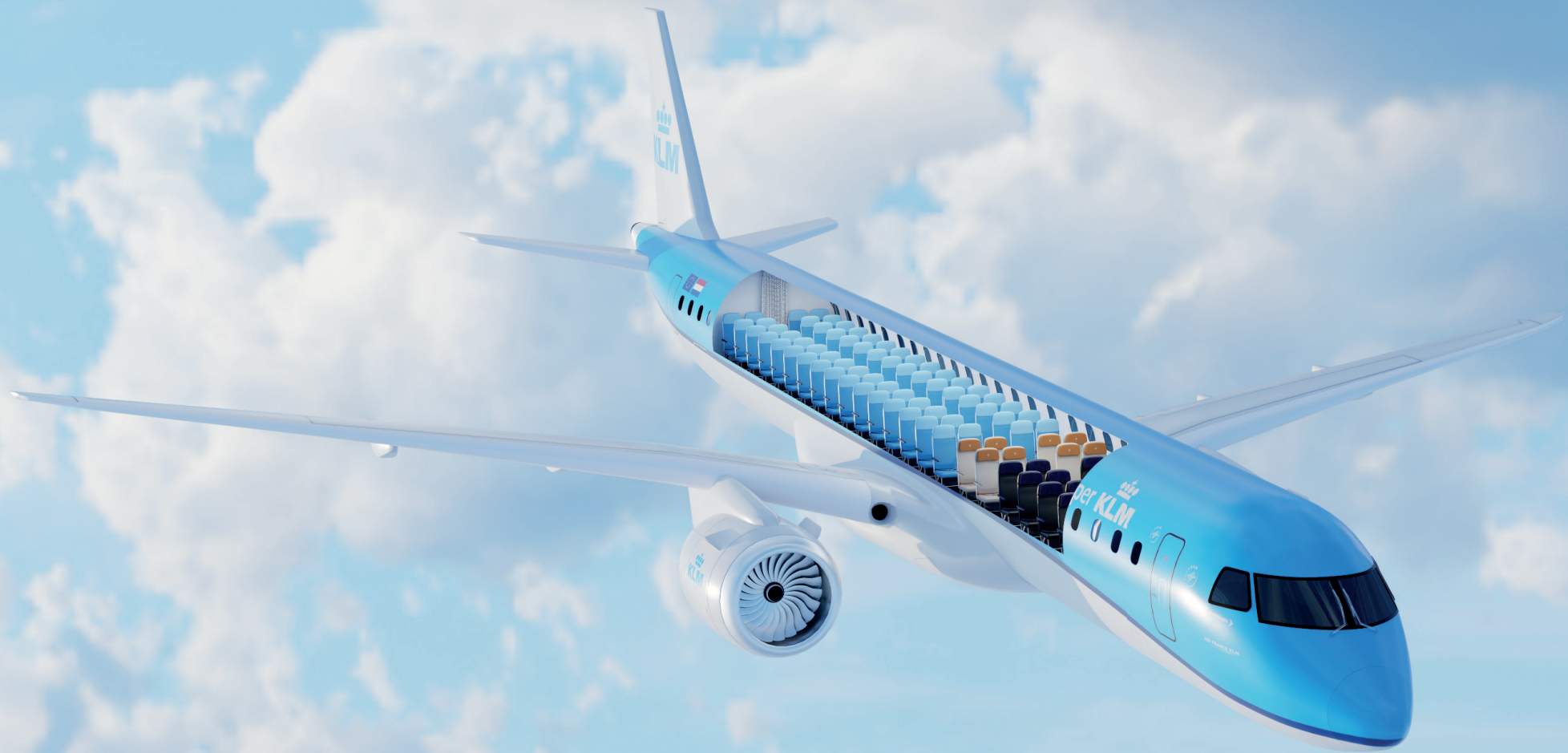


# CMF DESIGN BUILD BOOK

EMBRAER 195-E2 ✨ KLM CITYHOPPER



**VERA KLERKEN**

FACULTY OF INDUSTRIAL DESIGN ENGINEERING

DELFT UNIVERSITY OF TECHNOLOGY ✨ MSC THESIS BUILD BOOK ✨ 30/01/2026



**AUTHOR**

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TU Delft - Faculty of Industrial Design Engineering  
MSc Strategic Product Design

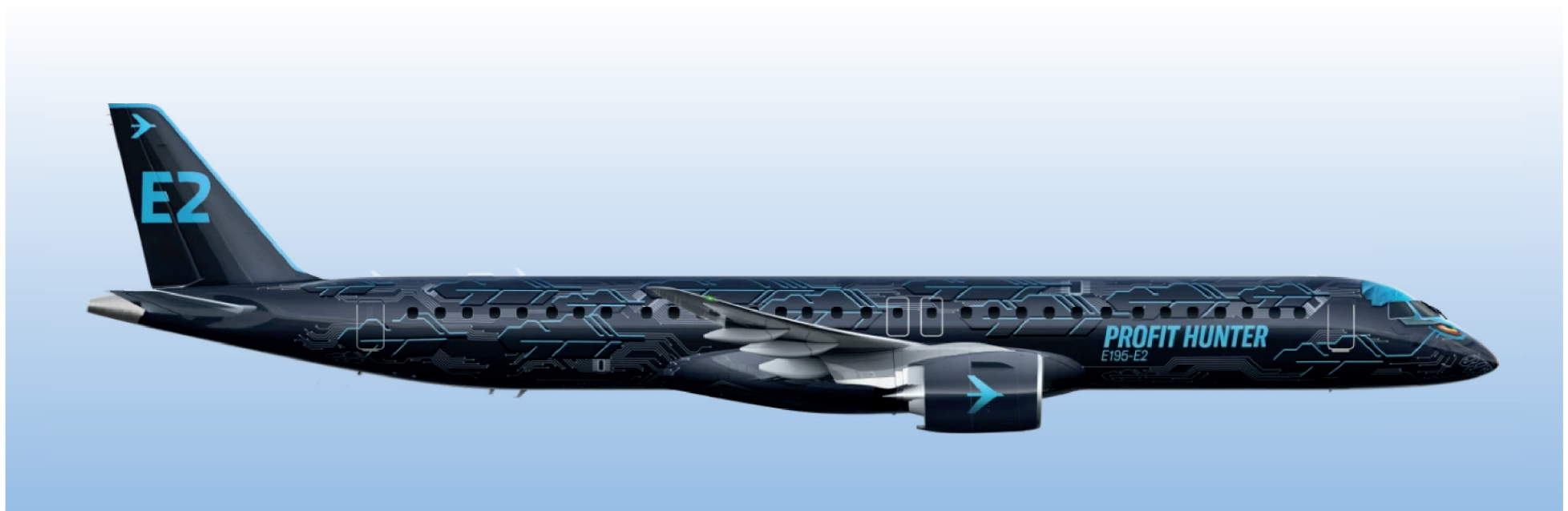
# EMBRAER 195-E2/KLM CITYHOPPER

The Embraer 195-E2 is the backbone of KLM Cityhopper's regional fleet, connecting Amsterdam Schiphol with cities across Europe. Operating in a high-frequency, short-haul network, the aircraft is characterized by fast turnaround times, high passenger throughput, and a strong focus on operational efficiency and sustainability.

KLM Cityhopper operates the E195-E2 in a three-class configuration: Economy, Economy Comfort, and Business Class. While the structural seat architecture is largely shared, each class communicates a distinct level of comfort, exclusiveness, and service.

This build book documents the CMF development of a mono-material seat concept based on bacterial cellulose, designed specifically for the Embraer 195-E2 cabin of KLM Cityhopper. The material strategy replaces conventional polyurethane foams with bacterial cellulose variants, enabling a reduction in environmental impact while introducing a new tactile and visual language across the three classes.

By structuring the CMF concept per class and per component, this build book serves as a translation between design vision and engineering integration. Ultimately, the book captures how the Embraer 195-E2 cabin can express KLM Cityhopper's values of clarity, care, and inclusivity through material choice.



## DELTA DISCOVERY

### Y-CLASS

Evoking the energy of shared exploration, rooted in Dutch openness, directness and movement. The name suggests both place and mindset, discovery as a collective journey. The design invites collectivity, clarity, curiosity, and a humble sense of freedom.



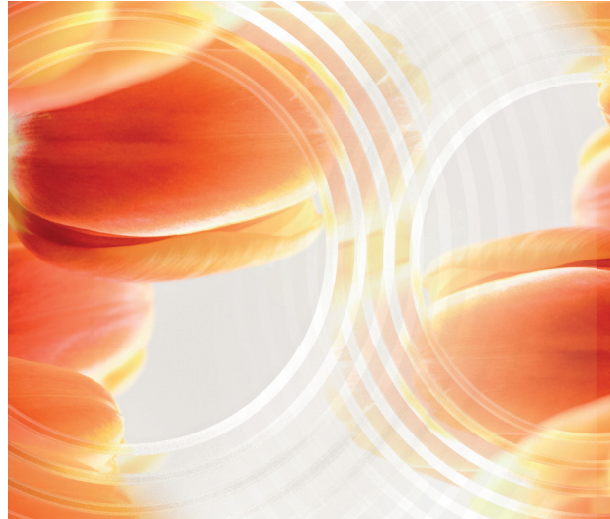
"PLAYFUL MIXING"



## CROCUS COMFORT

### W-CLASS

Named after one of the Netherlands' earliest spring flowers, this class embodies gentle renewal and tactile warmth. The orange crocus signals optimism, softness, and seasonal transition, mirroring the comfort and brightness this class offers.



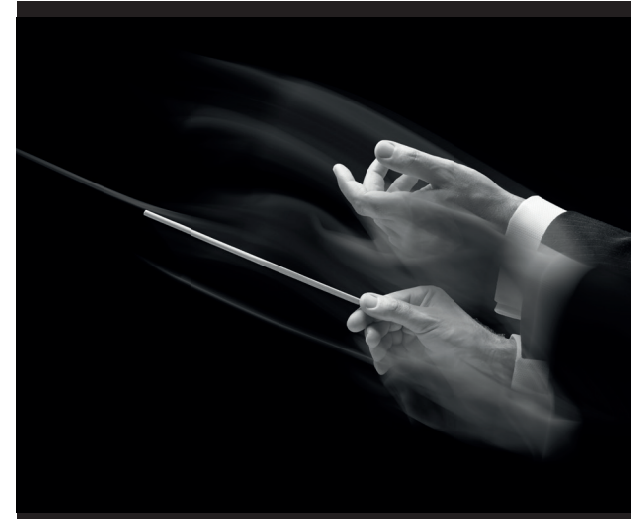
"SYMBIOTIC GROWTH"



## VERMEER VESPER

### J-CLASS

Combining the quiet brilliance of Dutch painter Vermeer with the word vesper, meaning "evening star", the design reflects a moment of flow and focus. Symbolizing a refined, introspective space that supports calmness, privacy, confidence, and presence.



