

MATERIALS FOR
WEARABLE ELECTRONICS



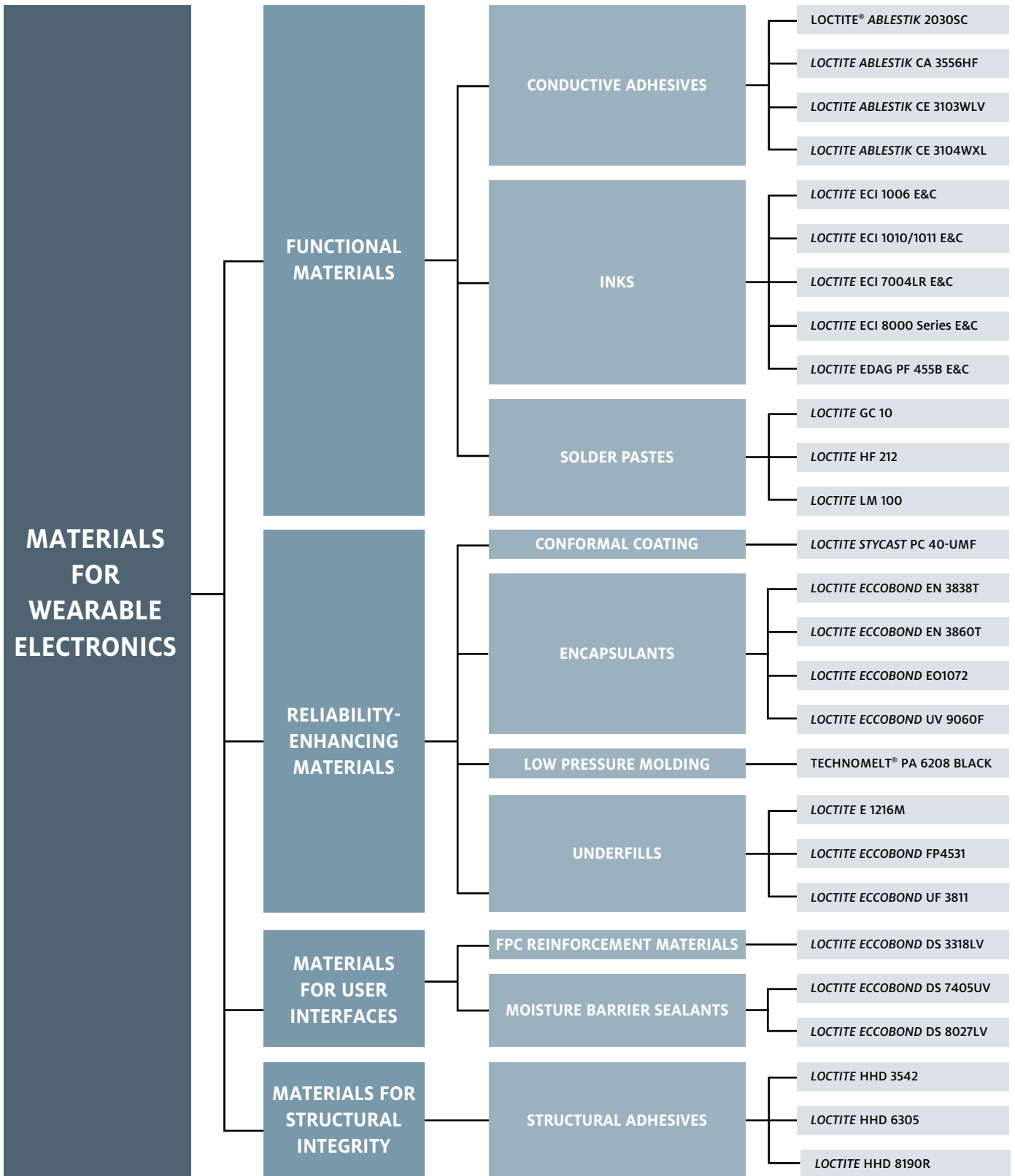
INTRODUCTION

From watches to fitness bands to smartglasses and textiles, wearable electronics are what many believe could be the next big...or small...thing in electronics. Challenging dimensions, product flexibility and demanding functionality requirements have wearables pushing the limits of design and mobile performance integration. Enabling robust functionality, reliability, structural integrity and user-friendly interfaces of wearable devices is highly dependent upon the performance of the electronic materials used to produce today's wearables and this is where Henkel delivers. With a full portfolio of materials designed to facilitate the demands of wearable electronics, Henkel is helping its customers bring some of the most exciting new products to market.

