



ENABLING APPLICATION SPECIFIC HEAT TRANSFER ENHANCEMENT IN

High Performance Vertical Condensing

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.

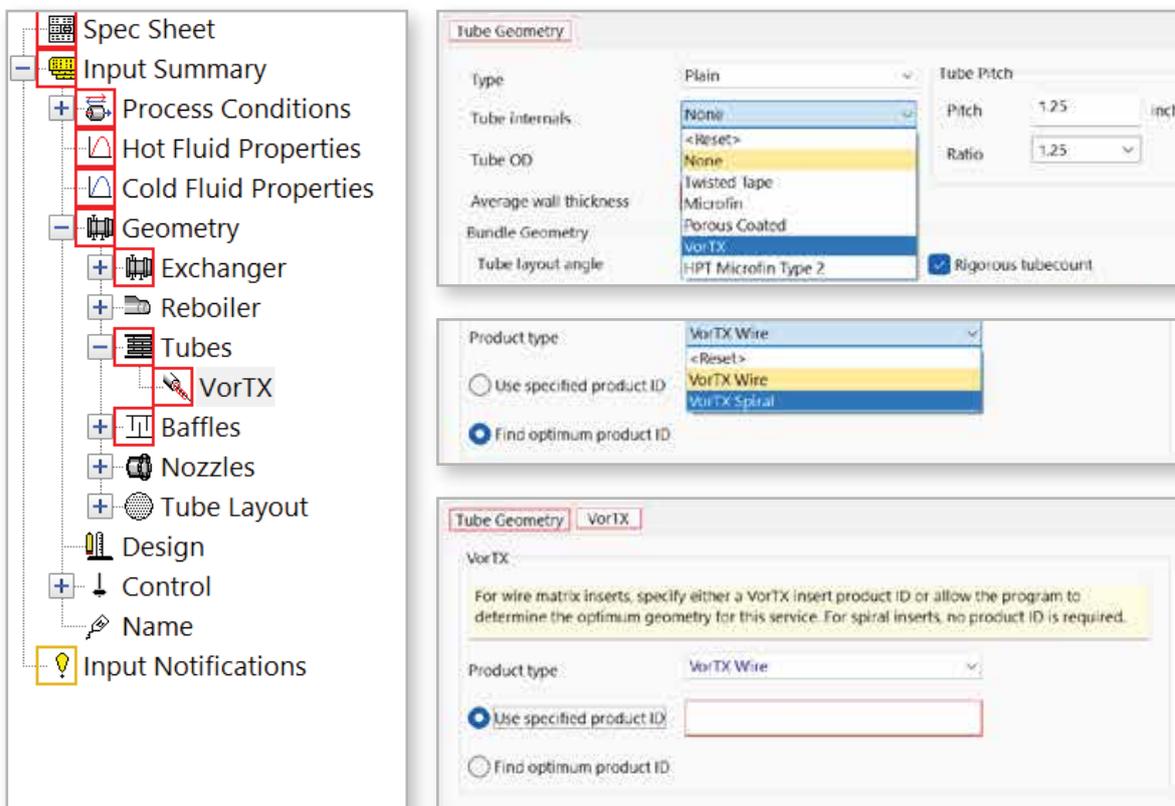
Multiple Concept Engineering International turbulators (wire and spiral tube inserts) were tested at HTRI's Research and Technology Center in Navasota, Texas, USA.

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.

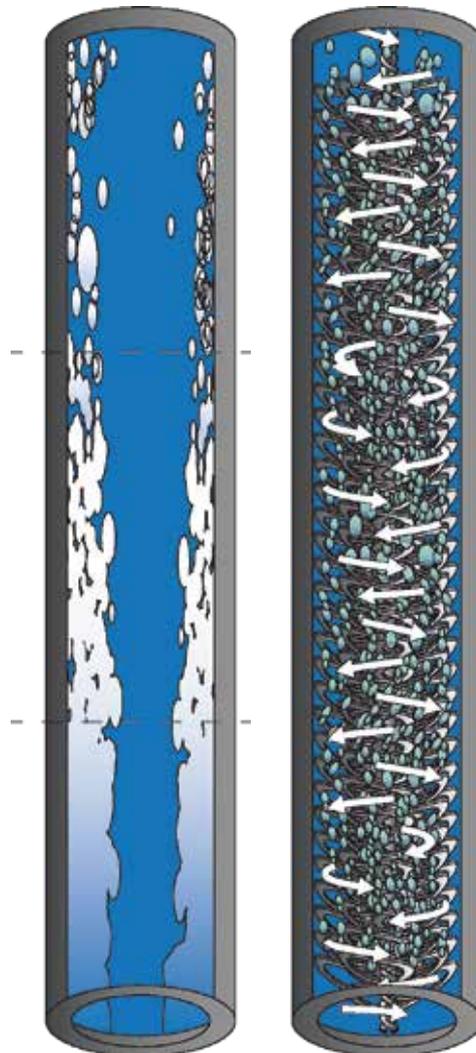
High-Performance Vertical Condensing: Advanced Film Management

