

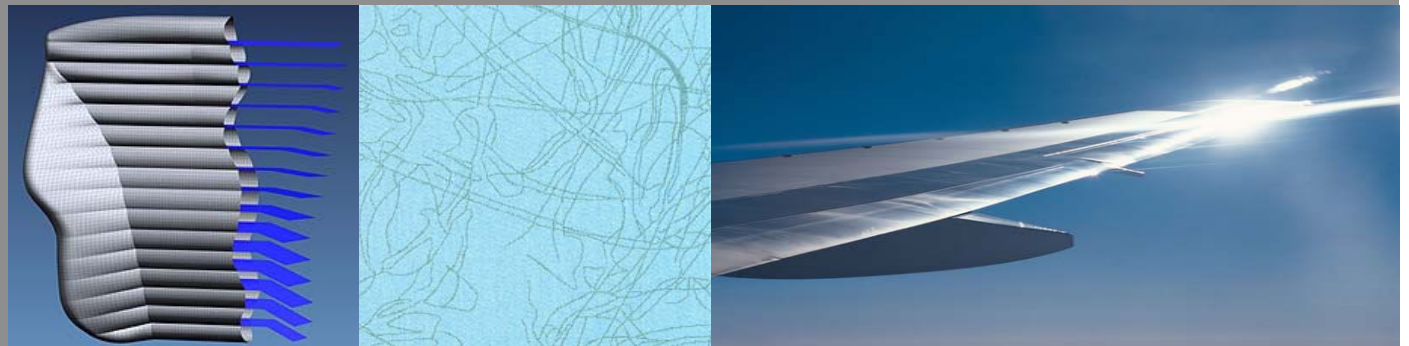
Lantal - Transportation Fashion

Well-being for passengers ... *and crews*



A Revolution in Light Weight Seats and Mattresses – Lantal's Novel Pneumatic Cushion System

Dr. Roland von Ballmoos, VP Corp. Dev. & Pneumatic Systems
AIE Open Concepts & Ideas Forum, Hamburg, April 4, 2006



Content

- **Introduction** to Lantal, its Vision and Status
- **Pneumatic Cushion System** – Description
- **Pneumatic Crew Rest Mattresses** – Outlook
- **Ergonomics**
- **Testing and Certification**
 - Certification
 - Qualification
- **Summary**



Lantal's Vision

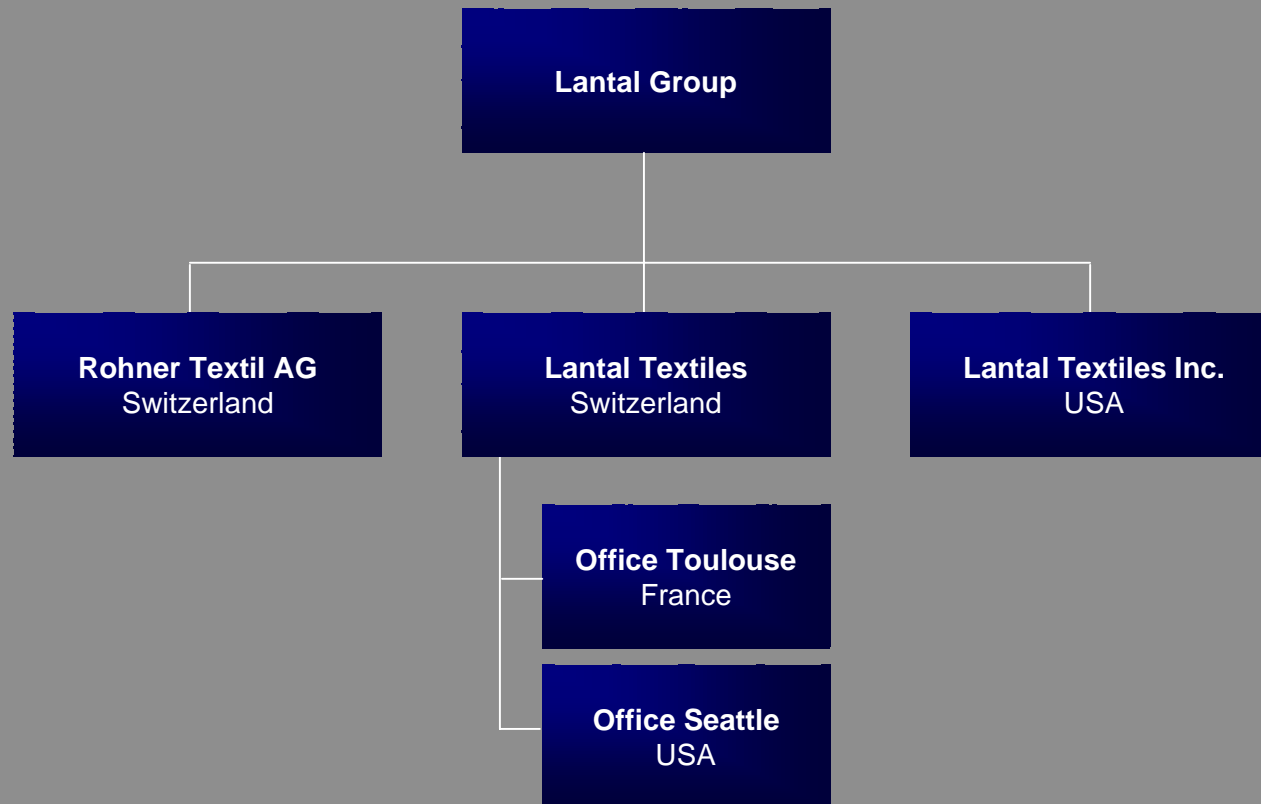
Lantal is a leader in the design, production, and distribution of textiles and services for the international community of operators of aircraft, buses, and railways.