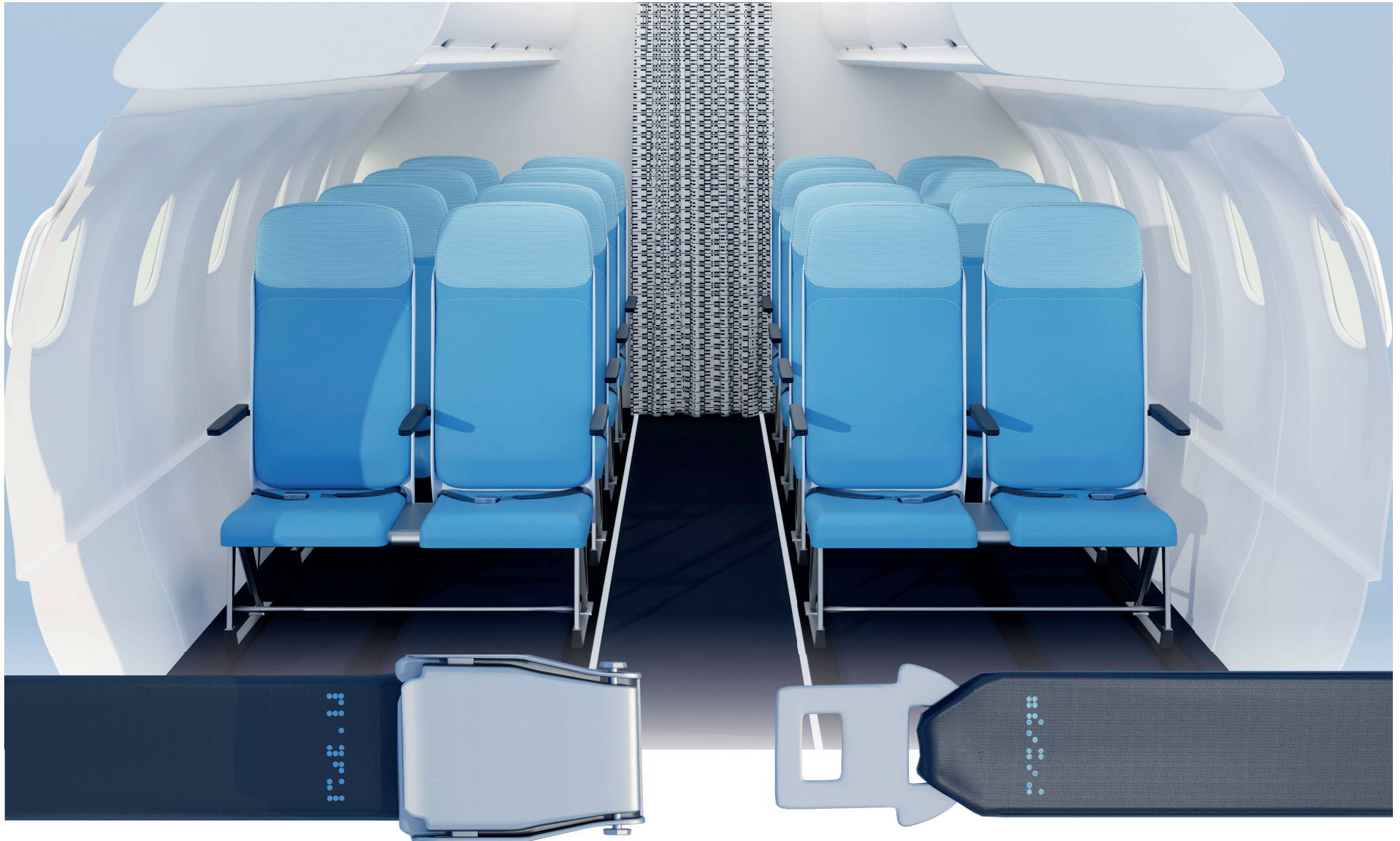
"QUIET HARVESTING"



## DELTA DISCOVERY ✨ Y-CLASS

104 seats total ✨ 79% of the plane ✨ €330 (+ €0)

Standard legroom, complimentary snacks and drinks, 1 × carry-on bag and assigned seat. €370 (+€40) For front Y-class seats.  
€440 (+€110) For emergency exit seats with extra leg room (61 cm), early boarding and priority overhead storage space.



## CROCUS COMFORT ✨ W-CLASS

8 seats total ✨ 6% of the plane ✨ €510 (+ €180)

Extra legroom (7 cm), priority boarding, a seat located at front of cabin and faster disembarkation. Extra flying blue miles, amount depending on passenger's Flying Blue status.



## VERMEER VESPER ✨ J-CLASS

20 seats total ✨ 15% of the plane €890 (+ €560)

Extra legroom (12 cm), lounge access at Schiphol, extra leg room (upgraded inflight meal service, flexible rebooking, 2 × baggage allowance, priority boarding and disembarkation. Extra flying blue miles, amount depending on passenger's Flying Blue status.



# DELTA DISCOVERY

Y-CLASS ✨ ECONOMY CLASS

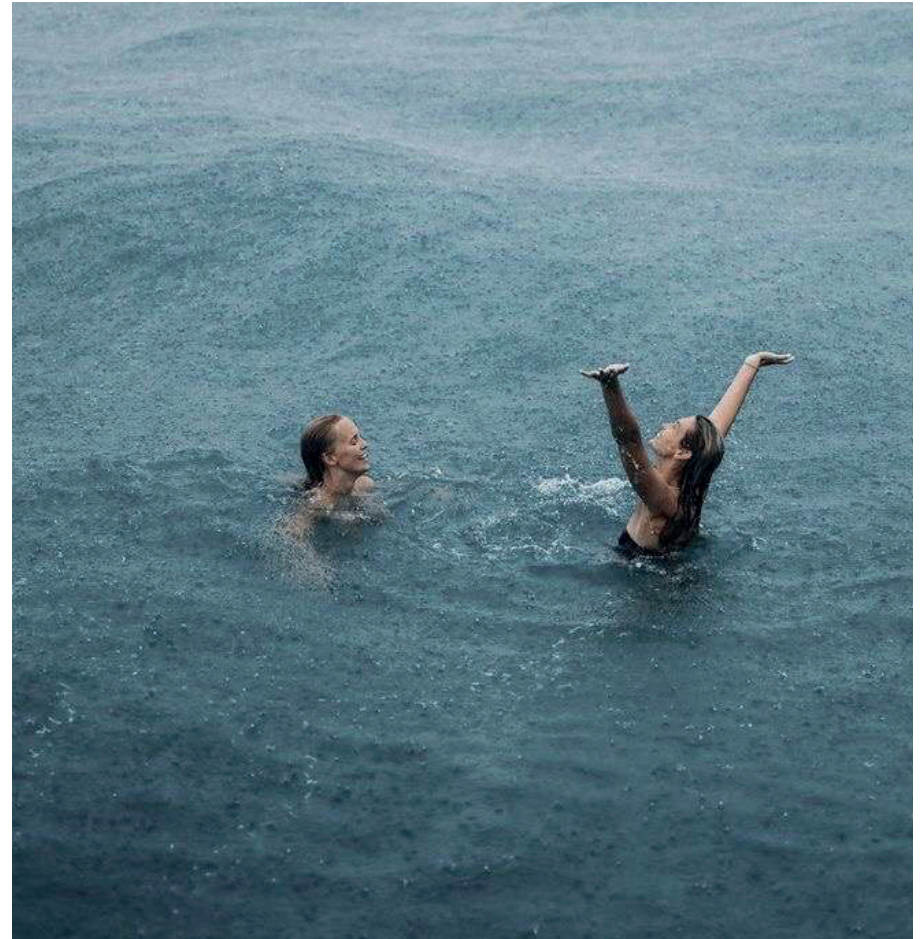
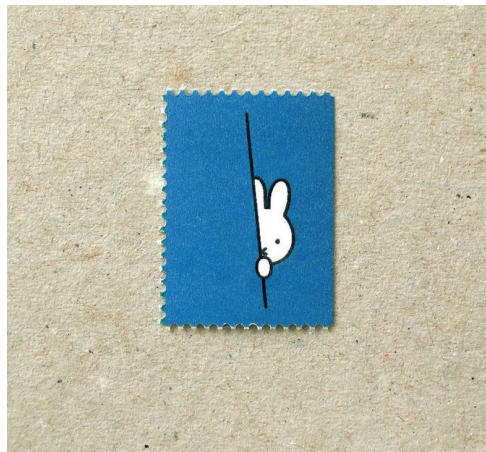
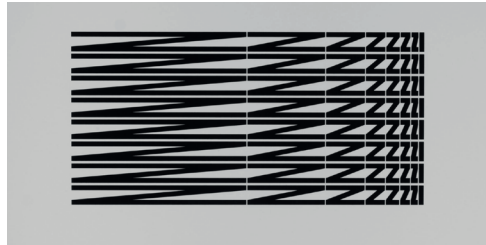


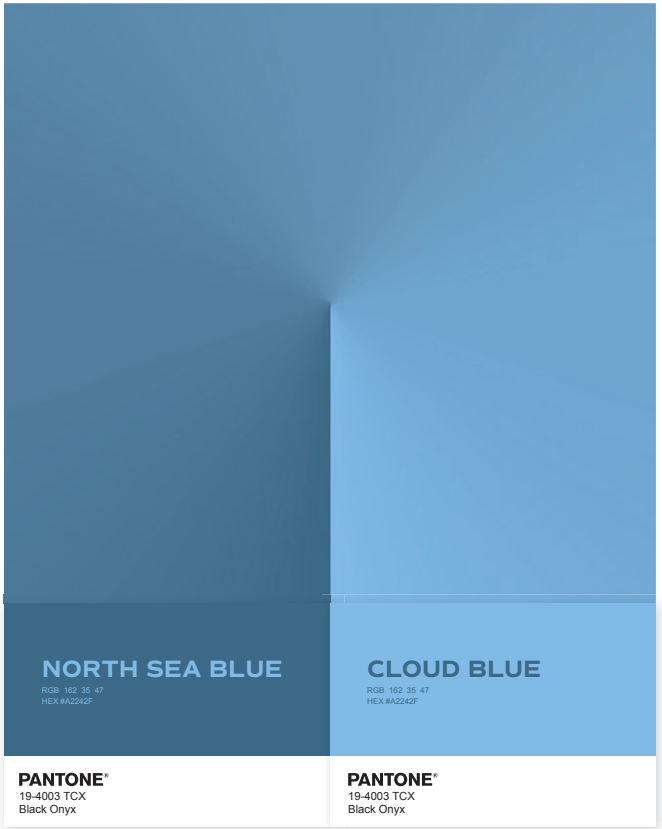
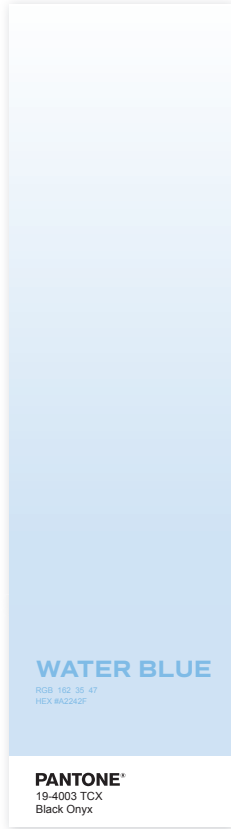
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The name of this class evokes the energy of shared exploration, rooted in Dutch openness, directness and movement. The name suggests both place and mindset, discovery as a collective journey.

