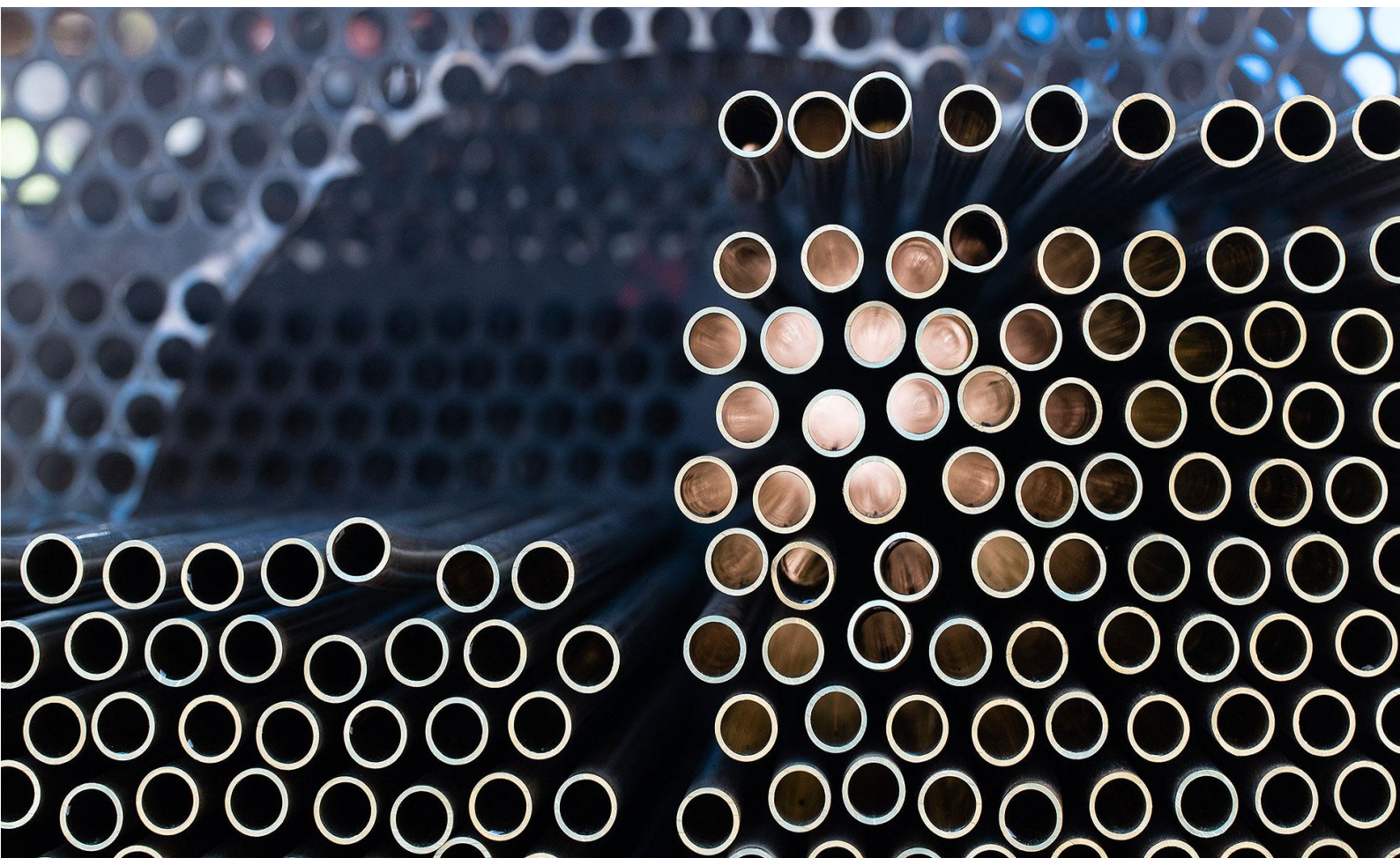




Heat Exchanger Tubes

Heat exchanger tubes are tubes that are used in heat exchangers to transfer heat between two fluids. Heat exchanger tubes are the elements of the heat exchanger, which are placed in the cylinder and used for heat exchange between the two media.

Heat exchanger tubes are commonly used in various industries such as chemical processing, power generation, and refrigeration applications.

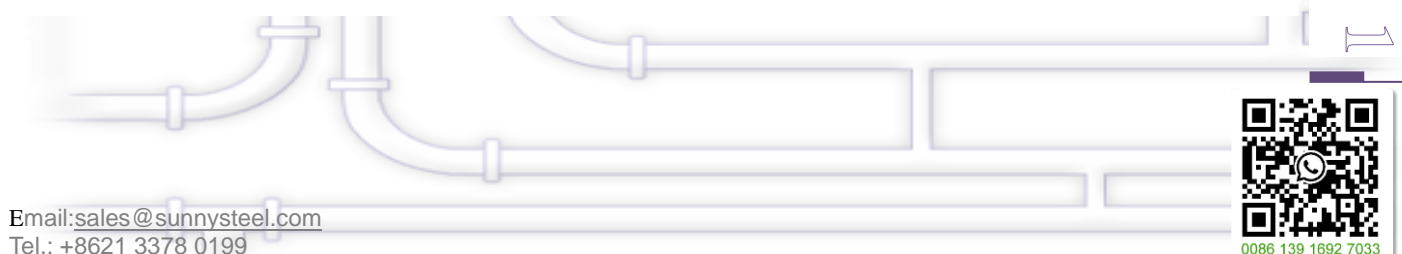


Heat exchanger tubes can be made from a variety of materials, including carbon steel, stainless steel, titanium, copper, and others, depending on the type of fluid being used and the operating conditions.

Some of the key features and properties of heat exchanger tubes include:

- **High thermal conductivity:** Heat exchanger tubes are designed to have high thermal conductivity, allowing for efficient heat transfer between two fluids.
- **Corrosion resistance:** Heat exchanger tubes are often exposed to corrosive media, so they must have good corrosion resistance to maintain their performance over time.
- **Resistance to fouling:** Heat exchanger tubes can experience fouling due to the buildup of deposits on their surfaces, so they need to be designed in a way that minimizes fouling and maximizes cleaning efficiency.
- **Good strength and durability:** Heat exchanger tubes must be strong enough to withstand the pressure and temperature changes that occur during operation.

Heat exchanger tubes can come in a variety of shapes and sizes, including straight tubes, U-shaped tubes, and spiral tubes. They can be manufactured using various processes, such as seamless or welded, depending on the application requirements.



In summary, heat exchanger tubes are an essential component in heat exchangers used in various industries. They must be designed to have high thermal conductivity, good corrosion resistance, resistance to fouling, and good strength and durability to maintain efficient heat transfer between two fluids.

