



New Technology to Solve Vibration and Fabrication Problems in U-Tube Bundles

Jonathan Breaux, Thermal Designer & Estimating Manager, Gulf Coast Exchanger

Russel Miller, Vice-President, Gulf Coast Exchanger

Amar Wanni, Ph.D. (Inventor)

Thomas Rudy, Ph.D.



Introducing Vibration Problems

- Cause downtime due to unplanned maintenance
- Lead to loss of revenue

Path Forward:

- Must be established quickly
- Tube plugs are common fix
- Tube plugging may lead to additional concerns if caused by Flow-Induced Vibration

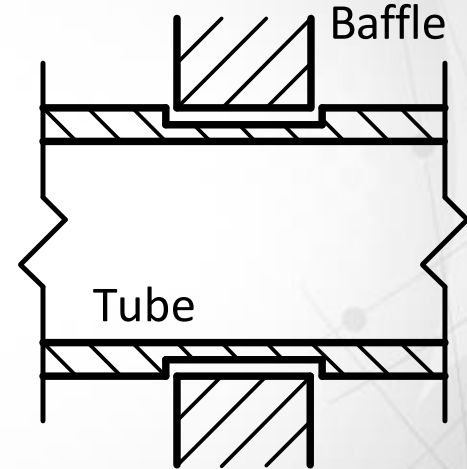
Introducing Vibration Problems

Main Modes of Flow-Induced Vibration

- Acoustic Vibration
 - Intense noise, not known to cause tube damage
 - Solution: install one or two axial deresonating baffles
- Fluid-Elastic Instability
 - Most common mode of failure
- Vortex Shedding
 - Tubes may shear quickly once a crack is initiated

Introducing Vibration Problems

- Fluid-Elastic Instability
 - Orbital motion of tubes causes gradual removal of metal
 - Failure could occur within hours, years, or decades depending on severity of vibration
 - May not be revealed during inspection

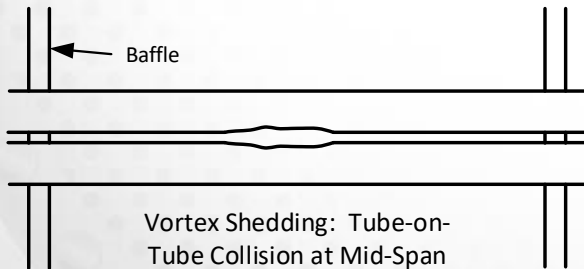


Introducing Vibration Problems

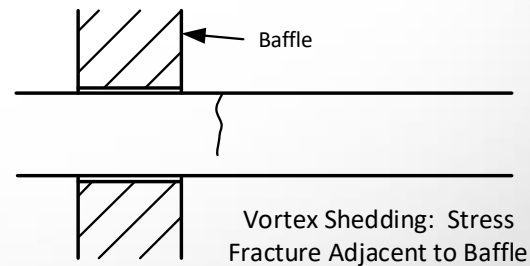
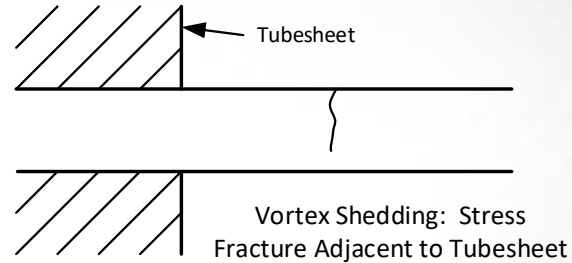
- Vortex Shedding
 - Tube-on-Tube collisions at mid-span or stress fractures near tubesheets or baffles
 - Stress Fractures: Tubes may shear very quickly once a crack is initiated
 - Cracks may take years or decades to form based on severity of vibration and resonance matching
 - Difficult to detect during routine inspection

Introducing Vibration Problems

- Vortex Shedding
 - Tube-on-Tube Collisions
 - Fatigue Failure



Fatigue Failure -- Catastrophic
(Undetectable During Inspection)



