CTD

CryoCoat™ UltraLight™ Insulation

presented by:

Michael L. Tupper

COMPOSITE TECHNOLOGY DEVELOMENT INC.

1505 Coal Creek Drive

Lafayette, Colorado 80026

January 2001

CTD

The Innovation of UltraLight™

- *UltraLight*™ is a high integrity, low density material...

that is not a foam!

- Mechanical integrity of a syntactic foam
- density & thermal conductivity of a chemically expanded foam
- Material lighter than 5 PCF has been fabricated
- Meet the requirements for insulating the space shuttle external tank

CTD

The Systems Approach

- Layered, Cryogenic Insulation System
- Incorporates CTD's expertise:

  Adhesives

  Thermal Insulation

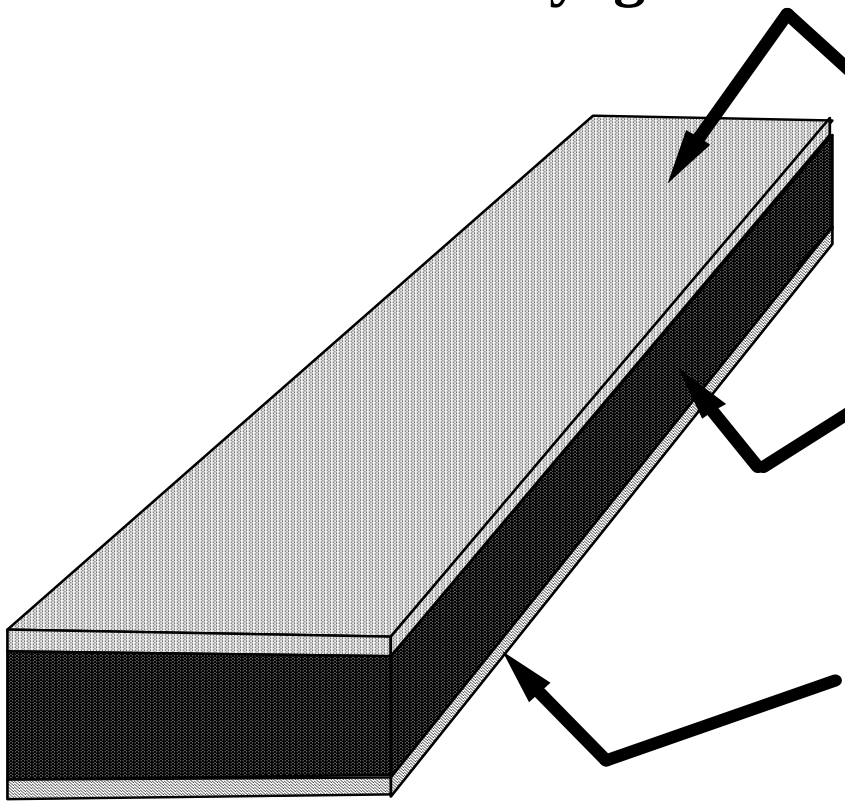
  Protective Coatings

- Each layer can be optimized
  - gives best system performance

CTD

CryoCoat™ UltraLight™

Cryogenic Insulation



Protective Coating

Moisture Barrier &
Flame Retardant

Ultra light Insulation

Density less than 5 lbs/ft3

Adhesive Layer

Low Density

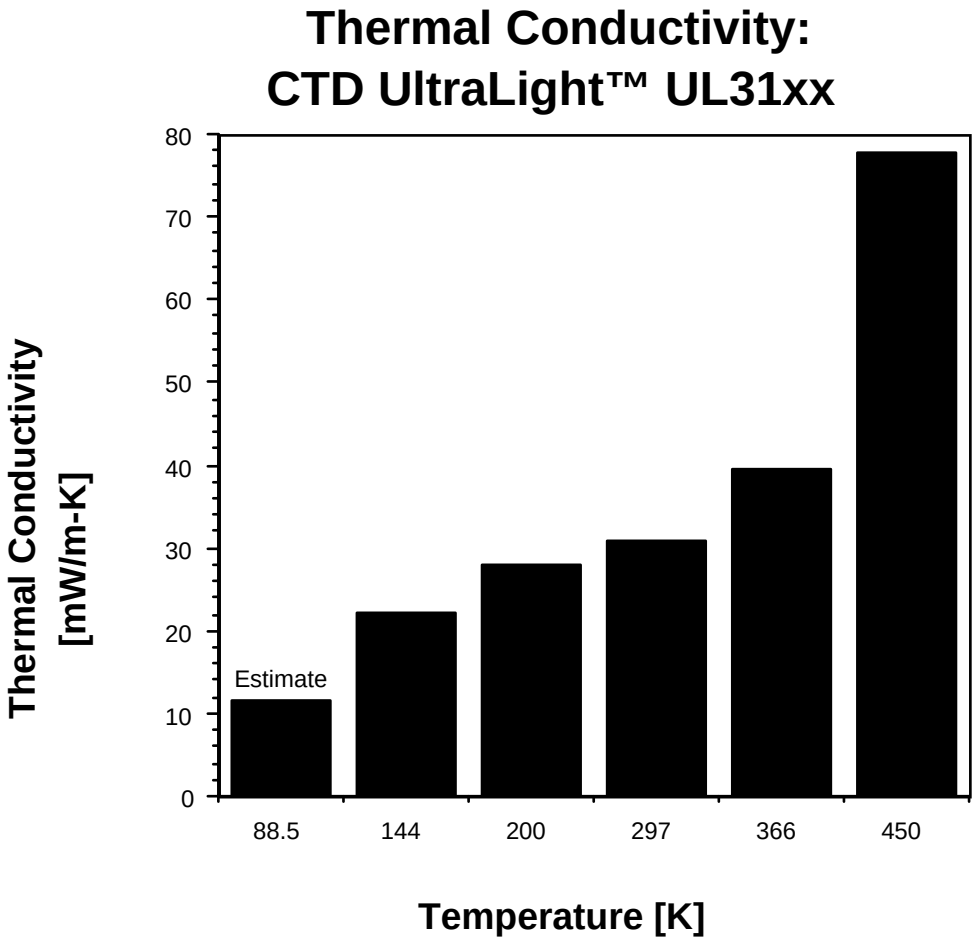
CTD

Advantages

- Light weight
- Dimensional stability
- Easily machined or modified
- Field repairable
- Consistent manufacturing process
- Easy to apply
- Tailorable properties
- Low cost