We offer our customers forward-looking counsel in the domains of style, design, construction, **and comfort.**

The underlying objective is to achieve the highest level of well-being for passengers – *and crews.*



Group structure



Products and markets

Products

- Seat cover fabrics
- Curtain fabrics
- Velvet
- Wall coverings
- Carpets
- Leather
- Artificial leather
- Sheep skins
- Accessories

Aircraft



Bus



Train



Cruise



Services

Design

Ready-made parts

Lantal in Numbers, 2004

Performance

- Revenue 2004: CHF 98 Mio
- Employees: 387
(303 Switzerland, 84 USA)
- Market share Aviation ww: 60 %
- 136 Looms for Flat-wovens, Velvets and Carpets
- Own yarn dyeing and production in Switzerland and in the USA

Annual Capacities

- Flat wovens: 2'600'000 m
- Velvets: 450'000 m
- Woven carpets: 800'000 m²
- Handtufted carpets : 2'500 m²



References

Aircraft



- Airbus
- Swiss
- Lufthansa
- Air France
- Boeing
- Delta Airlines
- Aerolineas Argentinas
- American Airlines
- Malaysian Airlines
- Singapore Airlines
- China Airlines
- Saudi Arabian Airlines
- Kuwait Airlines
- Emirates
- Air India
- Egypt Air
- South African Airways
- Tunis Air
- Air Afrique

Train



- Alstom
- Antolin Loire
- Belgische Staatsbahn
- BLS Lötschbergbahn
- Bombardier
- Chapman Seating
- Compin
- Fainsa
- Französische Staatsbahn
- Holländische Bahn
- Polnische Staatsbahn
- Railcor
- Recaro
- Schlegel
- Schweizer Privatbahnen
- SBB
- Siemens
- Stadler

Bus



- Astron
- American Seating
- Bova
- EvoBus
- Grammer
- Irisbus
- Irizar
- Isringhausen
- Kiel
- MAN
- MCI
- Mercedes-Benz
- National Seating
- Neoplan
- AB-Noco-Stolar
- Prevost
- Scania
- Setra
- Van Hool
- Vogel
- Volvo

Cruise



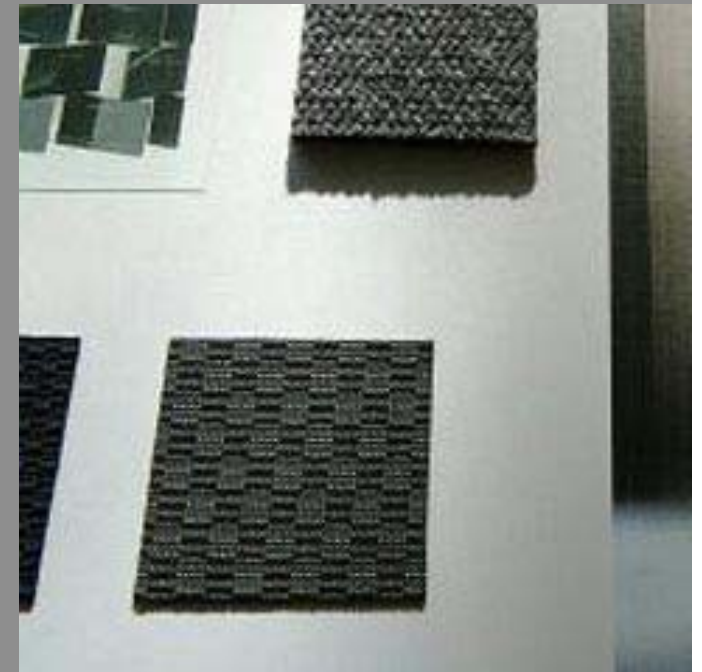
- Holland America Line
- Carnival Cruise Lines
- Royal Caribbean International

Design and consulting services

- In-house development of customized interior concepts
 - professional designers
 - computer aided design

- Consulting of
 - quality and design developments
 - delivery and stock programs
 - after sales services
 - maintenance trainings

- ➔ Customer oriented products, designed for optimal service life
Coordinated interior concepts

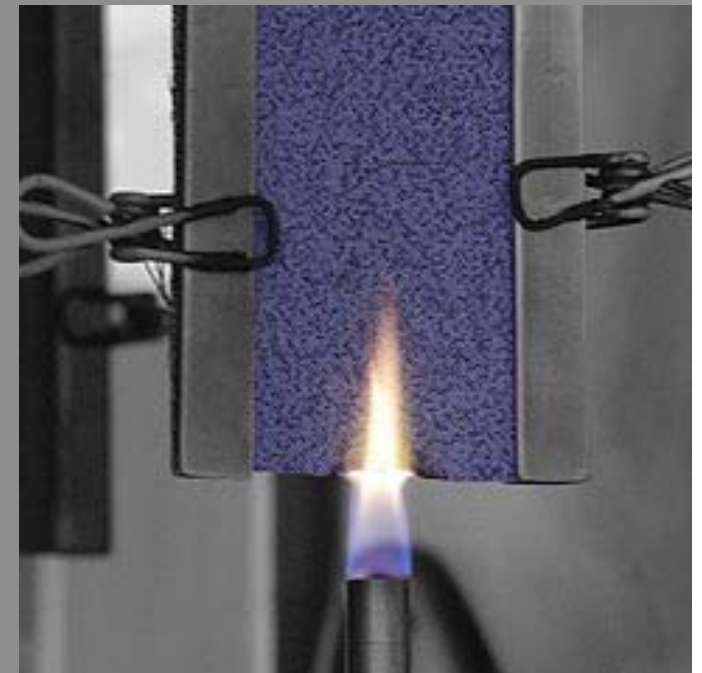


Product enhancement services

- Ready made items
 - seatcovers
 - headrests
 - pleated curtains
 - carpet cutting
 - carpet serging

- Testing
 - flammability test
 - smoke/toxicity test
 - flammability test for seat cushions
 - heat release rate

