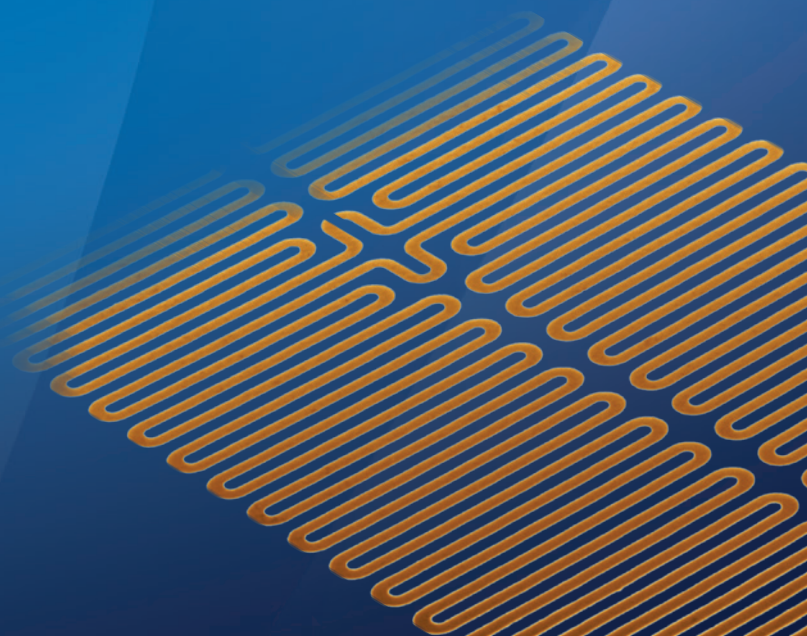
Zoppas Industries
Heating Element Technologies

FLEXIBLE HEATER FOR SPACE MARKET (SATELLITE - VEHICLE - LAUNCHER AND GROUND SEGMENT)



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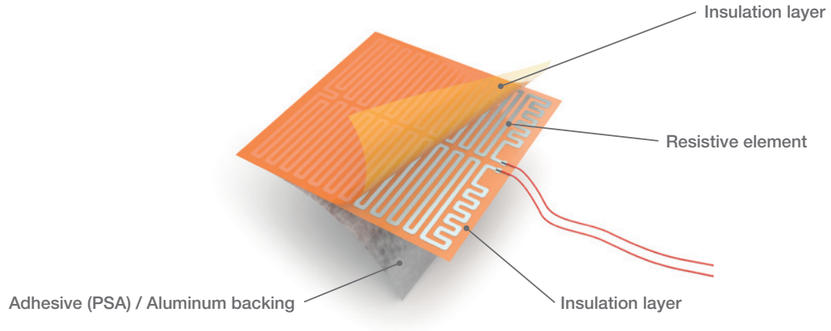
BASIC INFORMATION ON OUR HEATING ELEMENT

Zoppas Industries Heating Element Technologies (here after referred to as ZIHET) is a global supplier of heaters and systems for space satellites, spacecrafts, pressurized modules and ground-based antennas, ESA/ESCC-qualified since 1992. The flexible heating element consists of an etched foil resistive element laminated between two insulation layers. Flexible heating foils produced by ZIHET start with a minimum thickness of just 0.15 mm, they can generate a heat up of 200°C to allow excellent heat transfer results from the heater's thin design and direct bonding to an application. The heaters can be applied to the most complex shapes, geometries, curves and pipes conceivable without sacrificing efficiency or dependability. Flexible heaters provide fast heat-up and cool-down rates, ensuring uniform heat distribution at various watt densities.



QUALIFICATION LEVELS

We know that Space is no longer only the domain of large exploration vessels owned by governments or militaries. New Space Economy's satellite and space systems are more and more driven by fast-paced and budget minded practices.

For these reasons, we propose our heaters with 3 incremental qualification levels:
→ Same materials and manufacturing, different inspections and tests.

The available options are described in the Table here below, and allow coverage of all possible usages of the ZIHET heater: from Institutional, Military or Commercial Programs, Cubesats, Nanosats or Constellations, to Ground testing facilities.

In this way, you will be able to tune your procurement according to your mission-specific needs.
Contact us for more details and a quotation!

