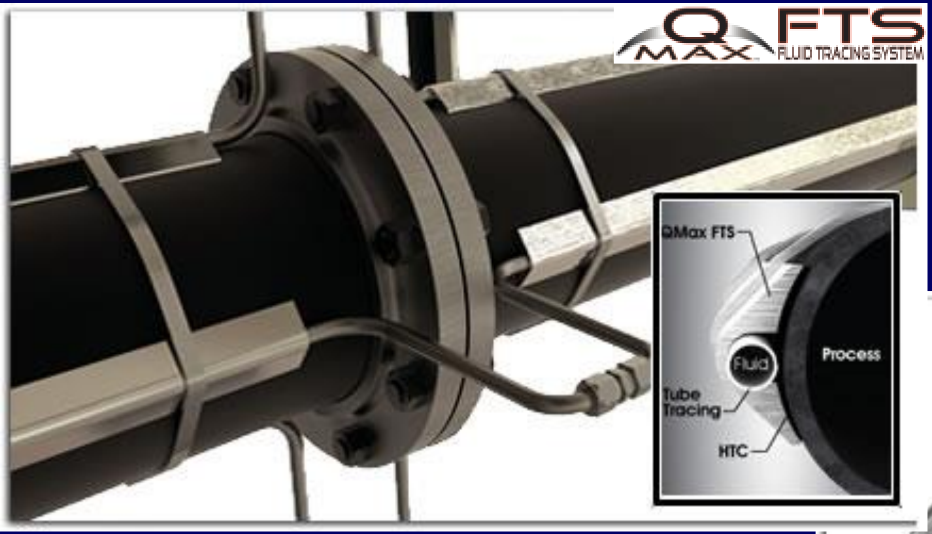
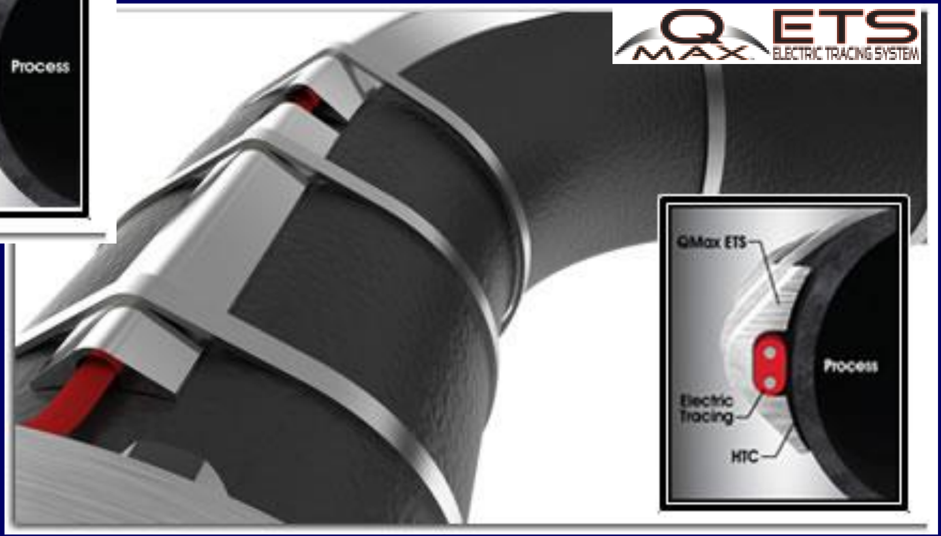
Understanding Installation of Steam Tracing for Long-Term Application Success

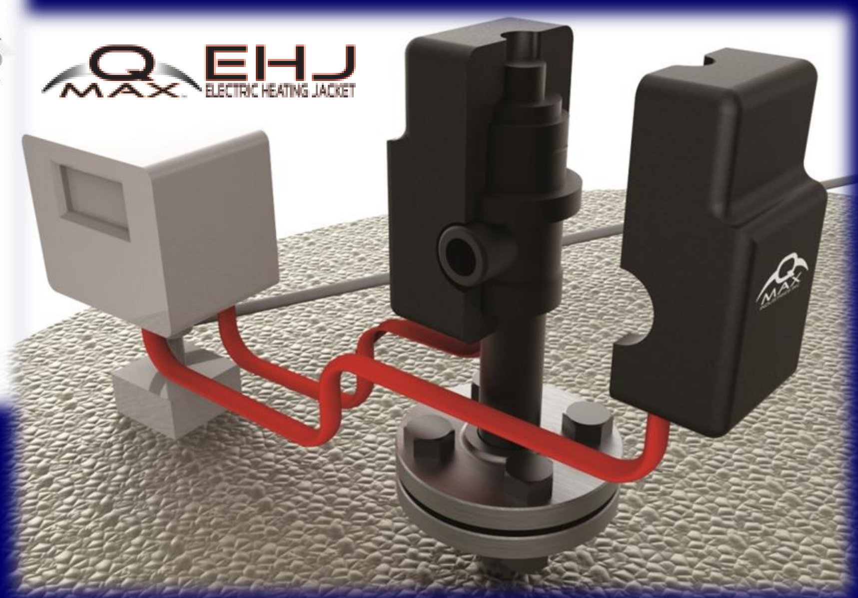
- Thomas Perry - QMax
- Carson Hannah - QMax

