Water to Water
Heat Exchanger

A shell and tube heat exchanger is a class of heat exchanger designs. It is the most common type of heat exchanger in oil refineries and other large chemical processes, and is suited for higher-pressure applications. As its name implies, this type of heat exchanger consists of a shell (a large pressure vessel) with a bundle of tubes inside it. One fluid runs through the tubes, and another fluid flows over the tubes (through the shell) to transfer heat between the two fluids. The set of tubes is called a tube bundle, and may be composed of several types of tubes: plain, longitudinally finned, etc.

Two fluids, of different starting temperatures, flow through the heat exchanger. One flows through the tubes (the tube side) and the other flows outside the tubes but inside the shell (the shell side). Heat is transferred from one fluid to the other through the tube walls, either from tube side to shell side or vice versa. The fluids can be either liquids or gases on either the shell or the tube side. In order to transfer heat efficiently, a large heat transfer area should be used, leading to the use of many tubes. In this way, waste heat can be put to use. This is an efficient way to conserve energy. Heat exchangers with only one phase (liquid or gas) on each side can be called one-phase or single-phase heat exchangers. Two-phase heat exchangers can be used to heat a liquid to boil it into a gas (vapor), sometimes called boilers, or cool a vapor to condense it into a liquid (called condensers), with the phase change usually occurring on the shell side.

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PACKMAN Heat Exchanger Properties

Shell and tube Heat Exchangers of PACKMAN Company are U-TYPE and Duplex with Copper Coil. The manufacturing method is based on the ASME VIII DIV.1 & THEMA CLASS C standards for the transfer of heat between two fluids (steam to water or water to water). The design and construction of exchangers are analyzed, designed and tested via relevant engineering software.
PACKMAN heat exchanger are made in different diameters of 6 inches to 30 inches, according to the customer's request.
In U-TYPE exchangers, the hot fluid enters the tube and the cold fluid enters. The shell material is steel based on the standard. The shell material could be stainless steel as requested by the customer. The pipe is the best-quality of seamless copper pipes to achieve the highest heat transfer coefficient.
The diameter of the pipes used in the exchanger is 3/4 inches and is designed with thicknesses based on working pressure and triangular layout.
In this type of exchangers, the connection of pipes to the tube-sheet is waltz and there is the ability to replace tubes in the exchangers.

The exchangers cap with diameter of 14-inch of PACKMAN are made of cast iron. Water flows (input and output) are in parallel. Higher diameter exchangers are made of steel cap and water flows are perpendicular.

Design of heat exchanger

Design of these types of exchangers is done via engineering software or upon request of the customer.
In order to optimize the heat exchanger design, it is necessary to specify characteristics such as the hot fluid flow rate, the inlet and outlet temperature of the hot fluid, the flow of the heat exchanger and the inlet and outlet temperature of the heat exchanger or heat transferable heat exchanger. In order to use heat exchangers with a fluid other than water, the design of the exchanger should be based on this fluid.

hermal design of a shell and tube heat exchanger typically includes the determination of heat transfer area, number of tubes, tube length and diameter, tube layout, number of shell and tube passes, type of heat exchanger (fixed tube sheet, removable tube bundle etc.), tube pitch, number of baffles, its type and size, shell and tube side pressure drop etc.

Shell is the container for the shell fluid and the tube bundle is placed inside the shell. Shell diameter should be selected in such a way to give a close fit of the tube bundle. The clearance between the tube bundle and inner shell wall depends on the type of exchanger. Shells are usually fabricated from standard steel pipe with satisfactory corrosion allowance. The shell thickness of 3/8 inch for the shell ID of 12-24 inch can be satisfactorily used up to 300 psi of operating pressure.

Tube OD of and 1 are very common to design a compact heat exchanger. The most efficient condition for heat transfer is to have the maximum number of tubes in the shell to increase turbulence. The tube thickness should be enough to withstand the internal pressure along with the adequate corrosion allowance. The tube thickness is expressed in terms of BWG (Birmingham Wire Gauge) and true outside diameter (OD). The tube length of 6, 8, 12, 16, 20 and 24 ft are preferably used. Longer tube reduces shell diameter at the expense of higher shell pressure drop. Stainless steel, admiralty brass, copper, bronze and alloys of copper-nickel are the commonly used tube materials.

