



ENABLING APPLICATION SPECIFIC HEAT TRANSFER ENHANCEMENT IN

Steam & Thermic Oil Heating

VorTX Wire
Turbulators



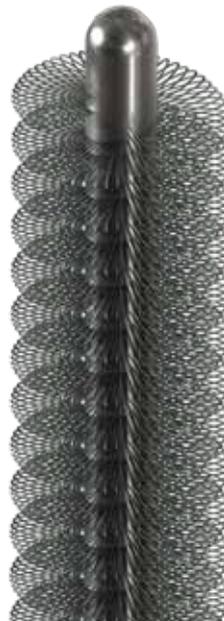
VorTX Spiral
Turbulators



Twisted Tape
Turbulators



Rigid Soldered
Turbulators



Wire Wound
Fin Tubes



Finding the right turbulator for an application is an exercise we are equipped to handle.

We make a bunch of different turbulator types and many different geometries within those types.

And it's because we make the entire spectrum of turbulator types and have data on where they stand that we can rank them in order of performance without letting bias creep in.

Rigid Soldered Turbulator



The highest performing turbulator there is as in addition to turbulence it also increases the internal surface area of the tube anywhere between 2x to 4x because of the solder bond effect. It makes drastic size (and cost) reduction in viscous fluid coolers possible.

It is also a gamechanger in gas coolers where the surface area extension is the dominant play other than simply turbulence as gas is naturally turbulent anyway. A 4x increase in internal surface area at 75% bond efficiency would still give a 3x bump in heat transfer coefficient.

Wire Turbulator



Wire turbulators offer the flexibility of easy insertion and the second highest performance profile in our range. Second only to rigid soldered turbulators. Their performance and pressure drop correlations are mapped into our VorTX DLL. Wire Turbulators are ideal for cases where tubeside limitation is severe.

Spiral Turbulator



Spiral Turbulators sit in between the performance of tight L/D Twisted Tape and Low Dense Wire Turbulators. A sweet spot in terms of pressure drop penalties. Spiral Turbulators also have their performance and pressure drop correlations mapped into our VorTX DLL. Spiral Turbulators are ideal for viscous and semi-viscous applications where pressure drop allowance is tight and twisted tapes can't give enough performance.

Twisted Tape



CEI Twisted Tapes have perfect L/D conformance and can be made in a wide range of materials and sizes. Even the L/D range that we can make these in is large giving a lot of flexibility in terms of design choices.

What VorTX is.

VorTX is Concept Engineering International's dynamic link library (DLL) developed by HTRI under proprietary contract with Concept Engineering International.

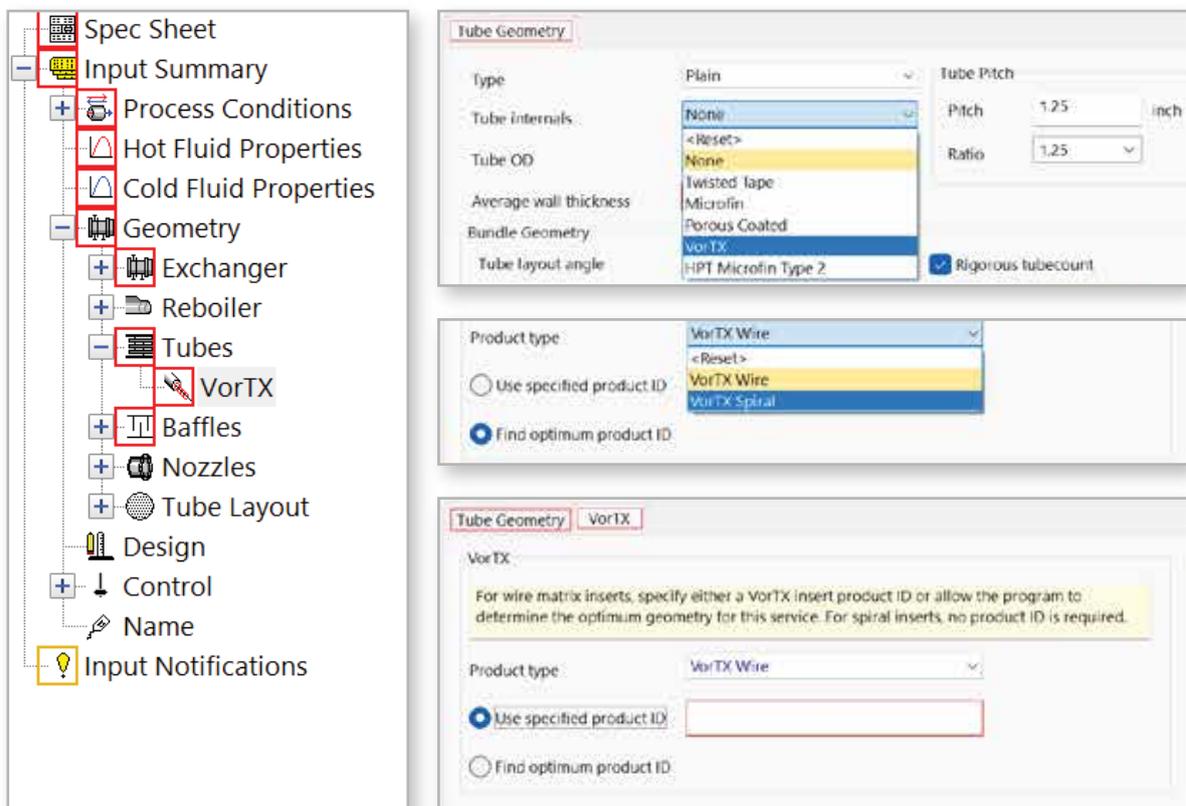
Multiple Concept Engineering International turbulators (wire and spiral tube inserts) were tested at HTRI's Research and Technology Center in Navasota, Texas, USA.

