THERMAC®

CLOSED CIRCUIT COOLERS
SERIE CR - CCS - CCAE

THERMAC AND THE PRINCIPLE OF ADIABATIC COOLING

Thermac has a long experience in manufacturing of equipment that use the principal of adiabatic cooling. In its long history Thermac has applied this principle in the construction of:

- open circuit cooling towers both with centrifugal and axial fans;
- closed circuit cooling towers;
- air handling units with humidification system using air washer or wet deck;
- desert coolers for evaporative cooling of large industrial areas, especially used in countries with a warm and dry climate;
- air washers single and double bank and in a range from a few thousand m^3/h up to 240.000 m^3/h.

The exploitation of the adiabatic principle for the closed circuit fluid cooler was developed by Thermac on three lines of machines:

1) **SERIE 21 CR:** they are closed circuit cooling towers with heat exchanger in smooth copper pipes wetted externally by recycled water that promotes the exchange of heat between the fluid inside and the outside air.

2) **SERIE CCS:** it maintains separate the effect of evaporative cooling (outdoor air / intermediate water) from the forced convection cooling between intermediate water and water to be cooled. The first continues to take place in a traditional type cooling tower, while the second will take place in a stainless steel plate heat exchanger. The water to be cooled and the intermediate water coming from the cooling tower meet in a perfect counter flow, obtaining an efficiency much higher than in a traditional close circuit cooling tower.

3) **SERIE CCAE:** it is an evolution of dry-coolers in which instead of the dry bulb temperature the wet bulb temperature is operating.

TECHNICAL AND CONSTRUCTIONAL FEATURES SERIE 21 CR

The THERMAC serie **21 CR** closed circuit coolers are particularly suitable for:

- ◆evaporative cooling of water, or water-glycole solution in closed circuit for airconditioning or refrigeration plants;
- ◆water cooling for diesel motors;
- ◆water or oil cooling for industrial processes.

The serie 21 CR coolers are of the forced draft type with a centrifugal fan; fan and motor are always on the dry side and in the best operational conditions. The centrifugal fans have a hot-dip galvanized wheel with forward curved blades and are belt driven. The water circulation pump is of the centrifugal type, directly coupled to a 3-phase motor. The pump seal of the mechanical type is particularly suited for this type of operation. The pump is factory assembled in the coil spraying circuit. A set of rubber centrifugal nozzles, of the no-clog and low pressure drop type ensure a uniform distribution of the recirculated water over the coil. The coil is entirely fabricated of steel tube hot-dip galvanized after assembly or in copper tubes. The coil allows maximum thermal expansion and it is completely drainable in case of prolonged periods of inactivity during winter. The casing is in galvanized sheet metal, with an external protection of zinc-chrome painting.

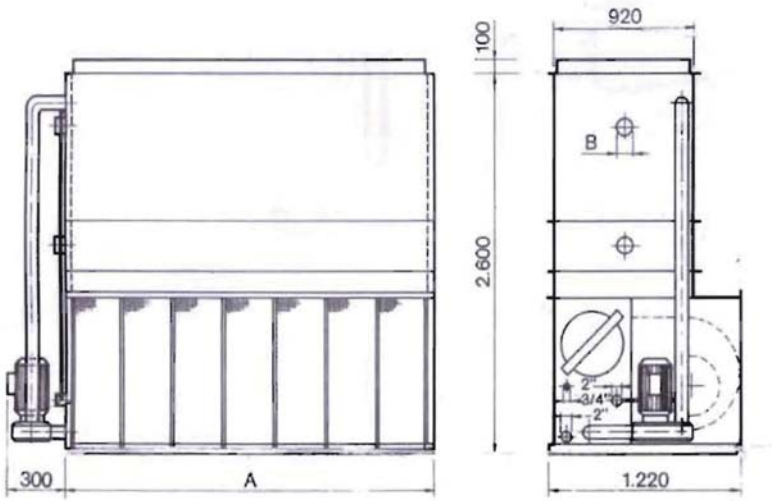
The sump tank is fabricated in press-bent galvanized sheet metal with no welding. The tank in complete with water make-up connection with float valve, quick fill, overflow and drain. The moisture eliminator are in painted press-bent galvanized sheet metal or in self-extinguishing PVC and eliminate any passage of water droplets.

