Wytwórnia Urządzeń Chłodniczych "PZL-Dębica" S.A.

SPRAY-EVAPORATIVE CONDENSERS

type SWC

Dębica 2015

APPLICATION

They are designed for condensing the vapours of refrigerants generally applied in cooling systems and in particular R717, R404A. They are characterised by low water consumption what makes it possible to apply them even in places where there are considerable water consumption limitations.

CONSTRUCTION

The SWC condensers are of steel construction completely protected against corrosion by hot galvanising. Side covers are made of galvanised steel sheets. External surfaces are additionally covered with paint coating. The basic assembly of condenser is the lower set with a water tank and fans.

The water tank is equipped with the following stub pipes:

* outflow of water to a pump or to an external tank DN150,
* supplementing of fresh water G2”,
* overflow G1”,
* general drain of water G2”.

On a side wall of water tank there is a manhole enabling the access to service a float valve and a strainer which is mounted on the water outflow stub pipe.

Condenser fans can be driven either by one common driving motor – version 1 or by means of individual electric motors – version 2.

On the top of the lower set there is situated the upper set consisting of condensing sections. Over the batteries there is mounted the spraying system and a set of highly efficient eliminators.

The SWC condensers can be delivered together with accessory equipment consisting of:

* electric heater installed in the water tank together with a thermostat – symbol “G”
* circulating water pump together with water discharge pipeline as well as the heater and the thermostat as above – symbol “P”.

The SWC condensers compose the type-series of 10 sizes enabling optimum selection.

The basic dimensions are shown on Fig. 1 and in Table 1.

Table 1

Condenser type	Number of fans	Dimensions [mm]						Weight [kg]		
	[pcs]	A	B	C	D	E	F	Lower set	Upper set	Condenser when operating
SWC 9	2	3730	1940	1150	1180	-	4126	1780	2950	5100
SWC 10	2	3730	2120	1150	1330	-	4126	1780	3260	5300
SWC 11	2	3980	1940	1400	1180	-	4126	1890	3450	5600
SWC 12	2	3980	2120	1400	1330	-	4126	1890	3600	5800
SWC 13	3	3730	1880	1150	1230	-	6000	2200	3900	6700
SWC 15	3	3730	2000	1150	1140	-	6000	2200	4200	6980
SWC 16	3	3730	2230	1150	1590	540	6000	2300	4620	7540
SWC 17	3	3980	2050	1400	1440	480	6000	2300	4950	7900
SWC 18	3	3980	2170	1400	1530	510	6000	2350	5230	8200
SWC 20	3	3980	2440	1400	1740	570	6000	2400	5560	8550

OPERATION

The operation of spray-evaporative condensers is based on the exchange of heat and mass. Refrigerant vapour is supplied to condensing sections where it is condensed. The condensing heat is carried away to the water and then to the air. Condensed refrigerant flows down to outflow collectors and then it is carried away from there to refrigerating system.

The air flows in a counter-current to water stream forced by silent running drum fans. The heat from water is transmitted to the air by evaporation of water, thanks to that temperature of circulating water remains at a constant level.

The water is to be constantly supplemented due to continuous evaporation of it and in order to maintain concentration of mineral salts at a stable low level. The quantity of water for supplementing is adjusted with the float valve. This quantity is to be determined depending on water hardness with the assumption that quantity of entrained water is equal to about 2 ÷ 3% of quantity of evaporated water.

Maximum theoretical quantity of evaporated water is equal to the quotient of condenser heat capacity and water evaporation heat (2455 kJ/kg). The factual capacity of evaporated water is lower of even by 30%.

The water from the circulating water tank is sucked by the pump and pumped to the spraying system and then sprayed through nozzles in the space over pipes of condensing section. Small droplets entrained by the air flow are caught by eliminators where they cumulate and fall down.

To cool the condenser it is necessary to use water of hardness not higher than 8°n. Water of a higher hardness shall be treated with magnetic and chemical method.