Qualification level	Description
Qualification Model (QM)	These heaters are provided in full compliance with the applicable ESCC specification's prescribed materials and manufacturing; a minimal set of verification steps (i.e. Functional visual inspection, Production Control tests and #ESCC-compliant Final Room Temperature Electrical Measurements) is performed, to ensure its suitability for functional and environmental qualification testing.
ProtoFlight Model (PFM)	These heaters are provided in full compliance with the applicable ESCC specification's prescribed materials and manufacturing; a partial verification campaign with respect to ESCC requirements is performed, mainly: - Visual inspection only focused on functional defects (according to internal ZIHET procedure available for review) - "Room Temperature Electrical Measurements" performed only once - Burn-in test performed on statistical sample, according to UNI ISO 2859-1 type G, AQL 025
ESCC Flight Model (FM)	Fully ESA-qualified Space Heater, covering all the inspections, controls and tests foreseen by the applicable ESCC specification.

POLYIMIDE HEATING ELEMENT

The polyimide heater is produced by an etching process delivering a thin and lightweight flexible heater, which provides excellent tensile strength, tear resistance and dimensional stability.
Advanced Zoppas Industries technology allows us to provide sophisticated double-sided heaters and heating elements with a very high ohmic density.
According to ESA specifications, heater resistive elements and terminal leads connections can be coated either with Polyimide Polymer/FEP or Polyimide Film/ Acrylic Adhesive.

Heaters' technical specifications

voltage range	≤400 AC/DC (1 or 3-phase)
ohmic density	up to 200 Ω/cm² (FEP), up to 330 (Acrylic) Ω/cm²
resistance tolerance (± %)	2, 3, 5, 10% according to ESCC spec
length	8 - 600 mm
width	6 - 590 mm
min thickness	0.15 mm (depending on product configuration)
max continuous operating temperature	200°C (FEP), 150°C (Acrylic)
min operating temperature	-65°C
RoHS	YES
optional additional layers	adhesive (3M 966) / Aluminum backing / second heating layer with redundant circuit
approval	ESCC 4009/002 - ESCC 4009/004

Benefits

- Extremely precise track layout
- Optimal heat transfer
- Very high operating temperature
- Small bending radius
- Lightweight
- Easy installation
- Low outgassing in vacuum

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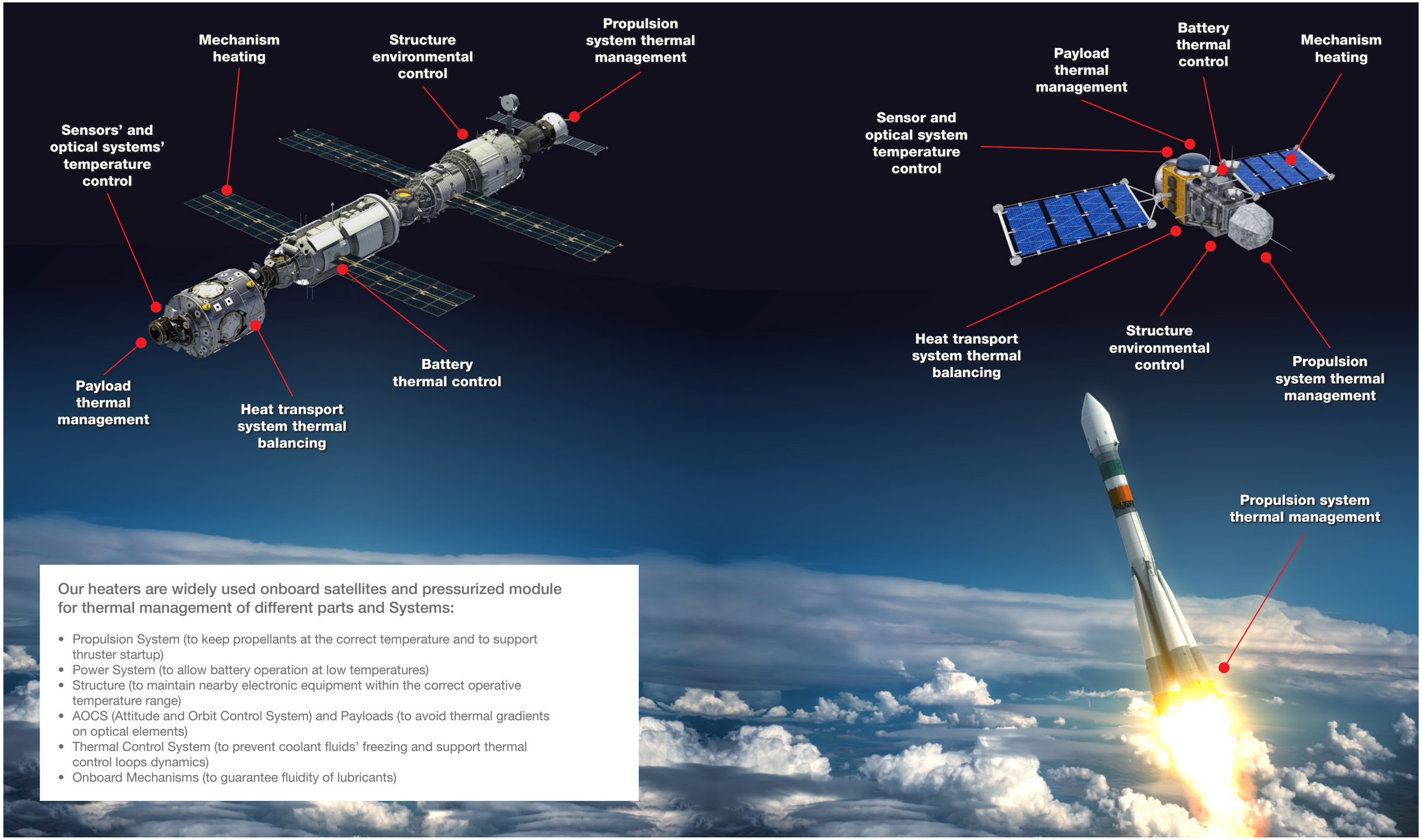