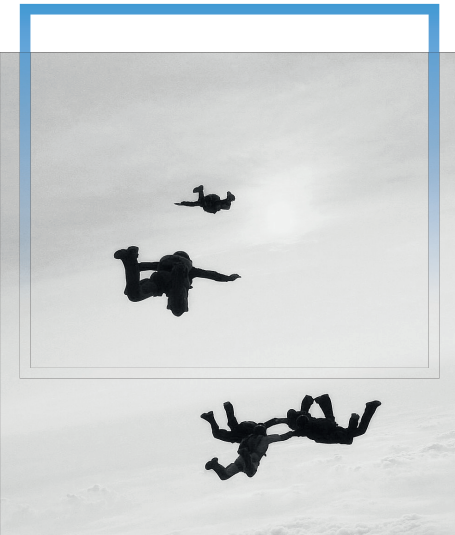
The design invites collectivity, clarity, curiosity, and a grounded sense of freedom through universal materials and bold simplicity.





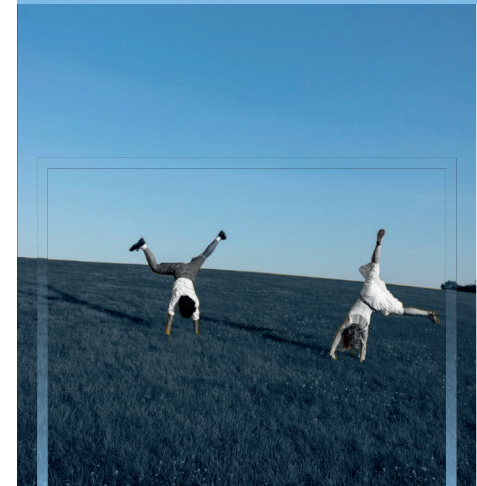
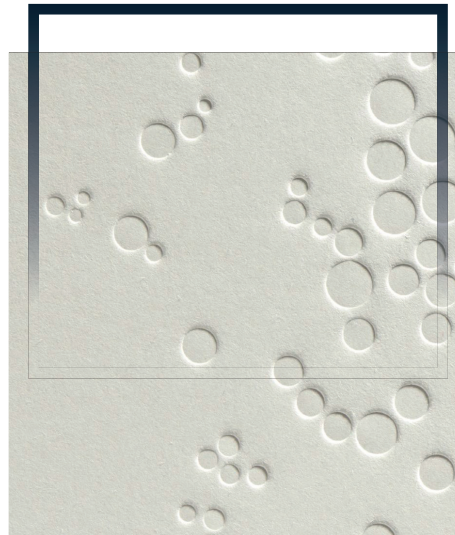


**EXHILARATION**



**COLLECTIVE**

**SIMPLE**



**FRIVOLOUS**

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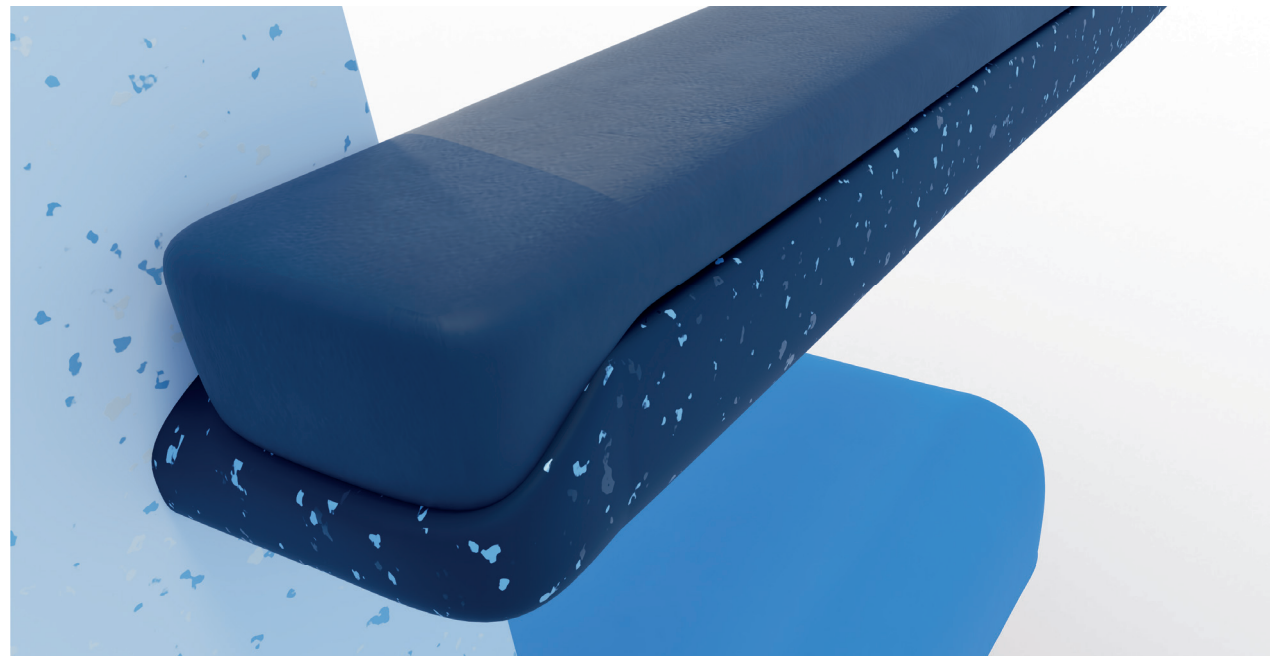
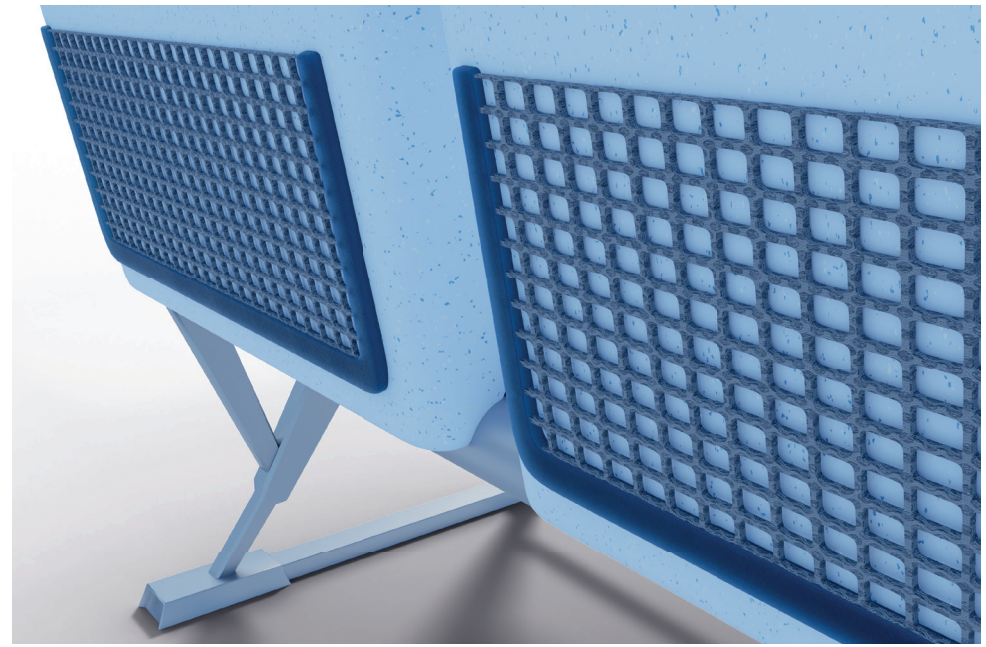
## PLAYFUL MIXING

“Your heartbeat racing with excitement as you play hide-and-seek with your friends in kindergarden, searching for the perfect spot, feeling carefree, connected and playful, fully immersed in childhood freedom and joy.”