The VorTX DLL contains tube side single phase heat transfer and pressure drop correlations for modeling Concept Engineering International's products which were developed under proprietary contract with HTRI using Concept Engineering International's proprietary data.

HTRI used laminar flow CFD results to supplement empirical testing measurements at Reynolds numbers under 500.

The VorTX DLL can be used with HTRI Software for the following purposes:

1. Identifying an optimal Concept Engineering International product from those supported by the VorTX DLL based on utilizing the maximum amount of pressure drop allowed.
2. Evaluating the performance of a Concept Engineering International product supported by the VorTX DLL that resembles the geometry of those tested by HTRI.



What VorTX enables.

Data really drives every enhancement decision we make.

We're looking for the best operating window for our products from a Reynolds standpoint.

We're diving deep into wall correction factor impact of our geometries in software outputs.

We're looking at the additional hydraulic load of each geometry. Small tweaks in angles of attack.

How much the shear stress is when you pit turbulator vs bare tube.

What the impact on fouling is likely to be because of that additional wall sheer stress.

How we can disrupt film boiling to move over to nucleate boiling, arrest mist flow and reduce bubbles down to size.

These are questions that only data has the answer for.

Our turbulator range (multiple geometries) has been tested for a hard data mining operation.

Post that, the data has been analyzed and curve fitted and then modeled into correlations along with a test report for each insert geometry.

We've also done supplemental CFD work via a proprietary contract to home in on more accuracy.

To completely integrate into software platforms, we've also had developed the **VorTX.DLL** plugin that will hold this data and allow you, the user, to design your exchangers using our products in a matter of seconds if you're using compatible software.

If you're an end-user like a refinery who uses a performance monitoring software, we're also looking at hard coding our mined data in software such as this to see the impact we can have on refinery exchangers to mitigate fouling by looking at shear stress increases and what that will mean for overall CO2 emissions reduction.

High-Performance Thermal Solutions: Steam & Thermic Oil Heating

In industrial process heating, the efficiency of a heat exchanger is governed by the "weakest link" in the thermal chain. When utilizing **Steam** on the shell side, you have an exceptionally high heat transfer coefficient due to phase change. However, if the liquid on the tube side is viscous or in laminar flow, that high performance is wasted.

