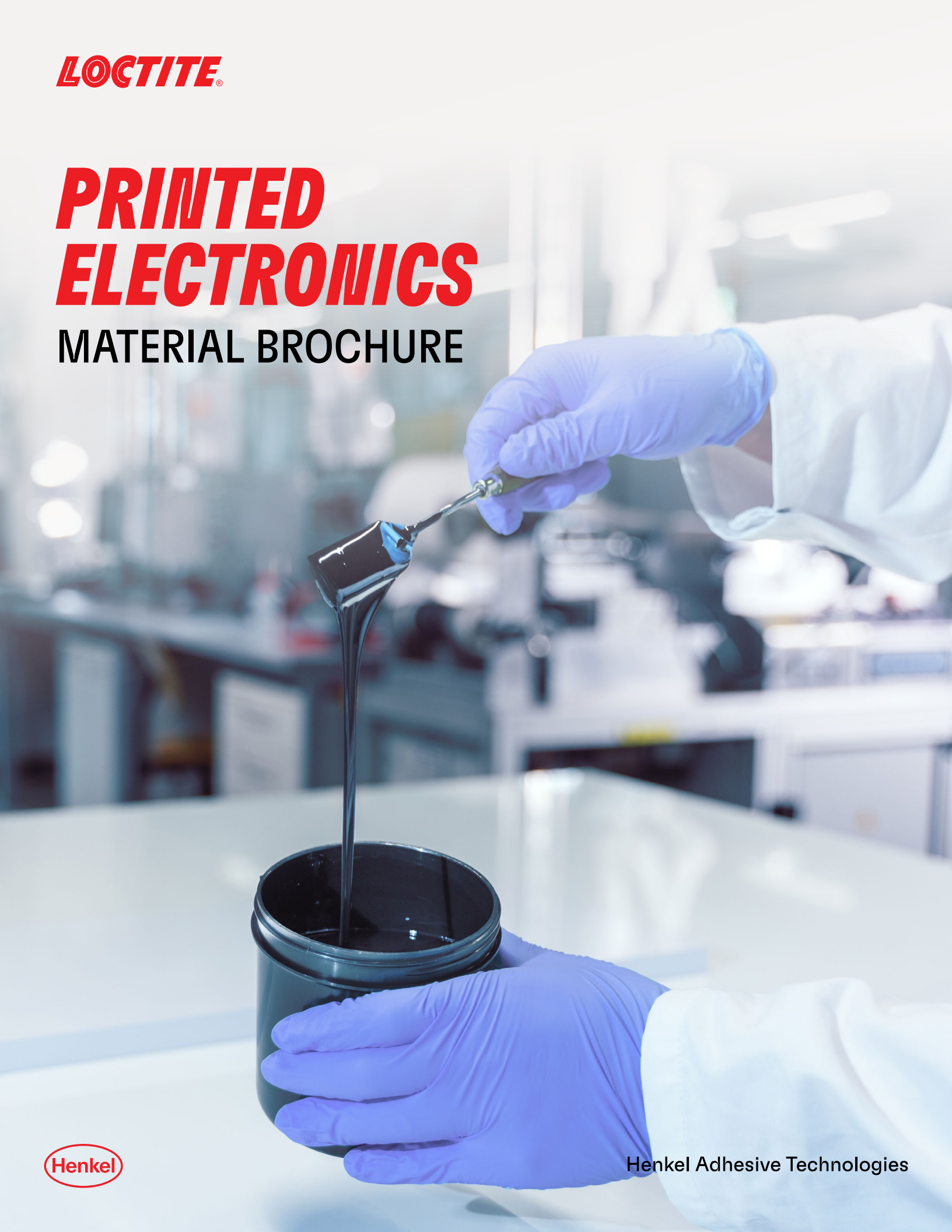
LOCTITE®

PRINTED ELECTRONICS

MATERIAL BROCHURE



Henkel

Henkel Adhesive Technologies

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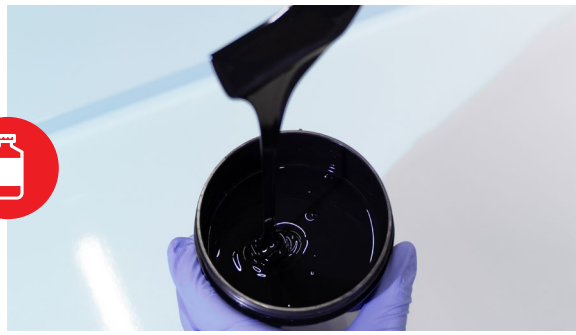
INTRODUCTION



Henkel Adhesive Technologies holds leading market positions worldwide in the industrial and consumer business. As a global leader in the adhesives, sealants, and functional coatings markets, Henkel has developed a large material portfolio of LOCTITE® conductive inks and coatings suitable for printed electronics.

Printed electronics technology allows the creation of thin, lightweight, and flexible circuitry that can be produced at high speeds. Driven by megatrends such as digitalization and sustainability, printed electronics offers a complementary solution to traditional electronics circuitry, which opens new opportunities for electronics integration across industries.

LOCTITE® functional inks and coatings are ideal for creating the next generation of flexible printed electronics circuitry. This brochure introduces the LOCTITE® product portfolio, provides an overview of markets and applications, and summarizes the key technical product data. By building on more than four decades of material formulation and application expertise and our network of industry partners, we enable customers to innovate without the hassle of innovating.

MATERIALS

- Conductive Inks & Coatings
- Resistive Inks
- Dielectric Inks

Henkel has a range of Electrically Conductive Adhesives (ECAs) suitable for Printed Electronics.

For more information and to get a customized recommendation, please contact **printed.electronics@henkel.com**.

APPLICATION METHODS

- Screen Printing
- Flexographic Printing
- Rotogravure Printing
- Pad Printing
- Other printing techniques

APPLICATION

- Printed heaters
- Membrane switches
- Capacitive sensors
- Resistive sensors
- Force sensitive resistors
- Printed sensors for diagnostics & hygiene
- Medical wearables
- Medical heaters
- Antenna for medical wearables
- Pad printable antenna
- RFID antenna
- Energy storage

HENKEL PRINTED ELECTRONICS
PRODUCT PORTFOLIO

CONDUCTIVE INKS & COATINGS

Conductive ink and coating formulations contain conductive particles for electrical conductivity.

Henkel's LOCTITE® branded conductive ink portfolio covers different silver (Ag), silver/silver chloride (Ag/AgCl), and carbon ink (C) formulations as well as conductive coatings, including silver (Ag), carbon (C), copper (Cu), and nickel (Ni).

Our LOCTITE® conductive inks are designed to print electronic components and circuits and are compatible with different substrates. Conductive inks can be used for many types of applications, including traditional electronic components, such as membrane switches, antennas, sensors, batteries, and more. Conductive coatings can be applied to shielding applications, including Electromagnetic Interference (EMI) applications.

SILVER INK
LOCTITE® EDAG PF 006 E&C
LOCTITE® EDAG PD 056 E&C
LOCTITE® EDAG PF 410 E&C
LOCTITE® EDAG PM406V1 E&C
LOCTITE® EDAG 418SS E&C
LOCTITE® EDAG PM 460A E&C*
LOCTITE® EDAG 479SS E&C
LOCTITE® EDAG 725A (6S54) E&C
LOCTITE® ECI 1001 E&C
LOCTITE® ECI 1006 E&C
LOCTITE® ECI 1010 E&C
LOCTITE® ECI 1011 E&C
LOCTITE® ECI 1014
LOCTITE® ECI 1016
LOCTITE® ECI 1203 E&C
LOCTITE® ECI 1204 E&C
LOCTITE® ECI 1205 E&C
LOCTITE® ECI 1216 E&C
LOCTITE® ECI 1217 E&C
LOCTITE® ECI 1501 E&C

SILVER/SILVER CHLORIDE INK
LOCTITE® EDAG PE 007 E&C*
LOCTITE® EDAG PE 409 E&C
LOCTITE® EDAG PE 428E RC E&C*
LOCTITE® EDAG 7019

CARBON INK
LOCTITE® EDAG PF 407A E&C
LOCTITE® EDAG PF 407C E&C
LOCTITE® EDAG 423SS E&C
LOCTITE® EDAG 440A E&C
LOCTITE® EDAG 440B E&C
LOCTITE® EDAG 965SS E&C
LOCTITE® ECI 7001 E&C
LOCTITE® ECI 7007 E&C*

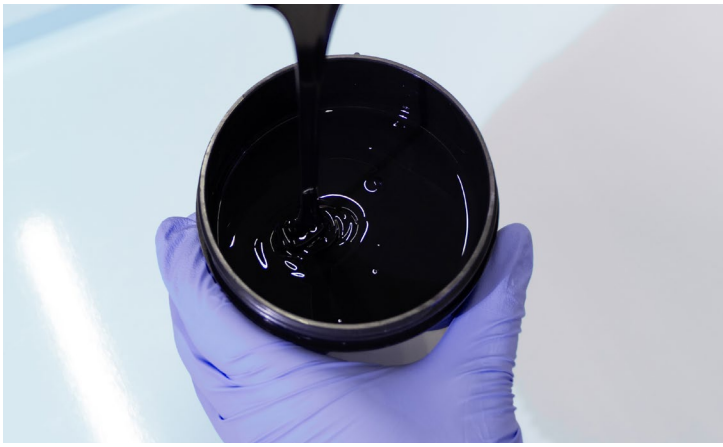
SILVER/COPPER/CARBON / NICKEL COATING
LOCTITE® EDAG 109 E&C*
LOCTITE® EDAG SP 413 E&C
LOCTITE® EDAG 437 E&C
LOCTITE® EDAG 440 AS E&C
LOCTITE® EDAG 1415M E&C
LOCTITE® EDAG 6041 E&C

* High-Speed Printable

RESISTIVE INKS

Resistive inks are formulations based on different conductive inks containing conductive and non-conductive particles. This allows for the adjustment of resistance levels according to the application requirements. Henkel's LOCTITE® branded portfolio of resistive inks includes carbon (C), carbon positive-temperature-coefficient (PTC), and non-conductive blendable inks.

