Johns Manville
A Berkshire Hathaway Company

CONSIDERATIONS FOR THIN BLANKET INSULATIONS

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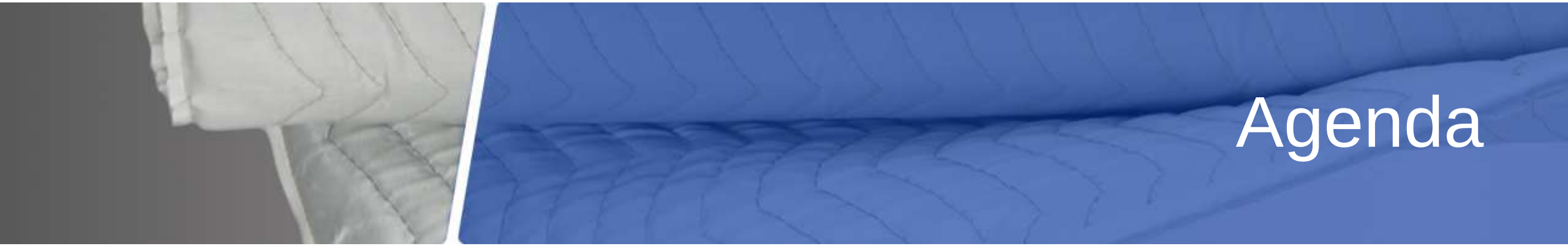


Agenda

Overview

- Microporous Blanket Insulations: Description/Benefits
- Thermal Performance
- Corrosion Prevention
- Health & Safety

InsulThin® HT Microporous Blanket Insulation

- Temp Range: Ambient – 1200°F
- Not to be used in cryogenic applications
- Quilted product
- Hydrophobic

Thin Blanket Uses

- Confined spaces
- Large-diameter
- Small-diameter
- Temperatures between ambient -1200°F
- Meet code requirements at smaller profile

Code Requirements

- Changing energy codes are requiring more insulation – but there is no room for it
- Additional pipes in existing tunnels are requiring thinner, more efficient insulation materials
- Thermal conductivity values based on mineral fiber insulation
- Meet code with less insulation

TABLE C403.11.3
MINIMUM PIPE INSULATION THICKNESS (in inches)[a, c]

