4 67.9 68.4 69.0	227 197 202 207 213 219 225 225 231 243 249 255 251 225 232 238 244 251 251 252 261 271 272 273 274 271 275 275 275 275 275 275 275 275 275 275	164 131 136 141 148 150 155 161 166 172 177 183 189 148 153 159 148 153 159 188 199 120 1207	59.5 63.1 63.6 64.1 64.5 64.9 65.4 66.9 67.4 67.9 68.5 71.5 72.0 73.6 74.1 74.6 75.2 75.8	223 194 199 205 210 215 221 227 233 245 251 257 219 225 238 245 251 257 264 271 278
	15 4 5 6 7 8 9 10 11 12 13 14 15 6 6 7 8 9 10 11 12 13 14 15 15 10 11 12 13 14 15 15	187 155 160 165 171 176 182 187 193 199 205 211 217 181 187 193 200 206 212 212 213 225 231 235 245 245	45.4 47.4 47.4 48.2 48.7 49.1 49.6 50.0 50.5 50.9 51.4 51.9 52.4 52.7 53.2 53.7 54.2 54.6 55.1 55.1 56.6 57.1 56.6 57.1	233 202 208 214 220 225 231 237 244 250 256 263 269 233 240 247 254 260 267 27 27 288 288 288 289 302 310	180 1447 152 157 163 168 168 174 179 185 191 196 202 208 172 178 184 190 202 209 215 221 221 221 224 234	49.6 52.2 52.6 53.0 53.5 54.0 54.4 54.9 55.3 56.8 57.3 56.8 57.3 58.2 58.6 60.1 60.6 61.1 61.6 62.1 62.6 63.2 63.2 63.7	230 199 205 210 216 212 228 234 240 248 253 259 265 230 236 243 249 256 263 277 283 290 305	172 140 144 149 154 159 165 170 176 182 187 193 199 161 167 173 178 184 191 197 203 209 216 222 228	54.3 57.5 57.9 58.3 58.7 59.2 60.2 60.7 61.6 62.1 61.6 62.1 64.3 64.8 65.3 66.8 66.3 66.8 67.4 67.9 68.4 69.0 69.6	227 197 207 219 207 213 219 225 231 237 243 249 255 261 232 238 244 251 257 264 271 278 285 299	164 131 136 141 148 150 155 161 166 172 177 183 189 148 153 159 148 153 159 165 171 177 182 188 195 201 207	59.5 63.1 63.6 64.1 64.5 64.9 65.4 66.9 67.4 67.9 68.5 71.5 72.0 72.5 73.0 73.6 74.1 74.1 74.6 75.2 75.8	223 194 199 205 210 215 221 227 233 245 251 257 219 225 232 238 245 251 257 27 288 245 251 267 27 288 245 251 267 27 288 245 251 267 27 288 245 251 267 264 271 278 284
	15 4 5 6 7 8 9 10 11 12 13 14 5 6 7 8 9 10 11 12 13 14 15 15 16 17 18 19 10 11 12 13 14 14 15 16 17 18 18	187 155 160 165 171 176 182 187 193 199 205 211 217 181 187 200 208 212 218 225 231 238 245	45.4 47.7 47.8 48.2 48.7 49.1 49.6 50.0 50.0 51.4 51.9 52.4 52.7 53.2 53.7 54.2 56.6 56.1 56.6 57.1 57.6 58.2 58.3	233 202 208 214 220 225 231 237 244 250 256 263 269 233 240 247 254 260 267 274 281 288 295 302	180 147 152 157 163 168 174 179 185 191 196 202 208 172 178 184 199 202 209 215 221	49.6 52.2 52.6 53.0 53.5 54.4 54.9 55.3 56.3 56.8 57.3 58.2 56.6 60.1 60.6 61.1 61.6 62.1 62.6 63.2 63.7 70.2	230 199 205 210 218 222 228 234 240 246 253 259 265 230 236 243 249 256 257 277 277 283 290 298	172 140 144 149 154 159 165 170 176 182 187 193 199 161 167 173 178 184 191 197 203 209 218 222	54.3 57.5 57.9 58.3 58.7 59.2 59.7 60.2 60.2 60.2 61.1 61.6 62.1 64.3 64.8 65.8 66.3 66.8 66.3 66.8 67.4 67.9 68.4 69.0	227 197 202 207 213 219 225 225 231 243 249 255 251 225 232 238 244 251 251 252 261 271 272 273 274 271 275 275 275 275 275 275 275 275 275 275	164 131 136 141 148 150 155 161 166 172 177 183 189 148 153 159 148 153 159 188 199 120 1207	59.5 63.1 63.6 64.1 64.5 64.9 65.4 66.9 67.4 66.9 77.5 73.0 73.6 74.1 74.6 75.2 75.8 76.4 76.9	223 194 199 205 210 215 221 227 233 245 251 257 219 225 238 245 251 257 264 271 278
	15 4 5 6 7 8 9 10 11 12 13 14 15 4 5 6 7 7 8 9 10 11 11 12 13 14 15 4 15 16 17 18 18 18 18 18 18 18 18 18 18 18 18 18	187 155 160 165 171 176 182 187 199 205 211 217 181 187 200 206 211 227 218 229 218 225 231 238 245 252 233	45.4 47.4 47.4 48.2 48.7 49.1 49.6 50.0 50.5 50.9 51.4 51.9 52.4 52.7 53.2 53.7 54.2 54.6 55.1 55.1 56.6 57.1 56.6 57.1	233 202 208 214 220 225 231 237 244 250 256 263 269 233 240 247 254 260 267 274 281 288 295 302 310 286	180 147 152 157 163 168 174 179 185 191 199 202 208 172 208 172 208 209 215 221 228 234 241	49.6 52.2 52.6 53.0 53.5 54.0 54.4 54.9 55.3 56.8 57.3 56.8 57.3 58.2 58.6 60.1 60.6 61.1 61.6 62.1 62.6 63.2 63.2 63.7	230 199 205 210 216 221 228 234 240 246 253 259 265 230 236 243 249 266 263 270 277 283 290 298 305 262	172 140 144 149 154 159 165 170 176 182 187 193 199 161 167 178 184 191 197 203 209 216 222 228 200	54.3 57.5 57.9 58.3 58.7 59.2 60.2 60.7 61.6 62.1 61.6 62.1 64.3 64.8 65.3 66.8 66.3 66.8 67.4 67.9 68.4 69.0 69.6	227 197 202 207 213 219 225 231 237 249 255 261 225 232 244 255 238 244 257 264 271 271 285 292 292 292 292 293	164 131 136 141 146 150 155 161 166 172 177 183 189 148 153 159 165 171 177 182 188 189 195 201 207 213	59.5 63.1 63.6 64.1 64.5 64.9 65.4 66.9 67.4 67.9 68.5 71.5 72.0 72.5 73.0 73.6 74.1 74.1 74.6 75.2 75.8	223 194 199 205 210 215 221 227 233 239 245 251 267 219 225 238 245 251 257 264 271 278 284 291 278
	15 4 5 6 7 8 9 10 11 12 13 14 5 6 7 8 9 10 11 12 13 14 5 5 6 7 8 9 10 11 12 13 14 15 4 5 5 6 7 8 9 10 11 12 13 14 15 15 15 16 17 18 18 18 18 18 18 18 18 18 18 18 18 18	187 155 160 165 171 176 182 187 193 205 211 217 181 187 200 206 212 218 225 231 238 245 252 223 230	45.4 47.4 47.8 48.2 48.7 49.6 50.0 50.5 50.9 51.4 51.9 52.4 52.7 53.2 53.7 54.2 54.6 55.1 55.6 56.1 56.6 57.1 57.6 58.2 63.4 63.9	233 202 208 214 220 225 231 237 244 250 256 263 269 233 240 247 254 260 267 274 281 281 285 302 310 286 298 298 298 298 298 298 298 298 298 298	180 147 152 157 163 168 174 179 185 191 196 202 208 172 178 184 190 196 202 209 215 221 228 234 241 211	49.6 52.2 52.6 53.0 53.5 54.0 54.4 54.9 55.3 56.8 56.3 56.8 57.3 58.2 58.6 60.1 60.1 61.6 62.1 62.6 63.2 63.2 63.2 70.7	230 199 205 210 216 221 228 234 240 245 253 259 230 236 243 249 256 267 277 283 290 298 305	172 140 144 149 154 159 165 170 176 182 187 193 199 161 167 173 178 184 191 197 203 209 216 222 228 200 207	54.3 57.5 57.9 58.3 58.7 59.2 60.2 60.7 61.1 61.6 62.1 62.7 64.3 64.8 66.3 66.8 66.3 66.3 67.4 67.9 68.4 69.0 69.6 70.1 77.7 78.2	227 197 202 207 213 219 225 231 231 249 255 261 225 232 244 251 257 264 271 278 285 292 299 277 285	164 131 136 141 148 150 155 161 166 172 177 183 189 148 153 159 165 171 177 182 188 195 201 207 213	59.5 63.1 63.6 64.1 64.5 64.9 65.4 65.9 66.4 66.9 67.4 67.9 72.5 73.0 73.6 74.1 74.6 75.2 75.8 76.9 76.9	223 194 199 205 210 215 221 227 233 245 251 257 219 225 238 245 251 257 264 271 278 284 291 273 281
	15 4 5 6 7 8 9 10 11 12 13 14 15 5 6 7 8 9 10 11 12 13 14 15 4 5 6 7 8 9 10 11 12 13 14 15 4 6 6 7 8 9 10 11 12 13 14 15 6 6 7 8 9 10 11 12 13 14 15 6 6 6 7 8 9 9 10 11 11 12 13 14 15 4 6 6 6 6 6 6 7 8 9 9 10 11 11 12 13 14 15 4 6 6 6 6	187 155 160 165 171 176 182 187 193 199 205 211 217 181 187 193 200 206 212 218 225 231 231 235 245 252 233 237	45.4 47.4 47.8 48.2 48.7 49.6 50.0 50.5 50.9 51.4 51.9 52.7 53.2 53.2 53.7 54.2 54.6 55.1 56.6 57.1 56.6 57.1 56.6 57.1 56.2 63.4 63.4 64.3	233 202 208 214 220 225 231 237 244 250 256 263 269 233 240 247 254 260 267 274 281 288 295 302 310 286 296 301	180 1447 152 157 163 168 167 174 179 185 191 196 202 208 177 178 184 190 202 202 202 203 204 204 204 204 204 204 205 206 206 207 208 208 208 208 208 208 208 208 208 208	49.6 52.2 52.6 53.0 53.5 54.0 54.4 54.9 55.3 56.8 56.3 56.8 57.3 58.2 58.6 60.1 60.6 61.1 61.6 62.1 62.6 63.2 63.7 70.2 70.7 71.2	230 199 205 210 216 212 228 234 240 248 253 259 265 230 238 249 266 263 270 277 283 290 298	172 140 144 149 154 159 165 170 176 182 187 193 199 161 167 173 178 184 191 197 203 209 216 222 228 200 207 214	54.3 57.5 57.9 58.3 58.7 59.2 60.2 60.7 61.1 61.6 62.1 62.1 64.3 64.8 65.3 66.8 66.3 66.8 67.4 67.9 68.4 69.0 69.6 70.1 77.7 78.2 78.7	227 197 202 207 213 219 225 231 237 243 249 255 261 225 232 238 244 251 267 277 278 285 299 277	164 131 136 141 148 150 155 161 166 172 177 183 189 153 159 148 153 159 161 171 177 177 182 188 195 201 213 187 207	59.5 63.1 63.6 64.1 64.5 64.9 65.4 66.9 67.4 67.9 66.4 67.9 72.0 72.5 73.0 73.6 74.1 74.6 75.2 75.8 76.4 76.9 77.5 86.1 86.5	223 194 199 205 210 215 221 227 233 239 245 261 267 27 27 28 245 261 27 27 28 248 29 29 248 29 29 248 29 29 29 20 20 20 20 20 20 20 20 20 20 20 20 20
210	15 4 5 6 7 8 9 10 11 12 13 14 5 6 7 8 9 10 11 12 13 14 5 6 7 8 9 10 11 12 13 14 15 4 5 6 7 7	187 155 160 165 171 176 182 187 199 205 211 217 181 187 199 205 211 217 218 220 206 211 221 231 238 245 252 223 230 237 245	45.4 47.7 47.8 48.2 48.7 49.1 49.6 50.0 50.0 51.4 51.9 52.4 52.7 53.7 54.2 54.6 55.6 56.1 56.6 57.1 57.6 58.2 63.4 63.9 64.9	233 202 208 214 220 225 231 237 244 250 256 263 269 233 240 247 254 260 267 274 281 288 295 302 310 286 294 301 309	180 147 152 157 163 168 174 179 185 189 179 189 202 208 172 278 190 190 215 221 228 234 241 211 219 228 233	49.6 52.2 52.6 53.0 53.5 54.0 54.4 54.9 55.3 56.3 56.3 56.3 56.3 56.3 56.6 60.1 60.6 60.1 60.6 61.1 61.6 62.1 62.6 63.2 63.7 70.2 70.7 71.2 71.7	230 199 205 210 216 221 228 234 240 246 253 259 265 230 236 243 249 266 270 277 277 283 290 298 305	172 140 144 149 154 159 165 170 176 182 187 193 199 161 167 178 184 197 203 209 216 222 228 200 207 214	54.3 57.5 57.9 58.3 58.7 59.2 59.7 60.2 60.2 60.2 61.1 61.6 62.1 62.7 64.3 64.8 65.3 66.8 66.3 66.8 66.3 66.9 69.0	227 197 202 207 213 219 225 231 237 243 249 255 261 225 232 244 251 267 264 277 268 285 299 277 285 301	164 131 136 141 146 150 155 161 166 172 177 183 188 148 153 159 165 171 177 182 188 189 165 201 207 213 187	59.5 63.1 63.6 64.1 64.5 64.9 65.4 66.9 67.4 66.9 72.5 73.0 73.6 74.1 74.6 75.2 75.8 76.4 76.9 76.9 77.5 76.9	223 194 199 205 210 215 221 227 233 239 245 251 257 219 225 238 245 251 257 299 225 238 245 251 257 284 281 271 278 284 281 273 281
	15 4 5 6 7 8 8 9 10 11 12 13 14 15 4 5 6 7 8 8 9 10 11 11 12 13 14 15 6 6 7 8 8	187 155 160 165 171 176 182 187 199 205 211 217 217 218 200 206 218 229 221 221 225 231 232 233 230 237 245 253	45.4 47.4 47.8 48.2 48.7 49.6 50.0 50.5 50.9 51.4 51.9 52.4 52.7 53.2 53.7 54.2 54.6 55.6 56.1 56.6 56.2 63.9 64.3 64.3 64.9 65.5	233 202 208 214 220 225 231 237 244 250 258 269 233 240 247 254 260 267 274 281 285 302 310 286 294 301 309 318	180 147 152 157 163 168 174 179 185 191 196 202 208 172 178 199 202 209 215 221 228 234 241 219 226 233 240	49.6 52.2 52.6 53.0 53.5 54.0 54.4 54.9 55.3 56.8 56.3 56.8 57.3 58.2 58.6 60.1 61.6 62.1 62.6 63.2 63.2 63.7 70.2 70.7 71.2 71.7 72.2	230 199 205 210 216 222 228 234 240 253 259 265 230 236 243 249 256 267 277 283 290 298 305 282 290 298 305 313	172 140 144 149 154 159 165 170 176 182 187 193 199 161 167 173 178 184 191 197 203 209 216 222 228 200 207 214	54.3 57.5 57.9 58.3 58.7 59.2 60.2 60.7 61.1 61.6 62.1 62.7 64.3 64.8 65.3 66.3 66.3 66.3 66.3 67.4 67.9 68.4 69.6 70.7 77.7 78.2 78.7 79.2 79.7	227 197 202 207 213 219 225 231 237 249 255 261 225 232 238 244 251 257 264 271 278 285 292 299 277 285	164 131 136 141 148 150 155 161 166 172 177 183 189 148 153 159 165 171 177 182 188 195 201 207 213 187 194 201 209 216	59.5 63.1 63.6 64.1 64.5 64.5 65.9 66.4 66.9 67.4 67.9 68.5 71.5 72.0 72.5 73.0 73.6 74.6 75.2 75.8 76.8 76.9 76.8 76.9 77.5 76.8 76.9 76.9 76.9 76.9 76.9 76.9 76.9 76.9	223 194 199 205 210 215 221 227 233 239 245 251 257 219 225 238 245 251 257 264 271 278 284 291 273 281 288 296 304 312 320