Our LOCTITE® resistive inks are designed for printing electronic components, such as printed resistors, potentiometers, force-sensitive resistors (FSR), heating elements, and more.



CARBON INK	CARBON PTC INK	NON-CONDUCTIVE BLENDABLE INK
LOCTITE® EDAG 6017SS E&C	LOCTITE® ECI 8001 E&C	LOCTITE® EDAG PM 404 E&C
LOCTITE® ECI 7004HR E&C	LOCTITE® ECI 8060HV E&C	LOCTITE® NCI 7002 E&C
LOCTITE® ECI 7004LR E&C	LOCTITE® ECI 8090 E&C	LOCTITE® NCI 8002 E&C
	LOCTITE® ECI 8120 E&C	

DIELECTRIC INKS

Dielectric ink formulations are non-conductive inks used for electrical isolation and environmental protection of an application.

Henkel's LOCTITE® branded dielectric inks are designed for printing dielectric layers, conformal coatings, and encapsulations.

DIELECTRIC INK	
LOCTITE® EDAG PF 021 E&C	LOCTITE® EDAG 451SS E&C
LOCTITE® EDAG 452SS E&C	LOCTITE® EDAG PF 455B E&C
LOCTITE® EDAG PF 455BC E&C	LOCTITE® EDAG 456 E&C
LOCTITE® EDAG PF 465 E&C	LOCTITE® EDAG ML 25208 E&C
LOCTITE® EDAG ML 25240 E&C	LOCTITE® EDAG ML 25265 E&C
LOCTITE® NCI 9001 E&C	LOCTITE® NCI 9006 E&C

APPLICATION METHODS

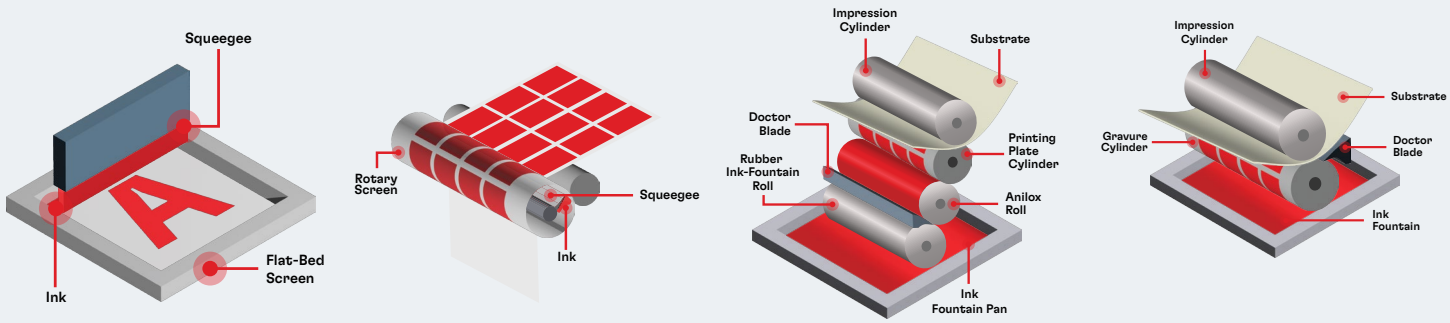
Printed electronics can be created by different printing methods, such as screen printing, rotary screen, flexographic, or rotogravure printing.

The selection of a printing method depends upon multiple aspects, such as the production volume, the application type, and the material and substrate compatibility.

Our team offers specialized knowledge to facilitate accurate material and printing method selection and application support, from prototyping to large-scale manufacturing.

CONVENTIONAL PRINTING METHODS

FLAT-BED SCREEN	ROTARY SCREEN	FLEXOGRAPHY	ROTOGRAVURE

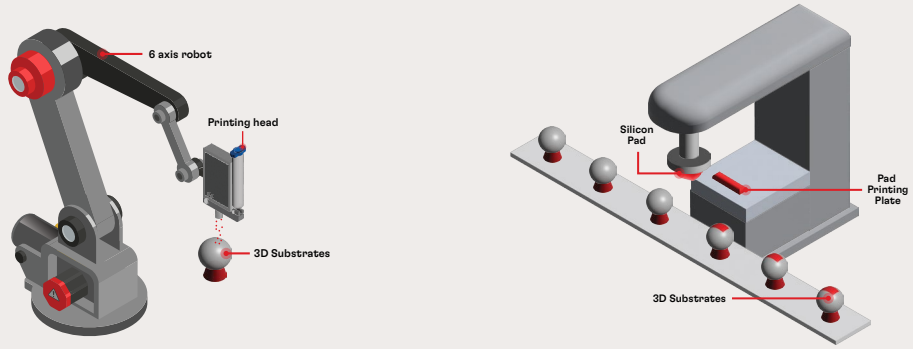


PRINTING SPEED

The advantage of screen printing is the ability to apply thick layers (5 - 25 µm), but it is a slower process in comparison with flexographic or gravure printing.

3D PRINTING METHOD

DIRECT 3D PRINTING	PAD PRINTING



Pad-printable functional inks allow customers to print directly onto 3D-shaped surfaces, eliminating the need for wires, etching, or electroplating. Direct 3D printing is enabled by placing a printing head at the end of a robotic arm. The print head can be adjusted to different coating processes, such as spray-coating, valve-jet dispensing, aerosol jet, and dispensing.

PRINTED ELECTRONICS

MARKETS & APPLICATIONS

SMART SURFACES

APPLICATIONS

With the ongoing trend of IoT, our environment is increasingly becoming smarter. By integrating electronic circuitry and components, you can transform previously simple surfaces into intelligent, interactive, and smart surfaces.

Printed electronics play a crucial role in this transformation by enabling flexible, thin, and lightweight circuitry. Our LOCTITE® portfolio of conductive, resistive, and dielectric inks offers customers new design opportunities complementary to traditional electronics.

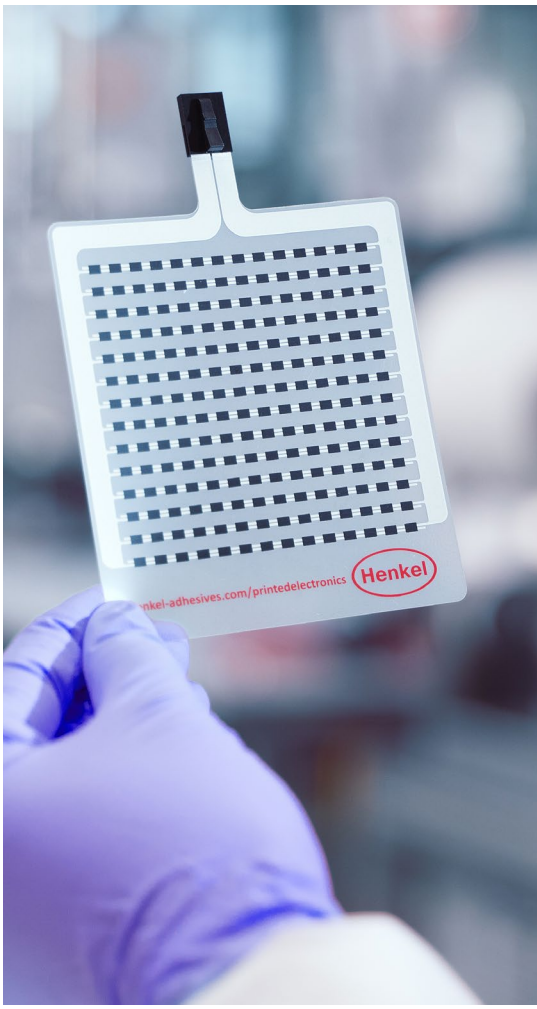
Smart surface solutions include traditional membrane switches, keyboards, capacitive and resistive sensors, flexible heaters, and many more.

In the context of smart surfaces, printed electronics are applied to connect and enable a response to environmental stimuli, enabling meaningful data collection and paving the way for sustainable digital applications in mobility, connectivity, building, and construction.

PRINTED HEATERS

Printed heaters, including fixed-resistance silver track, fixed-resistance silver carbon, and Positive-Temperature-Coefficient (PTC) heaters, are thin, lightweight, flexible, and rapidly heating solutions.

PTC inks are specifically engineered to be self-regulating, which makes them an ideal choice for highly efficient and safe heating elements. LOCTITE® inks possess the unique ability to adjust their electrical resistance in response to temperature changes and minimize the risk of overheating. PTC inks find utility in diverse scenarios, from automotive cabin heating systems to industrial applications and small electronic devices.



MATERIAL PORTFOLIO	
SILVER INK	DIELECTRIC INK
LOCTITE® EDAG PF 410 E&C	LOCTITE® EDAG PF 455BC E&C
LOCTITE® EDAG 479SS E&C	LOCTITE® EDAG 456 E&C
LOCTITE® ECI 1010 E&C	NON-CONDUCTIVE BLENDABLE INK
CARBON INK	LOCTITE® EDAG PM 404 E&C
LOCTITE® EDAG 423SS E&C	LOCTITE® NCI 8002 E&C
LOCTITE® EDAG 965SS E&C	CARBON PTC INK
LOCTITE® EDAG 6017SS E&C	LOCTITE® ECI 8001 E&C
	LOCTITE® ECI 8090 E&C
	LOCTITE® ECI 8120 E&C
	LOCTITE® ECI 8060HV E&C

MATERIAL SPOTLIGHT

LOCTITE® ECI 8001 E&C

LOCTITE® ECI 8001 E&C is a positive temperature coefficient (PTC) ink for the creation of low voltage (< 50 Volt) self-regulating heating elements up to ±60°C.

LOCTITE® ECI 1010 E&C

LOCTITE® ECI 1010 E&C is a conductive silver ink with excellent mechanical performance. It offers high conductivity combined with optimal performance.