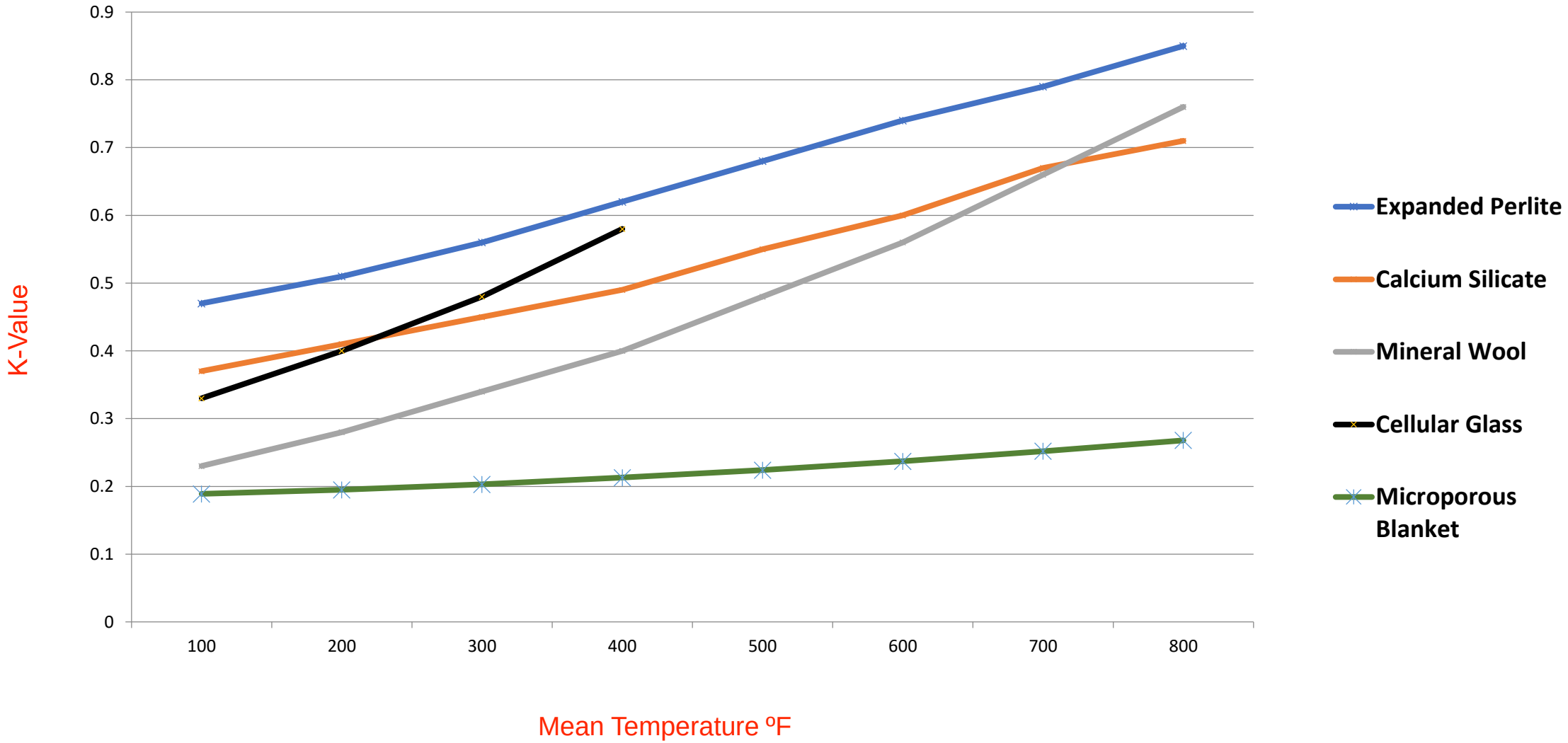
FLUID OPERATING TEMPERATURE RANGE AND USAGE (°F)	INSULATION CONDUCTIVITY		NOMINAL PIPE OR TUBE SIZE (inches)				
	Conductivity Btu • in./(h • ft^2• °F)[b]	Mean Rating Temperature, °F	< 1	1 to < 1 $^1/_2$	1 $^1/_2$ to < 4	4 to < 8	≥ 8
> 350	0.32 – 0.34	250	4.5	5.0	5.0	5.0	5.0
251 – 350	0.29 – 0.32	200	3.0	4.0	4.5	4.5	4.5
201 – 250	0.27 – 0.30	150	2.5	2.5	2.5	3.0	3.0
141 – 200	0.25 – 0.29	125	1.5	1.5	2.0	2.0	2.0
105 – 140	0.21 – 0.28	100	1.0	1.0	1.5	1.5	1.5
40 – 60	0.21 – 0.27	75	0.5	0.5	1.0	1.0	1.0
< 40	0.20 – 0.26	50	0.5	1.0	1.0	1.0	1.5

For SI: 1 inch = 25.4 mm, °C = [(°F) - 32]/1.8.

https://codes.iccsafe.org/content/iecc2018/chapter-4-ce-commercial-energy-efficiency