MODEL	NOMINAL POWER Kcal	AIR FLOW m^3/h	FAN MOTOR CV	WATER FLOW l/h	PUMP MOTOR CV	WEIGHT OPERATING Kg
21 CR 30	30.000	8.000	3,0	6.200	0,50	820
21 CR 35	35.000	8.400	3,0	6.200	0,50	870
21 CR 40	40.000	8.800	4,0	6.200	0,50	930
21 CR 65	65.000	16.700	5,5	12.200	0,75	1.200
21 CR 75	75.000	16.700	5,5	12.200	0,75	1.285
21 CR 100	100.000	17.000	7,5	12.200	0,75	1.380
21 CR 130	131.000	23.800	7,5	18.800	1,00	1.680
21 CR 145	145.000	24.700	7,5	18.800	1,00	2.000
21 CR 165	165.000	25.600	10,0	18.800	1,00	2.150

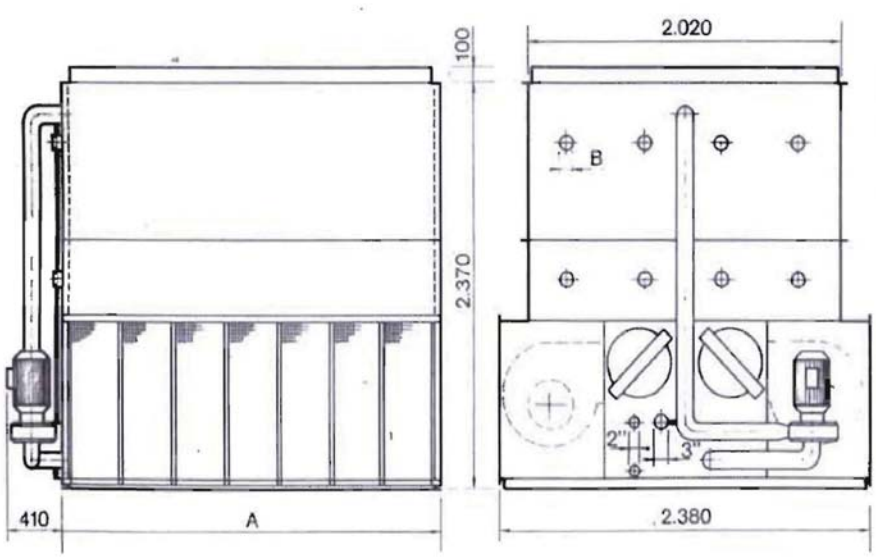
MODEL	NOMINAL POWER Kcal	AIR FLOW m³/h	FAN MOTOR CV	WATER FLOW l/h	PUMP MOTOR CV	WEIGHT OPERATING Kg
21 CR 190	188.000	34.000	2 x 5,5	24.600	1,50	2.800
21 CR 220	220.000	35.800	2 x 5,5	24.600	1,50	2.950
21 CR 250	250.000	37.500	2 x 7,5	24.600	1,50	3.120
21 CR 280	280.000	47.600	2 x 7,5	34.200	1,50	3.400
21 CR 320	320.000	49.500	2 x 7,5	34.200	1,50	3.740
21 CR 360	360.000	53.000	2 x 10	34.200	1,50	4.150
21 CR 390	390.000	69.700	2 x 5,5	51.000	2,00	5.300
21 CR 430	430.000	73.200	4 x 5,5	51.000	2,00	5.700
21 CR 490	490.000	76.500	4 x 7,5	51.000	2,00	6.200
21 CR 530	530.000	95.200	4 x 7,5	68.000	3,00	6.700
21 CR 635	635.000	103.000	4 x 10	68.000	3,00	7.200
21 CR 720	720.000	108.000	4 x 10	68.000	3,00	8.010

* The performances are at these conditions: water in 35°C; water out 30°C; wet bulb temperature 24°C

