Automotive Interior Applications
Requirements, Materials and Solutions
Michael Hörr, Market Development Automotive EU

Source: Volkswagen
Fully variable interior
Individualization
Automatic positioning
Precrash control
Selective airbags
Connected Car

Source: BMW AG

The automotive interior of the future with Celanese plastics
“Comfort and Safety in Interior will continue to grow”

Comfort
- Electronic adjustments/
  lumbar seat
- Active seat/
  single seat
- Climatisation/
  Heating
- Ambience/
  Lighting
- Memory
- Sound

Safety
- Airbag
  - Window and seat
  - Knee and feet
  - Anti-submarining
    selective airbags
- Beltsystem
  - Integrated
    beltsystems
  - Twin tensioner
  - 4 points belts
  - „Airbag belt“
- Seat structure
  - Active head rests
  - Electronic adjustors
  - Sensors
    (passengers)
  - Lightweight

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Automotive Interior Applications 3
Interior Requirements

Development trends

► Low-emission plastics
► Attractive surface
► Design freedom
► Function integration
► Metal replacement
► Weight reduction

Material choice

► Appearance (structure, colour, gloss)
► Strength (stiffness, crash, temperature)
► Stability (UV, chemical, time)
► Cost (production, aftertreatment, integration)
# Overview Materials and Segments
## Automotive Interior

<table>
<thead>
<tr>
<th></th>
<th>Cockpit</th>
<th>Seats</th>
<th>Trim</th>
<th>Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structural Parts</strong></td>
<td>Celstran® LFT</td>
<td>Celstran® LFT</td>
<td>Celstran® LFT</td>
<td>Celstran® LFT</td>
</tr>
<tr>
<td><strong>Functional Parts</strong></td>
<td>Hostaform® XAP² Hostaform® Tribological Types Hostaform® GV Celanex® PBT GV</td>
<td>Hostaform® XAP² Hostaform® Tribological Types Hostaform GV Celanex® PBT Fortron® PPS Vectra® LCP Celstran® LFT</td>
<td>Hostaform® XAP² LS Celanex® PBT/PET</td>
<td>Hostaform® XAP² Hostaform® Tribological Types Hostaform GV Celanex® PBT Fortron® PPS Vectra® LCP Celstran® LFT</td>
</tr>
<tr>
<td><strong>Visible Parts</strong></td>
<td>Hostaform® XAP² LS Celanex® PBT/PET MetaLX</td>
<td>Hostaform® XAP² LS Hostaform® LS</td>
<td>Hostaform® XAP² LS Hostaform® LG MetaLX</td>
<td>Hostaform® XAP² LS</td>
</tr>
</tbody>
</table>

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Overview: Four categories of interior groups
Requirements for material choice

1. Cockpit
2. Seats
3. Trim
4. Safety

Source: Audi
Cockpit
Trends on cockpit design

Cost reduction
► Simplification of assembly
► Integration of additional functions
► Weight reduction
► Part reduction
► Modularisation

Comfort
► Modularity for individuality
► Low emission
► Colorability
► Good tribological behavior