Thermal Performance

Thermal Performance

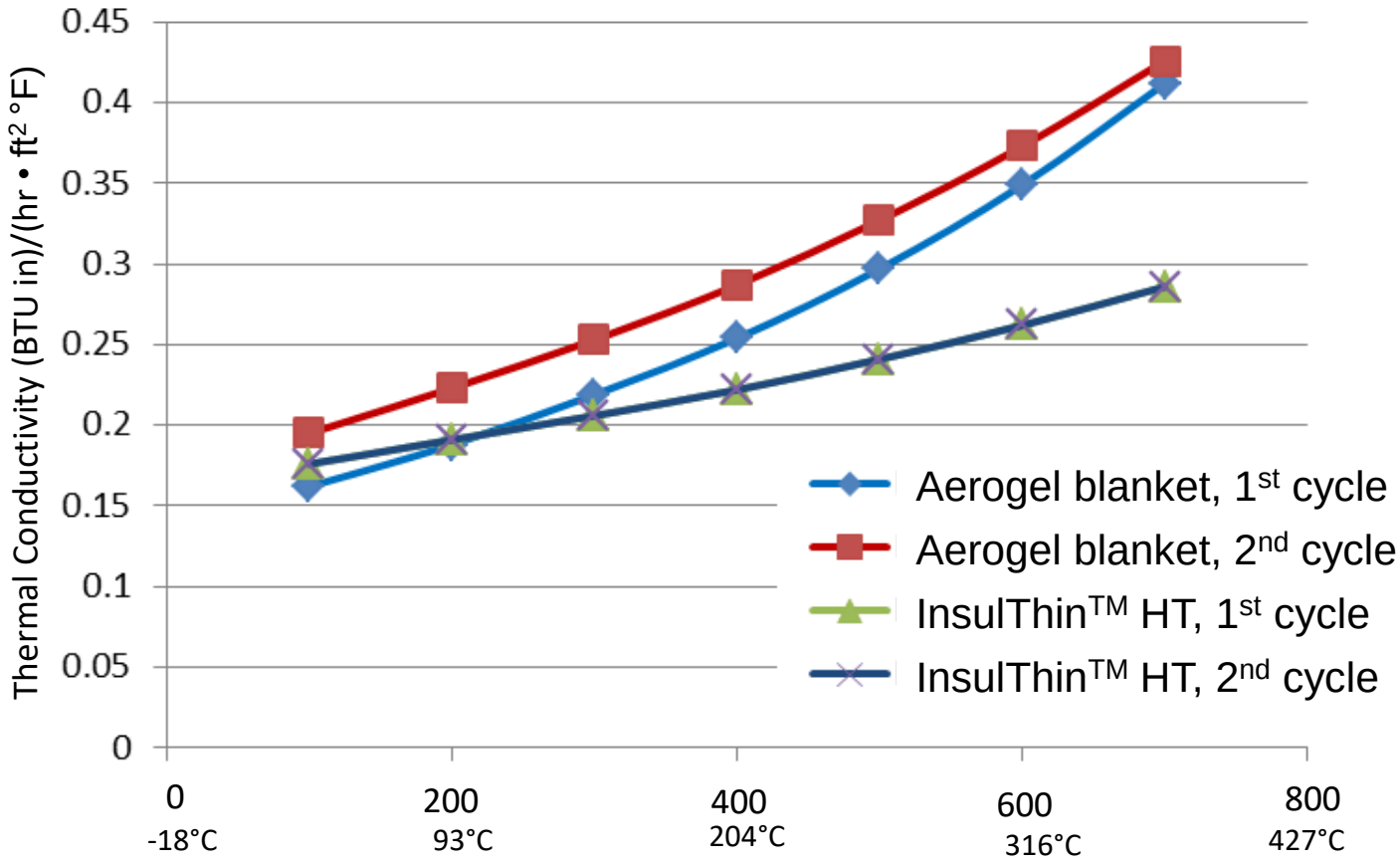


Thermal Shift Definition

Thermal Shift: the permanent change in an insulation material's thermal conductivity due to exposure to high temperatures (>300°F/149°C).

Silica Aerogel vs. Microporous Insulation

Microporous insulation performs better than silica aerogel blanket after being heated to 700°F mean temperature