Heat exchange tubes are intended for heating or cooling process fluids, they are for example suitable for closed circuit cooling of electrical equipment using demineralised water and for cooling water soluble oil solutions in quenching tanks.

The former is suitable for heat transfer and vibration occasions without phase change, and the latter is suitable for reboiling, condensing heat transfer and vibration-free general occasions. The heat exchanger pipe shall be able to withstand certain temperature differences, stress and corrosion resistance.

The length of the heat exchange tube is generally 1.0m, 1.5m, 2.0m, 2.5m, 3.0m, 4.5m, 6.0m, 7.5m, 9.0m, 12.0m. The material of the pipe can be carbon steel, stainless steel, aluminum, copper, brass and copper-nickel alloy, nickel, graphite, glass and other special materials, also often used composite pipe. In order to expand the area of effective heat transfer tube at the same time maximize the tube side heat transfer coefficient, heat exchange tube processing or in tube inserted into the internal and external surfaces of the disturbed flow components, producing fluid turbulence the inside and outside



at the same time, commonly used such as rough surface tubes, finned tube, the supporting pipe, inside the plug-in type, etc.

Heat exchanger Tubes are used in all types of process industries.

Characteristic requirements are: bead worked weld, fixed lengths and extensive testing. In order to meet the demand for rapid delivery, we have a strip stock with both standard and special grades of steel in the most common thicknesses.

We supply both seamless and welded tubes which meet the requirements for shell and tube heat exchangers:

- ASTM A213/A213M Seamless tube
- ASTM A556M-88/ASME SA556 heater tubes 1
- ASTM A249/A249M Welded tube

Size range 6.35mm - 76.2mm OD x 0.91mm – 3.25mm wall thickness

Heat exchanger tubes are supplied in Standard Wire Gauge (SWG) or Birmingham Wire Gauge (BWG)

Popular grades: 1.4306 (304L), 1.4404 (316L)

Whether your application requires seamless or welded stainless steel tubing, you can always count on consistent, high quality tubing manufactured by our specialists at Sunny Steel. Many of the world's leading heat exchanger manufacturer's turn to us for their tubing needs. Applications include:



- What kinds of finned tubes are used in air cooled heat exchanger?
- High-pressure boiler tube heat defect
- Heat boiler seamless extrusion technology
- We offer quick turnaround as well as specialty and nickel alloys.

Delivery Conditions

1. Annealed, Normalized, Normalized and Tempered
2. Main Testing Terms according to ASTM A213-09 and ASTM A1016
3. High pressure hydraulic Test: Minimum 10 Maps.
4. Eddy current test, Ultrasonic Test

Mechanical Test

- OD and WT tolerance Test.

Surface treatment

- Oil-dip, Varnish, Passivation, Phosphating, Shot Blasting.

Understanding TEMA Types for Shell-and-Tube Exchangers

Shell-and-tube designs incorporate fixed or floating tube sheets, fixed or removable tube bundles and expansion joints as needed to create an effective heat transfer vessel. Gain a better understanding of the TEMA types to improve your selection process. Among the most common types of heat



transfer equipment used in industrial applications are the various configurations of shell-and-tube heat exchangers. Suitable for a range of pressure and temperature conditions, shell-and-tube heat exchangers can be robust enough to handle corrosive or even lethal fluids.

The shell-and-tube heat exchanger design allows heat transfer between two independent, pressurized chambers through the walls of the tubes. The design consists of an array of tubes, which is connected on each side to a flat plate called a tube sheet. The tube sheet also separates the shell and tube sides of the exchanger. Baffles on the outside of the tubes direct the flow of the shell-side fluid back and forth across the tubes to promote heat transfer. The process fluid can flow through either the shell or tube side, with the opposite side typically acting as the service side (usually a heating or cooling medium). The exchanger also can have a process fluid on both sides.

For most shell-and-tube heat exchanger types, the first step in designing an exchanger for a specific process is thermal design. Given the process conditions and heat transfer requirements, the thermal design determines the exchanger's size, shape, number and size of tubes, number of baffles and baffle pitch, etc. Other factors considered at this stage include allowable pressure drop through the exchanger, any space constraints on the unit, the potential fouling of the unit and any resulting flow-induced vibration from the proposed design.



After the exchanger size is determined by the thermal design, a mechanical design is performed. This step determines the thickness of all parts as well as welding details required for the temperature and pressure conditions.

Many different configurations of shell-and-tube heat exchangers are available. There are advantages and disadvantages to each design, depending on factors such as process and thermal requirements, available space, financial budget and cleaning requirements. This article provides information on several of the most widely used configurations and briefly discusses some of the issues to consider when planning for and selecting a heat exchanger configuration.

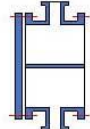
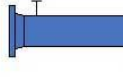
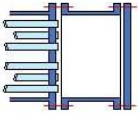
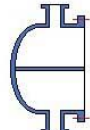
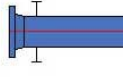
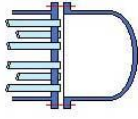
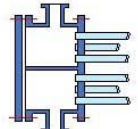
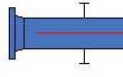
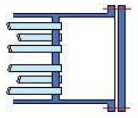
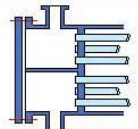
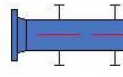
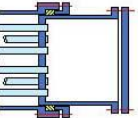
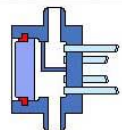
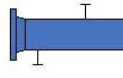
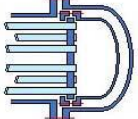
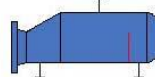
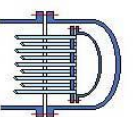
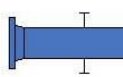
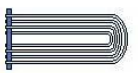
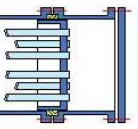
The Tubular Exchanger Manufacturers Association, or TEMA, publishes a standard that establishes design, fabrication, tolerances, installation and maintenance of shell-and-tube type exchangers. This standard and the ASME code are the main standards used to design and fabricate exchangers along with any applicable customer specifications. The TEMA standard also defines the classes and main configuration styles of exchangers.

Heat Transfer by Heat Exchangers TEMA Design

Because of the number of variations in mechanical designs for front and rear heads and shells, and for commercial reasons, TEMA has designated a system of notations that correspond to each major type of front head, shell



type and rear head. The first letter identifies the front head, the second letter identifies the shell type and the third letter identifies the rear head type.