The number of passes is chosen to get the required tube side fluid velocity to obtain greater heat transfer co-efficient and also to reduce scale formation. The tube passes vary from 1 to 16. The tube passes of 1, 2 and 4 are common in application. The partition built into exchanger head known as partition plate (also called pass partition) is used to direct the tube side flow.

Product Capacity Calculation & Selection:

Shell and tube heat exchanger is designed by trial and error calculations. The main steps of design following the Kern method. Engineering software could be used to help the designers. Once the correct type of exchanger has been chosen, the engineering staff of the supplier will need to make sure that the model supplied is correctly sized for the job. The basic heat design equation, which has been widely used for many years, is:

$$Q = U A \Delta t_m$$

Where:

Q is the rate of heat transfer between the two fluids in the heat exchanger

U is the overall heat transfer coefficient. This depends on the conductive properties of the fluids and the heat exchanger material

A is the heat transfer surface area

Δt_m is the log mean temperature difference, calculated from the inlet and outlet temperatures of both fluids.

The value of U is harder to calculate:

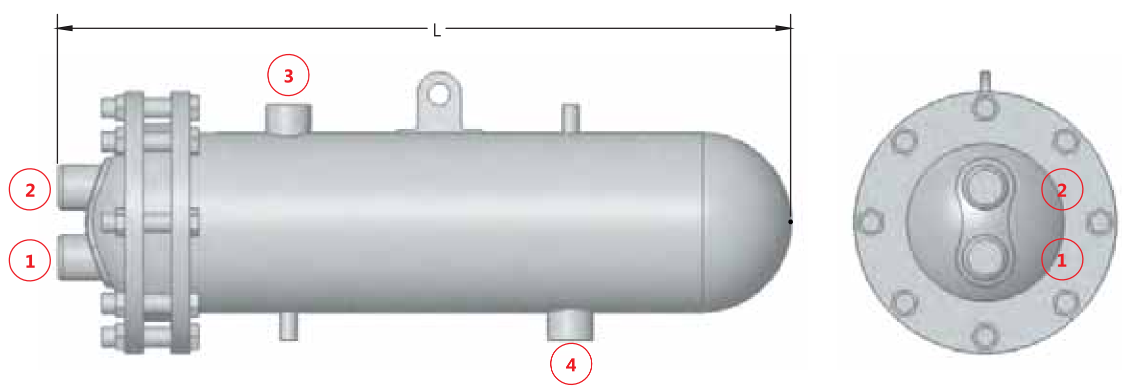
$$U = \frac{1}{\frac{1}{h_1} + R_{f1} + R_w + \frac{1}{h_2} + R_{f2}}$$

h1 and h2 are the partial heat transfer coefficients, W/m2.oK (tube and shell side)

Rw is the thermal resistance of the wall, m2.oK /W

Rf1 and Rf2 are the fouling factors, m2.oK /W (tube and shell side)

While the values for Rf are usually specified by the client, the values of h and Rw can be influenced directly by the designer depending on the choice of tube size and thickness, and the materials used for construction. The values of the partial heat transfer coefficients h depend greatly on the nature of the fluids but also, crucially, on the geometry of the heat transfer surfaces with which they are in contact. Importantly, the final values are heavily influenced by what happens at the level of the boundary layers: the fluid actually in contact with the heat transfer surface. The driving force for heat transfer is the difference in temperature between the two elements. In the case of a tubular heat exchanger, the temperature of the two fluids changes as they pass through the heat exchanger.



