

# Automotive Interior Solutions

Optimised performance and surface  
aesthetics



**BOREALIS**

بروج

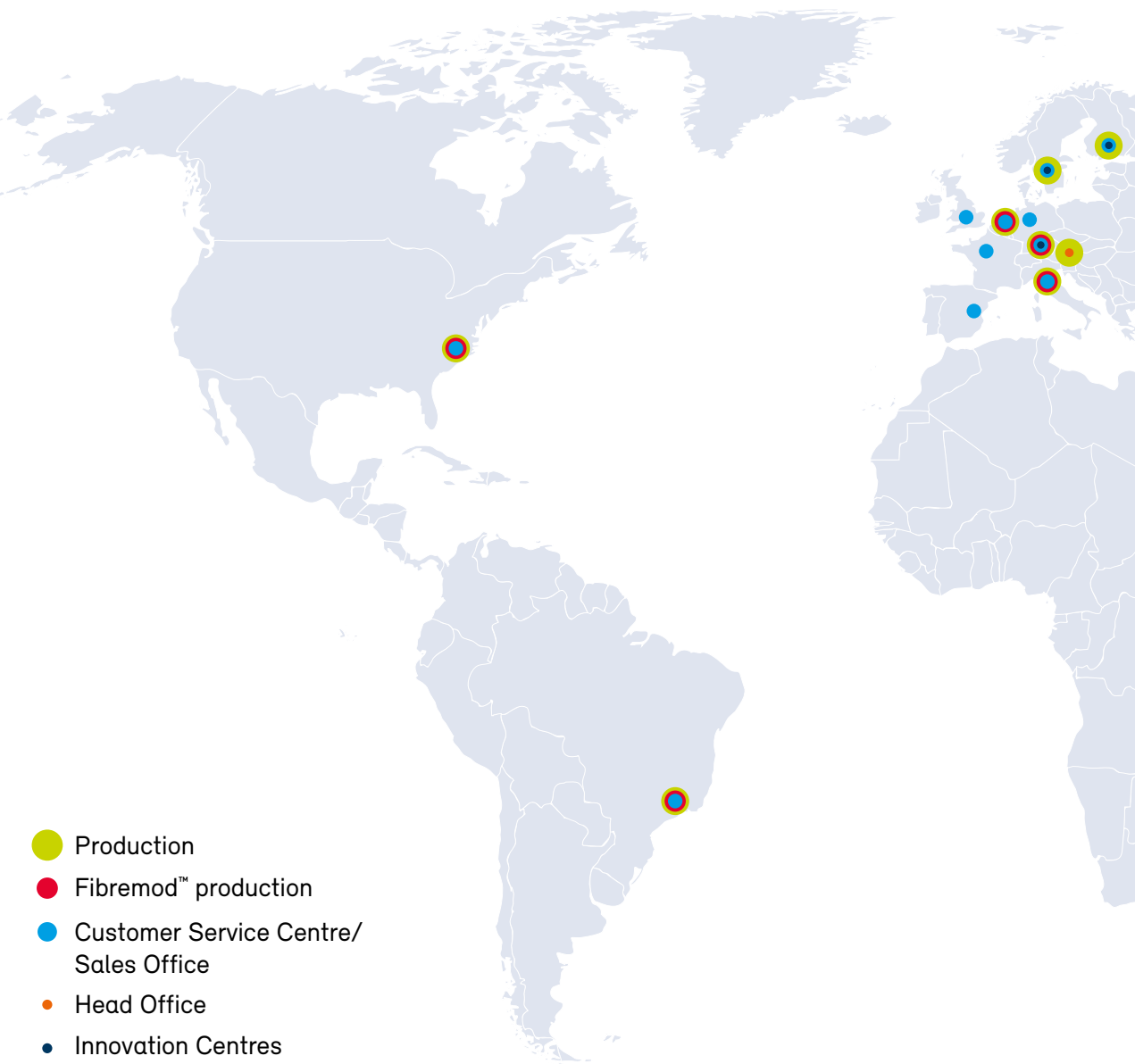
**Borouge**



# Borealis and Borouge – partners for long-term success

**Building on Borealis' unique Borstar® technology and experience in polyolefins of more than 50 years, Borealis and Borouge provide innovative, value creating plastics solutions for the infrastructure – pipe systems and power and communication cables – automotive and advanced packaging industries. In addition, Borealis offers a wide range of base chemicals from melamine and plant nutrients to phenol and acetone.**

Borealis is a leading provider of innovative solutions in the fields of polyolefins, base chemicals and fertilizers. With headquarters in Vienna, Austria, the company currently has around 6,500 employees and operates in over 120 countries. Borealis generated EUR 7.7 billion in sales revenue and a net profit of EUR 988 million in 2015. The International Petroleum Investment Company (IPIC) of Abu Dhabi owns 64% of the company, with the remaining 36% belonging to OMV, an international, integrated oil and gas

- 
- Production
  - Fibremod™ production
  - Customer Service Centre/  
Sales Office
  - Head Office
  - Innovation Centres

company based in Vienna. Borealis provides services and products to customers around the world in collaboration with Borouge, a joint venture with the Abu Dhabi National Oil Company (ADNOC).