Best Overall Solutions for Pipe Tracing

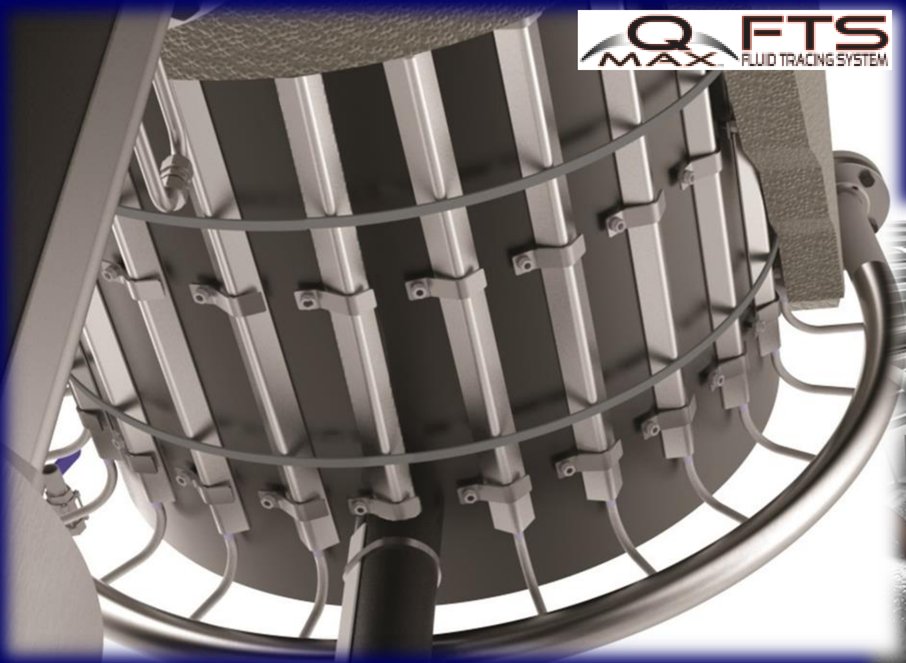




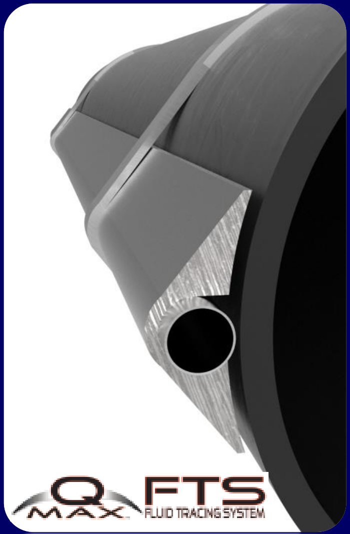
Most Options for Equipment Jacketing



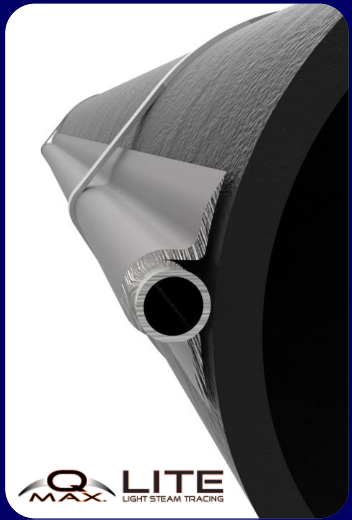
Most Effective Systems for Tank Heating



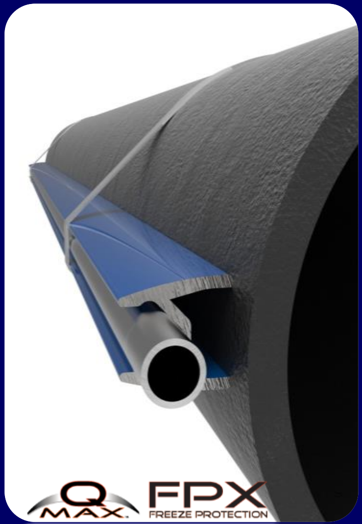
Steam Heating Systems for Piping



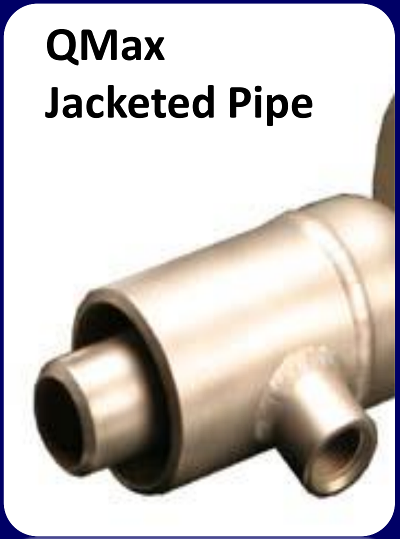
High Heat



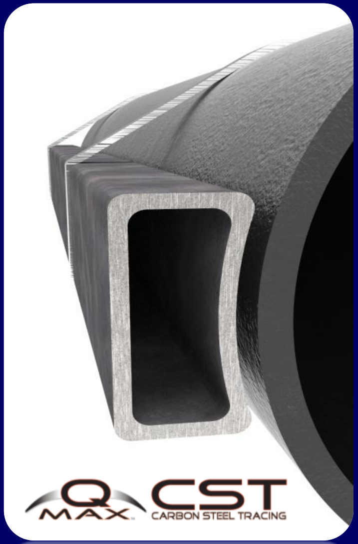
Medium Heat



Freeze Protection (Isolation Tracer)

