



Hair Pin
(Double Pipe)
Heat Exchangers

Hair Pin Heat Exchangers

Hair Pin Heat Exchangers: A hairpin heat exchanger can be described as a single-pass shell-and-tube (double pipe) unit that has been folded in half to give it a hairpin appearance. It is a type of shell and tube heat exchanger

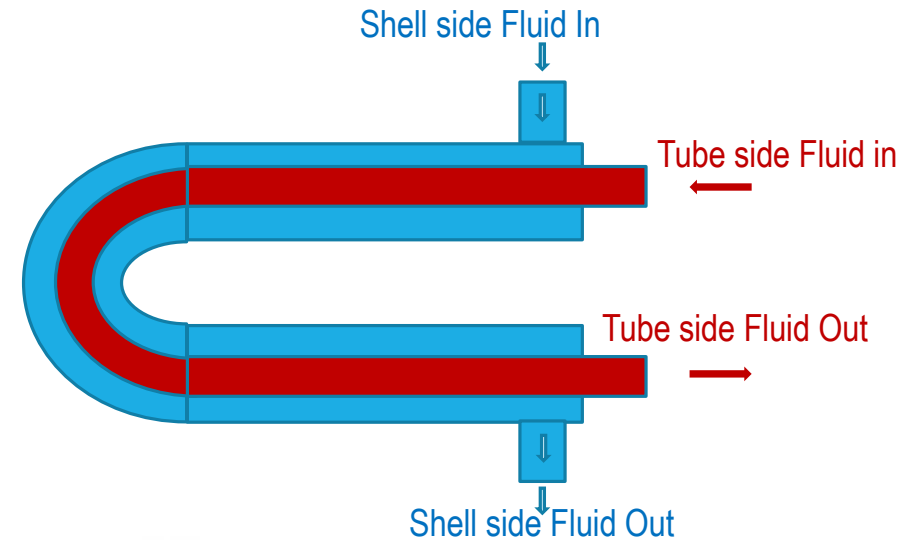
Main standards: API 663 & PIP VESH001, in addition to TEMA and ASME BPVC



