National Aeronautics and Space Administration

Technology Opportunity

Thermal Insulation Test Apparatuses

Thermal Insulation Test Apparatus With Sleeve (Cryostat 1)
Multipurpose Thermal Insulation Test Apparatus (Cryostat 2)
Thermal Insulation Test Apparatus for Flat Specimens (Cryostat 4)

The National Aeronautics and Space Administration (NASA) seeks to license its Thermal Insulation Test Apparatuses. Designed by the Cryogenics Test Laboratory at the John F. Kennedy Space Center (KSC) in Florida, these patented technologies (U.S. Patent Numbers: Cryostat 1 – 6,742,926, Cryostat 2 – 6,487,866, and Cryostat 4 – 6,824,306) allow manufacturers to fabricate and test cryogenic insulation at their production and/or laboratory facilities. These new inventions allow for the thermal performance characterization of cylindrical and flat specimens (e.g., bulk-fill, flat-panel, multilayer, or continuously rolled) over the full range of pressures, from high vacuum to no vacuum, and over the full range of temperatures from 77K to 300K.

In today's world, efficient, low-maintenance, low-temperature refrigeration is taking a more significant role, from the food industry, transportation, energy, and medical applications to the Space Shuttle. Most countries (including the United States) have laws requiring commercially available insulation materials to be tested and rated by an accepted methodology. The new Cryostat methods go beyond the formal capabilities of the ASTM methods to provide testing for real systems, including full-temperature differences plus full-range vacuum conditions.

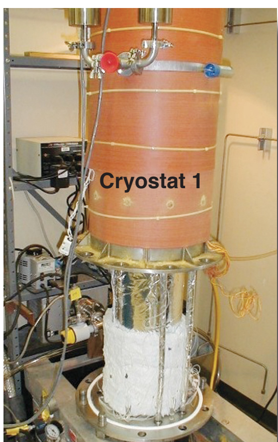

Figure 1. Overall view of Cryostat-1 with the vacuum can assembly removed.

Figure 2. View of Cryostat-2 showing the cold-mass assembly mounted on a workstand.

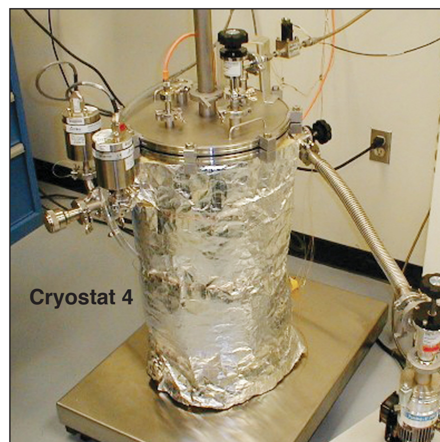

Figure 3. Overall view of Cryostat-4.

Potential Commercial Uses

- Thermal conductivity measurement for performance qualification of statistical quality control
- Performance range determination of standard product lines
- Assistance in new product development
- Multilayer insulation (MLI)
- Process piping and storage tanks
- Research and testing
- Refrigeration

Benefits

- New standard test method
- Relatively quick testing
- Mobile and adaptable to different sizes and thicknesses
- Requires minimal user intervention
- High sensitivity and excellent repeatability
- Produces long-duration, steady-state measurement of heat flux through insulation test article
- Provides flexibility of pressure environments
- One-step cooling, filling, and thermal stabilization process
- Displays complete temperature profile across thickness of insulation test article for detailed performance information

Explore. Discover. Understand.

The Technology

Cryostat 1 is a cylindrical test apparatus for direct measurement of the absolute thermal conductivity of a material system. This apparatus, shown in Figure 1, includes a cold mass and provides absolute k-values for specimens. A simplified schematic of the insulation test apparatus is given in Figure 4.

Cryostat 2 is a cylindrical test apparatus for measurement of the comparative k-value (see Figure 2). This apparatus includes a cold mass and accepts specimens up to 50 mm thick. An overall diagram of Cryostat 2 is given in Figure 5.

Cryostat 4 is a flat-plate test apparatus used for comparative k-value measurements. An overall view of this apparatus is shown in Figure 3. The Cryostat 4 cold-mass assembly can be configured for rigid or soft materials, with or without compressive loads applied. An optional load cell assembly can also be provided. A simplified schematic of the test apparatus showing the temperature sensor locations is given in Figure 6.