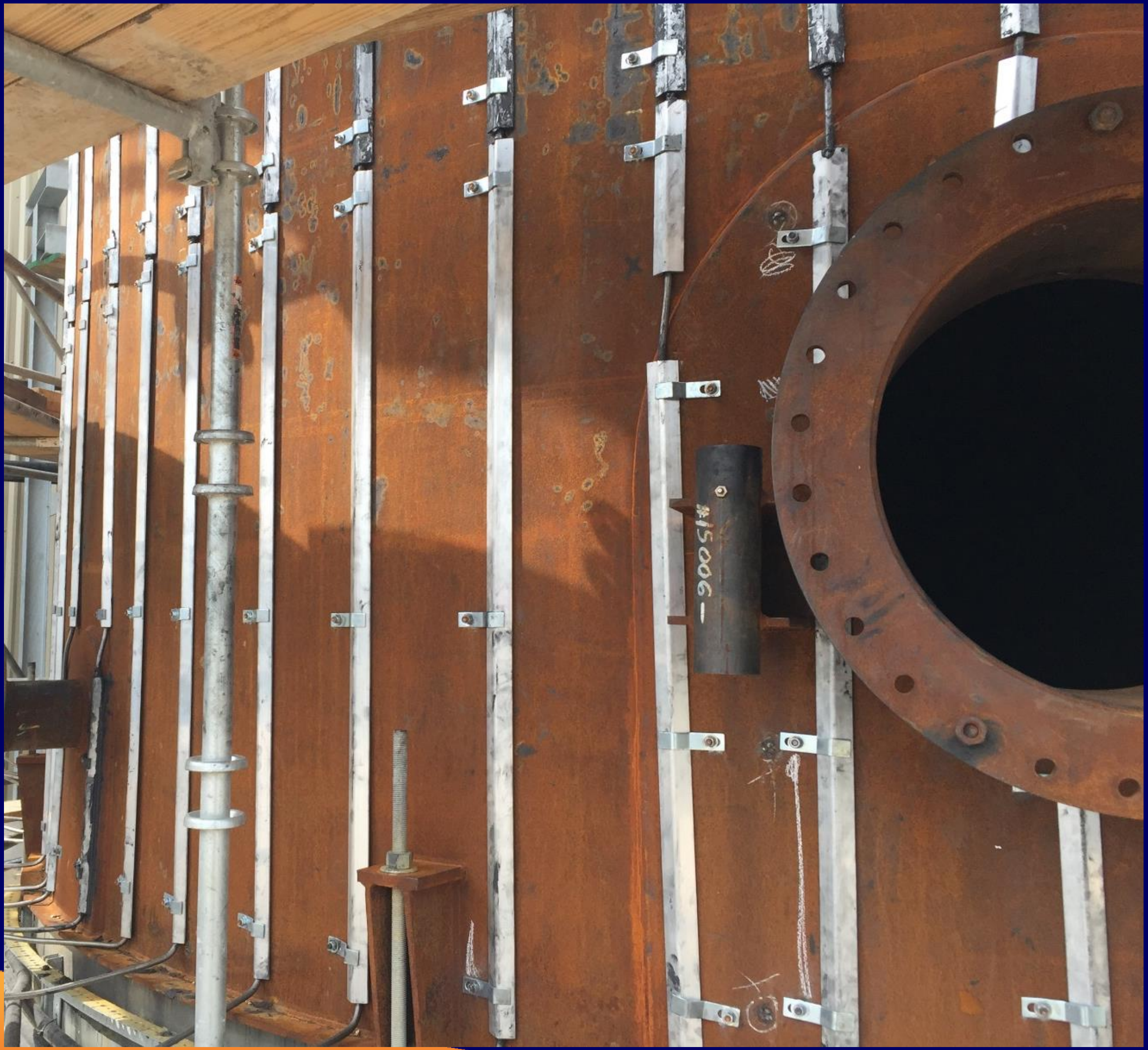


Special Case Heating



Long Run Hot Oil

Is this a good Steam Tracing System installation?



Is this a good Steam Tracing System installation?

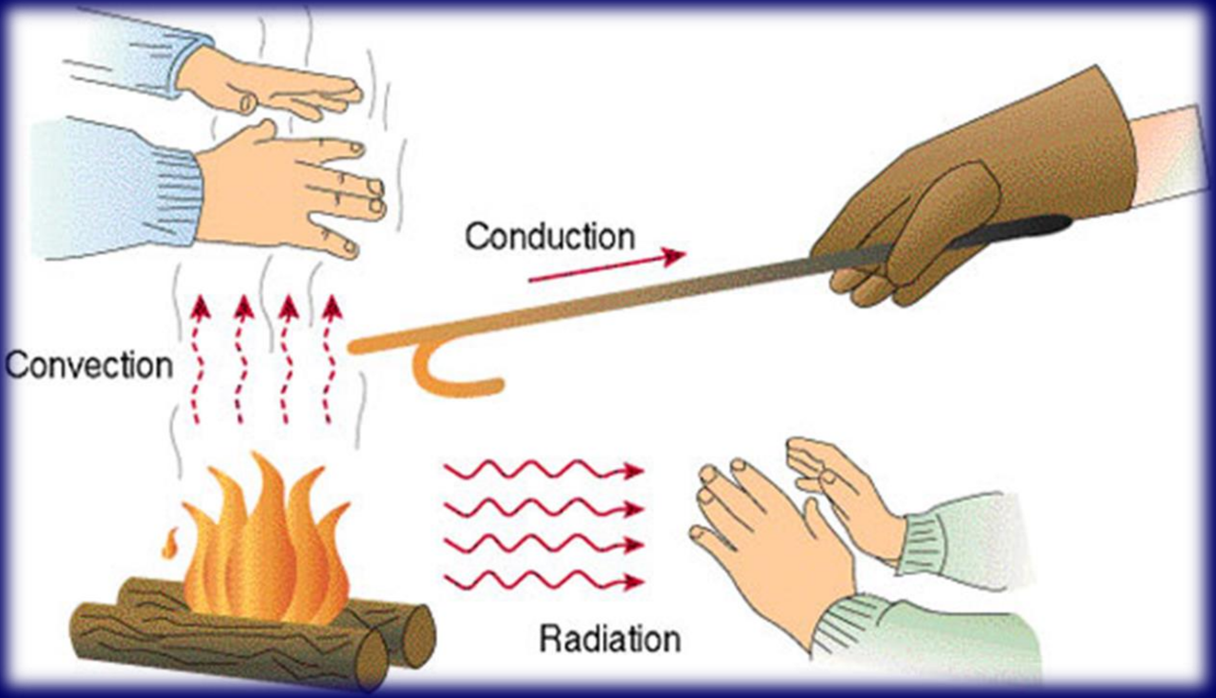
Is this a good Steam Tracing System installation?

Today we'll look at:

- Conduction Heat Transfer
- What is Heat Transfer Compound (HTC)
- Test Results – Melting Sulfur w/ Steam Tracing using HTC
    - Steam Tracing Designs Tested
    - Simulating Varying HTC Thicknesses
    - Melt-Out Test Results
    - Lessons Learned