DIMENSIONS SERIE CR



MODEL	A	B
21 CR 30	1.360	3"
21 CR 35	1.360	3"
21 CR 40	1.360	3"
21 CR 65	2.460	3"
21 CR 75	2.460	3"
21 CR 100	2.460	3"
21 CR 130	3.010	4"
21 CR 145	3.010	4"
21 CR 165	3.010	4"



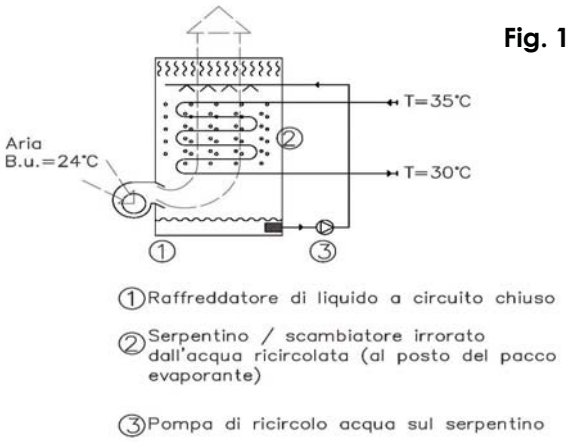
MODEL	A	B
21 CR 190	2.460	2"
21 CR 220	2.460	2"
21 CR 250	2.460	2"
21 CR 280	3.010	3"
21 CR 320	3.010	3"
21 CR 360	3.010	3"
21 CR 390	4.920	3"
21 CR 430	4.920	3"
21 CR 490	4.920	3"
21 CR 530	6.020	4"
21 CR 635	6.020	4"
21 CR 720	6.020	4"

TECHNICAL FEATURE SERIE CCS

The coolers THERMAC CCS represent a significant step forward in the technique of evaporative cooling. In the traditional closed circuit coolers, the cooling of the process liquid occurs in a heat exchanger generally consisting of a series of smooth pipes, made of galvanized iron or copper. The tubes surface is kept wet by spray of water, while an outside air flow is blown on tubes.

Substantially the closed circuit coolers are cooling towers where the wet deck has been substituted with a galvanized or copper tubes serpentine (fig.1).

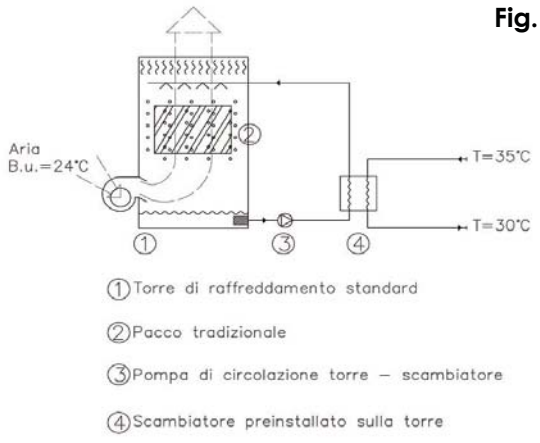
Fig. 1



On the surface of the tubes, a complex phenomenon of heat and mass exchange between the water inside the tubes, the water wetting the outside tube surface and the air flow, occurs. The wetting water evaporates, taking away heat from inside water, and saturates the air flow. This complex phenomenon requires a large exchange surface; in fact, for the same heat exchanged, water temperature conditions incoming/outgoing and W.B. air flow, the closed circuit towers have a size and an air flow rate 2 or 3 times higher than the traditional towers.

The innovative system proposed by THERMAC (fig.2) intends to keep separated the effect of evaporative cooling of intermediate water from the cooling of process water. The first continues to take place in a traditional type cooling towers, the second in a stainless steel plate heat exchanger. The two water flows exchange heat in perfect counterflow with much higher efficiency than the traditional serpentine. The first continues to take place in a tower of the traditional type, while the second will be in a plate heat exchanger made of stainless steel, where the water to be cooled and the water coming from the tower meet in perfect countercurrent, with a much higher efficiency the traditional serpentine.