210	15 4 5 6 7 8 9 10 11 12 13 14 15 5 6 7 8 9 10 11 15 4 5 6 7 7 8 9 10 11 12 13 14 15 6 7 8 9 9 10 11 12 13 14 15 9 10 11 12 13 14 15 9	187 155 160 165 171 176 182 187 199 205 211 217 217 181 187 193 200 206 212 218 225 231 230 237 245 253 262 270 279	45.4 47.4 47.8 48.2 48.7 49.6 50.0 50.5 50.9 51.4 51.9 52.4 52.7 53.2 53.7 54.2 54.6 55.1 55.6 56.1 57.6 58.2 63.9 64.3 64.9 65.5 66.0 66.7 67.3	233 202 208 214 220 225 231 237 244 250 256 263 269 233 240 247 254 260 267 274 281 281 285 302 310 309 318 328 337 346	180 147 152 157 163 168 174 179 185 191 196 202 172 178 199 208 172 208 209 215 221 228 234 241 219 226 233 240 249 245 266	49.6 52.2 52.6 53.0 53.5 54.0 55.3 55.8 56.3 56.8 56.3 56.8 57.3 58.2 58.6 60.1 60.1 61.6 62.1 62.6 63.2 63.2 70.7 71.2 77.2 72.2 72.8 73.4 74.0	230 199 205 210 216 222 228 234 240 253 259 265 230 236 243 249 256 267 277 283 305 290 298 305 313 322 3311 340	172 140 144 149 154 159 165 170 176 182 187 193 199 161 167 173 178 184 191 197 203 209 216 222 228 200 207 214 222 229 236 243	54.3 57.5 57.9 58.3 58.7 59.2 60.2 60.7 61.1 61.6 62.1 62.7 64.3 64.8 65.3 66.3 66.3 66.3 66.3 66.3 67.4 67.9 68.4 67.9 68.7 77.7 78.2 78.7 79.2 79.7 80.2 80.8	227 197 202 207 213 219 225 231 231 249 255 261 225 222 28 244 251 277 264 271 278 285 292 299 277 285 293 301 309 316 324 333	164 131 136 141 148 150 155 161 166 172 177 183 189 148 153 159 165 171 177 182 188 195 201 207 213 187 194 201 209 216 224 224	59.5 63.1 63.6 64.1 64.5 64.5 66.9 66.4 66.9 67.4 67.9 68.5 71.5 72.0 72.5 73.0 73.6 74.1 74.6 75.2 75.2 76.4 76.9 77.5 86.1 86.5 87.5 86.5 87.5 88.0 88.5 88.0 88.5 88.0 88.5	223 194 199 205 210 215 221 227 233 239 245 251 257 219 225 238 245 251 273 288 298 298 281 288 281 283 281 283 281 283 281 283 281 283 281 283 281 283 281 283 283 281 283 283 281 283 283 281 283 283 281 283 283 281 283 283 281 283 283 281 283 283 283 284 304 312 322 327
210	15 4 5 6 7 8 9 10 11 12 13 14 15 4 5 6 7 8 9 10 11 12 13 14 15 4 5 6 6 7 8 9 10 11 12 13 14 15 15 15 16 17 18 18 19 10 11 11 12 18 18 18 19 19 10 10 11 11 12 12 13 14 15 15 15 16 17 18 18 19 10 10 11 11 12 12 12 13 14 15 15 15 16 17 18 18 19 10 10 10 10 10 10 10 10 10 10 10 10 10	187 155 160 165 171 176 182 187 193 199 205 211 217 181 187 200 206 212 218 225 231 232 245 252 233 245 252 279 262 270 279 287	45.4 47.4 47.8 48.2 48.7 49.6 50.0 50.5 50.9 51.4 51.9 52.4 52.7 53.2 54.2 54.6 55.1 56.6 57.1 57.6 58.2 63.9 64.3 64.9 65.5 66.0 66.7 67.3 67.8	233 202 208 214 220 225 231 237 244 250 256 263 269 233 240 247 254 260 267 274 281 288 295 302 310 301 301 301 301 301 301 301 301 301	180 147 152 157 163 168 174 179 185 191 196 202 208 172 178 184 190 202 208 215 221 228 234 241 211 211 226 233 240 249 257 266 275	49.6 52.2 52.6 53.0 53.5 54.0 55.3 56.3 56.3 56.8 56.3 56.8 57.3 58.2 58.6 60.1 60.6 61.1 61.6 62.1 62.6 63.2 63.2 63.2 63.7 70.7 71.2 71.2 72.2 72.8 73.4 74.7	230 199 205 210 218 222 28 234 240 246 253 259 265 230 236 243 249 256 263 270 277 283 290 298 305 282 290 298 305 313 322 331 340 350	172 140 144 149 154 159 165 170 176 187 193 199 161 167 173 188 184 191 197 203 209 216 222 228 200 207 214 222 229 236 243 252 260	54.3 57.5 57.9 58.3 58.7 59.2 60.2 60.7 61.1 61.6 62.1 62.7 64.3 64.8 65.3 66.8 66.3 66.8 66.3 67.4 67.9 68.4 69.9 69.0 70.1 77.7 80.2 80.2 80.3	227 197 202 207 213 219 225 231 231 249 255 261 225 232 238 244 251 257 278 289 277 278 289 297 278 299 277 278 299 277 309 316 324 333 343	164 131 136 141 148 150 155 161 166 172 177 183 189 148 153 159 148 152 189 195 201 207 213 187 201 207 213 213 201 207 213 213 224 231 238 246	59.5 63.1 63.6 64.1 64.5 64.9 65.4 66.9 67.4 67.9 68.5 71.5 72.0 73.6 74.1 75.2 75.8 76.4 76.9 86.5 86.5 86.5 86.5 86.5 86.5 87.0 87.0 87.0 87.0 87.0 87.0 87.0 87.0	223 194 199 205 210 215 221 227 233 245 251 257 219 225 238 245 251 257 264 271 278 284 291 273 281 288 296 304 312 320 327 336
210	15 4 5 6 7 8 9 10 111 12 13 14 5 6 7 8 9 10 11 12 13 14 5 6 7 8 9 10 11 12 13 14 5 6 7 8 9 10 11 11 12 13 14 15 4 15 15 10 11 11 12 13 14 15 14 15 15 16 17 18 18 19 10 11 11 11 11 11 11 11 11 11 11 11 11	187 155 160 165 171 178 182 187 199 205 211 217 181 181 200 206 212 218 225 221 231 238 245 252 223 230 237 245 252 270 279 279 279 279 279 279 279 279 279 279	45.4 47.7 47.8 48.2 48.7 49.1 49.6 50.0 50.0 50.5 50.9 51.4 52.7 53.2 52.4 52.7 53.7 54.2 54.2 55.6 66.1 67.6 66.7 67.3 66.7 67.3 66.3	233 202 208 214 220 225 231 237 244 250 256 263 269 233 240 247 254 260 267 274 281 288 295 302 288 295 300 309 318 328 337 346 355 363	180 147 152 157 163 168 174 179 189 189 189 189 202 208 172 208 172 178 190 196 202 209 215 221 228 234 241 211 219 228 233 240 249 257 266 275 266	49.6 52.2 52.6 53.0 53.5 54.0 54.4 54.9 55.3 56.3 56.3 56.3 56.3 56.3 56.3 56.3 56.2 56.6 60.1 60.6 60.1 61.1 61.6 62.1 62.6 63.2 63.2 70.2 70.7 71.2 71.7 72.2 72.8 73.4 74.0 74.7 75.3	230 199 205 210 216 222 228 234 240 246 253 259 265 230 236 243 249 266 270 277 283 290 298 305 282 290 298 305 313 332 340 340 350 358	172 140 144 149 154 159 165 170 176 182 187 193 199 161 167 178 184 191 197 203 209 216 222 288 200 207 214 222 229 236 243 255 260 269	54.3 57.5 57.9 58.3 58.7 59.2 59.7 60.2 60.7 61.1 61.6 62.7 64.3 64.8 65.3 66.8 66.3 66.8 67.4 67.9 69.0	227 197 202 207 213 219 225 231 231 249 255 232 244 251 226 238 244 251 267 264 277 264 277 285 292 277 265 301 309 3016 324 333 343 352	164 131 136 141 148 150 155 161 166 172 177 183 189 148 153 159 165 171 177 182 188 195 201 207 213 187 194 209 216 224 231 238 248	59.5 63.1 63.6 64.1 64.5 64.9 65.4 66.9 67.4 66.9 67.4 66.5 71.5 72.0 73.0 73.6 74.1 74.6 75.2 75.8 76.4 76.9 86.5 86.1 86.5 86.1 86.5 87.5 87.5 87.5 87.5 88.0 88.5 89.0 89.0 89.0 89.0 89.0	223 194 199 205 210 215 221 227 233 239 245 251 257 219 225 238 245 251 257 219 225 238 245 251 257 284 291 273 281 283 296 304 312 320 327 336 345
210	15 4 5 6 7 8 8 9 10 11 12 13 14 5 6 7 8 8 9 10 11 12 13 14 5 6 7 8 9 10 11 12 13 14 15 4 15 10 11 11 12 13 14 15 15 16 17 18 18 19 10 11 11 12 13 14 15 15 16 17 18 18 19 10 11 11 11 12 13 14 15 16 16 17 18 18 18 19 10 11 11 12 13 14 15 14 15 16 16 17 18 18 18 19 10 11 11 12 13 14 14 15 16 16 17 18 18 18 18 18 18 18 18 18 18 18 18 18	187 155 160 165 171 176 182 187 199 205 211 217 181 187 193 200 206 212 218 225 231 245 252 233 230 237 245 253 262 270 279 287 295 303	45.4 47.4 47.8 48.2 48.7 49.6 50.0 50.5 50.9 51.4 51.2 52.4 52.7 53.2 53.7 54.2 54.6 55.1 55.6 56.1 57.6 58.3 63.9 64.3 64.9 65.5 66.0 67.3 67.8 68.3 68.9	233 202 208 214 220 225 231 237 244 250 269 233 240 247 254 260 267 274 281 288 299 302 310 308 318 328 337 346 355	180 147 152 157 163 168 174 179 185 191 199 202 172 178 190 190 215 221 228 234 241 219 226 233 240 249 257 266 275 283 281	49.6 52.2 52.6 53.0 53.5 54.4 54.9 55.3 56.3 56.8 56.3 56.8 57.3 58.2 58.6 60.1 60.1 60.1 61.6 62.1 62.6 63.2 70.7 71.2 71.2 72.2 72.8 73.4 74.0 74.7 75.3 75.8	230 199 205 210 216 222 228 234 240 246 253 259 265 230 236 243 249 256 230 277 277 283 290 298 305 262 290 298 305 313 322 3311 340 350 358	172 140 144 149 154 159 165 170 176 182 187 193 199 161 167 173 178 184 191 197 203 209 207 214 222 228 229 236 243 252 260 269 278	54.3 57.5 57.9 58.3 58.7 59.2 59.7 60.2 60.7 61.1 61.6 62.1 62.7 64.3 64.8 65.3 66.8 66.3 66.3 66.8 66.3 66.3 66.9 67.4 67.9 68.9 69.9 69.0	227 197 202 207 213 219 225 231 237 249 255 261 225 222 288 244 261 277 285 292 299 277 285 293 300 316 309 3164 333 343 343 343 343	164 131 136 141 148 150 155 161 166 172 177 183 189 148 153 159 165 171 177 182 188 195 201 207 213 187 194 201 209 216 224 231 238 246 253	59.5 63.1 63.6 64.1 64.5 64.9 65.4 66.9 67.4 67.9 68.5 71.5 72.0 73.6 74.1 74.6 75.2 75.8 76.4 76.9 77.5 86.1 86.5 87.0 88.5 88.5 88.0 88.5 88.0 88.5 88.0 88.5 88.0 88.5 88.0 88.5 88.0 88.5 88.5	223 194 199 205 210 215 221 227 233 245 251 257 219 225 238 245 251 257 264 271 278 284 291 273 281 288 296 304 312 320 327 336 345
210	15 4 5 6 7 8 9 10 111 12 13 14 5 6 7 8 9 10 11 12 13 14 5 6 7 8 9 10 11 12 13 14 5 6 7 8 9 10 11 11 12 13 14 15 4 15 15 10 11 11 12 13 14 15 14 15 15 16 17 18 18 19 10 11 11 11 11 11 11 11 11 11 11 11 11	187 155 160 165 171 178 182 187 199 205 211 217 181 181 200 206 212 218 225 221 231 238 245 252 223 230 237 245 252 270 279 279 279 279 279 279 279 279 279 279	45.4 47.7 47.8 48.2 48.7 49.1 49.6 50.0 50.0 50.5 50.9 51.4 52.7 53.2 52.4 52.7 53.7 54.2 54.2 55.6 66.1 67.6 66.7 67.3 66.7 67.3 66.3	233 202 208 214 220 225 231 237 244 250 256 263 269 233 240 247 254 260 267 274 281 288 295 302 288 295 300 309 318 328 337 346 355 363	180 147 152 157 163 168 174 179 189 189 189 189 202 208 172 208 172 178 190 196 202 209 215 221 228 234 241 211 219 228 233 240 249 257 266 275 266	49.6 52.2 52.6 53.0 53.5 54.0 54.4 54.9 55.3 56.3 56.3 56.3 56.3 56.3 56.3 56.3 56.2 56.6 60.1 60.6 60.1 61.1 61.6 62.1 62.6 63.2 63.2 70.2 70.7 71.2 71.7 72.2 72.8 73.4 74.0 74.7 75.3	230 199 205 210 216 222 228 234 240 246 253 259 265 230 236 249 249 259 270 277 283 290 298 305 282 290 298 305 313 332 340 350 358	172 140 144 149 154 159 165 170 176 182 187 193 199 161 167 178 184 191 197 203 209 216 222 288 200 207 214 222 229 236 243 255 260 269	54.3 57.5 57.9 58.3 58.7 59.2 59.7 60.2 60.7 61.1 61.6 62.7 64.3 64.8 65.3 66.8 66.3 66.8 67.4 67.9 69.0	227 197 202 207 213 219 225 231 231 249 255 232 244 251 226 238 244 251 267 264 277 264 277 285 292 277 265 301 309 3016 324 333 343 352	164 131 136 141 148 150 155 161 166 172 177 183 189 148 153 159 165 171 177 182 188 195 201 207 213 187 194 209 216 224 231 238 248	59.5 63.1 63.6 64.1 64.5 64.9 65.4 66.9 67.4 66.9 67.4 66.5 71.5 72.0 73.0 73.6 74.1 74.6 75.2 75.8 76.4 76.9 86.5 86.1 86.5 86.1 86.5 87.5 87.5 87.5 87.5 88.0 88.5 89.0 89.0 89.0 89.0 89.0	223 194 199 205 210 215 221 227 233 239 245 251 257 219 225 238 245 251 257 219 225 238 245 251 257 284 291 273 281 283 296 304 312 320 327 336 345

