

A MANUFACTURER'S GUIDE TO FLEXIBLE HEATERS POWERED BY PRINTED ELECTRONICS

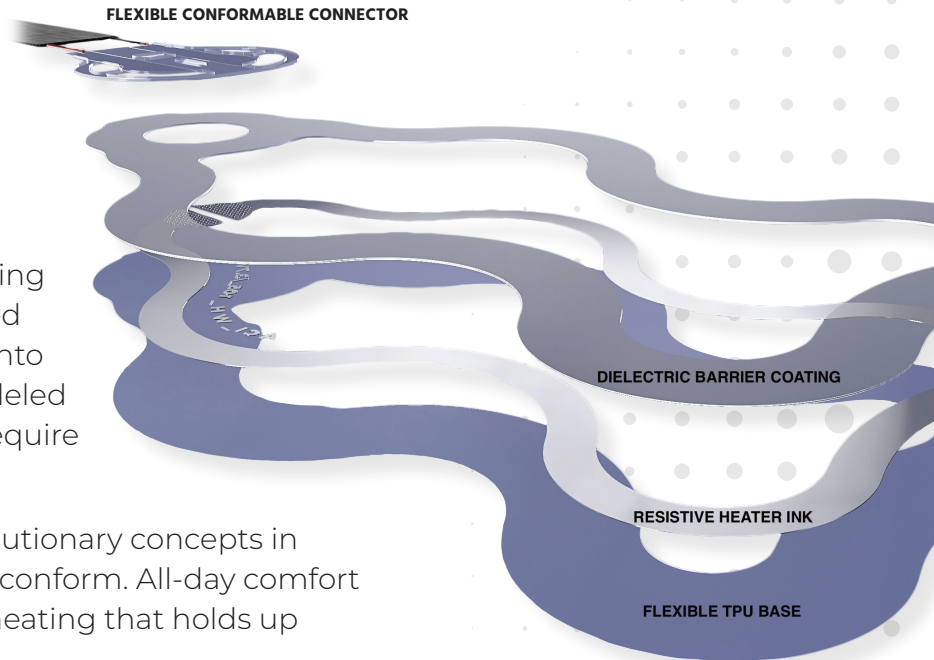


What are flexible heaters?

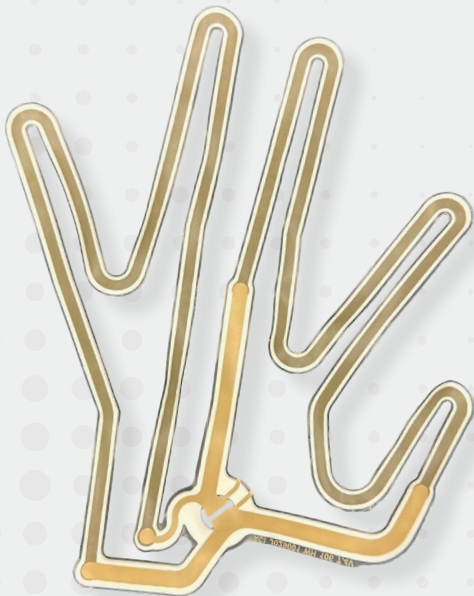
Imagine a wearable heating element that's inconspicuous, comfortable, that flexes and flows with the fabric. This concept is not a futuristic vision; it's here and DuraTech can help you bring it to market.

DuraTech creates human-friendly heating elements powered by innovative printed electronics. They integrate seamlessly into wearable technology and offer unparalleled design freedom for applications that require a conformable heat source.

Our flexible heating elements use revolutionary concepts in inks and films designed to stretch and conform. All-day comfort combines with safe, durable personal heating that holds up after dozens of wash cycles.



Learn more about our innovative design approach to delivering heat, safely and comfortably.