Protection of condenser against freezing of water in the tank:

Ways of protecting the condenser against freezing of water in the tank during a standstill of condenser at air temperature below 0° C:

- draining the water out of the tank, the pump and the whole spraying system after ambience temperature drops below 0° C.
- application of circulating water tank of minimum volume 1,5 m^3 (for SWC 9÷12) and 2,5 m^3 (for SWC 13 ÷ 24) situated in a heated room.
- application of condensers equipped with heaters for heating the water in the tank (version of condenser equipment "G" and "P"). In those versions of condensers a thermostat switches a heater on when water temperature around the uptake stub pipe drops down to +2°C ÷ +4°C. This system enables to operate the condenser at air temperature down to about minus 10°C. At air temperature lower than minus 10°C the water in the condenser and the whole system shall be drained off.

TECHNICAL CHARACTERISTICS

Technical data:

- pressure of strength test for condensing section 3,5 MPa,
- pressure of leak proof test for condensing section 2,1 MPa,
- maximum working pressure 2,1 MPa,
- maximum working temperature of refrigerant +150°C,
- working range of the outside air temperature from minus 20 to +40°C,
- noise level of condenser according to Fig.3,
- sizes and application of stub pipes according to Fig. 1.

Technical characteristics of the SWC condensers:

Table 2

Condenser type	Rated heat capacity [kW] 1)	Marking of fan drive version	Fan drive 2)		Water for spraying	
			Power [kW]	Number of motors [pcs]	Quantity [dm^3 /s]	Minimum swell in nozzles [kPa]
SWC 9	648	SWC 9-1	11	1	19	40
		SWC 9-2	5,5	2		
SWC 10	729	SWC 10-1	11	1		
		SWC 10-2	7,5	2		
SWC 11	792	SWC 11-1	15	1		
		SWC 11-2	7,5	2		
SWC 12	868	SWC 12-1	18,5	1		
		SWC 12-2	11	2		
SWC 13	950	SWC 13-1	18,5	1	29	40
		SWC 13-2	7,5	3		
SWC 15	1035	SWC 15-1	18,5	1		
		SWC 15-2	7,5	3		
SWC 16	1138	SWC 16-1	22	1		
		SWC 16-2	11	3		
SWC 17	1197	SWC 17-1	22	1		
		SWC 17-2	11	3		
SWC 18	1269	SWC 18-1	22	1		
		SWC 18-2	11	3		
SWC 20	1470	SWC 20-1	30	1		
		SWC 20-2	11	3		

1) The capacity calculated for conditions:
   - R717 (NH_3) - refrigerant
   - t_k = +35°C - condensing temperature
   - t_m = +18°C - wet bulb air temperature
2) Drive of fans:
   - supply voltage: 3 x 400 V
   - frequency: 50 Hz
   - rotations: 920 ^{1}/min.

SELECTION OF CONDENSER

The condenser shall be selected on basis of cooling capacity of installation as well as rated power of compressor driving motors.

Sequence of selection

- define the cooling capacity of installation - Q_z,
- define working parameters of installation - condensing temperature t_k, wet bulb temperature for inflow air t_m and refrigerant,
- define power consumption of driving motors of refrigerating compressors - Q_e,
- specify required heat capacity of condenser - $Q_s=Q_z+Q_e$,
- basing on the table 3 specify the conversion coefficient for the assumed working parameters of installation- f,
- calculate the required rated heat capacity of condenser Q_{zn} multiplying the required heat capacity of condenser Q_s by the conversion coefficient f,
- from the table 2 select a condenser of rated capacity which is equal or higher than required capacity calculated in the way shown above.

Example selection of condenser - refrigerant R717:

- Cooling capacity of installation Q_z=585 kW.
- Condensing temperature t_k=+35°C, wet bulb temperature for the inflow air to the condenser t_m=+24°C, refrigerant - ammonia NH_3.
- Power consumption of driving motors of refrigerating compressors Q_e=155 kW.
- Required heat capacity of condenser $Q_s=Q_z+Q_e$=585+155=740 kW.
- Conversion coefficient f = 1,39 (from table 3 for t_k=+35°C and t_m=+24°C).
- Required rated capacity of condenser $Q_{zn}=Q_s \times f$=740×1,39=1028,5 kW.
- On basis of table 2 we select a condenser of the SWC 15 type of rated heat capacity 1035 kW.

Example selection of condenser - refrigerant R404A:

- Sequence of selection is analogous with R717 however the calculated required capacity of condenser for R717 refrigerant shall be increased by 12%.