NOTES

Cc (cooling capacity) - Pi (unit power input) - ELWT (Evaporator leaving water temperature - \triangle t 5°C) - Condenser Water temperature \triangle t 5°C Data refers to 0,0176m² °C/kW evaporator fouling factor Data refers to 0,0440m² °C/kW condenser fouling factor CAPCOOL 1-2-3-4-5-6 Re

CAPCOOL_1-2-3-4-5-6_Rev.00_2

6

Capacity tables 6

6 - 1 **Cooling Capacity Tables**

EWWD280~400J-SS

						Ent	erina condense	er water temp.	(°C)				
	EWLT		15			20			25			30	
Unit	(°C)	Cc (kW)	Pi (kW)	Hc (kW)	Cc (kW)	Pi (kW)	Hc (kW)	Cc (kW)	Pi (kW)	Hc (kW)	Cc (kW)	Pi (kW)	Hc (kW)
	4				281	56.0	337	271	60.5	331	259	65.7	324
	5				289	56.8	346	280	61.4	341	268	66.6	334
	6				297	57.6	355	287	62.2	350	277	67.5	345
	7				305	58.5	364	295	63.0	358	285	68.3	353
	9				314 322	59.3 60.2	373 382	304 312	63.9 64.7	367 376	293 301	69.1 69.9	362 371
280	10				322	00.2	302	320	65.6	386	309	70.8	380
	11							328	66.5	395	317	71.6	389
	12							337	67.4	404	326	72.5	398
	13							346	68.4	414	334	73.5	408
	14							354	69.3	424	343	74.4	417
	15							363	70.3	433	351	75.3	427
	4				305	61.6	367	294	68.2	363	282	75.0	357
	5				314	62.2	377	304	68.8	372	292	75.8	368
	6				324	62.8	386	313	69.4	382	301	76.4	378
	8				333 343	63.4 64.2	397 407	322 331	70.0 70.8	392 402	310 320	77.0 77.8	387 398
	9				352	64.8	417	341	71.4	413	329	78.6	408
310	10				***			351	72.2	423	339	79.2	418
	11							361	73.0	434	349	80.0	429
	12							371	73.6	445	358	80.8	439
	13							381	74.4	456	368	81.6	450
	14							392	75.2	467	379	82.2	461
	15							402	76.0	478	389	83.2	472
	4				328	66.0	394	316	73.0	389	303	80.5	384
	5 6				338 348	66.7 67.4	404 415	326 336	73.8 74.5	400 411	313 324	81.3 82.0	395 406
	7				358	68.1	426	346	75.2	421	334	82.7	416
	8				369	68.9	438	357	76.0	433	344	83.6	427
	9				380	69.7	449	367	76.7	444	354	84.4	439
330	10							378	77.5	456	365	85.1	450
	11							389	78.4	467	375	86.0	461
	12							400	79.1	479	386	86.9	473
	13							411	80.0	491	397	87.7	485
	14							423	80.9	504	408	88.5	497
	15 4				250	70.4	421	434 337	81.7 77.8	516 415	420 324	89.5 86.0	509 410
	5				350 361	70.4 71.2	421 432	349	78.8	415	335	86.8	421
	6				372	72.0	444	359	79.6	439	346	87.6	433
	7				384	72.8	456	371	80.4	451	357	88.4	445
	8				395	73.6	469	382	81.2	463	368	89.4	457
360	9				407	74.6	481	393	82.0	475	379	90.2	469
	10							405	82.8	488	390	91.0	481
	11							417	83.8	501	402	92.0	494
	12 13							429 441	84.6 85.6	513 527	414 426	93.0 93.8	507 520
	14							454	86.6	540	438	94.8	533
	15							466	87.4	554	451	95.8	546
	4				380	74.4	454	366	82.4	448	351	90.9	442
	5				392	75.2	467	377	83.3	461	362	91.8	454
	6				403	76.0	479	389	84.2	473	375	92.7	467
	7				416	76.9	492	401	85.0	486	386	93.5	480
	8				428	77.7	505	413	85.9	499	398	94.5	492
380	9				440	78.7	519	425 438	86.7 87.6	512	410 422	95.3 96.2	505 518
	11							450	88.6	525 539	422	97.2	532
	12							463	89.5	553	447	98.2	545
	13							476	90.5	567	460	99.1	559
	14							490	91.5	581	473	100	573
	15							503	92.4	595	486	101	587
	4				410	78.4	488	394	87.0	481	378	95.8	474
	5				422	79.2	501	406	87.8	494	390	96.8	487
	7				435 447	80.0 81.0	515 528	419 431	88.8 89.6	507 521	403 416	97.8 98.6	501 514
	8				460	81.8	542	444	90.6	535	428	99.6	528
	9				474	82.8	557	457	91.4	549	441	100	541
400	10							471	92.4	563	454	101	555
	11							484	93.4	577	467	102	570
	12							497	94.4	592	481	103	584
	13							511	95.4	607	494	104	599
	14							526	96.4	622	508	105	613
	15							540	97.4	637	522	106	628

NOTES

Cc (cooling capacity) - Pi (unit power input) - ELWT (Evaporator leaving water temperature - \triangle t 5°C) - Condenser Water temperature \triangle t 5°C Data refers to 0,0176m² °C/kW evaporator fouling factor Data refers to 0,0440m² °C/kW condenser fouling factor CAPCOOL 1-2-3-4-5-6 Re