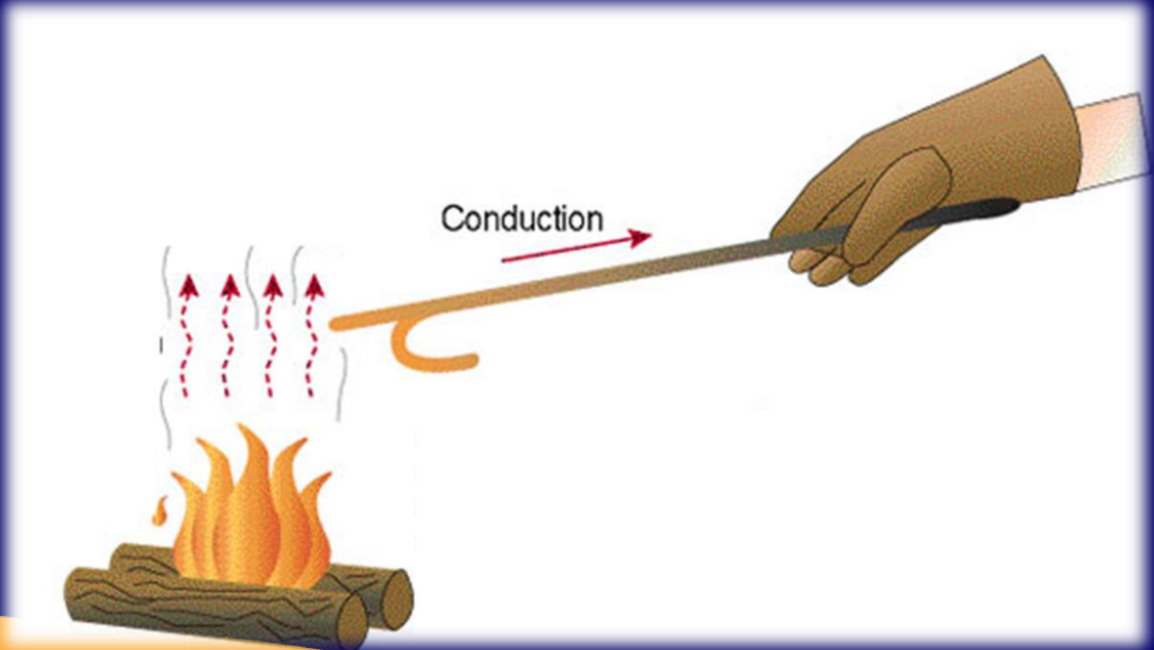
Heat Transfer 101

- Conduction
- Convection
- Radiation



Conductive Heat Transfer

- $Q = UAdT$, $U = k / l$



Conductive Heat Transfer

- Q = UAdT , U = k / l

$\frac{\text{Poor “k”}}{\text{Large “l”}}$	=	Poor Heat Transfer
$\frac{\text{Poor “k”}}{\text{Very Small “l”}}$	=	Excellent Heat Transfer

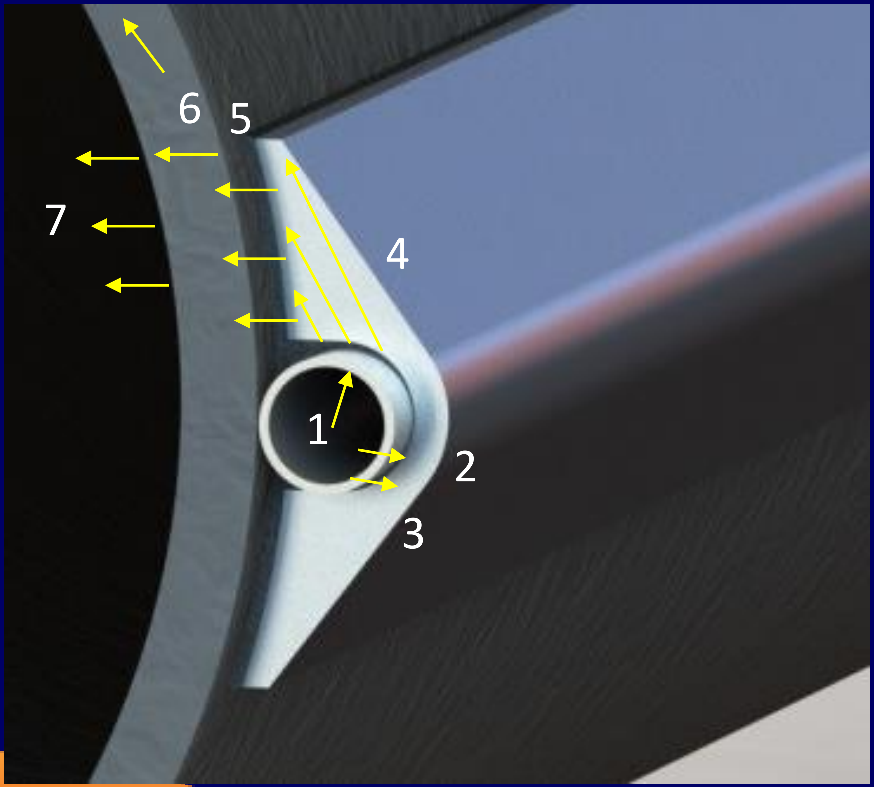
What is Heat Transfer Compound

Heat Transfer Compound (HTC) is used to bridge the thermal gap between two parts (in this case, pipe and conductive tracing).

