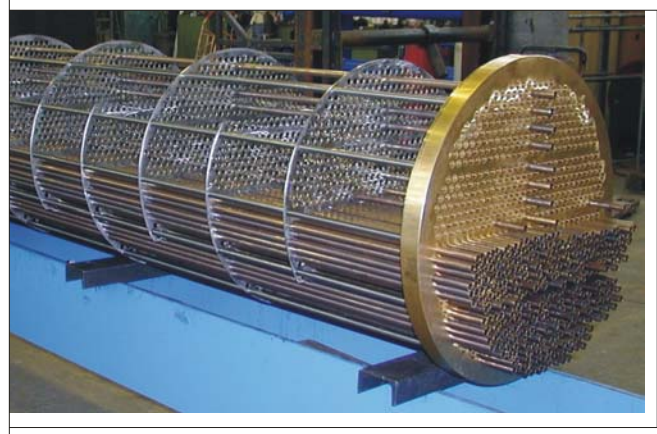


OK/LK
Shell & Tube Heat Exchangers

Issued: 08.26.02

OELTECHNIK

Shell & Tube Introduction

OELTECHNIK has developed, tested and continuously improved its shell & tube product program in response to the challenges of the industry. The in-house developed software is based on recognized literature such as VDI Wärmeatlas and HEI. It has been checked against actual test performance of our equipment.

OELTECHNIK has always taken challenges to explore further design options for shell & tube heat exchangers. Shell & tube heat exchangers are rated, designed and fabricated in-house and can be supplied according to individual customer's specifications.

OELTECHNIK 's products are successfully in use worldwide. Our design and fabrication capabilities are covering all international design codes and national regulations.

Our type OK coolers are standardized from 100 mm [4"] to 400 mm [16"] in shell diameter. Typically, oil is on the shell side and water on the tube side. For every application the coolers are individually check-rated with our thermal rating programs. For higher flow rates custom tailored designs are prevailing. Certainly, the OK type shell & tube heat exchanger can be used for other liquid to liquid applications.

The type LK indicates that one fluid is gaseous or has major gas components. Together with our customer we decide whether the gaseous fluid is on shell or tube side. Factors like design pressure, desired nozzle location, agressiveness of fluids, desired material combination, thermal performance and allowable pressure drop influence the decision about fluid location.

OELTECHNIK will assist you in making the most economical selection under consideration and evaluation of all parameters.

Typical Fluids:

Shell Side: Oil, water, glycol, water glycol solutions, other liquids, wet gases with separators
Tube Side: Water, glycol, water glycol solutions, dry gases under high pressure, wet gases with separator in down-stream.

Capabilities/Range of Application:

Design Pressure:	[2 - 210]	barg	[29 - 3046]	psig
Design Temperature:	[-25 - 350]	°C	[-13 - 662]	°F
Shell Diameter:	[80 - 4000]	mm	[3 - 157]	inches
Maximum Weight:	[35]	t		

Material Combinations:

Tubes: Bare tubes or Low-Fin tubes made of:
90/10 CuNi, 70/30 CuNi, Admirality, 304 SS, 316 SS, Duplex, Super Duplex, Titanium and all other commercial available materials.

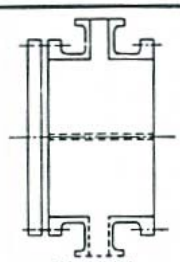
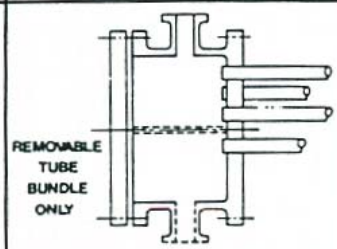
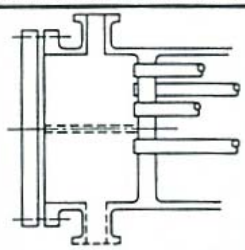
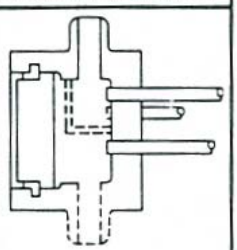
Tube Sheets: Carbon steel, 90/10 CuNi, 70/30 CuNi, solid, cladded, CuZn 38 SnAl, Stainless steel, Duplex, Titanium, and all other commercial available plate materials.