LOCTITE® EDAG PF 455BC E&C

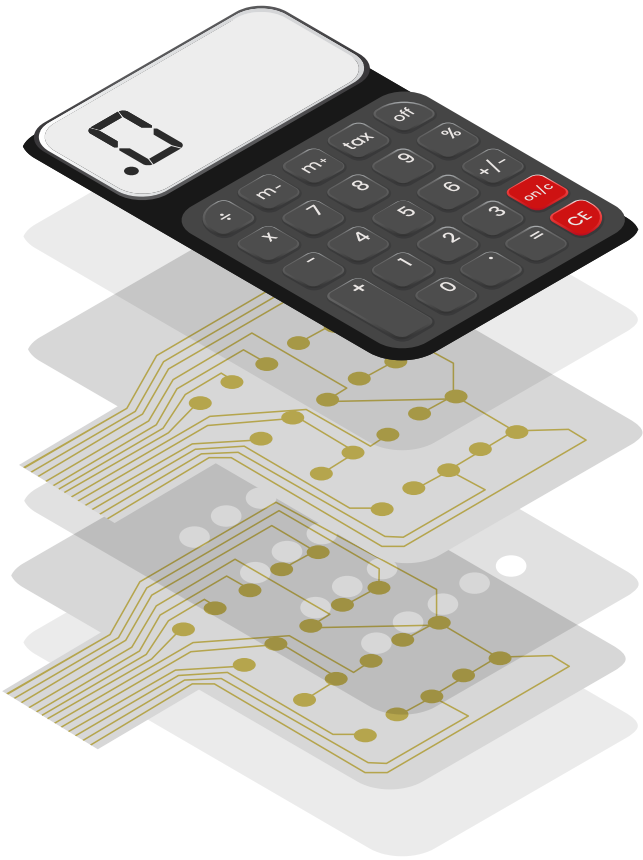
LOCTITE® EDAG PF 455BC E&C is a clear UV-curable dielectric ink with good adhesion onto treated and untreated polyester. It offers superior humidity resistance and dielectric strength. It is suitable for crossovers with reduced risk of silver migration and high breakdown voltage. It is also available as a green dielectric under **LOCTITE® EDAG PF 455B E&C**.

Suitable for: Printed Self-Regulating PTC Heaters

MEMBRANE SWITCHES

Membrane switches are created by printing silver tracks onto PET and laminating two prints with a spacer in between. Once mechanical pressure is applied, the electrical circuit is closed.

The LOCTITE® silver inks portfolio is suitable for a wide variety of membrane switch applications, such as keyboards and industrial control panels.



MATERIAL PORTFOLIO	
SILVER INK	DIELECTRIC INK
LOCTITE® EDAG PF 410 E&C	LOCTITE® EDAG 452SS E&C
LOCTITE® EDAG 479SS E&C	LOCTITE® EDAG PF 455B E&C
LOCTITE® ECI 1001 E&C	LOCTITE® EDAG PF 455BC E&C
LOCTITE® ECI 1010 E&C	
CARBON INK	
LOCTITE® EDAG 423SS E&C	
LOCTITE® EDAG 965SS E&C	

MATERIAL SPOTLIGHT

LOCTITE® EDAG 965SS E&C

LOCTITE® EDAG 965SS E&C is a conductive carbon ink with optimal adhesion and abrasion resistance. It is useful to protect silver pads and tracks from chemical attack and silver migration. It can be blended with **LOCTITE® EDAG 479SS E&C** and **LOCTITE® EDAG PF 410 E&C**.

LOCTITE® ECI 1001 E&C

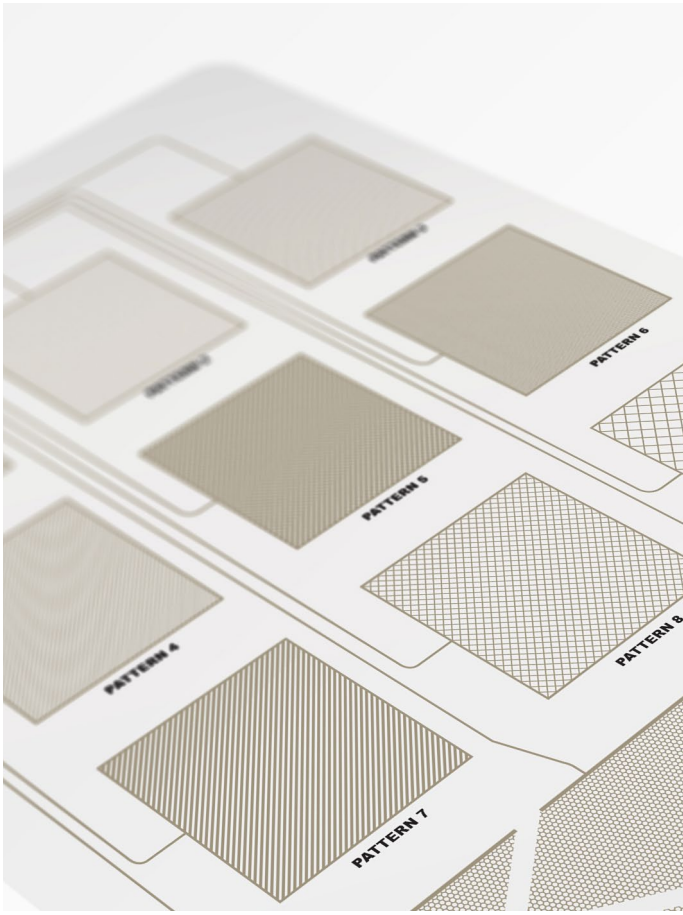
LOCTITE® ECI 1001 E&C is a screen printable, conductive ink designed for use on membrane touch switch and other flex circuit applications.

LOCTITE® EDAG 479SS E&C

LOCTITE® EDAG 479SS E&C is a halogen-free, conductive silver ink with good flexibility. LOCTITE® EDAG 479SS E&C is compatible with LOCTITE® EDAG dielectric and carbon inks. Further, it is solderable with low-temperature $Sn_{42}Bi_{58}$ solder pastes. It is available in Europe with similar product properties under **LOCTITE® EDAG PF 410 E&C**.

CAPACITIVE SENSORS

Capacitive sensors can detect and measure different variables like pressure and proximity. The LOCTITE® portfolio offers conductive inks with high conductivity, fine line printability, compatibility with transparent conductors, and non-yellowing dielectrics for transparency. Capacitive touch applications and non-contact water level sensors are examples of capacitive printed sensors.



MATERIAL PORTFOLIO	
SILVER INK	DIELECTRIC INK
LOCTITE® EDAG PF 410 E&C	LOCTITE® EDAG 452SS E&C
LOCTITE® EDAG 479SS E&C	LOCTITE® EDAG PF 455B E&C
LOCTITE® ECI 1001 E&C	LOCTITE® EDAG PF 455BC E&C
LOCTITE® ECI 1006 E&C	LOCTITE® NCI 9001 E&C
LOCTITE® ECI 1010 E&C	LOCTITE® EDAG ML 25265 E&C
LOCTITE® ECI 1501 E&C	
CARBON INK	
LOCTITE® EDAG 423SS E&C	
LOCTITE® EDAG 965SS E&C	

MATERIAL SPOTLIGHT

LOCTITE® ECI 1006 E&C

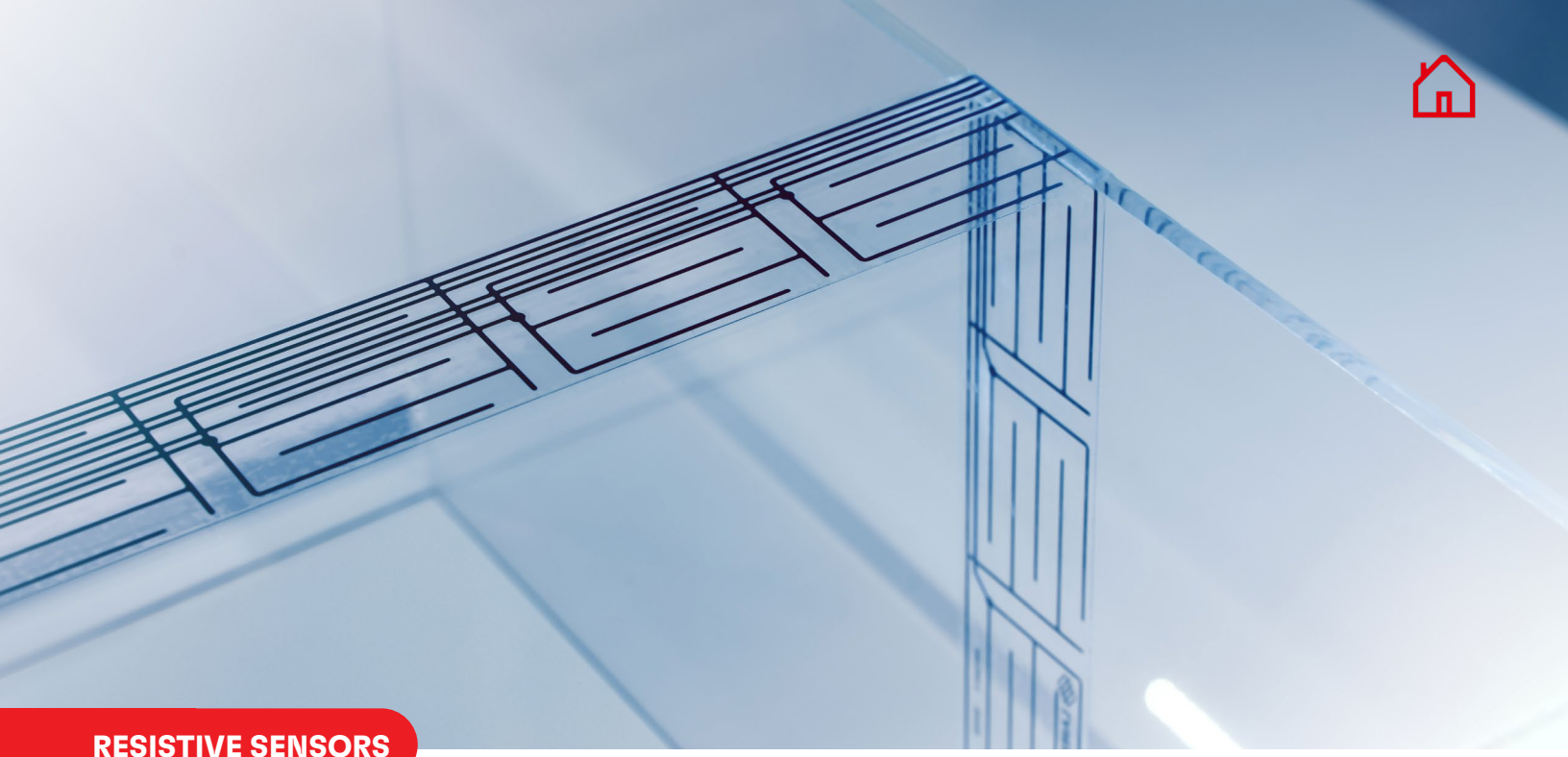
LOCTITE® ECI 1006 E&C is a halogen-free, low particle size conductive silver ink with a high viscosity. It is suitable for fine line screen printing with possible 50 µm line/spacing when using appropriate processing parameter.

