Decorative and Functional Surface Printing of TPO Interiors

Jeremy Husic
Staff Engineer, Advanced Development Group

Roman Quintal
Process Development Engineer, Advanced Development Group

SPE TPO Global Automotive Conference
Oct 1, 2025

Inteva at a Glance

100+
Customers

Inteva has a true global presence and reach, with engineering and production capabilities across the Americas, Asia and Europe.

30
Global Sites

From our headquarters in Troy - Michigan, we operate
30 global facilities.

9000+
Employees

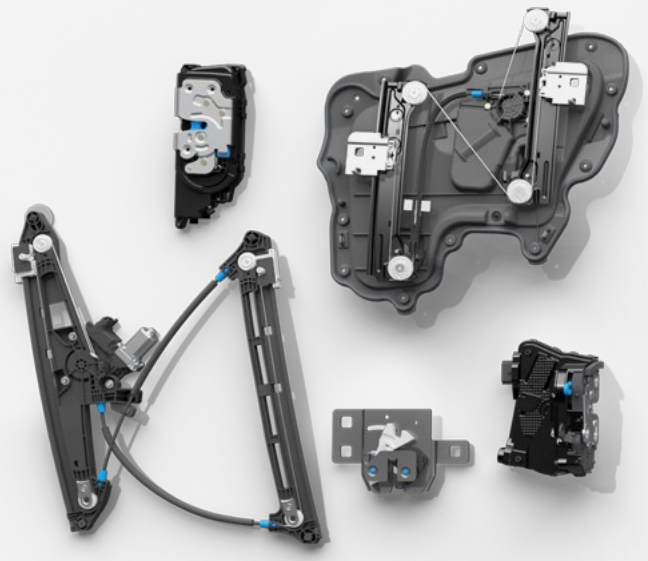
Our global team shares one common vision: ensuring that customers and partners recognize Inteva as a global leading company in innovation, sustainability, and products that enhance the consumer experience.

3
Areas of Excellence

Inteva combines a culture of continuous improvement with our advanced expertise in Interior Systems, Closure Systems, and Motors & Electronics to provide world-class solutions to customer needs.

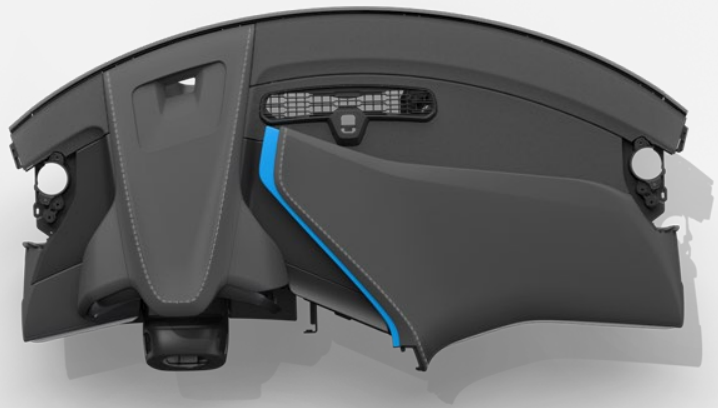
INTEVA PRODUCTS

Products



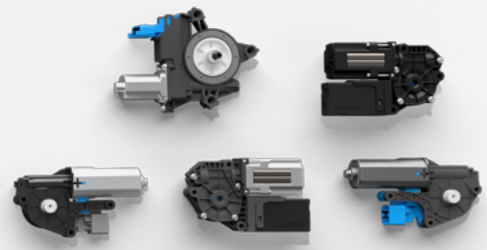
Closure Systems

- Latching Systems
- Window Regulators
- Door Modules
- Smart Actuators
- Smooth Motion Systems
- Actuators and Strikers (KDS JV)



Interior Systems

- Instrument Panels, Door Trim, Floor Consoles
- Cockpit Assembly
- Inteather™ Materials
- InStitch™ Technology
- Smart Soft Surfaces
- Electronics for Touch Sensing and Lighting



