SCHMÖLE

Truco® High Performance Coaxial Condensers for Heat Pumps and Refrigeration Units

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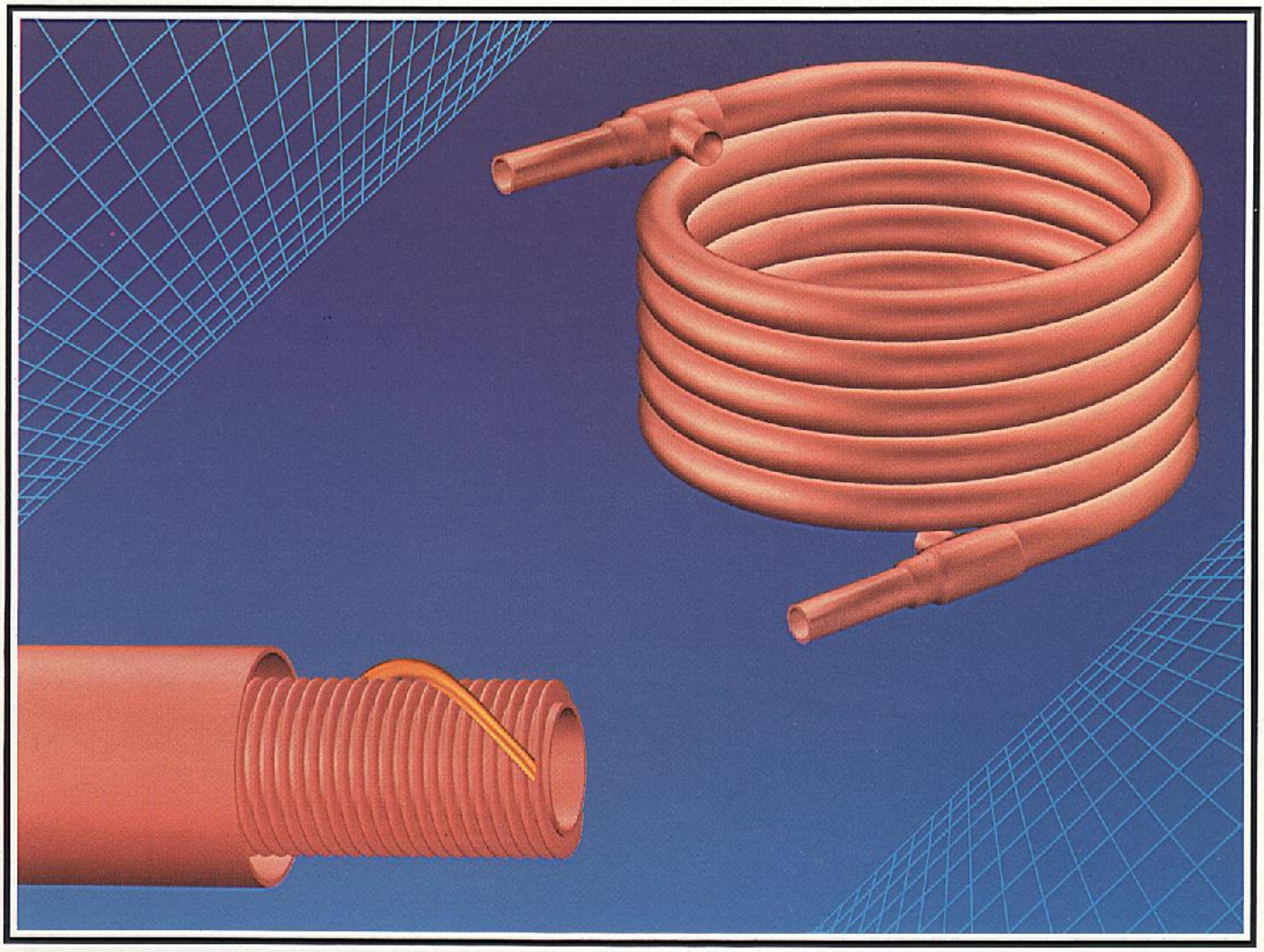