Removable Cover hair pin Exchanger



Name gained from shape similarity of Hair pin



Stacked skid

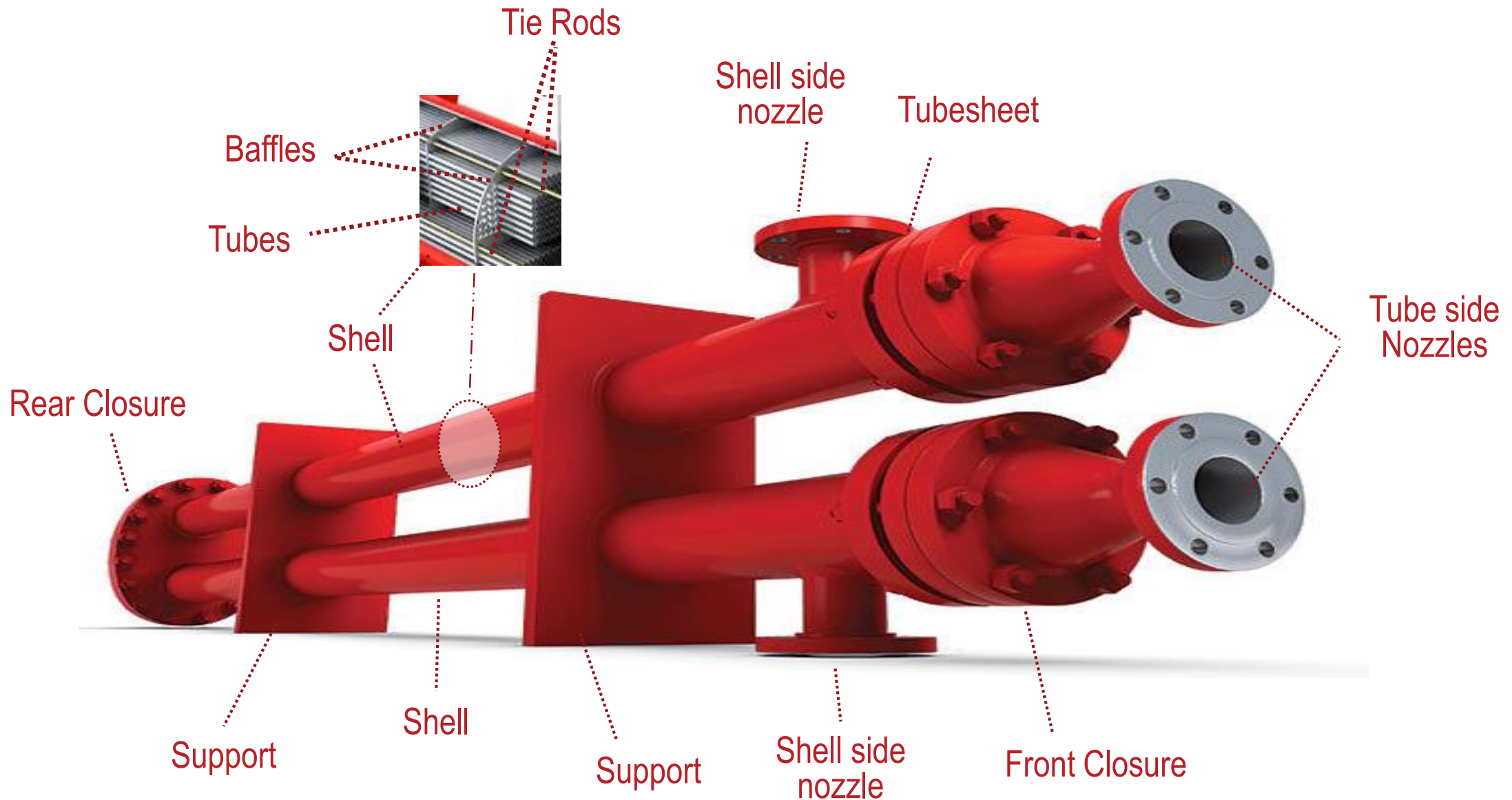


Bundle during fabrication



Removable bundle type Hair Pin Heat Exchanger

Main Components of Hair Pin Heat Exchangers



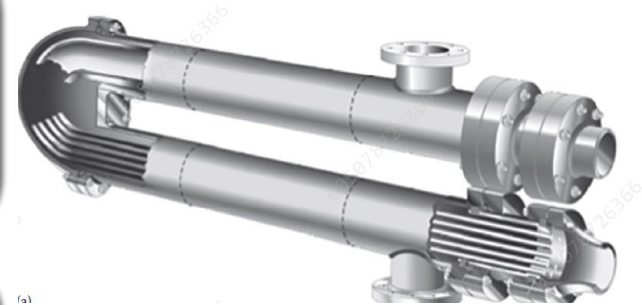
Advantages of Hair Pin Heat Exchangers

Pure counter flow permits close temperature approach and temperature cross

High thermal performance and compact footprint as compared to traditional shell and tube heat exchangers

As it is a U-tube design, metallic expansion joints are not required to absorb the differential expansion between the service channel and the product channel