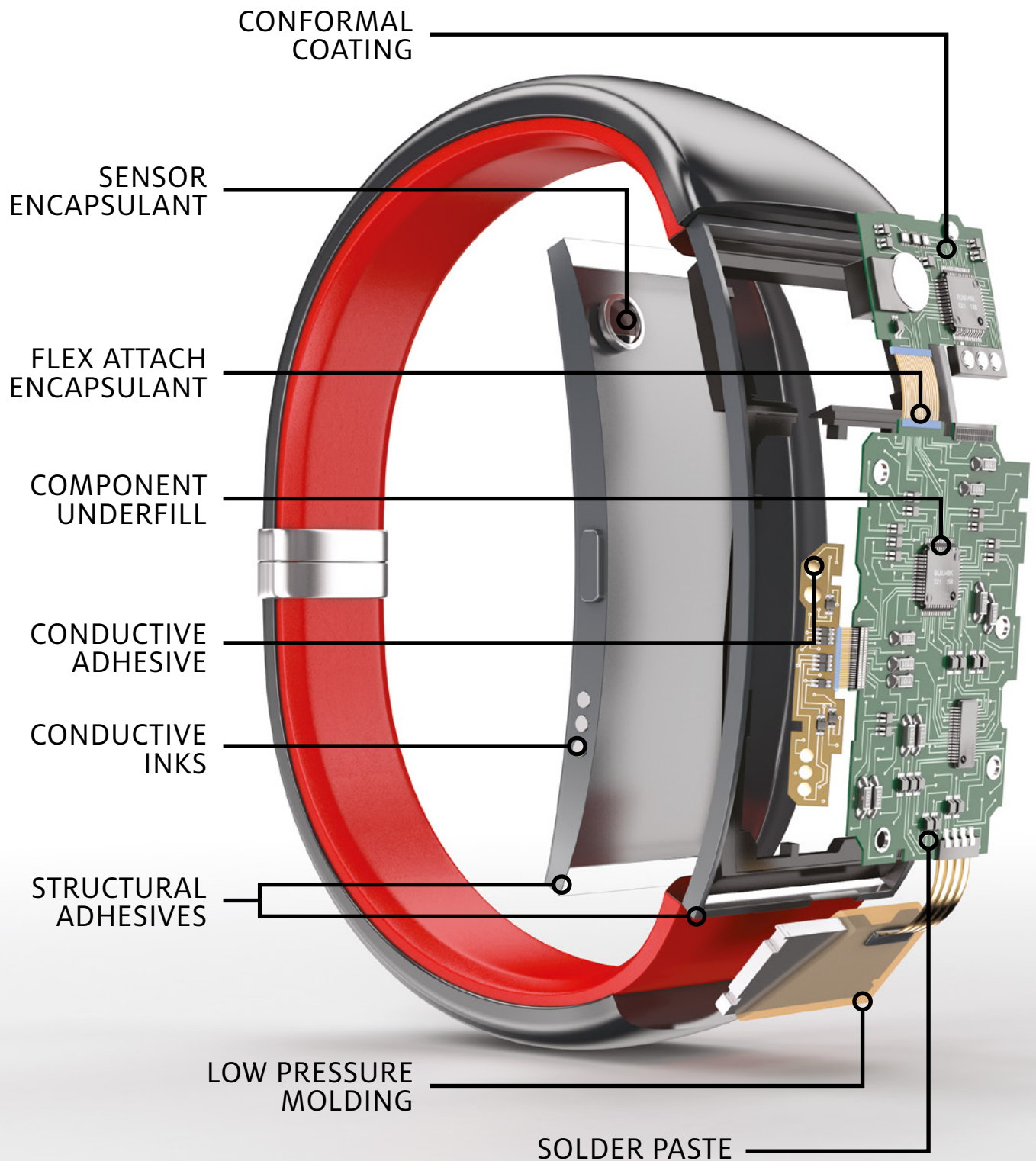
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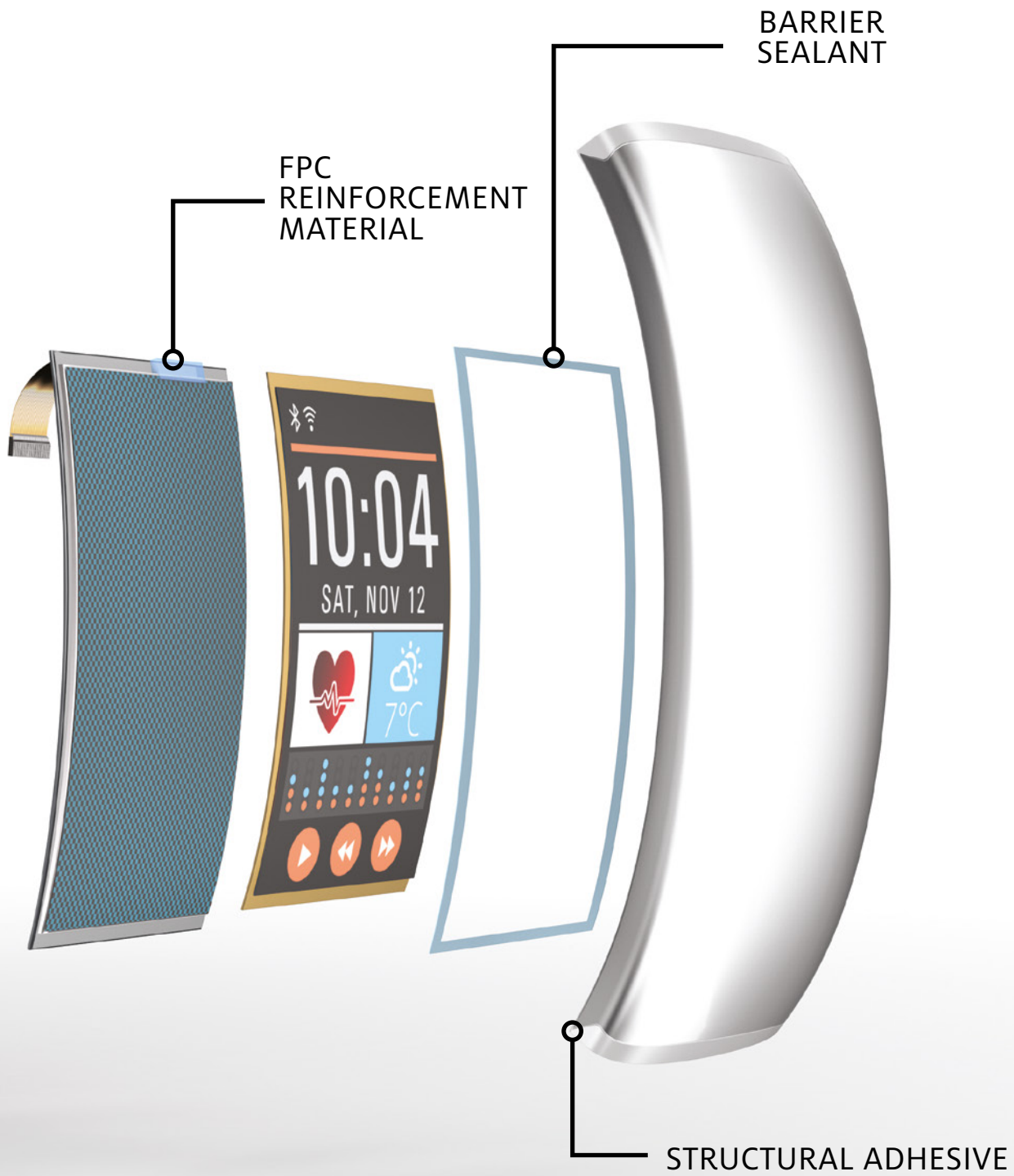
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PRODUCT PORTFOLIO