	Stationary Head Types	Shell Types	Rear Head Types
A	 channel and removable cover	E  one pass shell	L  fixed tubesheet like 'A' stationary head
B	 bonnet (integral cover)	F  two pass shell with longitudinal baffle	M  fixed tubesheet like 'B' stationary head
C	 channel integral with tubesheet and removable cover	G  split flow	N  fixed tubesheet like 'C' stationary head
N	 channel integral with tubesheet and removable cover	H  double split flow	P  outside packed floating head
D	 special high pressure closure	J  divided flow	S  floating head with backing device (split ring)
		K  kettle type reboiler	T  pull through floating head
		X  cross flow	U  u-tube bundle
			W  packed floating tube sheet with lantern ring



Removable bundle exchangers

Removable bundle exchangers give the customer the ability to replace the tube bundle without replacing the shell or Bonnets. They are generally less cost effective than non removable designs.

BEU/AEU- U Bundle Exchangers are generally the most cost effective design style of removable bundle exchanger. Tubes may be water blasted, steam or chemically cleaned. These units must have an even number of tube passes, sometimes limiting their applicability to a service(e.g. they generally can not be used when a temperature cross occurs).

CEU- This design has the tube sheet welded to the Bonnet. You can remove the bundle from the shell, however to replace the bundle, the inlet Bonnet is included or you must cut off the tube sheet. Tubes may be chemically cleaned, water blasted or steam cleaned.

BEW/AEW- These are straight tube units with one floating head and one stationary head. The floating head is generally sealed with an O-Ring. These units are most often used as oil coolers or air coolers. Cleaning can be performed by either a chemical, mechanical method, water blast or steam cleaning.

AEP/BEP- These are straight tube units with one inside packed floating head and one stationary head. The floating head is generally sealed with packing.

These units are most often used as intercoolers and aftercoolers with the gas



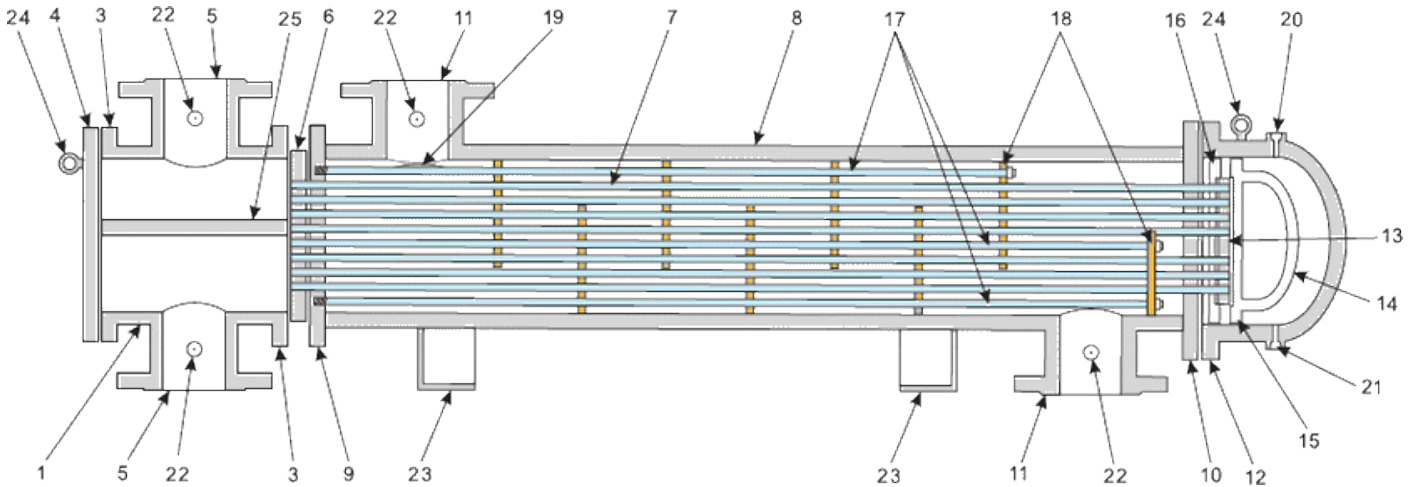
on the tube side. They are also the most common style for oxygen service exchangers. These units have been used in services with tube side design pressures in excess of 2000 PSIG.

TEMA, Tubular Exchanger Manufacturers Association

AES/AET- These units are the most expensive of the removable bundle designed units. The floating head is internal to the shell. Tubes can be cleaned mechanically , chemically, water blasted or steam cleaned. The design of these units forces an even number of tube side passes therefore they suffer the same service restrictions as U bundles. Although in theory one pass unit can be designed, this is rarely done. These units are generally used in services where U bundles are not desired and the service may be too corrosive/damaging to the packing used in AEP/BEP units.



Heat Exchanger TEMA type AES with Floating Head



- | | |
|---|--|
| 1. Stationary Head-Channel | 13. Floating Tubesheet |
| 2. Stationary Head-Bonnet | 14. Floating Head Cover |
| 3. Stationary Head Flange Channel or Bonnet | 15. Floating Head Cover Flange |
| 4. Channel Cover | 16. Floating Head Backing Device |
| 5. Stationary Head Nozzle | 17. Tierods and Spacers |
| 6. Stationary Tubesheet | 18. Transverse Baffles or Support Plates |
| 7. Tubes | 19. Impingement Plate |
| 8. Shell | 20. Vent Connection |
| 9. Shell Flange, Stationary Head End | 21. Drain Connection |
| 10. Shell Flange, Rear Head End | 22. Instrument Connection |
| 11. Shell Nozzle | 23. Support Saddle |
| 12. Shell Cover Flange | 24. Lifting Lug |
| | 25. Pass Partition |

Non removable bundle exchangers

These types of units are often used in high pressure services and services where you wish to avoid leakage problems at gasketed joints. Another advantage is that they are generally more cost effective than removable bundle designs.



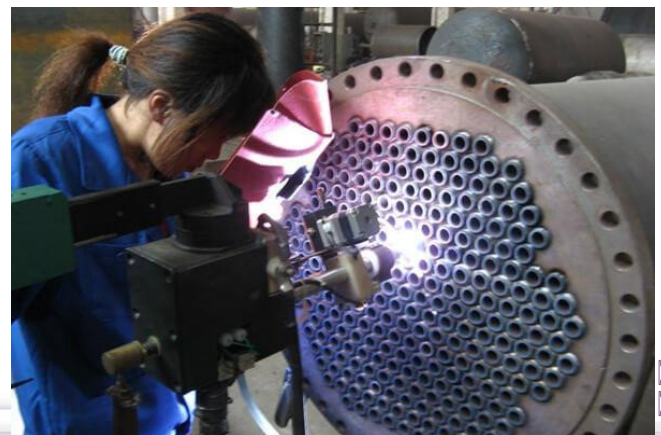
NEU- The most cost effective design available. The tube sheet is welded to both the shell and Bonnet. There is no access to the shell. Tubes may be chemically cleaned, water blasted or steam cleaned from inside only. These units are commonly used in high pressure services (such as feedwater heaters), where process conditions allow for even pass exchangers.