➔ Turn-key programs



Laboratories

- Certified and recognized by EASA/FAA
 - flammability tests
 - smoke/toxicity tests
 - flammability tests for seat cushions
 - heat release rate (OSU)
 - many more

- Third party testing
 - ➔ Recognized certificates are enclosed with every shipments

 - ➔ Brochure Test Facilities

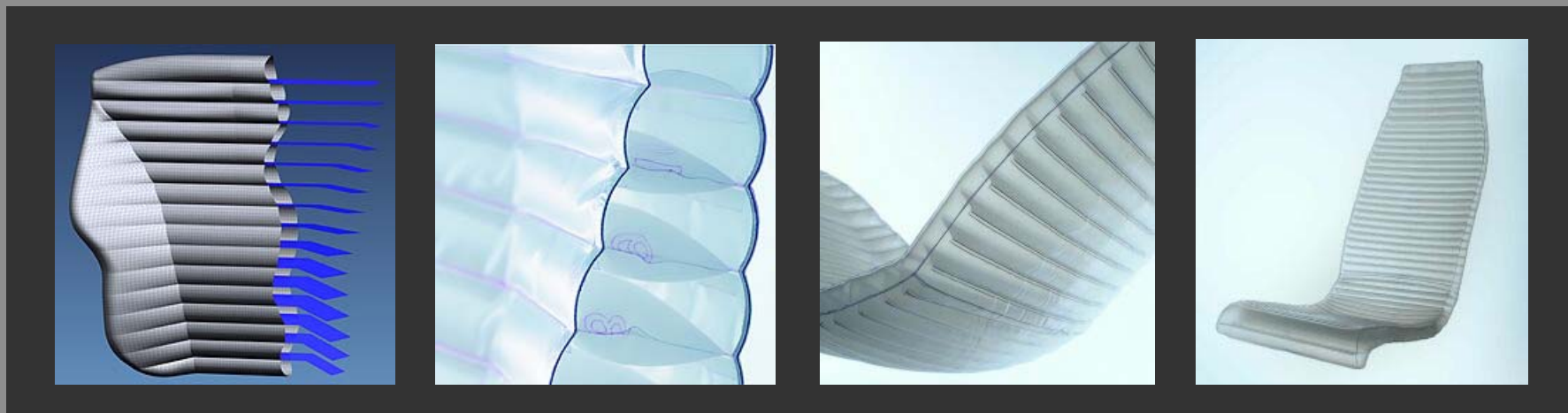


Lantal's Pneumatic Seat Cushion: Vision and Goal - 2001

Commercialize an innovative concept for a novel aircraft seat cushion:

- give passengers increased comfort with pneumatic seat cushions
- reduce operating costs through significant weight savings

➔ **Lantal's pneumatic seat cushions offer an entirely new comfort experience for aircraft passengers – and present an opportunity also for the automobile industry**



RECARO and Lantal jointly commercialized the first pneumatic seat product in 1Q2005

Announced Goal: The new pneumatic seat cushion will be ready to market towards the end of 2004, right on time not only for the next aircraft generation, but also for any retrofit program (*Aircraft Interiors Expo, Hamburg, 2004*).

The innovative system will be “in the air” in the first semester of 2005.

We kept our promise!

Lantal’s pneumatic seat cushion is

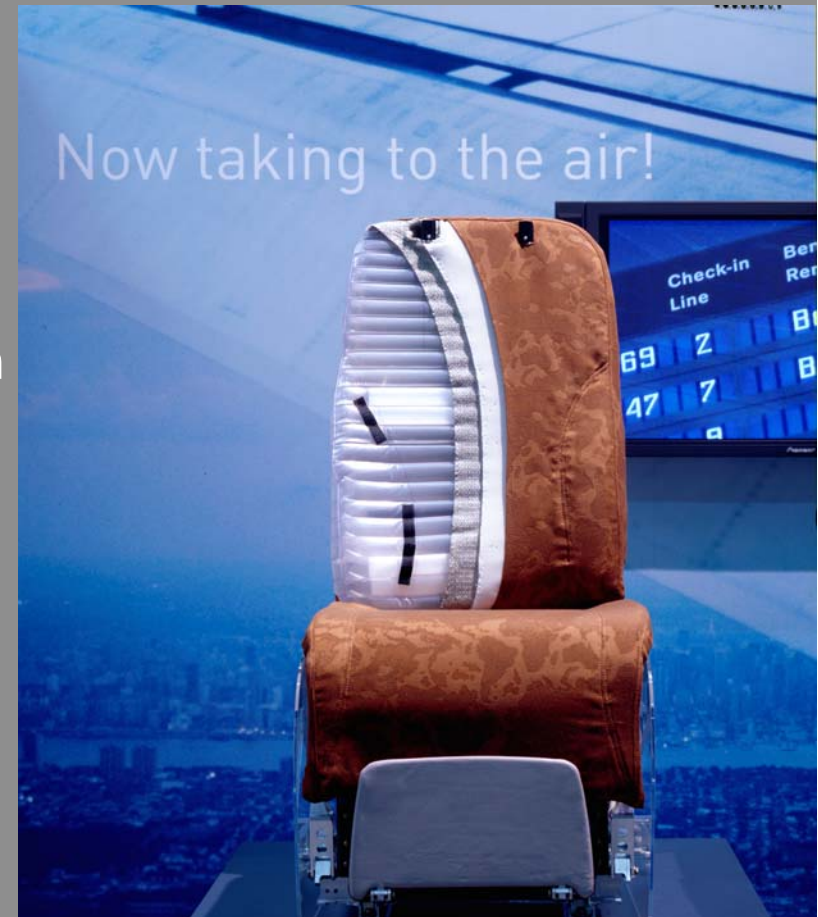
Taking to the Air – Flying successfully



Status today: First Commercial Product in the Air

- The cushions are automatically adjusted to suit posture and firmness preferences during takeoff, while eating or reading (harder), while relaxing (softer) and while sleeping (full-body support with just the right degree of firmness)
- No other type of seat can offer this spectrum of flexibility in addressing the expectations of passengers