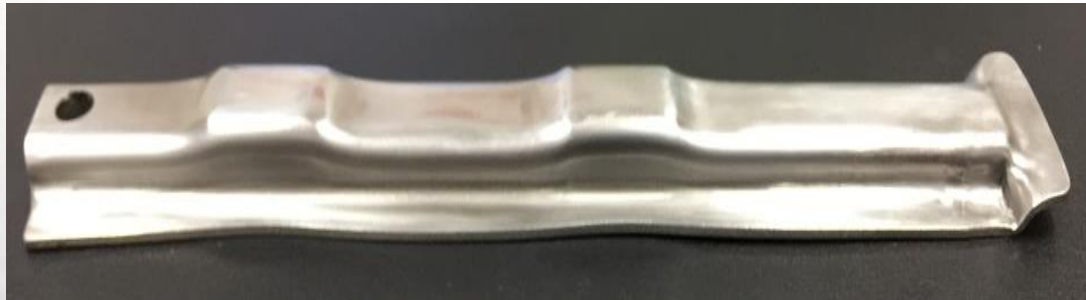
A Peace of Mind Solution

Corrugated Tube Support (CTS) Technology

- Solves vibration problems by reducing unsupported tube span and by stabilizing tubes
- Ideal in:
 - Any tube arrangement (in-line, staggered, finned, etc.)
 - Any common metallurgy (stainless, Inconel, titanium)
 - U-tube bundles
- Heart of technology ensures positional integrity
- Patented and proprietary

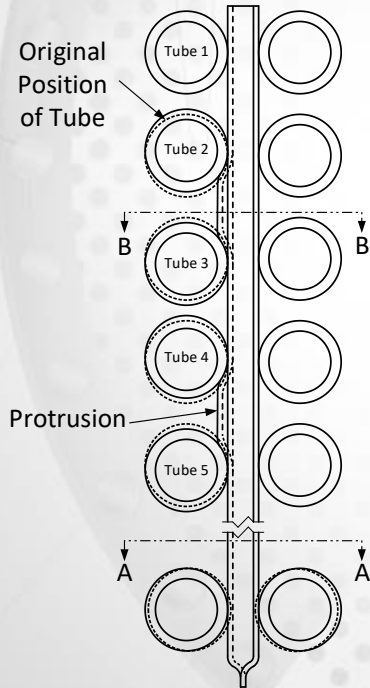
CTS Technology

- Design provides Peace of Mind to equipment owners
 - Heart of the technology is protrusions, specifically designed according to tube arrangement