- High condensing capacity using Trufin® S/T Finned Tubes
- High cooling medium outlet temperatures using the advantageous counterflow principle
- Optimum refrigerant flow by locating the inner tubes in the centre of the outer shell tubes by means of distance pieces
- Simple construction, therefore more economical than shell-and-tube condensers
- Corrosion resistant copper construction

Truco® High Performance Coaxial Condensers

Application

Truco High Performance Coaxial Condensers are used in

- Heat pumps
- Refrigeration and air-conditioning units
- Heat recovery units
- Air conditioner cabinets
- Temperature stabilizers

for cooling and condensing of refrigerants.

Description

The Truco High Performance Coaxial Condensers manufactured by KM-Schmöle are equipped with Trufin® S/T Finned Tubes produced by a rolling process from seamless tubes. Heat transfer from the condensing refrigerant to the tube wall is greatly improved by the increased outside surface area of the Trufin S/T Finned Tubes.

The optimum heat transfer of the KM-Schmöle Truco High Performance Coaxial Condensers is achieved by the application of Trufin S/T Finned Tubes and by special design of the flow path of the refrigerant and the water. Furthermore the counterflow principle for improved heat transfer is applied. It permits an extensive exploitation of the superheat of the hot refrigerant vapour and a subcooling of the liquid refrigerant.

Truco High Performance Coaxial Condensers are constructed – dependent on size – of one or three Trufin S/T Finned Tubes in a plain outer shell tube. This tube system is bent into coils and spirals.

The superheated refrigerant vapour flowing in the free space between the outer shell tube and the finned inner tubes cools down firstly and then condenses on the outside surface of the Trufin S/T Finned Tubes. The condensate thus developed flows to the free space at the bottom of the system.

The cooling medium, e. g. the domestic or central heating water to be heated, flows in the inner tubes according to the counterflow principle, whereby, together with the exploitation of superheat, high water outlet temperatures – possibly above the condensing temperature – and a thorough subcooling of the condensate are obtained.

In order to achieve an optimum refrigerant flow and also to avoid any vibration between the inner and outer tube, the inner tubes are located in the centre of the outer shell tube by means of distance pieces. In condensers having three inner tubes the contact of the tubes between one another is avoided by means of a formed strip.

All KM-Schmöle Truco High Performance Coaxial Condensers with one inner tube are equipped with T-pieces at the connection ends. They have no brazing joint between shell and tube side and correspond to DIN 1988, Part 4, regarding heating of drinking water.

KM-Schmöle Truco High Performance Coaxial Condensers with three inner tubes are brazed according to procedures approved by AD*-Merkblatt HP 5/2.

* AD = Arbeitsgemeinschaft Druckbehälter
(German Pressure Vessel Association)

For a range of capacity up to about 56 kW KM-Schmöle supply 8 standard condensers, all 8 in coil form (WT) and 4 in spiral form (ST) available from stock.

Truco High Performance Coaxial Condensers in spiral form are particularly suitable for parallel connections because of their low construction height.

Dimensions and nominal capacities of the standard condensers can be taken from diagram 1.

Materials and range of application

For Truco High Performance Coaxial Condensers the following materials are used:

Component	Copper construction		Cupro-nickel construction	
	Material	Standard	Material	Standard
Outer shell tube	SF-Cu	DIN 1787	SF-Cu	DIN 1787
Trufin S/T tube	SF-Cu	DIN 1787	CuNi10Fe1Mn	DIN 17664
T-pieces	SF-Cu	DIN 1787	SF-Cu	DIN 1787
Sleeves, Tube plates*	SF-Cu	DIN 1787	CuNi10Fe1Mn	DIN 17664
Refrigerant connections	SF-Cu	DIN 1787	SF-Cu	DIN 1787
Cooling medium connections	SF-Cu	DIN 1787	CuNi10Fe1Mn	DIN 17664
Brazing solder	L-Ag2P	DIN 8513	L-Ag45Sn	DIN 8513