Motors & Electronics

- Window Motors
- Sunroof Motors
- Electronics

INTEVA™ PRODUCTS

5 Pillars of Technology

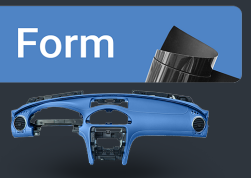
Interior Systems

Inteather™

Family of Olefin-Based Materials

Foam

Form

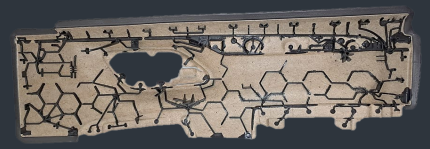


Cast

Wrap

InLite™

Lightweighting Technology



Soft Clad Nonwoven One-Step

NFPP for Circularity

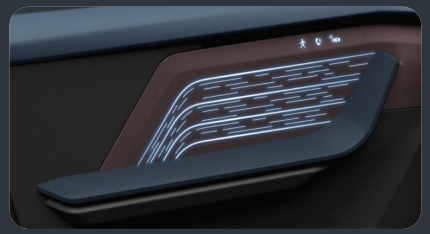
InTouch™

Smart Soft Surfaces

Smart Surfaces

Illuminated Stitching

Hidden Front TPO

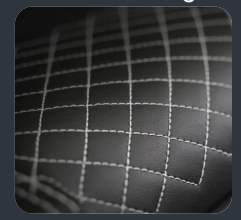


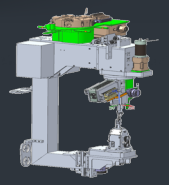
InStitch™

Robotic Sewing Technology

360° Turning Head

Robotic Quilting



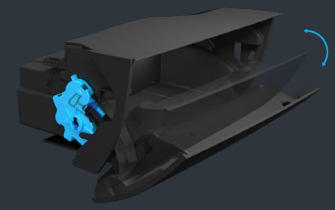


Stitch-Through IMGL

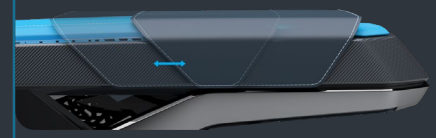
InMotion™

Smooth Motion Systems

E-Glove Box



Sliding Armrest



E-Table

INTEVA

InTouch™

Inteva's Solution for Intelligent Interiors

Decorative Lighting

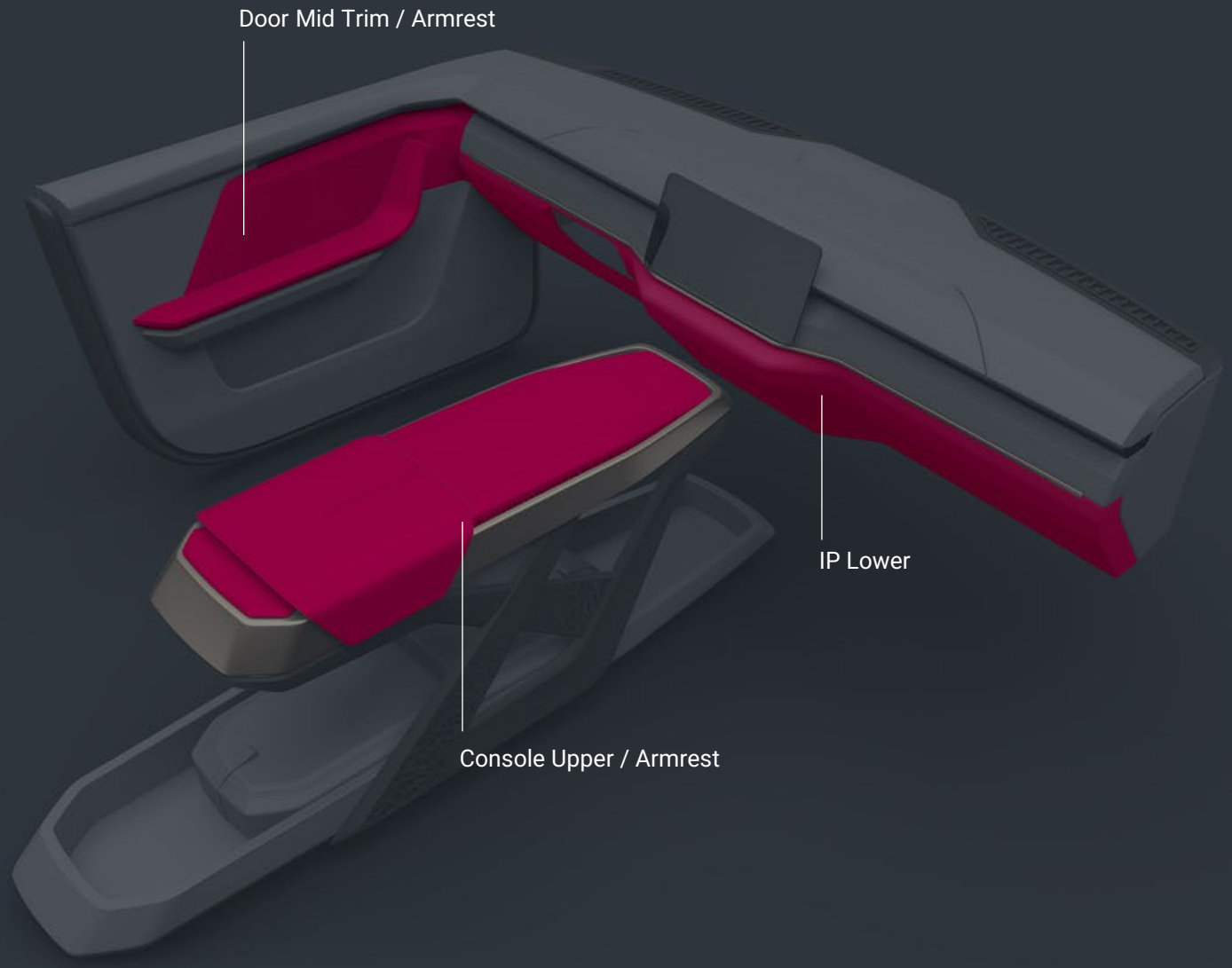
- Backlit Logos, Patterns, and Styling Features