Our heaters are widely used onboard satellites and pressurized module for thermal management of different parts and Systems:

- Propulsion System (to keep propellants at the correct temperature and to support thruster startup)
- Power System (to allow battery operation at low temperatures)
- Structure (to maintain nearby electronic equipment within the correct operative temperature range)
- AOCS (Attitude and Orbit Control System) and Payloads (to avoid thermal gradients on optical elements)
- Thermal Control System (to prevent coolant fluids' freezing and support thermal control loops dynamics)
- Onboard Mechanisms (to guarantee fluidity of lubricants)

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CUSTOM FLEXIBLE HEATERS

Flexible heaters give you design options that other heater types cannot match. Here below you can find an overview of the capabilities at ZIHET for custom flexible heaters.

Element design

Outline shapes, heat profiles and terminations can be fine-tuned to create the exact thermal and physical component to fit your unique requirements. ZIHET offers:

- options for distributed wattage, unheated areas, single or multi electric circuits
- various types of leads
- three-dimensional factory formed shapes
- different mounting methods like pressure sensitive adhesive (PSA), or mechanical fasteners

VALUE-ADDED PROJECT DEVELOPMENT

New projects provide the ability and opportunity for new development and solutions.

ZIHET is fully equipped to provide project analysis, concept design and laboratory testing to optimize your unique project from prototype to a complete winning solution.

We will support you throughout the complete development phase.

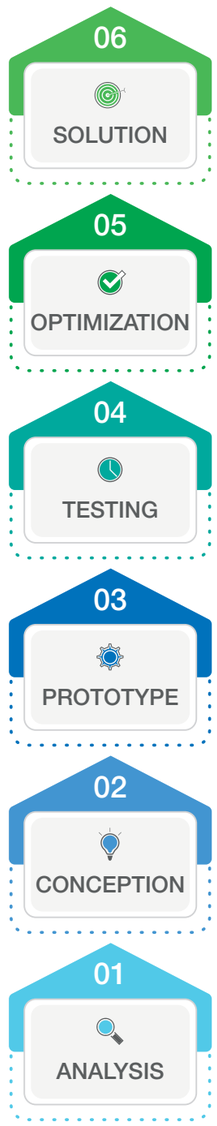
EARLY SUPPLIER INVOLVEMENT

At ZIHET we trust in the process of early supplier involvement (ESI). ESI presents an engineer with a direct outline of our capabilities.

When ZIHET is involved early in a project's design phase, it provides cost cutting benefits, makes the project more feasible to manufacture, and ultimately cuts down the lead time between concept and production.

A second set of eyes on your project from ZIHET can only improve your design.

Let ZIHET
be your heating element design team
and thermal system supplier!



Worldwide Local Supplier

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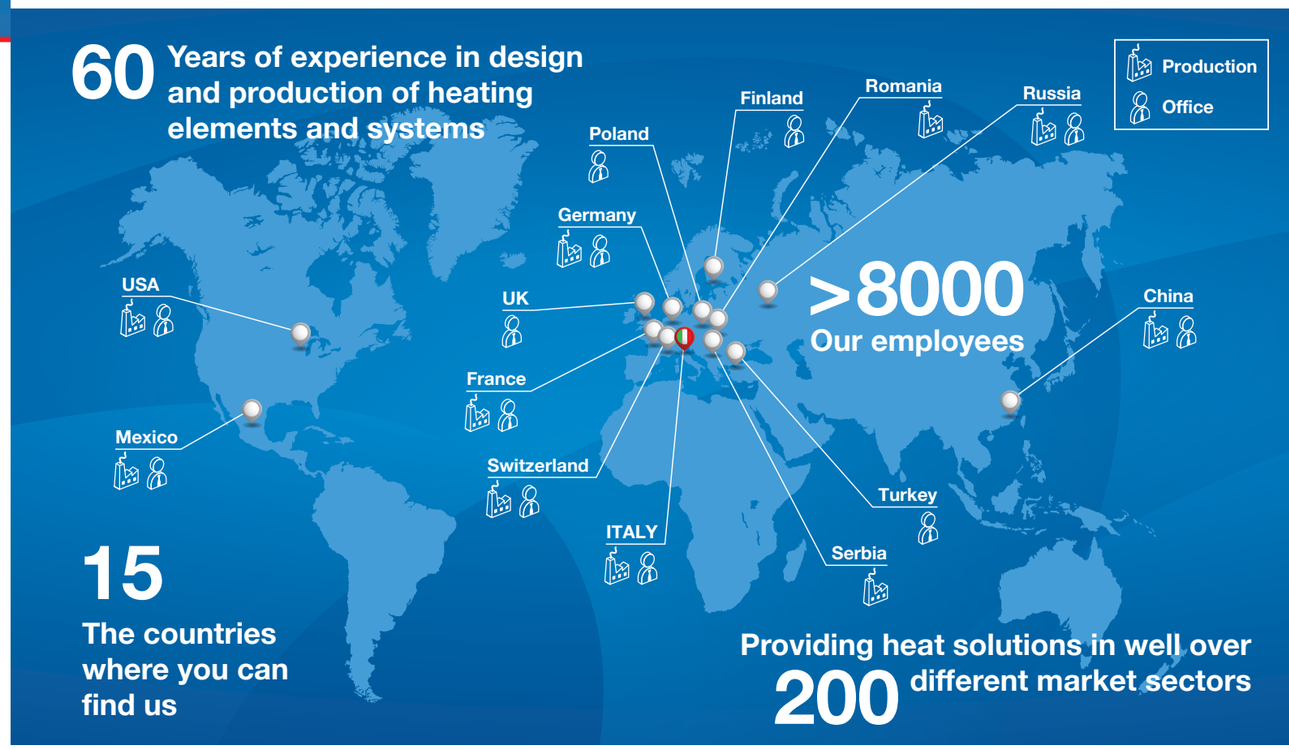

ZOPPAS INDUSTRIES Partner

- Experience Zoppas Industries increasing efficiency using lean enterprise across all facilities and departments.
- Access our state-of-the-art laboratory facilities with over 30 years' design experience.
- Benefit from Zoppas Industries manufacturing and design facilities which maintain Quality Management Systems according to ISO 9001, EN 9100 and IATF 16949, Environmental Management System according to ISO 14001 and Energy Management System according to ISO 50001.
- Access one of the widest Heating Element Technology product portfolios in the world including completely integrated thermal assemblies with sensors, connectors, enclosures, etc.
- Benefit from Zoppas Industries global presence through design and manufacturing facilities across Europe, North America, South America and Asia - lowering your Total Cost of Ownership (TCO) including reduced logistics, design, communication and support costs.
- Access Zoppas Industries' in-house design, development and R&D capabilities, such as CAD 3D design, FEA, DOE, FMEA.
- Benefit from Zoppas Industries products third-party certification, such as UL and VDE: marking applied on customer's request.

We at ZOPPAS INDUSTRIES put you in the front seat of internationalization - sourcing your local needs globally.

PRODUCT TRADEMARKS

Compliance with the mark of each specific product must be properly reviewed with our Sales Department.

COMPANY CERTIFICATIONS

AS 9100 · ISO 9001 · IATF 16949 · IT-75.12-6975 12/054P_IND EN 15085-2 · IT-75.12-6975 12/055P_IND ISO 3834-3 · 9191.IRCR · 9196.IRC8

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