



ENABLING APPLICATION SPECIFIC HEAT TRANSFER ENHANCEMENT

Fouling Mitigation And Heat Transfer Enhancement In Refinery And Other Industries

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.

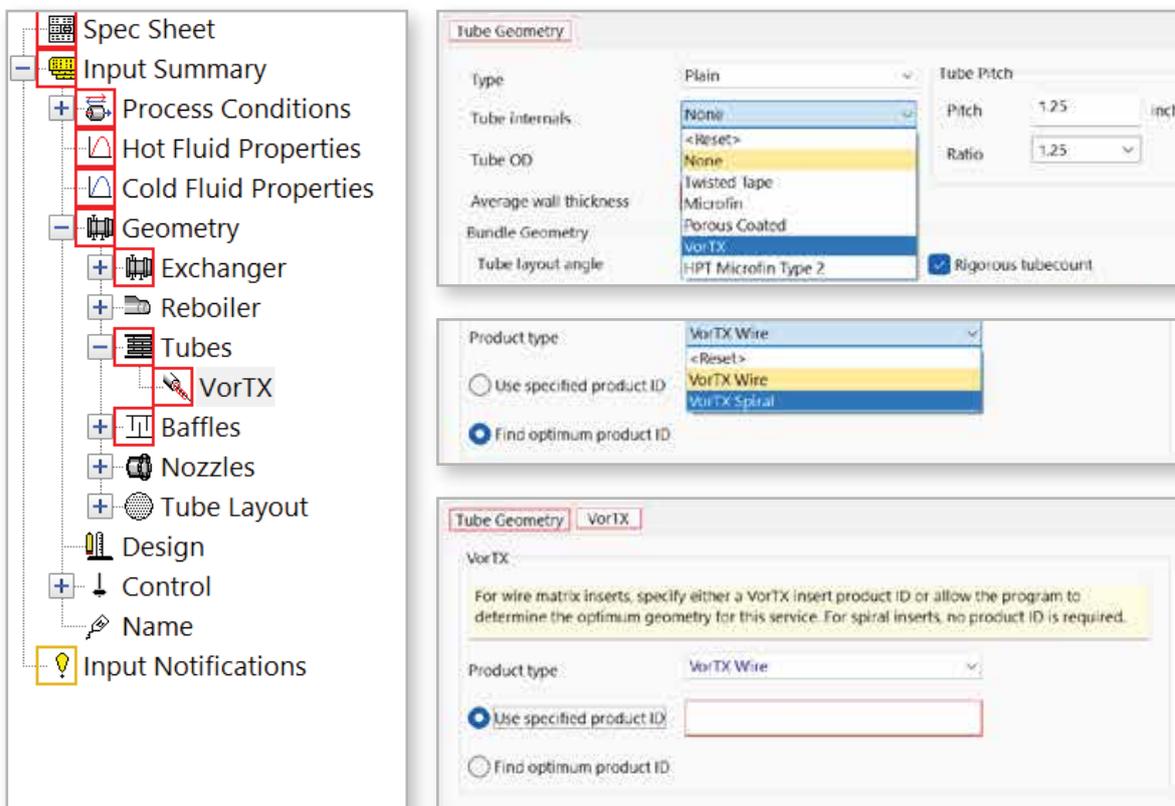
Multiple Concept Engineering International turbulators (wire and spiral tube inserts) were tested at HTRI's Research and Technology Center in Navasota, Texas, USA.

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.

Engineering Resilience:

Fouling Mitigation & Heat Transfer Enhancement

In refinery and heavy process industries, fouling is a primary driver of lost efficiency and increased carbon emissions. At **Concept Engineering**, we focus on active mitigation—engineering internal geometries that prevent deposition by managing fluid dynamics at the tube wall.

The Science of Mitigation: Wall Shear Stress

Fouling thrives in the stagnant laminar sub-layer. By increasing Wall Shear Stress, our turbulators physically sweep away precursors—such as asphaltenes and salts—before they can settle and "bake" onto the heat transfer surface.