The pneumatic cushions offer an unprecedented seating experience that cannot be matched by any existing foam aircraft seat cushion



Fourfold Launch at Hamburg's AI Expo 2005

Four companies jointly celebrated the launch of their latest product in April 2005 :

- **Airbus:** first Business Jet A319 CJ, long range
- **eurofly:** first VIP-Business service, Milano-Manhattan
- **Recaro:** first aircraft with only 6510 full flat seats
- **Lantal:** first aircraft with the innovative pneumatic seat cushions, technology-launch



The first aircraft with Lantal's pneumatic cushions on board: **eurowly's A319CJ**

- Airbus' newest jet, the long range A319 CJ with only business class seats by Recaro and with Lantal's seat back cushions

Currently leased to NAS – with positive feedback



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System description

- Realization of adaptive pneumatic seatback cushion for RECARO 6510 seat within the set targets
- Climatized seating comfort with functional new materials (fireblocker and mechanical protection)
- Pneumatic lumbar support (4-way), highly effective, with massage function
- Electronic pressure control and management system, one pump per double seat, 2 valve blocks



Actual and Potential Weight Savings

Conservative weight reduction estimates in First Class and Business Class, with one existing small compressor per double seat.
Pneumatic cushions, with fireblocker and comfort layer.

Typical weight savings per PAX for pneumatic cushions vs. foam

Backrest: 500-800 g

Seat bottom: 700-1'000 g

All cushions: 1'200 – 1'800 g



Challenges of using pneumatic structures as seat cushions

A polyurethane (PUR) pneumatic structure is, of course, air tight!

This, and PUR's inherent material properties, may give rise to concerns for users in demanding environments:

- Climatization
- Seating comfort, ergonomics
- Haptics (touch-and-feel)
- Noise
- Accidental damage
- Certification issues



Solutions found to PUR challenges with the use of specialized textiles

Nomex/Kevlar felt solves issues related to the PUR material properties:

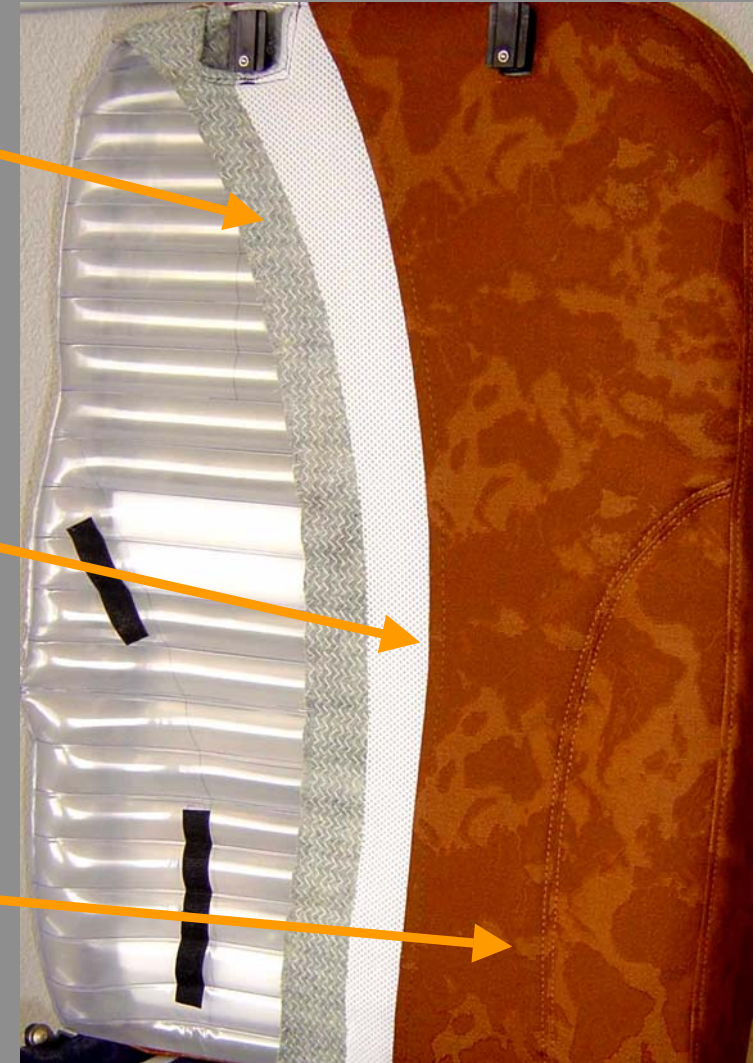
- Noise
- Accidental damage
- Certification issues (flammability)

Polyester 3D-mesh solves issues „close“ to the passenger:

- Climatization
- Seating comfort, ergonomics
- Haptics (touch-and-feel)

Lantal fabric cover (wool blend or Climatex®):

- Comfort, wearability, protection
- Individual Design Concept



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New Products: Pneumatic Crew Rest Mattresses – light, adaptable, and comfortable

- Half the weight of today's mattress solutions
- Adaptable in hardness, durable, very comfortable
- 3" mattress in evaluation by customers
- 2" version a viable option – more headspace in CRC



Weight Savings

Estimated weight reduction for pneumatic crew rest mattresses
(pneumatic mattresses, with fireblocker and comfort layers, incl. Air system)