NEN- Tube sheets are welded to both the Shell and Bonnets. Access to the tubes is through covers on the channels. These units are favored in very high pressure designs as their construction minimizes the tube sheet thickness and number of high pressure retaining flanges.

AEM/BEM/AEL-SHELL side is completely welded up, however, the Bonnets are removable. Chemical, mechanical, and water blast cleaning of the tubes is possible, however you do not have access to the shell.

You should avoid using Steam cleaning on a fixed tube sheet unit unless the unit has a shell side expansion joint. The steam will cause the tubes to expand and pull out of the Tube Sheet causing failure at startup.

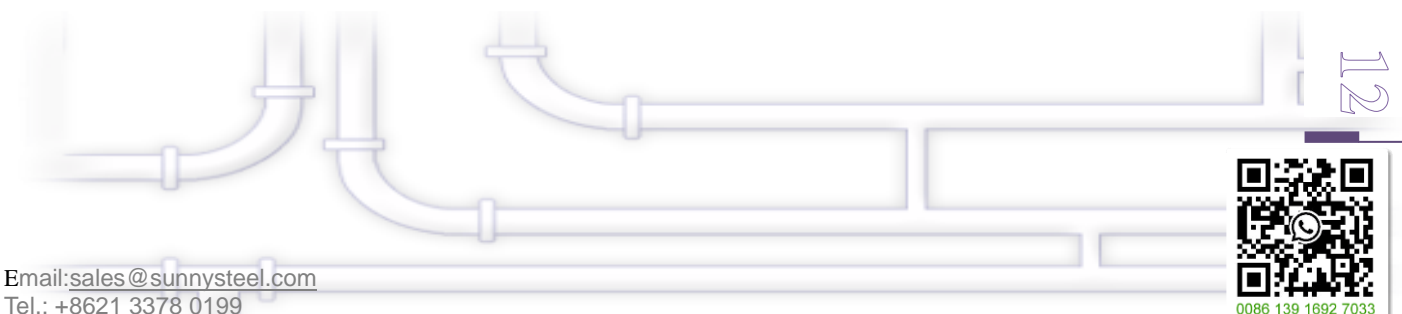
How is the heat exchange tube connected with the tube sheet?



The connection form of heat exchange tube and tube plate mainly includes expansion, welding, expansion welding, etc. The strength expansion joint refers to the expansion of the sealing performance and tensile strength of the connection between the heat exchange tube and the tube sheet. It relies on the plastic deformation of the tube end to withstand the pulling force. The residual stress after the expansion of the tube will gradually weaken when the temperature increase so that the sealing performance and strength of the connection between the tube and the tube sheet will decrease.

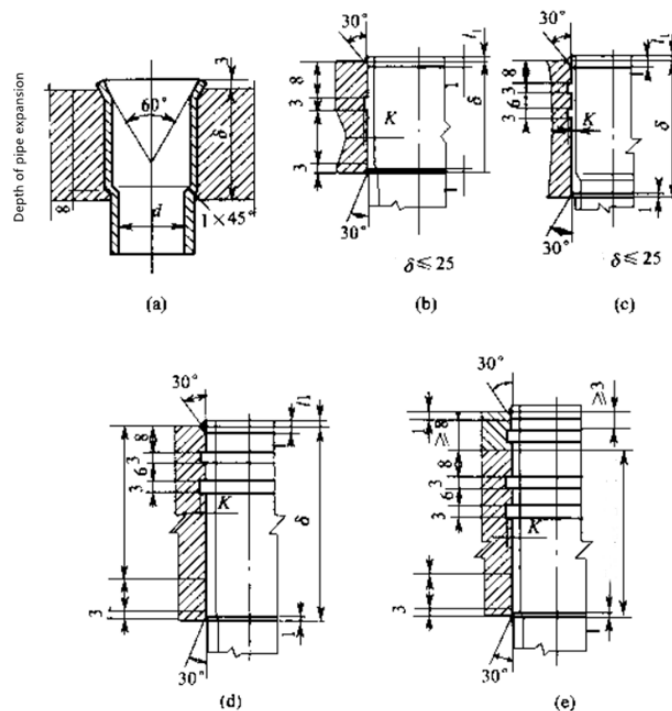
Therefore, the strength expansion is suitable for the design pressure is less than or equal to 4MPa, the design temperature is less than or equal to 300°C. The strength expansion should not be used in the case of severe vibration, large temperature difference, or obvious stress corrosion during operation.

When expanding the tube, the hardness of the tube should be lower than that of the tube sheet. The gap between the pipe and the pipe and the smoothness of the pipe affects the quality of the expanding pipe. The rough surface of the pipe hole can produce a large friction force and is not easy to pull off, but it is easy to produce leakage. The surface of the pipe hole is strictly prohibited to have a longitudinal through the groove. The smooth surface of the tube hole is not easy to leak, but easy to pull off. Generally, the surface roughness is required to be less than or equal to 12.5 μm . There are two kinds of pipe holes:

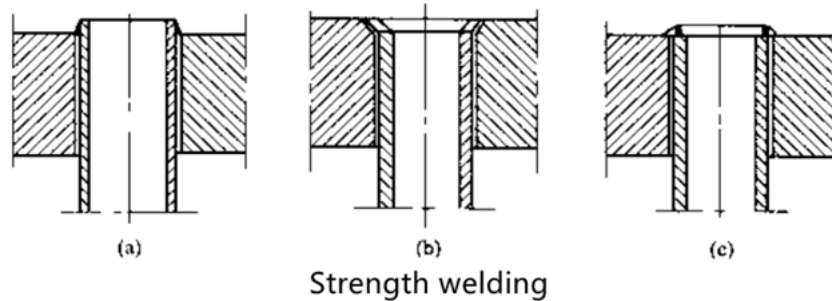


holes and annular grooving, the former as shown in figure (a) below, and the latter as shown in Figure (b) and (c) below.

After grooving, the steel tubes are squeezed into the grooves when expanding, which can improve the pull-off resistance and enhance the sealing performance. The number of annular slots in the tube hole depends on the thickness of the tube plate. Generally speaking, a slot is opened when the thickness is less than 25mm, and two slots are opened when the thickness is greater than 25mm. When the tube plate is thick or to avoid gap corrosion, the structure shown in the following figure (d) can be used, the composite tube plate and heat exchange tube can also be expanded, when the cladding is greater than or equal to 8mm, should be in the groove on the tube hole, the structure is shown in the following figure (e).



