

DuPont™ Liveo™ Soft Skin Conductive Tape 1-3150

Skin electrode technology enabling improved outpatient monitoring and physicians' diagnostic yield

Outpatient monitoring is becoming increasingly relevant for preventive care, diagnostics and therapeutic treatments requiring long-term tracking of specific biosignals, such as ECG, EEG and EMG. Medical devices that integrate such biosensors are emerging for prophylactic and therapeutic healthcare and are expected to grow at a rate of 15% to 20% per year.

Due to their alignment with patients' expectations in terms of comfort and discretion, smart skin patches are being used increasingly, especially in the cases of continuous glucose-monitoring and cardiac-monitoring applications driven by trends such as population aging, cardiovascular diseases and obesity.

Currently available sensor technologies, such as Hydrogel-Ag/AgCl electrodes, present some limitations and are less successful in meeting key industry needs in terms of patient comfort and compliance for long wear time. As a result, a new generation of conductive interface materials is entering the smart wearables market.

Addressing market requirements and overcoming current technology limitations

Hydrogel-Ag/AgCl electrodes have been the standard technologies developed for commodity single or snap electrodes used in short-term monitoring (i.e., a few hours). For longer-term wear, acrylic PSAs have dominated the fixation of the patch to patient skin. However, these technologies represent shortfalls that the industry is searching to overcome for better patient outcomes and comfort.

Wear time and signal quality: As most hydrogels are water-based, they are likely to dry out after a few hours or days on the skin. This can result in a negative impact on the biosignal quality, as the interface to the skin will deteriorate. *The industry is looking to develop long-wear patches for remote monitoring and treatment of patients while ensuring high data quality over the expected wear time.*



Effects on patient skin: Skin irritation is an oft-reported issue that is detrimental to patient compliance. Some researchers have found that dermatological complications were present in one in every three patients due to irritation from sweating, occlusion, etc. under the adhesive and represent a significant challenge to using continuous subcutaneous insulin infusion (CSII) and continuous glucose monitoring (CGM) to treat adults with Type 1 diabetes.¹ This can be due to the chemical nature of the adhesive and electrode, which can contain skin-irritating substances, especially when occluded (e.g., residual monomers and additives). *The industry is looking for technology that is biocompatible and non-irritating to the skin.*

Patient comfort and feel: Patients do not like a sticky and wet feeling on their skin, especially for longer periods of time. Residues also tend to remain on skin, which is unpleasant and jeopardizes patients' compliance with monitoring or treatment. *Patients are looking for a skinlike solution that they can forget about, with miniaturized, conformal and flexible sensing technologies.*

Shelf life and packaging: To prevent water evaporation and unexpected drying, hydrogel electrodes are protected in expensive aluminum-based multilayer packaging to ensure a multiple-month shelf life when unopened. Once nurses open the pouches containing several electrodes, the shelf life of the product often is limited to a couple of days. This can result in significant waste if the full pack cannot be utilized. *The industry is looking for a more sustainable technology that can be packaged cost-effectively and stored outside of its packaging for a longer time.*

¹*Skin Problems Associated with Insulin Pumps and Sensors in Adults with Type 1 Diabetes: A Cross-Sectional Study.* Anna Korsgaard Berg, Kirsten Nørgaard, Jacob P. Thyssen, Claus Zachariae, Eva Hommel, Karen Rytter, and Jannet Svensson. July 2018. <https://doi.org/10.1089/dia.2018.0088>

Innovative skin electrode technology from DuPont™ Liveo™

Based on market feedback, DuPont developed DuPont™ Liveo™ Soft Skin Conductive Tape 1-3150, which enables long-term patient monitoring with stable data quality and high patient comfort.

Liveo™ Soft Skin Conductive Tape 1-3150 is a highly conformable, electrically conductive silicone-based thermoset adhesive tape with tunable width and thickness ranging from 150 µm to 200 µm.

Benefits

Liveo™ Soft Skin Conductive Tape 1-3150 is intended to be used as a skin interface electrode for electric biosignal-monitoring that requires good skin conformability, no drying over time, and repositionability with gentle adhesion and atraumatic removal. It can be used in single electrodes for short-term monitoring and is best suited in medical wearable patches for long-term monitoring (i.e., seven days or longer).