CAPCOOL_1-2-3-4-5-6_Rev.00_3

Cooling Capacity Tables 6 - 1

EWWD280~400J-SS

Part			Entering condense					r water temp.	(°C)					
Column C	11.5			35									50	
F	Unit						(
Fig.														
T														
10														
200 7.0 200 7.5 306 278 62.6 300 26.3 69.9 30.3 26.8 90.0 30.5 110 208 7.7 383 224 84.2 377 281 91.6 372 205 99.8 35.5 112 304 77.5 383 224 84.2 377 281 91.6 372 205 99.8 35.5 113 302 78.3 4021 510 58.6 36.6 29.7 60.8 35.3 224 99.8 35.5 115 3022 78.3 4021 510 58.6 36.6 29.7 60.8 35.3 30.9 22.8 102 30.8 115 3038 3011 44.7 33.6 87.7 44.4 31.3 96.0 48.8 22.8 110 30.3 116 208 80.1 40.2 31.6 40.7 44.4 31.3 96.0 48.8 22.8 110 30.3 117 40.8 40.2 40.2 40.8 40.8 40.8 40.8 40.8 40.8 40.8 118 208 80.2 30.2 20.6 91.4 30.7 22.2 101 30.2 22.8 110 30.8 119 80.2 80.4 30.3 30.2 20.6 91.4 30.7 20.8 40.8 20.8 111 30.7 110 80.2 80.4 30.3 30.2 40.8 30.8 30.7 20.9 10.2 30.7 20.8 111 30.7 110 80.3 80.4 80.2 30.3 30.4 30.8 30.7 20.9 10.2 30.7 20.8 111 30.7 110 80.3 80.2 80.4 30.3 30.4 30.8 30.7 20.9 10.2 30.7 20.8 111 30.7 110 80.3 80.2 80.4 30.3 30.3 40.4 30.7 22.8 10.4 30.8 30.7 20.8 10.8 30.														
10 968 79.7 37.4 268 83.4 269 272 69.8 363 252 69.8 365 36														
12 314 78.4 3902 3902 81.0 397 288 96.5 381 274 101 3904 3904 3904 3904 3905 3905 283 102 3946 3964 3965 396	280	10	298	76.7	374	286	83.4	369	272	90.8	363	256	98.9	355
13		11	306	77.5	383	294	84.2	378	281	91.6	372	265	99.8	365
14 331 89.2 411 318 89.7 406 506 54.1 399 290 102 399														
16 339														
### 14														
S									-					
10 10 10 10 10 10 10 10														
8 307 86.4 303 2944 93.0 387 278 103 381 322 113 375														
10		7	298	84.6	383	284	92.8	377	269	102	371	254	112	366
10 328 888 413 312 952 407 207 104 402 281 115 395 11 335 876 433 331 98.8 428 318 106 412 239 116 416 12 345 884 433 331 98.8 428 318 106 422 309 117 449 14 395 99.0 445 350 98.4 449 335 108 443 318 118 430 15 375 90.8 446 350 98.4 449 335 108 443 338 118 447 4 289 88.8 378 276 97.5 373 281 107 396 245 118 395 5 299 89.4 398 285 89.3 383 270 108 378 224 119 373 6 310 99.2 400 295 99.1 394 279 109 388 233 120 383 7 320 91.0 411 205 99.9 405 206 111 400 281 121 403 8 330 91.8 422 315 101 416 208 111 400 281 121 403 10 350 93.4 444 335 103 438 319 112 420 291 122 413 11 891 94.3 455 346 103 449 320 113 443 314 112 420 11 891 94.3 455 346 103 449 339 115 446 322 125 447 11 891 94.3 455 346 103 449 320 113 443 318 112 420 11 891 94.3 455 346 103 449 339 114 454 322 125 447 13 832 96.0 478 367 105 477 390 114 454 322 125 447 14 993 99.9 490 377 100 483 390 116 446 322 125 447 14 993 99.6 490 377 106 483 390 116 446 322 126 448 14 393 99.9 490 377 106 483 390 116 446 322 126 448 14 393 99.9 490 377 106 483 390 117 488 333 128 449 18 300 94.8 447 335 105 447 390 116 446 322 126 448 19 344 457 502 388 107 485 371 117 488 333 128 441 14 49 50 50 50 50 381 107 485 371 117 488 333 128 446 15 40 40 40 40 40 40 40 4		8		85.4	393	294	93.6	387	278	103				
11 335 87.6 423 321 99.0 417 397 105 412 290 116 406 416 122 346 88.4 433 331 99.8 428 316 100 422 300 116 416 416 13 355 89.2 444 341 97.6 438 325 107 432 309 117 432 436 136 138 118 438 436 428 448 335 448 449 335 100 445 336 118 438 438 428 448 449 335 448 449	310													
12 345 884 433 331 596 428 316 100 422 300 116 416 13 355 892 444 341 876 438 325 107 432 309 117 426 14 395 90.0 455 350 596 449 335 100 443 318 118 439 15 375 90.8 466 390 992 459 345 100 445 338 118 439 4 299 88.6 378 276 975 373 261 107 398 254 119 372 5 299 88.6 380 285 596 33 383 270 100 388 224 119 372 6 310 90.2 400 296 991 394 279 100 388 263 120 383 7 320 91.0 411 305 99.9 405 289 110 398 227 227 121 393 8 330 91.8 422 318 101 416 228 111 408 221 121 403 9 340 92.7 433 325 102 427 300 112 420 291 122 413 11 991 94.3 446 335 103 438 339 112 432 301 123 424 11 991 94.3 455 346 103 449 329 119 446 322 125 447 13 392 96.0 477 396 104 440 339 114 454 322 125 447 14 493 395 699 440 377 105 472 350 116 476 342 127 438 15 44 593 699 440 377 105 472 350 116 476 342 127 498 4 599 546 404 326 107 445 371 177 485 385 177 485 371 177 485 385 177 485 371 177 485 385 177 485 385 177 485 385 177 485 385 177 485 385 177 485 385 177 485 385 177 485 385 177 485 385 177 485 385 177 485 385 177 485 385 177 485 385 177 485 385 177 485														
13 355 882 444 341 976 438 325 107 432 309 117 436 14 395 90.0 445 390 984 448 335 108 443 336 118 118 438 4 299 88.6 3378 279 97.5 373 221 107 396 245 118 383 5 299 88.6 3378 279 97.5 373 221 107 396 224 119 375 6 370 90.2 440 389 285 98.3 383 270 108 378 224 119 375 7 330 91.0 411 305 89.9 405 288 110 388 272 121 393 8 340 82.7 433 225 102 477 308 111 409 281 122 413 8 330 81.8 422 315 102 477 308 110 422 301 122 433 10 350 334 444 335 103 438 318 112 422 301 123 438 11 361 843 435 346 103 449 339 113 443 331 112 432 13 352 60.0 478 357 105 472 380 115 464 322 125 447 14 393 669 478 357 105 472 380 116 476 342 127 489 18 330 698 404 407 356 104 460 339 116 454 322 127 489 18 404 67.8 502 388 107 485 371 117 485 331 128 438 4 300 64.8 404 236 105 409 288 117 452 383 127 489 180 331 660 476 307 105 473 300 116 476 342 127 489 180 331 664 427 315 108 445 339 117 445 332 126 445 4 300 648 404 236 107 485 371 117 486 331 128 431 180 36 375 100 476 336 107 485 371 177 486 371 177 486 331 187 431 431 180 376 100 476 336 107 435 339 116 437 301 130 430 180 381 102 403 308 110 448 339 308														
14 355 50.0 455 350 594 449 335 100 443 318 118 436 15 375 50.8 466 380 99.2 489 3456 100 445 338 119 447 4 299 88.6 370 276 97.5 373 261 107 369 245 118 363 6 310 50.2 400 296 99.1 394 270 100 388 263 120 383 7 320 91.0 411 30.5 39.0 285 99.1 394 270 100 388 263 120 383 8 330 91.8 422 315 101 416 298 111 400 291 121 403 9 340 50.7 433 325 102 427 300 112 420 291 122 413 10 350 59.4 444 335 102 427 300 112 420 291 122 413 11 991 64.3 445 346 103 449 329 113 443 311 124 439 12 372 59.1 467 356 104 460 339 114 454 322 125 447 13 392 59.0 470 377 105 472 330 116 476 332 126 447 14 49 593 59.9 440 377 105 472 330 116 476 342 127 489 4 599 59.6 404 328 107 455 331 117 445 353 127 489 4 599 59.6 440 328 107 455 337 117 445 346 347 347 4 599 59.6 447 397 105 471 380 116 476 342 127 489 4 599 59.6 440 328 107 455 371 117 445 436 346 446 5 320 59.6 446 427 315 105 421 388 117 425 326 127 439 6 331 59.6 404 328 107 455 331 117 425 326 127 439 8 345 59.2 451 337 106 445 331 117 445 327 127 439 8 345 59.2 451 337 108 445 338 117 445 327 127 138 8 345 59.2 451 337 108 445 331 118 437 331 134 441 10 375 50.0 341 119 449 389 117 445 348 341														
15 375 90.8 468 380 99.2 459 345 109 453 328 119 447														
S														
19		4	289	88.6	378	276	97.5	373	261	107	369	245	118	363
330 91 0 411 305 99.9 405 289 110 398 272 121 393 8 330 918 4 422 315 101 416 298 111 398 272 121 393 10 330 918 422 315 102 427 399 112 420 291 122 413 110 330 92 7 433 325 102 427 399 112 420 291 122 413 110 330 93.4 444 335 103 438 319 112 432 391 122 413 111 301 94.3 455 346 103 449 329 113 443 311 124 435 112 372 95.1 407 356 104 400 399 114 443 311 124 455 113 382 96.0 478 397 105 472 390 114 443 322 126 445 114 393 96.9 450 377 106 433 390 114 443 322 126 445 115 404 97.8 502 388 107 485 371 117 488 333 128 481 116 309 94.8 404 295 104 399 279 115 394 291 126 388 117 483 391 96.4 477 315 106 421 298 117 445 291 126 388 118 432 97.4 439 335 107 432 398 117 445 281 128 440 119 364 99.2 463 335 107 432 398 117 445 231 128 441 110 386 101 467 370 381 108 445 319 118 437 391 139 449 110 375 100 475 399 110 488 341 120 481 332 132 434 111 386 101 487 370 111 488 341 120 481 332 133 465 110 375 100 475 399 110 488 341 120 481 332 132 433 455 111 386 101 487 370 111 488 341 120 481 332 132 433 455 111 386 101 487 370 111 488 341 120 481 332 132 433 455 113 340 103 575 100 475 399 110 488 341 120 481 322 132 433 455 114 422 104 525 404 114 588 341 120 481 322 132 433 465 114 422 104 525 404 114 588 341 120 481 322 132 433 485 113 440 114 478 114 472 104 481 333 138 465 114 473 333 138 465 114 473 333 133 465 114 473 333 133 465 114 473 333 133 465 114 473 333 133 465 114 473 333 133 465 114 473 333 133 465 114 473 333 133 465 114 473 333 133 465 114 473 333 133 465 114 473 333 133 465 114 473 333 133 465 114 474 475 475 475 475 475 475 475 475 47														
8 330 918 422 315 101 416 288 111 409 281 121 403 9 340 92.7 433 325 102 427 309 112 420 291 122 413 10 350 634 444 335 103 438 319 112 420 291 122 413 11 361 943 455 346 103 449 329 113 443 311 124 426 11 361 943 455 346 103 449 329 113 443 311 124 430 11 382 96.0 478 367 105 472 350 115 465 332 125 447 13 382 96.0 478 367 105 472 350 115 465 332 126 488 14 933 96.9 490 377 106 483 350 116 476 332 127 489 15 440 497.8 502 388 107 496 371 117 488 353 128 481 15 404 97.8 502 388 107 496 371 117 488 353 128 481 16 331 96.4 447 392 5104 499 289 116 405 271 127 399 16 331 96.4 427 315 106 421 298 117 445 291 129 420 17 342 97.4 439 325 107 432 308 117 425 291 129 420 18 333 86.2 451 337 108 445 319 118 437 301 130 430 10 375 100 475 359 110 488 341 120 449 311 131 441 11 386 101 487 370 111 480 352 124 473 333 133 465 12 398 102 500 381 112 483 383 112 448 313 446 14 422 104 525 404 114 514 480 352 124 473 333 133 465 12 398 102 500 381 112 483 382 124 473 333 133 465 12 398 102 500 381 112 483 383 122 485 344 134 476 13 410 103 573 139 110 488 341 120 481 322 122 423 134 479 14 422 104 525 404 114 518 581 591 120 486 332 122 485 344 134 479 15 344 105 529 404 114 518 581 397 122 423 278 136 489 16 331 444 105 529 404 114 518 388 124 499 331 133 446 17 344 10 103 513 383 113 466 332 124 489 355 135 490 14 4 322 104 486 330 111 480 352 121 473 333 133 465 15 347 101 448 330 111 443 312 122 443 278 136 489 16 388 102 500 381 112 483 393 122 485 344 134 476 17 370 103 473 333 113 466 332 124 496 301 137 437 17 370 103 473 333 113 466 332 124 496 301 137 437 17 370 103 473 333 113 466 332 124 496 301 137 437 18 433 109 551 424 119 543 490 301 122 423 379 144 489 489 16 384 100 558 447 116 500 558 447 119 543 490 301 132 597 331 144 589 19 394 105 499 376 115 491 356 127 449 301 136 446 522 440 106 548 440 107 558 449 119 543 440 300 137 447 448 449 111 448 459 111 559 449 371 110 440 300 115 500 440 307 144 489 301 144 446 300 115 500 446 307 119 544 489 301 144 489 301 144 446 300 115 500 446 307 119 544 489 300 116 5														
9 340 92.7 433 325 102 427 390 112 420 291 122 413 10 350 33.4 444 335 103 448 319 112 432 301 123 424 11 361 64.3 455 346 103 449 329 113 443 311 124 436 12 372 96.1 467 356 104 460 339 114 454 332 125 447 13 382 96.0 478 367 105 472 350 115 465 332 126 448 14 393 96.9 490 377 106 483 360 116 476 342 127 499 15 404 97.8 502 388 107 495 371 117 488 353 128 441 5 302 95.6 440 29.8 104 399 279 115 394 281 128 489 6 331 96.4 427 315 108 421 288 117 415 281 128 410 7 342 97.4 439 325 107 432 308 117 415 281 128 410 7 342 97.4 439 332 109 457 330 119 449 311 131 441 10 375 100 475 359 110 488 341 120 489 331 133 465 11 386 101 437 370 111 480 352 121 473 333 133 465 12 388 101 437 370 111 480 352 121 473 333 133 465 13 410 103 513 393 113 505 374 122 448 355 135 449 4 335 100 435 319 110 430 301 122 423 337 137 448 5 347 101 448 330 111 441 518 388 124 510 386 136 502 380 9 394 495 488 393 113 505 374 123 498 355 135 490 14 422 104 525 404 114 518 388 124 510 386 136 502 15 347 101 448 330 111 441 518 388 124 510 386 135 449 4 335 100 435 319 110 430 301 122 423 278 135 449 14 433 443 105 539 416 115 531 397 125 523 377 137 514 4 335 104 446 362 449 376 115 449 344 289 344 289 344 349 9 344 105 539 446 115 530 397 125 533 379 144 549 14 438 335 100 435 319 110 430 301 122 423 278 135 449 15 344 105 539 446 346														
