CONCEPT

HTRI MEMBER

ENABLING APPLICATION SPECIFIC HEAT TRANSFER ENHANCEMENT IN

High Performance Air Cooled Heat Exchangers (ACHE)

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 turbulation 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 turbulation 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

vortx enabled

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

vortx enabled

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.

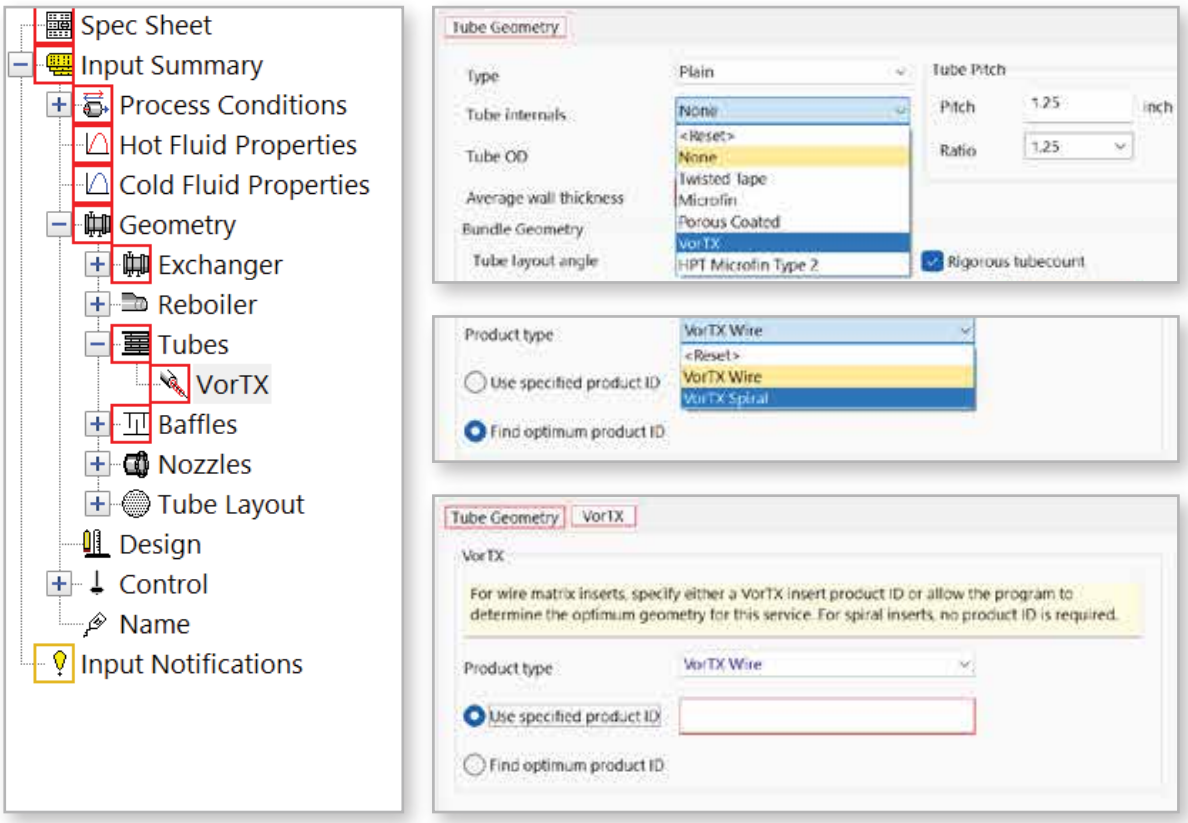
Multiple Concept Engineering International turbulators (wire and spiral tube inserts) were tested at HTRI's Research and Technology Center in Navasota, Texas, USA.

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 Air-Cooled Heat Exchangers (ACHE)

In modern process plants, water scarcity and environmental regulations have made Air-Cooled Heat Exchangers (ACHE) the definitive choice for heat rejection. However, the massive imbalance between the efficient air-side (finned surface) and the often-limited tube-side heat transfer can lead to oversized, expensive units. Concept Engineering bridges this gap with internal enhancements that balance thermal resistance, allowing for more compact and efficient "Fin-Fan" designs.

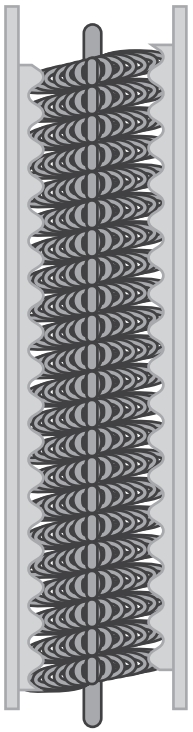
Balancing the Thermal Equation

In a typical ACHE, the air-side is heavily enhanced with external fins, while the tube-side remains the "bottleneck," especially with viscous fluids or low-pressure gases. Our internal turbulators redistribute this thermal load, maximizing the utility of every square meter of your bundle.

Rigid Soldered Turbulators:

The "Compact" Specialist

When project specifications demand extremely compact air-coolers—due to limited plot space on offshore rigs or modular skids—the rigid soldered turbulator is the premier solution.