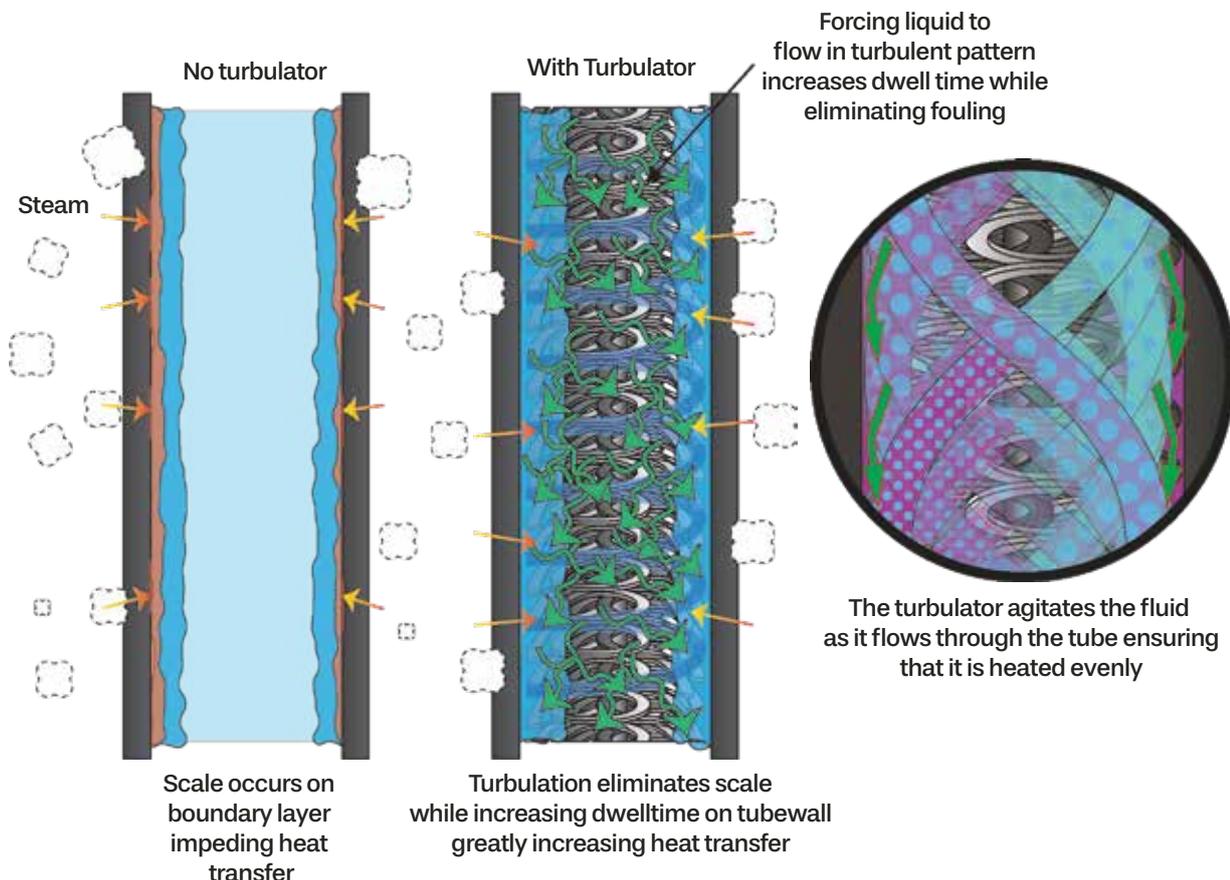
Concept Engineering internal enhancements bridge this gap, allowing the tube-side fluid to match the high flux of the steam.

Footprint Revolution: The Steam-Shell Advantage

By combining the high coefficient of condensing steam on the shell side with our tube-side enhancements, we achieve an enormous reduction in equipment footprint.

When the tube-side resistance is eliminated, the Overall Heat Transfer Coefficient can increase by 300% to 500%. This allows engineers to:

- **Reduce Bundle Length:** Shorten exchangers significantly while maintaining the same thermal duty.
- **Minimize Plot Space:** Ideal for modular skids where every centimeter of deck space carries a premium.
- **Lower Capital Costs:** Smaller shells, fewer tubes, and lighter support structures.



Targeted Liquid Applications

From our extensive industry experience, we have identified five key fluids where tube-side enhancements provide a transformative jump in performance when heated by shell-side steam:

Thermic Fluids (Heat Transfer Oils):

The Problem: High viscosity creates a thick, insulating laminar layer.