ASTM C335 – 3rd Party

Corrosion Prevention

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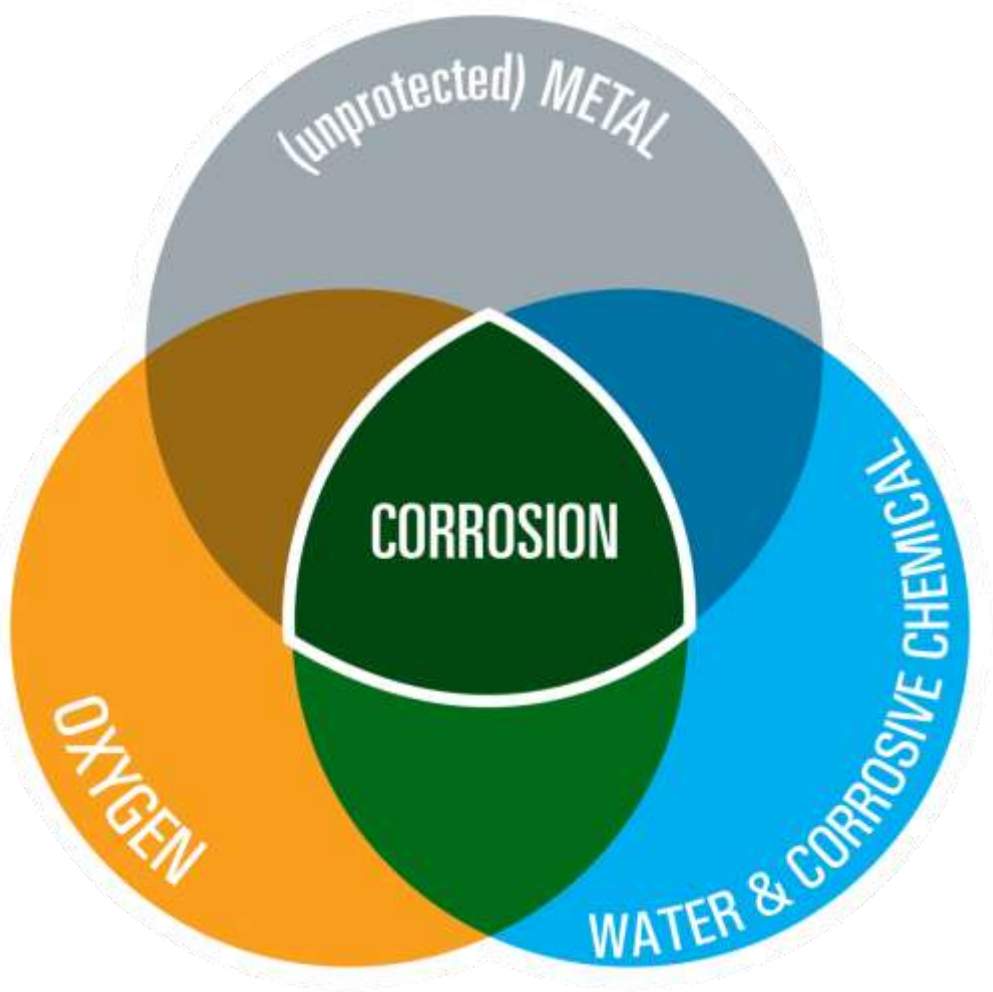
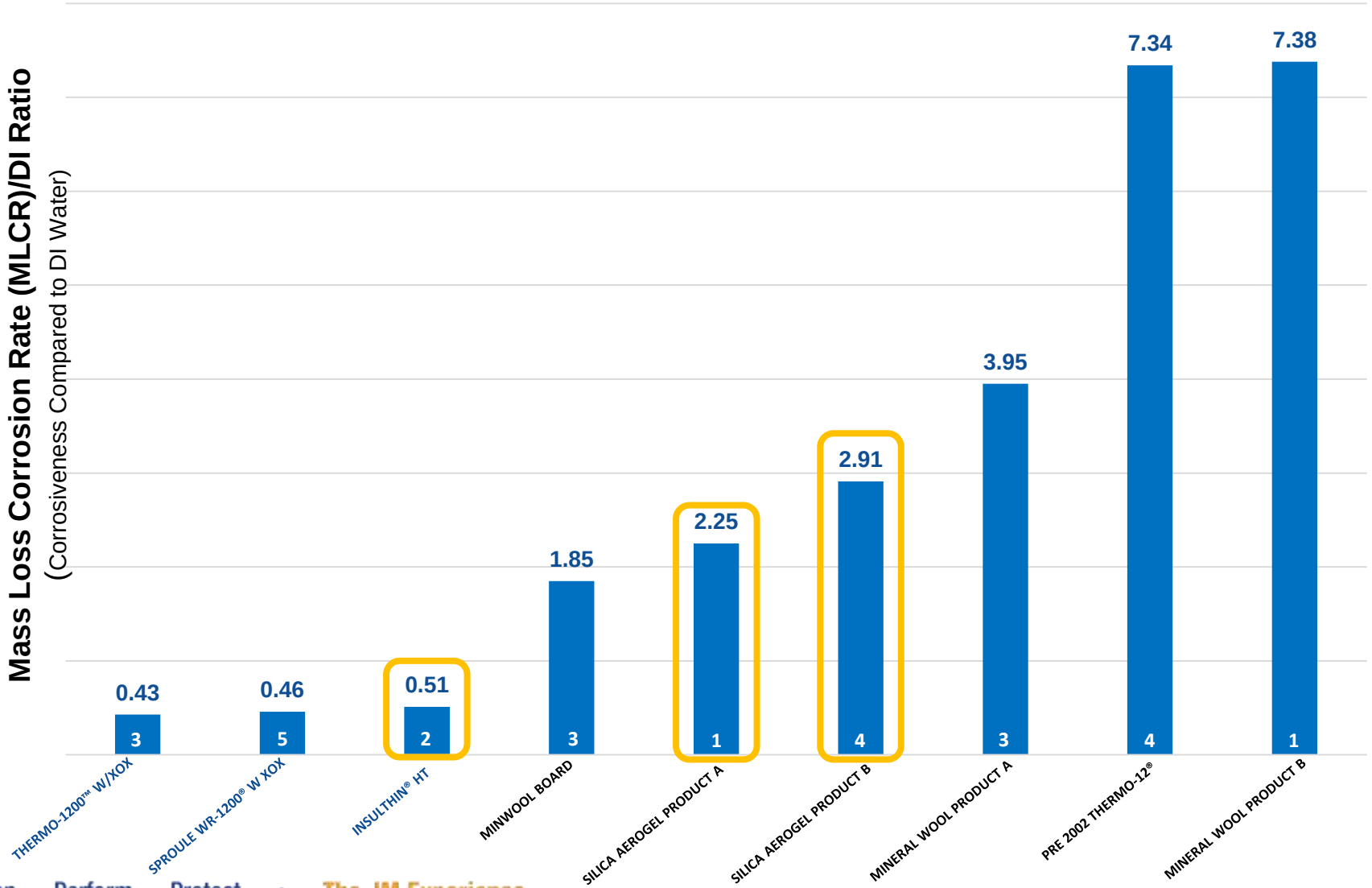
The Recipe for Corrosion Under Insulation