Safety
► Increased crash requirements
## Cockpit
I-Panel and I-Panel applications and requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structural parts</strong></td>
<td></td>
</tr>
<tr>
<td>► Dashbord</td>
<td>► Celstran® LFT</td>
</tr>
<tr>
<td>► Center Console</td>
<td></td>
</tr>
<tr>
<td>► High mechanical load by stress</td>
<td></td>
</tr>
<tr>
<td>► Stiffness</td>
<td></td>
</tr>
<tr>
<td>► Dimensional stability</td>
<td></td>
</tr>
<tr>
<td>► Noise behavior</td>
<td></td>
</tr>
<tr>
<td><strong>Metal substitution</strong></td>
<td></td>
</tr>
<tr>
<td>► Weight reduction</td>
<td>► Celstran® LFT</td>
</tr>
<tr>
<td>► Modularisation</td>
<td></td>
</tr>
<tr>
<td>► Functional intergration</td>
<td></td>
</tr>
<tr>
<td><strong>Functional parts</strong></td>
<td></td>
</tr>
<tr>
<td>► Gears and gear housings</td>
<td>► Hostaform® POM</td>
</tr>
<tr>
<td>► Sliding elements</td>
<td>► Celstran® LFT</td>
</tr>
<tr>
<td>► Clips and Switches</td>
<td>► Celanex® PBT</td>
</tr>
<tr>
<td>► Low friction &amp; wear</td>
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<td>► High stiffness</td>
<td></td>
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<tr>
<td>► Low emission</td>
<td></td>
</tr>
<tr>
<td><strong>Visible parts</strong></td>
<td></td>
</tr>
<tr>
<td>► Loud speaker grilles</td>
<td>► Hostaform® POM</td>
</tr>
<tr>
<td>► Air outlet guides</td>
<td>► Celanex® PBT</td>
</tr>
<tr>
<td>► Push buttons, knobs</td>
<td>► Celstran® LFT</td>
</tr>
<tr>
<td>► Covers</td>
<td></td>
</tr>
<tr>
<td>► UV-stability</td>
<td></td>
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<td>► Low warpage</td>
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<td>► High stiffness/strength</td>
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<tr>
<td>► High HDT</td>
<td></td>
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<tr>
<td>► Low emission</td>
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</tr>
</tbody>
</table>
## Cockpit
### I-Panel and I-Panel Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Requirements</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-Panel</td>
<td>Weight reduction, high stiffness and impact strength, passenger airbag function -35°C till +85°C, higher dimensional stability, tighter tolerances, lower warping, better heat aging behavior;</td>
<td>Celstran® LFT</td>
</tr>
<tr>
<td>Bildschirm-kinematic</td>
<td>Requirements: Long term functionality, comfort through noise-deadening and wear-protecting, reduce acoustic vibrations, low emission, improved tribology</td>
<td>Hostaform® POM XAP^2</td>
</tr>
<tr>
<td>Head up Display</td>
<td>Requirements: Weight reduction, dimensional stability, temperature resistance, tight tolerances, CTE - creep resistance comparable to aluminium</td>
<td>Fortron® PPS 6165 A6</td>
</tr>
<tr>
<td>Display Instrument Housing</td>
<td>Requirements: High stiffness, slip and wear properties, appearance, UV stability, coloration, lasermarkable, scratch resistance</td>
<td>Hostaform® POM LM LS XAP^2</td>
</tr>
</tbody>
</table>

Source: Volkswagen
Cockpit I-Panel Components

**Display Instrument Housing**
- Requirements: High light proofness, high stiffness and strength, low warping
- Products: Celanex® PBT

**Carrier Plate Instrument Board**
- Requirements: Functional Integration by outsert technology
- Products: Hostaform® POM

**Clima**
- High strength, rigidity and hardness, slip and wear performance, chemical resistance, appearance and haptic
- Products: Hostaform® POM GV

**Ventilation**
- Requirements: Stiffness, appearance, good tribological behavior, low emission, tight tolerances, dimensional stability, colorability, UV stability
- Products: Hostaform® POM XAP², Celanex® PBT

Source: Volkswagen
Cockpit
I-Panel Components Center Console

Requirements: High light proofness, high stiffness and strength, low warping
Products: Celanex® PBT

Shifter Console

Requirements: Stress cracking resistance, sliding properties, improved tribology, high rigidity, snap fitting, UV-stability, low emission
Products: Hostaform® POM XAP®

Gear Shift

Requirements: High stiffness, wear resistance and impact strength, good acoustic properties, weight and CO₂ reduction
Products: Celstran® LFT, Hostaform® POM GV, Celanex® PBT

Lever

Requirements: High stiffness and strength, good slip & wear properties, good dimensional stability, overmolded metal inserts, low emission
Material: Hostaform® POM C 9021 GV

Source: Volkswagen
Cockpit
Steering wheel

Turning Switch
Requirements: Good slip and wear behavior, low emission grades, good mechanical properties, laser inscription, snap fit properties
Products: Hostaform® POM, Celanex® PBT

Switch
Glass fiber reinforcement 10% - 26% (w/w). Tensile modulus up to 9200 MPa., very high strength and rigidity and increased hardness, scratch and write resistance, reduced thermal expansion and shrinkage. Product: Hostafom® POM GV

Decor Elements
Metallic look, low emission grades, colorability, high surface quality (haptic), UV and chemical resistance, cost reduction
Products: Hostaform® POM, Celanex® PBT, MetaLX

Clock Spring
Good friction, slip and noise properties, high flowability; dimensional stability, temperature behavior - 40°C to +80°C, low emission
Products: Hostaform® POM XAP²
## Cockpit Pedals