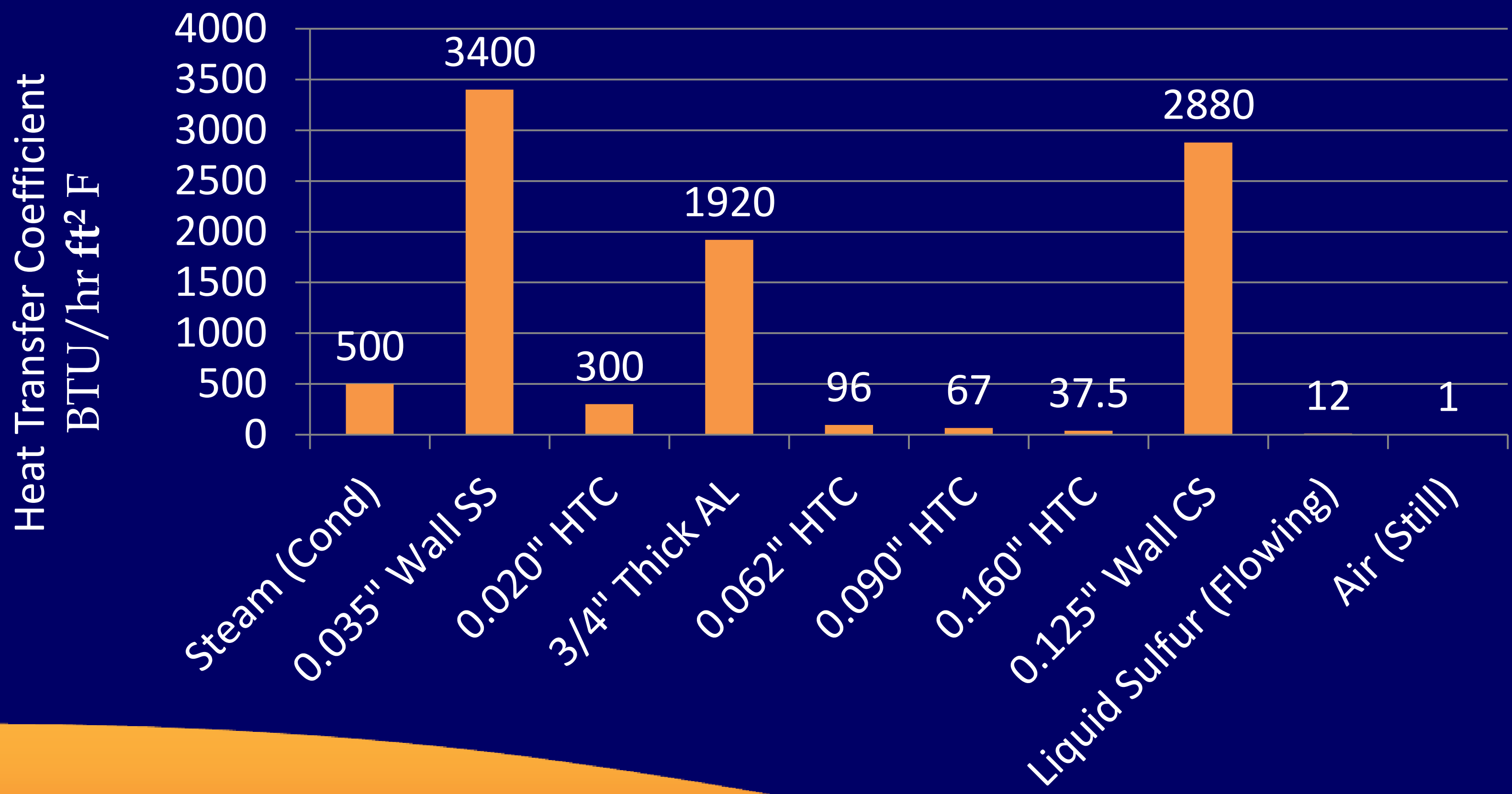
HTC contains graphite and one or more binder components which are formulated for different applications.

Heat Transfer Boundaries of Conductive Steam Tracing

1) Film Coefficient of Steam
2) Conduction thru Tubing
3) **Conduction thru very thin HTC**
4) Conduction thru Aluminum
5) **Conduction thru very thin HTC**
6) Conduction thru Pipe Wall
7) Film Coefficient of Process



Purpose of Heat Transfer Compound



**** HTC = Heat Transfer Compound (k = 0.5 BTU/hr ft F)**

Bottom Line

Heat Transfer Compound has a poor "k" so it MUST be used in very thin layers to achieve good heat transfer.

The HTC must also stay in place for long-term success.

How does this affect the thermal performance?

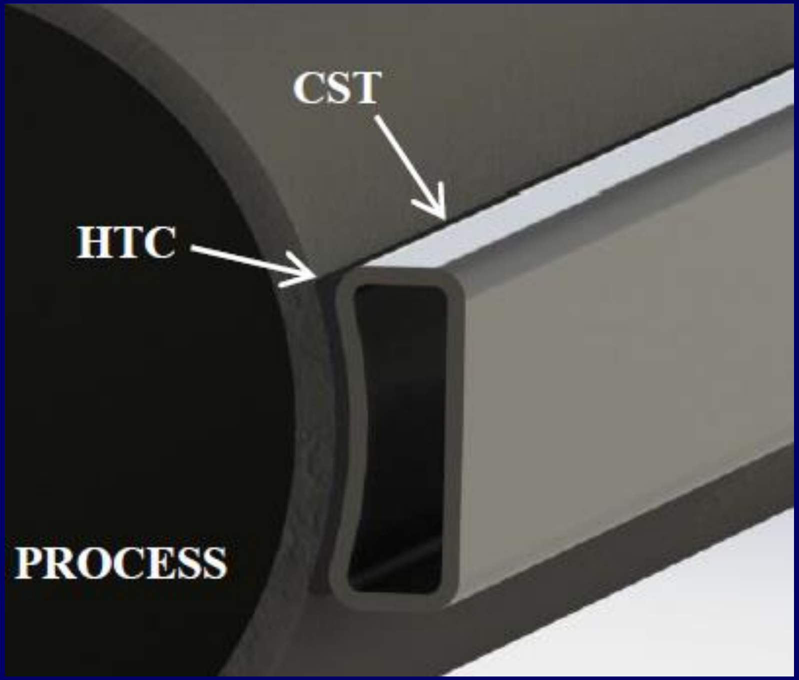
Melt-Out Testing Using Steam Tracing and HTC

Steam Tracing Designs Tested

CST (Carbon Steel Tracing)

Maximize the heat transfer from a contoured, carbon steel tube to the pipe wall / process