Maximum Thermal Density: By creating a metallic bridge between the internal fin and the tube wall, we achieve a 300%–500% boost in the tube-side coefficient.

Footprint Optimization: Utilizing these inserts allows for a drastic reduction in the number of tube rows and overall bundle length, leading to significant savings in structural steel and shipping costs.

Structural Integrity: The soldered bond provides a rigid internal structure that resists the pulsations and vibrations common in high-pressure air-cooled service.

Target Applications:

- **Space-constrained offshore lube oil coolers**
- **High-flux gas aftercoolers**
- **Compact modular power-gen radiators.**

Turbine Lube Oil Air-Coolers

For power generation skids where water is unavailable, air-cooled lube oil systems must maintain precision temperature control to protect high-speed bearings.

- **Precision Temperature Control:** Enhanced heat transfer allows for a quicker response to ambient air temperature changes, preventing the "localized hot spots" that lead to oil varnishing.
- **Millipore Compliance:** Every internal enhancement—including our rigid soldered line—is manufactured and cleaned to comply with Millipore testing for oil flushing, ensuring your turbine's lubrication circuit remains free of manufacturing debris.
- **Target Applications:**
  - **Gas And Steam Turbine Lube Oil Skids**
  - **Large-Scale Gearbox Coolers**
  - **Centrifugal Compressor Aftercoolers.**

Multicomponent Condensing: Gravity Flow Regimes

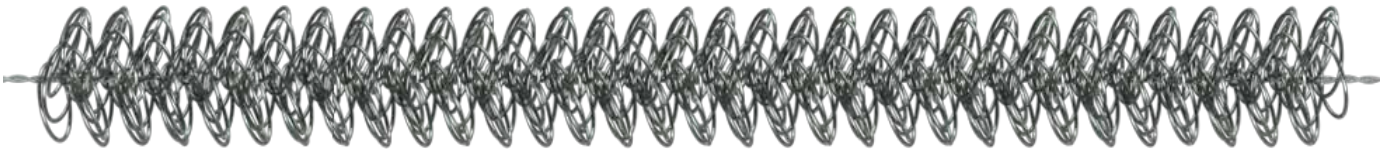
Condensing complex mixtures in an air-cooled environment often faces challenges with phase separation and gravity flow.

- **Film Management:** Our enhancements are designed to thin the condensate film on the tube wall, which is the primary barrier to heat transfer in gravity-driven condensing.
- **Vapor-Liquid Interaction:** We utilize spiral and wire geometries to promote radial mixing, ensuring that even in gravity flow regimes, the vapor and liquid phases remain in close thermal contact.
- **Mitigating "Dead Zones":** By inducing turbulence, we prevent the accumulation of non-condensable gases that can "blanket" the heat transfer surface and degrade performance.
- **Target Applications:**
  - **Refinery Overhead Condensers**
  - **Chemical Process Vent Condensers**
  - **Steam Surface Condensers.**

In vertical condensers, turbulators can help drain the liquid from the wall through the center to allow for more condensation. This can really improve performance.

Internal Enhancement Portfolio for ACHEs

Wire Turbulators

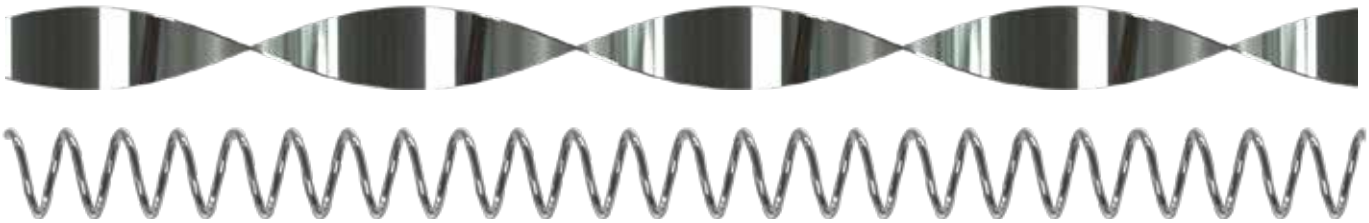


The preferred choice for refinery ACHE applications where fouling is a concern. Increases wall shear stress to prevent the deposition of waxes or asphaltenes.

Fouling layer build-up on tube wall reduces heat transfer

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

Spiral & Twisted Tape Turbulators:



Optimized for high-volume, low-pressure gas cooling and glycol loops. Induces a helical path that increases effective velocity without a prohibitive pressure drop.

The NexTherm Advantage for ACHE

By integrating our enhancements into your air-cooled designs, you achieve:

- **Throughput Recovery:** Retrofitting existing ACHE units can increase cooling capacity by up to 40% without changing the fan motor or physical structure.
- **Power Savings:** Improved thermal efficiency can allow for reduced fan speeds, lowering your plant's parasitic power load.
- **Reliability:** All internal enhancements are designed to meet the rigors of industrial service with high-temperature and corrosion-resistant metallurgy.

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