* in case of condensers with 3 inner tubes

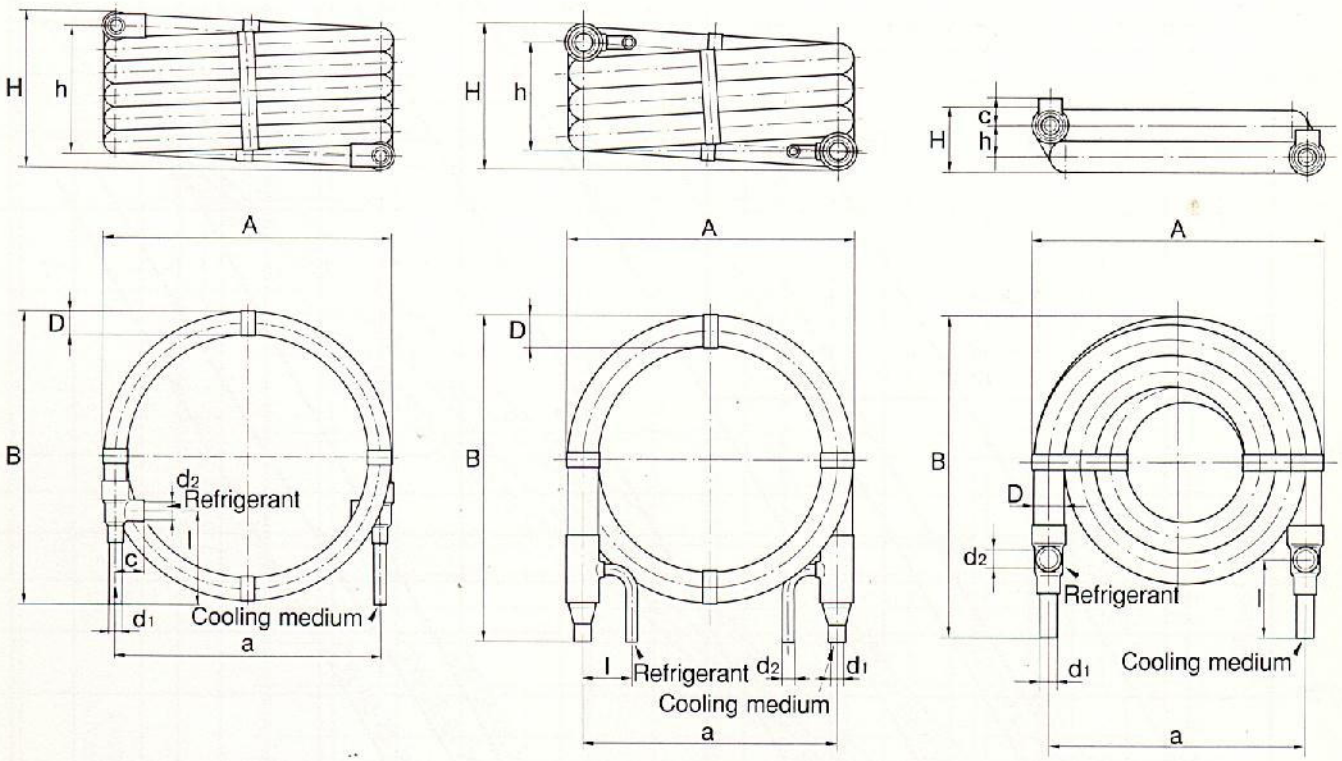
Truco High Performance Coaxial Condensers from copper are suitable for cooling and condensing of refrigerants by cooling media such as domestic water, circuit water and ground water. In case of higher exposure to corrosion – e. g. for swimming pool water, sea water or water from rivers and lakes – the cupro-nickel construction can be used. The suitability of the cooling medium used for the material chosen (copper or cupro-nickel) must be verified by the user for the individual case.

Due to special regulations in some countries the direct connection of condensers to drinking water lines or their use for domestic hot water heating may be restricted. This refers to standard condensers of the types K 15-30 WT and K 25-50 WT.