10 390 93.4 4444 335 103 438 319 112 432 301 123 424 131 114 438 115 114 315 438 115 112 432 301 123 424 1438 115 114 315 315 115 115 465 312 115 447 135 368 104 480 339 114 454 322 125 447 135 362 96.0 476 367 105 472 350 115 465 332 128 488 148 144 383 196 96 476 342 127 466 148 148 148 148 148 148 148 148 148 148														
11	330													
12 372 95.1 467 356 104 460 339 114 454 322 125 447 13 382 96.0 478 367 105 433 360 115 465 332 126 458 14 393 96.9 450 377 106 433 360 116 476 342 127 469 15 404 97.8 502 388 107 495 371 117 488 353 128 481 4 309 94.8 404 295 104 399 279 115 394 281 126 388 5 320 95.6 415 304 105 409 289 116 405 271 127 399 6 331 96.4 427 315 106 421 298 117 415 281 128 410 7 342 97.4 439 325 107 432 308 117 425 281 129 420 8 353 98.2 451 337 108 445 319 118 437 301 130 430 9 364 98.2 463 348 109 457 330 119 449 311 311 441 10 375 100 475 359 110 488 341 120 461 322 132 453 12 338 102 500 381 112 493 383 122 485 344 134 478 13 411 103 513 393 313 505 374 123 486 356 135 490 15 434 105 539 416 115 531 397 125 523 377 137 514 4 432 104 486 339 111 441 312 123 434 289 136 425 6 338 102 460 341 112 443 332 124 448 300 137 437 15 447 101 448 330 111 441 312 123 434 289 136 425 16 338 102 460 341 112 443 322 124 438 355 135 440 17 370 103 473 353 113 466 332 124 448 300 137 437 7 370 103 473 353 113 446 332 124 448 300 137 437 7 370 103 473 353 113 466 332 125 433 321 139 460 10 406 106 511 388 116 504 367 128 449 330 144 448 8 382 104 486 364 114 479 344 126 469 321 139 460 10 406 106 511 388 116 504 367 128 499 330 146 478 10 406 106 511 388 116 504 367 128 499 330 146 478 11 446 611 610 636 612 638 613 602 646 613 610														
14 393 96.9 490 377 106 483 360 116 476 342 127 469 15														
15		13	382	96.0	478	367	105	472	350	115	465	332	126	458
10 10 10 10 10 10 10 10														
S														
360 380 380 380 380 380 380 380														
180 364 39.2 451 337 108 445 319 118 437 301 130 430														
8														
9 364 99.2 463 348 109 457 330 119 449 311 131 441														
10 375	260		364	99.2	463	348	109	457	330	119	449	311	131	441
12 398 102 500 381 112 493 363 122 485 344 134 478 13	360	10					110		341	120		322	132	
13														
14														
16														
4 335 100 435 319 110 430 301 122 423 278 135 413 5 347 101 448 330 111 441 312 123 434 289 136 425 6 358 102 460 341 112 453 322 124 446 300 137 437 7 370 103 473 353 113 466 332 125 457 311 138 448 8 382 104 486 364 114 479 344 126 469 321 139 460 9 394 105 499 376 115 491 356 127 482 332 140 471 10 406 106 511 388 116 504 367 128 495 343 141 484 11 418 107 525 400 117 517 379 129 508 355 142 496 12 430 108 538 412 118 530 391 130 520 367 143 509 13 443 109 551 424 119 543 403 131 533 379 144 522 14 456 110 565 436 120 556 415 132 547 390 145 535 15 469 111 579 449 121 570 427 133 560 402 146 548 6 386 107 494 367 118 485 346 131 476 318 145 463 7 399 108 507 380 119 449 367 118 485 346 311 476 318 145 463 7 399 108 507 380 119 449 357 132 489 330 146 476 8 412 109 521 392 120 512 369 133 502 342 147 489 9 424 110 534 405 121 526 381 134 515 353 148 501 10 437 111 548 417 122 540 394 135 525 335 148 501 11 450 112 562 430 123 553 406 136 542 377 150 527 12 463 113 576 443 124 567 449 137 556 390 152 541 13 476 114 590 455 125 581 444 138 569 402 135 555 14 490 115 605 469 126 595 444 139 583 414 154 568 14 490 115 605 469 126 595 444 139 583 414 154 568 14 490 115 605 469 126 595 444 139 583 414 154 568 14 490 115 605 469 126 595 444 139 583 414 415 456 15 468 412 412 412 412 412 412 412 412 412														
5 347 101 448 330 111 441 312 123 434 289 136 425 6 358 102 460 341 112 453 322 124 446 300 137 437 7 370 103 473 353 113 466 332 125 457 311 138 448 8 382 104 486 364 114 479 344 126 469 321 139 460 9 394 105 499 376 115 491 356 127 482 332 140 471 10 406 106 511 388 116 504 367 128 495 343 141 484 11 418 107 525 400 117 517 379 129 508 355 142 496 12 430 108 538 412 118 530 391 130 520 367 143 509 13 443 109 551 424 119 543 403 131 533 379 144 522 14 456 110 565 436 120 556 415 132 547 390 145 535 15 469 111 579 449 121 570 427 133 560 402 146 548 4 362 105 467 344 116 460 322 129 451 295 143 438 5 374 106 480 355 117 473 334 130 464 307 144 451 6 386 107 494 367 118 485 346 131 476 318 145 463 7 399 108 507 380 119 499 357 132 489 330 146 476 8 412 109 521 392 120 512 369 133 502 342 147 489 9 424 110 534 405 121 526 381 134 515 353 148 501 10 437 111 548 417 122 540 394 135 529 365 149 514 11 450 112 562 430 123 553 406 136 542 377 150 527 12 463 113 576 443 124 567 419 137 556 390 152 541 13 476 114 490 115 605 469 126 595 444 139 583 414 154 568 14 490 115 605 469 126 595 444 139 583 414 154 568 14 490 115 605 469 126 595 444 139 583 414 154 568 15 469 415														
6 358 102 460 341 112 453 322 124 446 300 137 437 7 370 103 473 353 113 466 332 125 457 311 138 448 8 332 104 486 334 114 479 344 126 489 321 139 480 9 394 105 499 376 115 491 356 127 482 332 140 471 10 406 106 511 338 116 504 367 128 495 343 141 449 11 418 107 525 400 117 517 379 129 508 355 142 496 12 430 108 538 412 118 530 391 130 520 367 143 509 13 443 109 551 424 119 543 403 131 533 379 144 522 14 456 110 565 436 120 556 415 132 547 390 145 535 15 469 111 579 449 121 570 427 133 500 402 146 548 4 362 105 467 344 116 460 322 129 451 295 143 438 5 374 106 480 355 117 473 334 130 464 307 144 451 6 386 107 494 367 118 485 346 131 476 318 145 463 7 399 108 507 380 119 499 357 132 489 330 146 476 8 412 109 521 392 120 512 399 133 502 342 147 489 9 424 110 534 405 121 526 381 134 515 353 148 501 10 437 111 548 417 122 540 394 135 529 365 149 514 11 450 112 562 430 123 553 406 136 542 377 150 527 12 463 113 576 443 124 567 419 137 556 390 152 541 13 476 114 590 455 581 444 138 599 402 153 555 14 490 115 605 469 126 595 444 138 589 402 153 555 14 490 115 605 469 126 595 444 138 589 402 153 555 14 490 115 605 469 126 595 444 138 589 402 153 555 14 490 115 605 469 126 595 444 138 589 402 153 555 14 490 115 605 469 126 595 444 138 589 402 153 555 14 490 115 605 469 126 595 444 138 589 402 153 555 14 4														
8 382 104 486 364 114 479 344 126 469 321 139 460 9 394 105 499 376 115 491 356 127 482 332 140 471 10 406 106 511 388 116 504 367 128 495 343 141 484 11 418 107 525 400 117 517 379 129 508 355 142 496 12 430 108 538 412 118 530 391 130 520 367 143 509 13 443 109 551 424 119 543 403 131 533 379 144 522 14 456 110 565 436 120 556 415 132 547 390 145 535 15 469 111 579 449 121 570 427 133 560 402 146 548 5 374 106 480 355 117 473 334 130 464 307 144 451 6 386 107 494 367 118 485 346 131 476 318 145 463 7 399 108 507 380 119 499 357 132 489 330 146 476 8 412 109 521 392 120 512 369 133 502 342 147 489 9 424 110 534 405 121 526 381 134 515 353 148 501 10 437 111 548 417 122 540 394 135 529 365 149 514 11 450 112 562 430 123 553 406 136 542 377 150 527 12 463 113 576 443 124 567 444 139 583 444 138 569 402 155 551 13 476 114 590 455 125 581 444 138 599 402 153 555 14 490 115 605 469 126 595 444 139 583 414 158 599 402 153 555 14 490 115 605 469 126 595 444 139 583 414 154 568														
9 394 105 499 376 115 491 356 127 482 332 140 471 10														
10 406 106 511 388 116 504 367 128 495 343 141 484 11 418 107 525 400 117 517 379 129 508 355 142 486 12 430 108 538 412 118 530 391 130 520 367 143 509 13 443 109 551 424 119 543 403 131 533 379 144 522 14 456 110 565 436 120 556 415 132 547 390 145 525 15 469 111 579 449 121 570 427 133 560 402 146 548 4 362 105 467 344 116 460 322 129 451 295 143 438 5 374 106 480 355 117 473 334 130 484 307 144 451 6 386 107 494 367 118 485 346 131 476 318 145 463 7 399 108 507 380 119 499 357 132 489 330 146 476 8 412 109 521 392 120 512 369 133 502 342 147 489 9 424 110 534 405 121 526 381 134 515 353 148 501 10 437 111 548 417 122 540 394 135 522 369 390 152 57 12 463 113 576 443 124 567 449 137 556 390 152 57 12 463 113 576 443 124 567 449 137 556 390 152 57 12 463 113 576 443 124 567 449 137 556 390 152 57 12 463 113 576 443 124 567 449 137 556 390 152 57 12 463 113 576 443 124 567 449 137 556 390 152 57 12 463 113 576 443 124 567 449 137 556 390 152 57 12 463 113 576 448 124 567 449 137 556 390 152 57 14 490 115 605 469 126 595 444 139 583 414 154 568														
11 418 107 525 400 117 517 379 129 508 355 142 496 122 430 108 538 412 118 530 391 130 520 367 143 509 144 522 144 119 543 403 131 533 379 144 522 146 548 149 149 149 149 149 149 149 149 149 149	380													
12														
13														
15														
4 362 105 467 344 116 460 322 129 451 295 143 438 55 374 106 480 355 117 473 334 130 464 307 144 451 6 386 107 494 367 118 485 346 131 476 318 145 463 7 399 108 507 380 119 499 357 132 489 330 146 476 8 412 109 521 392 120 512 399 133 502 342 147 489 9 424 110 534 405 121 526 381 134 515 353 148 501 10 437 111 548 417 122 540 394 135 529 365 149 514 11 450 112 562 430 123 553 406 136 542 377 150 527 12 463 113 576 443 124 567 419 137 556 390 152 541 13 476 114 490 115 605 469 126 595 444 139 583 414 154 568		14		110	565	436	120	556	415	132	547	390	145	535
6 374 106 480 355 117 473 334 130 464 307 144 451 6 386 107 494 367 118 485 346 131 476 318 145 463 7 399 108 507 380 119 499 357 132 489 330 146 476 8 412 109 521 392 120 512 369 133 502 342 147 489 9 424 110 534 405 121 526 381 134 515 333 148 501 10 437 111 548 417 122 540 384 135 522 369 330 146 48 501 11 450 112 562 430 123 553 406 136 542 377 150 527 12 463 113 576 443 124 567 419 137 556 390 152 541 13 476 114 590 455 125 581 431 138 569 402 153 555 14 490 115 605 469 126 595 444 139 563 414 154 568														
6 386 107 494 367 118 485 346 131 476 318 145 463 7 399 108 507 380 119 499 357 132 489 330 146 476 8 412 109 521 392 120 512 369 133 502 342 147 489 9 424 110 534 405 121 526 381 134 515 533 148 501 10 437 111 548 417 122 540 394 135 529 365 149 514 11 450 112 562 430 123 553 406 136 542 377 150 527 12 463 113 576 443 124 567 419 137 556 390 152 541														
400 7 399 108 507 380 119 499 357 132 489 330 146 476 8 412 109 521 392 120 512 369 133 502 342 147 489 9 424 110 534 405 121 526 381 134 515 353 148 501 10 437 111 548 417 122 540 394 135 529 365 149 514 11 450 112 562 430 123 553 406 136 542 377 150 527 12 463 113 576 443 124 567 419 137 556 390 152 541 13 476 114 490 115 605 469 126 595 444 139 583 414														
8 412 109 521 392 120 512 369 133 502 342 147 489 9 424 110 534 405 121 526 381 134 515 353 148 501 10 437 111 548 417 122 540 394 135 529 365 149 514 11 450 112 562 430 123 553 406 136 542 377 150 527 12 463 113 576 443 124 567 419 137 556 390 152 541 13 476 114 590 455 125 581 431 138 569 402 153 555 14 490 115 605 469 126 595 444 139 583 414 154 568														
400 9 424 110 534 405 121 526 381 134 515 353 148 501 10 437 111 548 417 122 540 394 135 529 365 149 514 11 450 112 562 430 123 553 406 136 542 377 150 527 12 463 113 576 443 124 567 419 137 556 390 152 541 13 476 114 590 455 125 581 431 138 569 402 153 555 14 490 115 605 469 126 595 444 139 583 414 154 568														
400 10 437 111 548 417 122 540 394 135 529 365 149 514 11 450 112 562 430 123 553 406 136 542 377 150 527 12 463 113 576 443 124 567 419 137 556 390 152 541 13 476 114 590 455 125 581 431 138 569 402 153 555 14 490 115 605 469 126 595 444 139 583 414 154 568														
12 463 113 576 443 124 567 419 137 556 390 152 541 13 476 114 590 455 125 581 431 138 569 402 153 555 14 490 115 605 469 126 595 444 139 583 414 154 568	400													
13 476 114 590 455 125 581 431 138 569 402 153 555 14 490 115 605 469 126 595 444 139 583 414 154 568											542			
14 490 115 605 469 126 595 444 139 583 414 154 568														
<u>116 620 482 127 609 457 140 597 427 155 582</u>														
		15	503	116	620	482	127	609	457	140	597	427	155	582