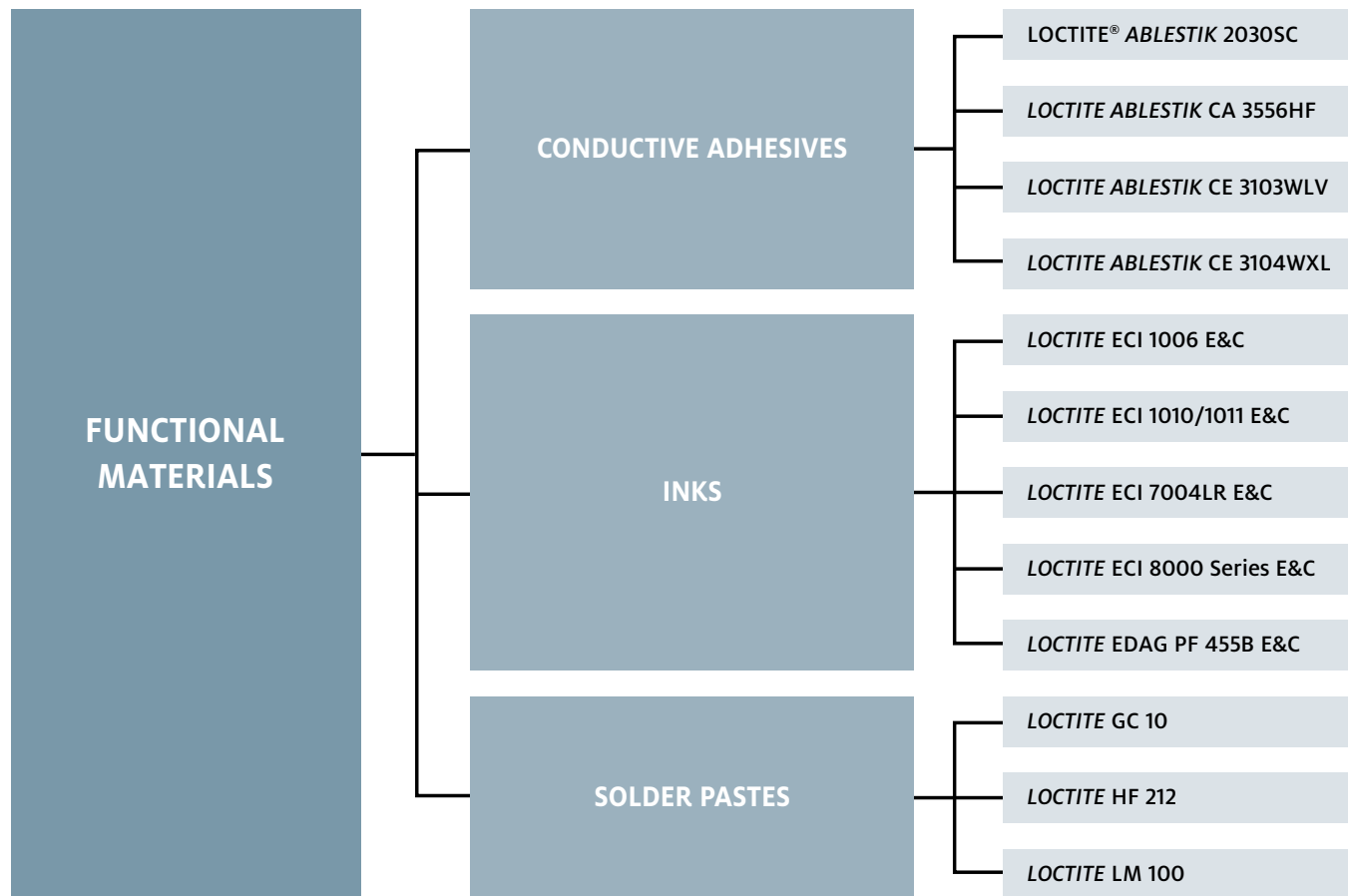
ADHESIVES IN ACTION





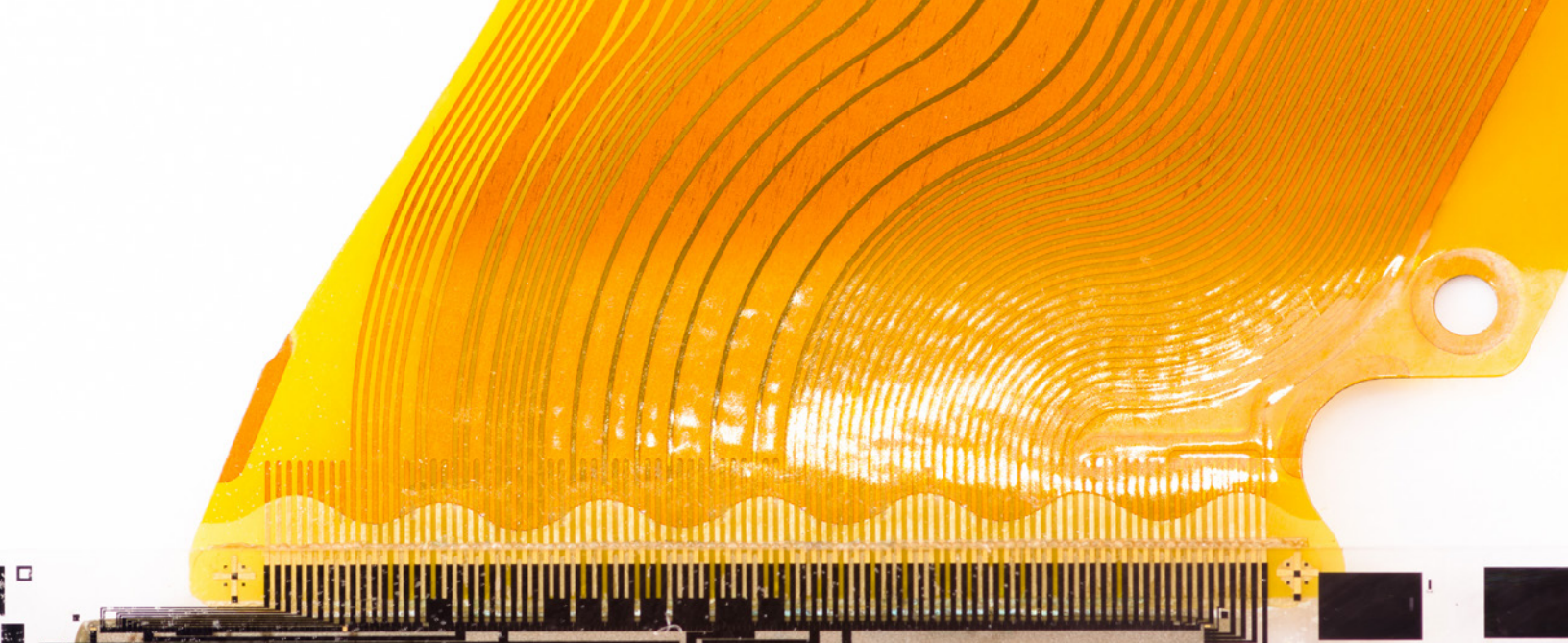
FUNCTIONAL MATERIALS

Critical to the function of any electrical device are the conductive materials that allow component interconnectivity. Henkel's line of high-performance solder pastes, electrically conductive adhesives and inks offers the processability, flexibility, product compatibility and low cost of ownership needed for wearable functionality and cost-effective production.



CONDUCTIVE ADHESIVES

PRODUCT	DESCRIPTION	CURE	VOLUME RESISTIVITY (Ω·cm)	STORAGE MODULUS at 25°C (MPa)
<i>LOCTITE ABLESTIK 2030SC</i>	Electrically conductive adhesive with a fast, low-temperature cure designed to minimize stress and resulting warpage between dissimilar surfaces. Good adhesion to inks and metals.	90 sec. at 110°C	0.0002	3,300
<i>LOCTITE ABLESTIK CA 3556HF</i>	Electrically conductive adhesive with a fast, low-temperature cure, good adhesion and excellent flexibility. Ideal for high throughput production processes and applications where high peel strength is desired.	120 sec. at 110°C	0.0025	650