Working condition	Permissible range of application	
	Shell side	Tube side
Pressure	≤ 25 bar	≤ 16 bar
Temperature	≤ 140 °C	≤ 90 °C

Insulation jackets

In order to obtain a better heat efficiency it is recommended to equip the Truco High Performance Coaxial Condensers with insulation. On request KM-Schmöle can supply suitable insulation jackets from Armaflex for the standard condensers K 3-5 WT to K 15-30 WT.



Coil form (1 inner tube)
K 1-3 WT K 7-13 WT
K 3-5 WT K 11-19 WT
K 5-9 WT K 20-40 WT

Coil form (3 inner tubes)
K 15-30 WT
K 25-50 WT

Spiral form (1 inner tube)
K 3- 5 ST
K 5- 9 ST
K 7-13 ST
K 11-19 ST

Truco Coaxial Condenser	Nominal capacity*	Water flow rate	Connection dimensions		Assembly dimensions								Approx. weight
			Cooling medium	Refrigerant									
	$\dot{Q}_k$ kW	$\dot{V}_w$ m³/h	d_1 mm	d_2 mm	A mm	B mm	H mm	a mm	c mm	h mm	l mm	D mm	$G_{Cu/CuNi}$ kg
Coil form (1 inner tube)													
K 1- 3 WT	3.5	0.6	15	15 I.D.	240	245	90	210	19	55	90	22	2.1
K 3- 5 WT	5	0.6	15	15 I.D.	310	315	110	280	19	77	100	22	3.8
K 5- 9 WT	9	1.0	18	18 I.D.	330	325	180	295	22	143	105	26	7.5
K 7-13 WT	14	1.4	22	22 I.D.	360	355	310	315	29	263	110	35	16.0
K 11-19 WT	20	2.0	28	28 I.D.	500	545	305	450	42	254	120	39	25.2
K 20-40 WT	39	3.9	35	35 I.D.	525	555	390	460	45	325	140	50	41.6
Coil form (3 inner tubes)													
K 15-30 WT	30	4.0	35 I.D.	28	500	545	260	430	–	189	80	54	28.8
K 25-50 WT	56	6.0	42 I.D.	28	600	655	420	520	–	341	80	62	74.0
Spiral form (1 inner tube)													
K 3- 5 ST	5	0.6	15	15 I.D.	320	360	55	288	19	22	100	22	3.8
K 5- 9 ST	9	1.0	18	18 I.D.	445	460	65	408	22	26	105	26	7.5
K 7-13 ST	14	1.4	22	22 I.D.	555	600	85	508	29	35	110	35	16.0
K 11-19 ST	20	2.0	28	28 I.D.	690	730	90	640	42	39	120	39	25.2

* based on the following working data:

- Refrigerant = R 22
- Condensing temperature ϑ_k = 45 °C
- Condensate subcooling $\Delta\vartheta_u$ = 5 K
- Cooling medium = Water
- Water inlet temperature ϑ_{we} = 35 °C

Diagram 1:
Dimensions and nominal capacities of the Truco High Performance Coaxial Condensers

Construction requirements

When installing Truco High Performance Coaxial Condensers in heat pumps and refrigeration units the relevant requirements and the actual operating conditions have to be respected.

When using condensers as desuperheaters, the nominal capacity of the heat pump or the refrigeration unit must be used for the determination of the condenser size. For this application we recommend our HGW Tube Coil Heat Exchanger (hot gas heat exchanger) especially developed for cooling of superheated refrigerant vapour.

In order to obtain the indicated condensing capacities, the condensers have to be mounted horizontally. The refrigerant vapour line must be connected to the top of the condenser. In addition, horizontal installation of the condensers permits draining.

To protect the condenser against unacceptable stresses, it is recommended to install a compensator (vibration absorber) and a muffler (sound absorber) between compressor and condenser.

The refrigerant and cooling medium side connections of the condensers are suitable for capillary brazing to commercial tubes to DIN 1786 and DIN 59753. Brazing of connections must be carried out with all necessary care and low melting point brazing solders.