CTD

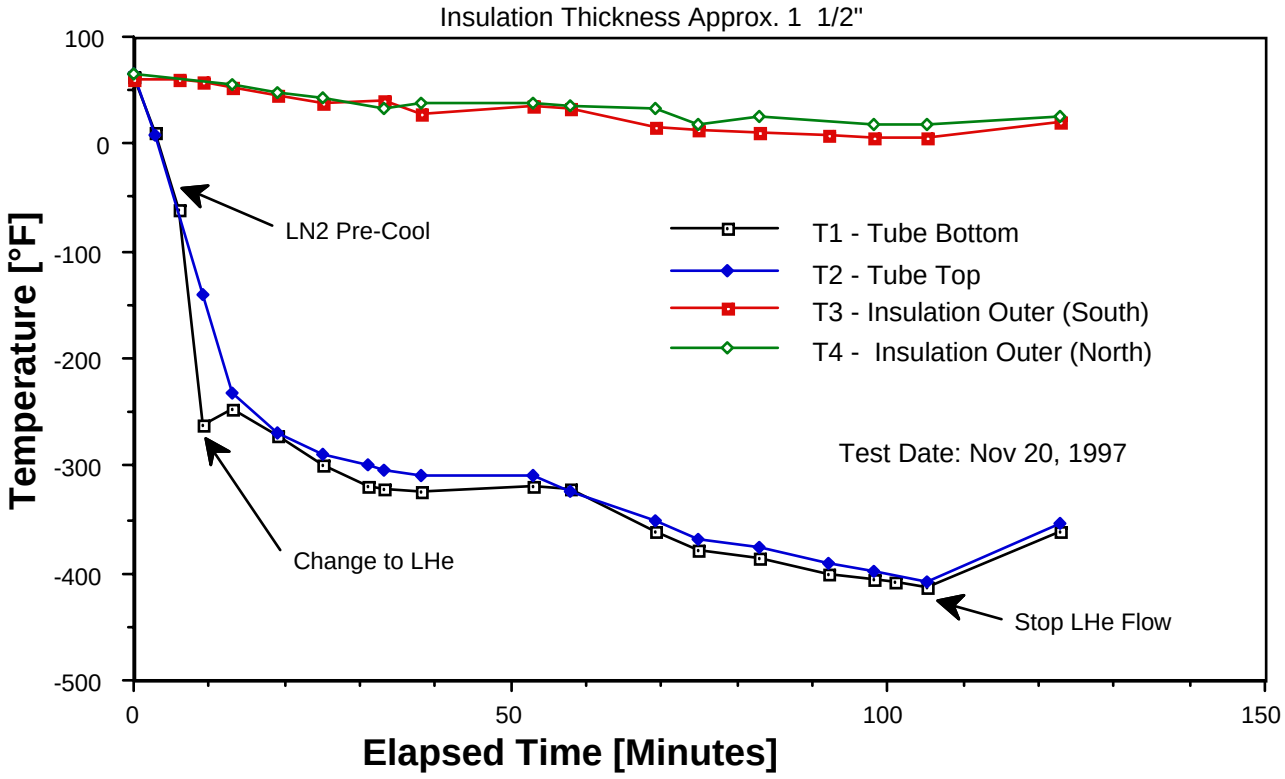
Thermal Conductivity Range



CTD

Helium Flow Test

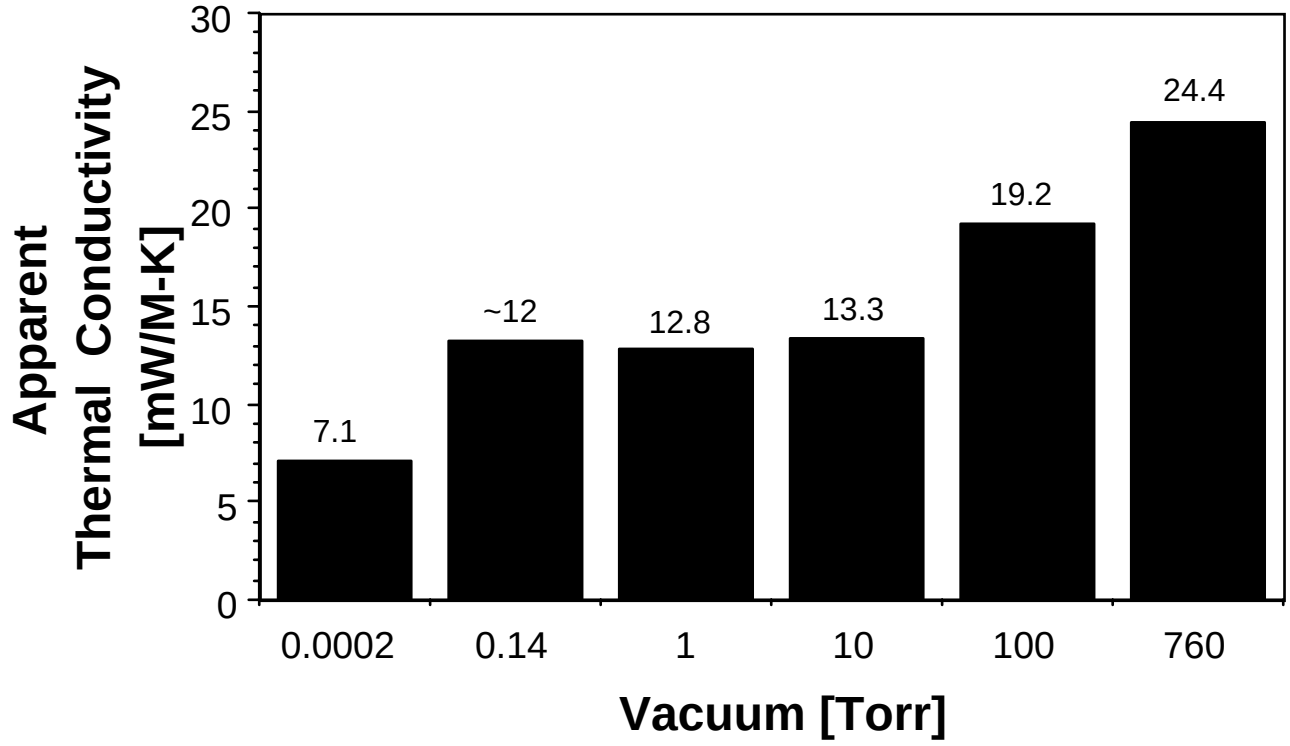
Thermal Time History for Approximately 1 1/2” of Cryocoat™ UltraLight™ UL79 insulation on 4” Diameter Inconel Tube