Model	Tube Sheet Size	Heating Surface (sq ft)	Water Inlet	Water Outlet	Hot water inlet	Hot water outlet	Total Length (MM)	Total Weight (KG)
PHXW-65	6"	5'	2"	2"	2"	2"	600	52
PHXW-67		7.5'	2"	2"	2"	2"	650	59
PHXW-610		10'	2"	2"	2"	2"	1050	67
PHXW-612		12.5'	2"	2"	2"	2"	1300	74
PHXW-615		15'	2"	2"	2"	2"	1500	82
PHXW-617		17.5'	2"	2"	2"	2"	1700	92
PHXW-620		20'	2"	2"	2"	2"	1950	99
PHXW-622		22.5'	2"	2"	2"	2"	2200	107
PHXW-820	8"	20'	2"	2"	2"	2"	1100	105
PHXW-830		30'	2"	2"	2"	2"	1550	128
PHXW-835		35'	2"	2"	2"	2"	1650	140
PHXW-840		40'	2"	2"	2"	2"	1850	150
PHXW-1035	10"	35'	2,1/2"	2,1/2"	3"	3"	1150	161
PHXW-1040		40'	2,1/2"	2,1/2"	3"	3"	1300	171
PHXW-1045		45'	2,1/2"	2,1/2"	3"	3"	1500	185
PHXW-1050		50'	2,1/2"	2,1/2"	3"	3"	1600	192
PHXW-1055		55'	2,1/2"	2,1/2"	3"	3"	1700	203
PHXW-1260	12"	60'	3"	3"	3"	3"	1400	225
PHXW-1270		70'	3"	3"	3"	3"	1600	306
PHXW-1280		80'	3"	3"	3"	3"	1800	328
PHXW-1290		90'	3"	3"	3"	3"	1900	342
PHXW-12100		100'	3"	3"	3"	3"	2100	364
PHXW-1480	14"	80'	3"	3"	3"	3"	1550	299
PHXW-1490		90'	3"	3"	3"	3"	1600	319
PHXW-14100		100'	3"	3"	3"	3"	1700	334
PHXW-14110		110'	3"	3"	3"	3"	1900	359
PHXW-14120		120'	3"	3"	3"	3"	2000	374

Model	Tube Sheet Size	Heating Surface (sq ft)	Water Inlet	Water Outlet	Hot water inlet	Hot water outlet	Total Length (MM)	Total Weight (KG)
PHXW-16100	16"	100'	4"	4"	4"	4"	1450	281
PHXW-16110		110'	4"	4"	4"	4"	1560	295
PHXW-16120		120'	4"	4"	4"	4"	1660	307
PHXW-16130		130'	4"	4"	4"	4"	1760	319
PHXW-16140		140'	4"	4"	4"	4"	1860	331
PHXW-16150		150'	4"	4"	4"	4"	1960	343
PHXW-16160		160'	4"	4"	4"	4"	2060	355
PHXW-18140	18"	140'	4"	4"	4"	4"	2140	420
PHXW-18150		150'	4"	4"	4"	4"	2200	412
PHXW-18160		160'	4"	4"	4"	4"	2240	436
PHXW-18170		170'	4"	4"	4"	4"	2340	449
PHXW-18180		180'	4"	4"	4"	4"	2440	461
PHXW-18190		190'	4"	4"	4"	4"	2500	471
PHXW-18200		200'	4"	4"	4"	4"	2540	480
PHXW-18210		210'	4"	4"	4"	4"	2700	492
PHXW-20200	20"	200'	6"	6"	8"	8"	2330	514
PHXW-20210		210'	6"	6"	8"	8"	2370	523
PHXW-20220		220'	6"	6"	8"	8"	2470	537
PHXW-20230		230'	6"	6"	8"	8"	2500	546
PHXW-20240		240'	6"	6"	8"	8"	2570	556
PHXW-20250		250'	6"	6"	8"	8"	2670	569
PHXW-20260		260'	6"	6"	8"	8"	2720	578
PHXW-20270		270'	6"	6"	8"	8"	2770	588
PHXW-20280		280'	6"	6"	8"	8"	2870	602
PHXW-24290	24"	290'	10"	10"	8"	8"	2330	713
PHXW-24300		300'	10"	10"	8"	8"	2330	719
PHXW-24320		320'	10"	10"	8"	8"	2430	739
PHXW-24360		360'	10"	10"	8"	8"	2580	764
PHXW-24380		380'	10"	10"	8"	8"	2630	792
PHXW-24400		400'	10"	10"	8"	8"	2730	813
PHXW-24420		420'	10"	10"	8"	8"	2830	833
PHXW-24440		440'	10"	10"	8"	8"	2880	849

Steam to Water
Heat Exchanger

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The exchangers cap with diameter of 14-inch of PACKMAN are made of cast iron. Water flows (input and output) are in parallel. Higher diameter exchangers are made of steel cap and water flows are perpendicular.