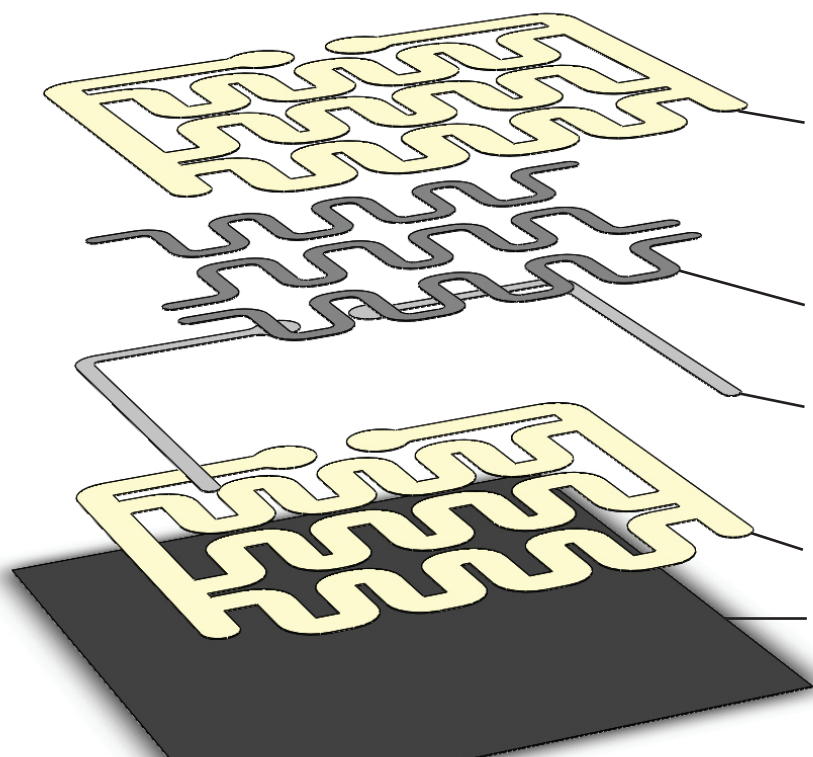
Flexible heaters by DuraTech: Designed to be conformable

Our flexible heating elements are more advanced than silicone flexible heaters.

We use printed conductive inks and films designed to perform while being stretched, whereas silicone heaters consist of polyamide film coated with silicone and uncomfortable copper wiring.

Our printed flexible heaters are lighter, more durable, washable, and less prone to breakage, offering better flexibility and energy efficiency.

Elements of the printable electronics flexible heater



A look at the layers

Cover film: Made of thermoplastic polyurethane (TPU) or dielectric, it adds a soft, elastic top layer that's easy on the skin and conforms to the body.

Heating element: Made of specially resistant carbon and silver printed inks.

Busbar system: Silver conductive inks conduct electrical signals while also being stretchable and flexible.

Base: TPU film

Fabric: Optional

INNOVATION CORNER:

The D-Bit connector

When it comes to flexible heating elements designed for personal or medical use, comfort is top priority. DuraTech is proud to hold the world's manufacturing rights for the D-Bit connector, the most comfortable connector in the market for apparel and medical heaters.

Developed in partnership with ACI and DuraTech, the D-Bit connector is unique in the industry because it's non-metallic, flexible and integrates with fabric. Slightly thicker than two human hairs, this connector is imperceptible to the user.

Our unique innovation is what further enhances the comfort and ease of our flexible heating elements.

Printable silver inks

To create these high performance flexible heaters, ACI developed a groundbreaking method to use cavitation in silver ink production for use in printed electronics.