<i>LOCTITE ABLESTIK CE 3103WLV</i>	Dispensable, electrically conductive epoxy adhesive with good adhesion to inks and metals.	10 min. at 120°C	0.0008	4,500
<i>LOCTITE ABLESTIK CE 3104WXL</i>	Printable, electrically conductive epoxy adhesive with good adhesion to inks and metals. Controlled particle sizes provide ultra-fine pitch resolution less than 500 µm.	8 min. at 125°C	0.0007	4,500



INKS

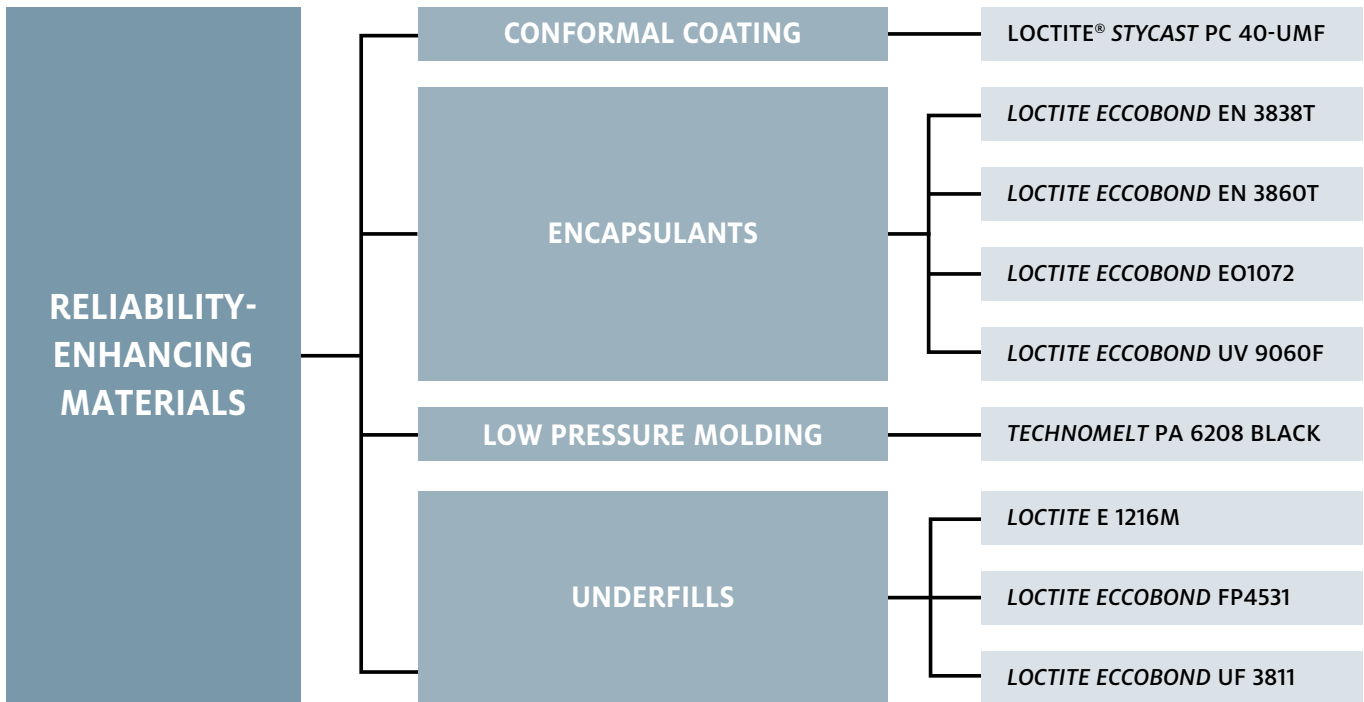
PRODUCT	DESCRIPTION	APPLICATIONS	SHEET RESISTANCE ($\Omega/\text{sq./25 } \mu\text{m}$)	CHEMISTRY	CONDUCTIVE MEDIUM
LOCTITE ECI 1006 E&C	Halogen-free, flexible, conductive, silver-filled, printable ink with fine line and high resolution printing capabilities ideal for tight spaces	<ul style="list-style-type: none"> • Touch screens • Flexible circuits 	< 0.030	Thermoplastic	Silver
LOCTITE ECI 1010/1011 E&C	Flexible, highly conductive, silver-filled, screen-printable ink with lower ink consumption.	<ul style="list-style-type: none"> • Flexible circuits 	< 0.005/0.007	Thermoplastic/ Vinyllic	Silver
LOCTITE ECI 7004LR E&C	Conductive, screen-printable ink specially designed for blending with LOCTITE NCI 7002 E&C to provide exceptional resistance in the production of low voltage circuitry on polyester film.	<ul style="list-style-type: none"> • Force-sensitive modules and sensing devices 	35	Thermoplastic	Carbon
LOCTITE ECI 8000 Series E&C	Positive Temperature Coefficient (PTC), flexible, conductive, screen-printable ink that functions as a self-regulating heater by heating rapidly and maintaining a constant temperature.	<ul style="list-style-type: none"> • Heating elements • Flexible circuits 	1,700	Thermoplastic	Carbon
LOCTITE EDAG PF 455B E&C	Non-conductive, translucent, flexible, printable ink with excellent humidity resistance and adhesion. Formulated as a crossover dielectric and compatible with other LOCTITE EDAG E&C inks.	<ul style="list-style-type: none"> • Flexible circuits • RFID • Biosensors 	> 2×10^9	Acrylate	N/A