Typical weight savings per mattress for pneumatic system vs. foam

3" pneumatic: 4.0 kg

2" pneumatic: 3.8 kg

System weight: approx. 0.5 kg per mattress

Net savings: 3.0+ kg/crew rest mattress

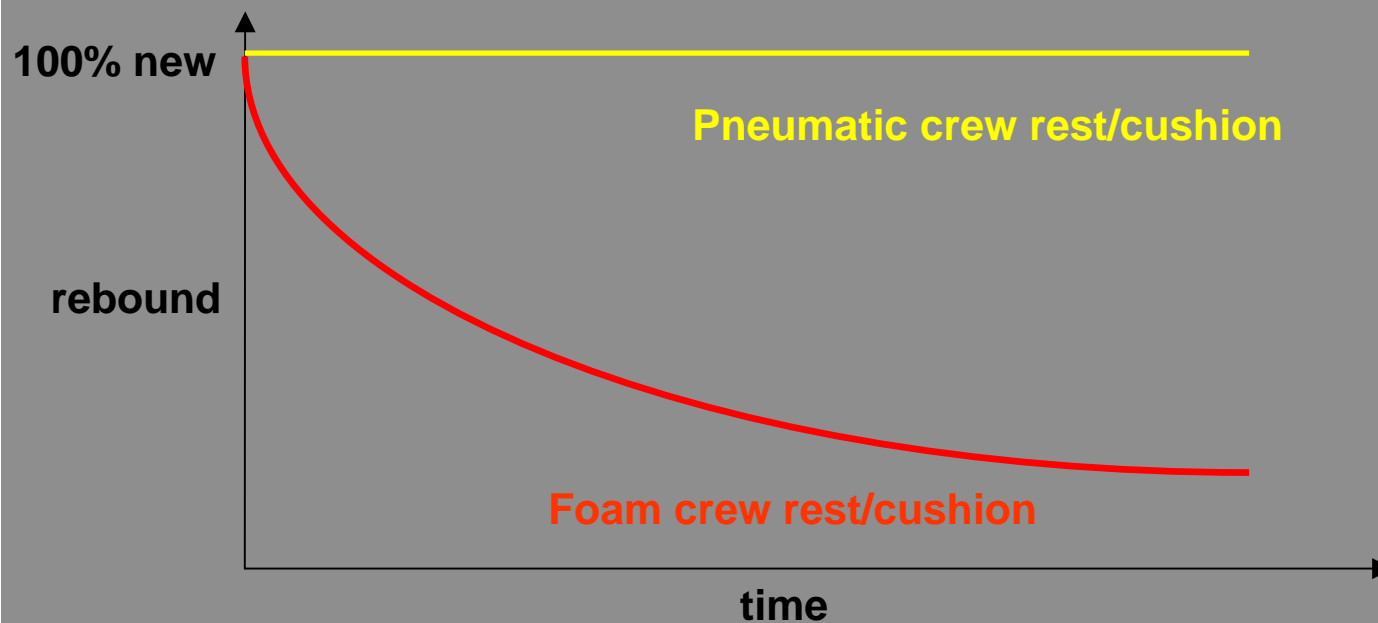
Weight savings per aircraft:

2 flight c.r, 8 attendant c.r: approx. 35 kg



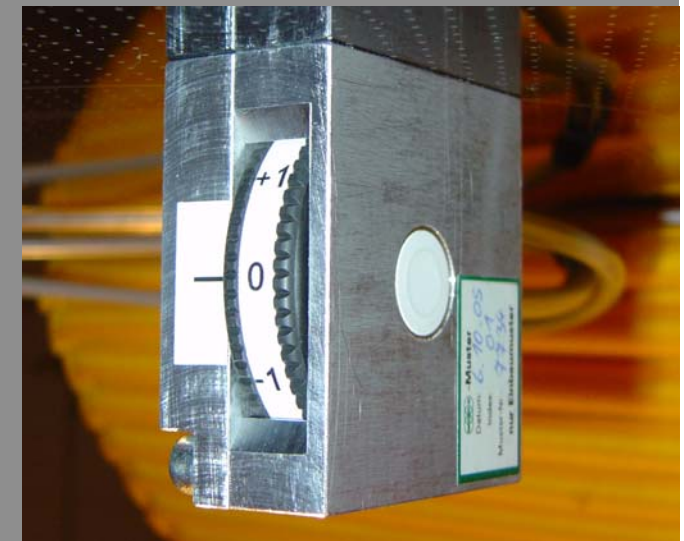
Pneumatic Crew Rest Mattresses – Longevity

- Foams degrade very quickly, high loss of rebound and flex in first 6 months
- Foam mattresses will not “come back” – crew member “bottoms out”
- Lantal’s pneumatic structures are guaranteed for 3 years
- Same hardness every time, and maintained over lifetime!



Pneumatic Crew Rest Mattresses – Surface Area and Material

- Foams have very high surface areas, open or closed cell types, 100's of m²
 - Pneumatic crew rests mattresses have very low surface area, approx. 4 m²
 - Body fluids, sweat, and spilled drinks/food will be absorbed/retained in foam
 - The same liquids will not penetrate PUR film, will not be retained
 - PUR films are not susceptible to fungi, absorbed drinks/food (sugar, fat)
-
- The amount of flammable material is reduced
 - Less PUR, less CO₂, less heat release
-
- Simple mechanical pressure regulator for crew rest mattresses (Lantal exclusive, right)



Content

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Lantal's Technology provides the passenger with the utmost well-being in all positions

- Recaro's full flat seat 6510 is also a bed: over 2 m long
- Lantal's pneumatic backrest cushion adapts its hardness and shape according to the angle of the seat back
- Supportive when sitting and reading, sofa-like for relaxing, soft yet firm enough for sleeping
- **Today's foam cushions can only represent a compromise**