Minimize the HTC layer between tracing and pipe

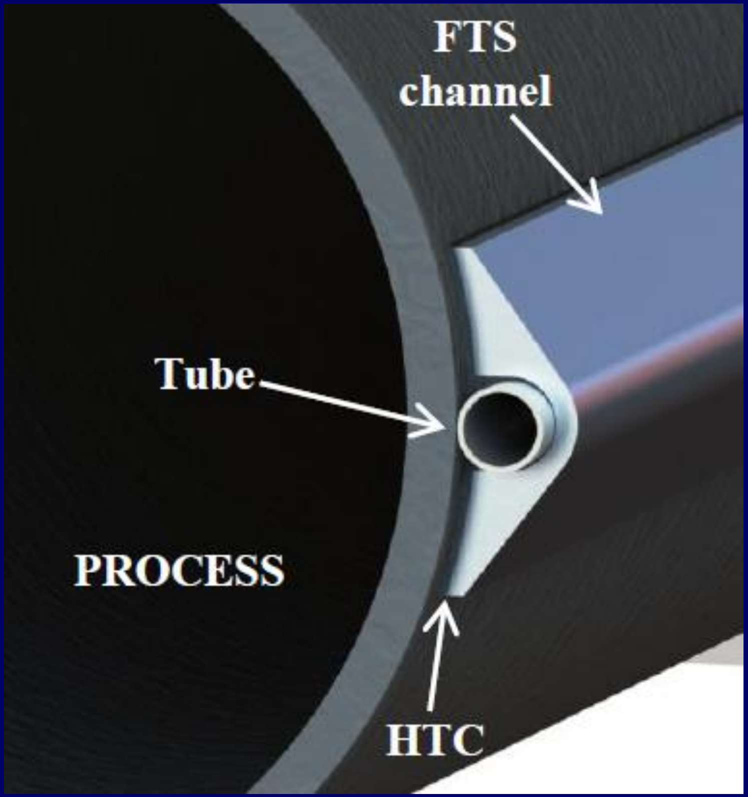


Steam Tracing Designs Tested

FTS (Fluid Tracing System)

Maximize the heat transfer from a single tube into pipe wall / process using highly conductive aluminum

Minimize the HTC layer between tracing and pipe



Simulating Varying HTC Thicknesses

Field Effects on Thickness

- Raised Weld Crowns
- Uneven Distribution of HTC
- Air Gaps between pipe & Trace
- Imperfect Fitting/Welding of tracing

Simulating Varying HTC Thicknesses

(3) Different Simulated Gaps

- 1/32 inch (0.031 inch or 0.8 mm)
- 3/32 inch (0.094 inch or 2.4 mm)
- 5/32 inch (0.156 inch or 4.0 mm)

Melt-Out Test Results

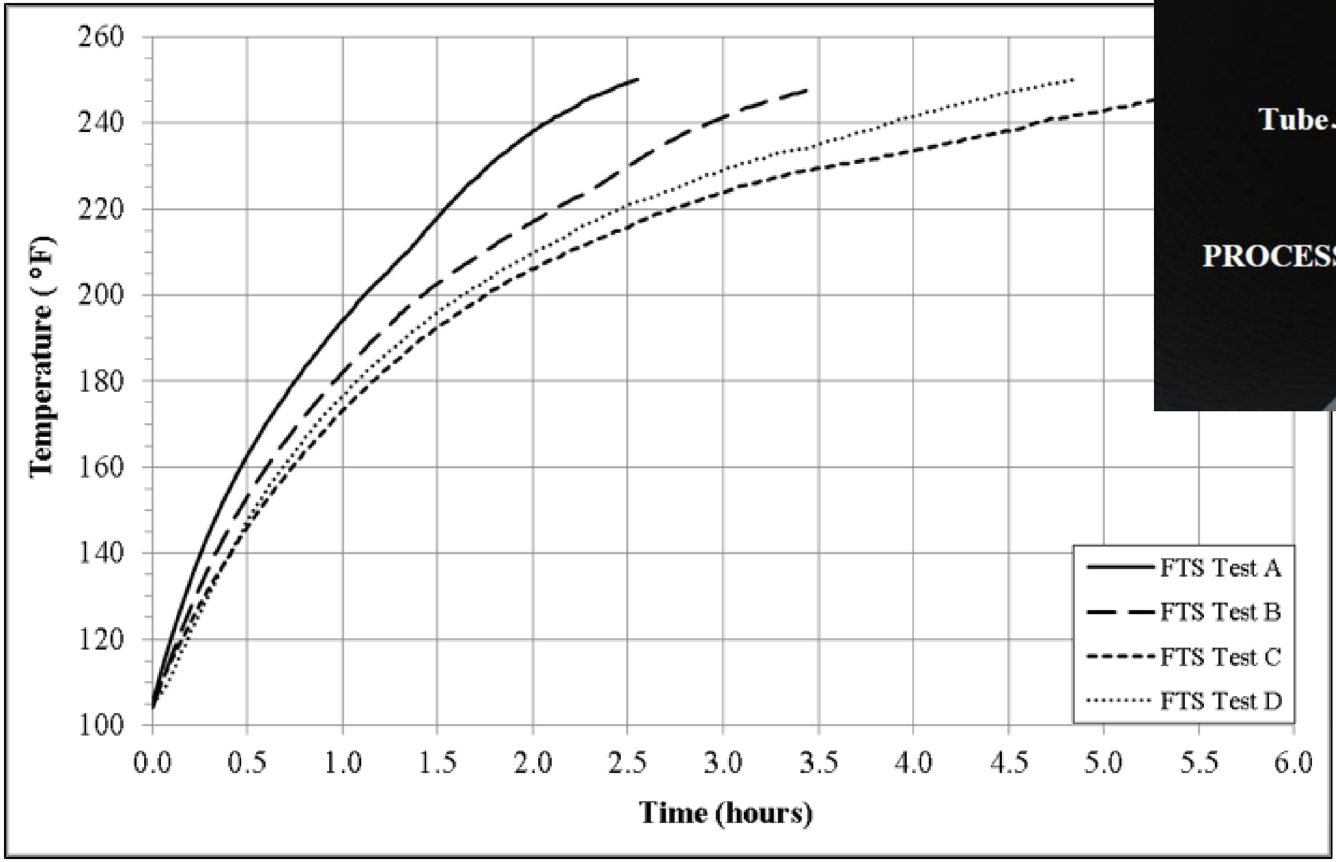
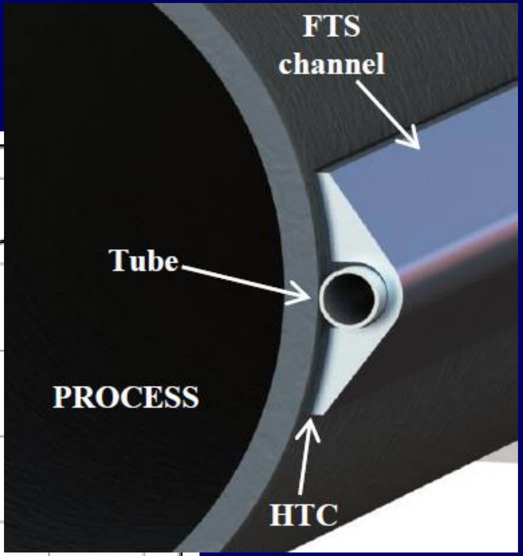