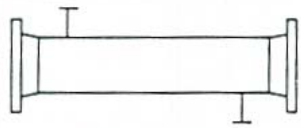
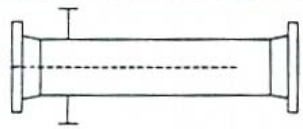
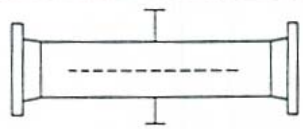
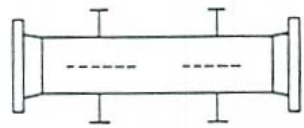
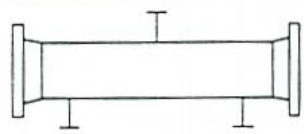
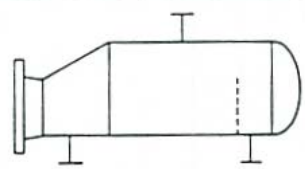
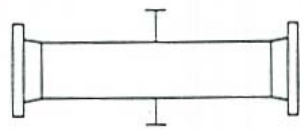
Channels: Carbon steel, Stainless steel, Castings in iron and copper alloys.

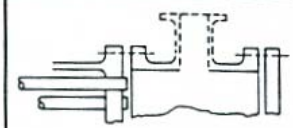
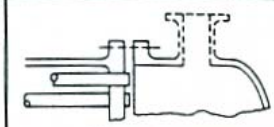
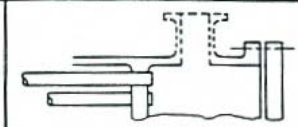
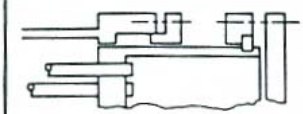
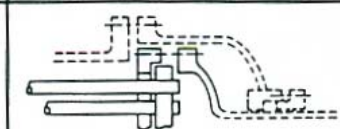
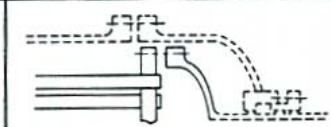
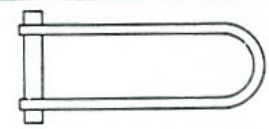
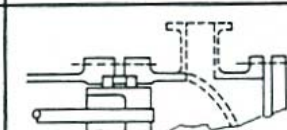
Shell Side: Carbon steel, Stainless steel.

Shell & Tube Overview

OELTECHNIK designs and fabricates shell and tube heat exchangers according to the recommended good manufacturing practice of TEMA (Standard of the **T**ubular Heat **E**xchanger **M**anufacturing **A**ssociation). TEMA nomenclature has gained worldwide recognition due to its systematic approach of classifying shell and tube heat exchangers by front head design, shell, and rear head design. Combinations of C,N, and D for front heads or L,M,N for rear heads result in a non-removable bundle design. To allow for thermal expansion floating head designs types P,S,T, and W are chosen. The following table is taken from the TEMA book.

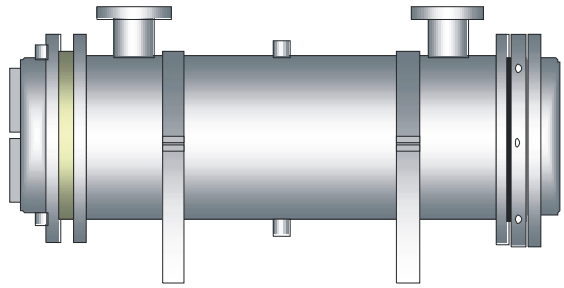
	FRONT END STATIONARY HEAD TYPES
A	 CHANNEL AND REMOVABLE COVER
B	 BONNET (INTEGRAL COVER)
C	 CHANNEL INTEGRAL WITH TUBE-SHEET AND REMOVABLE COVER
N	 CHANNEL INTEGRAL WITH TUBE-SHEET AND REMOVABLE COVER
D	 SPECIAL HIGH PRESSURE CLOSURE

	SHELL TYPES
E	 ONE PASS SHELL
F	 TWO PASS SHELL WITH LONGITUDINAL BAFFLE
G	 SPLIT FLOW
H	 DOUBLE SPLIT FLOW
J	 DIVIDED FLOW
K	 KETTLE TYPE REBOILER
X	 CROSS FLOW