### Electronic accelerator Pedal
- **Requirements:** Light weight coupled with high strength, insensitivity to moisture and temperature, good mechanical properties, surface appearance, tight tolerance and high functionality
- **Products:** Celstran® LFT, Hostaform® POM, Celanex® PBT

### Control Housing and Pedal
- **Requirements:** Strength, stiffness, low deformation, low weight, low emission, appearance
- **Products:** Celstran® LFT

### Pedal Bracket
- **Requirements:** Weight and cost reduction, vs. metal, low deformation, good damping behavior (acoustics), high stiffness and toughness, low warping, appearance
- **Products:** Celstran® LFT

### Functional Elements (sliders, bearings)
- **Requirements:** High stiffness, high dimensional stability, good electrical and dielectric properties, tribologic performance
- **Products:** Hostaform® XAP®, Celanex® PBT GV, Celstran® PP
Automotive Seating
Trends on seat systems

Cost reduction
► Simplification of assembly
► Integration of additional functions
► Weight reduction
► Part reduction
► Modularity

Comfort
► Modularity for individuality
► Low emission
► Colorability
► Good tribological behavior

Safety
► Increased crash requirements
► Active headrest
# Automotive Seating

## Seating applications and requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Material</th>
</tr>
</thead>
</table>
| **Tribologically treated components**  
► Guidances, slider, bearings  
► Slidings  
► Gear wheels | ► Low friction & wear  
► Hostaform® POM |
| **Metal substitution**  
► Sliding elements  
► Seat structure | ► High stiffness/strength  
► High HDT  
► Low warpage  
► Celstran® LFT |
| **Functional parts**  
► Head rest sleeves  
► Sliding elements | ► Low moisture abs.  
► Low friction & wear  
► High stiffness  
► Hostaform® POM  
► Celstran® LFT |
| **Visible parts**  
► Seat release buttons  
► Belt outlet covers  
► Push buttons | ► UV-stability  
► Low warpage  
► High stiffness/strength  
► High HDT  
► Hostaform® POM  
► Celanex® PBT  
► Celstran® LFT |
Automotive Seating
Functional Parts

- **Seat Belt Tensioner**
  - Requirements: weight reduction to metal, strength and stiffness even at high temperature, acoustic performance, functional integration, tribology; Products: Impet® PET GV

- **Seat Adjustment Lever**
  - Requirements: strength, stiffness and inherent tribologic performance, UV stability, coloration, lasermarkable; Products: Hostaform® POM LM XAP

- **Wire Suspension / Spring Elements**
  - Requirements: strength, stiffness, snap fit properties and resilience, low emission grades; Products: Hostaform® POM XAP

- **Sliding Rails / Seat Adjustment**
  - Requirements: Slip modified, improved friction and abrasion behavior, coloration, low emission; Products: Hostaform® POM

- **Seat Ventilation**
  - Requirements: flowability and low warping and noising, slip modified, improved friction and abrasion behavior, high stiffness; Products: Hostaform® POM, Vectra® LCP E130i

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Automotive Seating
Functional Parts: Functional integration

Back Seat Table (Picnic Table)
Requirements: strength, snap fit and resilience, slip and wear performance, no moisture absorption, dimensional stability, comfort (slip, wear, noise) regulations
Products: Hostaform® POM

Lumbar Support
Requirements: Slip modified, improved friction and abrasion behavior, resilience, creeping;
Products: Hostaform® POM, Celanex® PBT

Power Seat Adapter
Requirements: High temperature and torque resistance, slip and wear performance
Products: Fortron® PPS, Celanex® PBT

Actuator
Requirements: Stiffness, high dimensional stability; functional integration, low warp, tribological performance:
Products: Hostaform® POM, Celanex® PBT
<table>
<thead>
<tr>
<th>Component</th>
<th>Requirements</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rear seat release button</td>
<td>Strength, high stiffness, appearance (colors, UV stability, scratch and write resistance), inherent tribological performance; resilience</td>
<td>Hostaform®, POM LS XAP®</td>
</tr>
<tr>
<td>Headrest adjustment</td>
<td>Excellent tribological behavior, low emission, independency of strength/stiffness behavior by moisture</td>
<td>Hostaform®, POM XAP®</td>
</tr>
<tr>
<td>Headrest adjustment (Integral seat)</td>
<td>Low creeping, high modulus and strength (belt tension behavior), heat aging, slip and wear behavior</td>
<td>Hostaform®, POM XAP®</td>
</tr>
</tbody>
</table>