Conversion coefficients – refrigerant R717:

Table 3

Condensing temp. t_k [°C]	Wet bulb temperature t_m [°C]								
	10	16	18	20	21	22	24	26	27
30	1,02	1,3	1,56	1,74	1,9	2,1	2,65	-	-
32	0,9	1,11	1,25	1,44	1,56	1,68	1,98	2,49	-
35	0,77	0,92	1,0	1,11	1,17	1,22	1,39	1,59	1,74
38	0,67	0,78	1,2	0,89	0,92	0,97	1,05	1,18	1,27
40	0,61	0,7	0,74	0,8	0,82	0,85	0,92	1,02	1,08
42	0,57	0,63	0,65	0,7	0,72	0,75	0,8	0,88	0,92
46	-	0,52	0,55	0,57	0,59	0,61	0,64	0,69	0,71

DELIVERY

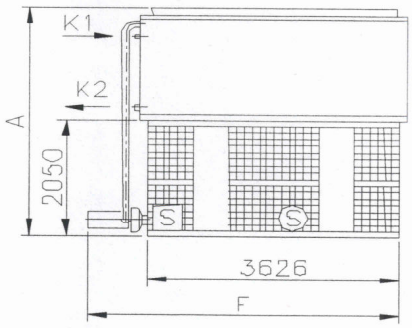
The condensers are delivered in two basic transport sets (lower set and upper set). Wiring system related to driving motors of fans and accessory equipment is not included into delivery range.

MOUNTING OF CONDENSER

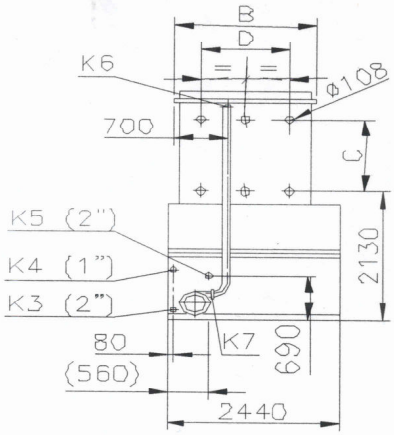
The condensers should be situated on the levelled foundation (supporting structure) adapted to the given type of condenser while observing the recommended distances from walls which are shown on Fig. 3.

Dimensions of lower frame are shown on Fig. 2.

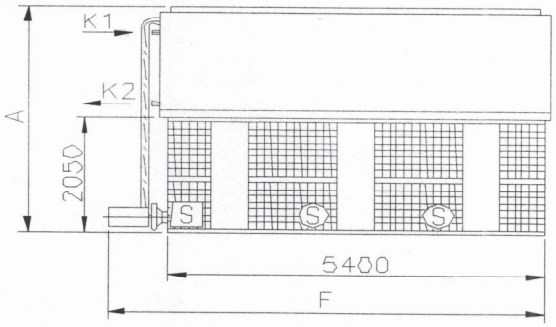
SW C 9 – SW C 12



SW C 9 – SW C 15



SW C 13 – SW C 20



SW C 16 – SW C 20

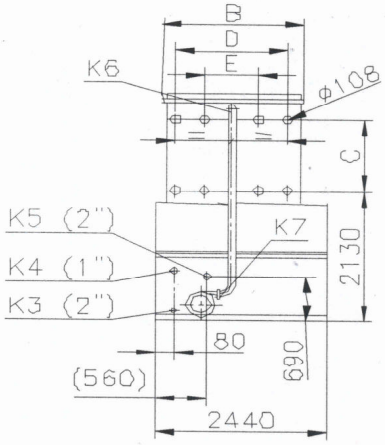


Table of stub pipes	
Mark.	Application
K1	Inlet of refrigerant vapour
K2	Outlet of refrigerant liquid
K3	General drain of water
K4	Supplementing of water
K5	Overflow
K6	Water in flow DN 125
K7	Outflow of water from the tank DN 150

Fig. 1

HOW TO ORDER

Orders shall be directed to the address of WUCH „PZL - Dębica" S.A., specifying in the order:

* type and size of condenser,
* version of execution regarding the drive of fans,
* marking of accessory equipment.