Lighting with Sensing / Touch

- Smart Surface Touch Controls Behind Décor Materials

Lighting with Heating

- Heated Trim Panels with Integrated Lighting
- Radiant Heating



INTEVA

Printing on TPO

Technology Overview

- **Description**
  - Printing is a requirement for most Smart Surface and advanced lighting applications. Printing can add the necessary graphics & electronics where they are needed within the trim stack up. TPO is one of the décor materials covering Smart Surfaces.

- **Value & Benefits**
  - Decorative graphics can be added to almost any wrapping and thermoforming product.
  - Printing is a significant enabler to lighting and Smart Surface applications
  - Customer applications will have the best possible distinction of image for their new HMI applications.

- **Market Drivers & Relevance for Customers**
  - Smart surfaces are a definite trend
  - OEM's have shown interest in concepts that require screen printing or similar technologies.

Development Status

Concept	Development	Validation	SOP Ready	In Production
		10/2025		

Cost Impact

Favorable — Valuable

Degree of Innovation

Evolution — Revolution

Sustainability

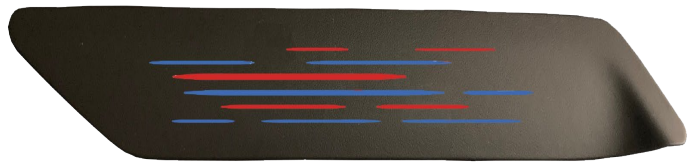
Negative — Positive

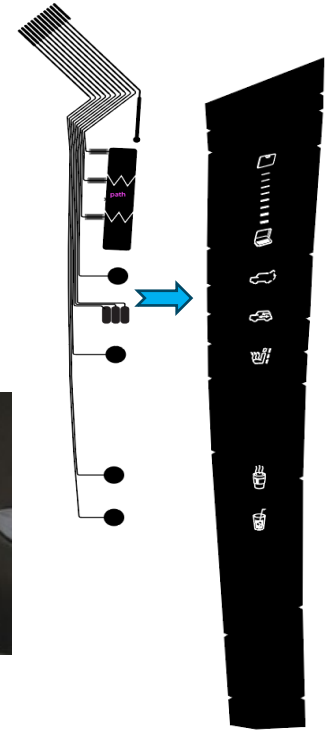
Relevance for Customer

Low — High

Intellectual Properties

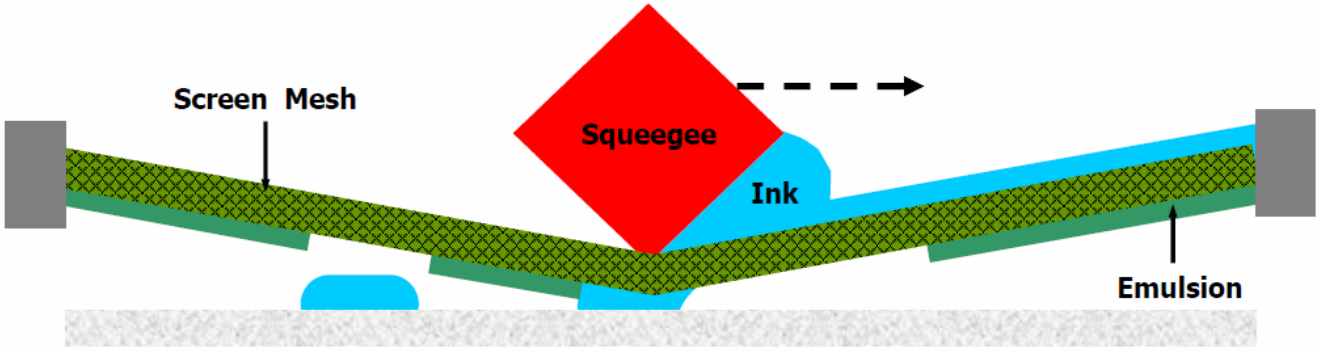
High Risk — Inteva Ownership





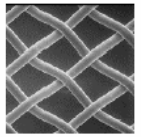
INTEVA PRODUCTS

Screen Printing

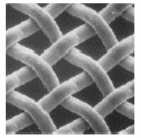


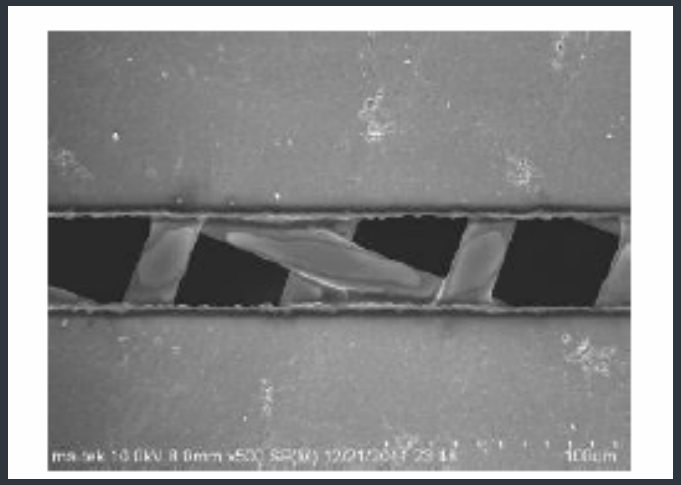
- Squeegee moves ink across & through screen mesh
- Emulsion defines & gaskets printed pattern
- Mesh count, wire diameter, & emulsion affect deposit