NOTES

Cc (cooling capacity) - Pi (unit power input) - ELWT (Evaporator leaving water temperature - \triangle t 5°C) - Condenser Water temperature \triangle t 5°C Data refers to 0,0176m² °C/kW evaporator fouling factor Data refers to 0,0440m² °C/kW condenser fouling factor CAPCOOL 1-2-3-4-5-6 Reference of the condenser fouling factor

CAPCOOL_1-2-3-4-5-6_Rev.00_4

6

6 Capacity tables

6 - 1 Cooling Capacity Tables

EWWD450~560J-SS

			Entering condenser water temp. (°C)											
	EWLT (°C)		15		20				25 30					
Unit	(C)	Cc (kW)	Pi (kW)	Hc (kW)	Cc (kW)	Pi (kW)	Hc (kW)	Cc (kW)	Pi (kW)	Hc (kW)	Cc (kW)	Pi (kW)	Hc (kW)	
	4				457	85.6	543	439	95.0	534	421	105	527	
	5				472	86.5	559	454	95.9	550	435	106	541	
	6				487	87.4	575	468	97.0	565	449	107	557	
	7				503	88.3	591	484	97.9	581	464	108	572	
	8				517	89.2	606	499	98.9	598	479	109	588	
450	9				531	90.1	621	513	100	613	495	110	605	
450	10							528	101	629	509	111	620	
	11							542	102	644	524	112	636	
	12							557	103	660	538	113	651	
	13							572	104	676	553	114	667	
	14							587	105	692	568	115	683	
	15							603	106	709	583	116	699	
	4				505	92.8	598	484	103	587	465	114	580	
	5				522	93.8	616	501	104	605	479	115	594	
	6				540	94.8	635	518	105	623	496	116	612	
	7				558	95.6	653	536	106	642	513	117	630	
	8				573	96.6	670	554	107	661	530	119	649	
500	9				589	97.4	686	570	108	678	548	120	668	
300	10							585	109	694	565	121	685	
	11							601	110	711	580	122	702	
	12							617	111	728	596	123	719	
	13							633	112	745	612	124	736	
	14							649	113	762	628	125	753	
	15							666	114	780	644	126	770	
	4				534	102	636	513	112	625	491	123	614	
	5				550	104	654	530	113	643	507	124	631	
	6				567	105	672	547	115	661	525	126	651	
	7				584	106	690	563	116	679	541	127	668	
	8				600	108	708	581	118	698	558	128	687	
530	9				616	109	725	596	119	715	575	130	705	
550	10							613	120	733	591	131	723	
	11							629	122	750	607	133	740	
	12							645	123	768	624	134	757	
	13							662	124	786	640	136	776	
	14							679	126	805	657	137	794	
	15							696	127	823	673	138	812	
	4				563	112	675	541	121	662	517	131	649	
	5				578	114	692	559	123	682	536	133	669	
	6				594	115	710	575	124	699	554	135	689	
	7				611	117	728	591	126	717	570	137	707	
	8				627	119	746	607	128	735	586	138	724	
560	9				644	120	764	623	129	753	602	140	742	
	10							640	131	771	618	142	760	
	11							657	133	790	635	143	778	
	12							674	135	809	651	145	796	
	13							691	137	828	668	147	815	
	14							709	139	847	686	149	834	
	15							726	141	867	703	151	853	

NOTES

Cc (cooling capacity) - Pi (unit power input) - ELWT (Evaporator leaving water temperature - \triangle t 5°C) - Condenser Water temperature \triangle t 5°C Data refers to 0,0176m² °C/kW evaporator fouling factor Data refers to 0,0440m² °C/kW condenser fouling factor

CAPCOOL_1-2-3-4-5-6_Rev.00_5

6 - 1 Cooling Capacity Tables

EWWD450~560J-SS

		Entering condenser water temp. (°C)											
	EWLT		35			40			45			50	
Unit	(°C)	Cc (kW)	Pi (kW)	Hc (kW)	Cc (kW)	Pi (kW)	Hc (kW)	Cc(kW)	Pi (kW)	Hc (kW)	Cc (kW)	Pi (kW)	Hc (kW)
	4	404	116	520	383	128	512	361	142	503	335	158	492
	5	417	117	534	397	129	526	374	143	517	348	159	506
	6	430	118	548	410	130	540	387	144	531	361	160	520
	7	444	119	563	423	131	554	400	145	545	374	161	534
	8	459	120	579	437	132	569	414	146	560	387	162	549
450	9	474	121	595	451	133	585	427	147	574	400	163	563
450	10	489	122	611	466	135	600	440	148	589	413	164	577
	11	504	123	627	481	136	617	455	149	604	426	165	591
	12	518	124	643	496	137	633	470	151	620	440	166	606
	13	533	125	658	511	138	649	485	152	637	455	167	622
	14	547	127	674	525	139	664	500	153	653	470	168	638
	15	562	128	690	539	140	679	514	154	668	485	170	654
	4	446	127	572	423	140	563	399	155	554	374	172	546
	5	460	128	587	438	141	579	413	156	570	388	173	561
	6	473	129	602	453	142	595	428	157	586	403	174	577
	7	489	130	619	467	143	610	444	158	602	417	175	592
	8	506	131	637	481	144	625	458	159	618	432	176	608
500	9	523	132	655	497	146	643	472	160	632	448	177	625
500	10	541	133	674	514	147	661	487	162	649	461	178	639
	11	558	135	693	532	148	680	504	163	667	475	179	654
	12	574	136	709	550	149	699	521	164	685	491	180	671
	13	589	137	726	566	151	716	538	165	704	508	182	690
	14	605	138	743	581	152	733	556	167	723	525	183	708
	15	621	139	760	597	153	750	571	168	739	543	184	727
	4	469	135	604	446	149	594	423	164	586	396	181	577
	5	485	136	621	461	150	611	437	165	602	411	182	593
	6	501	138	638	477	151	628	452	166	618	426	183	609
	7	518	139	657	493	153	645	467	167	635	441	184	625
	8	535	141	675	509	154	663	483	169	652	455	185	640
530	9	551	142	693	527	155	682	499	170	669	471	187	658
930	10	568	143	712	543	157	700	516	172	687	487	188	675
	11	585	145	730	559	158	718	533	173	706	503	189	692
	12	601	146	747	576	160	736	549	175	724	520	191	711
	13	617	148	764	593	161	754	566	176	742	537	192	729
	14	633	149	782	609	163	771	583	178	760	553	194	747
	15	650	151	800	625	164	789	598	179	777	570	196	765
	4	493	143	636	469	157	626	446	172	618	418	189	607
	5	510	145	655	484	158	643	460	173	634	434	190	624
	6	528	147	675	502	160	661	475	175	649	450	192	642
	7	547	148	695	519	162	681	491	176	667	464	193	657
	8	564	150	714	537	163	700	508	178	686	478	194	673
560	9	579	152	731	556	165	721	526	180	706	495	196	691
	10	595	153	749	571	167	738	544	182	726	513	198	710
	11	612	155	767	587	168	756	562	183	745	530	200	730
	12	628	157	785	603	170	773	577	185	762	549	201	750
	13	645	159	803	619	172	791	593	187	780	565	203	768
	14	661	160	822	636	173	809	609	188	797	581	205	786
	15	678	162	841	653	175	828	625	190	815	597	207	803

NOTES

Cc (cooling capacity) - Pi (unit power input) - ELWT (Evaporator leaving water temperature - \triangle t 5°C) - Condenser Water temperature \triangle t 5°C Data refers to 0,0176m² °C/kW evaporator fouling factor Data refers to 0,0440m² °C/kW condenser fouling factor

CAPCOOL_1-2-3-4-5-6_Rev.00_6

Pressure drops

7 - 1 **Evaporator Pressure Drops**

Evaporator and Condenser Pressure Drops

EWWD~J-SS

	120	140	150	180	210	250	280	310	330	360
Cooling capacity (kW)	120	146	155	178	208	256	285	310	334	357
Water flow (l/s) - Evaporator	5.73	6.98	7.41	8.50	9.94	12.25	13.63	14.81	15.96	17.06
Evaporator Pressure Drops (kPa)	15	13	40	38	36	28	33	40	40	38
Water flow (l/s) - Condenser	7.04	8.57	9.25	10.62	12.30	15.06	16.89	18.49	19.91	21.28
Condenser Pressure Drops (kPa)	20	12	11	11	11	16	26	11	11	11

Water flow and pressure drop referred to nominal condition: evaporator water in/out: 12/7°C - condenser water in/out: 30/35°C

	380	400	450	500	530	560
Cooling capacity (kW)	386	416	464	513	541	570
Water flow (l/s) - Evaporator	18.44	19.88	22.17	24.51	25.85	27.23
Evaporator Pressure Drops (kPa)	38	36	36	28	28	33
Water flow (I/s) - Condenser	23.15	24.59	27.33	30.10	31.92	33.78
Condenser Pressure Drops (kPa)	11	11	11	16	16	26

NOTES

Water flow and pressure drop referred to nominal condition: evaporator water in/out: 12/7°C - condenser water in/out: 30/35°C

Evaporator and Condenser Pressure Drops

To determinate the evaporator or condenser pressure drop for different versions or at different working condition, please refer to the following formula:

$$PD_{2}(\text{kPa})\!=\!PD_{1}(\text{kPa})\!\times\left(\begin{array}{c} & \mathbf{Q}_{2}(\text{I/s}) \\ \hline & \mathbf{Q}_{1}(\text{I/s}) \end{array}\right)^{1}\!.$$

where:

 PD_2 Pressure drop to be determinated (kPa) PD₁ Pressure drop at nominal condition (kPa) Q_2 water flow at new working condition (I/s) water flow at nominal condition (I/s)

How to use the fomula: Example (Evaporator)

The unit EWWD280J-SS has been selected for working at the following conditions:

- evaporator water in/out: 11/6°C condenser water in/out: 30/35°C

The cooling capacity at these working conditions is: 277 kW

The evaporator water flow at these working conditions is: 13.23 l/s

The unit EWWD280J-SS at nominal working conditions has the following data: -evaporator water in/out: $12/7^{\circ}$ C

- condenser water in/out: 30/35°C

The cooling capacity at these working conditions is: 285 kW

The evaporator water flow at these working conditions is: 13.62 l/s The evaporator pressure drop at these working conditions is: 33 kPa

The evaporator pressure drop at the selected working condition will be:

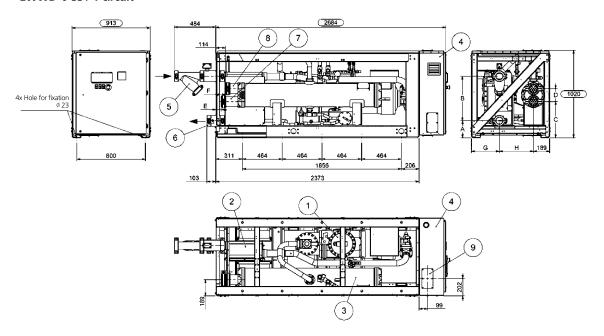
$$PD_2$$
 (kPa) = 33 (kPa) $\times \left(\frac{13,23 \text{ (l/s)}}{13.62 \text{ (l/s)}} \right)^{1}$.
 PD_2 (kPa) = 31 (kPa)

Note: If the calculated evaporator water pressure drop is below 10 kPa or above 100 kPa please contact the factory for dedicated evaporator..

ECPD_1_Rev.00_1

Dimensional drawings

EWWD~J-SS / 1 circuit



Models		Dimensions (mm)									
EWWD~J -SS	A	В	C	D	E	F	G	Н			
120	198	519	445	115	54	104	326	398			
140	198	519	422	150	64	114	326	398			
150	198	568	422	150	64	114	311	413			
180	198	568	422	150	64	114	311	413			
210	198	568	422	150	64	114	311	413			
250	198	568	422	150	64	114	311	413			
280	198	568	422	150	64	114	311	413			

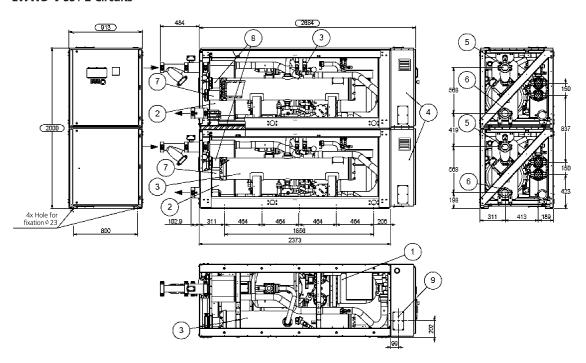
Legend

- 1 Compressor
- 2 Evaporator
- 3 Condenser
- 4 Electrical panel5 Evaporator water inlet
- 6 Evaporator water outlet
- 7 Condenser water inlet connection
- 8 Condenser water outlet connection
- 9 Power connections slot

DMN_1-2_Rev.00_1

8 Dimensional drawings

EWWD~J-SS / 2 Circuits



Note: Dimension refers to 2 circuit units (size from 310-560).

Legend

- 1 Compressor
- 2 Evaporator
- 3 Condenser
- 4 Electrical panel5 Evaporator water inlet
- 6 Evaporator water outlet
- 7 Condenser water inlet connection
- 8 Condenser water outlet connection
- 9 Power connections slot

DMN_1-2_Rev.00_2

9 Sound data

9 - 1 Sound Level Data

EWWD~J-SS

Unit size		Soun	d pressure lev	el at 1 m from	the unit in se	nispheric free	field (rif.2 x 10) ⁻⁵ Pa)		Power
Unit Size	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	dB(A)	dB(A)
120	64.6	69.1	74.1	78.5	73.6	71.2	58.6	55.7	79.0	88.9
140	64.6	69.1	74.1	78.5	73.6	71.2	58.6	55.7	79.0	88.9
150	64.6	69.1	74.1	78.5	73.6	71.2	58.6	55.7	79.0	88.9
180	64.6	69.1	74.1	78.5	73.6	71.2	58.6	55.7	79.0	88.9
210	64.6	69.1	74.1	78.5	73.6	71.2	58.6	55.7	79.0	88.9
250	67.3	67.3	72.8	77.8	72.3	73.3	62.3	58.8	79.0	88.9
280	67.3	67.3	72.8	77.8	72.3	73.3	62.3	58.8	79.0	88.9
310	67.6	72.1	77.1	81.5	76.6	74.2	61.6	58.7	82.0	94.4
330	67.6	72.1	77.1	81.5	76.6	74.2	61.6	58.7	82.0	94.4
360	67.6	72.1	77.1	81.5	76.6	74.2	61.6	58.7	82.0	94.4
380	67.6	72.1	77.1	81.5	76.6	74.2	61.6	58.7	82.0	94.4
400	67.6	72.1	77.1	81.5	76.6	74.2	61.6	58.7	82.0	94.4
450	69.2	71.3	76.5	81.2	76.0	75.4	63.8	60.5	82.0	94.4
500	70.3	70.3	75.8	80.8	75.3	76.3	65.3	61.8	82.0	94.4
530	70.3	70.3	75.8	80.8	75.3	76.3	65.3	61.8	82.0	94.4
560	70.3	70.3	75.8	80.8	75.3	76.3	65.3	61.8	82.0	94.4

NOTE

- The values are according to ISO 3744 and are referred to: evaporator 12/7°C, condenser 30/35°C, full load operation.
 The above sound pressure levels will decrease by 4dB(A) when a compressor sound enclosure (option) is installed.