Fig. 2



The advantages of this innovative solution are multiple and summarized as follows:

1. **required space for installation halved;**
2. **electrical power consumption reduced by half;**
3. **installed power halved;**
4. **exchanger cleaning simple and effective:** The water that evaporates on smooth tubes of the heat exchangers used in the traditional closed circuit coolers, causes a deposit of limestone on the outer surface difficult to remove, especially for the more internal ranks, with decrease of the overall heat transfer coefficient due to the increase in fouling factor. In the solution proposed by Thermac, any deposit of limestone takes place on the PVC wet deck of the tower, whose eventual replacement after years of running can be made in an economical way. The cleaning of the heat exchanger by us proposed, occurs in case of need, in a simple way, being possible the complete inspection of the exchange surface;
5. **less noise due to reduced air flow;**
6. **lower initial cost and operating costs.**

CONSTRUCTIONAL FEATURES SERIE CCS

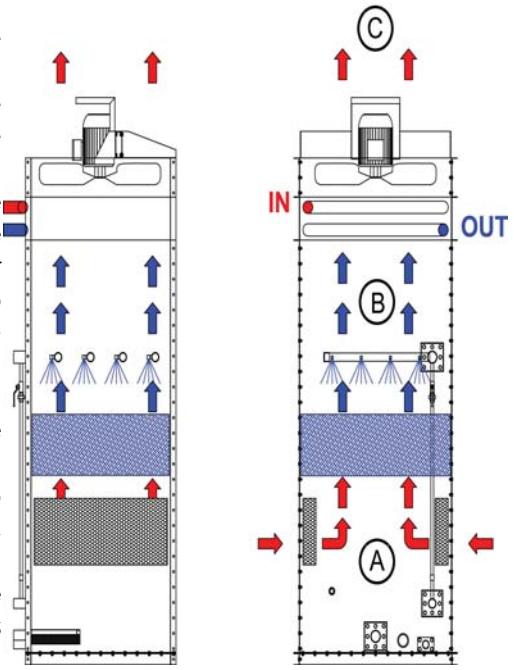
The Thermac liquid coolers CCS are formed essentially of three parts:

- cooling tower with blow throw centrifugal fan. This means that the fan and the electric motor are always dry and in the best operating conditions. The fans are centrifugal type impeller with forward curved blades made of galvanized sheet steel; coupled with the electric motor by "V" belts and pulleys. The filling material is made of self-extinguishing PVC, as well as the droplet separator. The water distribution system consists in a main collector and secondary polyethylene tubes bearing spray nozzles. The nozzles are centrifugal, rubber type, wide-opening, self-cleaning and no-clogging. Upon request, the basin or the whole tower can be made of stainless steel. The tower can be fitted with silencers both in the inlet and outlet. Antifreeze devices are available to be inserted in the basin;
- plate heat exchangers are made of AISI 304 stainless steel with painted carbon steel frame. Connection are flanged or threaded depending on the diameter. Pressure/testing 16/23 bar. The heat exchangers are easy to open allowing access to the channels of the plates for cleaning and maintenance;
- centrifugal pump to connect cooling tower to plate heat exchanger.