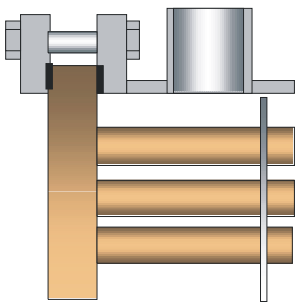
	REAR END HEAD TYPES
L	 FIXED TUBESHEET LIKE "A" STATIONARY HEAD
M	 FIXED TUBESHEET LIKE "B" STATIONARY HEAD
N	 FIXED TUBESHEET LIKE "N" STATIONARY HEAD
P	 OUTSIDE PACKED FLOATING HEAD
S	 FLOATING HEAD WITH BACKING DEVICE
T	 PULL THROUGH FLOATING HEAD
U	 U-TUBE BUNDLE
W	 EXTERNALLY SEALED FLOATING TUBESHEET

Shell & Tube OK Overview

OELTECHNIK's standard oil cooler is designed for 10 barg [145 psig] shell and tube side design pressure, and design temperature 95°C [203°F] on both sides. Carbon steel shell, cast iron or brass heads, 90/10 CuNi tubing and brass tube sheets are available material combinations.
Design per PED 97/23/EC acc. AD-Merkblatt and ASME Code in lieu of Werkstandard available.

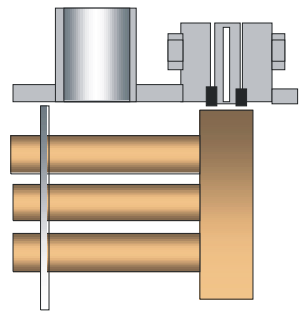


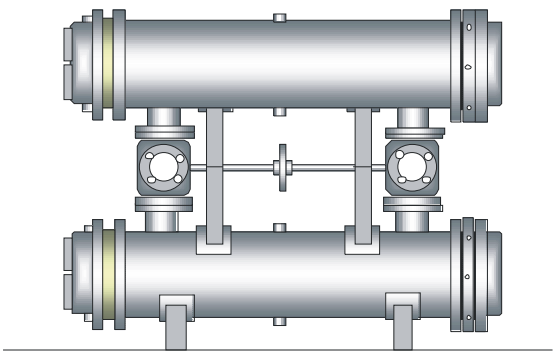
Stationary Tube Sheet



The stationary tube sheet is fastened with bolting between shell flange and front cover flange. Flat gaskets on both sides of the tube sheet seal against water and oil leakage to atmosphere. The floating tube sheet can thermally expand in axial direction. A double rubber packing held in place by a support ring seals on the circumference of the tube sheet against oil getting into the water cycle and vice versa.

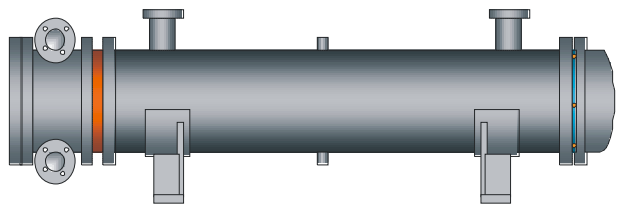
Floating Tube Sheet

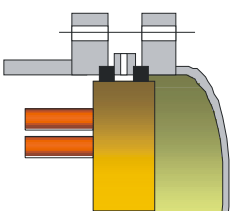




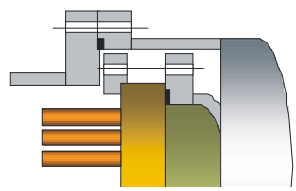
For oil systems with high availability requirements, OELTECHNIK offers the twin cooler assembly including continuous-flow transfer valves. Each oil cooler is designed to handle 100% oil flow. The flow can be switched from one cooler to the other with the help of two transfer valves connected to shell side oil in- and outlet. Tube side fouling on the oil cooler which is not in operation can be removed without causing any downtime of the system.

OELTECHNIK's OKG (TEMA type **AEW**) oil coolers show a typical channel with removable cover for the front head. This allows for tube side cleaning without disconnecting the water piping due to free access to tube ends by removing the flat cover.