Strength welding refers to ensure the sealing performance and tensile strength of the heat exchange tube and tube sheet connection, is the most widely used tube sheet connection types. Strength welding manufacturing is simple, the tensile ability is strong, such as welding part failure, can be secondary repair welding, more convenient heat exchange tube. The use of strength welding is not limited by pressure and temperature, but it is not suitable for the occasion of large vibration or gap corrosion. The general form of strength welding is shown in figure (a) below. In order to avoid liquid accumulation around the pipe end, the structure as shown in figure (b) below is often used. The structure as shown in figure (c) below is generally used in the situation where the tube sheet is stainless steel.



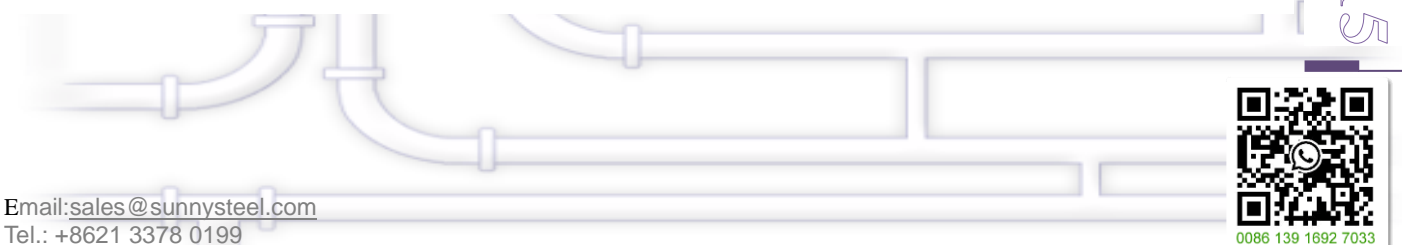
The sealing performance of the joint between tube and tube plate is required to be high, or there is clearance corrosion, withstand severe vibration and other occasions, single expansion or welding can not meet the requirements, the combination of the two can provide enough strength and good sealing performance. The combination of expansion and welding can be divided into two kinds according to the expansion and welding sequence: expansion and



welding after expansion. The general expansion method will inevitably have oil stains in the joint gap, which will be welded after expansion. These oil stains and the air in the gap will reduce the weld quality.

Weld before expansion, will cause damage to the weld. At present, there is no uniform provision for the choice of the two orders. In the actual engineering, such as expansion after welding, before welding should be clean oil; If the first welding after expansion, should be a limit to the expansion position of the tube end, generally to control from the surface of the tube plate 15mm above the scope of expansion. The first expansion and then welding generally adopts the form of strength expansion and seal welding. The strength expansion ensures the sealing performance of the tube and tube sheet, providing enough tensile strength, and the seal welding further ensures the sealing performance of the tube and tube sheet. The structure is shown in the figure (a). Strength welding ensures the sealing performance of the tube and tube sheet, providing sufficient tensile strength, and sticking expansion eliminate the gap between the tube and the tube hole to ensure the sealing performance. The structure is shown in figure (b).

In essence, explosive expansion is also a kind of strength expansion, the latter usually adopts roller expansion, the former uses the explosive in a very short period of time to produce high-pressure gas shock wave to make the pipe firmly attached to the tube hole. High explosive expansion and connection



efficiency, no need of lubricating oil, easy to weld after expansion, large tensile strength, small axial elongation and deformation.

Explosive expansion is suitable for thin wall tubes, small diameter tubes and large thickness tube sheet expansion, heat exchange tube end leakage, mechanical expansion is difficult to repair the occasion.

Advantages of U tube heat exchanger

U tube heat exchanger is characterized by its simple structure, good tightness, convenient maintenance and cleaning, low cost, good thermal compensation performance and strong pressure bearing capacity. The U-tube heat exchanger has the largest heat exchange area under the same diameter. The main structure of U-shaped tube heat exchanger includes tube box, cylinder, head, heat exchange tube,



nozzles, baffle, anti-shock plate and guide tube, anti-short circuit structure, support and other accessories of the shell and tube side, is the most commonly used in shell and tube heat exchanger.

Tube sheet

Tube sheet is one of the most important parts of shell – tube heat exchanger. The tube plate is the barrier between the shell side and the pipe side. When the heat exchange medium has no corrosion or slight corrosion, it is generally made of low carbon steel, low alloy steel or stainless steel. The connection form of tube-sheet and shell is divided into non-detachable and detachable types. The former is the connection between tube-sheet and shell in the fixed tube-sheet heat exchanger. The latter, such as U-shaped tube type, floating head type and stuffing box type and sliding tube plate type heat exchanger tube plate and shell connection. For removable connections, the tube plate itself is usually not in direct contact with the shell, but the flange is connected to the shell indirectly or is clamped by two flanges on the shell and the tube box.

Tube box

Most of the shell tube heat exchangers with larger shell diameters adopt tube and box structures. The tube box is located at both ends of the heat exchanger, which evenly distributes the fluid from the pipe to the heat exchanger tubes and gathers the fluid in the tubes together to send out the



heat exchanger. In a multi-pipe shell, the casing can also change the flow direction. The structure of the tube box is mainly determined by whether the heat exchanger needs to be cleaned or whether the tube bundle needs to be divided.

Shell and U-tube heat exchanger has become the most commonly used structure type of heat exchanger in the field of petrochemical industry due to many advantages, but it also has some disadvantages such as pipe cleaning is more difficult, the utilization rate of tube plate is low due to the limitation of curvature radius of bend pipe; The distance between the innermost tubes of the tube bundle is large, the shell process is easy to short circuit, and the scrap rate is high. It is suitable for large temperature difference between pipe and shell wall or shell side where medium is easy to scale and needs cleaning, and is not suitable for using floating and fixed tube plate type occasions, especially suitable for clean and not easy to scale under high temperature, high pressure, corrosive medium.

What is a tube sheet (tube sheet) in heat exchanger ?