LOCTITE® EDAG ML 25265 E&C

LOCTITE® EDAG ML 25265 E&C is a translucent UV-curable dielectric ink with good dielectric strength and adhesion onto ITO coated films and aluminum. It shows high peel strength in high temperature and humidity environment. It is also available as a green version under the name of **LOCTITE® EDAG ML 25240 E&C**.

LOCTITE® EDAG 423SS E&C

LOCTITE® EDAG 423SS E&C is a conductive carbon ink used for contact areas to protect the silver layer against oxidation.



RESISTIVE SENSORS

Resistive sensors show changes in their electrical resistance in response to different mechanical and physical stimuli. The LOCTITE® portfolio offers inks with different electrical resistances suitable for creating resistive sensors. Typical application examples are potentiometers, photoresistors, and resistive leak detection sensors.

MATERIAL PORTFOLIO	
SILVER INK	DIELECTRIC INK
LOCTITE® EDAG PF 410 E&C	LOCTITE® EDAG PF 455BC E&C
LOCTITE® EDAG 479SS E&C	
CARBON INK	
LOCTITE® EDAG PF 407A E&C	
LOCTITE® EDAG 423SS E&C	
LOCTITE® EDAG 965SS E&C	
LOCTITE® ECI 7007 E&C	

MATERIAL SPOTLIGHT

LOCTITE® EDAG PF 407A E&C

LOCTITE® EDAG PF 407A E&C is a polymer thick film carbon ink designed for production of low voltage circuitry on polyester film and solvent sensitive substrates such as polycarbonate. It is often used for printing contact areas, sensors and crossovers onto flexible substrates.

LOCTITE® EDAG PF 455BC E&C

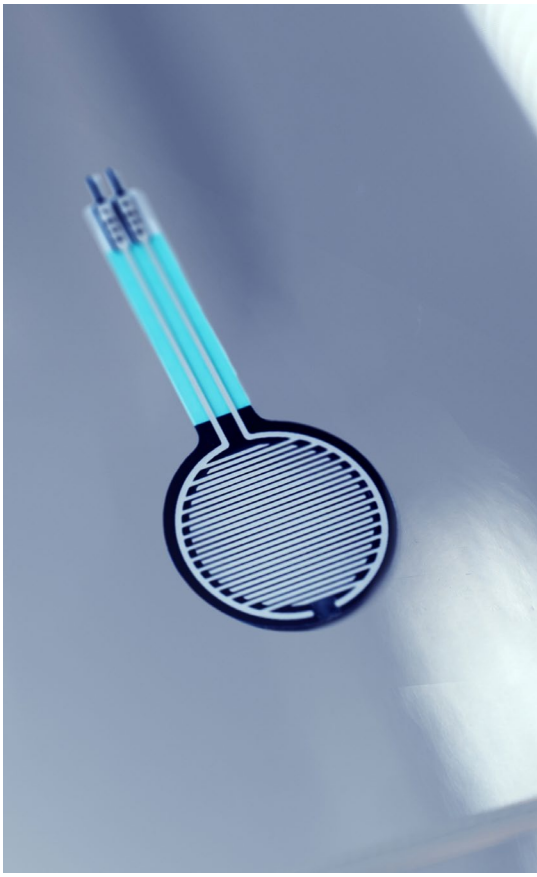
LOCTITE® EDAG PF 455BC E&C is a UV-curable dielectric ink suitable for treated and untreated polyester. It is also available as a green dielectric under **LOCTITE® EDAG PF 455B E&C**.

Suitable for: Leak Detection Sensors

FORCE SENSITIVE RESISTORS

Force-sensitive resistors (FSR) are responsive to different pressure levels and excel in enabling precise and accurate pressure distribution measurement. Our LOCTITE® portfolio offers a set of inks specifically developed for FSR applications.

The setup of the FSR equals a membrane switch with an added print layer of force-sensitive material. The ratio of LOCTITE® high resistance conductive inks and LOCTITE® non-conductive blendable inks define the sensitivity of the FSR sensor. FSR applications can be found in automotive interiors, interactive home elements, medical and industrial devices, and more.



MATERIAL PORTFOLIO	
SILVER INK	DIELECTRIC INK
LOCTITE® EDAG PF 410 E&C	LOCTITE® EDAG 452SS E&C
LOCTITE® EDAG 479SS E&C	LOCTITE® EDAG PF 455BC E&C
LOCTITE® ECI 1001 E&C	NON-CONDUCTIVE - BLENDABLE INK
LOCTITE® ECI 1010 E&C	LOCTITE® NCI 7002 E&C
CARBON INK	
LOCTITE® EDAG 423SS E&C	
LOCTITE® EDAG 965SS E&C	
LOCTITE® ECI 7004LR E&C	
LOCTITE® ECI 7004HR E&C	

MATERIAL SPOTLIGHT

LOCTITE® ECI 7004HR E&C

LOCTITE® ECI 7004HR E&C is a carbon ink that is suitable for high resistivity force sensors and slow responsive profiles.

LOCTITE® ECI 7004LR E&C

LOCTITE® ECI 7004LR E&C is a carbon ink that is suitable for low resistivity force sensors and fast responsive profiles.

LOCTITE® NCI 7002 E&C

LOCTITE® NCI 7002 E&C is a screen printable ink specifically designed for blending with **LOCTITE® ECI 7004HR E&C** and **LOCTITE® ECI 7004LR E&C** printable ink to provide range of resistance values.

HEALTHCARE

APPLICATIONS

Healthcare and digitalization go hand in hand. Printed electronics have revolutionized the healthcare market by enhancing patient care, diagnostics, and efficiency within the industry. One of the primary advantages is the flexibility and cost-effectiveness of producing electronic components through printing processes. The lightweight and portable nature of devices made with printed electronics solutions enable the development of wearable health monitoring devices, smart patches, and flexible sensors that can conform to the human body for continuous health tracking. Henkel offers an extensive portfolio of LOCTITE® branded conductive and dielectric inks for the healthcare market.

PRINTED SENSOR FOR DIAGNOSTICS AND HYGIENE

Printed biosensors can detect specific biological markers and enable rapid and accurate diagnostics. The LOCTITE® portfolio offers conductive inks applicable to biosensor applications. Integrating printed electronics technologies marks a significant stride towards more accessible, cost-effective, and efficient healthcare solutions.

MATERIAL PORTFOLIO	
SILVER INK	DIELECTRIC INK
LOCTITE® EDAG PF 410 E&C	LOCTITE® EDAG 452SS E&C
LOCTITE® EDAG 479SS E&C	LOCTITE® EDAG PF 455B E&C
LOCTITE® ECI 1010 E&C	LOCTITE® EDAG PF 455BC E&C
CARBON INK	SILVER/SILVER CHLORIDE INK
LOCTITE® EDAG 423SS E&C	LOCTITE® EDAG PE 007 E&C
LOCTITE® EDAG PF 407A E&C	LOCTITE® EDAG PE 409 E&C
LOCTITE® EDAG PF 407C E&C	LOCTITE® EDAG PE 428E RC E&C
LOCTITE® EDAG 6017SS E&C	LOCTITE® EDAG 7019
LOCTITE® ECI 7007 E&C	

MEDICAL WEARABLES

Printed electronics enable the creation of lightweight, flexible, and cost-effective components that can be seamlessly integrated into medical wearable devices. The LOCTITE® portfolio offers conductive inks and coatings for medical applications, including smart patches and electrodes. Wearable health patches enable continuous monitoring of vital signs, tracking of health metrics, and real-time data monitoring.

MATERIAL PORTFOLIO	
SILVER INK	DIELECTRIC INK
LOCTITE® EDAG PF 410 E&C	LOCTITE® EDAG 452SS E&C
LOCTITE® ECI 1010 E&C	LOCTITE® EDAG PF 455B E&C
LOCTITE® ECI 1014	LOCTITE® EDAG PF 455BC E&C
CARBON INK	LOCTITE® EDAG 456
LOCTITE® EDAG PF 407A E&C	SILVER/ SILVER CHLORIDE INK
LOCTITE® EDAG PF 407C E&C	LOCTITE® EDAG PE 007 E&C
LOCTITE® EDAG 6017SS E&C	LOCTITE® EDAG PE 409 E&C
SILVER/COPPER/CARBON/NICKEL COATINGS	LOCTITE® EDAG PE 428E RC E&C
LOCTITE® EDAG 109 E&C	LOCTITE® EDAG 7019 E&C

MATERIAL SPOTLIGHT

LOCTITE® ECI 1014

LOCTITE® ECI 1014 is a silver ink with high conductivity and high elongation.