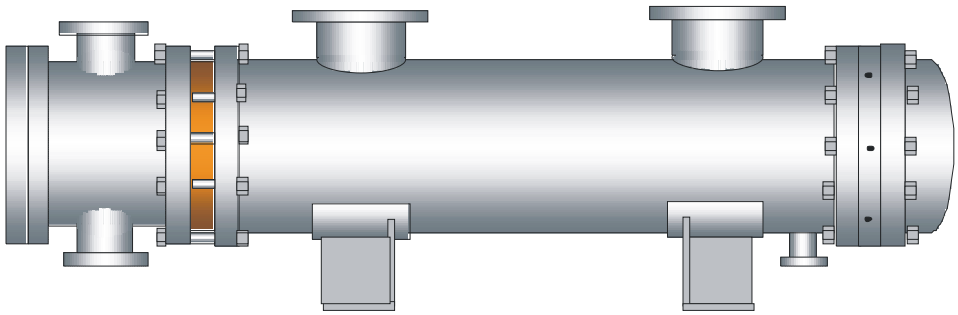
The TEMA type **AEW** seals floating tube sheets externally with two rubber packings. The support disc shows leak detection lines to immediately indicate disfunctional seals prior to leakage to the other fluid system. The TEMA type **AES** (figure on the right) seals the tube side against shell side with a floating head held by a backing ring.



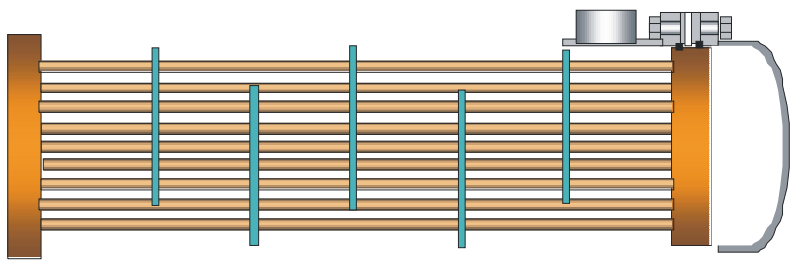
OELTECHNIK

Shell & Tube TEMA Type AEW and BET

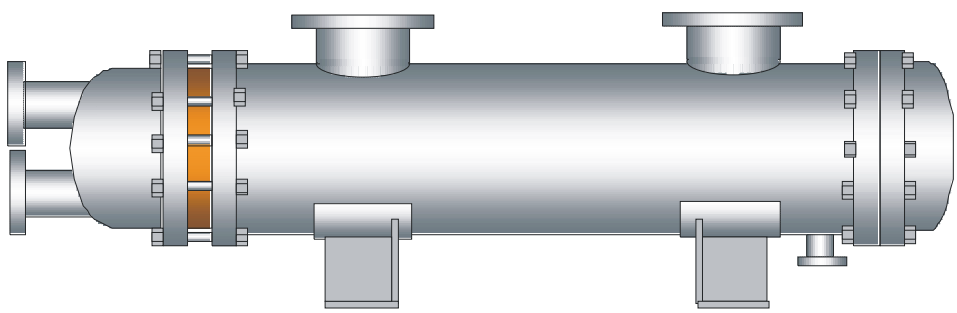
OELTECHNIK's TEMA Type **AEW** shell and tube heat exchangers can be used for gas on the shell side and gas on the tube side. The shell side nozzle connection may be turned 90° into and out of the plane. The nozzle spread has to be maintained to make best usage of the installed surface area.



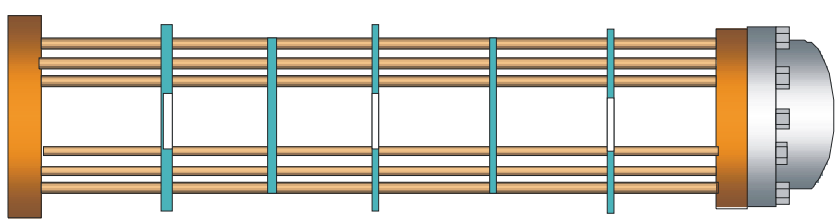
The baffles lead the shell side fluid across the tube bundle. Baffle spacing and percentage cut are selected in the rating process to allow for optimum flow conditions during operation. Heat transfer aspects and vibration prevention aspects are considered to find the optimum solution.