Fine Mesh



Coarse Mesh





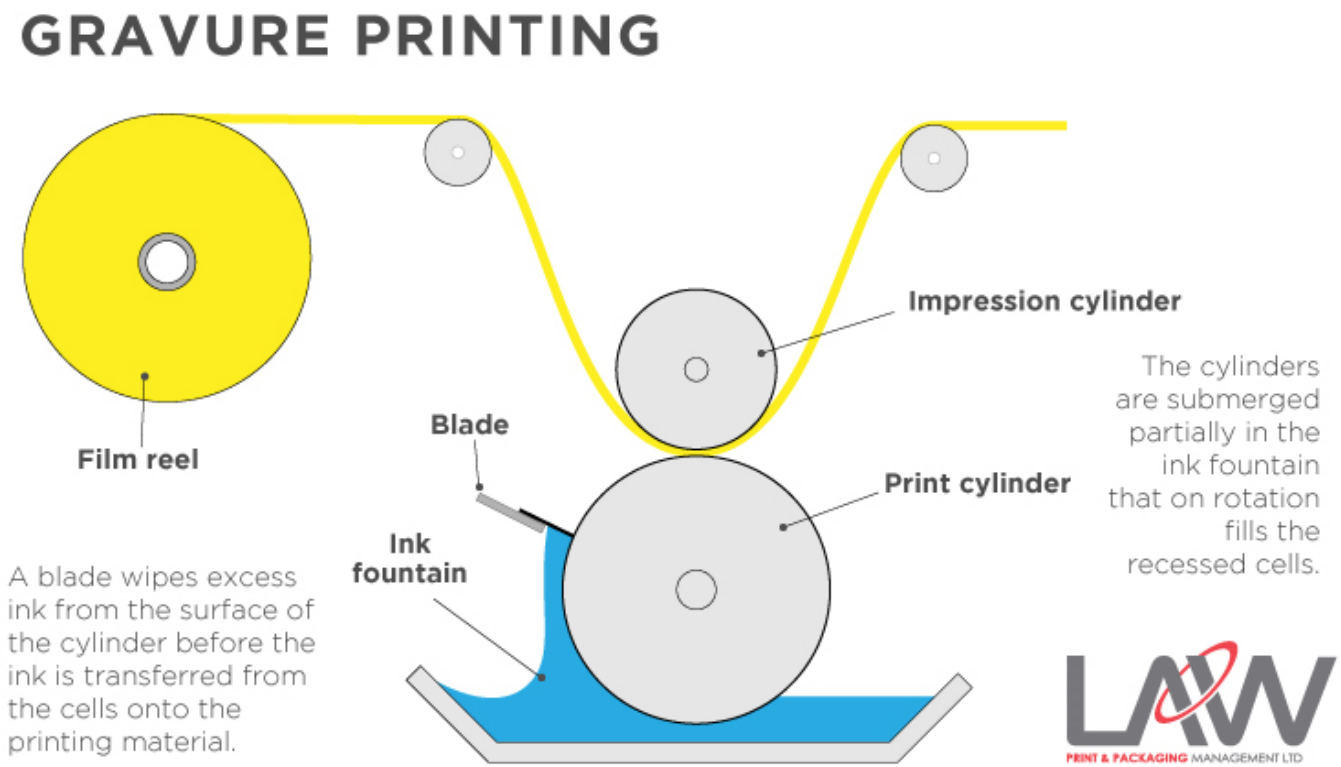
MICROMAX

INTEVA

Screen Printing

Demonstration

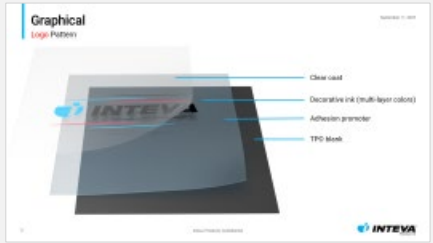
Gavure Printing



Printing Types

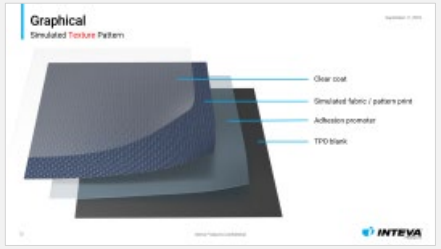
September 19, 2025

Graphical Printing (A Side)



Integration

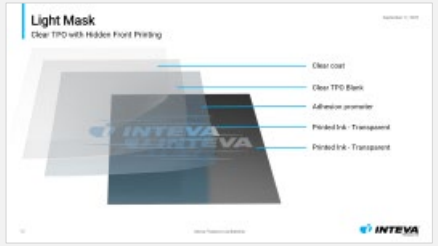
- Screen print
- Suitable for complex patterns
- Clear coat for protection



Integration

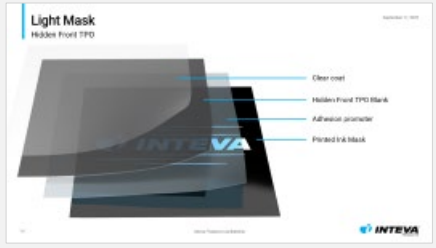
- Roto-graphic
- Roll coating of ink
- Use for repeating patterns
- Clear coat for protection

Light Mask Printing (B Side)



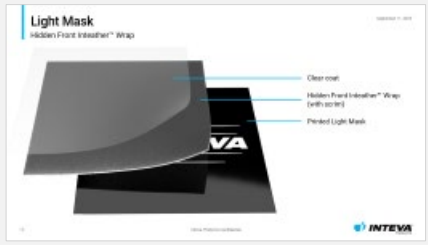
Integration

- Clear Substrate
- Translucent Ink
- Opaque Ink



Integration

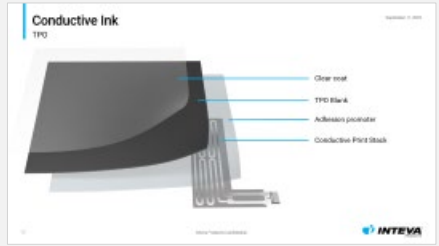
- Inteather Wrap
- Opaque Ink



Integration

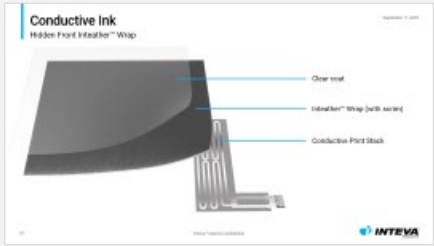
- Laminated Scrim
- Opaque Ink

Conductive Ink Printing (B Side)