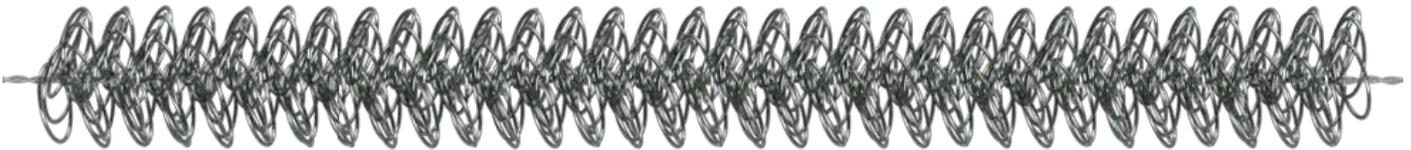
Fouling layer build-up on tube wall reduces heat transfer



Turbulators prevent build up by converting laminar flow to turbulent flow, increasing heat transfer



Wire Turbulators: The Self Cleaning Specialists



The industry standard for high-fouling refinery streams, particularly where thermal cracking or coking is a risk.

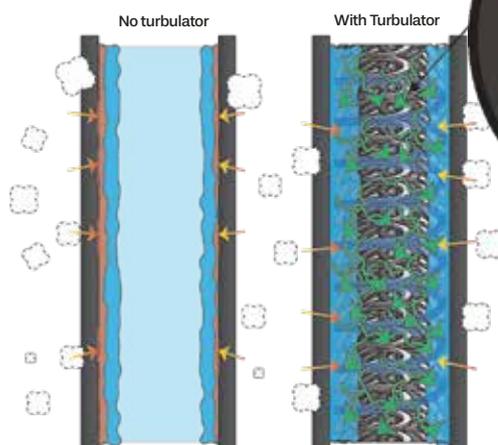
Active Boundary Layer Disruption: Continually breaks the stagnant fluid film, ensuring high-velocity contact at the tube wall.

Mitigating Coking: By eliminating "hot spots" and reducing residence time in the boundary layer, these inserts significantly delay the onset of coking in high-temperature exchangers.

Target Applications:

- **Crude pre-heat trains**
- **Vacuum distillation units (VDU)**
- **Atmospheric residue coolers.**

The turbulator agitates the fluid as it flows through the tube ensuring that it is heated evenly



Spiral & Twisted Tape Turbulators: Velocity Optimization



A robust, economical solution for balancing pressure drop with fouling resistance in medium-viscosity fluids.

- **Helical Flow Path:** Forces the fluid into a spiral motion, maintaining high effective velocities even at lower flow rates to keep solids in suspension.
- **Target Applications:** Hydrotreater effluent coolers, tank farm heaters, and chemical process interchangers.

Refinery Air-Cooled Heat Exchangers (AFCUs)

Air-cooled units often face "air-side" limitations or internal fouling that forces a reduction in throughput. Our internal enhancements allow for:

- **Throughput Recovery:** Increasing the tubeside coefficient allows the unit to process more volume without increasing the physical footprint of the fan bays.
- **Process Stabilization:** Managing the transition of heavy ends during condensing to prevent slugging and uneven cooling across the tube bundle.

Two-Phase Condensing & Phase Change

Refinery condensing units (such as Overhead Condensers) benefit from specific internal geometries that manage the liquid-vapor interface.

- **Film Thinning:** Our inserts work to thin the condensate film on the tube wall, reducing thermal resistance and increasing the overall heat transfer coefficient.
- **Vapor-Liquid Management:** Optimized for high-velocity vapor streams, ensuring stable pressure drops during the phase change process.

Technical Spotlight: Extending Run-Times

The primary ROI for our enhancements in refineries is the extension of the "run-period" between scheduled cleanings.

Parameter	Without Enhancement	With Wire Turbulators
Flow Regime	Laminar/Transitional	Turbulent at Wall
Wall Shear Stress	Low (allows deposition)	High (sweeps precursors)
Fouling Rate	Rapid (increases quickly)	Significantly Retarded
Cleaning Interval	Frequent Turnarounds	Extended Operation

Material Resilience for High-Temperature Service

To withstand the aggressive environments and high temperatures of refinery service, we manufacture using robust mechanical fitments in:

- **Stainless Steel (316L, 321, 347)**
- **Duplex & Super Duplex**
- **Monel & Inconel Alloys**
- **Chrome-Moly Steels**



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