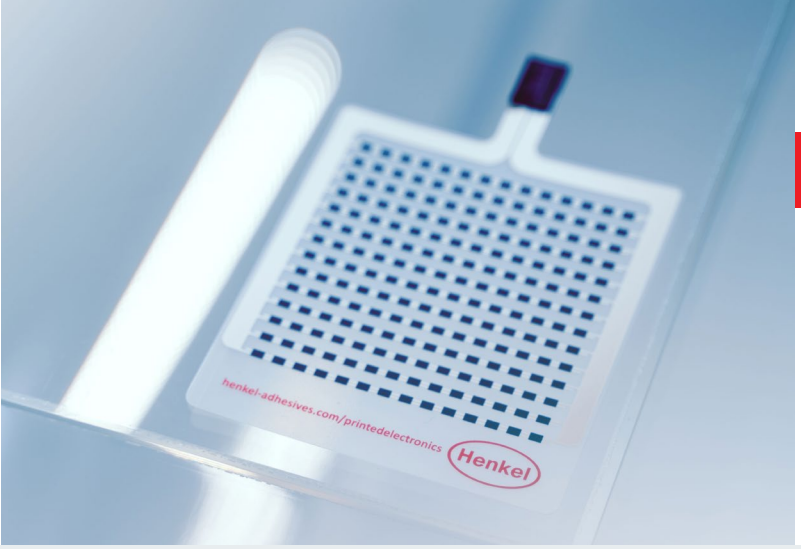
LOCTITE® EDAG 456

LOCTITE® EDAG 456 is a translucent highly flexible and stretchable UV-curable dielectric. It shows good compatibility with **LOCTITE® ECI 1014**.

LOCTITE® EDAG PE 409 E&C

LOCTITE® EDAG PE 409 E&C is a blend of finely divided silver and silver chloride particles in a thermoplastic resin. It has a silver/silver chloride ratio of 9:1.

Suitable for: Stretchable electrode combinations, compatible with TPU substrates and multiple hydrogels



MEDICAL HEATERS

Printed heaters enable thin, lightweight, and flexible heating. Heaters that use LOCTITE® Positive-Temperature-Coefficient (PTC), silver, and dielectric inks are suitable for medical applications. PTC heaters offer self-regulation, ensuring a consistent and safe heating experience.

MATERIAL SPOTLIGHT

LOCTITE® ECI 8001 E&C

LOCTITE® ECI 8001 E&C is a positive temperature coefficient (PTC) ink for the creation of low voltage (< 50 Volt) self-regulating heating elements up to ±60°C

LOCTITE® ECI 1010 E&C

LOCTITE® ECI 1010 E&C is a conductive silver ink with excellent mechanical strength. It offers high conductivity combined with optimal mechanical performance.

Suitable for: Printed Self-Regulating PTC Heaters for medical applications

ANTENNA FOR MEDICAL WEARABLES

Conductive inks can be used to create printed antennas that seamlessly integrate into medical wearable devices to facilitate wireless communication for real-time health monitoring. The LOCTITE® portfolio of high-conductive silver inks enables customers to design antennas across different frequency ranges. By adding printed antennas, the connectivity of medical wearables can be enhanced for the next generation of devices for the continuous monitoring of vital health parameters.

For more detailed information, please refer to full application page on Page 9 for Medical Heaters and Page 18 for Pad-Printable Antenna

MATERIAL SPOTLIGHT

LOCTITE® ECI 1216 E&C

LOCTITE® ECI 1216 E&C electrically conductive ink is specially designed for use in pad printable conductive pathways applications.

Suitable for: Pad printable medical applications

ANTENNA

APPLICATIONS

Adopting new communication standards has led to the development and integration of printed antennas in various applications, from RFID tags to cutting-edge pad-printed 5G antennas.

One major innovation amongst the LOCTITE® portfolio are pad-printable conductive inks. The unique range of conductive silver inks are specifically engineered to allow customers to print onto curved surfaces and eliminate the need for etching or electroplating, which makes the next generation of processing more environmentally friendly.

MATERIAL PORTFOLIO	
SILVER INK	
LOCTITE® EDAG PD 056 E&C	LOCTITE® ECI 1203 E&C
LOCTITE® EDAG PM406V1 E&C	LOCTITE® ECI 1204 E&C
LOCTITE® ECI 1010 E&C	LOCTITE® ECI 1205 E&C
LOCTITE® ECI 1011 E&C	LOCTITE® ECI 1216 E&C
LOCTITE® ECI 1014	LOCTITE® ECI 1217 E&C
LOCTITE® ECI 1016	LOCTITE® ECI 1218 E&C
	DIELECTRIC INK
	LOCTITE® NCI 9006 E&C

MATERIAL SPOTLIGHT

LOCTITE® ECI 1203 E&C

LOCTITE® ECI 1203 E&C electrically conductive ink is specially designed for use in pad printable conductive pathways applications.

LOCTITE® ECI 1204 E&C

LOCTITE® ECI 1204 E&C electrically conductive ink is specially designed for use in pad printable conductive contact point assembly.

LOCTITE® ECI 1216 E&C

LOCTITE® ECI 1216 E&C electrically conductive ink is specially designed for use in pad printable conductive pathways applications.

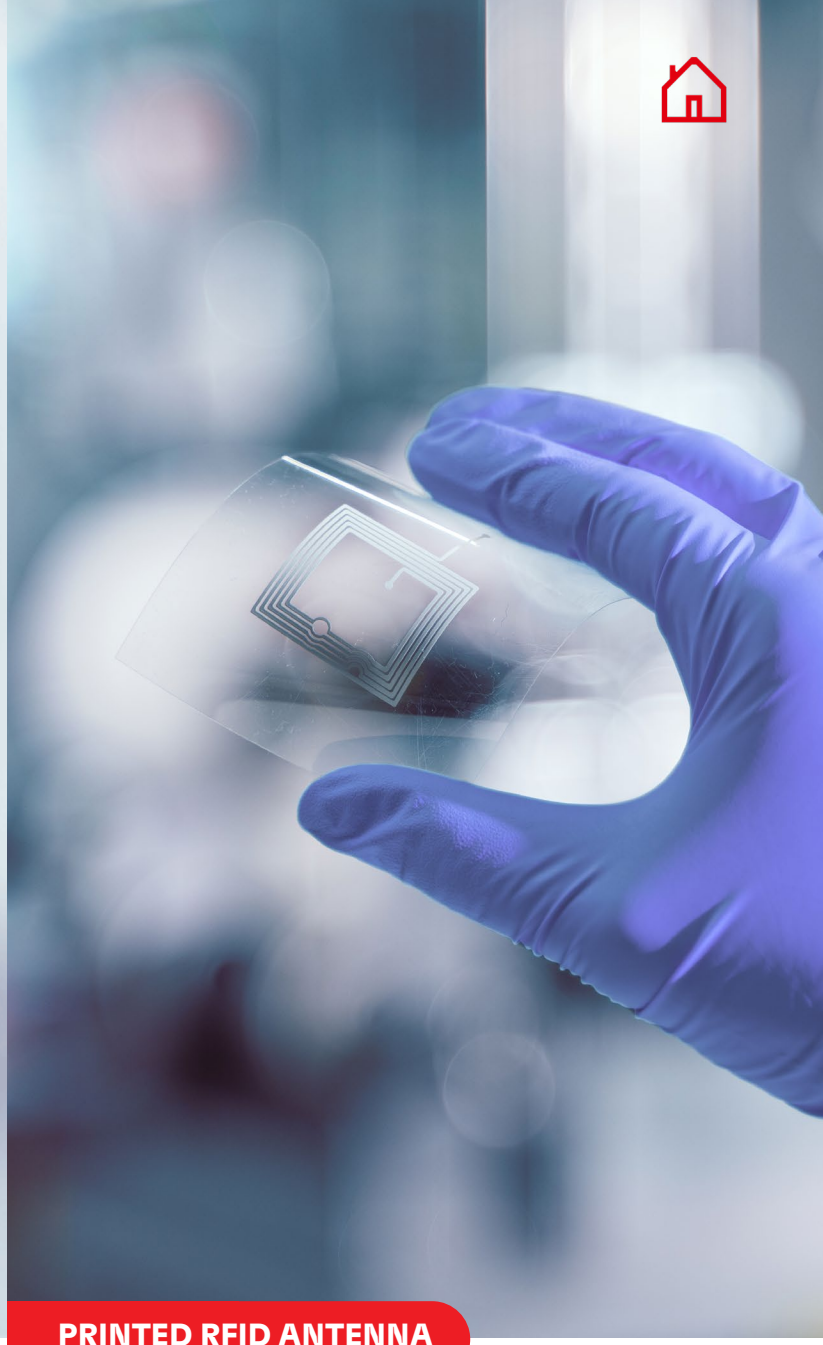
LOCTITE® ECI 1217 E&C

LOCTITE® ECI 1217 E&C electrically conductive ink designed for pad printable conductive contact point assembly.

Suitable for: Pad printable applications for 5G antennas

PAD-PRINTABLE ANTENNA

LOCTITE® conductive inks are suitable for printing 5G antennas. The specialized conductive ink formulations offer customers high conductivity and are pad-printable onto curved surfaces, which is useful for integrating 5G antennas into mobile communication devices. As smartphone antennas evolve with ink technology advancements, users can expect improved signal strength, faster data transfer rates, and enhanced overall connectivity.



PRINTED RFID ANTENNA

LOCTITE® conductive inks allow accurate printing of RFID antenna patterns on diverse substrates. The portfolio of inks can be applied to create HF and UHF RFID tags. By leveraging printed electronics technology, customers can craft RFID tags that are lightweight, slim, and adaptable to various frequency requirements. RFID antennas can be easily integrated into many applications, including RFID's for inventory tracking and other identification systems.

ENERGY STORAGE
APPLICATIONS

Improved performance and increased safety are fundamental drivers of innovation within energy storage applications. Our specialized LOCTITE® brand inks offer carbon based formulations for a variety of energy storage applications, including coatings for batteries and supercapacitors as well as inks formulated for printed battery applications.