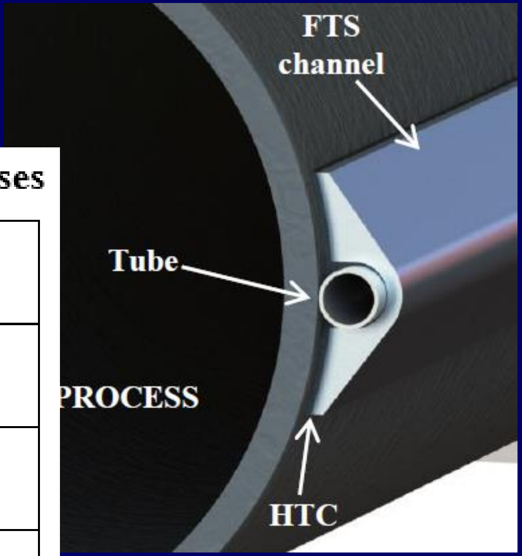
Figure 8: Temperature with respect to time for FTS tests



Melt-Out Test Results

Table 4: Time to melt sulfur using FTS with various HTC thicknesses

Test	HTC Layer Thickness (inches)	Time to heat sulfur from 105-248 °F
FTS-A	1/32	2 hours, 26 minutes
FTS-B	3/32	3 hours, 29 minutes
FTS-C	5/32	5 hours, 34 minutes
FTS-D	No HTC – Bare FTS tracer on pipe	4 hours, 36 minutes



Melt-Out Test Results

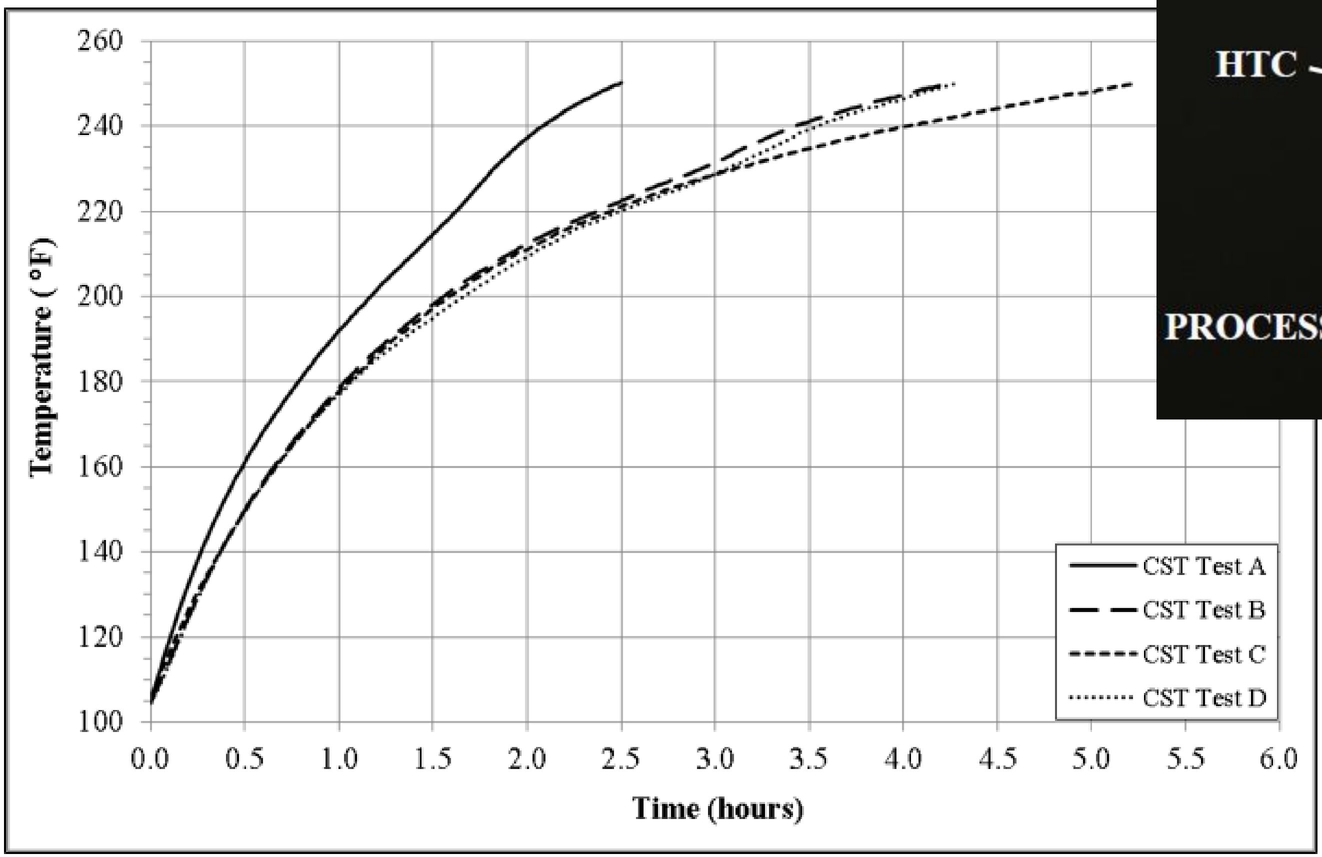
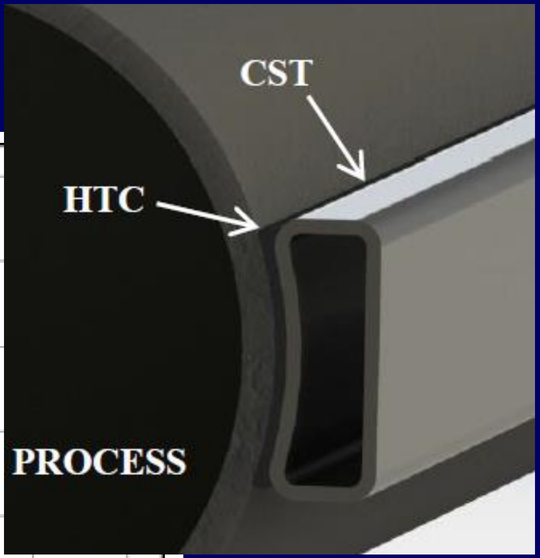