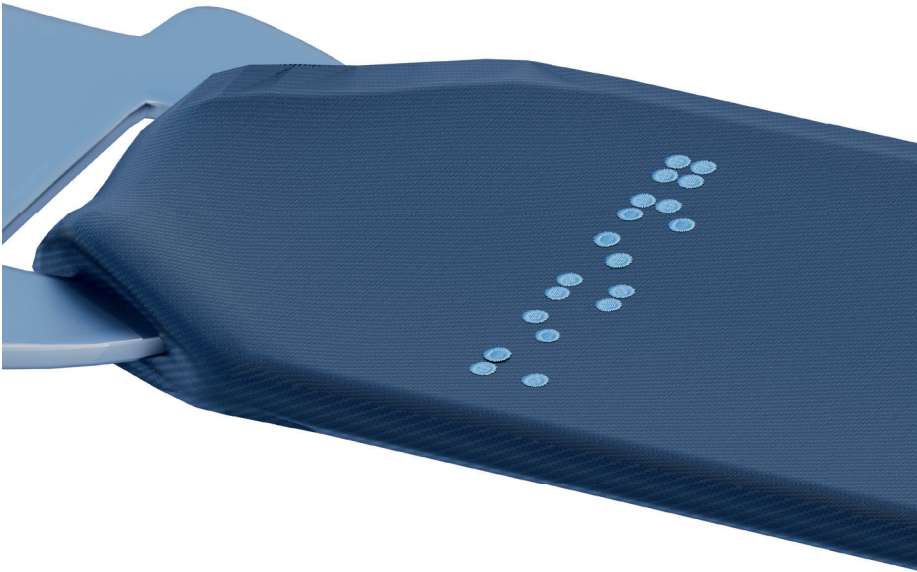
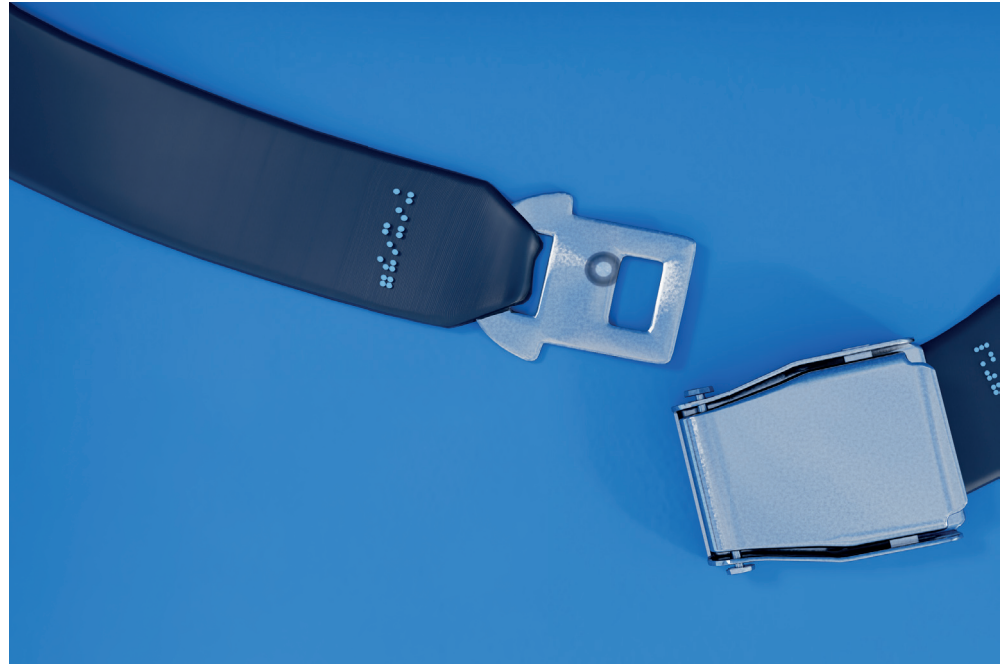
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Similar to the initial stage of bacterial cellulose formation, where multiple ingredients of the growth medium interact and merge, enabling the first emergence of a coherent material structure.











# SEAT MATERIALS

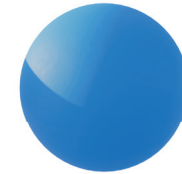
DELTA DISCOVERY ✨ Y-CLASS

## UPHOLSTERY

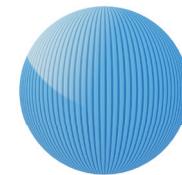


### M1.1 ✨ PAN & BACKREST UPHOLSTERY

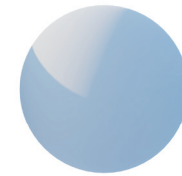
Color ✨ Night black  
Material ✨ BC Leather alternative  
Texture ✨ Smooth  
Thickness ✨ 0.9 mm  
Density ✨ 0.24 g/cm<sup>3</sup>

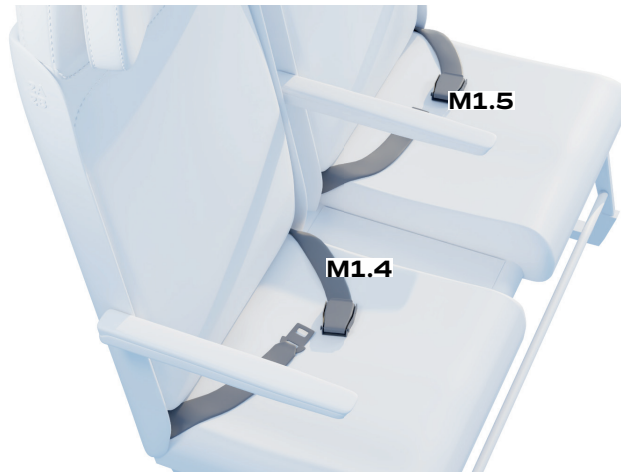


Color ✨ Charcoal gray  
Material ✨ BC Leather alternative  
Texture ✨ Suede-like  
Thickness ✨ 0.7 mm  
Density ✨ 0.1 g/cm<sup>3</sup>



Color ✨ Charcoal gray  
Material ✨ BC Leather alternative  
Texture ✨ Suede-like  
Thickness ✨ 0.7 mm  
Density ✨ 0.1 g/cm<sup>3</sup>





## SEATBELT

Color ✨ Delft blue  
 Material ✨ 100% Recycled high-tenacity polyester  
 Texture ✨ Tightly woven slightly ribbed  
 Thickness ✨ 1.5 mm  
 Density ✨ 1.38 g/cm<sup>3</sup>



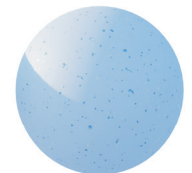
Color ✨ Delft blue  
 Material ✨ 85% Recycled aluminum  
 Texture ✨ Brushed satin metal  
 Thickness ✨ 4 mm  
 Density ✨ 2.7 g/cm<sup>3</sup>



## SEAT SHELL

### M1.6 ✨ SEAT SHELL & TRAY TABLE

Color ✨ Delft blue  
 Material ✨ 100% Recycled high-tenacity polyester  
 Texture ✨ Tightly woven slightly ribbed  
 Thickness ✨ 1.5 mm  
 Density ✨ 1.38 g/cm<sup>3</sup>



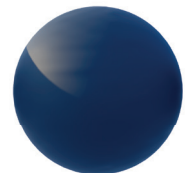
### M1.7 ✨ SEAT SHELL LITERATURE NET

Color ✨ Delft blue  
 Material ✨ 85% Recycled aluminum  
 Texture ✨ Brushed satin metal  
 Thickness ✨ 4 mm  
 Density ✨ 2.7 g/cm<sup>3</sup>



### M1.8 ✨ SEAT SHELL LITERATURE FRAME

Color ✨ Delft blue  
 Material ✨ 85% Recycled aluminum  
 Texture ✨ Brushed satin metal  
 Thickness ✨ 4 mm  
 Density ✨ 2.7 g/cm<sup>3</sup>





## FRAME

### M1.9 ✨ SEAT FRAME

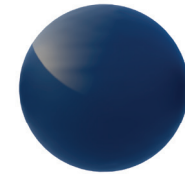
Color	✨ Delft blue
Material	✨ 100% Recycled high-tenacity polyester
Texture	✨ Tightly woven slightly ribbed
Thickness	✨ 1.5 mm
Density	✨ 1.38 g/cm <sup>3</sup>



## ARMREST

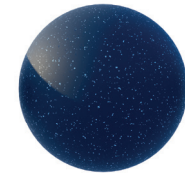
### M1.10 ✨ ARMREST UPPER

Color	✨ Delft blue
Material	✨ 100% Recycled high-tenacity polyester
Texture	✨ Tightly woven slightly ribbed
Thickness	✨ 1.5 mm
Density	✨ 1.38 g/cm <sup>3</sup>



### M1.11 ✨ ARMREST LOWER

Color	✨ Delft blue
Material	✨ 85% Recycled aluminum
Texture	✨ Brushed satin metal
Thickness	✨ 4 mm
Density	✨ 2.7 g/cm <sup>3</sup>

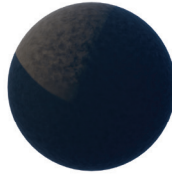


# CABIN MATERIALS

DELTA DISCOVERY ✨ Y-CLASS

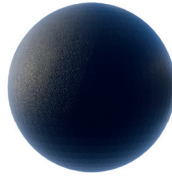
## M1.12 ✨ CARPET

Color ✨ Delft blue  
Material ✨ 100% Recycled high-tenacity polyester  
Texture ✨ Tightly woven slightly ribbed  
Thickness ✨ 1.5 mm  
Density ✨ 1.38 g/cm<sup>3</sup>



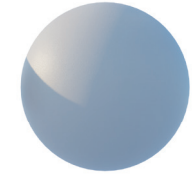
## M1.13 ✨ SEATRAILCOVERS

Color ✨ Delft blue  
Material ✨ 100% Recycled high-tenacity polyester  
Texture ✨ Tightly woven slightly ribbed  
Thickness ✨ 1.5 mm  
Density ✨ 1.38 g/cm<sup>3</sup>