Integration

- Conductive Ink Stack
- Functional
- TPO

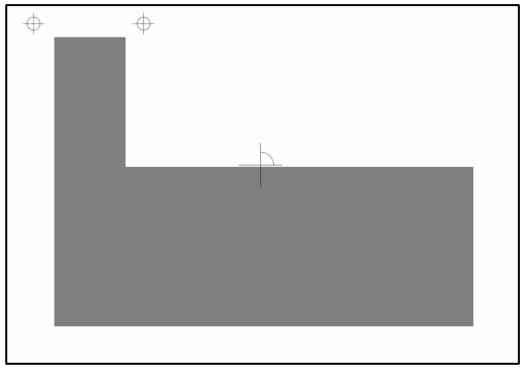


Integration

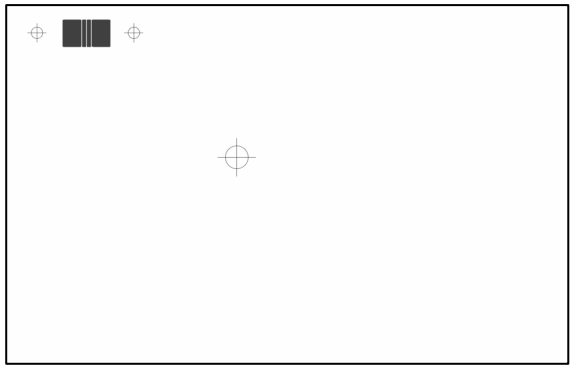
- Conductive Ink Stack
- Functional
- Inteather Wrap