Design of heat exchanger

Design of these types of exchangers is done via engineering software or upon request of the customer from the Blundgest Catalog (WU and SU models).

In order to optimize the heat exchanger design, it is necessary to specify characteristics such as the hot fluid flow rate, the inlet and outlet temperature of the hot fluid, the flow of the heat exchanger and the inlet and outlet temperature of the heat exchanger or heat transferable heat exchanger. In order to use heat exchangers with a fluid other than water, the design of the exchanger should be based on this fluid.

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$$Q = U A \Delta t_m$$

Where:

Q is the rate of heat transfer between the two fluids in the heat exchanger

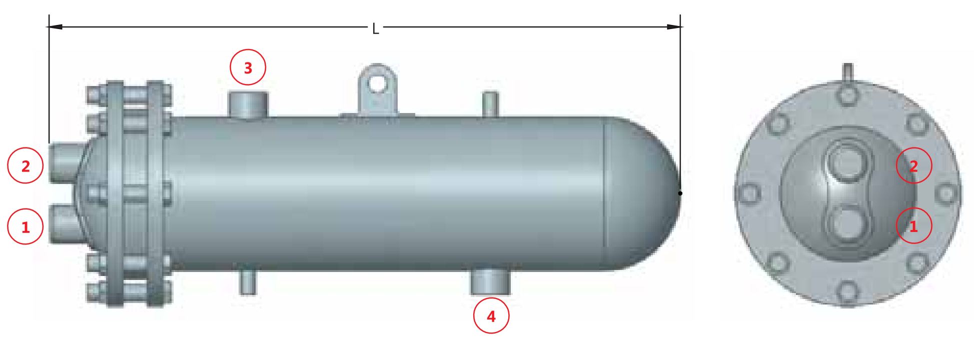
U is the overall heat transfer coefficient. This depends on the conductive properties of the fluids and the heat exchanger material.

A is the heat transfer surface area Δtm is the log mean temperature difference, calculated from the inlet and outlet temperatures of both fluids.

The value of U is harder to calculate:

$$U = \frac{1}{\frac{1}{h_1} + R_{f1} + R_w + \frac{1}{h_2} + R_{f2}}$$

h1 and h2 are the partial heat transfer coefficients, W/m2.oK (tube and shell side)
Rw is the thermal resistance of the wall, m2.oK /W
Rf1 and Rf2 are the fouling factors, m2.oK /W (tube and shell side)
While the values for Rf are usually specified by the client, the values of h and Rw can be influenced directly by the designer depending on the choice of tube size and thickness, and the materials used for construction. The values of the partial heat transfer coefficients h depend greatly on the nature of the fluids but also, crucially, on the geometry of the heat transfer surfaces with which they are in contact. Importantly, the final values are heavily influenced by what happens at the level of the boundary layers: the fluid actually in contact with the heat transfer surface. The driving force for heat transfer is the difference in temperature between the two elements. In the case of a tubular heat exchanger, the temperature of the two fluids changes as they pass through the heat exchanger.



Model	Tube Sheet Size	Heating Surface (sq ft)	Steam Inlet	Condensate Outlet	Hot Water Inlet	Hot Water Outlet	Total Length (MM)	Total Weight (KG)
PHXS-65	6"	5'	2"	1"	2"	2"	600	51
PHXS-67		7.5'	2"	1"	2"	2"	850	58
PHXS-610		10'	2"	1"	2"	2"	1050	66
PHXS-612		12.5'	2"	1"	2"	2"	1300	73
PHXS-615		15'	2"	1"	2"	2"	1500	81
PHXS-617		17.5'	2"	1"	2"	2"	1700	91
PHXS-620		20'	2"	1"	2"	2"	1950	98
PHXS-622		22.5'	2"	1"	2"	2"	2200	106
PHXS-820	8"	20'	2"	1"	2"	2"	1100	104
PHXS-825		25'	2"	1"	2"	2"	1300	113
PHXS-830		30'	2"	1"	2"	2"	1550	127
PHXS-835		35'	2"	1"	2"	2"	1650	139
PHXS-840		40'	2"	1"	2"	2"	1850	149

