

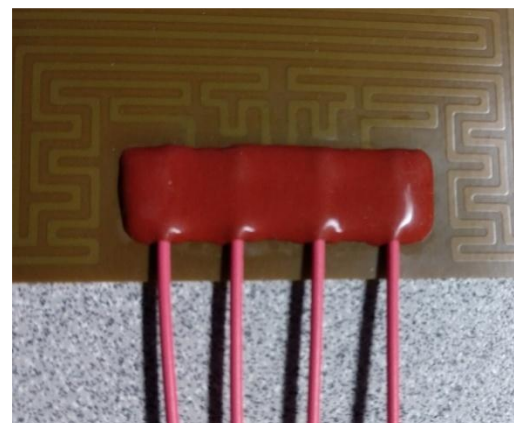


# Minco Custom All-Polyimide Heater with Flexible Lead Wire Encapsulation

*Designed to NASA S-311-P-841 with Custom Flexible Lead Wire Encapsulation*

## Overview

The Minco Custom Flexible Polyimide (AP) Heater is engineered to meet the rigorous requirements of NASA S-311-P-841, providing reliable thermal control in the demanding environments of space applications. This heater features a unique lead termination encapsulated in Minco's proprietary flexible lead wire encapsulation—developed as a specialized revision to specification section 3.4.1.5—to enhance strain relief, maintain performance through thermal cycling, and reduce the risk of cracking or delamination on curved surface when conformability is required. With its low outgassing materials, precise resistance tolerances, and lightweight construction, this heater is ideal for spaceborne instruments, electronics, and structures requiring dependable, uniform heating.



## Features

- **NASA S-311-P-841 compliant**, including all standard electrical, mechanical, and outgassing requirements
- **More conformability** than the alternative hardened epoxy
- **Custom flexible epoxy** per revised Spec 3.4.1.5, offering superior strain relief and durability in extreme environments
- **Lightweight, low-mass design** ideal for spacecraft and satellite integration
- **Uniform surface heating** with precision resistance tolerances
- **Flexible polyimide substrate** offers excellent thermal stability and chemical resistance
- **Available in custom sizes, shapes, and wattages** to meet mission-specific requirements

## Custom Flexible Lead Wire Encapsulation

In accordance with NASA S-311-P-841 Spec 3.4.1.5 (Minco Revision), the lead termination on this heater replaces the standard hardened epoxy with Minco's proprietary flexible lead wire encapsulation, designed to:

- Enhance strain relief in dynamic or vibration-prone environments

- Maintain flexibility and adhesion across extreme temperature cycles
- Resist cracking or delamination over long mission durations
- Meet or exceed outgassing requirements (Total Mass Loss < 1.0%, Collected Volatile Condensable Material < 0.1%)

This custom epoxy encapsulation is unique to Minco and engineered specifically for spaceborne heater applications with rigorous mechanical and environmental constraints.

## Specifications

| Parameter                    | Value / Description                                                                                         |
|------------------------------|-------------------------------------------------------------------------------------------------------------|
| <b>Substrate Material</b>    | Polyimide (Minco Type AP)                                                                                   |
| <b>Heater Thickness</b>      | 0.005–0.010 in (0.13–0.25 mm) typical                                                                       |
| <b>Power Density</b>         | 120W/in <sup>2</sup> , 40W/in <sup>2</sup> with aluminum backing and PSA, 20W/in <sup>2</sup> with PSA only |
| <b>Operating Temperature</b> | -115°C to 220°C – mounting method will affect temperature range                                             |
| <b>Resistance Tolerance</b>  | ±10% standard; ±5% or ±2% available on request                                                              |
| <b>Voltage Rating</b>        | 5 V to 120 V, depending on size and resistance                                                              |
| <b>Lead Wire Options</b>     | Kapton-insulated, Teflon-insulated, custom cables                                                           |
| <b>Lead Termination</b>      | Low Outgassing flexible epoxy encapsulation                                                                 |
| <b>Vacuum Suitability</b>    | Designed for low outgassing (per ASTM E595)                                                                 |
| <b>Mounting Options</b>      | Pressure-sensitive adhesive (space-rated), mechanical clamping, or bonded installation                      |

## Compliance and Testing

- **NASA S-311-P-841 compliant**
  - Successfully completed S-311-P-841 Group A Quality Conformance Inspection, including visual inspection, resistance, insulation resistance, voltage conditioning and thermal shock, and dielectric strength testing.
  - Successfully completed S-311-P-841 Group B Qualification Testing, including voltage conditioning, thermal shock, low-temperature operation, lead pull, life testing with all required electrical testing.
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- **Outgassing per ASTM E595**
- **Electrical tests:** Insulation resistance, dielectric strength, and resistance
- **Thermal cycling and mechanical testing** available on request

## Applications

- Deep space probes and planetary landers
- Avionics thermal control
- Optical instrument thermal conditioning
- Battery and propulsion system warming
- Any mission requiring high-reliability, low-outgassing flexible heaters

## Ordering Information

Minco Custom Flexible AP Heaters are built to your exact specifications. Contact MOD-TRONIC to get started on your custom design!



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