Smart Lining - acoustic requirements on future lightweight structures

Dr. Dietmar Völkle
Head of Innovation
Diehl Aircabin - One of Four Operational Units

Sales: over € 700 m
Employees: over 3,500
Headquarters: Laupheim, Germany

DIEHL
Aerospace
Sales: ≈ 230 m €
Employees: ≈ 1,200
Shareholders: 51% Diehl, 49% Thales
joint venture with

DIEHL
Aircabin
Sales: ≈ 330 m €
Employees: ≈ 1,400
Shareholders: 51% Diehl, 49% Thales
joint venture with

DIEHL
Comfort Modules
Sales: ≈ 140 m €
Employees: ≈ 490

DIEHL
Service Modules
Sales: ≈ 30 m €
Employees: ≈ 200

Trend 2012
Diehl Aerosystems - Building Blocks

From cockpit to cabin. Fully integrated or individual packages.
Product Overview

Air Distribution Systems

Air Ducting and Air Outlets  
Drain Pipes in Composite Technology  
Highly integrated and complex Air Ventilation Systems

Delivered in an approved quality and maturity, the compartments and monuments are optimized for quick and efficient installation. Completely tested, plug & play solutions.
Product Overview

Lining & Floor-to-Floor Capabilities

- Dado Panels
- Sidewalls
- Light Covers
- Bins
- Ceilings
- Door & Doorframe Lining
- Entrance Area

Delivered as preassembled modules with electric, lighting, O2 and safety equipment integrated.
Product Overview

**Individual Cabins / Mock-Ups**

VIP & Corporate Jet Linings  
* Designed by Mahler Industrial Design

Special Furniture / Real Wood Veneer

Mock-Ups

High-end surfaces based on extremely light weight composite materials. Integrated light solutions.
Acoustic Comfort
Noise Sources affecting Interior Noise

- **Noise sources outside cabin**
  - Engines
- **Fluid mechanic noise**
  - Boundary layer noise
  - Antenna noise
  - Landing gear, slats & flaps (departure + approach)

- **Noise sources inside cabin**
  - Air conditioning system
  - Hydraulic system
  - Avionic ventilation
  - Vacuum toilets
  - Air extraction system
  - Electrics
  - Passengers
Cabin wall construction
Noise transmission paths

- **Fuselage structure**
- **Fixing element**
- **Glass wool insulation**
- **Lining element**

**Air borne noise**

**Leakage Noise**

**Structure borne noise**

Source: Prof. Wolfgang Gleine
Example for Cabin Noise Distribution

A330 Cruise Conditions

Source: Airbus Operations
General Requirements on Interior Noise

- Creation of a comfortable acoustic environment inside Cabin and Cockpit
- Silent but acoustic privacy Cabin
- As silent as possible Crew Rest Compartments
- Well balanced noise in cabin Whole Cabin, Cockpit
- No tonal components Whole Cabin, Cockpit
- Good speech intelligibility Whole Cabin, Cockpit
- Compliance to noise regulations e.g. Galley area

“Stop snoring”

“Sorry”
Solutions for improved cabin acoustics

Mass enhancement:

- Additional silicone heavy layer is added in order to increase the transmission loss
- Extensive weight and cost impact
Noise masking

- Annoying noise from flight deck and galley within crew rest compartment
- Overlay of “ambient noise” in low frequency range
- 5 kg weight investment into intelligent noise masking system lead to savings of weight for standard insulation material
- Easy adaption of “masking sound” via software update
Conclusion

• All presented solutions show negative effects
  – Weight
  – Surface quality
  – ...

• New approach for enhanced cabin acoustics needed

• Cooperation with the German Aerospace Centre (DLR): Smart active Lining Module (SALIM)
Acoustic comfort with smart active lining modules

- Active control of noise emitting structural vibrations of the sidewall panel (ASAC)
- Best performance in the low-frequency range (< 500 Hz)
- Reduction of narrow- and broadband noises
- Effective for all noise sources entering from the exterior of the sidewall panels
- Suitable for retrofitting
Vielen Dank
für
Ihre Aufmerksamkeit