MODEL	Power to nominal conditions 35°-30° 24° b.u. kcal/h	Power to nominal conditions 35°-30° 24°b.u. Kw/h	Water flow primary and secondary (l/h)	Power pump indicative (kw)	Air flow (mc/h)	Installed power (kW)	Sound pressure (dBA)	Weight empty (kg)	Weight operating (kg)
CCS 20	58.500	68,00	11.700	0,54	8.500		57	650	970
CCS 25	71.000	83,00	14.200	0,66	10.000	1,5	58	660	980
CCS 30	87.800	102,00	17.600	0,81	11.500	2,2	58	680	1000
CCS 35	104.500	122,00	20.900	0,97	13.000	3	59	750	1020
CCS 40	114.900	134,00	23.000	1,06	13.500	3	59	760	1030
CCS 45	129.600	151,00	25.900	1,2	18.500	2,2	60	1170	1760
CCS 50	146.300	170,00	29.300	1,36	21.000	3	61	1190	1780
CCS 60	175.500	204,00	35.100	1,63	22.500	4	61	1210	1800
CCS 70	204.800	238,00	41.000	1,9	26.500	5,5	62	1240	1830
CCS 80	229.900	267,00	46.000	2,13	27.500	5,5	62	1250	1810
CCS 90	261.200	304,00	52.200	2,42	33.500	7,5	63	1510	2280
CCS 100	292.500	340,00	58.500	2,71	37.500	7,5	64	1530	2290
CCS 120	351.000	408,00	70.200	3,25	45.000	2 x 4,0	64	2140	3110
CCS 140	405.400	471,00	81.100	3,75	53.000	2 x 5,5	65	2200	3160
CCS 160	459.700	535,00	91.900	4,25	55.000	2 x 5,5	65	2220	3180
CCS 180	522.400	607,00	104.500	4,84	67.000	2 x 7,5	66	2590	3860
CCS 200	572.500	666,00	114.500	5,3	75.000	2 x 7,5	67	2630	3900
CCS 240	681.200	792,00	136.200	6,31	90.000	4 x 4,0	67	4090	6010
CCS 280	794.000	923,00	158.800	7,35	106.000	4 x 5,5	68	4200	6110
CCS 320	919.400	1069,00	183.900	8,51	110.000	4 x 5,5	69	4220	6130
CCS 360	1.044.800	1215,00	209.000	9,68	134.000	4 x 7,5	69	5260	7660
CCS 400	1.128.400	1312,00	225.700	10,45	150.000	4 x 7,5	70	5310	7740

TECHNICAL AND CONSTRUCTIONAL FEATURES SERIE CCAE

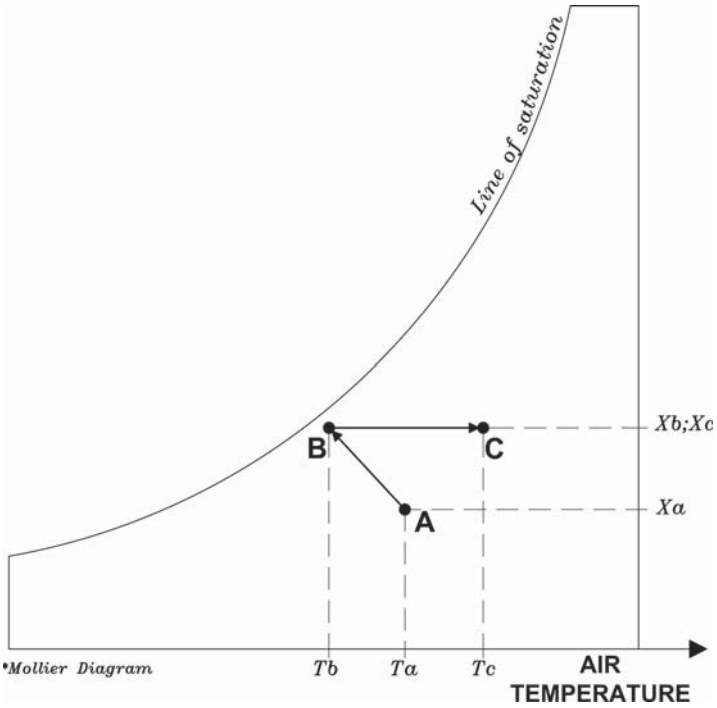
In an effort to minimize the consumption of water, in the recent years the use of dry-cooler for the cooling of process water or for air conditioning has been introduced . These devices, however, have a limit constituted by the outside air temperature that is used to cool the process water or the condensing device. The serie CCAE combines the advantages of closed circuit used in the dry-cooler with the increased efficiency of cooling towers. Indeed the outdoor air temperature used in the dry-cooler is the dry bulb temperature, while in the cooler of the serie CCAE, the outside air before arriving at the cooling coil passes through a wet deck, in which the dry bulb temperature is lowered almost to the value of the wet bulb, with an efficiency close to 90% of the process of adiabatic cooling.



With this system the water consumption is limited almost to the only quantity that evaporates during the process, limiting the amount of bleed-off and being able to use purified water. Even not using purified water, the replacement of the filling material that is being calcified is simple and economic.