Can be designed as fixed tubesheet or with removable bundle for easy maintenance

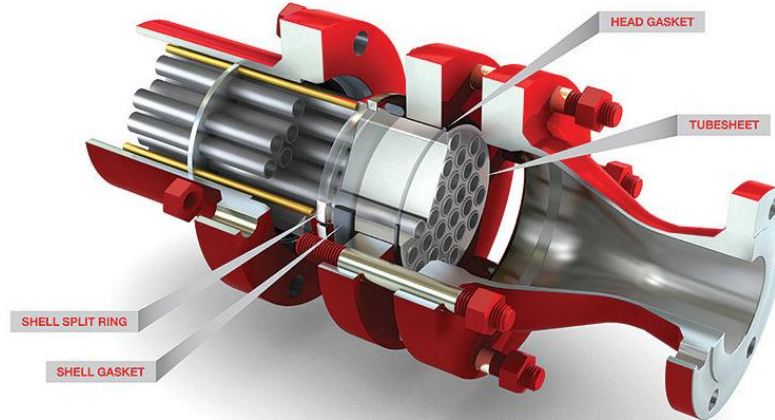


Hair Pin Heat Exchangers Front Closures



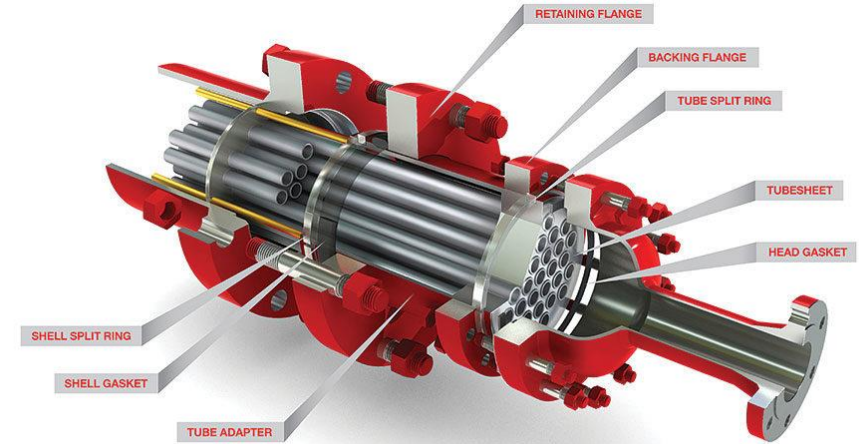
Non Removable Bundle

- Low Cost
- Fixed tubesheet
- Not suitable for dirty service
- Poor maintainability
- Less prone to leaks (less flanged connections)



Separated Closure

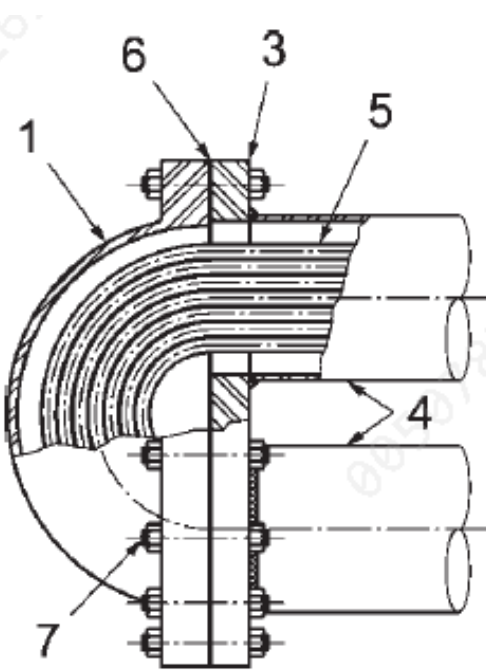
- Shell side and tube side closures are separately bolted through, ideal for applications involving wide temperature or pressure differences between the shell and tube side fluids (>220°C & 70 bar)
- Cyclic Service
- Hydrogen service