SOLDER PASTES

PRODUCT	DESCRIPTION	ALLOY	PARTICLE SIZE DISTRIBUTION	IPC J-STD-004B CLASSIFICATION	OPTIMAL SHELF LIFE
LOCTITE GC 10	Halogen- and Pb-free, no-clean, RoHS-compliant solder paste with excellent resistance in high humidity. Industry leader in paste-transfer efficiency. Improved stability at different storage and operating temperatures, with extended stencil life up to 72 hours and extended abandon time up to 24 hours. Suitable for high-density, small to large boards.	SAC305	Type 3, 4, 4.5 (4A), 5	ROLO	12 months up to 26.5°C
LOCTITE HF 212	Halogen- and Pb-free, no-clean, high tack, low voiding, RoHS-compliant solder paste with excellent fine pitch coalescence. Designed for medium to large boards.	90iSC SAC0307 SAC305 SAC387	Type 3, 4, 4.5 (4A), 5	ROLO	6 months at 0 – 10°C
LOCTITE LM 100	Halogen- and Pb-free, no-clean, solder paste designed for use with low-temperature solder alloys. Formulated to provide excellent dispensability, printability and solderability through various reflow profiles.	Bi58	Type 2	ROLO	6 months at 0 – 10°C

RELIABILITY-ENHANCING MATERIALS

Wearable electronics demand a high degree of reliability and consistent repeatability. They need to survive challenging and varied environments, and maintain performance after being dropped, bent or exposed to water or other fluids. Exceptional moisture, shock, drop and vibration protection is why today's top wearables manufacturers rely on Henkel. With award-winning underfills, encapsulants, conformal coatings and TECHNOMELT® low pressure molding materials, Henkel provides the reliability wearable devices require for consistent performance and long life cycles.



CONFORMAL COATING

PRODUCT	DESCRIPTION	BENEFITS	VISCOSITY at 25°C (cP)	CURE METHODS	STORAGE MODULUS at 25°C (MPa)	WVTR* at 50°C/100% RH (mg/m ² ·day)
LOCTITE STYCAST PC 40-UMF	Low-viscosity liquid polymer applied by spray or dip allowing for a uniform thin coating. Cured coating protects PCBs from impact of harsh environments such as high humidity, chemical exposure and thermal shock.	<ul style="list-style-type: none"> • Easily sprayed • Fast UV cure • Moisture cure for shadowed areas • Improved fluorescence for inspection • Halogen-free 	250 – 500	UV and moisture	1,929	< 30

