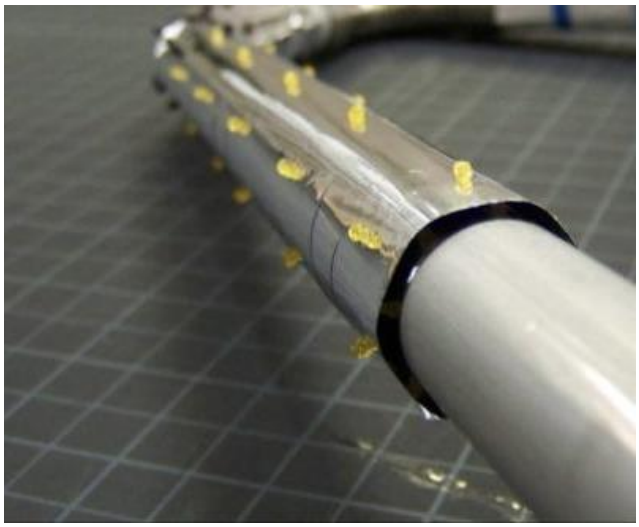
QUEST THERMAL GROUP
Innovative thermal solutions

Wrapped MLI
PRODUCT SHEET

Wrapped MLI (WMLI) is a high-vacuum superinsulation developed to significantly reduce heat leak through piping, tubing, and transfer lines for cryogenic fluid management.

Wrapped MLI uses a proprietary Discrete Spacer Technology designed for cryogenic transfer applications and includes several Quest technologies; Triple Orthogonal Disc (TOD) polymer spacers and low emissivity Nested Shells. The discrete spacers allow tight concentric wrapping of tube diameters from ¼" up to 6". WMLI offers a 12-fold improvement in heat leak compared to spiral-wrapped netting MLI, and can be utilized in existing VJP designs with minimal modifications. WMLI utilizes custom-designed Nested Shells via additive manufacturing to accommodate bends, tees, valves, and other plumbing equipment. WMLI can also provide integrated low thermal conductivity pipe supports and standoffs. Working with our customers, we provide engineering design, system analysis, and the fabrication and installation of our highly-modular extremely effective WMLI systems.



DIFFERENTIATORS

- Discrete Spacers form a robust structure.
- 12-fold heat leak reduction per layer compared to spiral-wrapped netting MLI.
- Accurate thermal modeling with predictable performance, heat flux within 30% of proprietary thermal models.
- Low ε Nested Shells accommodate bends, flanges, fittings & valves.
- Structure unaffected by gravity and compression.
- Enables high performance vacuum jacketed pipe solutions.
- Vapor cooled WMLI enables very low heat leak struts
- Modular WMLI solutions are engineered to meet or exceed your requirements.

APPLICATIONS

Aerospace

- Cryopropellant transfer lines
- Actively crycooled coolant lines
- In-space propellant transfer
- Lunar/Mars ISRU
- Launch facilities & GSE

Commercial

- Vacuum jacketed piping
- LH_2 aircraft fuel systems
- LH_2 infrastructure
- Superconductor cooling

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MEASURED THERMAL PERFORMANCE

WMLI CONFIGURATIONS

WMLI thermal performance has been tested via boiloff calorimetry at Quest Thermal Group. High- performance, robust structure and predictability are benefits of WMLI compared with traditional netting based feedline insulation (MLI). WMLI's unique features are engineered to reduce heat flux in cryogenic piping.

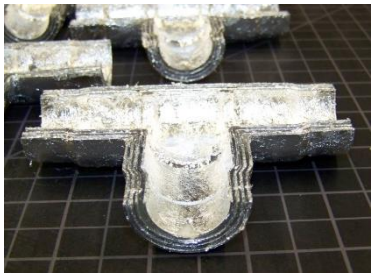
WMLI thermal performance vs netting MLI, 77 – 295K				
Insulation system	Layers	Heat Leak, W/m^2	e*	Conductivity, mW/m-K
WMLI	5	1.8	0.0047	0.063
WMLI	10	0.9	0.0024	0.063
WMLI	15	0.45	0.0012	0.063
Clamshell MLI	5	5.5	0.0130	0.13
Spiral MLI	5	26.6	0.0620	0.62

NESTED SHELLS

- Custom-designed Nested Shells via additive manufacturing accommodate bends, tees, valves, and other plumbing equipment.
- Shells have low solid heat conduction, and VDA coating limits radiative heat transfer.
- Provide good thermal performance.
- WMLI can provide integrated low thermal conductivity pipe supports and standoffs.
- Drastically reduce installation time and effort.

5-layer WMLI/VJP vs. standard Vacuum Jacketed Pipe

Insulation system	WMLI/VJP Heat Leak, W/m	Standard VJP Heat Flux, W/m	% Advantage WMLI/VJP over Standard VJP
0.5" diameter pipe	0.09	0.31	71%
0.75" diameter pipe	0.19	0.37	49%
1.5" diameter pipe	0.30	0.54	44%



For more information about our products, visit our website: questthermal.com

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