Corrosion protection for mixed installations

If copper comes into contact with water, copper ions are released to the water, which may immediately provoke corrosion damage to galvanized steel tubes down stream of the copper. However, all copper components are protected from this danger by a tenacious layer formed on the surface after a short time.

In order to reduce the susceptibility to corrosion in connection with mixed installations, Truco High Performance Coaxial Condensers with one inner tube are supplied on request with a chemical tin layer on the cooling medium side. In this case the condensers are equipped with threaded terminal ends on the cooling medium side and, if not yet provided, connection tubes on the refrigerant side.

Testing

The Truco High Performance Coaxial Condensers are subjected to a nitrogen pressure of 28 bar on the refrigerant side. Furthermore, the condensers with three inner tubes are helium leak tested.

Approval

For drinking water installations, Truco High Performance Coaxial Condensers are approved by the SVGW* by Test Report No. 9007-2465 according to Regulation W/TPW 101.

* SVGW = Schweizerischer Verein des Gas- und Wasserfaches (Swiss Association of the Gas and Water Field)

Thermal design

By means of graph No. 1 the transferable condensing capacity $\dot{Q}_k$ can be determined. This graph is based on our own measurements and was established for the refrigerant R 22, a condensing temperature of ϑ_k = 45 °C and the cooling medium water.

For conversion into the refrigerants R 12 / R 134a or R 502 and other condensing temperatures the conversion factors f_k of the following table can be used:

Conversion factors f_k				
Refrigerant	Condensing temperature ϑ_k			
	35 °C	45 °C	55 °C	60 °C
R 12, R 134a	0.96	0.93	0.88	0.85
R 502, R 22	1.04	1.00	0.95	0.93

The real condensing capacity is then given by the following equation:

$$\dot{Q}_{eff} = f_k \cdot \dot{Q}_k \text{ [kW]}$$

For the different Truco High Performance Coaxial Condensers the curves in graph No. 1 have been limited to a water flow velocity v_i of 0.5 to 1.8 m/s. The upper limit corresponds to the recommended maximum flow velocity of water in copper tubes.

When using condensers of CuNi10Fe1Mn a higher water flow velocity is permitted. For this case the corresponding curves (dotted lines) have been extended to a flow velocity v_i of 2.5 m/s.

Pressure drop

The water side pressure drop Δp_w of the Truco High Performance Coaxial Condensers being a function of the water flow rate $\dot{V}_w$ can be taken from graph No. 2. As can be seen from this graph, the water side pressure drop is generally below 0.2 bar.

Example of a thermal design

The following working data is given:

- Refrigerant = R 12
- Condensing temperature ϑ_k = 35 °C
- Condensing capacity $\dot{Q}_{eff}$ = 14.4 kW
- Cooling medium = Water
- Water inlet temperature ϑ_{we} = 20 °C

First of all it must be considered that the curves in graph 1 have been established for the refrigerant R 22 at a condensing temperature of ϑ_k = 45 °C. Therefore, in order to use this graph, it is necessary to divide the condensing capacity by the value f_k = 0.96 (see table).

This results in an apparent condensing capacity of $\dot{Q}_k$ = 15 kW.

Starting from this condensing capacity and the temperature difference $\vartheta_k - \vartheta_{we}$ of 15 K it results from graphs 1 and 2:

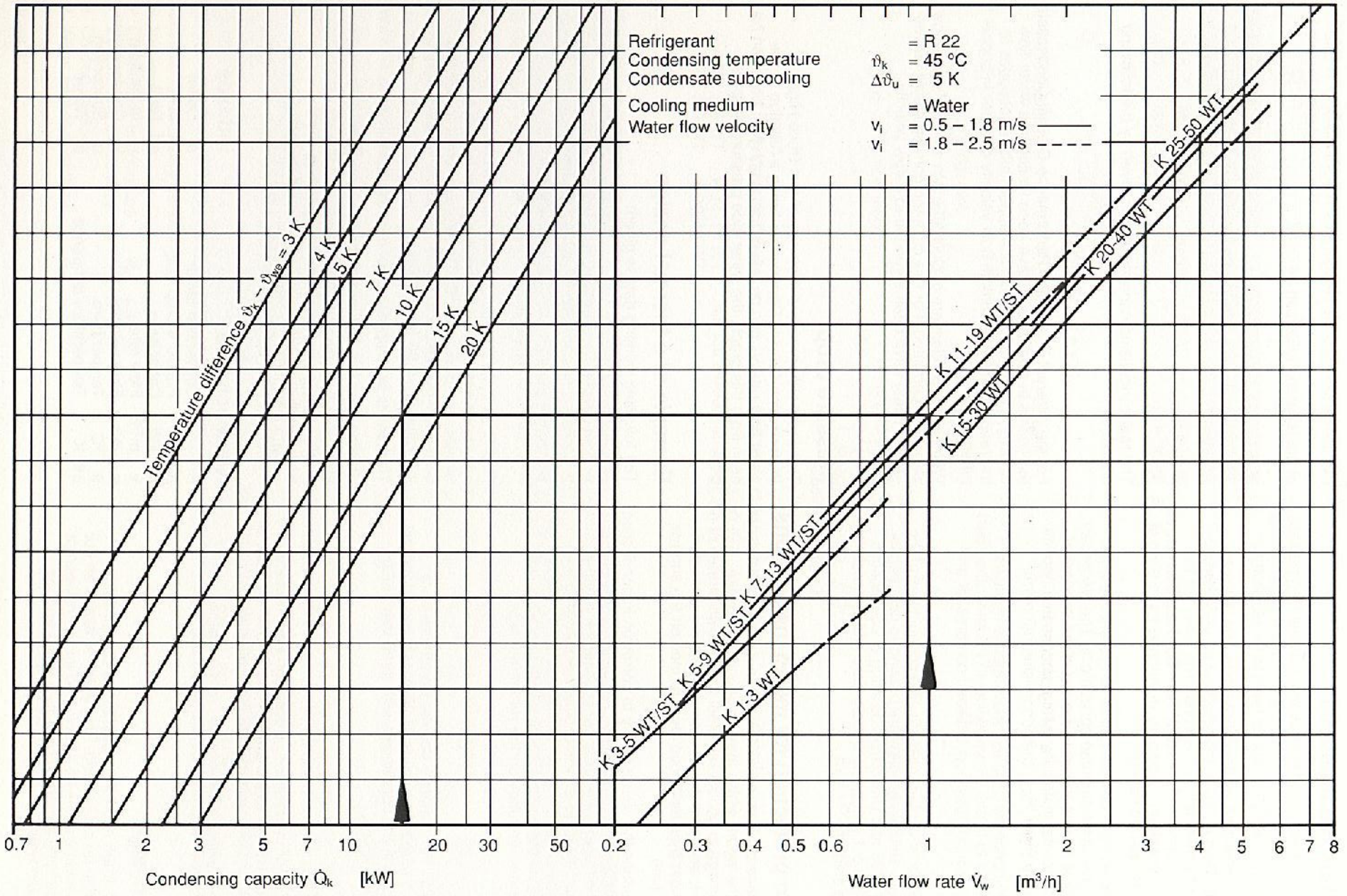
- Condenser type = K 7-13 WT
- Water flow rate $\dot{V}_w$ = 1.0 m³/h
- Water side pressure drop Δp_w = 0.12 bar

Nomenclature

f	–	Conversion factor
Δp	bar	Pressure drop
$\dot{Q}$	kW	Capacity
$\dot{V}$	m³/h	Flow rate
v	m/s	Flow velocity
ϑ	°C	Temperature
$\Delta\vartheta$	K	Temperature difference