ENCAPSULANTS

PRODUCT	DESCRIPTION	BENEFITS	CURE	DEPTH OF CURE	VISCOSITY at 25°C (cP)	GLASS TRANSITION TEMPERATURE, T _g (°C)	STORAGE MODULUS at 25°C (MPa)
LOCTITE ECCOBOND EN 3838T	Low T _g thermal cure encapsulant that provides physical protection for electronic components.	<ul style="list-style-type: none"> Reworkable Flexible / low modulus One component Fast cure 	> 8 min. at 130°C	N/A	6,700	2	550
LOCTITE ECCOBOND EN 3860T	CSP/BGA thermal cure encapsulant formulated to have low viscosity and good flow performance. Achieves waterproof capabilities in connector applications.	<ul style="list-style-type: none"> Halogen-free Fast cure Good flexibility and high elongation 2x Pb-free reflow without leakage 	10 min. at 130°C or 5 min. at 150°C	N/A	1,000	82	1,230
LOCTITE ECCOBOND EO1072	Thermal cure encapsulant that provides physical protection for connectors and sensitive components in handheld devices.	<ul style="list-style-type: none"> High T_g Low extractable ionics High performance Good shelf life Fast cure 	5 min. at 150°C	N/A	80,000	135	6,700
LOCTITE ECCOBOND UV 9060F	UV/Moisture-cure encapsulant that provides protection by coating selective components.	<ul style="list-style-type: none"> Halogen-free Fast cure One component Cures in shadowed areas 	25 sec. at 500 mW/cm ² (365 nm)	> 0.25 in.	11,000	75	2,200

LOW PRESSURE MOLDING

PRODUCT	DESCRIPTION	BENEFITS	COLOR	PERFORMANCE TEMPERATURE	SHORE HARDNESS
TECHNOMELT PA 6208 BLACK	Moldable polyamide that provides full encapsulation of electronics and protection from harsh environments. Its fast and easy process requires no mixing and improves throughput. Ideal for encapsulation of heat-producing components in appliances and consumer electronics.	<ul style="list-style-type: none"> Good adhesion to PCB surfaces and metal traces Excellent flexibility Provides electrical insulation Low viscosity Excellent moisture and environmental seal 	Black	-40°C to 130°C	78A

UNDERFILLS

PRODUCT	DESCRIPTION	BENEFITS	VISCOSITY at 25°C (cP)	POT LIFE at 25°C (days)	GLASS TRANSITION TEMPERATURE, T _g (°C)	COEFFICIENT OF THERMAL EXPANSION (ppm/°C)	CURE
LOCTITE E 1216M	Non-reworkable, high-reliability underfill.	<ul style="list-style-type: none"> RoHS compliant Under 900 ppm total halogens Excellent thermal cycle performance Excellent drop impact performance 	4,000	3	125	35	10 min. at 130°C
LOCTITE ECCOBOND FP4531	Underfill for CSP and flip-chip on flex circuits.	<ul style="list-style-type: none"> High T_g Very low CTE Fast cure 	10,000	1	161	28	7 min. at 160°C
LOCTITE ECCOBOND UF 3811	Flexible, high T _g , reworkable underfill.	<ul style="list-style-type: none"> Room-temperature flow capability Halogen-free Good thermal cycling reliability Excellent drop impact performance 	350	3	124	61	10 min. at 130°C

MATERIALS FOR USER INTERFACES

From LCD to LED and the emerging OLED, there are numerous types of displays, or user interfaces, and each has its own unique manufacturing requirements. Not only has Henkel formulated some of the industry's most promising OLED sealants and FPC reinforcement materials, it has also invested in and partnered with leading developers of next-generation display technologies to help accelerate display advances.



DISPLAY ADHESIVES

PRODUCT NAME	DESCRIPTION	CURE	VISCOSITY at 25°C (cP)	GLASS TRANSITION TEMPERATURE, T _g (°C)	WVTR* (g/m ² ·day)	PEEL STRENGTH (N/mm)
FPC Reinforcement Materials						
LOCTITE ECCOBOND DS 3318LV	Transparent, one-component, UV-curable acrylic adhesive with high flexibility and good moisture resistance. Suitable for enhancement of flexible printed circuits.	800 mJ/cm ² (LED Cure)	968	64	325.5 (at 25.4 µm thick and 50°C/100% RH)	2.89 (PI film to FPC-reinforced glass)
Moisture Barrier Sealants						
LOCTITE ECCOBOND DS 7405UV	One-component, acrylate adhesive designed for use as an OLED sealant. Light yellow paste is transparent after UV cure and has low modulus, low warpage and low stress.	≥ 6,000 mJ/cm ²	25,000	-38	53 (at 200 µm thick and 60°C/90% RH)	3.4 (glass to glass)
LOCTITE ECCOBOND DS 8027LV	Translucent, non-conductive, UV-curable epoxy perimeter sealant for OLED displays with good dispensability and excellent permeation resistance to water vapor.	7,500 mJ/cm ²	84,000	160	51.15 (at 25.4 µm thick and 50°C/100% RH)	–