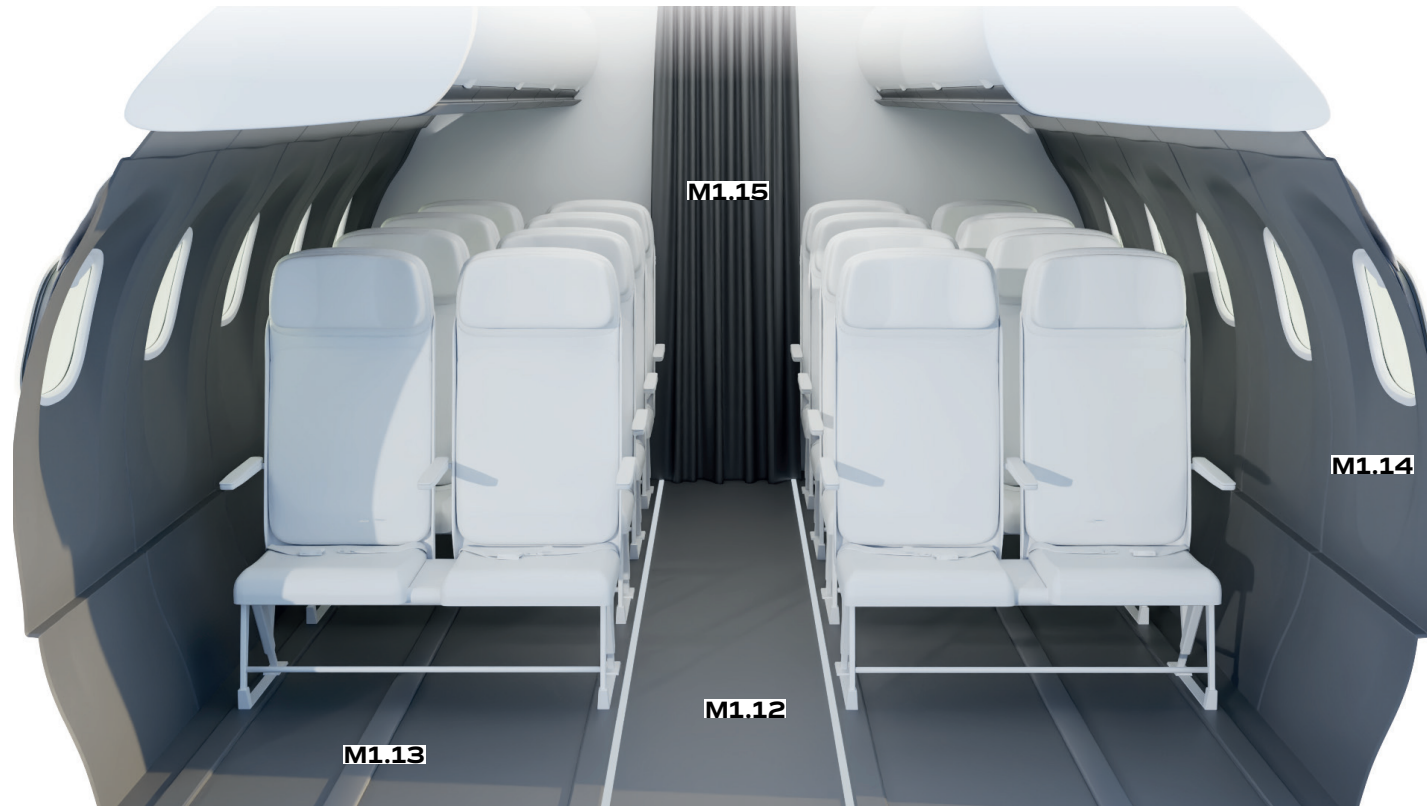
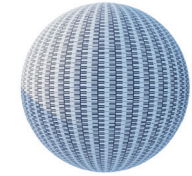
## M1.14 ✨ WALL PANEL

Color ✨ Delft blue  
Material ✨ 100% Recycled high-tenacity polyester  
Texture ✨ Tightly woven slightly ribbed  
Thickness ✨ 1.5 mm  
Density ✨ 1.38 g/cm<sup>3</sup>



## M1.15 ✨ CURTAIN

Color ✨ Delft blue  
Material ✨ 100% Recycled high-tenacity polyester  
Texture ✨ Tightly woven slightly ribbed  
Thickness ✨ 1.5 mm  
Density ✨ 1.38 g/cm<sup>3</sup>



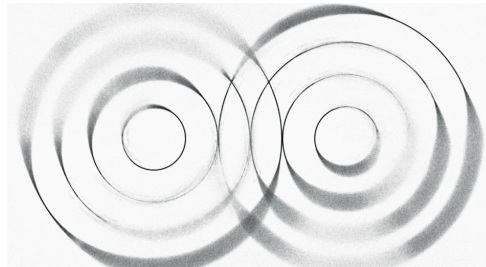
# CROCUS COMFORT

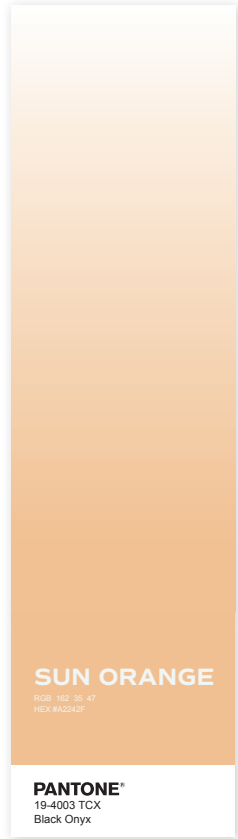
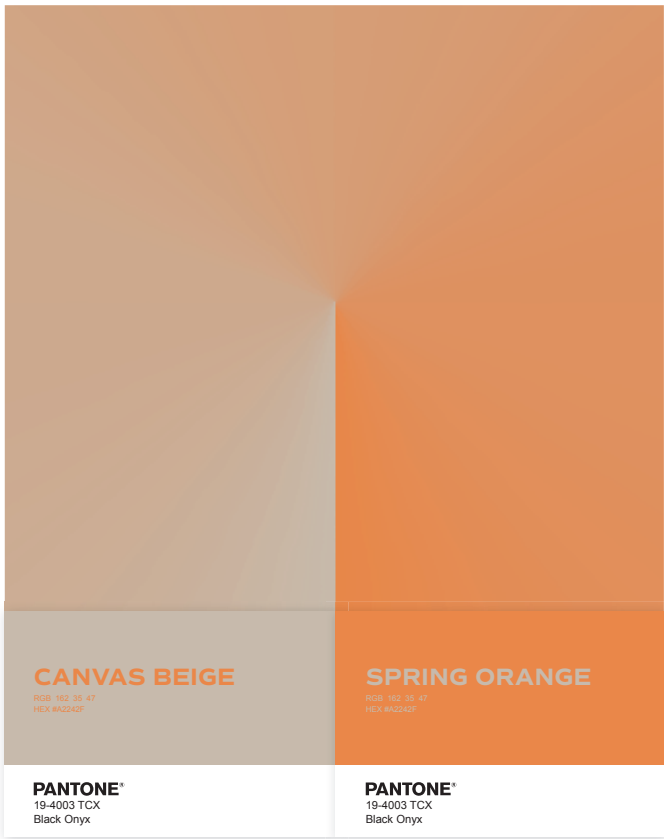
W-CLASS ✨ ECONOMY COMFORT CLASS

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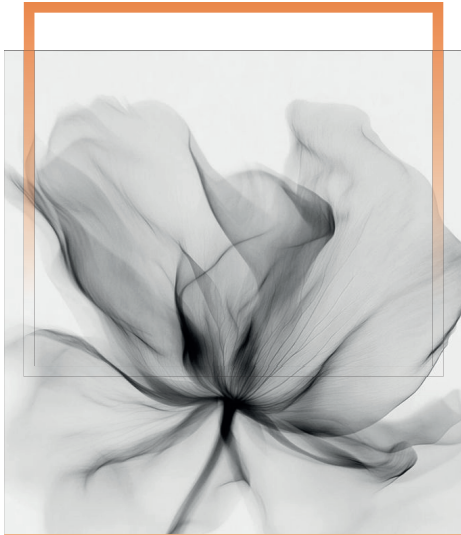
Named after the crocus, one of the Netherlands' earliest spring flowers, this class embodies gentle renewal and tactile warmth. The orange crocus signals optimism, softness, and seasonal transition, mirroring the comfort and brightness this class offers.





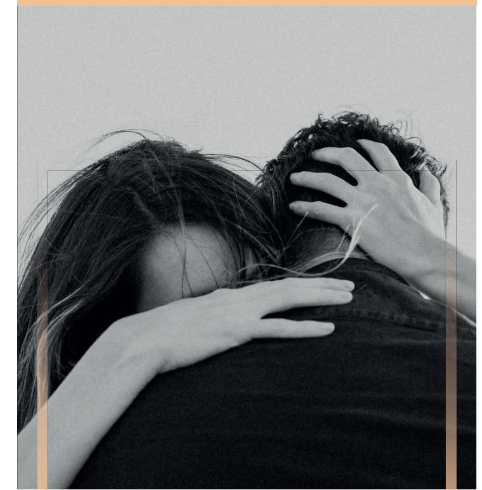
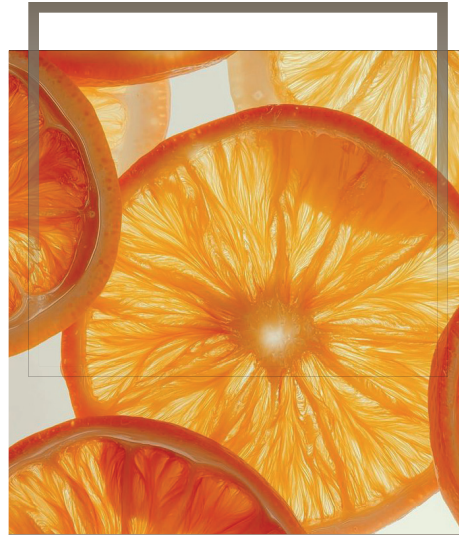