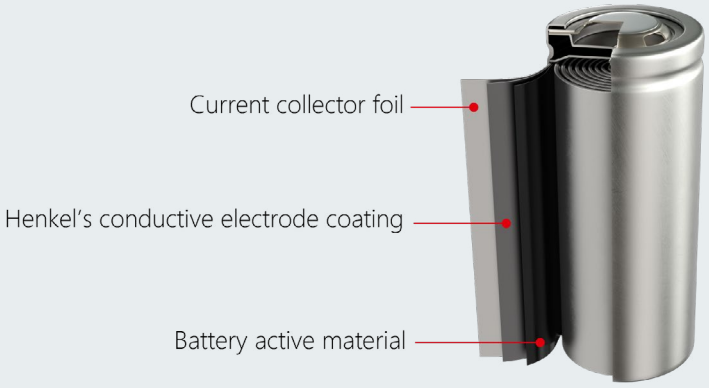
MATERIAL SPOTLIGHT

BONDERITE® S-FN EB-012 ACHESON

BONDERITE® S-FN EB-012 ACHESON is a versatile water-based dispersion of graphite in a thermoplastic binder. It forms a flexible, low-resistance coating suitable for lithium-ion polymer battery environments. It offers conductivity, chemical resistance, and can be applied by spray, brush, roll, or print methods. Once cured, it provides a durable, solvent-resistant coating for most metal substrates.

BONDERITE® L-GP EB 020A EU ACHESON

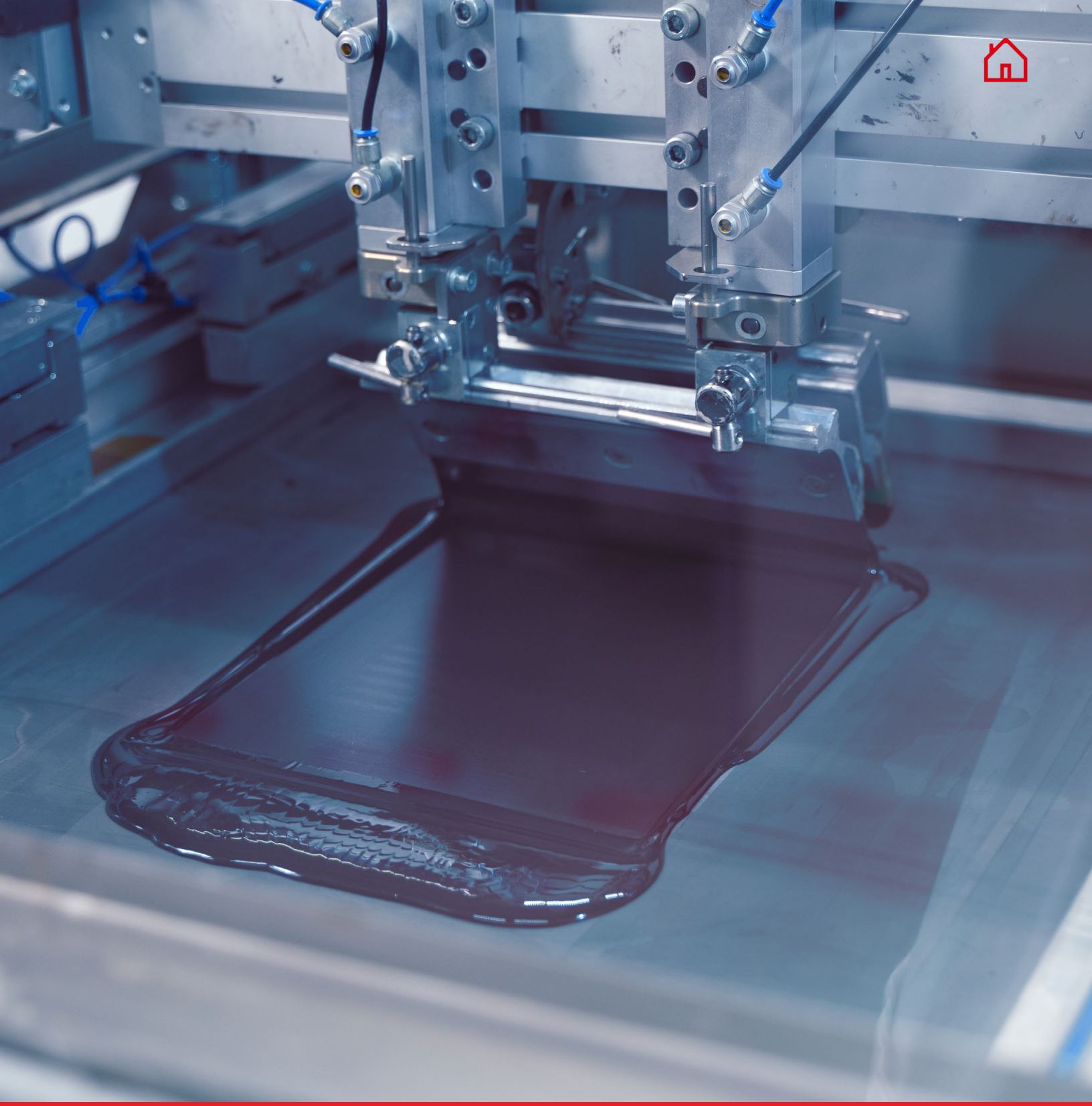
BONDERITE® L-GP EB 020A EU ACHESON is one in a series of conductive coatings designed to provide controlled electrical properties. BONDERITE® L-GP EB 020A EU ACHESON is a one-component thermosetting graphite coating of unusually high conductivity. BONDERITE® L-GP EB 020A EU ACHESON is water-based and particularly useful in solvent-prohibited areas.



LOCTITE® ECI 7001 E&C

LOCTITE® ECI 7001 E&C is a highly conductive flexible carbon ink. It is used for printable batteries applied on flexible substrates. This product is suitable for screen printing with coarse screens.

Suitable for: Current collector coatings within a battery cell or supercapacitor. These coatings can increase adhesion between the electrode & current collector, increase electrode conductivity, as well as reduce the potential for current collector corrosion, especially for the Lithium-Ion battery market.



TECHNICAL
PRODUCT DATA

TECHNICAL PRODUCT DATA
CONDUCTIVE INKS & COATINGS

Conductive inks and coatings are revolutionizing the way electronic components are crafted. LOCTITE® conductive inks and coatings can be printed onto various substrates, such as different plastics.

SILVER INKS

Product Name	Key Features	Compatible Substrates	Application Method	Optimum Drying Cycle/ Cure	Sheet Resistance (Ω/sq, at 25 µm dry coating thickness)
LOCTITE® EDAG PF 006 E&C	▪ Silver-carbon blend ▪ Low silver migration	PET, ABS, Paper	Screen printing	15 min, 120°C	< 0.020
LOCTITE® EDAG PD 056 E&C	▪ Silver pigment in a thermoplastic resin that dries at low temperatures to form a flexible conductive coating ▪ Suitable for security tags and antenna applications	ITO sputtered polyester film, copper circuitry, glass, metal substrates	Rotogravure, Flexographic	2 min, 70-100°C	<0.008
LOCTITE® EDAG PF 410 E&C	▪ Solderable with low melting $Sn_{42}Bi_{58}$ solder pastes ▪ Compatible with a large range of electrically conductive adhesives for component attach	PET, PI, PEN, ABS, Paper, Copper	Screen printing	15 min, 120°C	< 0.025
LOCTITE® EDAG PM406V1 E&C	▪ High conductivity ▪ High dry content	PET, PVC, ABS, Paper	Screen printing	15 min, 120°C	< 0.015
LOCTITE® EDAG 418SS E&C	▪ Good conductivity ▪ Good flexibility ▪ Compatible with solvent-sensitive substrates	PC, ABS, PVC, PET	Screen printing	15 min, 120°C	< 0.03
LOCTITE® EDAG PM 460A E&C	▪ High conductivity ▪ Fast drying ▪ Low resistance after heat exposure, cold, and humid conditions	PET, PEN, PI, Paper	Rotogravure, Flexographic	15 min, 70°C	< 0.010
LOCTITE® EDAG 479SS E&C	▪ Solderable with low melting $Sn_{42}Bi_{58}$ solder pastes ▪ Compatible with a large range of electrically conductive adhesives for component attach	PET, PI, PEN, Paper, Copper	Screen printing	15 min, 120°C	< 0.020
LOCTITE® EDAG 725A (6S54) E&C	▪ Excellent flexibility ▪ Used to create printed circuits, crossovers, and sensors	PET, PI, PEN, Paper	Screen printing	15 min, 120°C	< 0.015
LOCTITE® ECI 1001 E&C	▪ Good conductivity with low silver content	PET, PEN, PI, Paper	Screen printing	15 min, 120°C	< 0.025

SILVER INKS

Product Name	Key Features	Compatible Substrates	Application Method	Optimum Drying Cycle/ Cure	Sheet Resistance (Ω/sq, at 25 µm dry coating thickness)
LOCTITE® ECI 1006 E&C	▪ High viscosity ▪ Fine particle size for fine line printing	PET, PI, ITO, Copper	Screen printing	15 min, 120°C	< 0.030
LOCTITE® ECI 1010 E&C	▪ High conductivity ▪ Good mechanical strength performance	PET, PEN, PI, Paper	Screen printing	15 min, 120°C	< 0.008
LOCTITE® ECI 1011 E&C	▪ Very high conductivity ▪ Particle size below 2 µm	PET, PI, PEN, Paper	Screen printing, Flexographic, Rotogravure and Valve Jet Dispensing	10 min, 150°C	< 0.005
LOCTITE® ECI 1014	▪ Highly conductive stretchable ink ▪ Compatible with solvent sensitive substrates ▪ low-temperature drying	PC, PET, TPU, PI, PEN	Screen printing	15 min, 120°C	< 0.012
LOCTITE® ECI 1501 E&C	▪ Used to print formable circuits ▪ Good elongation performance ▪ Suitable for in-molded electronics	PC, PET, TPU, PI, PEN	Screen printing	15 min, 120°C	< 0.025
LOCTITE® ECI 1016	▪ High conductive silver ▪ Low viscosity ▪ Suitable for high-speed roll-to-roll rotary screen-printing	PET	Screen printing, Rotary screen-printing	2 min, 150°C	< 0.007
LOCTITE® ECI 1203 E&C	▪ Pad-printable ▪ Highly conductive	PA+Fiber, PC, PBT, PPS, Ceramic, Anodized Aluminum	Pad printing	2 hr, 80°C	< 0.01
LOCTITE® ECI 1204 E&C	▪ Pad printable ▪ High-abrasion resistance	PA+Fiber, PC, PBT, PPS, Ceramic, Anodized Aluminum	Pad printing	2 hr, 80°C	< 0.04
LOCTITE® ECI 1205 E&C	▪ Dispensable silver ink for via fill applications	PA+Fiber, PC, PBT, PPS, Ceramic	Dispensing	2 hr, 80°C	< 0.06
LOCTITE® ECI 1216 E&C	▪ Pad printable ▪ Highly conductive	PA+Fiber, PC, PBT, PPS, Ceramic, Anodized Aluminum	Pad printing	2 hr, 90°C	< 0.05
LOCTITE® ECI 1217 E&C	▪ Pad printable ▪ Excellent RCA abrasion	PA+Fiber, PC, PBT, PPS, Ceramic, Anodized Aluminum	Pad printing	120 min, 90°C	< 0.020
LOCTITE® ECI 1218 E&C	▪ Dispensable silver ink for via fill applications	PA+Fiber, PC, PPS, Ceramic	Dispensing	60 min, 90°C	< 0.020