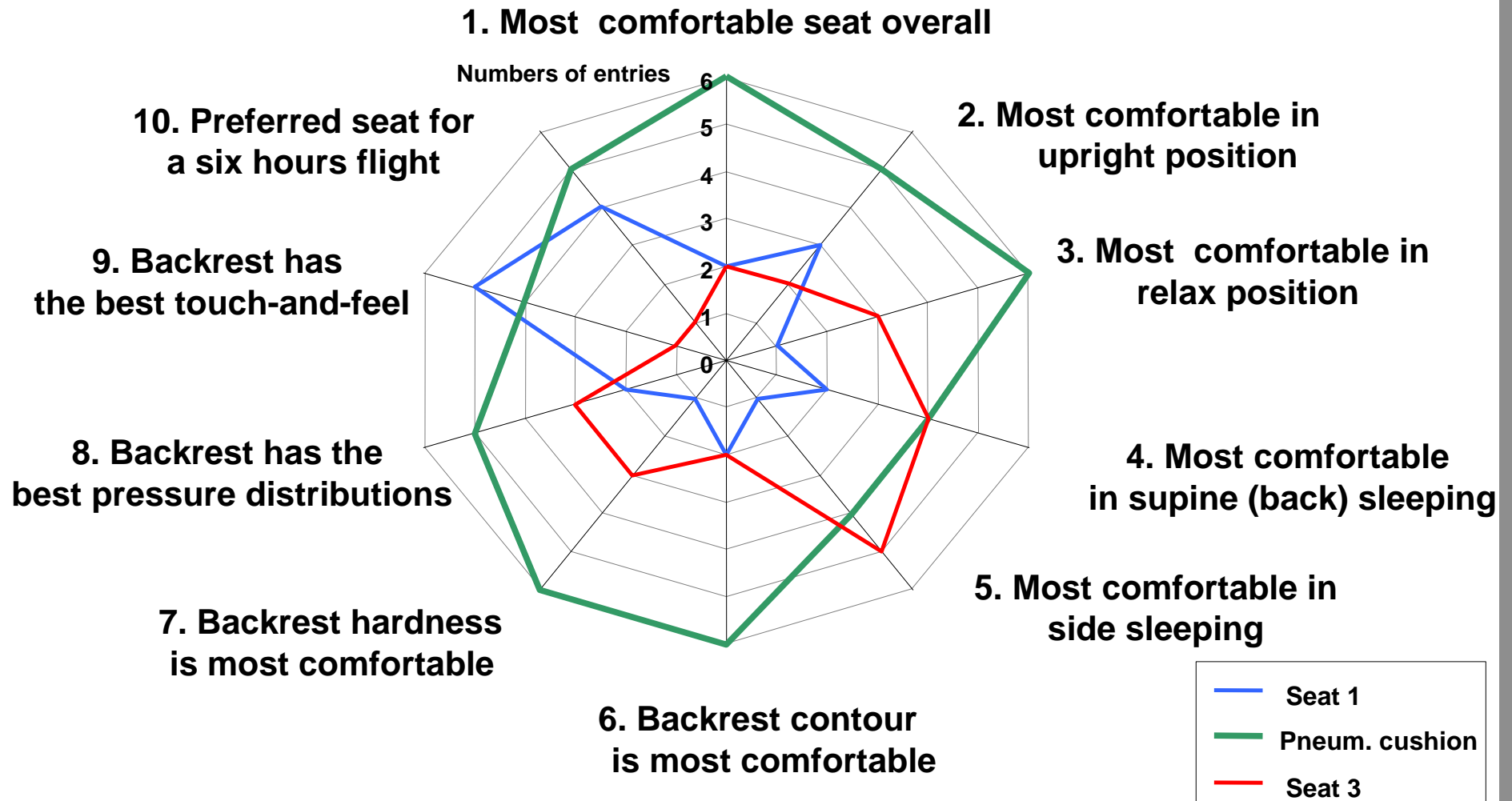


Extended Ergonomic Test Winner

Full scale ergonomic test confirms significantly increased comfort

- Lantal's pneumatic seat cushion was the overall winner and favorite seat in an extended study of a fully reclining Business Class seat
- Lantal's pneumatic seat cushion was rated best overall in 8 out of 10 test categories, placing 2nd in the other two
- Climatization issues are solved with innovative materials
- Noise as well as touch-and-feel topics are non-issues, Initial seating contact determined to be very favorable
- Test focused on automatic adaptable seat cushion – a cushion with full passenger interface is expected to yield even better results
- Lantal's pneumatic seat cushion technology possesses potential to enhance comfort, including additional features, in future developments

Ergonomic Study - Overall Assessment



Content

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Certification and Qualification Tests Passed

Certification by EASA, LBA, Airbus received, February 2005:

- All Flammability-Smoke-Toxicity tests passed
- Kerosene burner test (seat burn test) passed in multiple configurations
- System (valves, pump, controls) passed EMI and environmental tests
- Rapid decompression tests passed without additional controls, valves
- Certification tests and issues in combination with seat structure passed (SRP, positioning, etc.)
- Additional Qualification Tests with very favorable results: extended cycle testing, vandalism, climate and comfort.

Certification - FST

- **Flammability, Smoke Emission, and Toxicity Tests passed for all materials (ABD0031)**

- **Tested Materials:**
 - Polyurethane PUR film
 - Ultra light foam
 - PUR pneumatic tubing
 - Nomex FBL felt
 - 3D mesh, polyester
 - Velcro tape
 - Textile cover 91% wool, 9% polyamide, Lantal

Kerosene Burner Test passed, average loss 4.5% (requirement: < 10%)