NSL_1a-2a_Rev.01_1a

Sound pressure level correction for different distances

EWWD-J-SS

Unit size	Distance										
Offic Size	1m	5m	10m	15m	20m	25m					
120	0.0	-7.9	-12.7	-15.8	-18.1	-19.8					
140	0.0	-7.9	-12.7	-15.8	-18.1	-19.8					
150	0.0	-7.9	-12.7	-15.8	-18.1	-19.8					
180	0.0	-7.9	-12.7	-15.8	-18.1	-19.8					
210	0.0	-7.9	-12.7	-15.8	-18.1	-19.8					
250	0.0	-7.5	-12.2	-15.3	-17.5	-19.3					
280	0.0	-7.9	-12.7	-15.8	-18.1	-19.8					
310	0.0	-7.5	-12.2	-15.3	-17.5	-19.3					
330	0.0	-7.5	-12.2	-15.3	-17.5	-19.3					
360	0.0	-7.9	-12.7	-15.8	-18.1	-19.8					
380	0.0	-7.5	-12.2	-15.3	-17.5	-19.3					
400	0.0	-7.5	-12.2	-15.3	-17.5	-19.3					
450	0.0	-7.5	-12.2	-15.3	-17.5	-19.3					
500	0.0	-7.5	-12.2	-15.3	-17.5	-19.3					
530	0.0	-7.5	-12.2	-15.3	-17.5	-19.3					
560	0.0	-7.5	-12.2	-15.3	-17.5	-19.3					

NOTE

1. The values are dB(A) (pressure level).

NSL_1a-2a_Rev.01_2a

10 Installation

Installation notes

Warning

Installation and maintenance are to be performed only by qualified personnel who are familiar with local codes and regulations, and who are experienced with this type of equipment. Must be avoided the unit installation in places that could be considered dangerous for all the maintenance operations.

Handling

The chiller is mounted on heavy wooden skids to protect the unit from accidental damage and to permit easy handling and moving. It is recommended that all moving and handling be performed with the skids under the unit when possible and that the skids not be removed until the unit is in the final location.

If the unit must be hoisted, it is necessary to lift the unit by attaching cables or chains at the lifting holes in the evaporator tube sheets. Spreader bars must be used to protect the control cabinet and the other areas of the chiller.

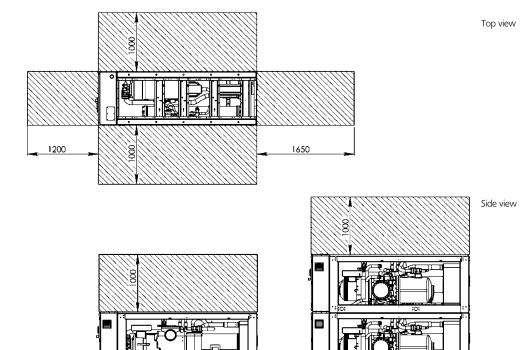
Location

A levelled and sufficiently strong floor is required. If necessary, additional structural members should be provided to transfer the weight of the unit to the nearest beams.

Rubber-in-shear isolators are furnished and field placed under each corner of the package. A rubber anti-skid pad should be used under isolators if hold-down bolts are not used. Vibration isolator in all water piping connected to the chiller are recommended to avoid straining the piping and transmitting vibration and noise.

Minimum space requirements

Every side of the machine must be accessible for all post-installation maintenance activities. The minimum space required is shown on the following drawing



Minimum clearance requirements for machine maintenance

INN_1_Rev.00_1

10 - 1 Water Charge, Flow and Quality

Water charge, flow and quality

				Cooling water		Cooled	d water		Heated	water ₍₂₎	High temperature 7.0 - 8.0 7.0 - 8.0 Below 30 Below 300 Below 30 Below 300 Below 30 Below 30 Below 50 Below 50 Below 70 Below 70 Below 50 Below 70 Below 60 Below 10 Below 10 B	
ITEMS	P(1) (5)		Circulatin	ng system	Once flow			Low ten	perature	High ten	nperature	Tendency if out of criteria
			Circulating water	Supply water(4)	Flowing water	Circulating water [Below 20°C]	Supply water(4)	Circulating water [20°C ~ 60°C]	Supply water(4)	Circulating water [80°C~80°C]	Supply water(4)	
	ph	at 25°C	6.5 ~ 8.2	6.0 - 8.0	6.0 - 8.0	6.8 - 8.0	6.0 - 8.0	7.0 ~ 8.0	7.0 ~ 8.0	7.0 ~ 8.0	7.0 ~ 8.0	Corrosion+Scale
	Electrical conductivity	[mS/m] at 25°C	Below 80	Below 30	Below 40	Below 80	Below 80	Below 30	Below 30	Below 30	Below 30	Corrosion+Scale
		(μS/cm) at 25°C	(Below 800)	(Below 300)	(Bellow 400)	(Bellow 800)	(Bellow 800)	(Below 300)	(Below 300)	(Below 300)	(Below 300)	Corrosion+Scale
	Chloride ion	[mgCl ²⁻ /l]	Below 200	Below 50	Below 50	Bellow 200	Below 50	Below 50	Below 50	Below 30	Below 30	Corrosion
	Sulfate ion	[mgSO ² ' ₄ /I]	Below 200	Below 50	Below 50	Below 200	Below 50	Below 50	Below 50	Below 30	Below 30	Corrosion
illed:	M-alkalinity (pH4.8)	[mgCaCO ₃ / 1]	Below 100	Below 50	Below 50	Below 100	Below 50	Below 50	Below 50	Below 50	Below 50	Scale
items to be controlled:	Total hardness	[mgCaCO ₃ /1]	Below 200	Below 70	Below 70	Below 200	Below 70	Below 70	Below 70	Below 70	Below 70	Scale
s to be	Calcium hardness	[mgCaCO ₃ /l]	Below 150	Below 50	Below 50	Below 50	Below 50	Below 50	Below 50	Below 50	Below 50	Scalle
Item	Silica ion	[mgSiO ₂ A]	Below 50	Below 30	Below 30	Below 30	Below 30	Below 30	Below 30	Below 30	Below 30	Scale
	Oxygen	[mgO2 /l]	Below 1.0	Below 1.0	Below 1.0	Below 1.0	Below 1.0	Below 1.0	Below 1.0	Below 1.0	Below 1.0	Corrosion
	Particole size	(mm)	Below 0.5	Below 0.5	Below 0.5	Below 0.5	Below 0.6	Below 0.5	Below 0.6	Below 0.5	Below 0.6	Erosion
	Total dissolved solids	(mg / l)	Below 1000	Below 1000	Below 1000	Below 1000	Below 1001	Below 1000	Below 1001	Below 1000	Below 1001	Erosion
	Ethykene, Propylene Gl	ycol (weight conc.)	Below 60%	Below 60%	Below	Below 60%	Below 60%	Below 60%	Below 60%	Below 60%	Below 60%	-
	Nitrate ion	(mg NO3-/l)	Below 100	Below 100	Below 100	Below 100	Below 101	Below 100	Below 101	Below 100	Below 101	Corrosion
	TOC Total organic carbon	(mg/l)	Below 1.0	Below 1.0	Below 1.0	Below 1.0	Below 1.0	Below 1.0	Below 1.0	Below 1.0	Below 1.0	Scale
	Iron	[mgFe/l]	Below 1.0	Below 0.3	Below 1.0	Below 1.0	Below 0.3	Below 1.0	Below 0.3	Below 1.0	Below 0.3	Corrosion+Scale
ed to:	Copper	[mgCu/l]	Below 0.3	Bellow 0.1	Below 1.0	Below 1.0	Below 1.0	Below 1.0	Below 0.1	Below 1.0	Below 0.1	Corrosion
Items to be referred to:	Sulfite ion	[mgS ² /l]	Not detectable	Not detectable	Not detectable	Not detectable	Not detectable	Not detectable	Not detectable	Not detectable	Not detectable	Corrosion
ns to b	Ammonium ion	[mgNH* _d /I]	Below 1.0	Below 0.1	Below 1.0	Below 1.0	Below 0.1	Below 0.3	Below 0.1	Below 0.1	Below 0.1	Corrosion
Iter	Remaining chlloride	[mgCL/l]	Below 0.3	Below 0.3	Below 0.3	Below 0.3	Below 0.3	Below 0.25	Below 0.3	Below 0.1	Below 0.3	Corrosion
	Free carbide	[mgC0 ₂ /l]	Below 4.0	Bellow 4.0	Below 4.0	Below 4.0	Below 4.0	Below 0.4	Below 4.0	Below 0.4	Below 4.0	Corrosion
	Stability index		6.0 ~ 7.0						***			Corrosion + Scalle

NOTES

- 1 Names, definitions and units are according to JIS K 0101. Units and figures between brackets are old units published as reference only.
- 2 In case of using heated water (more than 40°C), corrosion is generally noticeable. Especially when the iron material is in direct contact with water without any protection shields, it is desireable to give the valid measures for corrosion. e.g. chemical measure.
- 3 In the cooling water using hermetic cooling tower, closed circuit water is according to heated water standard, and scattered water is according to cooling water standard.
- 4 Supply water is considered drink water, industrial water and ground water except for genuine water, neutral water and soft water.
- 5 The above mentioned items are representable items in corrosion and scale cases.
- 6 The limits above have to be considered as a general prescription and can not totally assure the absence of corrosion and erosion.

 Some particular combinations of elements or the presence of components not listed in the table or factors not considered may trigger corrosion phenomena.

WAFLOWQUA_1-2_Rev.00_1

10 Installation

10 - 1 Water Charge, Flow and Quality

Water content in cooling circuits

The cooled water distribution circuits should have a minimum water content to avoid excessive compressors starts and stops.

In fact, each time the compressor starts up, an excessive quantity of oil goes from the compressor's pump and simultaneously there is a rise in the temperature of the compressor motor's stator, due to the inrush current during the start-up.

To prevent damage to the compressors, it has been envisaged the application of a device to limit frequent stops and restarts.

During the span of one hour there will be no more than 6 starts of the compressor. The plant side should therefore ensure that the overall water content allows a more constant functioning of the unit and consequently greater environmental comfort. The minimum water content per unit should be calculated using this simplified formula:

For 1 compressor unit M (Liters) = $(0.94 \times \triangle T(^{\circ}C) + 5.87) \times P(kW)$

For 2 compressors unit M (Liters) = $(0.1595 \times \Delta T(^{\circ}C) + 3.0825) \times P(kW)$

where:

M minimum water content per unit expressed in litres P Cooling Capacity of the unit expressed in kW

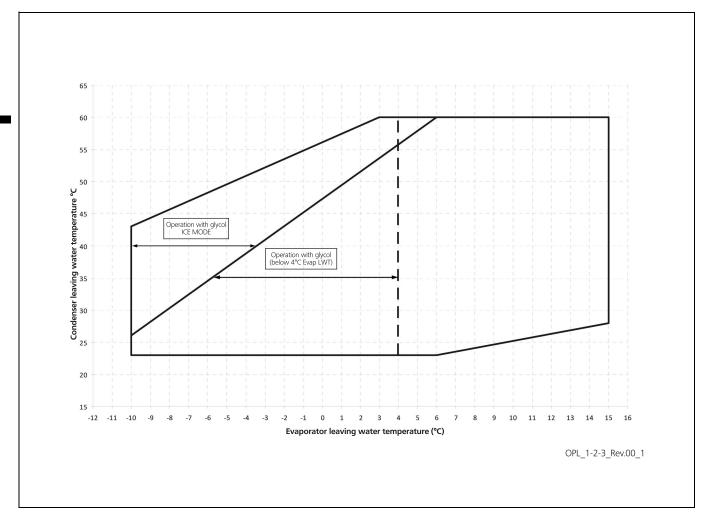
 $\triangle \mathsf{T}$ evaporator entering / leaving water temperature difference expressed in ${}^{\circ}\mathsf{C}$

This formula is valid for:

- standard microprocessor parameters

For more accurate determination of quantity of water, it is advisable to contact the designer of the plant.

WAFLOWQUA_1-2_Rev.00_2



11 Operation range

Table 1 - Evaporator/Condenser minimum and maximum $\triangle t$

Max evaporator water △T	°C	8
Min evaporator water △T	°C	4
Min condenser water △T	°C	4
Max condenser water △T	°C	8

Table 2 - Evaporator fouling factors

Fouling factors m ² °C / kW	Cooling capacity correction factor	Power input correction factor	EER correction factor
0.0176	1.000	1.000	1.000
0.0440	0.978	0.986	0.992
0.0880	0.957	0.974	0.983
0.1320	0.938	0.962	0.975

Minimum glycol percentage for low water temperature 3 - Condenser fouling factors

3,	•		
Fouling factors m ² °C / kW	Cooling capacity correction factor	Power input correction factor	EER correction factor
0.0176	1.000	1.000	1.000
0.0440	0.978	0.986	0.992
0.0880	0.957	0.974	0.983
0.1320	0.938	0.962	0.975
	0.0176 0.0440 0.0880	Fouling factors m²°C / kW Cooling capacity correction factor 0.0176 1.000 0.0440 0.978 0.0880 0.957	Fouling factors m²°C / kW Cooling capacity correction factor Power input correction factor 0.0176 1.000 1.000 0.0440 0.978 0.986 0.0880 0.957 0.974

Table 4.1 - Condenser fouling factors

Evaporator leaving water temperature °C	2	0	-2	-4	-6	-8
Ethylene glycol (%)	10	20	20	20	30	30
Propylene glycol (%)	10	20	20	30	30	30

Note: Minimum glycol percentage to be used with evaporator leaving water temperature below 4°C to prevent freezing of water circuit.