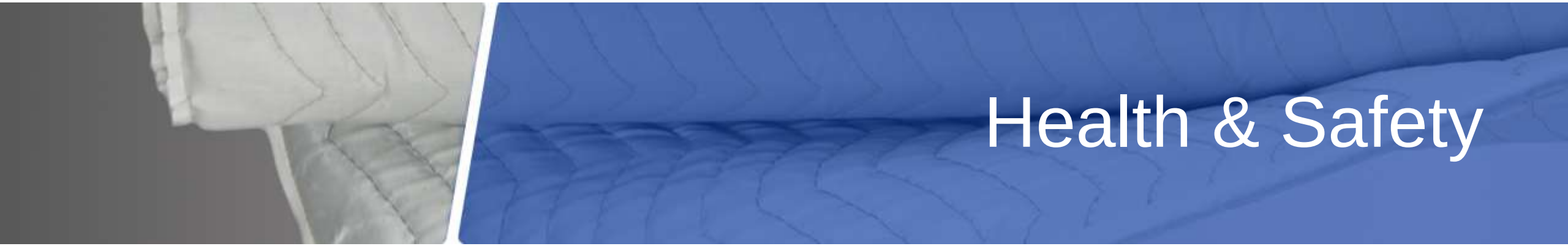


- Wet insulation holds water next to the pipe surface
- The insulation can impact the rate and type of corrosion that occurs on the pipe surface
- We measure the corrosive potential of insulation as a Mass Loss Corrosion Rate (MLCR) using ASTM C1617

ASTM C1617: Short-Term CUI Testing



Results are averaged based on the number of data points or tests executed and are reflected by the white numbers in the bar graph.

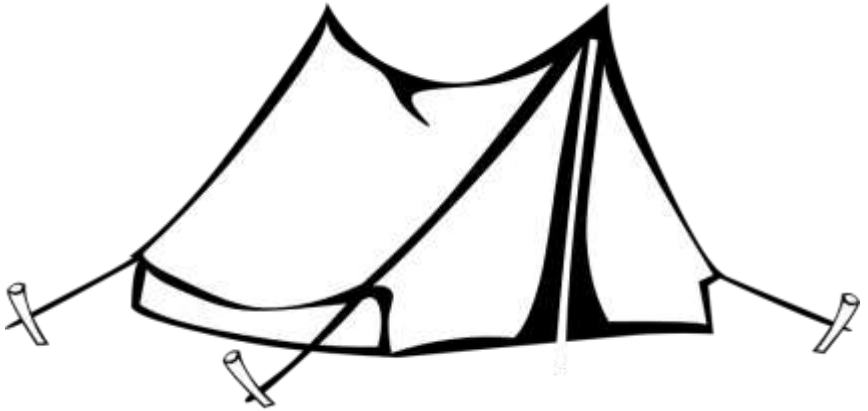


Health & Safety

What's the Fuss about Dust?

Nuisance dust generated during installation has caused some facilities to implement additional PPE standards