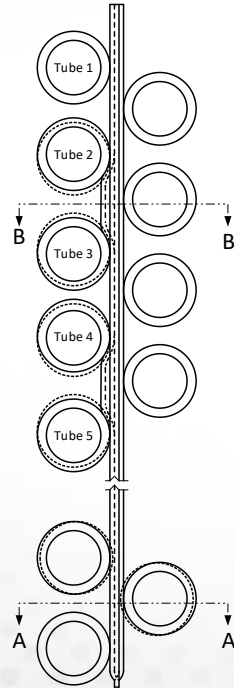


CTS Technology

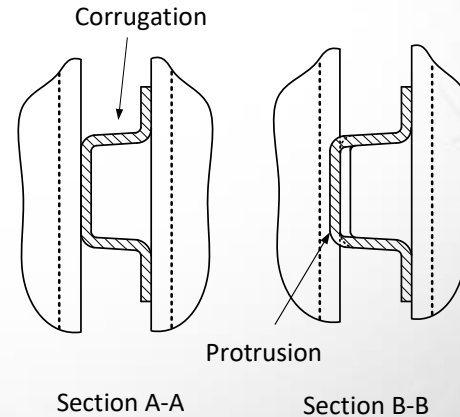
In-Line Arrangement



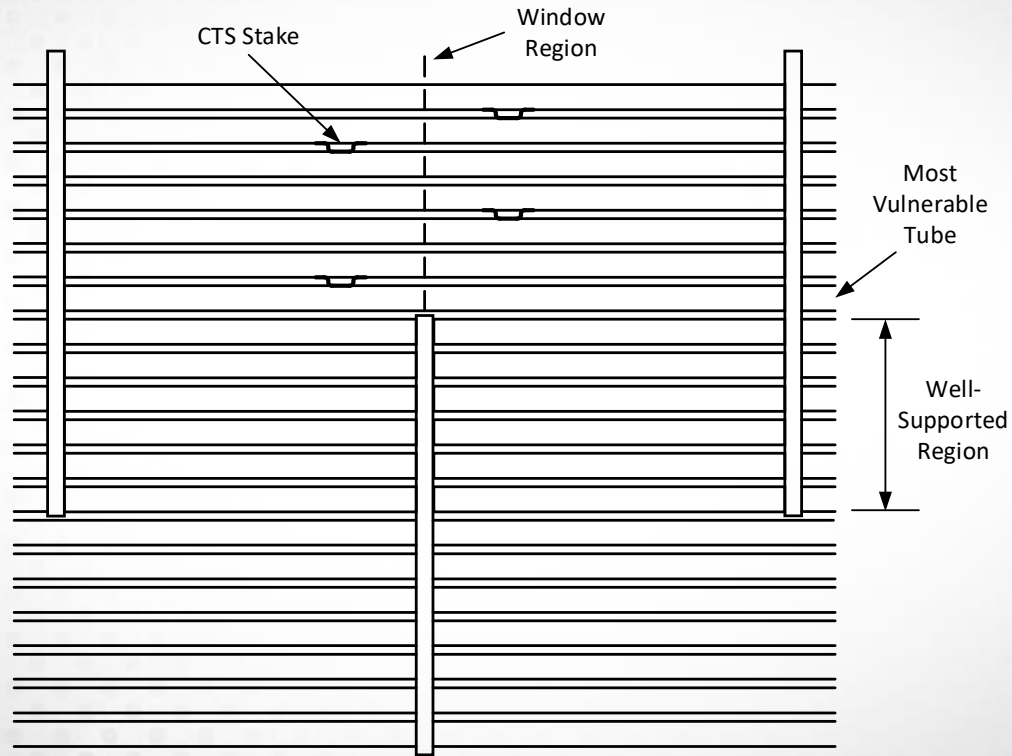
Staggered Arrangement



- Works with any tube arrangement and integrally finned tubes



CTS Technology - Installation



CTS Technology in U-Bundles

- Specially designed extension available for use in u-tube bundles
 - U-bend region is most vulnerable
 - Tie Plates (current solution) only possible during initial fabrication
 - Bending tolerance leads to fabrication difficulties

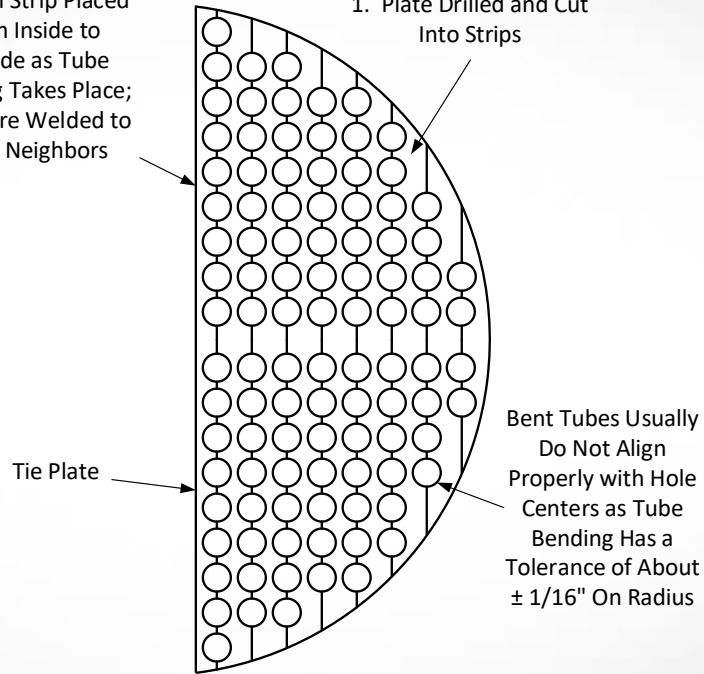
Tie Plate Details

- Plate(s) drilled with baffles
- Cut into strips according to tube rows
- Insert strips and secure during tube loading
- Cut tubes at tubesheet face for uniform projection
- Oversizing holes would lead to vibration issues