OELTECHNIK's TEMA Type **BET** is only used for even pass numbers on the tube side. In- and outlet connections of tube side are therefore on one side. The integral bonnet has to be removed in order to have access to the tubes on the floating end of the bundle.

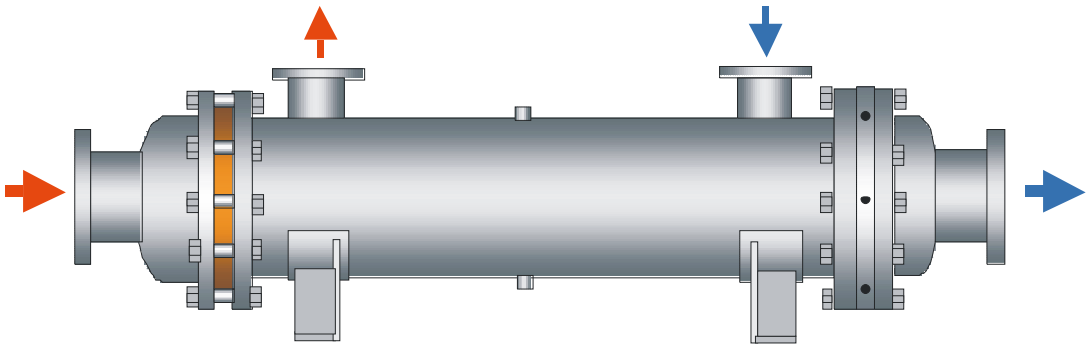


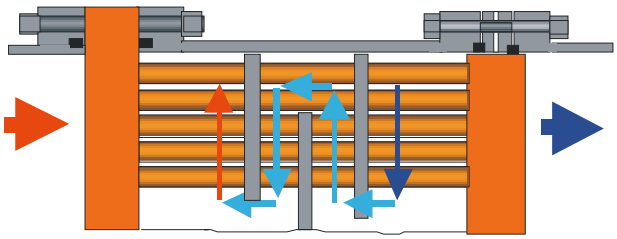
The rear water channel on the floating tube sheet is covered by the rear end bonnet which is bolted to the shell flange. The baffles have a disk and doughnut design. Water is going through the tubes, gas through the shell. The centre of the bundle does not show any tubes which reduces the gas side pressure drop.



Shell & Tube TEMA Type BEW and BEP

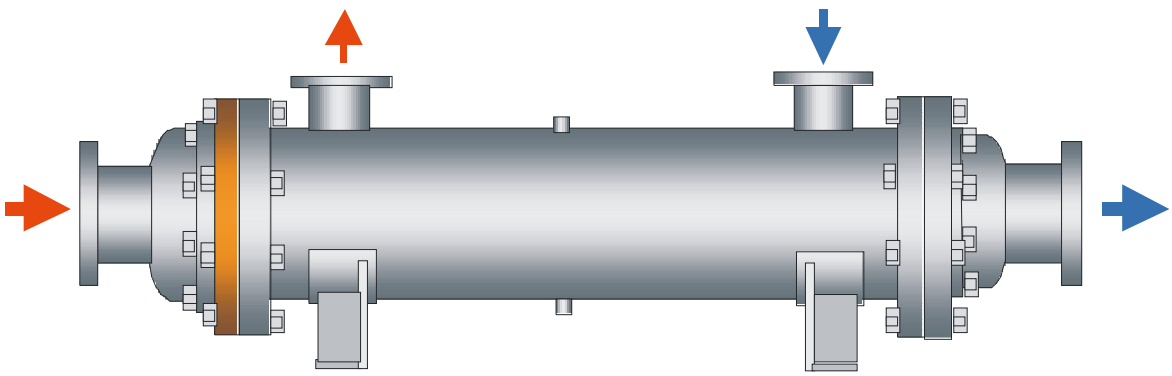
OELTECHNIK's TEMA Type **BEW** is mostly used for gas through the tubes and water on the shell side. The flow arrangement is counter-flow, cold water cools colder gas, warmed up water cools incoming hot gas. The tube and shell side are one pass, respectively. The bonnet can be designed as shown with axial connections or radial connections.