High signal quality

Benchmark patient-monitoring data conducted by the Holst Centre, including patient ECG and evaluation of comfort for five days, is available upon request.

Liveo™ Soft Skin Conductive Tape 1-3150 shows:

- More robust ECG signal quality than benchmark gel electrode, even with induced motion simulations
- Good ECG signal at T0; settling time similar to gel electrodes (0 minutes) without severe skin preparation
- Consistent low electrode-to-electrode impedance (<50 ohms) at variable electrode thickness and surface area
- Electrode-to-skin impedance similar to hydrogels
- Stable electrical properties (e.g., impedance, Ansi, ECG quality) in dry conditions (65°C, 15% RH)

Liveo™ Soft Skin Conductive Tape technology also offers resistive electrical conductivity. Resistive electrodes are far more reliable than capacitive electrodes, as capacitive electrodes are much more prone to noise, motion and muscle artifacts. Though capacitive electrodes might be useful in ambulatory/patient applications where the subject is lying down and remaining still most of the time, it is very difficult to use them in wearables, patches and long-term measurements.

Durable, stable and gentle

Thanks to DuPont's formulation expertise, Liveo™ Soft Skin Conductive Tape technology combines the key benefits of silicone technology with electrically conductive properties for electrical biosignal sensing and transfer:

- As a silicone-based thermoset adhesive with electrical conductivity, it brings the gentleness of silicone soft skin adhesives, which are ideal for all kinds of skin profiles – especially for the most sensitive skin (e.g., babies and the elderly).
- It exhibits good conformability to the skin, creating an optimized interface and ensuring high-quality biosignal sensing.
- As an inert technology in the conditions of use of an electrode, its performance will be stable, regardless of the environment. Patients can lead a normal life, as the tape is resistant to water and perspiration, and it adapts to body stretches. It also can be removed and repositioned.
- It leverages the benefits of silicone thermoset adhesives: It will be stable over several months to years and does not require expensive packaging to ensure improved shelf life of 12 months. These definitively key aspects will speak to sustainability-conscious citizens and organizations.

Safe and compliant

As a healthcare pure player for the past 70 years, DuPont™ Liveo™ has a track record of developing and commercializing pharmaceutical-grade and medical-grade solutions suited for the strict quality and regulatory requirements of the healthcare industry.

Continuing that tradition of safety and compliance, Liveo™ Soft Skin Conductive Tape 1-3150 is:

- Tested according to ISO 10993-10, ISO 10993-23, (ISO 10993 – 11)
- Compliant with ANSI/AAMI EC 12
- Manufactured at an ISO 9001 site

Processability and application



As an elastomeric adhesive, DuPont™ Liveo™ Soft Skin Conductive Tape 1-3150 should be used in thickness ranging from 100 µm to 200 µm, which is substantially lower than hydrogels and therefore compatible with a roll-to-roll lamination process as well as transfer-coating. It is suitable for laser- or die-cutting.

Liveo™ Soft Skin Conductive Tape 1-3150 is available as a rollstock of 3 cm wide coating at a thickness of 150 µm. Tape dimensions and shape can be adapted to customer requirements.

It utilizes lower-cost packaging (no multilayer occlusive pouch required), both as a rollstock and as a final patch.

DuPont™ Liveo™ Soft Skin Conductive Tape 1-3150 was successfully tested on the following substrates:

- Polyurethane films
- Electrically conductive silver ink, Ag/AgCl (does not require Ag/AgCl print and has good anchorage on silver prints)
- DuPont™ Liveo™ Silicone Membrane
- DuPont™ Kapton® Polyimide Films and DuPont™ Pyralux® Laminates
- Several liners, including polyester, polypropylene and Teflon™

In terms of skin preparation, only a light hydration of the skin with water through a wipe is recommended to increase the immediate skin contact and ensure the best conductivity at T0.