Head-to-toe protective suits



Temporary enclosure over the installation area

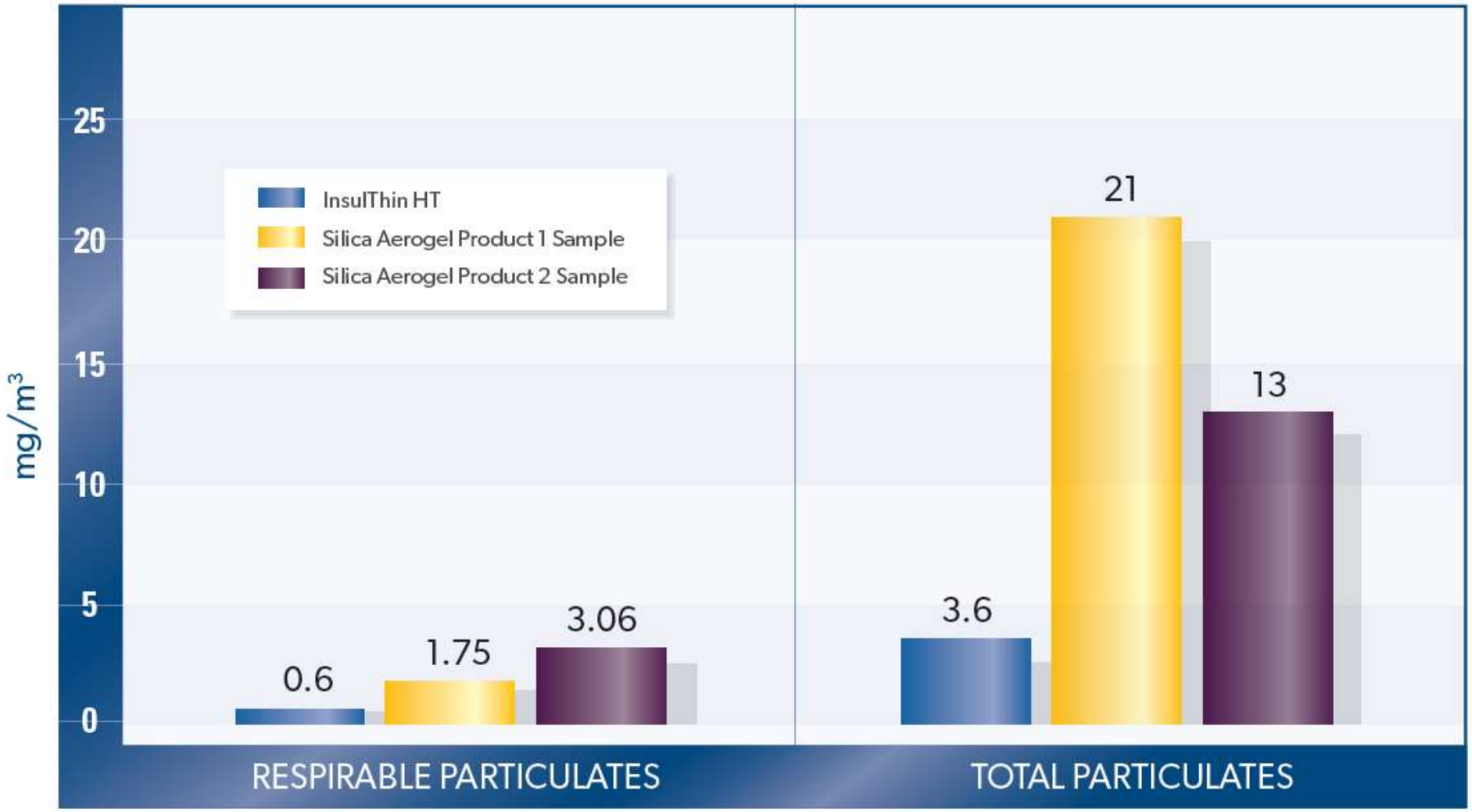
Special clean-up requirements

Test explanation

- Industrial hygiene sampling measured the total and respirable particulates generated during a 4-hour installation on 20” and 8” pipes (~2 hours per pipe)

- Sampling was performed on 3 insulations:
  - InsulThin® HT Microporous Blanket
  - Silica Aerogel Product 1 Sample
  - Silica Aerogel Product 2 Sample

Respirable & Total Particulates

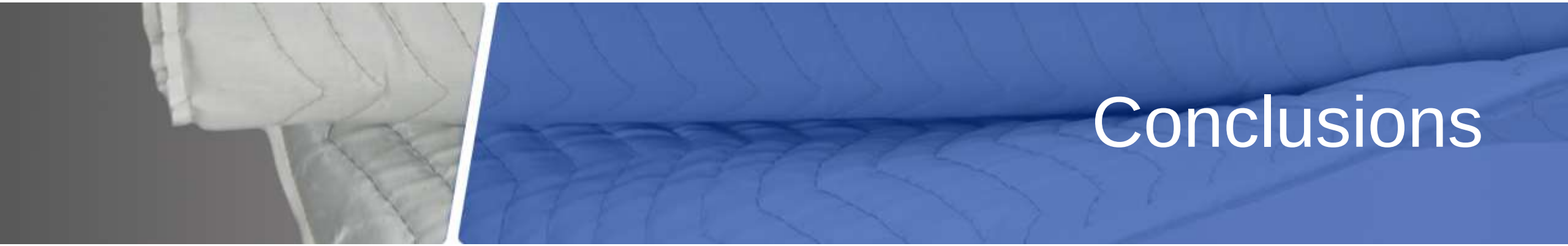


Interpreting the Results

- In this test InsulThin® HT microporous blanket insulation produced **65-80% less dust** than the two silica aerogel product samples that were tested

- The environment and work practices where the material is installed will influence the amount of dust that is present in the air

- Each facility is responsible for meeting OSHA standards



Conclusions

Takeaways

- InsulThin® HT microporous blanket can help achieve code requirements with substantially less insulation thickness compared to other insulation materials.

- InsulThin® HT microporous blanket has a lower corrosive potential than the tested silica aerogel blankets as demonstrated by ASTM C1617.

- InsulThin® HT microporous blanket generates 65-80% less dust than the silica aerogel blanket products it was tested against.