SILVER /SILVER CHLORIDE INKS

Product Name	Key Features	Compatible Substrates	Application Method	Optimum Drying Cycle/ Cure	Sheet Resistance (Ω/sq, at 25 µm dry coating thickness)
LOCTITE® EDAG PE 007 E&C	▪ 8:2 Ag:AgCl ratio	Polyester, Paper	Flexographic, Rotogravure	2 min, 107°C	< .10
LOCTITE® EDAG PE 409 E&C	▪ 9:1 Ag:AgCl ratio ▪ Suitable for biosignal sensing electrodes	PET, PI, PEN, Paper	Screen printing	15 min, 120°C	< .05
LOCTITE® EDAG PE 428E RC E&C	▪ 9:1 Ag:AgCl ratio ▪ Water-based	PET, Paper	Flexographic, Rotogravure	15 min, 95°C	< .03
LOCTITE® EDAG 7019 E&C	▪ 8:2 Ag:AgCl ratio ▪ Suitable for medical and biosensors	PET, PI, PEN, Paper	Screen printing	15 min, 120°C	< .05

CARBON INKS

Product Name	Key Features	Compatible Substrates	Application Method	Optimum Drying Cycle/ Cure	Sheet Resistance (Ω/sq, at 25 µm dry coating thickness)
LOCTITE® EDAG PF 407A E&C	▪ Conductive carbon ink ▪ Used for printing contact areas, sensors, and crossovers onto flexible substrates ▪ Faster drying modification of LOCTITE® EDAG PF 407C E&C	PET, PI, PC, Paper, Cardboard	Screen printing	30 min, 90°C or 15 min, 120°C	< 20
LOCTITE® EDAG PF 407C E&C	▪ Conductive carbon ink ▪ Used for printing contact areas, sensors, and crossovers onto flexible substrates	Treated and untreated polyester, PEN, Paper	Screen printing	5 min. at 120°C	< 15
LOCTITE® EDAG 423SS E&C	▪ Conductive carbon ink for low voltage circuitry ▪ Used for printing contact areas ▪ Protects silver tracks from oxidation	PET, PEN, PI	Screen printing	15 min, 120°C	< 42
LOCTITE® EDAG 440A E&C	▪ For conductive traces in flexible circuits ▪ Overprintable on LOCTITE® EDAG 725A E&C ▪ Blendable with LOCTITE® EDAG 725A E&C or LOCTITE® ECI 1010 E&C for sheet resistance adjustment	PET, PEN, Paper	Screen printing	10 min, 107°C	< 30
LOCTITE® EDAG 440B E&C	▪ For flexible circuit traces ▪ Overprintable on LOCTITE® EDAG 725A E&C ▪ Blendable with LOCTITE® EDAG 725A E&C or LOCTITE® ECI 1010 E&C	PET, PEN, Paper	Screen printing	10 min, 107°C	< 40
LOCTITE® EDAG 965SS E&C	▪ Suitable for tail connectors and silver track protection ▪ Good mechanical performance ▪ Abrasion resistant	PET, PEN, Paper, ITO	Screen printing	15 min, 120°C	< 60
LOCTITE® ECI 7001 E&C	▪ Good conductivity ▪ For printable batteries on flexible substrates	PET, PEN, Paper	Screen printing	10 min, 120°C	< 10
LOCTITE® ECI 7007 E&C	▪ High-speed printing ink ▪ High-conductivity	PET, Corona treated PE/PP, Paper	Flexographic, Rotogravure	2 min, 60°C	< 10

SILVER/COPPER/CARBON/ NICKEL COATINGS

Product Name	Key Features	Compatible Substrates	Application Method	Optimum Drying Cycle/ Cure	Sheet Resistance (Ω/sq, at 25 µm dry coating thickness)
LOCTITE® EDAG 109 E&C	▪ Carbon ink ▪ Low-viscosity ▪ Fast-drying ▪ After dilution, can be used as a sprayable EMI shielding coating onto plastic and metal substrates	PET, Paper	Flexographic, Rotogravure, Spraying	20 min, 80°C	< 30
LOCTITE® EDAG SP 413 E&C	▪ Silver coating for EMI shielding ▪ Improved from LOCTITE® EDAG 1415M E&C ▪ Excellent EMI shielding (70-80 dB) at low thickness	PC, ABS, PET, PU and other plastic enclosers	Spraying, Dipping or Brushing	15 min, 70°C	< 0.015
LOCTITE® EDAG 437 E&C	▪ Copper coating for EMI shielding ▪ Protects against ESD ▪ Stable in harsh conditions ▪ Over-paintable with 2 pot PU	Plastics	Spraying, Dipping or Brushing	30 min, 70°C	< 0.5
LOCTITE® EDAG 440 AS E&C	▪ Nickel-filled coating for EMI shielding ▪ Protects against electrostatic discharge ▪ Stable in harsh conditions (humidity, heat) ▪ Can be electroless plated ▪ Over-paintable with 2 pot PU paint ▪ Applied by spraying, air dried	Plastics	Spraying, Dipping or Brushing	20 min, 70°C	< 0.50
LOCTITE® EDAG 1415M E&C	▪ Silver coating for EMI shielding ▪ Protects against ESD ▪ Stable in harsh conditions ▪ Air dries without primer or top coat	Plastics	Spraying, Dipping or Brushing	30 min, 70°C	< 0.015
LOCTITE® EDAG 6041 E&C	▪ Thermoset silver-filled coating for EMI shielding ▪ Offers superior chemical and thermal stability ▪ Air dried and requires heat curing	Plastics, Phenolic paper, Epoxy paper, Glass epoxy	Spraying, Dipping or Brushing	60 min, 150°C	< 0.01

TECHNICAL PRODUCT DATA
RESISTIVE INKS

LOCTITE® resistive inks consist of conductive particles dispersed in a polymer matrix, allowing for the controlled modulation of electrical resistance. By precisely depositing resistive inks on substrates, such as plastic or paper, engineers can fabricate resistive elements like touch sensors and variable resistors. Resistive inks are suitable for developing touch-sensitive interfaces, pressure sensors, and other user interface components in electronic devices.

CARBON INKS

Product Name	Key Features	Compatible Substrates	Application Method	Optimum Drying Cycle/ Cure	Sheet Resistance (Ω/sq, at 25 µm dry coating thickness)
LOCTITE® EDAG 6017SS E&C	▪ Good flexibility ▪ Stable resistance for heater applications ▪ Blendable with LOCTITE® EDAG PM 404 E&C to end application need	PET, PEN, PI, Paper	Screen printing	15 min, 120 °C	< 35
LOCTITE® ECI 7004HR E&C	▪ Slow responsive sensitivity ▪ Force sensing ▪ Blendable with LOCTITE® NCI 7002 E&C to end application need	PET, PEN, PI	Screen printing	10 min, 120°C	3,500
LOCTITE® ECI 7004LR E&C	▪ Fast responsive sensitivity ▪ Force sensing ▪ Blendable with LOCTITE® NCI 7002 E&C to end application need	PET, PEN, PI	Screen printing	10 min, 120°C	35

CARBON PTC INKS

Product Name	Key Features	Compatible Substrates	Application Method	Optimum Drying Cycle/ Cure	Sheet Resistance (Ω/sq, at 25 µm dry coating thickness)
LOCTITE® ECI 8001 E&C	▪ Self-regulating temperature ▪ Low voltage suitability (<50 V) ▪ Self-regulating temperature of ±60°C	PET, PEN, PI	Screen printing	10 min, 120°C	1,700
LOCTITE® ECI 8060HV E&C	▪ Self-regulating temperature ▪ High voltage suitability (100 - 250 V) ▪ Self-regulating temperature of ±60°C	PET, PEN, PI	Screen printing	10 min, 120°C	40,000
LOCTITE® ECI 8090 E&C	▪ Self-regulating temperature ▪ Low voltage suitability (< 50 V) ▪ Self-regulating temperature of ±85°C	PET, PEN, PI	Screen printing	10 min, 120°C	1,000
LOCTITE® ECI 8120 E&C	▪ Self-regulating temperature ▪ Low voltage suitability (< 50 V) ▪ Self-regulating temperature of ±105°C	PET, PEN, PI	Screen printing	10 min, 140°C	1,700