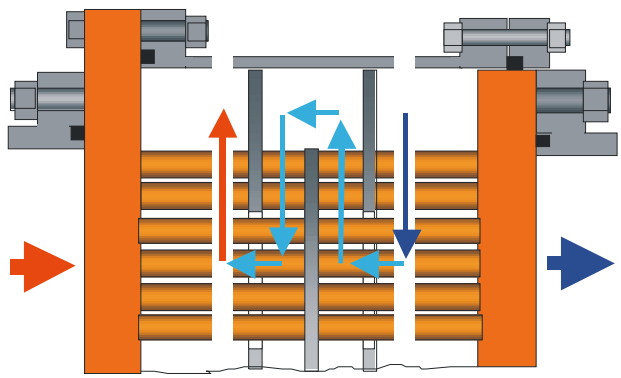


The stationary tube sheet is clamped between shell flange and water bonnet. The floating tube sheet slides in the external seal formed by shell flange and rear bonnet. Regular segmental baffles guide shell side fluid through the shell.

OELTECHNIK's TEMA Type **BEP** is a single pass tube side design with an outside packed floating tube sheet. This design is preferred for high pressures or dangerous fluids to be handled on the tube side since chances for the tube side fluid to leak to ambient or mix with the shell side fluid are eliminated.

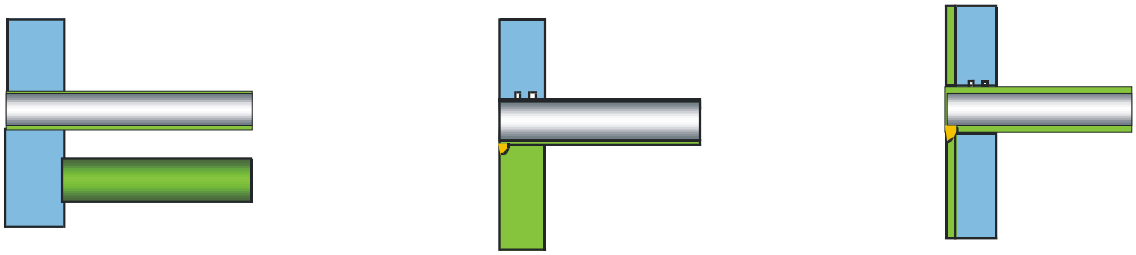


The bolt circle, gasket groove, and inner edge of the floating head bonnet determine the outer tube limit on the tube sheet. Disk and doughnut baffles are used for this design to block the clearance between inside shell diameter and outer tube limit. The rubber packing seals against leakage to atmosphere on the outer edge of the tube sheet. It is held inplace by a packing gland bolted to the shell flange.