Taking as reference the normal conditions of operation of a dry-cooler (incoming water at 40°C, 35°C with an entering air temperature of 25°C) this result can be obtained as long as the temperature of the incoming air is less than or equal to 25°C; in our latitudes this occurs for about 7200 hours per year; with the addition of the adiabatic cooling with an efficiency of 90%, the same result can be achieved for all of the hours per year (8736).

Using the adiabatic cooling even when the dry bulb temperature is below 25°C, we can obtain or an outlet temperature lower than the value of 35°C, or a longer period of operation with air flow partialized and consequent energy saving.



LEGEND:

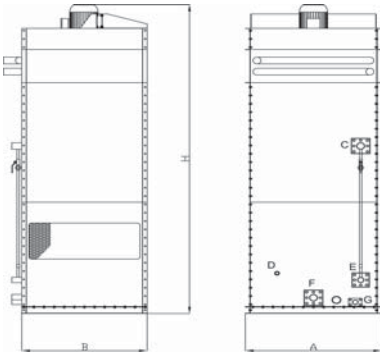
A = external air
B = air after adiabatic cooling
C = exhaust air

MODEL	NOMINAL POWER Kcal	AIR FLOW m³/h	FAN MOTOR KW	WATER FLOW l/h	PUMP MOTOR KW	WEIGHT OPERATING Kg
E CCAE 22	22.500	7.500	0,75	420	0,18	665
A CCAE 160	162.000	54.000	5,50	3.000	0,25	4.000
A CCAE 320	324.000	108.000	2x5,5	6.000	0,37	7.490
A CCAE 540	540.000	180.000	3x7,5	10.000	0,55	10.600
A CCAE 720	720.000	240.000	4x7,5	13.340	0,75	13.900
C CCAE 30	30.000	10.000	1,50	560	0,18	950
C CCAE 40	39.000	13.000	3,00	730	0,18	980
C CCAE 60	63.000	21.000	3,00	1.170	0,25	1.700
C CCAE 80	79.500	26.500	5,50	1.480	0,25	1.780
C CCAE 100	100.500	33.500	7,50	1.860	0,25	2.200
DC CCAE 160	159.000	53.000	2x5,5	2.950	0,25	3.000
DC CCAE 220	225.000	75.000	2x7,5	4.170	0,37	3.700
DC CCAE 320	318.000	106.000	4x5,5	5.890	0,37	5.900
DC CCAE 450	450.000	150.000	4x7,5	8.340	0,55	7.360
L C CCAE 260	261.000	87.000	15,00	4.840	0,37	5.400
L C CCAE 400	390.000	130.000	18,50	7.230	0,55	7.960
L C CCAE 520	522.000	174.000	2x15	9.670	0,55	10.670

* The performances are at these conditions: water in 40°C; water out 35°C; wet bulb temperature 25°C

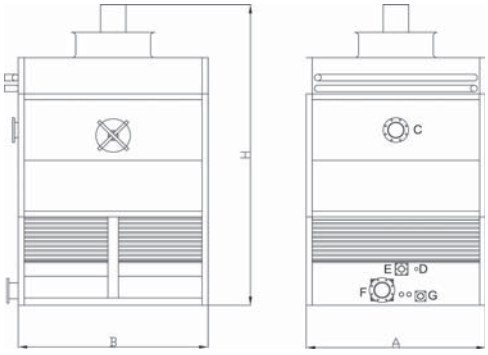
DIMENSIONS SERIE CCAE

DIMENSION MODEL "E"



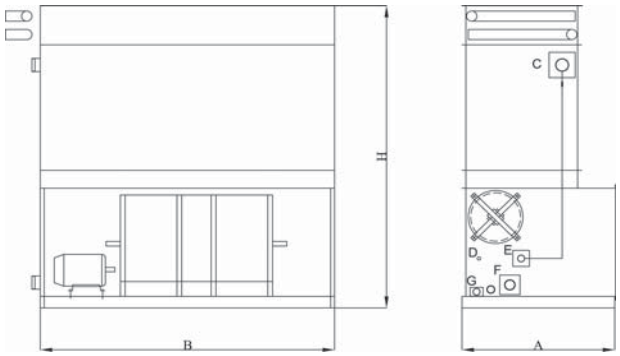
MODEL	A (mm)	B (mm)	H (mm)	C Water inlet	D Water make-up	E Overflow	F Water outlet	G Drain
E CCAE 22	1010	930	2460	2	½	1 ½	2	1 ½

