ISABELLENHÜTTE

Why Europe needs a second source for flexible heaters

Flexible heaters for spacecraft thermal control

Thermal control rarely appears at the top of a spacecraft requirements list, yet it decides how long a mission stays useful. Between direct solar exposure and deep-space cold, every subcomponent has a temperature window it is required to maintain to stay functional. Batteries lose capacity permanently when they are allowed to go too cold, propellant lines and valves can freeze, optical benches drift out of alignment as gradients build.

Passive components can carry parts of the thermal load but not everything. What they cannot do is hold a subsystem above its lower limit through an eclipse, a lunar night, or a cruise phase with limited illumination. That function belongs to heaters, which is why flexible heaters are among the most mission-critical elements on a spacecraft despite costing a fraction of the complete payload.

Flexibility as a system requirement

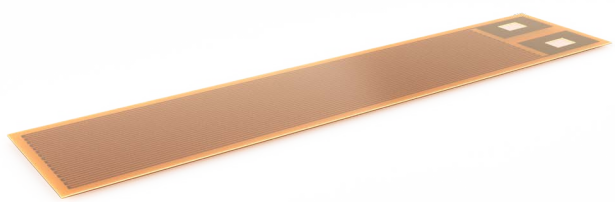
Despite being not so small systems, satellites, launchers or rovers are densely packed with different technologies: avionics, propulsion hardware or communication hardware. Consequently, this leaves little room for additional technologies such as thermal hardware and the heaters have to fit into the space left. Moreover, the surfaces that need heating are seldom flat. Cylindrical propellant tanks, curved battery cases or small-radius fluid lines. Flexible heaters answer this with excellent bendability.

However, bendability is only one dimension of the problem. Because each space platform has a unique geometry, standardized heating solutions with fixed geometries are often of limited use. A heater defined for one bus seldom transfers unchanged to the next. What manufacturers or programs need instead is the option for application-specific customization of shape or dimensions and electrical resistance. A supplier being able to vary all three within one qualified construction saves the thermal engineer from redesigning around the catalogue.

The constraint is on the supply side

The remaining constraint is not technical but rather commercial. The number of suppliers holding ESCC qualification for flexible heaters is manageable and for a given construction or program, it sometimes reduces to one. A single-source dependency is uncomfortable in any industry, but in space, it can be even worse. An unforeseen capacity bottleneck or process change on the supplier-side transmits directly to the manufacturer of the space program, with no substitution possible on short notice. Constellation architectures sharpen this. A traditional single-satellite program might need a few dozen heaters.
A constellation can need hundreds or thousands of them, delivered on a repeated build rhythm with consistent quality. Demand on this scale exposes a thin qualified supplier base immediately and explains why prime contractors and agencies are asking for second source.

The extent to which a limited choice causes problems depends on who is making the purchase. If ESA manufactures the product itself, the choice of components is mainly in favor of ESCC-qualified components. If the manufacture of the product is awarded to a prime contractor, the contractor then makes the procurement decision, and a genuine tender process is in place. Qualification is the gate in both routes, for different reasons. Where ESA builds, a second qualified source is what turns a mandated single source into a decision. Where a prime builds, it is what puts a supplier on the bid list at all. Moving from one ESCC-qualified European supplier to two does not merely mitigate a program risk but it also supports an open competitive tendering process.



The flexible heater from Isabellenhütte

As a contribution to widening the supplier base, Isabellenhütte has qualified a flexible heater to ESCC Detail Specification No. 4009/006. It is built from an etched MANGANIN® foil laminated between polyimide (Kapton) films. Typical applications include thermal management for spacecraft and extra-terrestrial vehicles, particularly satellites, launchers and rovers. Inside these platforms, the heaters prevent fuels from freezing, keep batteries within their permissible temperature range, and ensure the proper functioning of sensitive optical systems, for example.

GET TO KNOW OUR FLEXIBLE HEATER