Tie Plate Details

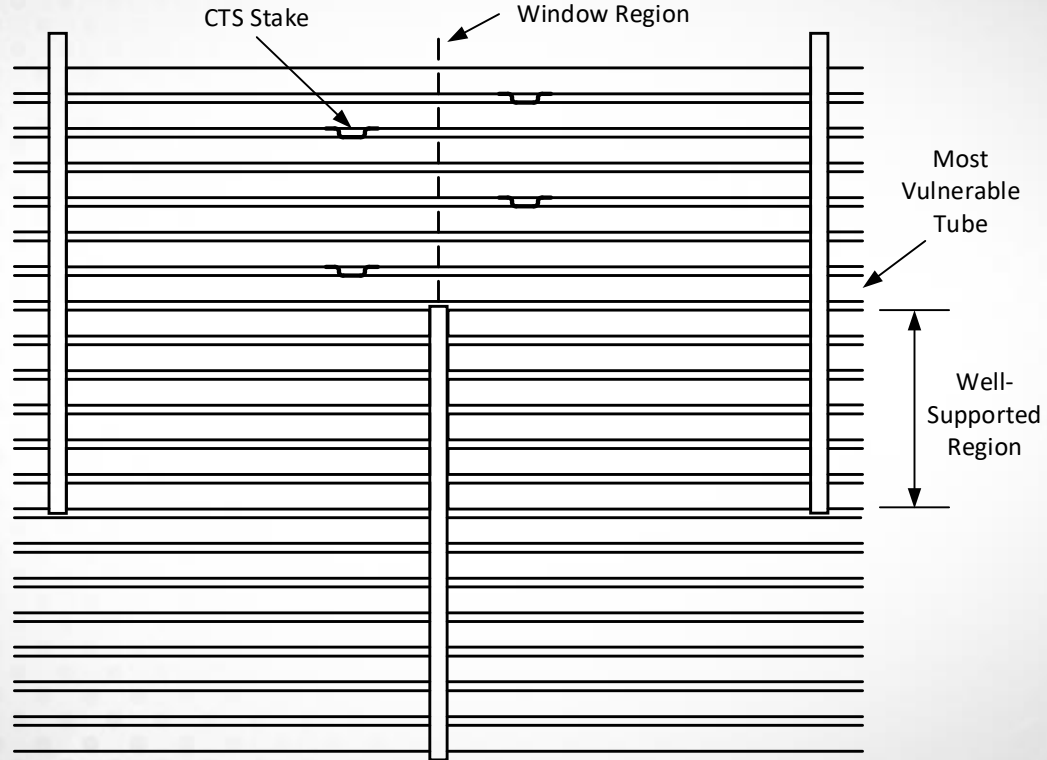
2. Each Strip Placed From Inside to Outside as Tube Loading Takes Place; Strips are Welded to Their Neighbors

1. Plate Drilled and Cut Into Strips

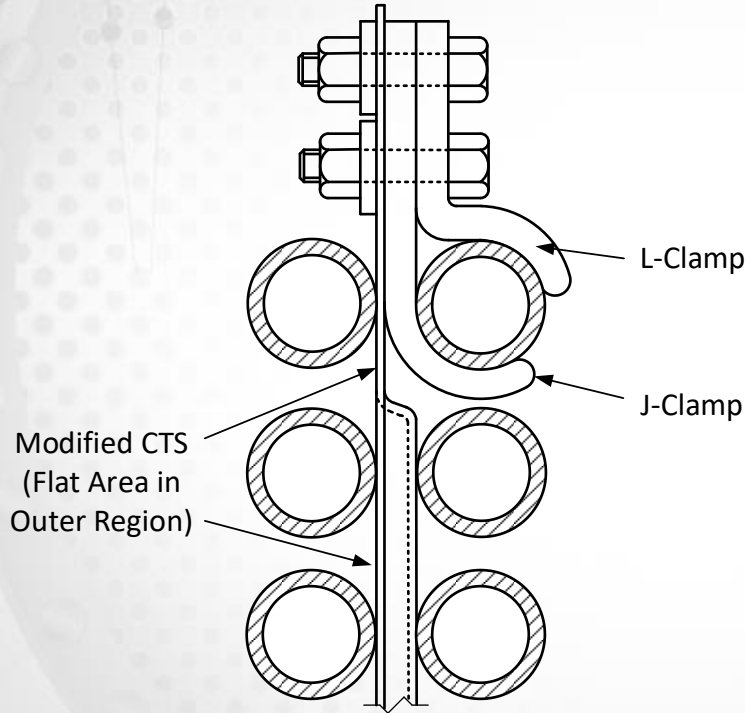


Section A-A

Bend View



CTS Technology in U-Bundles



- Shown for Inline Tube Arrangement
 - Patent-Pending Design
 - Clamps Squeeze Outermost Tube to Ensure Positional Integrity
 - Reduced Thickness of “J-Clamp” for Staggered Tube Arrangement

Additional Applications

- More Efficient Design for New Equipment
 - Allows greater shellside velocity without vibration concern
 - Unsupported tube length no longer a concern
- Change in Metallurgy
 - Decrease in corrosion allowance leads to thinner tube wall
- Capacity Creep
 - Analyzed with HTRI Xist or Xvib

Conclusions

- CTS technology offers a Peace-of-Mind Solution to vibration problems
- Protrusions are Heart of technology that ensure positional integrity
- Operations can improve with up-front design or installation mid-life
- Available in bend regions as improvement to industry standard tie plate

Contact Information

- Amar Wanni, Ph.D., Inventor
 - Amar.Wanni@gmail.com
- Russel Miller, P.E., Gulf Coast Exchanger Vice-President
 - Russel.Miller@gulfcoastexchanger.com
- Jonathan Breaux, E.I.T., Gulf Coast Exchanger Estimating Manager & Thermal Designer
 - Jon.Breaux@gulfcoastexchanger.com
 - (+1)409.719.3895