Figure 7: Temperature with respect to time for CST tests



Melt-Out Test Results

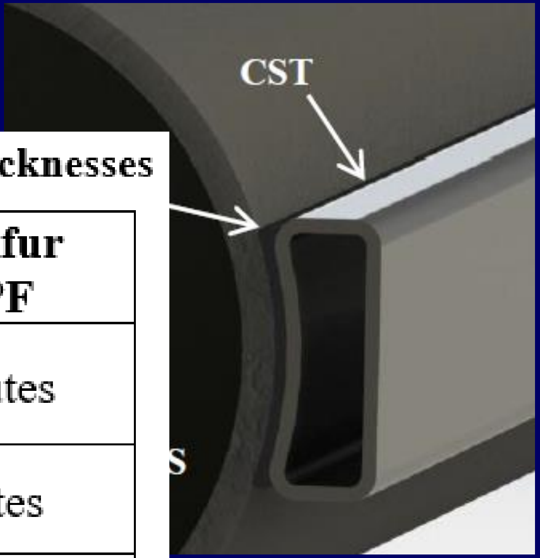


Table 3: Time to melt sulfur using CST with various HTC thicknesses

Test	HTC Layer Thickness (inches)	Time to heat sulfur from 105-248 °F
CST-A	1/32	2 hours, 24 minutes
CST-B	3/32	4 hours, 3 minutes
CST-C	5/32	5 hours, 12 minutes
CST-D	No HTC – Bare CST tracer on pipe	4 hours, 7 minutes

Melt-Out Test Results

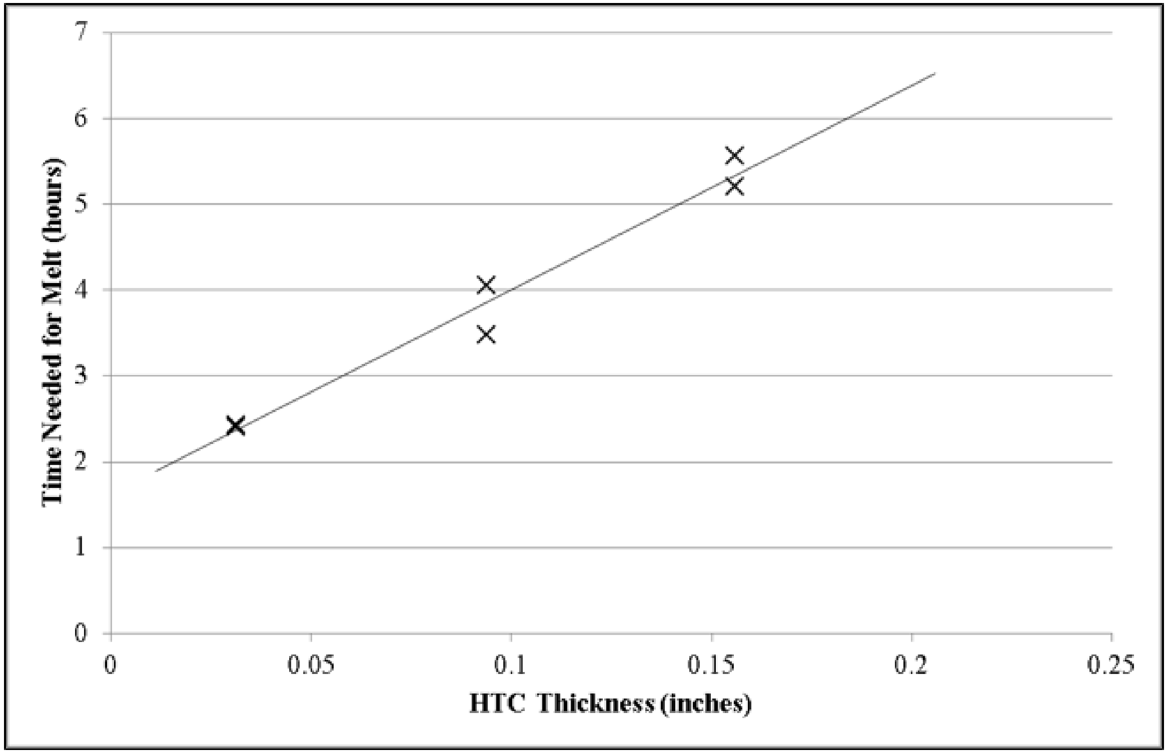
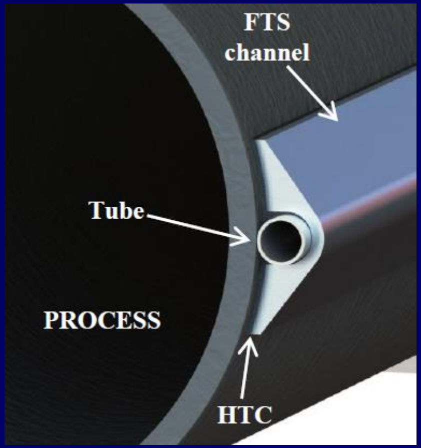
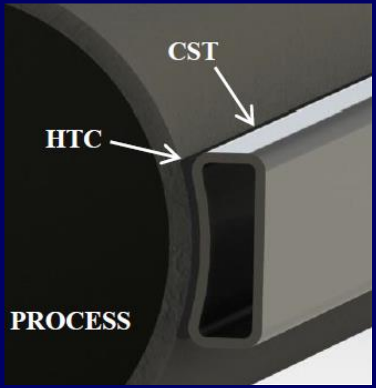


Figure 9: Time required for sulfur melt-out as a function of HTC thickness





Take-Aways

1) Follow Manufacturers' Guidelines for Installation

2) Training Installers on the purpose and use of Heat Transfer Compound

3) Use a Conductive Steam Tracing System that allows for excellent contact (small layers of HTC)

4) Avoid running Steam Tracing over weld beads

Tight Contact Leads to Long-Term Success

Loose Contact Leads to Failure

Thank you

Thomas Perry
Carson Hannah