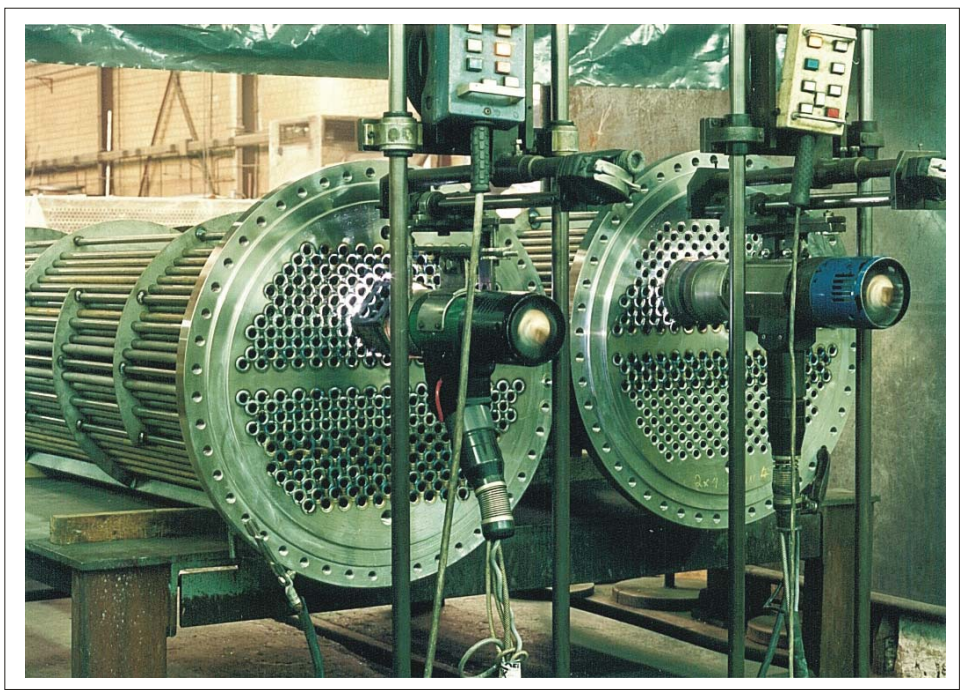
Shell & Tube Details

The tube to tube sheet connection is a critical joint which is exposed to both shell side and tube side fluid. It has to be tight against leakage and as a pressure bearing part it has to be resistant to stress and forces. Tube and tube sheet can be of different material or the same kind. The type of joint design which is the most efficient is a function of material combination, design pressure, design temperatures, and tightness requirement.



For higher design pressure which results in higher stress in tube to tube sheet joints, the tube hole is grooved or double grooved to give additional strength. In some cases the material combination is such that a welded joint is preferred to a roller expanded one. Strength welding secures tubes in the tube sheet and guarantees a low leakage rate. Seal welding provides a tight joint while the strength of the joint is added by roller expanding after welding. It is desired to have tube and tube sheet of the same or at least similar material for welded joints. A cladded tube sheet provides equal materials for the welded joint. It allows to select a strong base material for the structural strength and a corrosion resistant thin layer for the tube side.

Tube to Tube Sheet Welding



OELTECHNIK´s full automatic orbital welding equipment welds tube to tube sheet joints to a highest degree of perfection. All welding parameters entered by the certified welder based on the WPS (Welding Procedure Schedule) are stored on micro chip. Therefore a high level of welding quality is assured for every single tube joint on the tube bundle. For multiple weld layers each pass is checked for cracks and crevices by a Liquid Penetration Test (LPT).

How to reach us

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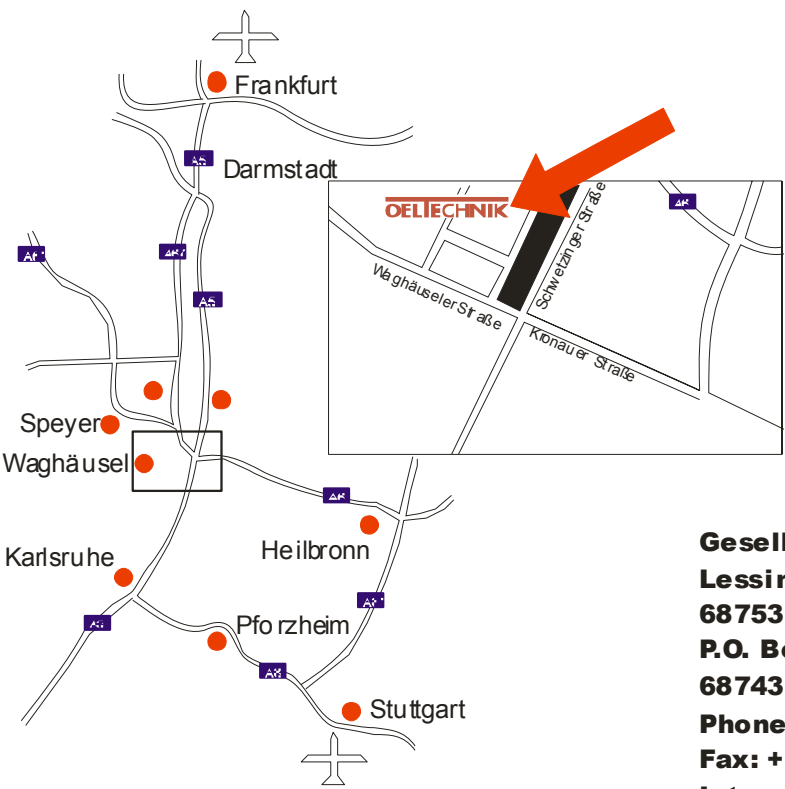
OELTECHNIK France

TUBETECH GmbH



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