

Tantalum heat exchangers and condensers

Tantalum is the most corrosion-resistant metal in common use today. It is inert to practically all organic and inorganic compounds, with a corrosion resistance very similar to glass. Tantalum is often used for the manufacture of dip tubes, piping and overhead condensers.

Text and images courtesy of Mersen

Applications of Tantalum should be considered wherever corrosion is a factor and where long-term benefits such as reduced downtime, increased life expectancy and profitability are important. Tantalum heat exchangers are used in ultra-corrosive and oxidizing applications, for example with concentrated sulfuric acid, nitric acid, free chlorine, or free bromine. They are also widely used as vapor condensers in multipurpose fine chemical and pharmaceutical applications. Mersen Linsengericht, near Frankfurt Germany, is a center of competence dedicated to the design and manufacturing of tantalum process equipment such as heat exchangers, pressure vessels, columns, and custom-made parts. The company's 3200 m² workshop enables the production of very large pieces of tantalum equipment (up to 4.4 meters in width and up to 4.2 meters in height, with a maximum weight of 20 tons).

Tantalum STHs for vertical or horizontal installation

Shell and tube heat exchangers (STHs) are the most common type of heat exchanger used in chemical processes and they are well-suited for high-pressure applications. This type of heat exchanger consists of a shell with a bundle of tubes inside it. One fluid runs through the tubes and another fluid flows over the tubes, to transfer heat between the two fluids. Mersen tantalum shell & tubes heat exchangers are specifically designed for condensation inside the tubes.



⚡ Tantalum shell and tube heat exchangers with glass lined headers.



⚡ Tantalum bayonet heat exchangers.

They can be installed horizontally or vertically. Key elements of the equipment include:

- $\frac{3}{4}$ " or 1" Ta2.5W tubes are used. They have a nearly 3 times higher mechanical strength than pure Ta tubes, with the identical corrosion resistance.
- The tube (0.4, 0.5, or 0.76 mm) and the tube sheet (0.5 or 0.76 mm) wall thicknesses are adapted to meet the customers' requirements in terms of pressure rating and cost.
- Up to 580 tubes, DN 800, 202 m² heat exchange surface

What is Tantalum?

The chemical element Tantalum (Ta) is a bright, silver-grey metal of Group 5 (Vb) of the periodic table. It is characterized by its high density, extremely high melting point, and excellent corrosion resistance to all acids except hydrofluoric acid at ordinary temperatures.

Closely associated with niobium in ores and in properties, tantalum was discovered (1802) by the Swedish chemist Anders Gustaf Ekeberg and named after the mythological character Tantalus because of the tantalizing problem of dissolving the oxide in acids. (Source: Britannica.org)

The material is welded by TIG. Extreme care is required to ensure that all surfaces, which due to the heat of welding reach temperatures above 300°C, are shielded with inert gas. Helium, argon, or a mixture of these two gases provides an atmosphere that prevents embrittlement by absorption of oxygen, nitrogen, or hydrogen into the heated metal. In the presence of a pure, inert atmosphere, the fusion and adjacent area will remain ductile. The duration of the weld should be kept as short as possible to avoid excessive external heating. Heated surfaces should be protected by appropriate gas shielding which cools the parts, limits the heat zone, and excludes air from the heat zone.



⚡ Tantalum bayonet heat exchanger with twisted tubes.



⚡ Tantalum U bundle heat exchanger.

The lip welding design is the standard design for connection of the tubes to the tube sheets. The flush mount welding design reduces the risk of fluid retention and makes for easier cleaning.

Shell and tube heat exchanger with twisted tantalum tubes

Heat Exchangers equipped with twisted tantalum tubes are more efficient than conventional tantalum shell and tube heat exchangers, when the fluid velocities are low or when the fluids are viscous.

Shell and tube heat exchangers fitted with twisted tantalum tubes require less heat transfer surface than conventional shell and tube heat exchangers and are therefore more compact and cheaper since they require less tantalum material.

Tantalum hairpin heat exchangers

Hairpin heat exchangers use true counter-current flow. Unlike multi-pass shell and tube designs, where correction factors are used to account for inefficiencies resulting from co-current passes, this hairpin design maximizes temperature differences between shell-side and tube-side fluids.



⚡ Tantalum bayonet heat exchangers.

Tantalum bayonet heaters

Bayonet heaters are vertical, often relatively small, liquid evaporators, which use steam as a heating medium. The design, typically consisting of a pair of concentric tubes, allows free tube expansion capabilities. For optimal results, the tube bundle is completely immersed in the tank and the bayonet is directly exposed to the fluid.

Tantalum u-bundle heat exchangers

Mersen tantalum U-bundle heat exchangers are designed for condensation inside or outside of the tubes. They are usually installed horizontally. Key elements include:

- $\frac{3}{4}$ " or 1" Ta2.5W tubes are used. They have nearly 3 times higher mechanical strength than pure Ta tubes, with the identical corrosion resistance.
- The tube (0.4, 0.5, or 0.76 mm) and the tube sheet (0.5 or 0.76 mm) wall thicknesses are adapted to meet the customers' requirements in terms of pressure rating and cost.
- up to 490 tubes, 317 m² heat exchange surface.

Summary

Tantalum is both a reactive and a refractory metal and can be welded under a protective atmosphere. A thin layer of tantalum oxide at its surface ensures outstanding corrosion resistance against ultra-corrosive and oxidizing chemicals including concentrated sulfuric acid, free chlorine or free bromine amongst others.

Tantalum heat exchangers, pressure vessels, reactors and columns are used in ultra-corrosive and oxidizing applications, for example with concentrated sulfuric acid, nitric acid, free chlorine or free bromine.

Thanks to its high level of ductility, tantalum is especially suitable for forming processes such as bending, stamping, or pressing.

About the Company

Mersen is a global expert in electrical specialties and advanced materials for high-tech industries. With more than 50 industrial sites and 16 R&D centres in 35 countries around the world, Mersen develops customized solutions and delivers key products to its clients to meet the new technological challenges shaping tomorrow's world.