In vertical shell-and-tube condensers, the primary barrier to heat transfer is the condensate film that forms on the internal tube wall. Under standard gravity-driven flow, this liquid layer thickens as it travels downward, creating an insulating "blanket" that severely restricts vapor access to the cold tube surface. Concept Engineering has engineered a specialized solution: the Directional Wire Turbulator.

The Science of "Film Stripping":

Our proprietary vertical condenser inserts utilize a high-density wire matrix where the loops are precision-angled, sloping downward toward the center support wire. This geometry transforms the fluid dynamics within the tube:

- **Centripetal Drainage:** The downward pitch of the loops acts as a mechanical conduit. Gravity and surface tension work in tandem to "strip" the liquid condensate away from the wall and channel it toward the central core.
- **Boundary Layer Thinning:** By constantly removing the liquid bulk, the insert ensures the vapor remains in direct contact with an ultra-thin film on the tube wall, where the thermal resistance is lowest.
- **Vapor-Phase Turbulence:** The wire matrix disrupts the vapor core, preventing the formation of stagnant non-condensable pockets and maintaining high mass-transfer rates.



Technical Comparison Report:

The Impact of Film Stripping

Data-driven analysis of directional enhancement in vertical process condensers.

Parameter	Bare Tube (Gravity Flow)	Directional Wire Turbulator
Film Thickness	Thickens progressively downward	Uniformly Thin (Continuously Stripped)
Flow Regime	Laminar / Wavy Film	High-Shear Turbulent Film
Heat Transfer	Baseline	25% Minimum
Non-Condensable Risk	High (Surface Blanketing)	Minimal (Constant Mixing)
Column Height	Standard	Enormous Footprint Savings (Reduced Height)

Case Analysis: Film Resistance Reduction

In a typical vertical reflux condenser, the liquid film can account for over 70% of the total thermal resistance. By utilizing our "loop-to-center" geometry, the liquid is diverted from the wall at every loop contact point. This reduces the effective film thickness by up to 60%, allowing the overall heat transfer coefficient (U) to remain high across the entire length of the tube, rather than degrading toward the bottom of the bundle.



Specialized Vertical Applications

- **Reflux Condensers:** Superior control over distillation top-products. Improved thermal efficiency allows for faster system response and higher purity levels.
- **Vent & Vacuum Condensers:** Essential for high-vacuum service where pressure drop must be minimized but condensation rates must remain high to protect vacuum pumps.
- **Multi-Component Organic Vapors:** Manages complex condensation where varying surface tensions typically cause erratic film behavior.
- **Knock-out Drums & Separators:** Enhances the removal of entrained liquids from gas streams by coalescing mist on the wire matrix and draining it centrally.

Engineering Resilience & Material Selection

Vertical condensers often handle aggressive process vapors and high-purity solvents. We manufacture our directional turbulators in robust, corrosion-resistant metallurgy to match your service life requirements:

- **Stainless Steel (316L, 321, 347)**
- **Duplex & Super Duplex**
- **Hastelloy, Monel & Inconel Alloys**
- **Titanium (for offshore or highly corrosive chemical service)**

The NexTherm Advantage: Compact Architecture

By integrating our directional enhancement, you can achieve an enormous footprint saving. For tall vertical columns, this means:

- **Reduced Vessel Height:** Significant savings in structural steel and wind-loading reinforcements.
- **Modular Integration:** Easily fits into compact process skids for offshore or mobile units.
- **Throughput Recovery:** Retrofit existing vertical condensers to handle increased vapor loads without replacing the shell.



Concept Engineering International,
#2 Krishna Mahal, Ground Floor,
63 Marine Drive,
Mumbai-400020. India
mail@conceptengg.com
+91-22-43533700-99
www.conceptengg.com