DIMENSIONS MODEL "A"



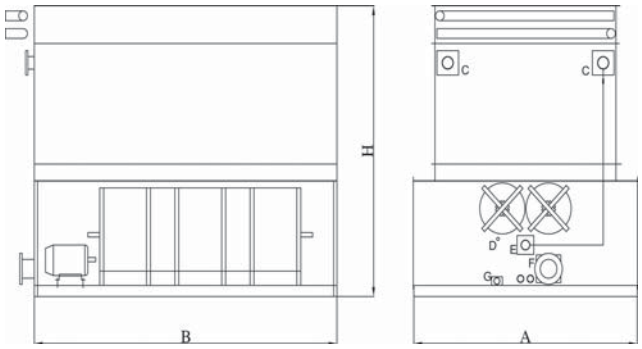
MODEL	A (mm)	B (mm)	H (mm)	C Water inlet	D Water make-up	E Overflow	F Water Outlet	G Drain
A CCAE 160	2400	2540	3710	DN 150	1 ¼	3	DN 150	3
A CCAE 320	2400	5000	3710	DN 200	2	3	DN 200	3
A CCAE 540	2400	7460	3710	2xDN 150	2	4	DN 200	3
A CCAE 720	2400	9920	3710	2xDN 200	2	4	DN 200	3

DIMENSIONS MODEL "C"



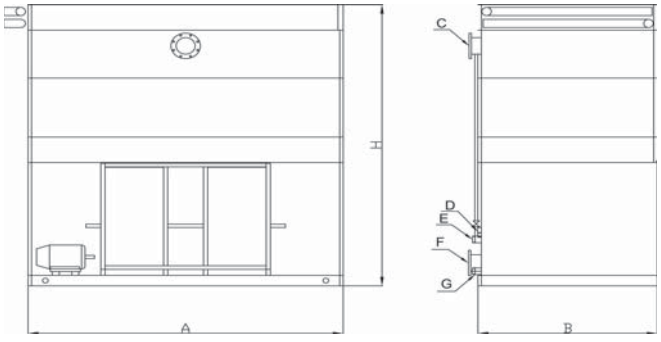
MODEL	A (mm)	B (mm)	H (mm)	C Water inlet	D Water make-up	E Overflow	F Water outlet	G Drain
C CCAE 30	1300	1276	2620	3	¾	2	3	2
C CCAE 40	1300	1276	2620	3	¾	2	3	2
C CCAE 60	1300	2476	2620	4	¾	2	4	2
C CCAE 80	1300	2476	2620	4	¾	2	4	2
C CCAE 100	1300	3076	2620	4	¾	2	4	2

DIMENSIONS MODEL "DC"



MODEL	A (mm)	B (mm)	H (mm)	C Water inlet	D Water make-up	E Overflow	F Water outlet	G Drain
DC CCAE 160	2240	2476	2620	DN 100	1 ¼	3	DN 150	2
DC CCAE 220	2240	3076	2620	DN 100	1 ¼	3	DN 150	2
DC CCAE 320	2240	4952	2620	DN 125	2	3	DN 200	2
DC CCAE 450	2240	6152	2620	DN 125	2	3	DN 200	2

DIMENSIONS MODEL "LC"



MODEL	A (mm)	B (mm)	H (mm)	C Water inlet	D Water make-up	E Overflow	F Water outlet	G Drain
L C CCAE 260	3640	2070	3840	DN 200	2	3	DN 200	3
L C CCAE 400	5480	2070	3840	2xDN 200	2	3	DN 200	3
L C CCAE 520	7280	2070	3840	2xDN 200	2	4	DN 250	3

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