Model	Tube Sheet Size	Heating Surface (sq ft)	Steam Inlet	Condensate Outlet	Hot Water Inlet	Hot Water Outlet	Total Length (MM)	Total Weight (KG)
PHXS-1035	10"	35'	2,1/2"	1,1/4"	3"	3"	1150	160
PHXS-1040		40'	2,1/2"	1,1/4"	3"	3"	1300	170
PHXS-1045		45'	2,1/2"	1,1/4"	3"	3"	1500	184
PHXS-1050		50'	2,1/2"	1,1/4"	3"	3"	1600	191
PHXS-1055		55'	2,1/2"	1,1/4"	3"	3"	1700	202
PHXS-1260	12"	60'	3"	1,1/2"	3"	3"	1400	223
PHXS-1270		70'	3"	1,1/2"	3"	3"	1600	304
PHXS-1280		80'	3"	1,1/2"	3"	3"	1800	326
PHXS-1290		90'	3"	1,1/2"	3"	3"	1900	340
PHXS-12100		100'	3"	1,1/2"	3"	3"	2100	362
PHXS-1480	14"	80'	3"	1,1/2"	3"	3"	1550	295
PHXS-1490		90'	3"	1,1/2"	3"	3"	1600	315
PHXS-14100		100'	3"	1,1/2"	3"	3"	1700	330
PHXS-14110		110'	3"	1,1/2"	3"	3"	1900	355
PHXS-14120		120'	3"	1,1/2"	3"	3"	2000	370
PHXS-16100	16"	100'	4"	2"	4"	4"	1450	279
PHXS-16110		110'	4"	2"	4"	4"	1560	291
PHXS-16120		120'	4"	2"	4"	4"	1660	303
PHXS-16130		130'	4"	2"	4"	4"	1760	315
PHXS-16140		140'	4"	2"	4"	4"	1860	327
PHXS-16150		150'	4"	2"	4"	4"	1960	338
PHXS-16160		160'	4"	2"	4"	4"	2060	350
PHXS-18140	18"	140'	4"	2"	4"	4"	2140	413
PHXS-18150		150'	4"	2"	4"	4"	2140	424
PHXS-18160		160'	4"	2"	4"	4"	2240	435
PHXS-18170		170'	4"	2"	4"	4"	2340	442
PHXS-18180		180'	4"	2"	4"	4"	2440	454
PHXS-18190		190'	4"	2"	4"	4"	2500	464
PHXS-18200		200'	4"	2"	4"	4"	2540	473
PHXS-18210		210'	4"	2"	4"	4"	2640	485
PHXS-20200	20"	200'	6"	3"	8"	8"	2330	508
PHXS-20210		210'	6"	3"	8"	8"	2370	517
PHXS-20220		220'	6"	3"	8"	8"	2470	531
PHXS-20230		230'	6"	3"	8"	8"	2500	540
PHXS-20240		240'	6"	3"	8"	8"	2570	550
PHXS-20250		250'	6"	3"	8"	8"	2670	564
PHXS-20260		260'	6"	3"	8"	8"	2720	573
PHXS-20270		270'	6"	3"	8"	8"	2770	582
PHXS-20280		280'	6"	3"	8"	8"	2870	596
PHXS-24290	24"	290'	8"	4"	10"	10"	2330	703
PHXS-24300		300'	8"	4"	10"	10"	2330	709
PHXS-24320		320'	8"	4"	10"	10"	2530	730
PHXS-24360		340'	8"	4"	10"	10"	2580	754
PHXS-24380		380'	8"	4"	10"	10"	2630	782
PHXS-24400		400'	8"	4"	10"	10"	2730	803
PHXS-24420		420'	8"	4"	10"	10"	2830	823
PHXS-24440		440'	8"	4"	10"	10"	2880	839