A tube sheet is usually made from a round flat piece of plate, sheet



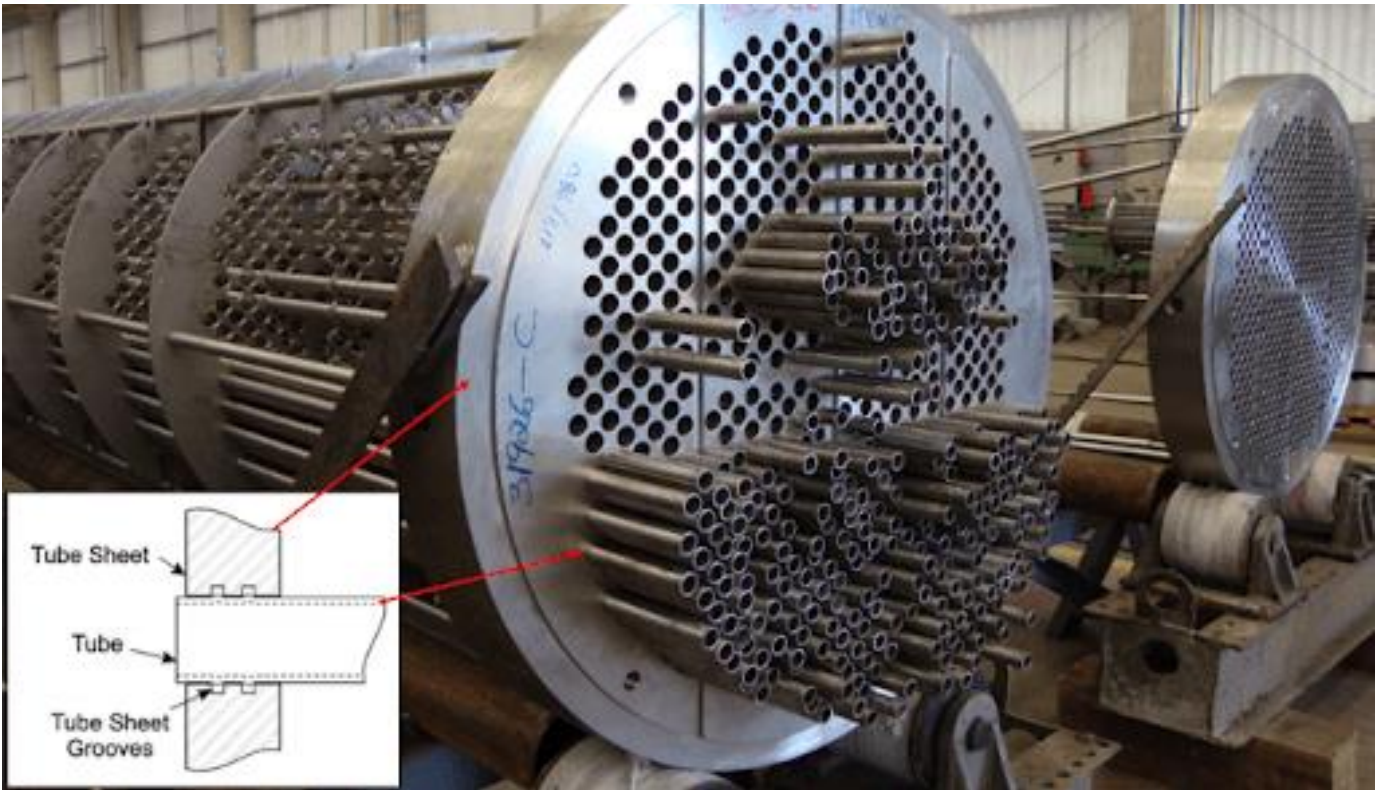
with holes drilled to accept the tubes or pipes in an accurate location and



pattern relative to one another. The tube sheets are used to support and isolate tubes in heat exchangers and boilers or to support filter elements. Tubes are attached to the tube sheet by hydraulic pressure or by roller expansion. A tube sheet may be covered in a cladding material which serves as a corrosion barrier and insulator. Low carbon steel tube sheets can include a layer of a higher alloy metal bonded to the surface to provide more effective corrosion resistance without the expense of using the solid alloy, which means it can save a lot of cost.

Tube sheet is one of the most important parts of shell – tube heat exchanger. The tube plate is the barrier between the shell side and the pipe side. When the heat exchange medium has no corrosion or slight corrosion, it is generally made of low carbon steel, low alloy steel or stainless steel. The connection form of tube-sheet and shell is divided into non-detachable and detachable types. The former is the connection between tube-sheet and shell in the fixed tube-sheet heat exchanger. The latter, such as U-shaped tube type, floating head type and stuffing box type and sliding tube plate type heat exchanger tube plate and shell connection. For removable connections, the tube plate itself is usually not in direct contact with the shell, but the flange is connected to the shell indirectly or is clamped by two flanges on the shell and the tube box.





Perhaps the best known use of tube sheets are as supporting elements in heat exchangers and boilers. These devices consist of a dense arrangement of thin walled tubes situated inside an enclosed, tubular shell. Tubes are supported on either end by sheets which are drilled in a predetermined pattern to allow the tube ends to pass through the sheet. The ends of the tubes which penetrate the tube sheet are expanded to lock them in place and form a seal. The tube hole pattern or “pitch” varies the distance from one tube to the other and angle of the tubes relative to each other and to the direction of flow. This allows the manipulation of fluid velocities and pressure drop, and provides the maximum amount of turbulence and tube surface contact for effective Heat Transfer.

In cases where it is critical to avoid fluid intermixing, a double tube sheet can be provided. The design of tube sheets is a fairly precise and complex process; the exact number of tubes needs to be established and a pattern of holes calculated to spread them evenly over the tube sheet surface. Large exchangers may have several thousand tubes running through them arranged into precisely calculated groups or bundles. Sheet design and production is largely automated these days with computer software (like CAD) performing the calculations and the tube sheet drilling done on computer numerical control (CNC) machines. In this design, the outer tube sheet is outside the shell circuit, virtually eliminating the chance of fluid intermixing. The inner tube sheet is vented to atmosphere so any fluid leak is easily detected. Duwa Piping factory drilling department has professional drilling equipment and working team, we can provide the best quality tube sheet for you.

ASTM standards for Heat-exchanger and condenser tubes

Abbr.	Corresponding	Application
A179	ASTM A179 / A179M	Standard Specification for Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes
A213	ASTM A213/A213M	Specification for Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes
A214	ASTM A214 / A214M	Specification for Electric-Resistance-Welded Carbon Steel Heat-Exchanger and Condenser Tubes
A249	ASTM A249 / A249M	Specification for Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes
A498	ASTM A498 / A498M	Specification for Seamless and Welded Carbon, Ferritic, and Austenitic Alloy Steel Heat-Exchanger Tubes with Integral Fins
A851	ASTM A851 / ASME SA851	Specification for High-Frequency Induction Welded, Unannealed, Austenitic Steel Condenser Tubes



What is 10MnDG?