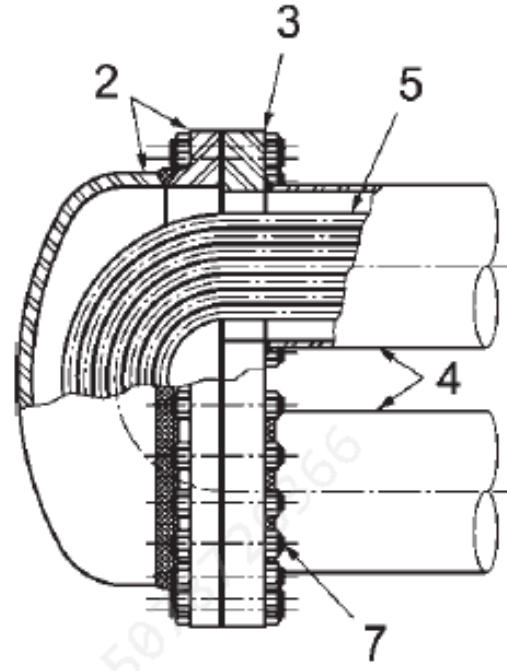
Common Closure

- Single bolted closure design. Ideal for applications involving low design temperature or pressure differences between the shell and tube side fluids
- Removable bundle, better maintainability compared to fixed tubesheet.

Hair Pin Heat Exchangers Rear Closures



Cast Closure



Fabricated Closure



Welded Closure

- 1) shell return bend housing
- 2) shell return housing assembly
- 3) shell return housing end flange
- 4) shell pipes

- 5) bundle or element assembly
- 6) return bend housing gasket
- 7) return bend housing bolting

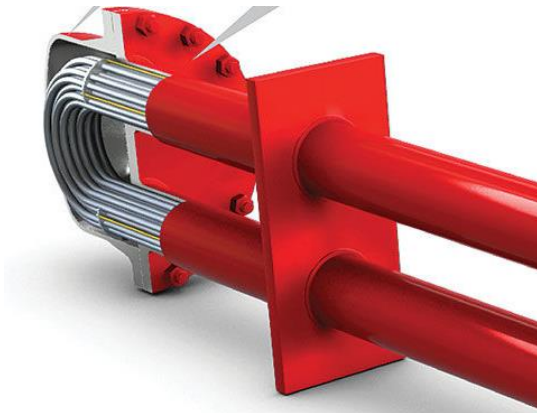
Removable Bundle Hair Pin Heat Exchangers

Removable Bundle Hair Pin Heat Exchangers



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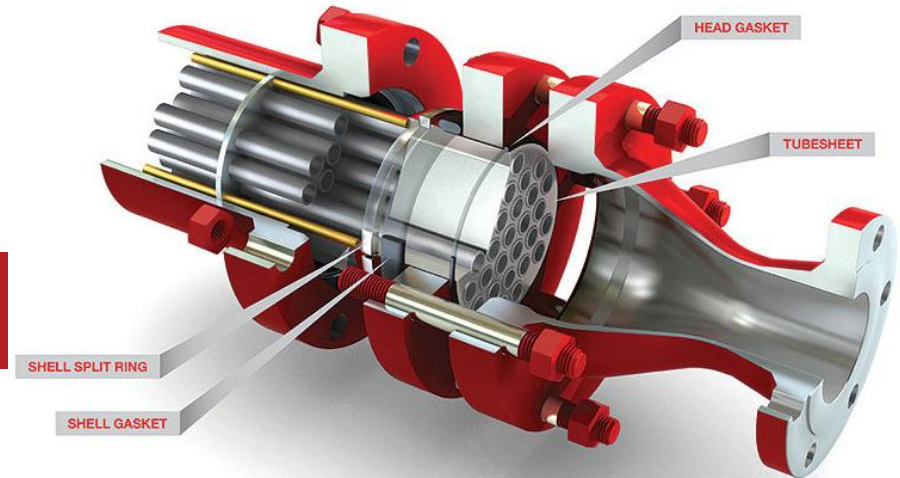
Change the configuration of the end U bend cover to be removable flanged assembly