NON-CONDUCTIVE BLENDABLE INKS

Product Name	Key Features	Compatible Substrates	Application Method	Optimum Drying Cycle/ Cure	Sheet Resistance (Ω/sq, at 25 µm dry coating thickness)
LOCTITE® EDAG PM 404 E&C	▪ Blendable non-conductive ink for resistance adjustment ▪ Adjusts and increases resistance of LOCTITE® EDAG 6017SS E&C	Polyester film, Paper and Cardboard	Screen printing	5 - 10 min, 120°C	Non-Conductive
LOCTITE® NCI 7002 E&C	▪ Blendable non-conductive ink for resistance adjustment ▪ Adjusts and increases resistance of LOCTITE® ECI 7004LR E&C and LOCTITE® ECI 7004HR E&C	PET, PEN, PI	Screen printing	10 min, 120°C	Non-Conductive
LOCTITE® NCI 8002 E&C	▪ Blendable non-conductive ink for resistance adjustment ▪ Adjusts and increases resistance of LOCTITE® ECI 8001 E&C and LOCTITE® ECI 8060HV E&C	PET, PEN	Screen printing	10 min, 120°C	Non-Conductive

TECHNICAL PRODUCT DATA
DIELECTRIC INKS

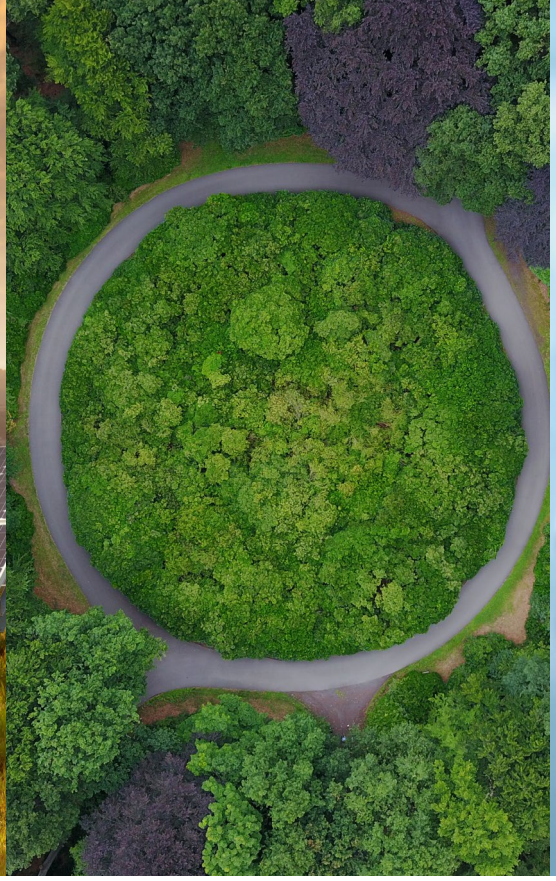
Dielectric inks are composed of materials with high dielectric constants that effectively block the flow of electrical current to create distinct layers and insulation between conductive elements. LOCTITE® dielectric inks are crucial for fabricating capacitors, insulating layers in printed circuit boards, and other components requiring electrical insulation. Their application ensures reliable and efficient performance by preventing unintended electrical crosstalk and minimizing interference.

DIELECTRIC INKS

Product Name	Key Features	Compatible Substrates	Application Method	Optimum Drying Cycle/ Cure	Breakdown Voltage (25 µm)
LOCTITE® EDAG PF 021 E&C	▪ Translucent ▪ UV-curable glob top coating ▪ Protects surface-mounted devices ▪ LED curable	PET, PC, FR-4	Dispensing	UV light 0.7 J/cm²	Non-Conductive
LOCTITE® EDAG 451SS E&C	▪ Translucent green	PET, PC	Screen printing	UV light 0.5 J/cm²	> 1500 V
LOCTITE® EDAG 452SS E&C	▪ Translucent green ▪ Also available in blue color under the name of LOCTITE® EDAG PF 465 E&C and clear under the name of LOCTITE® EDAG ML 25208 E&C	PC, PET, PEN	Screen printing	UV light 0.5 J/cm²	> 1500 V
LOCTITE® EDAG PF 465 E&C	▪ Translucent blue ▪ Also available in green color under the name of LOCTITE® EDAG PF 452SS E&C and clear under the name of LOCTITE® EDAG ML 25208 E&C	PET, PC, PEN	Screen printing	UV light 0.5 J/cm²	> 1500 V
LOCTITE® EDAG ML 25208 E&C	▪ Translucent ▪ Also available in blue under LOCTITE® EDAG PF 465 E&C and green under LOCTITE® EDAG 452SS E&C	PC, PET, PEN	Screen printing	UV light 0.5 J/cm²	> 1500 V
LOCTITE® EDAG PF 455B E&C	▪ Translucent green ▪ Also available as translucent under the name of LOCTITE® EDAG PF 455BC E&C	PET, PEN, PC	Screen printing	UV light 0.5 J/cm²	> 2800 V
LOCTITE® EDAG PF 455BC E&C	▪ Translucent ▪ Also available as green under LOCTITE® EDAG PF 455B E&C	PET, PEN, PC	Screen printing	UV light 0.5 J/cm²	> 2800 V

DIELECTRIC INKS

Product Name	Key Features	Compatible Substrates	Application Method	Optimum Drying Cycle/ Cure	Breakdown Voltage (25 µm thickness)
LOCTITE® EDAG 456	▪ Translucent ▪ Good compatibility with stretchable silver ink, LOCTITE® ECI 1014	PET, PI, PC, TPU	Screen printing	UV light 1 J/cm²	> 1000 V
LOCTITE® EDAG ML 25240 E&C	▪ Translucent green ▪ Also available in a clear version under the name of LOCTITE® EDAG ML 25265 E&C	Flexible copper circuits, ITO sputtered polyester film, metals and glass	Screen printing	UV light 0.5 J/cm²	> 2500 V
LOCTITE® EDAG ML 25265 E&C	▪ Translucent ▪ Also available in green as LOCTITE® EDAG ML 25240 E&C	Flexible copper circuits, ITO sputtered polyester film, metals and glass	Screen printing	UV light 0.5 J/cm²	> 2500 V
LOCTITE® NCI 9001 E&C	▪ Transparent ▪ Protective coating with high transparency (> 98%) ▪ Compatible with transparent conductive inks ▪ Primer coat for difficult to adhere to substrates	PET, PEN, ITO	Screen printing, Flexographic	5 min, 130°C	Non-Conductive
LOCTITE® NCI 9006 E&C	▪ Black ▪ Suitable for pad-printing ▪ Low-temperature curing	PA + glass fiber, PC, PBT, PPS, glass, ceramic, anodized aluminum, ITO	Pad printing	30 min, 120°C	> 1,500



SUSTAINABILITY
WE MAKE IT HAPPEN

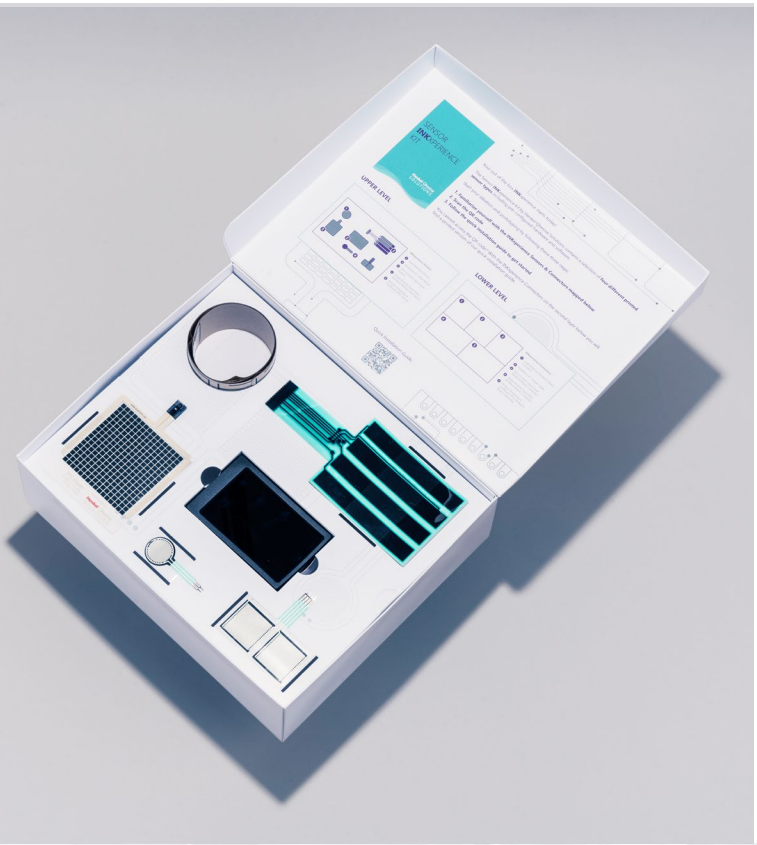
CLIMATE
Reducing the carbon footprint

CIRCULARITY
Utilizing renewable and recycled raw materials

SAFETY
Assessing product safety throughout the whole lifecycle

Henkel Adhesive Technologies is committed to fostering sustainable development by leveraging material science expertise in bonding, sealing, and coating. As part of our responsibility, we address challenges through innovative technologies, such as Printed Electronics. This additive technology positively impacts sustainability by enabling the direct printing of electrically conductive structures on substrates, reducing Bill of Materials (BOM), and introducing new possibilities in design. Our strategy aligns with industry trends, incorporating water-based, high-speed, and high-performance inks to continually enhance material portfolios, ensuring sustainability both in end applications and the underlying technology.

EXPLORE ENDLESS POSSIBILITIES
WITH OUR SENSOR KITS



The Sensor INKxperience Kit by Henkel Adhesive Solutions offers you a hands-on experience of four different types of printed electronics sensor functionalities, including a leak detection sensor, a non-contact liquid level sensor, a single and multi zone force sensitive resistor sensor, and a positive temperature coefficient (PTC) heater. The INKxperience kit sensors are pre- configurated with hardware and software, providing engineers with an easy setup for ideation, technology testing and first prototyping all out of one box.

inkxperiencekit.com

PRINTED ELECTRONICS
SAMPLE SHOP

We offer a wide range of different functional ink samples with different functionalities for smart product solutions across multiple markets such as automotive, medical, wearables, traditional electronics, and furniture & building. Simply select & test our LOCTITE® samples to accelerate and electrify your innovative product design.

print-your-electronics-with-loctite.com

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