**BLOOM**



**SUNSHINE**

**CRISP**



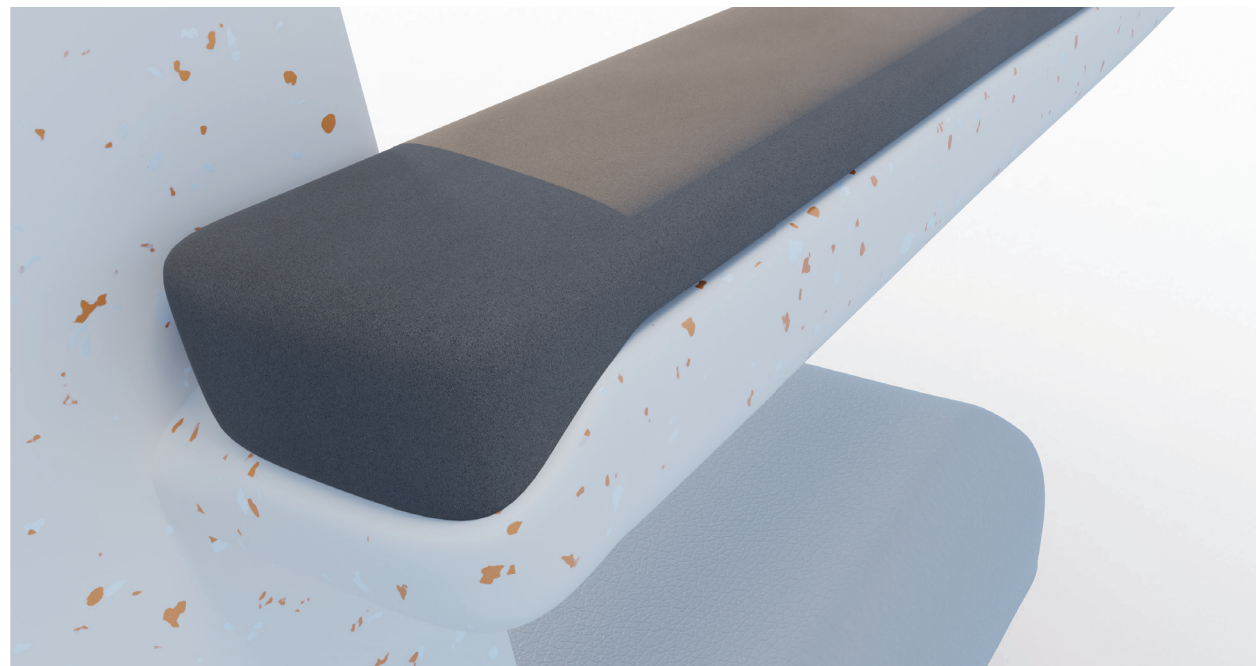
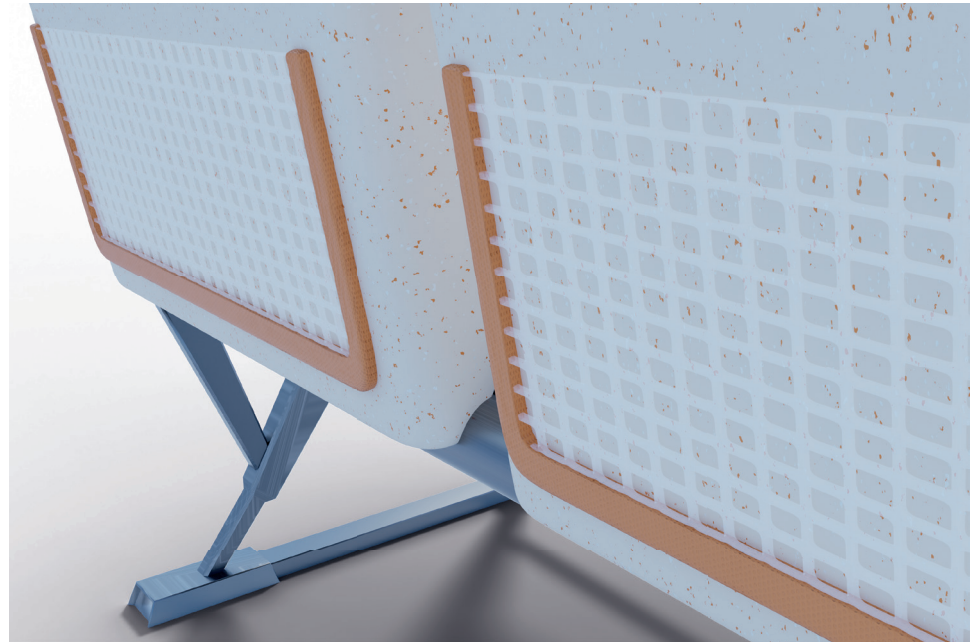
**CONNECTED**

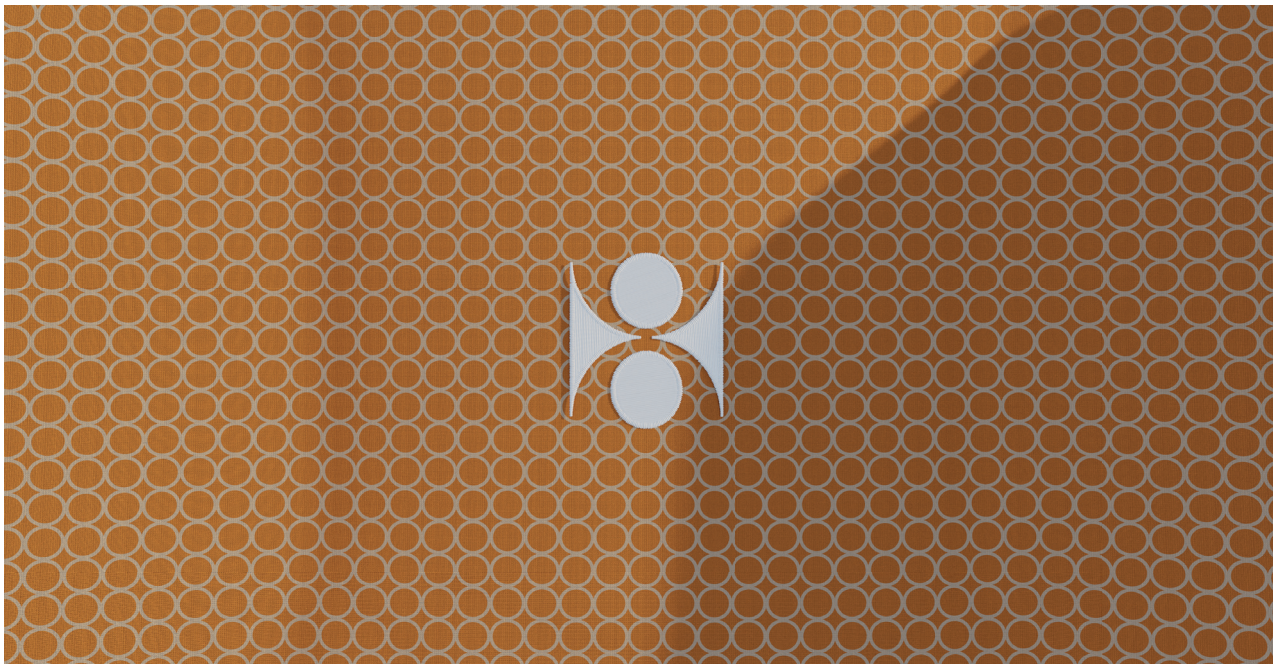
## SYMBIOTIC GROWTH

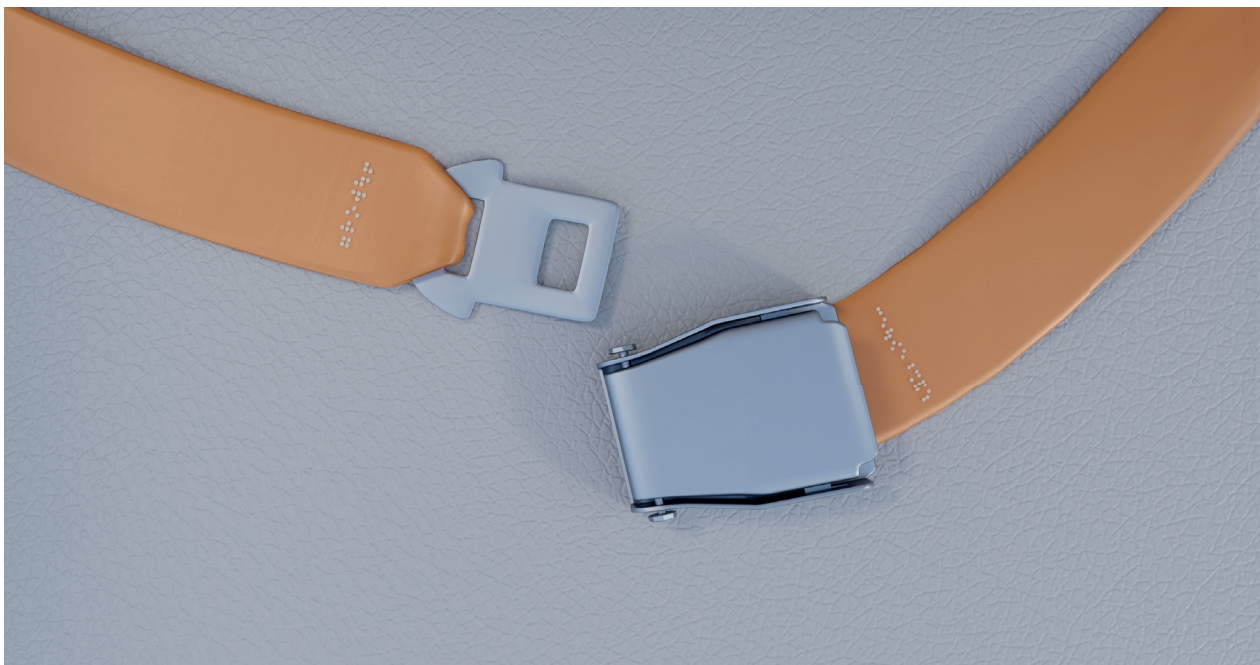
“A warm early-spring day in your late twenties, stepping out in the first light clothes of the year. What begins as an ordinary weekend day unfolds into one of your most treasured memories, promising yourself to the love that has effortlessly been there all along.”

Mirroring the central phase of bacterial cellulose formation, when bacteria and medium act in harmony, enabling the cellulose network to expand naturally and without external intervention.











# SEAT MATERIALS

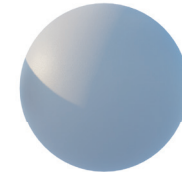
CROCUS COMFORT ✨ W-CLASS

## UPHOLSTERY



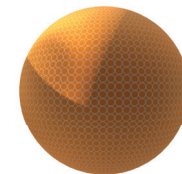
### M2.1 ✨ PAN & BACKREST UPHOLSTERY

Color ✨ Night black  
Material ✨ BC Leather alternative  
Texture ✨ Smooth  
Thickness ✨ 0.9 mm  
Density ✨ 0.24 g/cm<sup>3</sup>



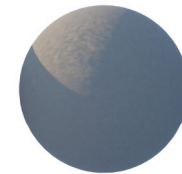
### M2.2 ✨ HEADREST UPHOLSTERY

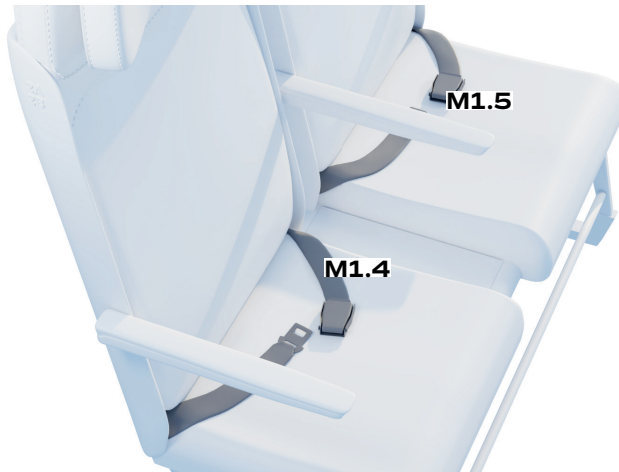
Color ✨ Charcoal gray  
Material ✨ BC Leather alternative  
Texture ✨ Suede-like  
Thickness ✨ 0.7 mm  
Density ✨ 0.1 g/cm<sup>3</sup>



### M2.3 ✨ STITCHING

Color ✨ Charcoal gray  
Material ✨ BC Leather alternative  
Texture ✨ Suede-like  
Thickness ✨ 0.7 mm  
Density ✨ 0.1 g/cm<sup>3</sup>