Intended uses

Liveo™ Soft Skin Conductive Tape 1-3150 is intended to be used for a wide range of electrical biosignals for patient diagnosis and monitoring, including:

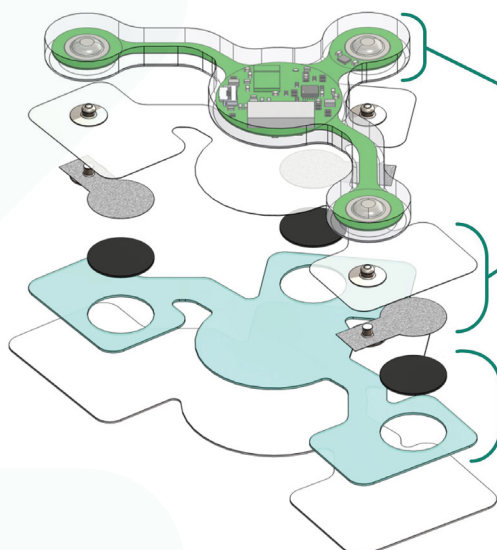
- ECG – Atrial fibrillation (AF) diagnosis
- EEG – Sleep monitoring; epilepsy monitoring
- EMG – Muscle stimulation; rehabilitation
- Monitoring of clinical trials

DuPont™ Liveo™ Healthcare Solutions has even collaborated with global semiconductor company STMicroelectronics and the DuPont Silicon Valley Technology Center to develop a biosensing patch prototype that includes the latest technologies from both STMicroelectronics and DuPont to enable higher-quality data for ECG and SCG.

The DuPont toolbox for wearable medical devices

DuPont™ Liveo™ and other DuPont brands provide a portfolio of commercial solutions to address new medical wearables design opportunities.

Available DuPont technologies for wearable patch applications



Smart, flexible electronic board with:

- DuPont™ Liveo™ MDX4-4210 BioMedical Grade Elastomer for silicone encapsulant
- DuPont™ Pyralux® and DuPont™ Kapton® Polyimide Films and Laminates for board substrate

Flexible substrate with silver conductive ink and attached snap connectors

Gentle medical-grade silicone skin interface with:

- DuPont™ Liveo™ Soft Skin Conductive Tape 1-3150
- DuPont™ Liveo™ MG 7-9960 Silicone Soft Skin Adhesive

About DuPont™ Liveo™ Healthcare Solutions

DuPont™ Liveo™ is a globally recognized leader in technology for a broad range of innovations in medical devices, biopharmaceutical processing and pharmaceutical solutions. DuPont high-performance materials help create safer healthcare environments and protect the health of patients and healthcare providers worldwide. We help enable smarter healthcare and positive patient outcomes.

For more information about Liveo™ solutions for smart wearable devices

Visit liveo.dupont.com – or scan the QR code at right to be taken directly to our wearable medical device solutions web page, where you'll find details on the full portfolio of Liveo™ Silicone Skin Adhesives and Liveo™ Silicone Elastomers.



To learn more about DuPont™ Liveo™ Healthcare Solutions, visit liveo.dupont.com.



Smarter Healthcare.
Positive Patient Outcomes.

DuPont™, the DuPont Oval Logo, and all trademarks and service marks denoted with ™, SM or ® are owned by affiliates of DuPont de Nemours, Inc. unless otherwise noted. Teflon™ is a trademark of The Chemours Company FC, LLC.
© 2023 DuPont.

The information set forth herein is furnished free of charge and is based on technical data that DuPont believes to be reliable and falls within the normal range of properties. It is intended for use by persons having technical skill, at their own discretion and risk. This data should not be used to establish specification limits nor used alone as the basis of design. Handling precaution information is given with the understanding that those using it will satisfy themselves that their particular conditions of use present no health or safety hazards. Since conditions of product use and disposal are outside our control, we make no warranties, express or implied, and assume no liability in connection with any use of this information. As with any product, evaluation under end use conditions prior to specification is essential. Nothing herein is to be taken as a license to operate or a recommendation to infringe on patents.

Caution: Do not use DuPont materials in medical applications involving implantation in the human body or contact with internal body fluids or tissues unless the material has been provided from DuPont under a written contract that is consistent with DuPont policy regarding medical applications and expressly acknowledges the contemplated use. The customer is solely responsible to determine whether DuPont products are suited for customer's intended purpose or application and may contact DuPont technical experts for more product details prior to sourcing products. DuPont disclaims liability for any incidental or consequential damages resulting from customer's use of DuPont products. For further information, please contact your DuPont representative. You may also request a copy of DuPont POLICY Regarding Medical Applications H-50103-4 and DuPont CAUTION Regarding Medical Applications H-50102-4.