Certification – Kerosene Burner Test

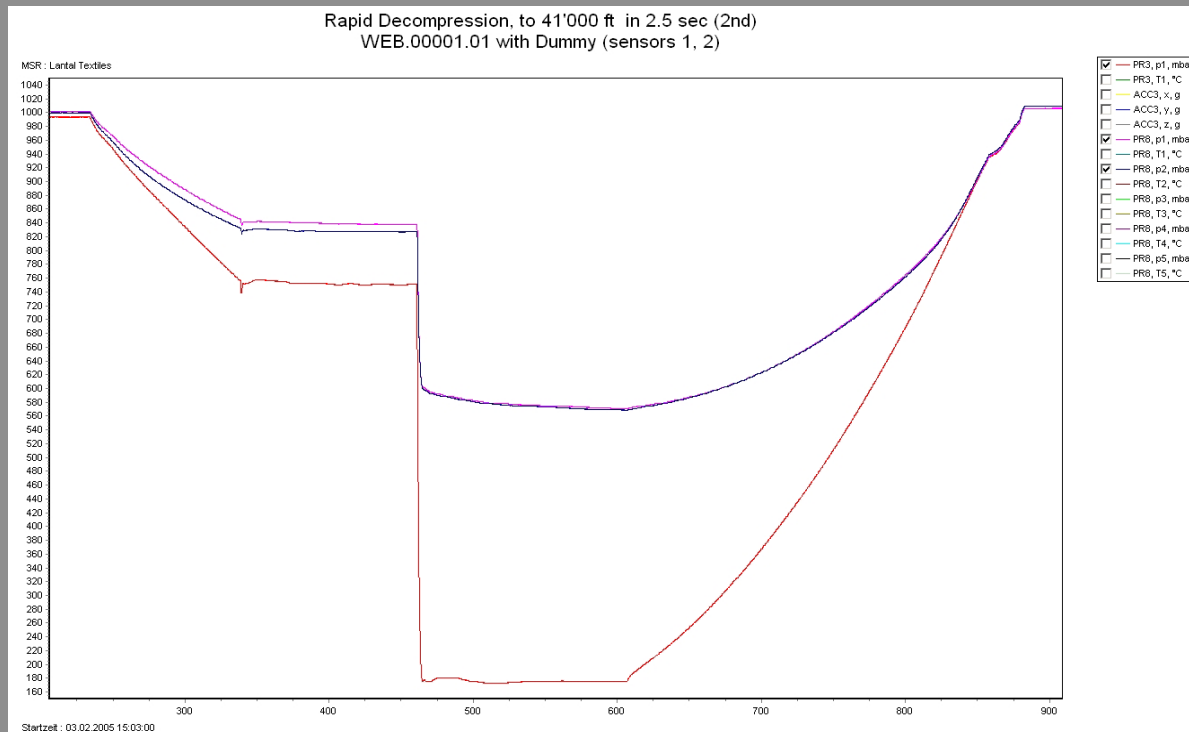
- **Weight loss:** **max. 10%**
 - 3 sets: 5%, 4.3%, 4.3%, **average: 4.5%**

- **Burn lengths:** **max. 43 cm**
 - Seat cushion top: 15, 18, 12 cm
 - Seat cushion bottom: 27, 30, 26 cm
 - Back cushion front: 27, 29, 20 cm
 - Back cushion rear: 0, 0, 0 cm

- **Extinguished after:** 75", 135", 75"

Extreme loads pose no problem for cushions

- **Rapid decompression** test in several configurations: no damage to cushion
- Tests conducted at Flugmedizinisches Institut, Königsbrück, Dresden
- Seatback cushion with FBL/climate cover and textile cover on seat structure
- No relief valves used (previous tests with relief valves showed minimal advantage)
- Decompression: 750 mbar to 180 mbar in 2.5 seconds, pressures recorded



Cushion during
Low pressure phase

Qualification - environmental

- **Temperature** (RTCA DO-160D sect. 4)
 - Ground survival low temperature -55°C
 - Ground survival high temperature $+85^{\circ}\text{C}$
 - Operating low temperature -15°C
 - Operating high temperature $+55^{\circ}\text{C}$, short time $+70^{\circ}\text{C}$

- **Rapid Decompression** (RTCA DO-160D sect. 4)
 - Decompression from 750 mbar (8'000 ft) to 240 mbar (33'000 ft) in 15 seconds
 - Additional testing from 750 mbar to 180 mbar (41'000 ft) in 2.5 sec

Qualification - environmental

- **Waterproofness** (acc. to RTCA DO-160D sect. 10)
 - justification by material information from suppliers

- **Fluids susceptibility** (acc. to RTCA DO-160D sect. 11)
 - justification by material information from suppliers
 - **Very low surface area**

- **Fungus resistance** (acc. to RTCA DO-160D sect. 13)
 - justification by material information from suppliers
no special fungicide treatment of cushion and cover
 - **Very low surface area**

Accidental damage protection established

- **Vandalism – puncture tests** with potentially hazardous objects
- Objects permitted on aircraft today (no needles, no sharp knives)
- Determination of maximum force before puncture and path traveled
- Small test cushions with FBL/climate cover and textile dress cover
- Maximum path exceeded height of test cushion (50mm) in each case
- Maximum force exceeded accidental force in each case
(200N design guideline, refer to DIN EN 1303, 5N force)

| Test Object | max. Force, N | max. Path, mm | Destroyed y/n |
|---------------------|---------------|---------------|---------------|
| Steel tip, r 0.5 mm | 354 | 104 | 2x yes |
| Ball point | 262 | 70 | yes |
| Knife | 595 | 108 | no |
| Fork | 295 | 77 | no, fork bent |

Long life cycle tests passed

- **Extended cycle tests and heavy load tests**, no pump connected
- Cushion with FBL/climate cover and textile cover, in seatback structure
- Cushion horizontal, 4.5g, (2100 N load, 1'000 cycles (1.4 hours)
- Cushion vertical, 12° angle, 1g, 460 N load, 200'000 cycles (170 hours)

- **Results:**
- Cushion's chambers have extremely low leak rates (< 1 mbar/h) at test end
- No physical damage, no surface marks or deterioration, fully usable