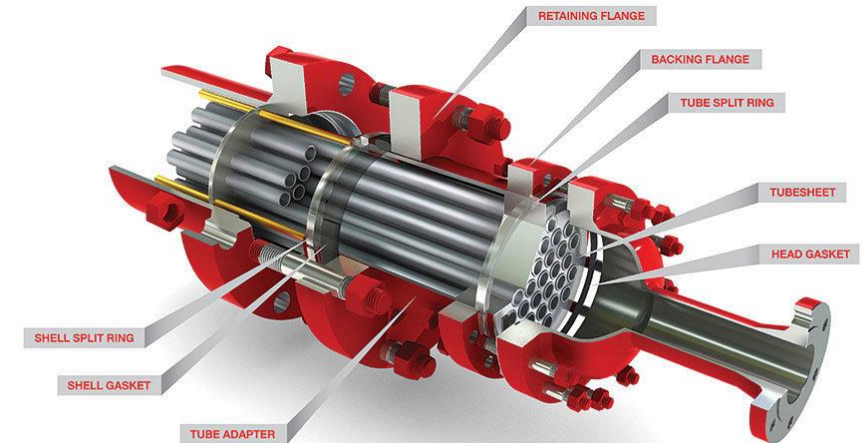
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+ one of those two configuration

Option-1
Common closure



Option-2
Separated closure



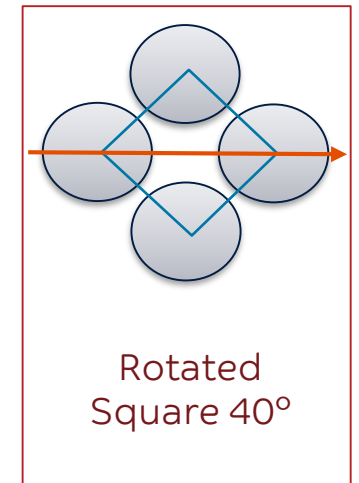
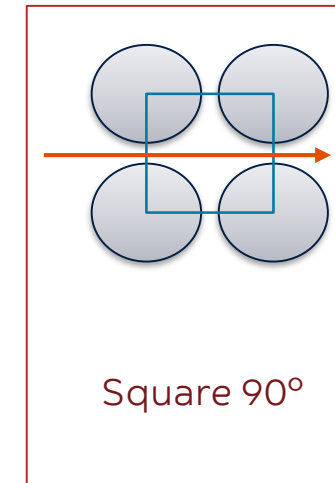
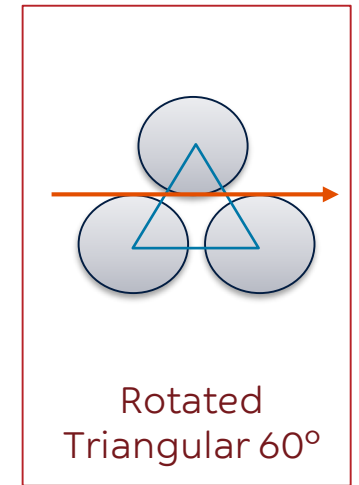
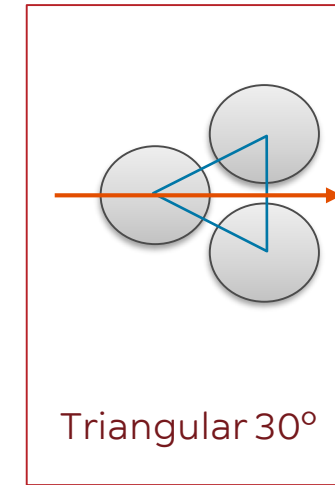
Tube Thickness

Minimum Recommended wall thickness of tubes

Tube Material	Minimum Wall Thickness
Carbon steel, low-alloy material (max. 9 % chromium), aluminum, and aluminum alloy	2.11
Copper and copper alloys	1.65
High-alloy [austenitic, ferritic, and austenitic / ferritic (duplex)] steel and other nonferrous materials	1.473
Titanium	1.067

