

HiTherm™ Flexible Graphite Thermal Interface Materials – The Material of Choice for Outgassing Performance in Space Applications

Why Outgassing Matters

In the vacuum of space, materials that release trapped gases or volatile compounds can contaminate sensitive optics and electronics. That's why NASA and satellite manufacturers demand materials that remain clean, stable, and reliable even under the most extreme conditions.



NeoGraf's HiTherm™ thermal interface materials (TIM) have built a proven track record of exceptional performance in spacecraft thermal management - with virtually zero outgassing.

Proven in Space

Because NeoGraf's HiTherm flexible graphite is inherently pure carbon, it does not outgas, dry out, or pump out, and it remains stable across temperature extremes - making it ideal for use in vacuum and space environments.

HiTherm products have been used on the International Space Station and the Hubble Telescope, and they continue to be used for satellites and space electronic systems.

HiTherm™ Thermal Interface Graphite: Outgassing & Performance Highlights

Material	Temperature Range	Oxygen-Free Limit	Outgassing Behavior
HT-1200 Series	up to 400°C (air)	~2800° (vacuum)	negligible outgassing
HT-C3200	up to 400°C (air)	~2800° (vacuum)	negligible outgassing

Advanced Thermal Solutions for Space Applications

HiTherm HT-1200 and HT-C3200 series thermal interface materials are ideal for satellites, spacecraft, and aerospace applications.

- **HiTherm 1200 Series**

The HiTherm 1200 series is a pure, flexible graphite thermal interface material (TIM) engineered for applications requiring very low contact resistance and outstanding through-plane thermal conductivity, making it especially suitable for mission-critical electronics and thermal management in aerospace systems. The 1200 series provides high reliability, broad operating temperatures (-2500 to +2800°C in a vacuum), and minimal outgassing, resulting in long-term stability for space environments.

- **HiTherm HT-C3200 Series**

The HiTherm HT-C3200 series is a highly compressible, 100% graphite-based TIM designed for maximum surface contact in applications with rough or uneven surfaces that require compensation for flatness variations. It features very high in-plane thermal conductivity, reliable performance over a broad temperature range (-250 to +2800°C), and extremely low outgassing. The HT-C3200 series is optimized for insulated-gate bipolar transistors (IGBTs) and other high-power modules, power drives, and RF devices commonly used in aerospace and space systems.

HiTherm™ Materials After 24 Hours at 125°C and 5×10⁻⁵ Torr

Material	Total Mass Loss (%)	Collected Volatile Condensable Material (%)	Water Vapor Recovered (%)
HT-1205	0.06	<0.01	0.01
HT-1205A	0.49	<0.01	0.02
HT-1210	0.07	<0.01	0.02
HT-C3200	0.01	<0.01	<0.01

Key Considerations & Insights

- The trace moisture that graphite naturally absorbs from the air acts as a lubricant, but this moisture is released in a vacuum, eliminating any outgassing concern.
- The HiTherm HT-2500 variant contains an oily polymer additive that improves thermal impedance but will outgas under vacuum or high temperature – avoid for space or optical systems.



Adhesive Performance & Application Guidance

The HiTherm “A” adhesive system uses a pressure-sensitive acrylic formulation, ensuring a reliable bond after proper curing. Below are key application details and operational guidelines for optimal adhesive performance.

- Standard HiTherm “A” adhesive is a water-based acrylic that cures as water slowly evaporates, forming a strong, stable bond.
- Curing: 1 week at room temperature for full crosslinking.
- Operating range: -40 °C to 150 °C.
- Not recommended for low-pressure environments until fully cured.

Independent Laboratory Testing (ASTM E 595-07)

Meeting NASA’s outgassing standards is essential to avoid contamination that could compromise the performance of sensitive spacecraft systems, such as optics and electronics. By rigorously qualifying materials for extremely low volatile emissions, mission reliability and data integrity are protected throughout the demanding conditions of space operation.

ASTM E595 sets strict outgassing criteria for spacecraft materials, requiring Total Mass Loss (TML) to be 1.00% or less and Collected Volatile Condensable Material (CVCM) to be no greater than 0.10% after testing at elevated temperature and vacuum. All HiTherm grades except for the HT-2500 series have passed these standards, confirming their suitability for contamination-sensitive space environments and compliance with NASA's qualification protocols.

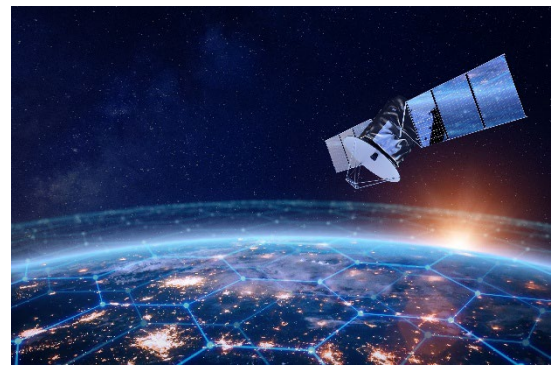
Pass/Fail Criteria for Space Materials (ASTM E 595)

- $TML \leq 1.00 \%$
- $CVCM \leq 0.10 \%$

All HiTherm grades except the HT-2500 series meet NASA's outgassing standards for spacecraft use.

NASA Validation

NASA validation provides trusted, independent confirmation that materials have passed the most rigorous industry standards for use in the space environment. With NASA's outgassing database widely recognized across the aerospace sector, listing under NeoGraf's portfolio umbrella 'eGraf' and assures engineers and mission planners that NeoGraf products have undergone stringent testing and are approved for contamination-critical applications.



NASA's outgassing database lists NeoGraf products under eGraf.

- Visit: <http://outgassing.nasa.gov/>
- Search Term: eGraf

The NeoGraf Advantage

NeoGraf's HiTherm materials are engineered for spacecraft and satellite hardware, delivering thermal management solutions that excel in extreme environments and meet NASA's outgassing criteria for space use.

HiTherm HT-1200 and HT-C3200 series products offer flexible graphite-based performance with virtually zero outgassing, reliable conductivity, and broad temperature stability—from cryogenic conditions to 2800 °C.

- Zero Outgassing Risk: Graphite-based construction ensures no contamination of optics or sensors.
- Extreme Temperature Stability: Maintains performance from cryogenic to 2800°C (vacuum).
- Proven Heritage: Flown and validated across NASA and commercial space missions.
- Custom Solutions: Thermal interface materials, heat spreaders, and flexible graphite films for any spacecraft application.



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