Conductive Ink Stack

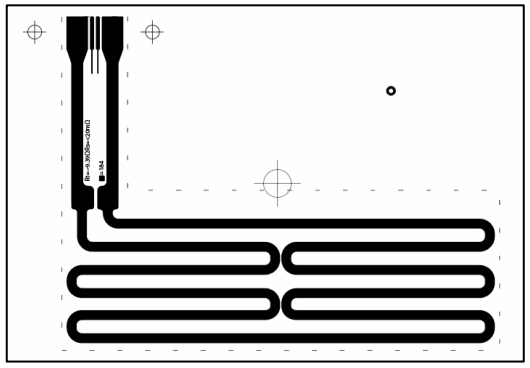
Layer Details



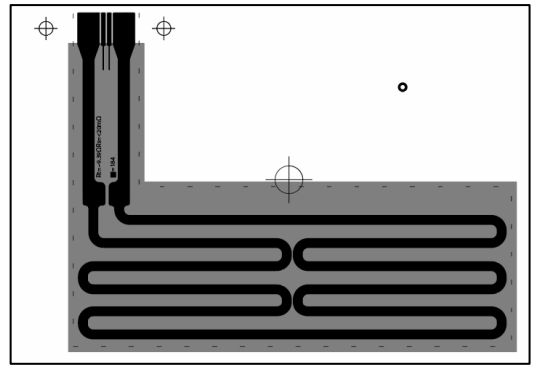
Layer 1: Dielectric



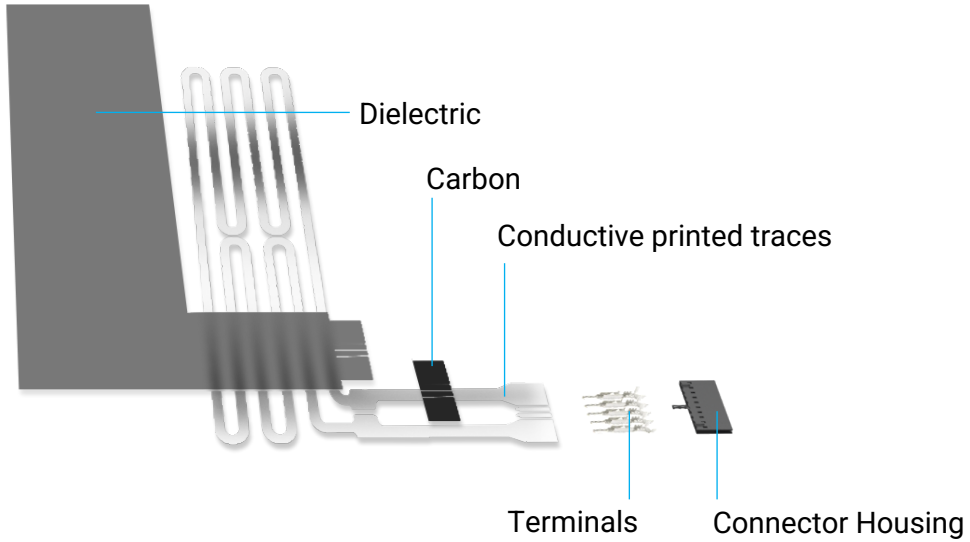
Layer 2: Carbon



Layer 3: Conductive



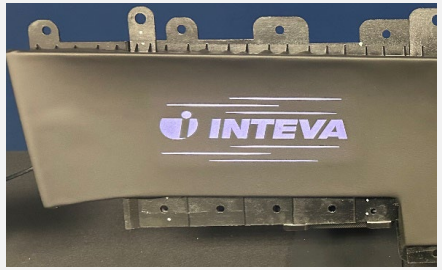
Final Stack up



Terminals Closeup

Constructions

Wrapping



Integration

- Graphics on A-surface
- Laminated Scrim
- Cut-Sew-Wrap

Thermoformed Bi-Laminate

Integration

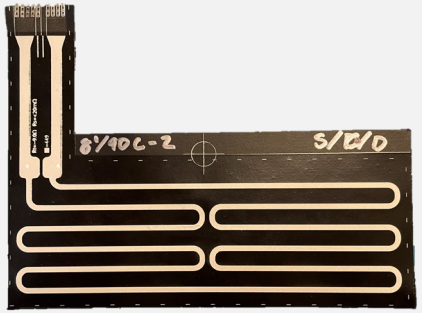
- Graphics on A-Surface
- Foam applied during extrusion

Thin Film Back Injection

Integration

- Graphics on A-Surface
- Heat film prior to back injection

Printed Heater



Integration

- Conductive on B-Side
- Heater Patten

Material Constructions Results

Quality test

- **Ink Application Strategy Based on Product Configuration**
  - Depending on the product design—such as hidden front panels or decorative graphics—ink may be applied to either the top or reverse side of the TPO substrate. Each surface presents distinct technical challenges:
- **Top-Side Applications**:
  - These require superior ink adhesion, along with high resistance to abrasion, chemical exposure, and environmental stressors such as UV radiation and temperature fluctuations.
- **Back-Side Applications**:
  - Since these are shielded from direct contact and environmental exposure, the primary performance criterion is the integrity of the ink-to-TPO bond.
- **Performance Validation – Hidden Front Material**
  - Initial laboratory evaluations of the hidden front material have yielded promising results across multiple test protocols:
  - **Cross Hatch Adhesion Test** – Pass
  - **Crocking Resistance Test** – Pass
  - **Chemical Resistance** – Acceptable performance under standard reagent exposure
  - **Xenon Arc Weathering Test** – 600 kJ exposure, no significant degradation observed
  - **Q-Cycle Environmental Simulation** – Completed
  - **Heat Aging Test** – Material maintained structural and visual integrity

Chemical resistance test
No visible discoloration

Cross hatch test
No visible transfer of ink

Printing Challenges

Lessons learned

- As every ink-paint application process there are challenges that needs to be assets and solve as needed so here there a few main lessons learned from the trials made during this project development

1. Incomplete Application

- This defect was influenced by multiple factors, making it particularly challenging for new applicators to manage. Key contributors included:
  - **Ink drying in the screen**
  - **High ink viscosity (too thick)**
  - **Misaligned squeegee**
  - **Insufficient squeegee pressure**

2. Layer-to-Layer Misalignment

- This visual defect was primarily caused by two critical factors:
  - **Inaccurate registration** – precise alignment between layers is essential.
  - **TPO material shrinkage** – occurs during the curing of the first ink layer due to heat exposure.

3. Lack of adhesion to TPO

- Material by itself or with corona treatment is not capable to hold the ink so an adhesion promoter was necessary to apply.

Thank You