Source: BMW
Automotive Seating
Functional Parts: Functional integration

- **Headrest Backseat Module**
  - Requirements: excellent tribological performance, moisture independence, low emission, stiffness, strength
  - Product: Hostaform® POM XAP²

- **Head Rest Adjustment**
  - Weight reduction, stiffness, dimensional stability, low warp, acoustics, low emission;
  - Products: Celstran® PP, Hostaform® POM XAP

- **Crashactive Head Rest Module**
  - Functional integration, stiffness, toughness, energy absorption and strength, dimensional stability, low warp, slip and wear performance,
  - Products: Celstran® PA, Celstran® PP, Hostaform® POM XAP, Celanex® PBT

- **Head Restraint Guides**
  - Requirements: stiffness, strength, excellent tribological behavior, colorability, low emission grades,
  - Product: Hostaform® POM XAP² LS
### Automotive Seating
#### Structural Parts

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Back Seat Structure</strong></td>
<td>Strength/stiffness to weight ratio, crash performance, weight and cost reduction, safety regulations:</td>
<td>Celstran® LFT+ Celstran® LFT Tapes</td>
</tr>
<tr>
<td><strong>Back Seat Panel</strong></td>
<td>Requirements: luggage retention, toughness, strength to weight ratio,</td>
<td>Celstran® LFT</td>
</tr>
<tr>
<td><strong>Head Rest</strong></td>
<td>Slim design, dimensional stability, low warp, slip and wear performance,</td>
<td>Celstran® PP</td>
</tr>
<tr>
<td><strong>Crashactive Headrest</strong></td>
<td>Function integration, stiffness, energy absorption and dynamic strength, dimensional stability, low warp, slip and wear performance,</td>
<td>Celstran® PA, Celstran® PP, Hostaform® POM XAP, Celanex PBT</td>
</tr>
</tbody>
</table>

*Sources: Esoro, Lear*
Trim
Trends on interior trim

Cost reduction
- Simplification of assembly
- Integration of additional functions
- Metallic surface with metallic touch
- Part reduction
- Modularity

Comfort
- Modularity for individuality
- Low emission
- Colorability
- Good tribological behavior

Safety
- Electromagnetic compatibility
- Laser markable grades
- Long term functionality
## Trim

**Trim applications and requirements**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tribologically treated</strong></td>
<td></td>
</tr>
<tr>
<td>components</td>
<td></td>
</tr>
<tr>
<td>► Sun wiser</td>
<td>► Hostaform® POM</td>
</tr>
<tr>
<td>► Cable guidances</td>
<td></td>
</tr>
<tr>
<td><strong>Metal substitution</strong></td>
<td></td>
</tr>
<tr>
<td>► Door handles</td>
<td>► Celanex® PBT</td>
</tr>
<tr>
<td>► Door bezels</td>
<td>► Celstran® LFT</td>
</tr>
<tr>
<td>► High stiffness/strength</td>
<td></td>
</tr>
<tr>
<td>► High HDT</td>
<td></td>
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<tr>
<td>► Low warpage</td>
<td></td>
</tr>
<tr>
<td><strong>Functional parts</strong></td>
<td></td>
</tr>
<tr>
<td>► Clips and Fasteners</td>
<td>► Hostaform® POM</td>
</tr>
<tr>
<td>► Low moisture abs.</td>
<td>► Celstran® LFT</td>
</tr>
<tr>
<td>► Low friction &amp; wear</td>
<td></td>
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<tr>
<td>► High stiffness</td>
<td></td>
</tr>
<tr>
<td><strong>Structural parts</strong></td>
<td></td>
</tr>
<tr>
<td>► Sun wiser</td>
<td>► Celanex® PBT</td>
</tr>
<tr>
<td>► UV-stability</td>
<td>► Celstran® LFT</td>
</tr>
<tr>
<td>► Low warpage</td>
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<td>► High stiffness/strength</td>
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<td>► High HDT</td>
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</table>
Hostaform® XAP² products will offer at least 50% improvement versus first generation XAP® products

► Significant reduction in emission confirmed by customers
  – Fulfilling future automotive OEM’s requirements <5 ppm

► Hostaform®/Celcon® XAP² products will offer Inherent
  – Process robustness – no mold deposit
  – Mechanical & Chemical properties
  – Impact resistance & resilience
  – Excellent Slip & Wear characteristics
  – Broadest range of Hostaform® / Celcon® XAP² grades available to date.