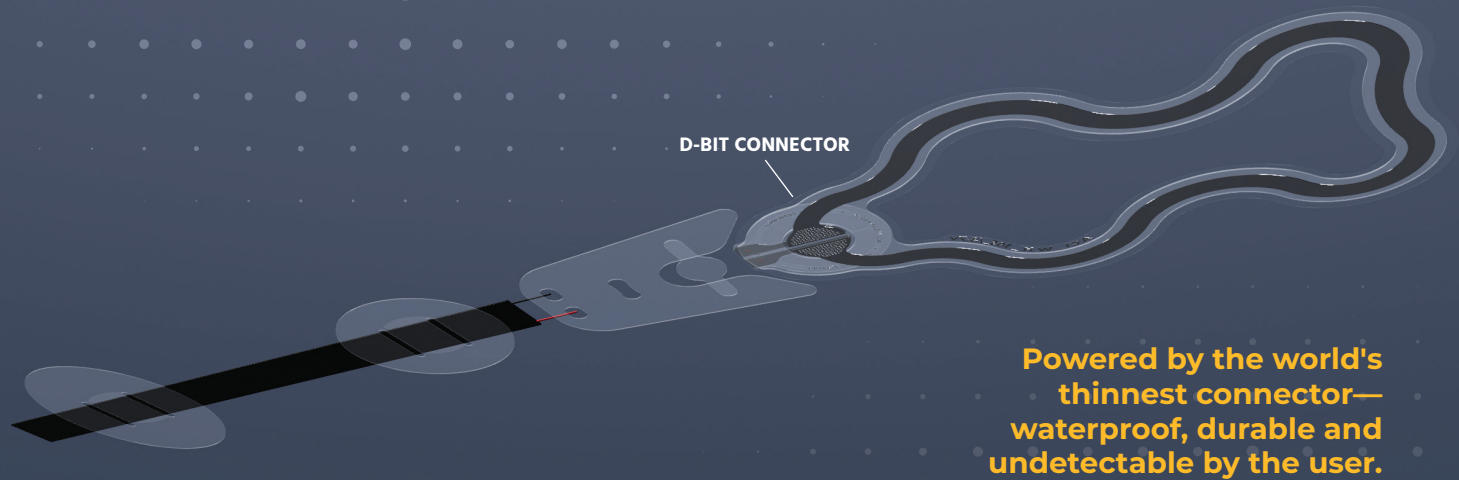
This unique cavitation process ensures the silver ink particles are evenly mixed, creating finely dispersed nanoparticles less than 0.1 microns.

These nanoparticles allow consistent resistance, improved conductivity and evenness of heating.

They also enable the inks to maintain performance without breaking even when repeatedly stretched, heated and cooled.



[Read more about ACI's cavitation process.](#)



Powered by the world's
thinnest connector—
waterproof, durable and
undetected by the user.

Industries and applications for flexible heaters

Introduce innovative new product lines in your market. Flexible heaters powered by printed electronics deliver unparalleled flatness, thinness and flexibility. As a result, your brand can raise the bar on comfort and care.

Medical devices

- **Thermal blankets:** Help patients recover and regulate whether in medical facilities or during emergency response.
- **Hot packs and heated braces:** Used for treating everything from injuries to arthritis, provide heat therapy that soothes muscles and joints while also being comfortable on the skin.
- **Heat therapy wraps for diabetics:** Helps improve blood circulation and alleviates discomfort for diabetic patients.

First responders and military

- **Heated uniforms:** Keep first responders and military personnel comfortable and safe in extreme cold and wet conditions, with unmatched breathability and freedom of movement.
- **Heated cold weather gear:** From gloves to jackets to boots, provide warmth and protection during missions or operations in cold climates.

Outdoors and athletics

- **Heatable clothing:** Heated jackets, pants, gloves and socks, provide warmth in cold and damp weather conditions.
- **Heated sleeping bags and sleep pads:** Ensure all-night comfort and warmth during outdoor adventures or camping trips.

Other industries

- **Have a vision?** Wherever safe, portable heat is required, our advanced printable technologies may have the solution you seek. The possibilities are limitless. Talk to us about your concept.

Benefits of printed flexible heaters

How does the technology made with silver conductive inks stack up against traditional copper wiring?

Precise temperature control

No overheating. Voltage and current management ensures consistent heat output within a targeted temperature ensuring the safety of the end user, even when the unit stretches.

Slimmer profile

Unlike traditional portable heating elements that use copper wiring, no bulky, expensive insulating material is required for silver printed inks. The thermal properties of the printable conductors can be brought closer to the end user — safely.

Safe and comfortable for skin proximity contact

The dielectric coating is FDA approved for direct skin contact, making our printable conductors truly unique in the industry.

Energy efficiency

Longer hours of heating time for less battery. Because the thermal source has no insulation to penetrate to reach the skin, a low-voltage rechargeable battery is all that's needed to power the element.

Water resistant and washable

Printed barrier coating protects conducting elements against water and moisture and it's FDA approved for medical products for direct skin contact. ACI has also tested it in dozens of machine wash cycles. Remove the battery, and you're all set.