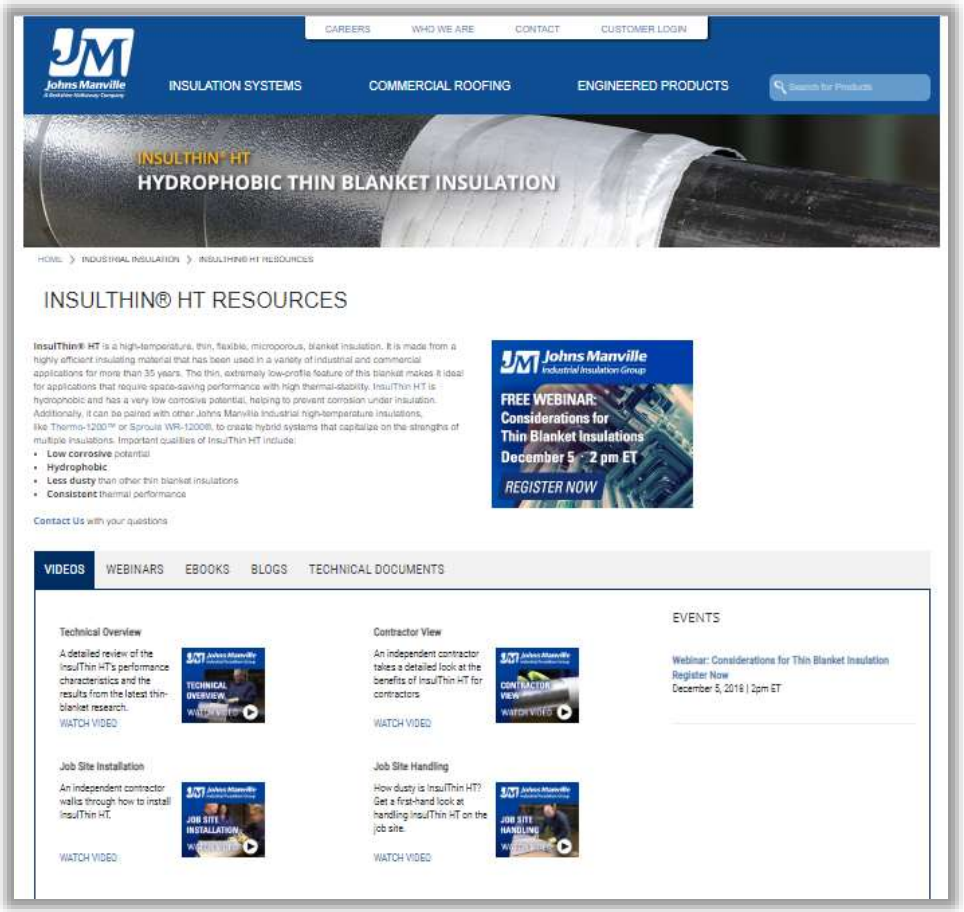
Additional Resources

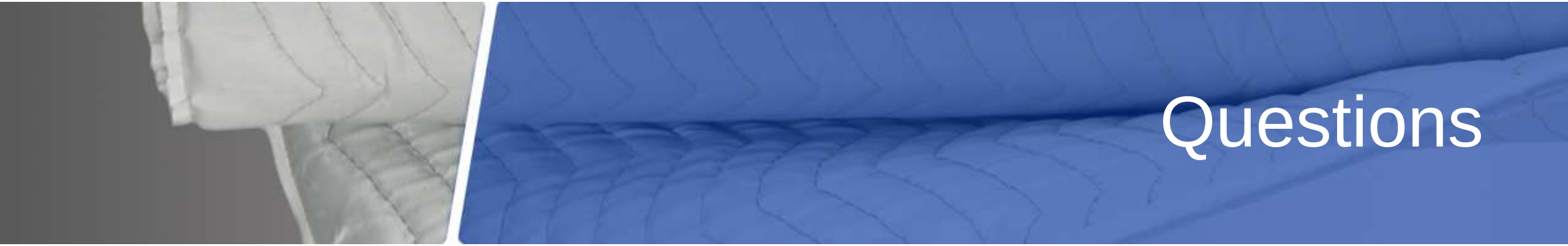
InsulThin® HT Resource Library Page

InsulThin® HT Resource Library

- Insulation Intel® eBook Series: Thin Blanket Insulation Considerations
- Installation videos
- Webinars on-demand
- Blogs about thin blanket insulation
- Technical documents and data sheet
- Installation guide
- CUI Performance data