10MnDG is a type of seamless steel pipe that belongs to the family of high-pressure boiler tubes. It is a low-alloy steel pipe with a chemical composition that includes carbon (C), silicon (Si), manganese (Mn), phosphorus (P), sulfur (S), and other trace elements.

The chemical composition of 10MnDG typically includes:

- Carbon (C): 0.08-0.13%
- Silicon (Si): 0.17-0.37%
- Manganese (Mn): 0.70-1.00%
- Phosphorus (P): $\leq 0.025\%$
- Sulfur (S): $\leq 0.015\%$
- Other trace elements such as chromium (Cr) and nickel (Ni)

10MnDG seamless steel pipe is mainly used in the manufacture of high-pressure and ultra-high-pressure boilers and pressure vessels. The pipes are designed to withstand high-pressure and high-temperature environments, making them suitable for use in applications such as power generation, chemical processing, and oil and gas refining.

10MnDG is a reliable material with excellent mechanical properties, including high strength, toughness, and resistance to creep deformation at high



temperatures. These characteristics make it an ideal choice for use in critical applications where performance and reliability are essential.

Overall, 10MnDG seamless steel pipe is an important component of industrial piping systems, providing safe and efficient means for transporting fluids at high pressures and temperatures.

What is 16MnDG?

16MnDG is a type of seamless steel pipe that is commonly used in the manufacturing of high-pressure vessels and boilers. It belongs to the family of low-alloy steels and has a chemical composition that includes carbon, silicon, manganese, phosphorus, sulfur, and other trace elements.

16MnDG seamless steel pipe has good mechanical properties, including high strength, toughness, and resistance to creep deformation at high temperatures. These characteristics make it an excellent choice for use in high-pressure and high-temperature environments, such as in the manufacture of boilers, pressure vessels, and other equipment used in power generation and chemical processing industries.

The seamless nature of 16MnDG pipes ensures uniformity and consistency in their structure, which makes them less prone to defects or failures. This enhances their reliability and safety, providing a secure means for transporting fluids at high pressures and temperatures. 16MnDG seamless steel pipe is an



important component of industrial piping systems, providing a reliable and efficient means for transporting fluids in harsh and demanding environments.

What is 09DG?

09DG is a type of seamless steel pipe that belongs to the family of high-temperature and pressure-resistant steel pipes. It has a chemical composition that includes carbon, silicon, manganese, phosphorus, sulfur, and other trace elements.

The chemical composition of 09DG typically includes:

- Carbon (C): 0.07-0.12%
- Silicon (Si): 0.17-0.37%
- Manganese (Mn): 0.40-0.70%
- Phosphorus (P): $\leq 0.025\%$
- Sulfur (S): $\leq 0.015\%$
- Other trace elements such as chromium (Cr) and nickel (Ni)

09DG seamless steel pipe is designed to withstand high-temperature and high-pressure conditions, making it suitable for use in the manufacture of boilers, heat exchangers, and other equipment used in the power generation and chemical processing industries.

The seamless nature of 09DG pipes ensures that they have a homogeneous and consistent structure, which reduces the likelihood of defects or failures.



This enhances their safety and reliability, providing a secure means for transporting fluids under high pressures and temperatures.

09DG seamless steel pipe has excellent mechanical properties, including high strength, good toughness, and resistance to creep deformation at high temperatures. These characteristics make it an ideal material for use in critical applications where performance and reliability are essential.

Overall, 09DG seamless steel pipe is an important component of industrial piping systems, providing a reliable and efficient means for transporting fluids at high pressures and temperatures.

Types of heat exchanger tubes

The heat exchange tube is one of the elements of the heat exchanger, which is placed in the cylinder and used for heat exchange between the two media. Has high thermal conductivity and good isothermal properties. It is a device that can quickly transfer heat energy from one point to another with almost no heat loss, so it is called a heat transfer superconductor, and its thermal conductivity is thousands of times that of copper.

Form

In addition to plain tubes, heat exchangers can also use a variety of enhanced heat transfer tubes, such as finned tubes, threaded tubes, spiral grooved tubes, etc. When the heat transfer coefficient on both sides of the inner



diameter of the tube has a large difference, the fins of the finned tube should be arranged on the side with the lower heat transfer coefficient.

Size

The commonly used dimensions of heat exchange tubes (outer diameter x wall thickness) are mainly $\Phi 19\text{mm} \times 2\text{mm}$, $\Phi 25\text{mm} \times 2.5\text{mm}$ and $\Phi 38\text{mm} \times 2.5\text{mm}$ seamless steel pipes and $\Phi 25\text{mm} \times 2\text{mm}$ and $\Phi 38\text{mm} \times 2.5\text{mm}$ stainless steel pipes. Standard pipe lengths are 1.5, 2.0, 3.0, 4.5, 6.0, 9.0m, etc. The use of small pipe diameter can increase the heat transfer area per unit volume, the structure is compact, the metal consumption is reduced, and the heat transfer coefficient is improved. It is estimated that by changing the heat exchange tube of the same diameter heat exchanger from $\Phi 25\text{mm}$ to $\Phi 19\text{mm}$, the heat transfer area can be increased by about 40%, and the metal can be saved by more than 20%. However, the small diameter of the pipe has large fluid resistance, which is inconvenient to clean and easy to scale and block. Generally, large diameter pipes are used for viscous or dirty fluids, and small diameter pipes are used for cleaner fluids.

Material

Commonly used materials are carbon steel, low alloy steel, stainless steel, copper, copper-nickel alloy, aluminum alloy, titanium, etc. In addition, there are some non-metallic materials, such as graphite, ceramics,



polytetrafluoroethylene, etc. In the design, appropriate materials should be selected according to the working pressure, temperature and corrosiveness of the medium.

Center distance

The arrangement of heat exchange tubes on the tube sheet mainly includes equilateral triangle, square and corner equilateral triangle and corner square. The equilateral triangle arrangement can arrange the maximum number of tubes on the same tube sheet area, so it is most commonly used, but it is not easy to clean the outside of the tube. To facilitate cleaning outside the tubes, tube bundles in a square or corner square arrangement can be used. The center distance of the heat exchange tube should ensure that the tube bridge (clearance distance between two adjacent tubes) has sufficient strength and width when the tube is connected to the tube sheet. When cleaning is required between the tubes, a channel for cleaning should also be reserved. The center distance of the heat exchange tubes should not be less than 1.25 times the outer diameter of the heat exchange tubes. The most commonly used center distances of the heat exchange tubes are as follows. Commonly used heat exchange tube center distance (mm).

outer diameter	10	12	14	16	19	20	25	32	35	38	45	50	57
center distance	13~14	16	19	22	25	26	32	40	44	48	57	64	72



How to determine the central moment of the heat exchange tube?