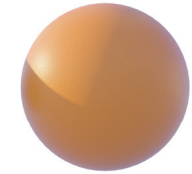




## SEATBELT

### M2.4 ✨ SEATBELT WEBBING

Color	✨ Delft blue
Material	✨ 100% Recycled high-tenacity polyester
Texture	✨ Tightly woven slightly ribbed
Thickness	✨ 1.5 mm
Density	✨ 1.38 g/cm <sup>3</sup>



### M2.5 ✨ SEATBELT BUCKLE & LATCH

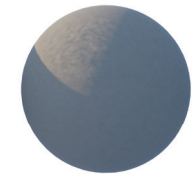
Color	✨ Delft blue
Material	✨ 85% Recycled aluminum
Texture	✨ Brushed satin metal
Thickness	✨ 4 mm
Density	✨ 2.7 g/cm <sup>3</sup>



## SEAT SHELL

### M2.6 ✨ SEAT SHELL & TRAY TABLE

Color	✨ Delft blue
Material	✨ 100% Recycled high-tenacity polyester
Texture	✨ Tightly woven slightly ribbed
Thickness	✨ 1.5 mm
Density	✨ 1.38 g/cm <sup>3</sup>



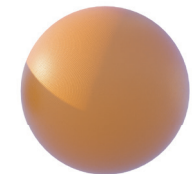
### M2.7 ✨ SEAT SHELL LITERATURE NET

Color	✨ Delft blue
Material	✨ 85% Recycled aluminum
Texture	✨ Brushed satin metal
Thickness	✨ 4 mm
Density	✨ 2.7 g/cm <sup>3</sup>



### M2.8 ✨ SEAT SHELL LITERATURE FRAME

Color	✨ Delft blue
Material	✨ 85% Recycled aluminum
Texture	✨ Brushed satin metal
Thickness	✨ 4 mm
Density	✨ 2.7 g/cm <sup>3</sup>





## FRAME

### M2.9 ✨ SEAT FRAME

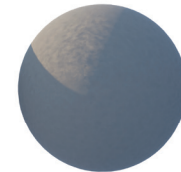
Color	✨ Delft blue
Material	✨ 100% Recycled high-tenacity polyester
Texture	✨ Tightly woven slightly ribbed
Thickness	✨ 1.5 mm
Density	✨ 1.38 g/cm <sup>3</sup>



## ARMREST

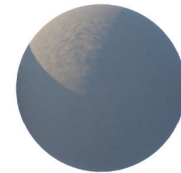
### M2.10 ✨ ARMREST UPPER

Color	✨ Delft blue
Material	✨ 100% Recycled high-tenacity polyester
Texture	✨ Tightly woven slightly ribbed
Thickness	✨ 1.5 mm
Density	✨ 1.38 g/cm <sup>3</sup>



### M2.11 ✨ ARMREST LOWER

Color	✨ Delft blue
Material	✨ 85% Recycled aluminum
Texture	✨ Brushed satin metal
Thickness	✨ 4 mm
Density	✨ 2.7 g/cm <sup>3</sup>

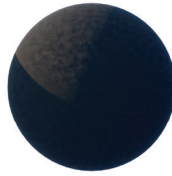


# CABIN MATERIALS

CROCUS COMFORT ✨ W-CLASS

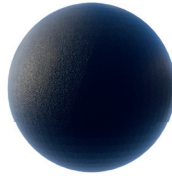
## M2.12 ✨ CARPET

Color ✨ Delft blue  
Material ✨ 100% Recycled high-tenacity polyester  
Texture ✨ Tightly woven slightly ribbed  
Thickness ✨ 1.5 mm  
Density ✨ 1.38 g/cm<sup>3</sup>



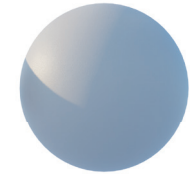
## M2.13 ✨ SEAT-RAIL COVERS

Color ✨ Delft blue  
Material ✨ 100% Recycled high-tenacity polyester  
Texture ✨ Tightly woven slightly ribbed  
Thickness ✨ 1.5 mm  
Density ✨ 1.38 g/cm<sup>3</sup>



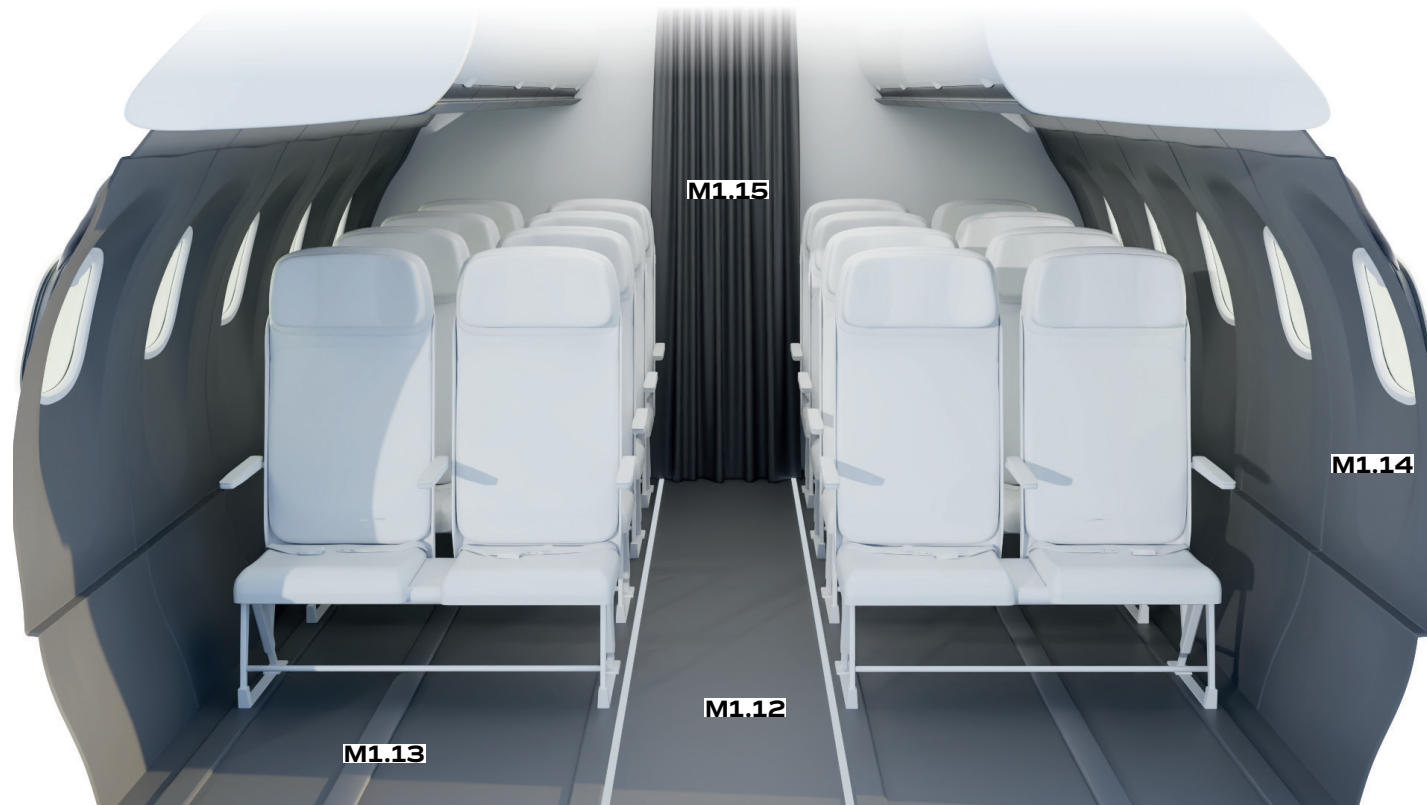
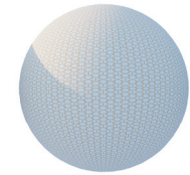
## M2.14 ✨ WALL PANEL

Color ✨ Delft blue  
Material ✨ 100% Recycled high-tenacity polyester  
Texture ✨ Tightly woven slightly ribbed  
Thickness ✨ 1.5 mm  
Density ✨ 1.38 g/cm<sup>3</sup>



## M2.15 ✨ CURTAIN

Color ✨ Delft blue  
Material ✨ 100% Recycled high-tenacity polyester  
Texture ✨ Tightly woven slightly ribbed  
Thickness ✨ 1.5 mm  
Density ✨ 1.38 g/cm<sup>3</sup>



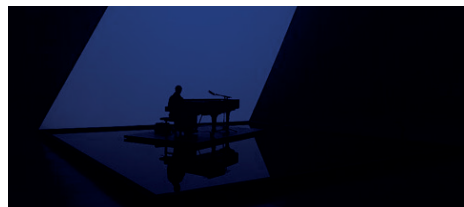
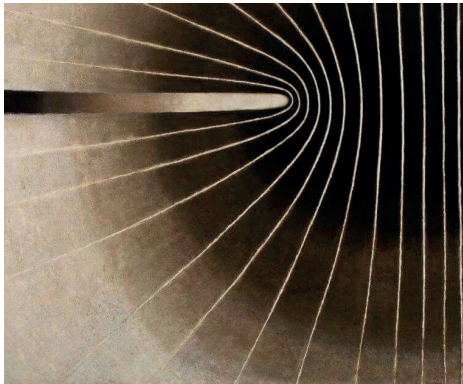
# VERMEER VESPER

