

Heat Transfer Performance Comparison Turbotec Twisted Tube versus Integrally Finned Tube

A series of tests were conducted in Turbotec's engineering laboratory to compare the heat transfer characteristics of Turbotec's titanium twisted tube and an integrally finned titanium tube. Three types of tests were conducted: 1.) water-to-water hydronics test to determine the overall heat transfer coefficient, 2. tube side pressure drop vs. water flow rate, and 3.) shell side pressure drop vs. water flow rate.

The Turbotec design considered for these tests was a 4 flute, 7/8" OD titanium twisted tube. The integrally finned tube was constructed from a 3/4" OD titanium tube. Each tube configuration was installed in a 1.5" OD pipe.

The hydronics testing was conducted with 110°F water flowing inside the tube and 80°F water flowing on the shell side in a counter flow arrangement. As shown in Figure 1, the overall heat transfer coefficient of the Turbotec twisted tube is significantly higher than an integrally finned tube. Turbotec's better heat transfer can be attributed to a combination of factors. First, the external flute geometry acts as numerous flow dispersion and turbulence evoking fins. Second, the internal flow is manipulated by the spiral pattern which produces a turbulent flow pattern that spins relative to the tube geometry. These effects can be observed in the higher tube side and shell side pressure drops shown in Figures 2 and 3.

DIMENSIONAL COMPARISON – TUBE GEOMETRY

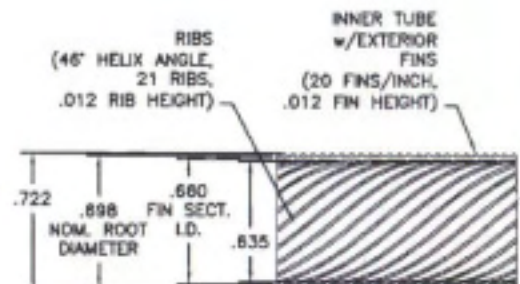
**Turbotec 4 Flute;
7/8"OD Twisted Titanium Tube**



Convex End

Concave End

**Integrally Finned
Titanium Tube**



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Overall Heat Transfer Coefficient