The central moment of the heat exchange tube is generally not less than 1.25 times the outer diameter of the heat exchange tube, which is mainly considered: During expansion, the elastic deformation ranges between the pipe holes do not intersect; when welding, leave a certain distance between the welds of each pipe section to reduce the welding stress between them. For slot welding around the tube hole on the tube sheet, the central moment of 125% of the outer diameter of the heat exchange tube is already the lower limit, and more than 132% of the outer diameter of the tube can be taken when conditions permit; this value is greater than or equal to 25mm. For heat pipes, it is convenient enough to clean the tube bundle, but for heat exchange tubes with an outer diameter of less than 25mm, in order to facilitate cleaning, the clear distance between the tubes should be 6mm.

Why can the heat exchange tubes not consider the corrosion allowance?

The corrosion of the heat exchange tube definitely exists, but it is mainly concentrated in the pipe joints, and uniform corrosion is generally not the main problem; the heat exchange tube is a heat exchange element, if it is too thick, it will affect the heat exchange efficiency; the diameter of the heat exchange



tube is very large. If it is small, the corresponding calculated thickness is also small, and the corrosion allowance is still there, but it is not as large as the shell, so its design service life is shorter than that of the shell; if the corrosion is serious, corrosion-resistant materials can be used. For example, some heat exchanger tubes are made of stainless steel, while the shells and heads of the shell side and tube side are all carbon steel; if the heat exchange tubes are corroded and penetrated, they can be replaced; The way to solve it, insist on using it until the next overhaul in order to replace the new heat exchanger.

What are the special requirements for heat exchange tubes?

The heat exchange tube is a pressure component. In addition to the material properties that it should have as a pressure component, the heat exchange tube itself has its own special requirements: high dimensional accuracy (outer diameter, wall thickness, length); material plasticity and toughness Good, especially for tube expansion, flanging and bending; welding performance of thin-walled tubes; low hardness value, generally lower than the hardness value of tube sheet; high test pressure.



What are the requirements for the number of multi-tube heat exchange tubes?

The number of tubes in each process of the multi-tube process should be as equal as possible, and the relative error should be controlled within 10%, and the maximum should not exceed 20%.

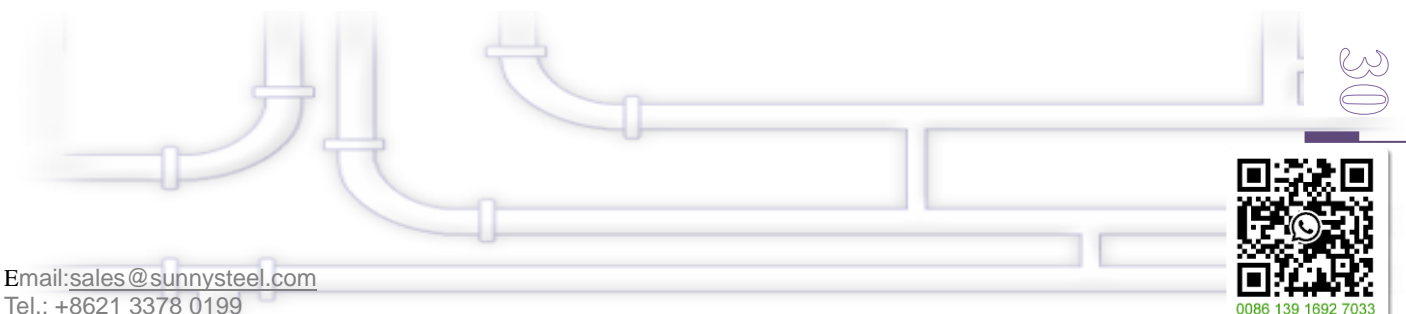
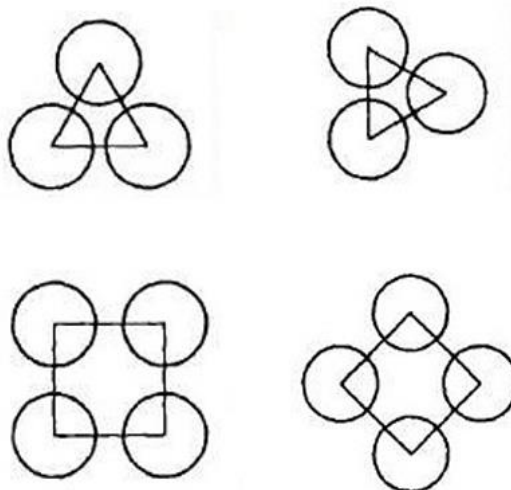
The relative error is calculated as follows:

$$\Delta N = \frac{[N_{CP} - N_{\min(\max)}]}{N_{CP}} \times 100\%$$

NCP : Average tube bundles for each tube pass

Nmin(max) : Minimum (maximum) number of tubes for each scale

What are the arrangements of heat exchange tubes?



There are four standard arrangements of heat exchange tubes: equilateral triangle, corner equilateral triangle, square, and corner square. Its arrangement is related to the flow direction of the fluid and the direction of the baffle notch. The direction of fluid flow is perpendicular to the notch of the baffle. To convert between equilateral triangles and corner equilateral triangles, it is necessary to rotate the piping by 90°. If the tube is rotated 90°, the arrangement of the heat exchange tubes is an equilateral triangle arrangement; if the tube is rotated 90°, the arrangement of the heat exchange tubes is an equilateral triangle. To convert between square and corner square, you need to rotate the pipe by 45° (note that 45° is not 90° here). If the tube is rotated 90°, the arrangement of the heat exchange tubes is still a square, and if the tube is rotated 45°, the arrangement of the heat exchange tubes is a corner square; if the tube is rotated 90°, the arrangement of the heat exchange tubes is still the corners are square, and if the pipe is rotated 45°, the heat exchange tubes are arranged in a square form.



Stainless heat exchanger tubes



Stainless heat exchanger tubes in an extensive range of austenitic stainless steels, duplex stainless steels, nickel alloys, titanium and zirconium, suitable for all types of heat exchangers, such as seawater coolers, condensers, evaporators, heaters and reheaters.

Heat exchanger tube in an extensive range of austenitic stainless steels, duplex stainless steels, nickel alloys, titanium and zirconium, suitable for all types of heat exchangers, such as seawater coolers, condensers, evaporators, heaters and reheaters.



HF finned tube for heat exchangers

HF Finned Tube is a type of heat exchanger tube that is designed to increase the surface area of the tube and enhance the heat transfer efficiency.



Note: Mill test certificates will be issued according to EN10204.3 3.1 or 3.2

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