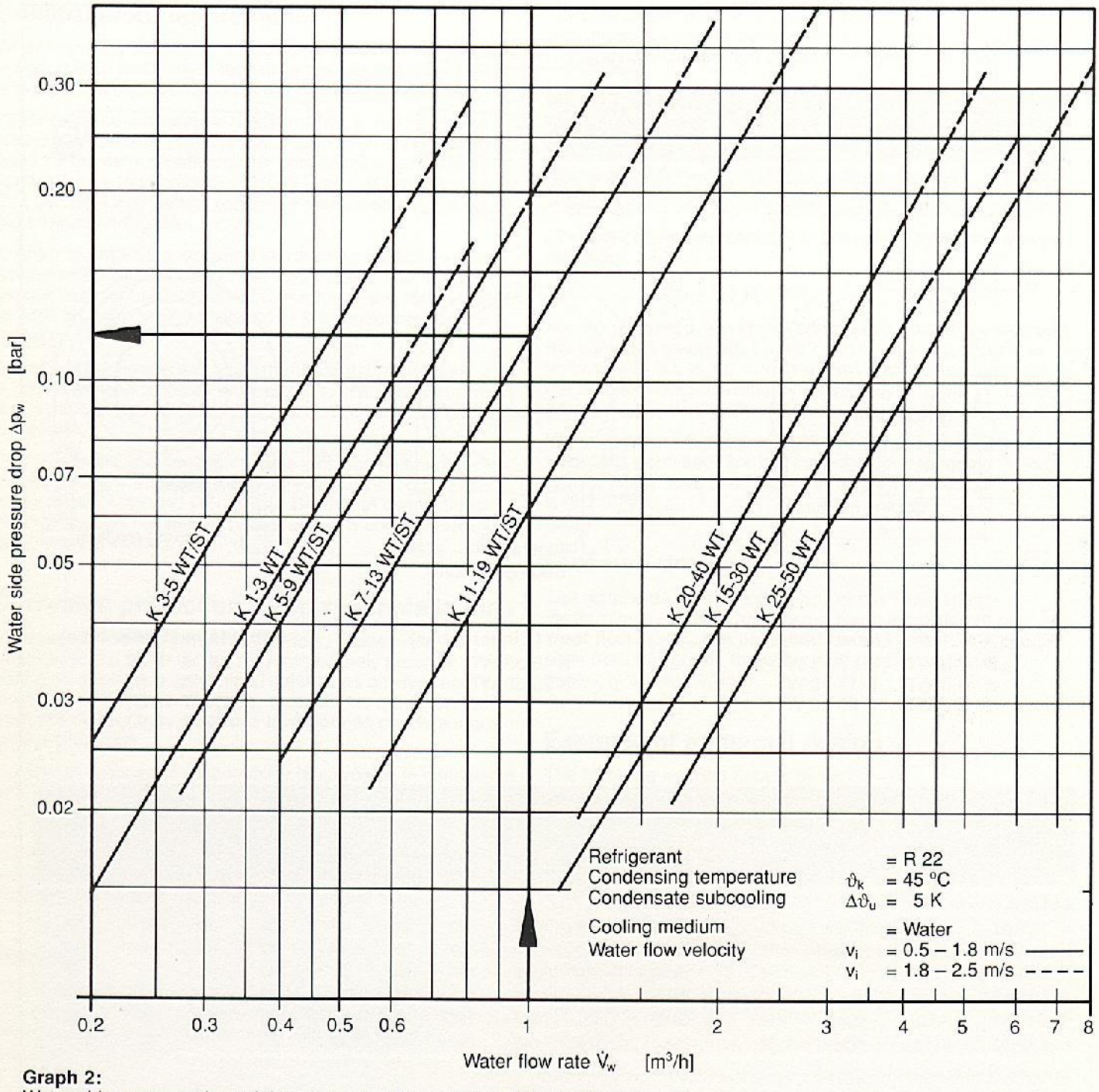
Indexes

a	Outlet
e	Inlet
eff	Real
i	In the tube
k	Condensation
u	Subcooling
w	Water



Graph 1:
Condensing capacity of the Truco High Performance Coaxial Condensers

Truco® High Performance Coaxial Condensers



Graph 2:
Water side pressure drop of the Truco High Performance Coaxial Condensers

Tube Coil Condensers LRK with cylindrical shell see leaflet No. 879 e!

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