* WVTR: Water Vapor Transmission Rate

MATERIALS FOR STRUCTURAL INTEGRITY

Since the infancy of wearables, Henkel has worked closely with the market's top manufacturers, lending process and design expertise, along with a total solutions approach. In fact, our structural adhesives can be found in multiple wearables applications – and for good reason. The Henkel portfolio of structural adhesives provides manufacturing flexibility with a range of different chemistries to accommodate specific process requirements, addressing numerous applications including bonding of the front cover, magnet, housing, belt to housing and sensor, among others.



MATERIALS FOR STRUCTURAL INTEGRITY

STRUCTURAL ADHESIVES

LOCTITE HHD 3542

LOCTITE HHD 6305

LOCTITE HHD 8190R

STRUCTURAL ADHESIVES

PRODUCT	DESCRIPTION	OPEN TIME (minutes)	TENSILE STRENGTH (MPa)	TENSILE MODULUS (MPa)	SHEAR STRENGTH ANODIZED Al (MPa)
LOCTITE HHD 3542	One-component polyurethane hot-melt adhesive that provides a strong bond and shock and impact resistance. Very effective on metal, ink-coated glass and engineered plastics.	< 4	> 8	91	7.2
LOCTITE HHD 6305	Halogen-free, two-part polyurethane adhesive with a fast fixture that bonds a wide variety of materials, including most metals, plastics and composites. Exhibits excellent impact and shear strength, moisture resistance and flexibility.	5 – 6	17.83	587	4.6
LOCTITE HHD 8190R	Two-part acrylic adhesive with a fast cure and excellent moisture resistance. Cured bond has consistent strength over a wide range of temperature and excellent adhesion to multiple substrates, including metals and composites.	3 – 7	23	1150	15

AMERICAS

UNITED STATES

Henkel Corporation
14000 Jamboree Road
Irvine, CA 92606
United States
Tel: +1.888.943.6535
Fax: +1.714.368.2265

Henkel Corporation
20021 Susana Road
Rancho Dominguez, CA 90221
United States
Tel: +1.310.764.4600
Fax: +1.310.605.2274

Henkel Corporation
18930 W. 78th Street
Chanhassen, MN 55317
United States
Tel: +1.952.835.2322
Tel: +1.800.347.4572
Fax: +1.952.835.0430

BRAZIL

Henkel Brazil
Av. Prof. Vernon Kriebel, 91
06690-070 Itapevi, Sao Paulo
Brazil
Tel: +55.11.3205.7001
Fax: +55.11.3205.7100

ASIA-PACIFIC

CHINA

Henkel Management Center
Building 7, No. 99 Jiang Wan Cheng Road
Shanghai 200438,
China
Tel: +86.21.2891.8000
Fax: +86.21.2891.8952

ABLESTIK (Shanghai) LIMITED
No. 332 Meigui South Road
WaiGaoQiao Free Trade Zone, Pu Dong
Shanghai 200131,
China
Tel: +86.21.2702.5888
Fax: +86.21.5048.4169

JAPAN

Henkel Japan Ltd.
27-7, Shin Isogo-cho
Isogo-ku Yokohama, 235-0017
Japan
Tel: +81.45.286.0161
Email: jp.ae-csdesk@henkel.com

KOREA

Henkel Korea Co., Ltd.
18th Floor of tower B, BYC High City Bldg
Gasan Digital 1-ro, Geumcheon-gu,
Seoul, 08506
South Korea
Tel: +82.2.6150.3000
Fax: +82.2.6947.5203

SINGAPORE

Henkel Singapore Pte Ltd.
401, Commonwealth Drive
#03-01/02 Haw Par Technocentre,
Singapore 149598
Tel: +65.6266.0100
Fax: +65.6472.8738 / +65.6266.1161

TAIWAN

Henkel Taiwan Ltd.
10F, No. 866, Zhongzheng Road,
Zhonghe District, New Taipei City, 23586
Taiwan
Tel: +866.2.2227.1988
Fax: +866.2.2226.8699

EUROPE

BELGIUM

Henkel Belgium N.V.
Nijverheidsstraat 7
B-2260 Westerlo
Belgium
Tel: +32.1457.5611
Fax: +32.1458.5530

UNITED KINGDOM

Henkel Ltd.
Adhesives Limited Technologies House
Wood Lane End
Hemel Hempstead
Hertfordshire HP2 4RQ
United Kingdom
Tel: +44.1442.278000
Fax: +44.1442.278071

Across the Board, 
Around the Globe.
henkel-adhesives.com/electronics