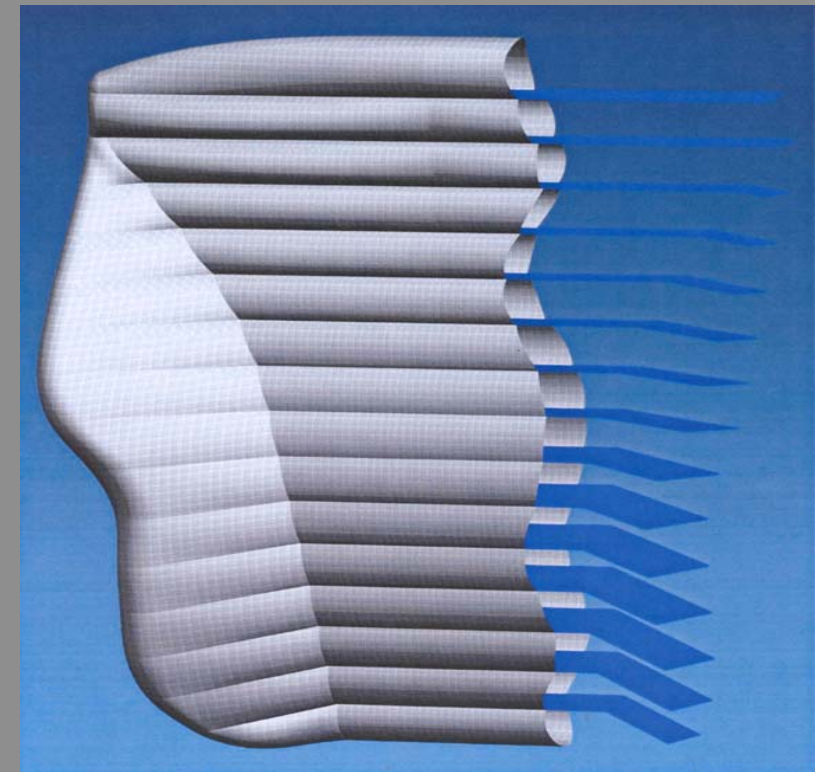
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A Commercial Success Factor: Lantal's Commitment to the Pneumatic Technology

- Lantal established on January 1, 2006, the new Business Unit „Pneumatic Systems“ with a clearly defined business plan
- As of March 1, 2006, Lantal has integrated the employees, the know-how, and the development expertise of the „Pneumatic Structures“ group of prospective concepts, Lantal's current technology partner
- Several high-level product development programs for seats and mattresses are running concurrently at the moment – the industry's interest is very high and concrete



Summary

- Lantal has developed and launched pneumatic aircraft seat cushions which replace foam entirely
- Market introduction has started and first aircraft product is operational
- Some benefits of Lantal's cushion technology are achieved in combination with specialized technical textiles
- Lantal's cushions are very light, adaptive, and rated very highly in terms of comfort
- Certified technology conforms to Airbus and EASA/FAA airworthiness specifications, longevity is inherent and guaranteed
- Pneumatic crew rest mattresses made of the same materials yield significant weight savings and increased comfort, longer life

Contact

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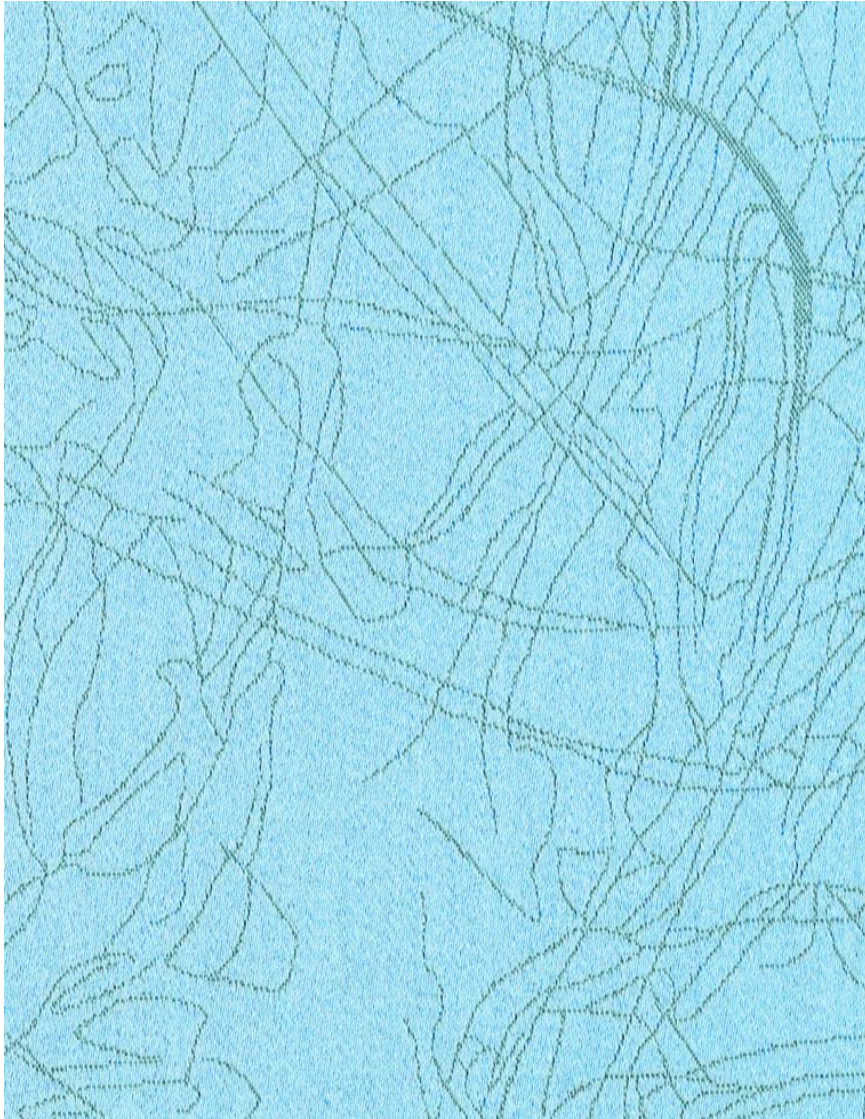
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Thank you for your interest