The Solution: Wire turbulators disrupt this "skin," increasing tubeside film coefficient by up to 2.5x and preventing oil degradation.

Heavy Fuel Oil (HFO) & Bitumen:

The Problem: Extremely high viscosity leads to sluggish flow and poor heat penetration.

The Solution: Spiral and wire inserts induce radial mixing, ensuring the core of the fluid reaches atomization or pumping temperatures rapidly.

Lube Oils (Turbine & Gearbox):

The Problem: Narrow temperature windows and strict cleanliness requirements.

The Solution: Enhancements ensure precise temperature control while maintaining Millipore compliance for debris-free operation.

Glycol-Water Mixtures:

The Problem: Often used in closed-loop heating where pump power (pressure drop) must be balanced with heat gain.

The Solution: Custom-pitched twisted tapes optimize this balance, allowing for higher throughput in standard-sized bundles.

Chemical Intermediates (Resins & Polymers):

The Problem: Temperature sensitivity; overheating at the tube wall can cause polymerization or "caking."

The Solution: Constant boundary layer renewal ensures uniform heat flux, protecting product quality and extending run-times.

Thermic Oil Stability & Film Temperature Control

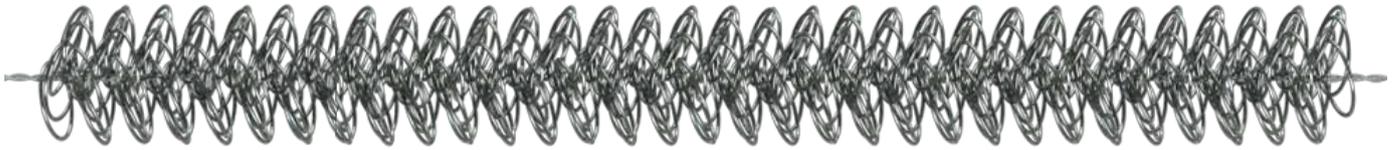
The primary cause of thermic oil failure is excessive film temperature. When oil moves too slowly near the tube wall, it "cracks," leading to carbon deposits (coking).

Active Wall Scrubbing: Our turbulators aggressively disrupt the stagnant film. By increasing the heat transfer coefficient, we reduce the temperature difference (ΔT) between the bulk oil and the tube wall.

Medium Longevity: Keeping the oil well below its cracking temperature significantly extends the life of your expensive heating fluid and prevents the need for frequent system flushes.

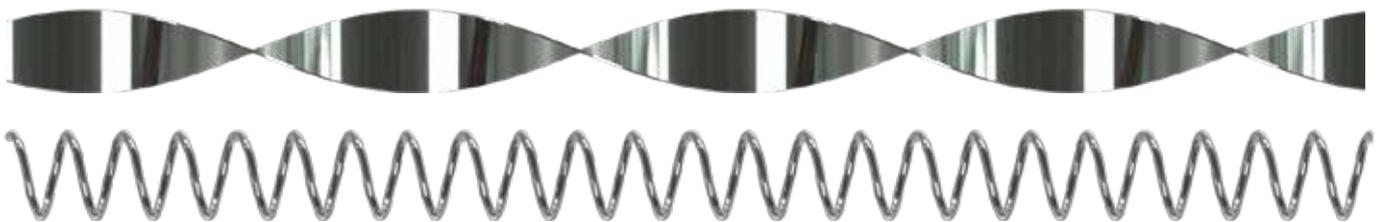
Internal Enhancement Portfolio for ACHEs

Wire Turbulators



The preferred choice for viscous process fluids and thermic oils. They provide high wall shear stress to physically sweep the tube wall clean.

Spiral & Twisted Tape Turbulators:



Optimized for high-flow process heating where pressure drop must be carefully managed. They induce a helical path that ensures uniform temperature distribution across the bundle.

Technical Performance Summary

Feature	Bare Tube	Wire Turbulator	Spiral / Twisted Tape
Heat Transfer	Baseline	1.5x – 2.5x Increase	1.3x – 1.8x Increase
Oil Stability	Poor (High Film Temp)	Excellent (Low Film Temp)	Good (Improved Mixing)
Footprint Reduction	Standard	Significant (Up to 40%)	Moderate (Up to 25%)
Millipore Compliance	N/A	Certified Compliant	Certified Compliant



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