



# Innovative Flexible Heater Technology

Since their invention, flexible heaters have changed the way we think about countless products that include heating elements in their design. As a manufacturer of flexible heaters for many years, All Flex Solutions is proud to utilize the revolutionary technologies inherent in these small-but-mighty heaters. Their flexibility — both physically and functionally — has made new technological advances possible and improved existing product designs across a wide range of industries. In this blog, we'll dive into the intricacies of this innovative flexible heater technology, including its specific advantages, various applications, and the impact it has had across some of the world's most critical industries.

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## How Do Flexible Heaters Work?

Flexible heaters, also referred to as “flex heaters,” are thin, pliable, and low mass heating elements that provide efficient, controlled heat distribution. They differ from other types of heaters in their namesake ability to “flex” to various shapes and fit into tight spaces. Unlike rigid heaters, flex heaters can be custom-designed to meet the needs of specific applications, including some of the most challenging requirements.

Etched foil heaters, a common type of flex heater, enable precise conductor patterns and efficient heat distribution, making them ideal for applications that demand uniform heating across a surface. Etched foil heaters are manufactured using a technology which

selectively etches precise conductor patterns into a resistive metal foil. These patterns allow the flex heaters to generate wattage based on Ohm’s law, a fundamental principle in electrical engineering that describes the relationship between current (I), voltage (V), and resistance (R) in an electrical circuit. Ohm’s law states that the current flowing through a conductor is directly proportional to the voltage applied across it, and inversely proportional to the resistance of the conductor. In the context of flex heaters, Ohm’s law helps determine the wattage generated by the resistive metal foil and enables precise control of heat output, making flex heaters quite versatile and customizable to a wide variety of applications.

## Flexible Heaters: Powered by Innovation

Flex heaters are made possible by many technological innovations and advances that, when combined, result in a highly effective heater with superior space economy. The variable and customizable layout options offered by flex heater technology allows for intricate designs and tailored heating solutions. This extends to multiple zones and two-in-one heaters, which provide independent temperature control in distinct areas and the ability to combine heating and sensing elements within a single circuit.

Another significant innovation is the flex heater's enhanced thermal efficiency, which delivers optimal heat transfer and energy utilization. The precise conductor patterns of etched foil heaters enable even heat distribution, eliminating hotspots and cold spots for uniform heating. This remarkable consistency and optimization is further enhanced by the flex heater's ability to achieve high thermal output levels — meaning flex heaters can provide a robust heating solution for applications with demanding requirements.

The materials used to manufacture flex heaters also play an important role in the final heater's versatility and efficacy. Flex heaters are manufactured with thin, low mass materials with high thermal conductivity, like polyimide films and metal alloys. These materials facilitate rapid, efficient heat transfer while maintaining physical flexibility. The material's thinness allows for compact and space-saving designs, making flex heaters particularly well-suited for applications with limited space.

While mounting surfaces can present challenges like non-uniform thermal results, flex heaters' physical attributes again come to the rescue. Flex heaters can bend and conform to irregular surfaces without sacrificing consistent heat distribution, even on complex or curved surfaces.



# Transforming the World, One Industry at a Time

These innovations in flex heater technology have improved their suitability for use in many industries, including critical applications with especially challenging requirements. Aerospace applications rely on flex heaters to maintain optimal operating temperatures in extreme conditions of space. In the medical industry, flex heaters are often used in devices such as blood analyzers, surgical tools, and patient warming systems. Vehicle manufacturers use flex heaters in seat warmers, defrosting systems, and battery thermal management. The uses of flex heaters are so vast and varied, they are usually used in high reliability never fail applications where reliability is a must have.

After your flexible heater design is complete, consider All Flex Solutions for your assembly as well. All Flex can add connectors, bonded heat sinks and stiffeners, components and sensors to your flexible heater for a full package solution. All Flex Solutions has the expertise in flexible assembly as well, to make your project a success.

As a leading provider of flexible heaters, All Flex Solutions is proud to serve these industries and many more with our expertly-engineered technologies. Founded in 1977, All Flex has spent decades perfecting our value-add process that produces customized flex heaters quickly and with an absolute commitment to quality. We are experts in the groundbreaking technology that powers our flex heaters and are dedicated to the pursuit of further innovation that will help the entire industry better meet the diverse needs of our customers.

## *Learn More*

To learn more about the innovative flex heater technology and explore the range of products offered by All Flex Solutions, visit us online at [www.allflexinc.com](http://www.allflexinc.com). Contact us to tell us more about your specific requirements, request a quote, and explore how a custom flex heater solution could be the answer you've been looking for!

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