www.JM.com/InsulThin-HT





Questions

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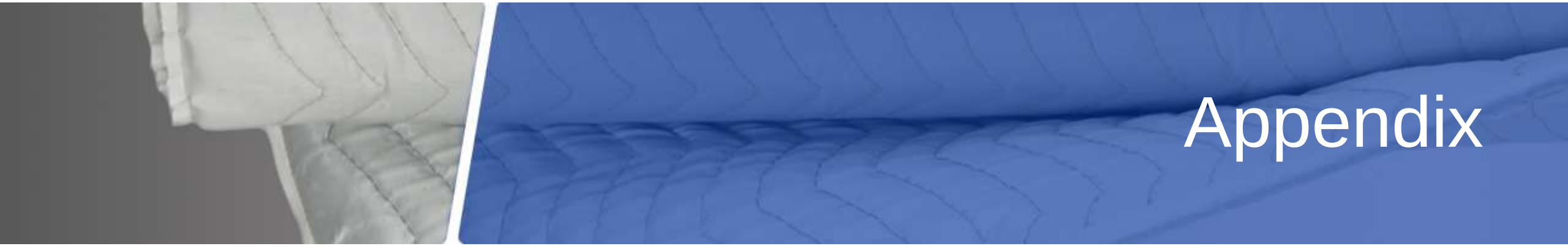

Appendix

Thermal Shift Explained

1. Organic components, including hydrophobic agents, are oxidized between 300°F (149°C) and 600°F(316°C).

2. Tested silica aerogels become more friable and break, resulting in fewer closed cell structures.

3. Thermal performance is reduced and is dependent on temperature exposure.

4. Once the silica aerogel within the blanket has been compromised, the thermal performance will be permanently reduced.

5. The material will reach a certain point of degradation, and then plateau, maintaining a new, consistent thermal conductivity afterward.

Thermal Shift Explained

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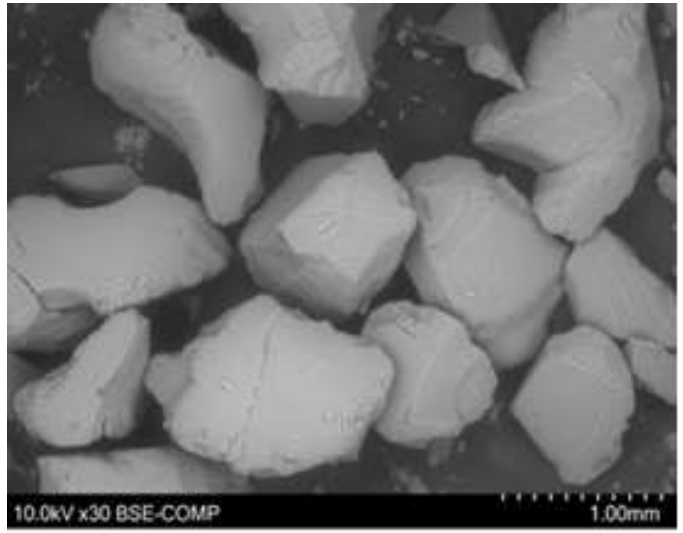
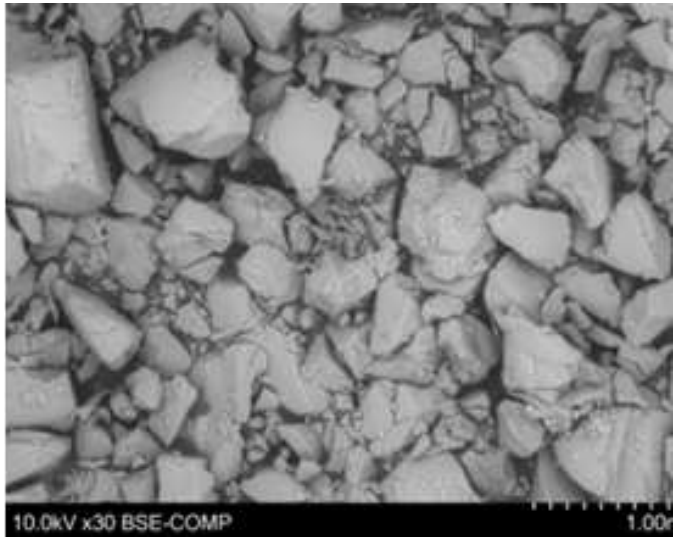
Before Heat Exposure



After Heat Exposure to 900°F/482°C



High temperatures break down the organic chemistry and microstructure of silica aerogel particles, reducing thermal performance and water repellency.

Conclusions

- Thermal Shift is unique to silica aerogel.

- Thermal Shift must be considered during the design phase in order to be certain the insulation performs as required for the life of the installation.

- Existing installations that have experienced Thermal Shift can be easily restored to design conditions by adding additional layers of insulation.