Stretchable

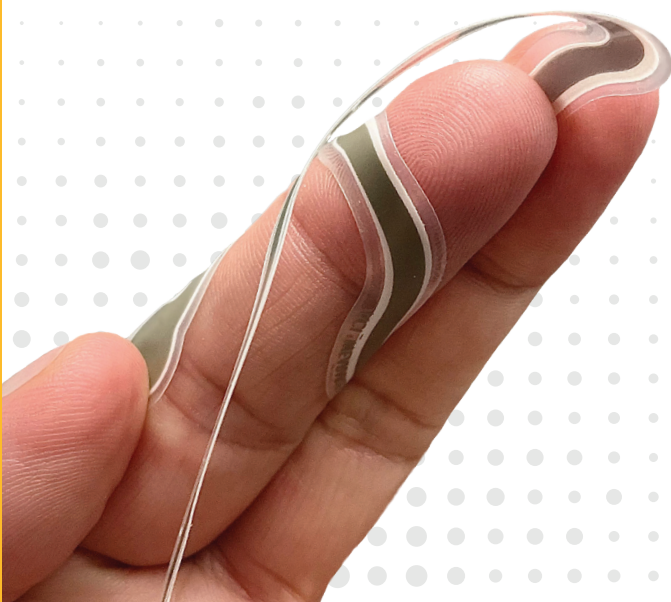
The film, inks, coatings and conductables that make up the element are all formulated to stretch and conform, ensuring consistent performance.

Durable

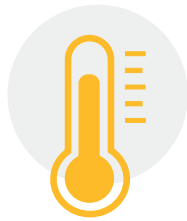
Unique cavitation process of silver conductive inks creates evenly mixed particles that flex and bend without breaking under stress. Endures repeated cycles of heating, cooling and stretching, unlike copper conductive inks that break under mechanical fatigue.

Additive manufacturing

The additive manufacturing process used in silver conductive printing is cleaner and more precise than that of copper. Unlike copper manufacturing, no acid stripping is required for creating silver conductive inks, enabling DuraTech to help companies meet and exceed green initiatives.



Benefits of printed flexible heaters



Temperature

To ensure the comfort and safety of the end user, the heater's voltage, resistance and current can be customized to reach only specific temperatures, ranging from 68 F to 122 F.



Graphics and color

The outer layers of TPU film can be clear, colored and feature custom graphics.



Adhesive bonding

We use adhesives that are formulated to work with textiles and stretchable surfaces.

Specifications for printed flexible heaters

ACI material	Alchemy series: semi sintering conductive Inks	SE5025: printed fixed resistance heater ink	SE3104: stretchable printed insulator
Deposition methods	Screen, microdispense direct write, spray, jet, etc.	Screen printing, syringe dispense/direct write	Screen printing
Curing time and temperatures	150 °C for 15 minutes in box oven	5 min box oven ≥ 135°C < 5 min in industrial convey or oven at ≥125 °C	5-15 min in box oven at 135°C 5 min in industrial convey or oven at 135°C
Recommended screen meshes	230 TPI, 0.0011" stainless steel or similar 420 TPI, 26-27 µm PET for cost reduction appl.	200/230 stainless steel	150/0.0026" – 200/0.0016" stainless steel 110/43 µm – 140/55 µm PET
Recommended cured thickness	2.5 µm to 10+ µm	8-12 µm	14 µm dry film thickness (DFT), 9 µm DFT
Coverage	40 m2/kg / 10 m2/kg	10/12 m2/kg	12/15 m2/kg

Why DuraTech?

DuraTech is the unparalleled choice when your product calls for a portable, personal heat source. Our cutting-edge technologies, technical acumen and strategic partnerships equip us to create flexible heating elements that set new standards for your industry.

Partnership with ACI



DuraTech collaborates with ACI, an advanced material supplier that creates innovative materials through their

decades of formulation experience and patented cavitation processes. Through this collaboration, DuraTech holds the license to use ACI's patented processes to create innovative new solutions, with access to their cutting-edge expertise.

In partnership, ACI and DuraTech developed the D-Bit connector, a barely-there design specifically created for flexible heating elements that require comfort for the user. To achieve unrivaled comfort and freedom of movement in heated apparel and therapeutic materials, DuraTech is the primary choice.

Work with DuraTech for your next flexible heater project

Let us put our expertise to work for you. Talk to us about how we can help you create next-level comfort in personal heating.



www.DuraTech.com

1-800-451-9503

dtwebinquiries@duratech.com