Table 4.2 - Minimum glycol percentage for low air temperature

Air ambient temperature (°C) (2)	-3	-8	-15	-23	-35
Ethylene glycol (%) (1)	10%	20%	30%	40%	50%
Air ambient temperature (°C) (2)	-3	-7	-12	-20	-32
Propylene glycol (%) (1)	10%	20%	30%	40%	50%

Note (1): Minimum glycol percentage to prevent freezing of water circuit at indicated air ambient temperature Note (2): Air ambient temperature do exceed the operating limits of the unit, as protection of water circuit may be needed in winter season at non-working conditions.

Table 5 - Correction factors for low evaporator leaving water temperature	erature					
Evaporator leaving water temperature °C	2	0	-2	-4	-6	-8
Cooling capacity	0.842	0.785	0.725	0.670	0.613	0.562
Compressor power input	0.950	0.940	0.920	0.890	0.870	0.840

Note: Correction factors have to be applied at working conditions: evaporator leaving water temperature 7°C

Table 6 - Correction factors for water and glycol mixture

able by confection factors for trace, and given mixture						
	Ethylene glycol (%)	10%	20%	30%	40%	50%
	Cooling capacity	0.991	0.982	0.972	0.961	0.946
Ethylene glycol	Compressor power input	0.996	0.992	0.986	0.976	0.966
	Flow Rate (△t)	1.013	1.04	1.074	1.121	1.178
	Evaporator Pressure Drop	1.070	1.129	1.181	1.263	1.308
	Cooling capacity	0.985	0.964	0.932	0.889	0.846
Ethylene glycol	Compressor power input	0.993	0.983	0.969	0.948	0.929
	Flow Rate (△t)	1.017	1.032	1.056	1.092	1.139
	Evaporator Pressure Drop	1.120	1.272	1.496	1.792	2.128

OPL_1-2-3_Rev.00_2

11 Operation range

How to use the Correction factors proposed in the previous tables

A) Mixture Water and Glycol---Evaporator leaving water temperature > 4°C

- -depending from the type and percentage (%) of glycol filled in the circuit (see table 4.2 and 6)
- multiply the Cooling Capacity, the Compressor Power Input by the Correction factor of Table 6
- starting from this new value of Cooling Capacity, calculate the Flow Rate (I/s) and the Evaporatore Pressure Drop (kPa)
- -now multiply the new Flow Rate and the new Evaporator Pressure Drop by the Correction Factors of Table 6

<u>Example</u>

Unit size: **EWWD120J-SS**

Mixture: Water

Working condition: ELWT 12/7°C - CLWT 30/35°C

- Cooling capacity: 121 kW - Power input: 27.3 kW - Flow Rate (△t 5°C): 5.78 - Evaporator Pressure Drop: 15kPa

Mixture: Water+Ethylene glycol 30% (for a winter air temperature up to -15°C)

Working condition: ELWT 12/7°C - CLWT 30/35°C - Cooling capacity: 121 x 0.972 = 118 kW - Power input: 27.3 x 0.986 = 26.9 kW

- Flow Rate (\triangle t 5°C): 5.64 l/s (referred to 118 kW) x 1.074 = 6.06 l/s - Evaporator Pressure Drop: 16 (referred to 6.06 l/s) x 1.181 = 19kPa

B) Mixture Water and Glycol---Evaporator leaving water temperature < 4°C

- -depending from the type and percentage (%) of glycol filled in the circuit (see table 4.1 and 4.2 and table 6)
- depending from the evaporator leaving water temperature (see table 5)
- multiply the Cooling Capacity, the Compressor Power Input by the Correction factor of Table 5 and Table 6
- starting from this new value of Cooling Capacity, calculate the Flow Rate (I/s) and the Evaporatore Pressure Drop (kPa)
- now multiply the new Flow Rate and the new Evaporator Pressure Drop by the Correction Factors of Table 6

<u>Example</u>

Unit size: **EWWD120J-SS**

Mixture: Water

Working condition: ELWT 12/7°C - CLWT 30/35°C

- Cooling capacity: 121 kW - Power input: 27.3 kW - Flow Rate (△t 5°C): 5.78 - Evaporator Pressure Drop: 15kPa

Mixture: Water+Ethylene glycol 30% (for a low evaporator leaving temperature of 0/-5°C)

Working condition: ELWT 0/-5°C - CLWT 30/35°C - Cooling capacity: 121 x 0.641 x 0.972 = 75.4 kW - Power input: 27.3 x 0.880 x 0.986 = 23.7 kW

- Flow Rate (\triangle t 5°C): 3.60 l/s (referred to 75.4 kW) x 1.074=3.87 l/s - Evaporator Pressure Drop: 7 kPa (referred to 3.87 l/s) x 1.181 = 9kPa

OPL_1-2-3_Rev.00_3

12 Specification text

Technical Specification for Water Cooled Screw Chiller

General

The water cooled screw chiller will be designed and manufactured in accordance with following European directives:

Construction of pressure vessel	97/23/EC (PED)	
Machinery Directive	2006/42/EC	
Low Voltage	2006/95/EC	
Electromagnetic Compatibility	2004/108/EC	
Electrical & Safety Codes	EN 60204-1 / EN 60335-2-40	
Manufacturing Quality Stds	UNI - EN ISO 9001:2004	

The unit will be tested at full load in the factory at the nominal working conditions and water temperatures. Before shipment a full test will be held to avoid any losses.

Chiller will be delivered to the job site completely assembled and charged with refrigerant and oil. Comply with the manufacturer instructions for rigging and handling equipment.

The unit will be able to start up and operate as standard at full load and condenser entering fluid temperature from $^{\circ}$ C to $^{\circ}$ C with an evaporator leaving fluid temperature between $^{\circ}$ C and $^{\circ}$ C

All units published performances have to be certified by Eurovent.

Refrigerant

Only HFC 134a will be accepted.

Freeze protection

- ✓ Number of water cooled screw chiller:
- ✓ Cooling capacity for single water cooled screw chiller: kW
- ✓ Power input for single water cooled screw chiller in cooling mode:kW
- ✓ Plate to plate evaporator entering water temperature in cooling mode:°C
- ✓ Plate to plate evaporator leaving water temperature in cooling mode:°C
- ✓ Plate to plate evaporator water flow: l/s
- ✓ Shell & tube condenser entering water temperature in cooling mode:°C
- ✓ Shell & tube condenser leaving water temperature in cooling mode: °C
- ✓ Shell & tube condenser water flow: I/s
- ✓ The unit should work with electricity in range 400V ±10%, 3ph, 50Hz without neutral and shall only have one power connection point.

Unit description

Chiller shall include as standard: 1 or 2 independent refrigerant circuits, semi-hermetic rotary single screw compressors, electronic expansion device (EEXV), direct expansion plate to plate evaporator and shell & tube condenser, R134a refrigerant, lubrication system, motor starting components, control system and all components necessary for safe and stable unit operation.

Chiller will be factory assembled on a robust base-frame made of zinc coated steel, protected by an epoxy paint.

Noise level and vibration

Sound pressure level at 1 meter distance in free field, semispheric conditions, shall not exceed dBA. The sound pressure levels must be rated in accordance to ISO 3744. Other types of rating unacceptable.

Vibration level should not exceed 2 mm/s.

Dimension

Unit dimensions shall not exceed following indications:

- ✓ unit length: mm,
- ✓ unit width: mm,
- ✓ unit height: mm.

SPC_1-2-3_Rev.00_1

12 Specification text

Chiller Components

Compressors

- ✓ Semi-hermetic, single-screw type with one main helical rotor meshing with gaterotor. The gaterotor will be constructed of a carbon impregnated engineered composite material. The gaterotor supports will be constructed of cast iron.
- ✓ The oil injection shall be used in order to get high EER (Energy Efficiency Ratio) also at high condensing pressure and low sound pressure levels in each load condition.
- ✓ Refrigerant system differential pressure shall provide oil flow throught service replaceble, 0.5 micron, full flow, cartridge type oil filter internal to compressor.
- ✓ Refrigerant system differential pressure shall provide oil injection on all moving compressor parts to correctly lubricate them. Electrical oil pump lubricating system is not acceptable.
- ✓ The compressor's oil cooling must be realized, when necessary, by refrigerant liquid injection. External dedicated heat exchanger and additional piping to carry the oil from the compressor to heat exchanger and viceversa will be not accepted.
- The compressor shall be provided with an external, high efficiency, cyclonic type oil separator and with built-in oil filter, cartridge type.
- ✓ The compressor shall be direct electrical driven, without gear transmission between the screw and the electrical motor.
- ✓ Shall be present two thermal protection realized by a thermistor for high temperature protection: one temperature sensor to protect electrical motor and another sensor to protect unit and lubricating oil from high discharge gas temperature.
- ✓ The compressor shall be equipped with an electric oil-crankcase heater.
- Compressor shall be fully field serviceable. Compressor that must be removed and returned to the factory for service shall be unacceptable.

Cooling capacity control system

- ✓ Each unit will have a microprocessor for the control of compressor slide valve's position and instantaneous RPM value of the motor.
- ✓ The unit capacity control shall be infinitely modulating, from 100% down to 25% for each circuit (from 100% down to 12,5% of full load for unit with 2 compressors). The chiller shall be capable of stable operation to a minimum of 12,5% of full load without hot gas bypass.
- ✓ Step unloading unacceptable because of evaporator leaving water temperature fluctuation and low unit efficiency at partial load.
- ✓ The system shall stage the unit based on the leaving evaporator water temperature fluctuation that shall be controlled y a PID (Proportional Integral Derivative) loop.
- ✓ Unit control logic shall to manage frequency level of the compressor electric motor to exactly match plant load request in order to keep constant the set point for delivered chilled water temperature. In this operation condition unit control logic shall modulate electrical frequency level in a range lower and upper the nominal electrical network value at 50 Hz.
- ✓ The microprocessor unit control shall detect conditions that approach protective limits and take self-corrective action prior to an alarm occurring. The system shall automatically reduce chiller capacity when any of the following parameters are outside their normal operating range:
 - o High condenser pressure
 - o Low evaporation refrigerant temperature
 - High compressor motor amps

Evaporator

- ✓ The units shall be equipped with a Direct Expansion plate to plate evaporator with copper tubes rolled into steel tubesheets.
- ✓ The external shell shall be linked with an electrical heater to prevent freezing down to -28°C ambient temperature, controlled by a thermostat and shall be insulated with flexible, closed cell polyurethane insulation material (10 mm thick).
- ✓ The evaporator will have 1 circuit.
- ✓ The water connections shall be threaded type connections as standard to ensure quick mechanical disconnection between the unit and the hydronic network.
- ✓ Evaporator is manufactured in accordance to PED approval.

SPC_1-2-3_Rev.00_2

12 Specification text

Condensers

- ✓ Condensers will be shell and cleanable, through-tube type.
- ✓ The unit will have one condensers per circuit.
- ✓ Each condenser shall have a carbon steel and seamless, integrally finned high efficiency copper tubes, roll expanded into heavy carbon steel tube sheets.
- ✓ Water heads shall be removable and include vent and drain plugs.
- ✓ Condensers will come complete with liquid shut-off valve, spring loaded relief valve.

Refrigerant circuit

Each circuit shall include as standard: electronic expansion device piloted by unit's microprocessor control, compressor discharge shut-off valve, suction line shut-off valve, replaceable core filter-drier, sight glass with moisture indicator and insulated suction line.

Control panel

- Field power connection, control interlock terminals, and unit control system should be centrally located in an electric panel (IP 54). Power and starting controls should be separate from safety and operating controls in different compartments of the same panel.
- ✓ Starting shall be Wye-Delta type as standard.
- Operating and safety controls should include energy saving control; emergency stop switch; overload protection for compressor
 motor, high and low pressure cut-out switch (for each refrigerant circuit); anti-freeze thermostat; cut-out switch for each
 compressor.
- ✓ All of the information regarding the unit will be reported on a display and with the internal built-in calendar and clock that will switch the unit ON/OFF during day time all year long.
- ✓ The following features and functions shall be included:
 - Resetting chilled water temperature by controlling the return water temperature or by a remote 4-20 mA DC signal or by controlling the external ambient temperature;
 - Soft load function to prevent the system from operating at full load during the chilled fluid pulldown period;
 - Password protection of critical parameters of control;
 - Start-to-start and stop-to-start timers to provide minimum compressor off-time with maximum motor protection;
 - Communication capability with a PC or remote monitoring;
 - discharge pressure control through intelligent cycling of condenser fans;
 - Lead-lag selection by manual or automatically by circuit run hours;
 - Double set point for brine unit version;
 - Scheduling via internal time clock to allow programming of a yearly start-stop schedule accommodating weekends and holidays

Optional High Level Communications Interface

The controller as a minimum shall be capable of providing the data shown in the above list, using the following options:

- RS485 Serial Card
- RS232 Serial Card
- LonWorks interface to FTT10A Transceiver.
- Bacnet Compatible
- Use of Compass Points (manufactured by North Communications) to allow communications with such as Honeywell, Satchwell, Johnson controls, Trend etc.

SPC_1-2-3_Rev.00_3



Daikin's unique position as a manufacturer of air conditioning equipment, compressors and refrigerants has led to its close involvement in environmental issues. For several years Daikin has had the intention to become a leader in the provision of products that have limited impact on the environment. This challenge demands the eco design and development of a wide range of products and an energy management system, resulting in energy conservation and a reduction of waste.











Daikin Europe N.V. participates in the Eurovent Certification programme for Air Conditioners (AC), Liquid Chilling Packages (LCP) and Fan Coil Units (FC), the certified data of certified models are listed in the Eurovent Directory. Multi units are Eurovent certified for combinations up to 2 indoor units.

Daikin products are distributed by:

