

EVAPORATORI A FASCIO TUBIERO TIPO "TUBO FORCINATO"

SHELL & TUBE EVAPORATORS TYPE "U TUBE"



TIPOLOGIE DI PRODOTTO

Questa sezione del catalogo si riferisce alle serie di evaporatori tubi forcinati. Gli scambiatori di calore appartenenti a queste serie possono essere utilizzati in un ciclo frigorifero a compressione, con un fluido frigorifero (CFC – HCFC – HFC – HFO) che scorre ed evapora all'interno dei tubi scambiatori e fluido secondario acqua o altro (fluidi anticongelanti) che si raffredda all'esterno dei tubi e all'interno del mantello. Il disegno riproduce un evaporatore con la descrizione dei suoi componenti principali.

FLUIDI UTILIZZABILI

Gli scambiatori sono progettati in accordo ai limiti di pressione e temperatura e con i materiali descritti in seguito. I dati salienti dello scambiatore, in base all'art. 4 del capo 1 della direttiva 2014/68/UE sono riportati sulla targhetta dati che corredata l'unità.

MATERIALI IMPIEGATI

L'utilizzo dei materiali impiegati negli evaporatori è subordinato ai rigidi controlli qualitativi effettuati in base alla normativa PED (Dir. 2014/68/UE) ed alle Norme Europee che regolano e sovrintendono alla costruzione dei recipienti a pressione.

I componenti standard sono:

- acciaio al carbonio: testata, piastra tubiera, mantello e connessioni frigorifere ed idrauliche,
- rame lega C12200 – EN12452/SB359 con rigatura interna elicoidale adatta per tubi scambiatori,
- guarnizioni esenti amianto idonee all'impiego per refrigeranti CFC, HCFC, HFC, HFO,
- setti in plastica PVC,
- viti di fissaggio conformi alle temperature di utilizzo in acciaio legato.

TEST, QUALITÀ, RINTRACCIABILITÀ

I controlli vengono effettuati in base al manuale interno di qualità UNI EN ISO 9001 e specificatamente tutti gli evaporatori vengono sottoposti a:

- prova pressione lato refrigerante e lato acqua (coefficiente x 1,43),
- prova con liquidi penetranti (PT) sulle saldature secondo normativa,
- prova di pressione differenziata di ogni singolo circuito refrigerante,
- prova di tenuta con cercafughe a elio (valore max. accettato comparabile a 3 g/anno di R22).

Al termine del test, i circuiti refrigeranti vengono asciugati e protetti con degli assorbitori di umidità prima di essere spediti ai clienti. Ogni evaporatore viene identificato attraverso un numero di serie riportato sulla targhetta. È importante fare riferimento a questo numero in tutte le comunicazioni con WTK e riguardanti l'unità acquistata al fine di consentire una corretta e veloce rintracciabilità del prodotto.

MODELLI (espansione secca) SCE – DCE – TCE – QCE – SBE – DBE – TBE – QBE – SFE – DFE – TFE – QFE

Gli evaporatori di cui sopra hanno tubi preformati ad "U" che garantiscono una libera dilatazione del fascio rispetto al mantello e lo rendono completamente estraibile (a partire dal modello SCE – DCE 63 incluso) e con la possibilità di variare la posizione degli attacchi acqua (verticali, destri o sinistri). I setti intermedi sono posizionati in modo tale da permettere una velocità nominale del fluido compatibilmente con le perdite di carico dello stesso e per ridurre al minimo eventuali by-pass di fluido. Inoltre tali modelli possono essere realizzati con distanza setti differente per mantenere un'alta efficienza anche con basse portate, in modo particolare, con le miscele anticongelanti.

Le opzioni disponibili sono staffe saldate, connessioni lato acqua flangiate, isolamento termico ignifugo con spessore da 10mm a 40mm, resistenze elettriche adesive, tubi in acciaio inossidabile o Cu/Ni-90/10. Le serie _CE e _BE sono utilizzabili con vari tipi di refrigerante e sono disponibili anche per alte pressioni (45 bar), mentre la serie _FE è progettata ed ottimizzata per funzionare con R134a e HFO ed è anche disponibile in versione alta pressione (30 bar).

Tutti i modelli a catalogo possono essere realizzati in versione bassa temperatura (T° evap. = -45°C).

TYPES OF PRODUCT

This section of the catalogue refers to the evaporator series U-tube. This series of heat exchangers can be used as evaporators in a compressor-driven refrigerating cycle, with a coolant (CFC – HCFC – HFC – HFO) that flows and evaporates inside the exchanger tubes and a secondary fluid water or others (anti-freezing fluids) that cools on the outside of the tubes and inside the shell.

The drawing shows an evaporator with the description of its main components.

COMPATIBLE FLUIDS

The heat exchangers are designed according to the pressure and temperature limits and with the materials described herebelow. The main data of the heat exchanger, according to Art. 4 of Annex 1 of the European Directive 2014/68/UE, are indicated on the unit's name plate.

MATERIALS

The choice of the materials used in the evaporators is the result of strict quality checks carried out in compliance with the PED norm (Dir. 2014/68/UE) and the European norms regulating the construction of pressure vessels.

The standard components are:

- carbon steel: head, tube sheet, shell and refrigerant and water connections,
- copper alloy C12200 – EN12452/SB359 with inner finned surface suitable for exchanger pipes,
- asbestos free gaskets suitable for the use of HCFC, HFC, HFO refrigerants,
- PVC plastic baffles,
- bonded steel bolts fit for the temperatures generated during the use.

TEST, QUALITY AND IDENTIFICATION

All tests comply with the procedures of our internal quality manual UNI EN ISO 9001 and specifically all the evaporators undergo the following:

- pressure test refrigerant and water side (coefficient x 1,43),
- test with penetration liquids [PT] on the weldings according to the norms,
- separate pressure test for each single refrigerant circuit,
- hydrostatic test with the use of a helium leakage detector (accepted max. level of 3 g/year of R22).

Once the tests are over and before shipping, the refrigerant circuits are dried and protected against humidity by means of moisture absorber bags. Each evaporator is identified by a serial number shown on the name plate. Always refer to this number in all communications to WTK regarding the unit purchased, in order to ensure a correct and prompt product identification.

MODELS (dry-expansion) SCE – DCE – TCE – QCE – SBE – DBE – TBE – QBE – SFE – DFE – TFE – QFE

All the above evaporator models have the tube bundle composed of a series of pre-shaped "U" tubes enabling a free expansion of the bundle independently from the shell; in addition such bundle is removable (from model SCE – DCE 63 included). There is the possibility to change the position of the water connections (vertical, right or left). The baffles are positioned to enable a nominal velocity of the fluid compatible with the pressure drop which may occur and to reduce to the least possible any by-pass of fluid. Besides such models can be assembled with different distance between the baffles in order to grant high efficiency even when the flow rate is low, particularly with anti-freezing solutions.

The options available are welded feet, water connections flanged type, thermal insulation fireproof with thickness from 10mm to 40mm, adhesive electric heaters, tubes of stainless steel or Cu/Ni-90/10.

Series _CE and _BE can operate with various types of refrigerant and are also available for high pressure (45 bar), while the series _FE is designed and optimized to work with R134a and HFO and it is as well available for high pressure (30 bar).

All the models shown in the catalogue are available in low temperature execution (T° evap. = -45°C).

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INSTALLATION AND APPLICATION OF THE SHELL & TUBE EVAPORATORS

The units must be installed only by qualified personnel, considering that the evaporators are pressurised vessels and as such are ruled by the Directive PED 2014/68/UE relating to these appliances. The operator must therefore observe all the active and passive safety requirements defined by the above directive and local regulations.

For a correct functioning of our shell & tube evaporators it is necessary to follow some simple pre-cautions.

STORAGE, HANDLING AND POSITIONING

1. While waiting for the installation, the evaporator must be stored in a dry sheltered place, at temperatures no lower than +4°C. Avoid sites where condensation may form inside the heat exchanger, due to temperature variations during the day.
2. The unit can be handled by using the lifting rings located on the shell or using elastic hoisting straps positioned at the sides of the exchanger.
3. Remove the anti-moisture bags, inserted at the end of the manufacturing process inside the refrigerant head (refrigerant outlet connections) in order to keep the refrigerant circuit dry.
4. Install the evaporator in horizontal position as non-horizontal installations may considerably affect the performance.
5. For outdoor installation, take suitable measures to protect the pressure vessel against atmospheric corrosion and low outside temperatures.

GENERAL INSTRUCTIONS FOR CORRECT OPERATION

1. Check, before the start-up, the torque of the bolts of the refrigerant head (see table of tightening torque for screws).
2. Do not reverse the water inlet and outlet in order not to decrease the evaporator performance or cause excessive vibrations of the tube bundle.
3. Do not expose the evaporator to excessive vibrations, installing vibration dampers near the refrigerant and water connections of the heat exchanger and of its supports/structure.
4. Take proper precautions (vibration dampers) so to avoid the transmission of the vibrations to the heat exchanger when the exchanger is installed as a support element of the compressor.
5. Avoid foreign particles (particularly debris, dirt or solid particles) to enter into the water circuit by applying suitable filters with a mesh size of max. 1,5mm. Filters must be fitted on the water side in the pump intake line to prevent sediments such as welding residues and solid particles from entering the shell side and damaging the tubes of the exchanger.
6. Analyze the water checking its compatibility with the materials of the heat exchanger before using the evaporator (especially in open circuits) also to reduce accidental corrosion.
The quality of the water, for the reasons described above, may significantly influence the operation and the life of the exchanger. Secondary fluids consisting of water and ethylene or propylene glycol solutions are generally not corrosive, unless contaminated by other substances.
Before using any other secondary fluid, check with WTK.
7. Always use waters or anti-freezing inhibited mixtures compatible with the materials of the evaporator, check the fluids from time to time and do not run the unit with temperatures near the freezing point, otherwise increase the percentage of anti-freezing. Install always in one of the service sockets, located in the water connections, an anti-freezing sensor.
8. On the refrigerant side, a minimum pressure switch is required; if the pump-down function is featured, also a timer should be installed to prevent extended pressure and temperature drops.
9. Avoid the use of the evaporator with waters containing chlorine (max. = 3 p.p.m.) when the unit is manufactured with standard materials

10. Avoid exceeding the max. flow rate “Mm” shown in the catalogue, as this may cause excessive vibrations and damages to the exchanger. In the case of parallel connections to other refrigerating units or systems with complex loop cycles, consider the maximum flow rate value, even if temporary, for the exchanger.

11. The operating pressure and temperature on the refrigerant side and water side of the system must comply with the maximum values shown on the evaporator's name plate.

12. During the filling of the water circuit, pay attention to discharge totally the air in the shell

13. Pay attention to discharge all the air from the circuit and evaporator, checking the presence of an adequate counter-pressure at the water outlet of the evaporator so not to let the drain free and to cause inside the evaporator a pressure drop at least equal to the catalogue or calculation one (if in open circuit it is better to install at the water outlet a regulation and calibration valve)

14. Between the thermostatic valve and the refrigerant inlet connection, install a straight section of tubing around 8-10 times longer than its diameter. The presence of any curves may affect the performance of the exchanger. If the valve is supplied with not completely liquid refrigerant it may reach unstable conditions, with continuous fluctuations: also this valve behaviour negatively affects the performance of the exchanger.

15. In order to avoid the ice formation, we advise a temperature approach of 5K with an evaporation temperature > -1°C

16. Do not operate with a superheating < 3K in order to guarantee a complete gas evaporation

17. Leave the evaporator totally full of water or totally empty if not in operation for long time

18. In case the shell needs to be emptied be sure that all the water is completely drained; never leave the evaporator partially loaded with water

19. Avoid, in open circuit, the water drainage of the evaporator during the pump stop

20. Avoid the cavitation of the pump and the presence of gas in the hydraulic circuit

21. Do not set partial loads (refrigerant side) lower than 50% of the total duty of the compressor, if necessary contact WTK

CLEANING OF THE HEAT EXCHANGERS

1. Evaporator mechanical cleaning - with opening and disassembling

Cleaning operations can help in keeping at high level the efficiency of the heat exchangers. Anyway, cleaning systems which may result in being too aggressive for the tubes have to be avoided.

Dismounting the refrigerant header, it is possible to remove the tube bundle (series U-Tubes). A specific procedure is available in case this operation should be performed, indicating disassembly instructions, tightening torque for the screws and torque procedure (contact WTK). New gaskets are required. Extract the tube bundle and carefully clean it with a water jet spray. Clean the inside of the shell.

2. Evaporator chemical cleaning - without opening and disassembling

Excluding the water circuit of the plant from the evaporator, you can do some chemical cleaning through the forced circulation of specific products for the removal of deposits or fouling agents; in this case it is important to select the right product for the specific agent to clean and therefore to follow the chemical product indications. If the deposit is non-organic, we recommend a product like P3 T288 by Henkel. If not available or in emergency cases, some soft acids such as formic acid, citric acid, acetic acid, ossalic acid or phosphoric acid can be used as well, as long as their solution in water is about 5%. After the cleaning with such acids, it is extremely important to rinse the heat exchanger with clean water for at least 30 minutes. Then discharge all the water inside the shell.

ATTENTION: never use strong inorganic acids as the nitric acid, sulphuric acid that can corrode the heat exchanger.

STARTING THE PLANT

1. Before starting the system, make sure the absorbent fillers have been removed.
2. When filling the exchanger with water, make sure the air is vented through the service connection on the bottom at the rear, or through the water connections. Careful attention must be paid when starting the system to ensure that there is no air inside the exchanger: the presence of air bubbles in the water may damage the tubes. In the case of water connections to open circuits, prevent air from entering the exchanger when the pumps are off: the presence of air will cause corrosion and damage the exchanger. The layout of the water piping must be designed so as to avoid the downflow of water from the exchanger, and consequently the inlet of air when the pumps are off.

MAINTENANCE OF THE EVAPORATOR

1. For the optimum maintenance of the exchanger components, periodical checks should be carried out by qualified personnel. The necessity and frequency of such checks depends on the operation of the exchanger over time.
2. Use suitable calibrate torque wrenches.

CHECK	FREQUENCY
Evaporator head screw tightening torque	Check at the starting of the plant and then at regular time intervals upon the operating time; Max every 2 years
Connection screws tightening torque	
Check the status of the seals on the head	

TABLE OF TIGHTENING TORQUE FOR SCREWS

Tipo di vite		M5	M6	M8	M10	M12	M14	M16	M20	M22	M24
 wrench TE- screws	mm	-	-	13	17	19	22	24	30	32	36
 wrench TC screw	mm	5	5	6	8	10	-	14	17	-	-
TIGHTENING TORQUE	Nm	6	10	25,5	35/50	87	130	210	410	600	750
	Kg*m	0,61	1	2,6	3,6/5	8,9	13,2	21,5	42	61	77

SUGGESTIONS FOR A CORRECT SELECTION

In the shell & tube evaporators, deposits of various substances external to the tubes between the baffles are an effect that must necessarily be considered when selecting the product. The fouling factor (f. f.) is thus a fundamental value for a correct choice of an evaporator. We therefore advise to choose the right value based on the following parametres.

- Normal fresh water in closed circuit	f.f. = 0,000043 m ² K/W
- Water in open circuit	f.f. = 0,000086 m ² K/W
- Glycol solutions < 40%	f.f. = 0,000086 m ² K/W
- Glycol solutions > 40%	f.f. = 0,000172 m ² K/W

The table herebelow shows, as function of the freezing point, the percentages in weight of the main anti-freezing mixtures.

FREEZING POINT	ETHYLEN GLYCOL	PROPYLEN GLYCOL	TYFOXIT
°C	% (mass)	% (mass)	% (g/cm ³)
-10	24	24	40 (1.10)
-20	36	36	50 (1.15)
-30	46	46	68 (1.17)
-40	53	53	80 (1.20)

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MODEL PART. No. SERIAL No.
MODELLO CODICE N° FABBRICA

TUBES SIDE - LATO TUBI
bar bar °C dm³
- Ps - - Pt - - Ts - - V - FLUID

SHELL SIDE - LATO MANTELLO
bar bar °C dm³
- Ps - - Pt - - Ts - - V - FLUID

PERMITTED REF. - REF. AMMESSI
CFC - HCFC - HFC - HFO

PED CATEGORY Gr.1 PED CATEGORY Gr.2 YEAR - ANNO

MADE IN ITALY

CE
NOTIFIED BODY
0948

ISO 9001