Turbotec Twisted Titanium Tube vs. Integrally Finned Tube

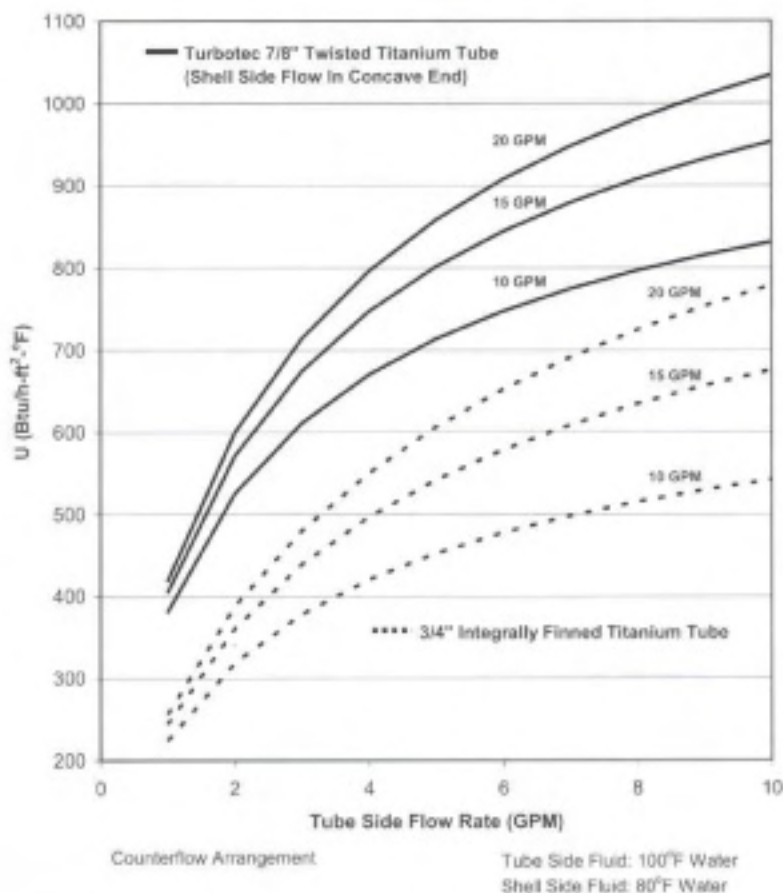


Figure 1 – U vs. Tube Side Flow Rate

Tube Side Pressure Drop

Turbotec Twisted Titanium Tube vs. Integrally Finned Tube

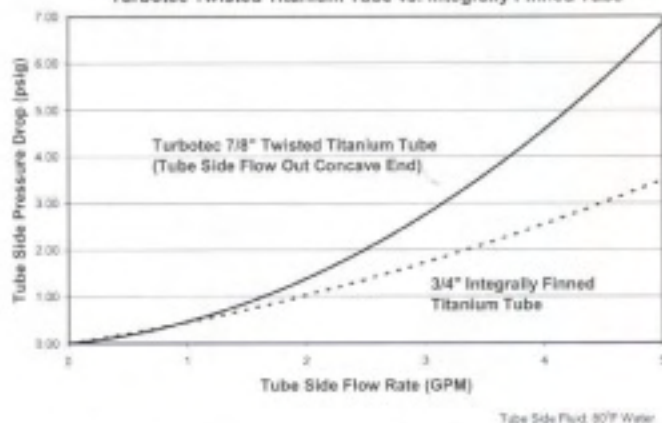


Figure 2 – Tube Side ΔP vs. Flow Rate

Shell Side Pressure Drop

Turbotec Twisted Titanium Tube vs. Integrally Finned Tube

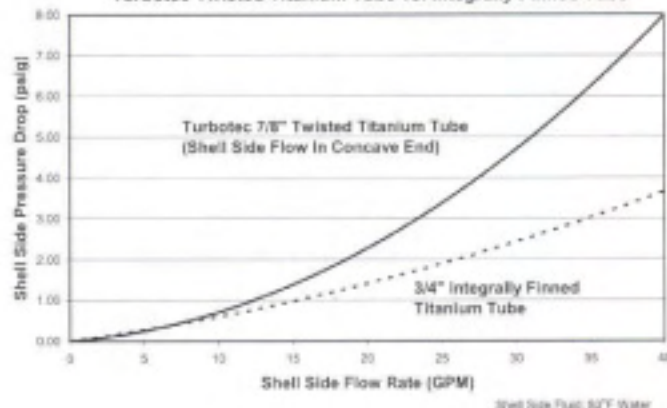


Figure 3 – Shell Side ΔP vs. Flow Rate

Heat Transfer Performance

At a tube side water flow rate of 10 gpm and a shell side water flow rate of 10 gpm, the heat transfer coefficient for the 7/8" OD titanium twisted tube is 831 Btu/h-ft²-°F compared to 542 Btu/h-ft²-°F for the 3/4" OD integrally finned titanium tube. This equates to 1.5 times improved heat transfer for the Turbotec twisted tube when compared to the integrally finned tube.

When considering the additional surface area that the Turbotec tube provides per linear foot versus the integrally finned titanium tube, additional heat transfer benefits can be realized in applications requiring a compact heat exchanger design. At the same tube side and shell side water flow rates described above, the UA per linear foot for the Turbotec titanium twisted tube is 2.4 times greater than the integrally finned titanium tube (237 Btu/h-ft²-°F vs. 98 Btu/h-ft²-°F).

Pressure Drop

The tube side pressure drop per linear foot for Turbotec's 7/8" OD titanium twisted tube can be up to 2 times greater than the integrally finned titanium tube at water flow rates up to 5 gpm. The shell side pressure drop per linear foot for Turbotec's 7/8" OD titanium twisted tube - in a 1.5" OD Schedule 40 plastic pipe - can be 1.6 to 2.1 times higher than the integrally finned titanium tube at water flow rates of 20 and 40 gpm, respectively.