CTD

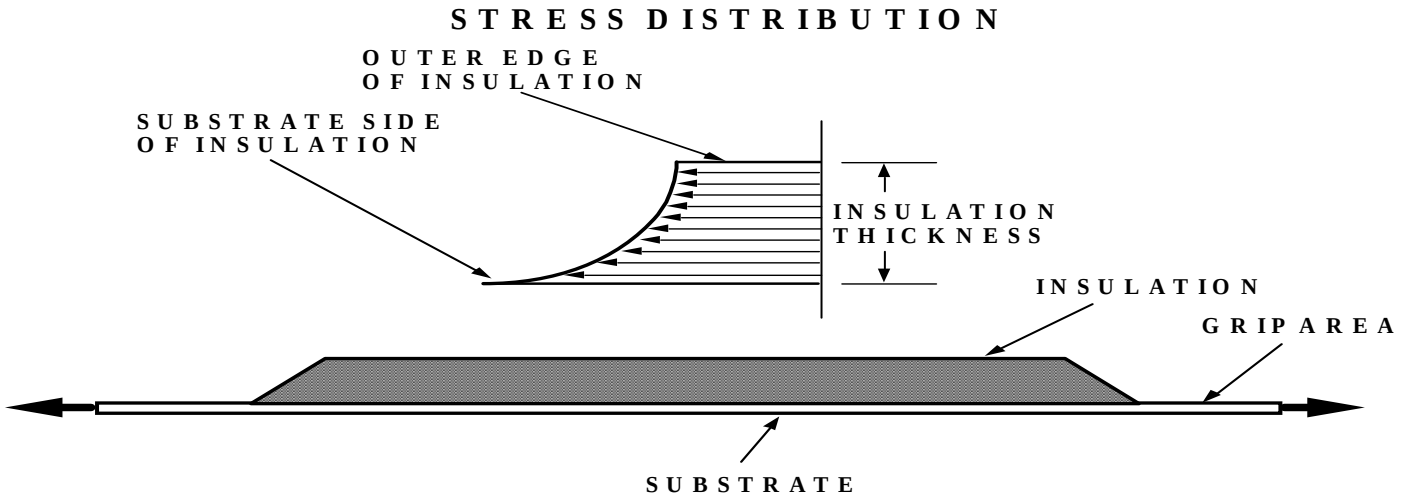
Apparent Thermal Conductivity UL79

between liquid nitrogen and room temperature
as a function of vacuum pressure
preliminary data from NASA Kennedy



CTD

Tensile Cryoflex Data



Substrate	Temperature [K (°F)]	Maximum Substrate Strain [με]	Comments
Aluminum	77 (-320)	>10,000	Substrate Yielded
Aluminum	4 (-454)	9,000	No Failure
Carbon Composite	77 (-320)	>6500	Insulation Cracking
Carbon Composite	4 (-454)	~5000	Insulation Cracking

CTD

Tension Test Results

Material	# of Specimens	Strength (psi)	Modulus (Ksi)	Strain to Failure (microstrain)
at LN2 Temp				
CryoCoat™ 620T	2	4,111	1,093	3,800
PW 28	2	2,080	548	3,800
PW 30	1	520	338	1,600
PW31	3	1,585	308	4,500
UL79	2	111	8	12,000
at Room Temp.				
PW31	3	195	14	26,000
UL79	1	92	7	17,000

CTD

Moisture Barrier Coating

85% Relative Humidity at Room Temperature