Source: Daimler
**Trim**

- **Loud speaker grilles**
  - Requirements: design freedom, thinwall moulding, long flow paths, low emission. UV resistant, tailor-made coloration, scratch resistance;
  - Products: Hostaform® POM XAP² LS colored

- **Door handles**
  - Requirements: high quality metallic effect, paint replacement, reduced handling cost;
  - Products: Hostaform® POM MetaLX UV stabilized

- **Interior Door handle surround Door bezel**
  - Requirements: appearance finish (colors, UV stab, low gloss), hardness (scratch and write resistance), snap fit properties;
  - Products: Hostaform® POM

Source: Daimler
### Trim

**Requirements:** strength, stiffness, appearance (colors, UV stab, scratch and write resistance), inherent tribologic performance; resilience

**Products:** Hostaform® POM LS XAP

### Sun Visor

**Requirements:** high quality surface, UV resistant, tribologically optimized Slip, wear and acoustic performance, clip performance, misuse, functionality. Mar and long term UV resistance: Coloration

**Products:** Hostaform® POM

### Clips and Fasteners

**Requirements:** snap fit and retention properties, low creep, low emission grades, weld line strength, high impact energy absorption.

**Products:** Hostaform® POM
Safety

Trends on interior safety systems

Comfort

Safety

► Precrash and passenger sensing
► Distance sensors

► Multi airbag systems
► Active inflating belt
► Long term functionality

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Automotive Interior Applications
26
Safety applications and requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tribologically treated components</strong>&lt;br&gt;► Belt retractor systems&lt;br&gt;► Cable guidances</td>
<td>► Low friction &amp; wear&lt;br&gt;► Hostaform® POM</td>
</tr>
<tr>
<td><strong>Metal substitution</strong>&lt;br&gt;► Airbag Container&lt;br&gt;► Belt Adjustment</td>
<td>► High stiffness/strength&lt;br&gt;► High HDT&lt;br&gt;► Low warpage&lt;br&gt;► Celanex® PBT&lt;br&gt;► Celstran® LFT</td>
</tr>
<tr>
<td><strong>Functional parts</strong>&lt;br&gt;► Clips and Fasteners&lt;br&gt;► Sensors</td>
<td>► Low moisture absorption&lt;br&gt;► Low friction &amp; wear&lt;br&gt;► High stiffness&lt;br&gt;► Hostaform® POM&lt;br&gt;► Celanex® PBT&lt;br&gt;► Vectra® LCP</td>
</tr>
<tr>
<td><strong>Structural parts</strong>&lt;br&gt;► Airbag Containers</td>
<td>► Low warpage&lt;br&gt;► High stiffness/strength&lt;br&gt;► High HDT&lt;br&gt;► Celstran® LaFT</td>
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</tbody>
</table>
More than 50 percent of all traffic accidents are rear end collisions
Active head restraint systems prevent neck injuries
Lower consequential costs in accidents

Consistent products and services – worldwide High-performance plastics in head restraint systems, guides and belt tensioners
Safety

Requirements: strength and toughness to weight ratio; low emission levels, excellent tribological behavior
Products: Hostaform® POM XAP²

Belt retractor systems

Seat belt tensioner

Ratched Wheel

Requirements: improved strength/thoughtness ratio, improved weldline integrity, low emission grades;
Products: Hostaform® S XAP²

Unique property profile
(stiffness- thoughtness and weldline performance); robust processing behavior/ thermal stability
Product: Hostaform S XAP2
### Safety

**Push Button**
- Requirements: dynamic strength and toughness, inherent tribological, scratch and write resistance; UV stable, colorability, slip and wear performance.
- Products: Hostaform® POM

**Seat belt tensioner**
- Requirements: friction properties, hardness, low emission grades.
- Products: Hostaform® POM XAP²

**Lateral Sensor Housing for Airbags**
- Requirements: Colorability, functional integration.
- Products: Celanex® PBT 2300

**Sensor for Safety Belt**
- Requirements: 3D MID Technology, functional integration, electrification.
- Products: Vectra® LCP
Summary

- Higher demands on low emission grades
- Greater product diversity - Efficient productivity
- Safety enhancement: Increased regulatory requirements - Converging global standards
- Celanese offers exclusive know how and processing opportunities beside a wide support on construction and calculation work
- In addition Celanese can provide trainings to customers on request

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Automotive Interior Applications 31

We are where the markets are – as well as one step ahead!
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