Tube Battern

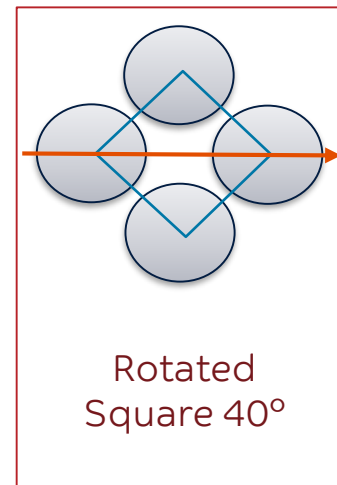
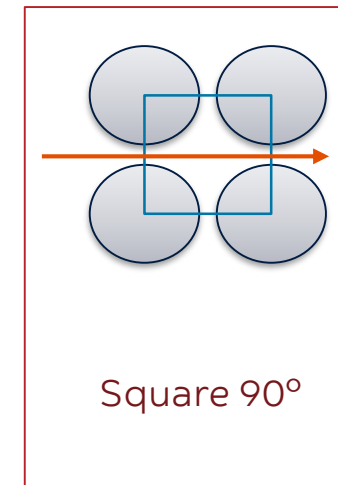
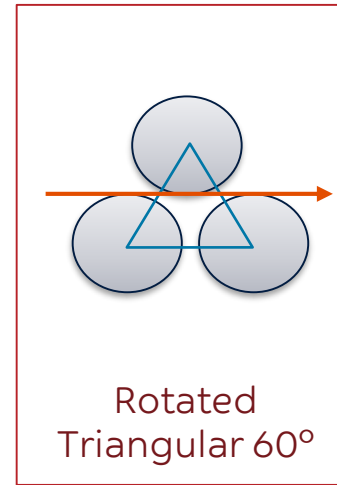
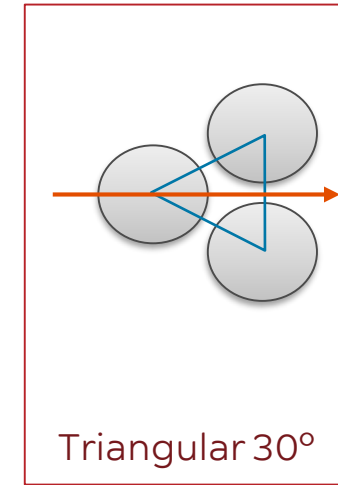
- Triangular pitch (30 deg) and rotated triangular (60 deg) accommodates more tubes and produces high flow turbulence is better for heat transfer and surface area per unit length (greater tube density)
- Square pitch is needed for mechanical cleaning, so it is preferred for dirty service applications
- **TEMA R-2.5** Tube Pitch shall be spaced minimum center to center of 1.25 tube OD, when the mechanical cleaning is specified, lanes of 6.4 mm (0.25 in) shall be provided



TEMA RCB-2.4

Tube Pattern

	Triangular		Square	
	30°	60° Rotated	90°	45° Rotated
Applicable shell side fluid	Low fouling tendency due to the difficulty of mechanical cleaning		No limitation	
Pressure drop(Shell side)	Larger than square		Smaller than triangular	
	Larger than rotated triangular	Smaller than triangular	Smaller than rotated square	Larger than square
Heat Transfer coefficient (shell side)	Higher than triangular		Lower than triangular	



Tube-to-Tubesheet Joints

Expanded

Process of expanding a tube to a fully plastic state into contact with tube hole that creates residual interface pressure between the tube and tubesheet

Strength Welded

Weld design strength is equal to or greater than the axial tube strength

Can be **Full strength Weld** or **Partial Strength Weld**

Full Strength Weld: in which the design strength is equal to or greater than the axial tube strength

Partial Strength Weld: in which the design strength is based on the mechanical and thermal axial tube loads that are determined from the actual design conditions

Seal Welded

Weld is used to supplement an expanded tube to tubesheet joint to ensure leak tightness