Options for Commercialization

NASA seeks qualified companies to commercialize these Thermal Insulation Test Apparatuses. These and other technologies are made available by the KSC Technology Transfer Office through a variety of licensing and partnering agreements.

Contact

If your company is interested in the Thermal Insulation Test Apparatuses or if you desire additional information, please reference Case Numbers KSC-12107, 12108, or 12390 and contact:

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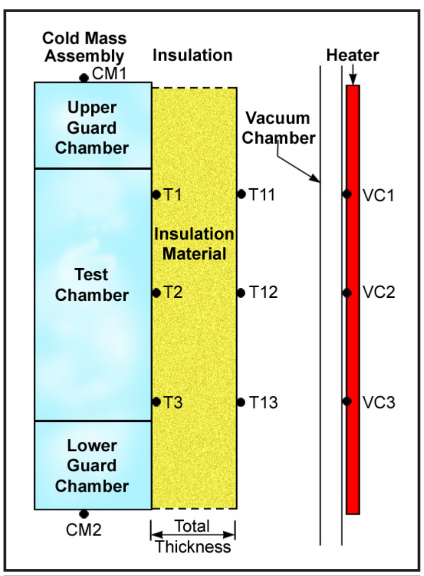
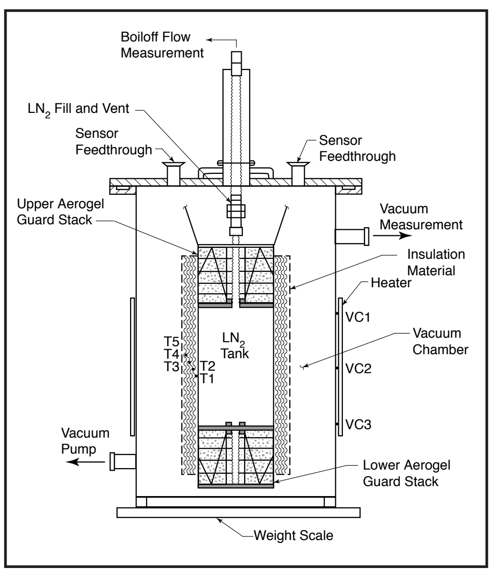
Telephone: (321) 861-7158, FAX: (321) 867-2050, Jeffrey.Kohler-1@ksc.nasa.gov



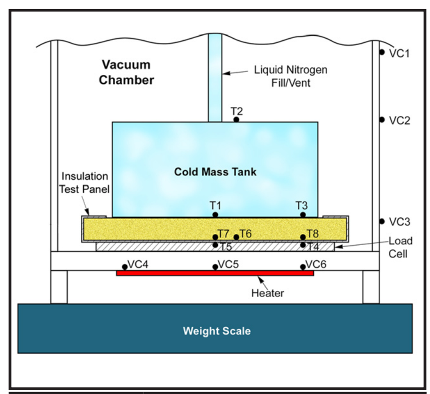
Surface Temperature Measurement	
Sensor	**Location**
VC1, VC2, VC3	Vacuum Can Temperature
T11, T12, T13	Warm-Boundary Temperature (WBT)
T1, T2, T3	Cold-Boundary Temperature (CBT)
CM1,CM2	Cold-Mass Temperature

Figure 4. Simplified schematic of Cryostat 1 showing typical locations of temperature sensors.



Surface Temperature Measurement	
Sensor	**Location**
T1	Inside Layer (Cold-Mass), CBT
T2, T3, T4	Middle Layers
T5	Outside Layer, WBT
VC1, VC2, VC3	Vacuum Chamber Exterior

Figure 5. Simplified schematic of Cryostat 2 showing locations of temperature sensors and equipment.



Surface Temperature Measurement	
Sensor	**Location**
T1, T3	Cold-Boundary Temperature (CBT)
T2	Top Cold-Mass
T4, T5	Warm-Boundary Temperature (WBT)
VC1, VC2, VC3	Vacuum Chamber Exterior
VC4, VC5, VC6	Heater Temperature

Figure 6. Simplified schematic of Cryostat 4 showing typical locations of temperature sensors.