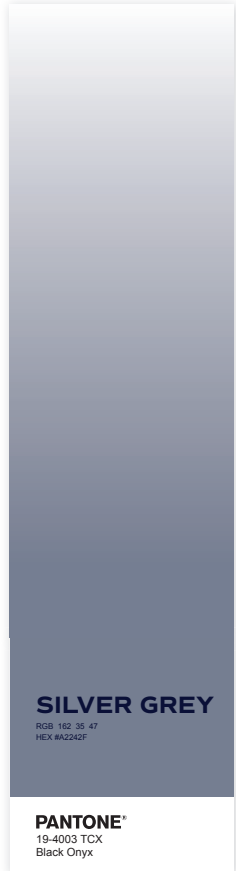
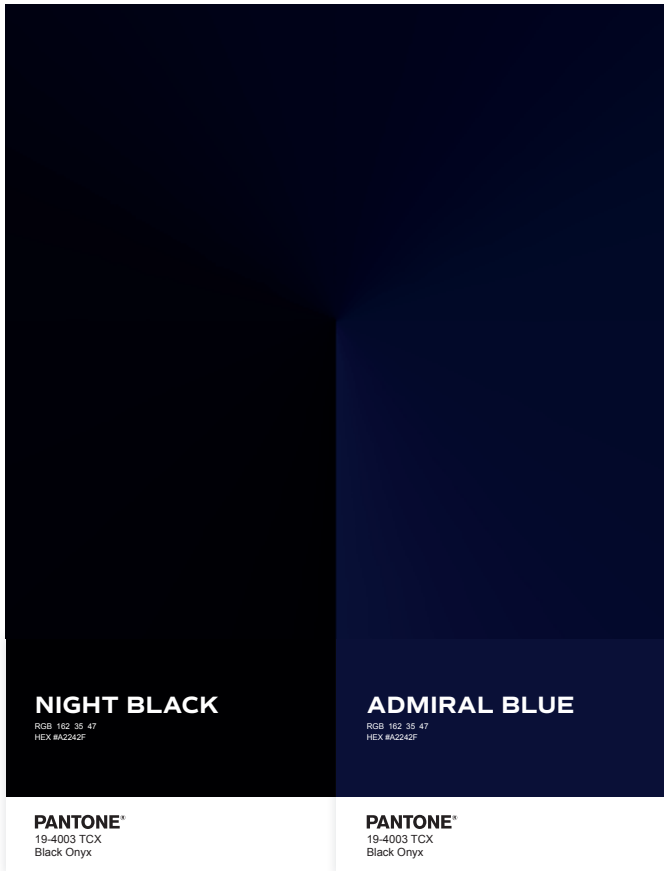
J-CLASS ✨ BUSINESS CLASS

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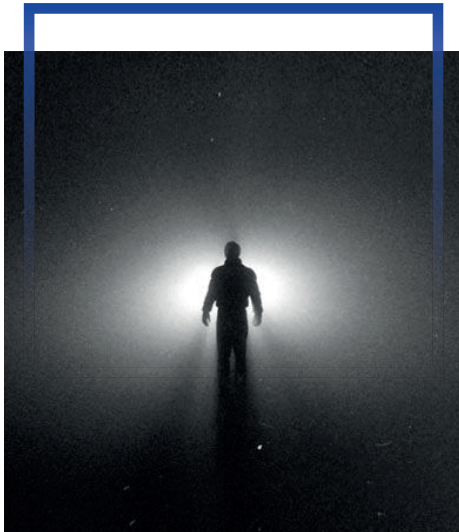
The name of this class combines the quiet brilliance of Dutch painter Vermeer with the word vesper, meaning “evening star” or “twilight.” The design reflects a moment of flow and focus. Symbolizing a refined, introspective space that supports calmness, privacy, confidence, and presence.





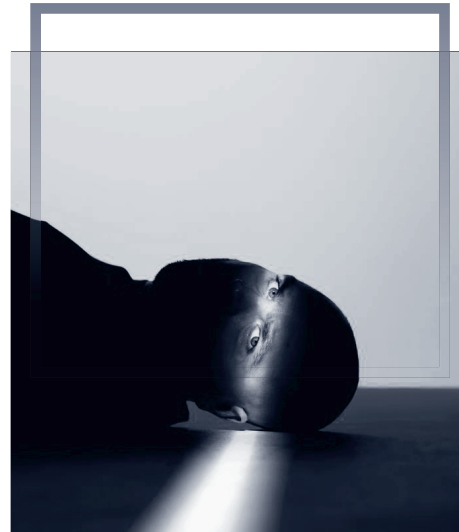


**CONFIDENCE**



**OPULENCE**

**FOCUS**



**HERITAGE**

## QUIET HARVESTING

“A warm early-spring day in your late twenties, stepping out in the first light clothes of the year. What begins as an ordinary weekend day unfolds into one of your most treasured memories, promising yourself to the love that has effortlessly been there all along.”

Reflecting the harvesting stage of bacterial cellulose production, in which biological activity has ceased and the material exists as a stable, non-living structure with defined properties.



# SEAT MATERIALS

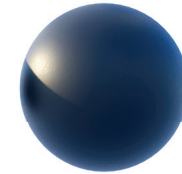
VERMEER VESPER ✨ J-CLASS

## UPHOLSTERY



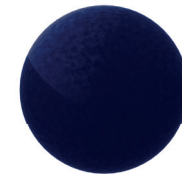
### M3.1 ✨ PAN & BACKREST UPHOLSTERY

Color ✨ Night black  
Material ✨ BC Leather alternative  
Texture ✨ Smooth  
Thickness ✨ 0.9 mm  
Density ✨ 0.24 g/cm<sup>3</sup>



### M3.2 ✨ HEADREST UPHOLSTERY

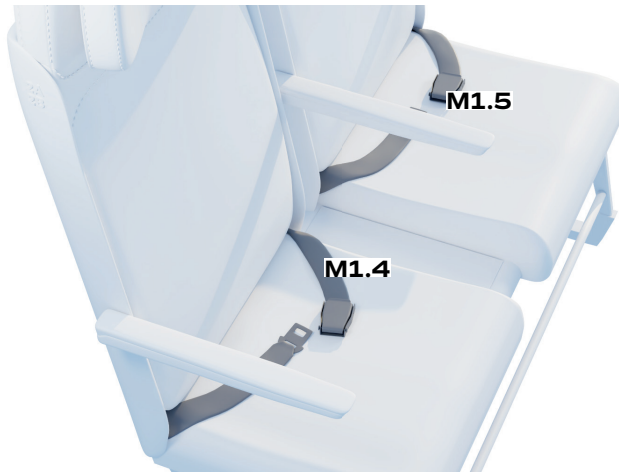
Color ✨ Charcoal gray  
Material ✨ BC Leather alternative  
Texture ✨ Suede-like  
Thickness ✨ 0.7 mm  
Density ✨ 0.1 g/cm<sup>3</sup>



### M3.3 ✨ STITCHING

Color ✨ Charcoal gray  
Material ✨ BC Leather alternative  
Texture ✨ Suede-like  
Thickness ✨ 0.7 mm  
Density ✨ 0.1 g/cm<sup>3</sup>





## SEATBELT

### M3.4 ✨ SEATBELT WEBBING

Color	✨ Delft blue
Material	✨ 100% Recycled high-tenacity polyester
Texture	✨ Tightly woven slightly ribbed
Thickness	✨ 1.5 mm
Density	✨ 1.38 g/cm <sup>3</sup>



### M3.5 ✨ SEATBELT BUCKLE & LATCH

Color	✨ Delft blue
Material	✨ 85% Recycled aluminum
Texture	✨ Brushed satin metal
Thickness	✨ 4 mm
Density	✨ 2.7 g/cm <sup>3</sup>



## SEAT SHELL

### M3.6 ✨ SEAT SHELL & TRAY TABLE

Color	✨ Delft blue
Material	✨ 100% Recycled high-tenacity polyester
Texture	✨ Tightly woven slightly ribbed
Thickness	✨ 1.5 mm
Density	✨ 1.38 g/cm <sup>3</sup>

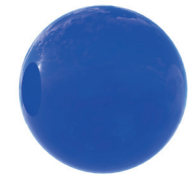


### M3.7 ✨ SEAT SHELL LITERATURE NET

Color	✨ Delft blue
Material	✨ 85% Recycled aluminum
Texture	✨ Brushed satin metal
Thickness	✨ 4 mm
Density	✨ 2.7 g/cm <sup>3</sup>

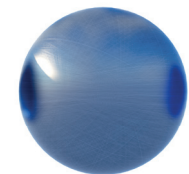
### M3.8 ✨ SEAT SHELL LITERATURE FRAME

Color	✨ Delft blue
Material	✨ 85% Recycled aluminum
Texture	✨ Brushed satin metal
Thickness	✨ 4 mm
Density	✨ 2.7 g/cm <sup>3</sup>



### M3.9 ✨ SEAT SHELL COAT HANGER

Color	✨ Delft blue
Material	✨ 85% Recycled aluminum
Texture	✨ Brushed satin metal
Thickness	✨ 4 mm
Density	✨ 2.7 g/cm <sup>3</sup>





## FRAME

### M3.10 ✨ SEAT FRAME & LUGGAGE RACK

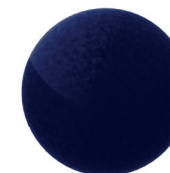
Color	✨ Delft blue
Material	✨ 100% Recycled high-tenacity polyester
Texture	✨ Tightly woven slightly ribbed
Thickness	✨ 1.5 mm
Density	✨ 1.38 g/cm <sup>3</sup>



## ARMREST

### M3.11 ✨ ARMREST UPPER

Color	✨ Delft blue
Material	✨ 100% Recycled high-tenacity polyester
Texture	✨ Tightly woven slightly ribbed
Thickness	✨ 1.5 mm
Density	✨ 1.38 g/cm <sup>3</sup>



### M3.12 ✨ ARMREST LOWER

Color	✨ Delft blue
Material	✨ 85% Recycled aluminum
Texture	✨ Brushed satin metal
Thickness	✨ 4 mm
Density	✨ 2.7 g/cm <sup>3</sup>

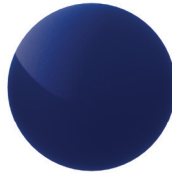


# CABIN MATERIALS

VERMEER VESPER ✨ J-CLASS

## M3.13 ✨ CARPET

Color ✨ Delft blue  
Material ✨ 100% Recycled high-tenacity polyester  
Texture ✨ Tightly woven slightly ribbed  
Thickness ✨ 1.5 mm  
Density ✨ 1.38 g/cm<sup>3</sup>



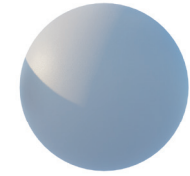
## M3.14 ✨ SEAT RAIL COVERS

Color ✨ Delft blue  
Material ✨ 100% Recycled high-tenacity polyester  
Texture ✨ Tightly woven slightly ribbed  
Thickness ✨ 1.5 mm  
Density ✨ 1.38 g/cm<sup>3</sup>



## M3.15 ✨ WALL PANEL

Color ✨ Delft blue  
Material ✨ 100% Recycled high-tenacity polyester  
Texture ✨ Tightly woven slightly ribbed  
Thickness ✨ 1.5 mm  
Density ✨ 1.38 g/cm<sup>3</sup>



## M3.16 ✨ CURTAIN

Color ✨ Delft blue  
Material ✨ 100% Recycled high-tenacity polyester  
Texture ✨ Tightly woven slightly ribbed  
Thickness ✨ 1.5 mm  
Density ✨ 1.38 g/cm<sup>3</sup>