EXAMPLE OF MARKING

The SWC-type spray evaporative condenser of size 15, with individual drive of fans - version "2", with accessory equipment including electric heater, thermostat, circulating water pump - "P": **SWC-15-2-P**

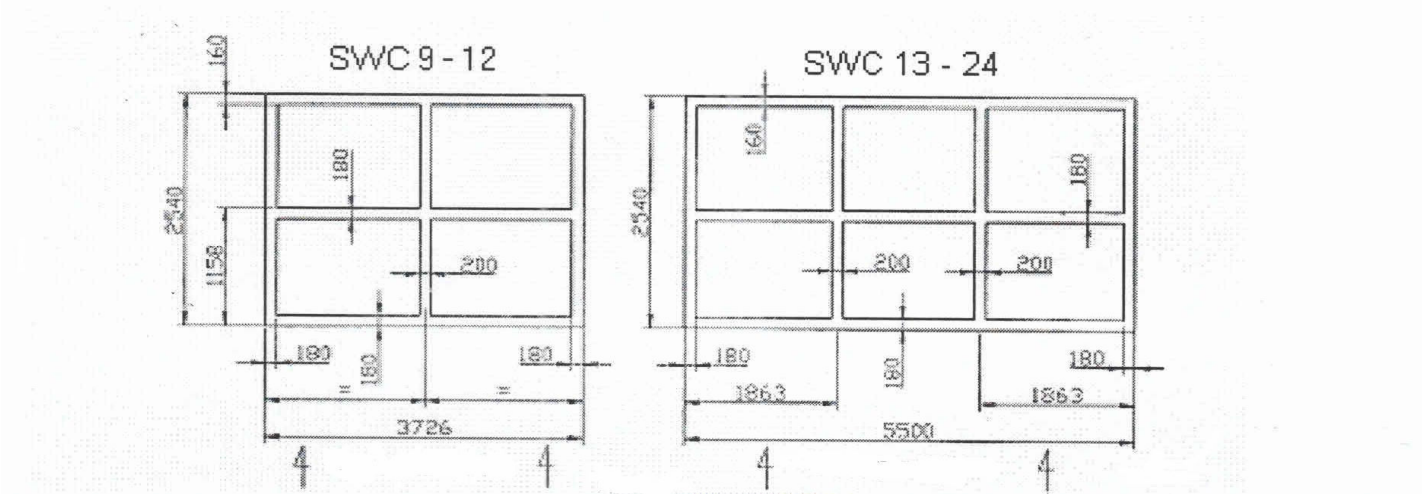
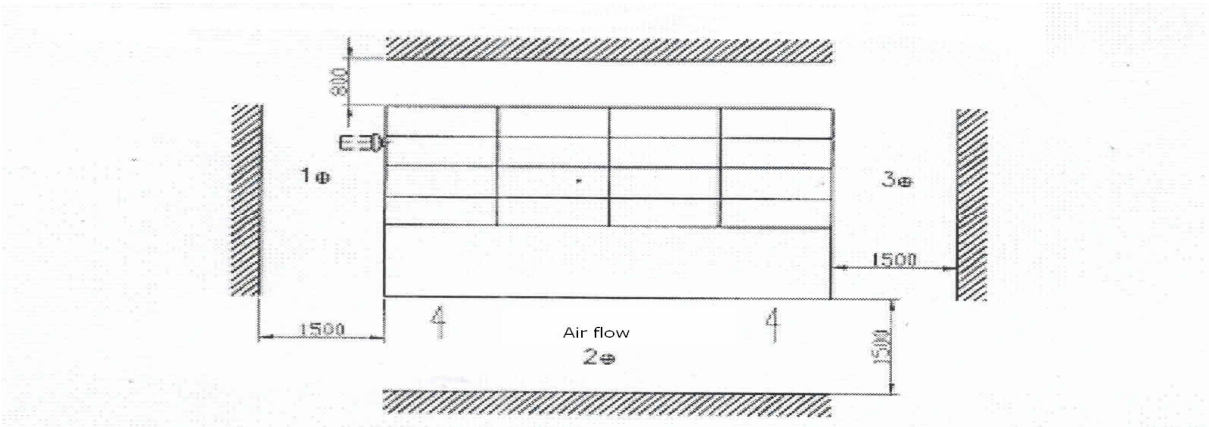


Fig. 2



Direction	Condenser loudness (dB)				
	Distance from condenser (m)				
	1	5	10	15	20
1	73	-	-	-	-
2	75	67	63	61	58
3	65	-	-	-	-

Fig. 3