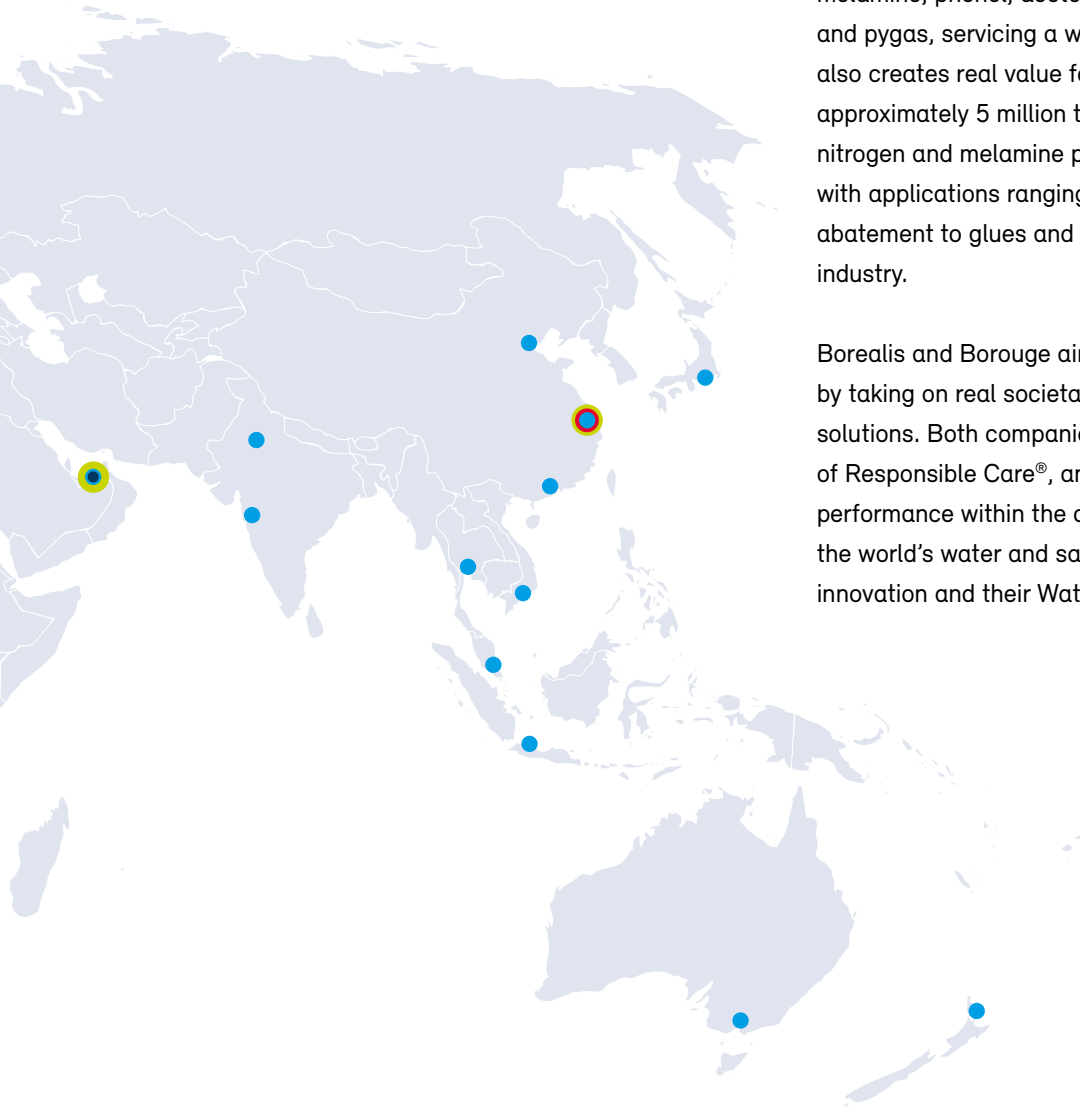
Building on its proprietary Borstar® and Borlink™ technologies and more than 50 years of experience in polyolefins, Borealis and Borouge support key industries with a wide range of applications in the areas of energy,

automotive, pipes, consumer products, healthcare, and advanced packaging.

The Borouge 3 plant expansion in 2015 made Borouge the world's largest integrated polyolefins complex. The additional 2.5 million tonnes of polyolefin capacity increased the total Borouge annual capacity to 4.5 million tonnes, attaining a combined Borealis and Borouge annual capacity of 8 million tonnes.

Borealis offers a wide range of base chemicals, including melamine, phenol, acetone, ethylene, propylene, butadiene and pygas, servicing a wide range of industries. Borealis also creates real value for the agricultural industry, selling approximately 5 million tonnes of fertilizers. Technical nitrogen and melamine products complement the portfolio with applications ranging from mono-nitrogen oxide (NOx) abatement to glues and laminates in the wood working industry.

Borealis and Borouge aim to proactively benefit society by taking on real societal challenges and offering real solutions. Both companies are committed to the principles of Responsible Care®, an initiative to improve safety performance within the chemical industry, and work to solve the world's water and sanitation challenges through product innovation and their Water for the World™ programme.





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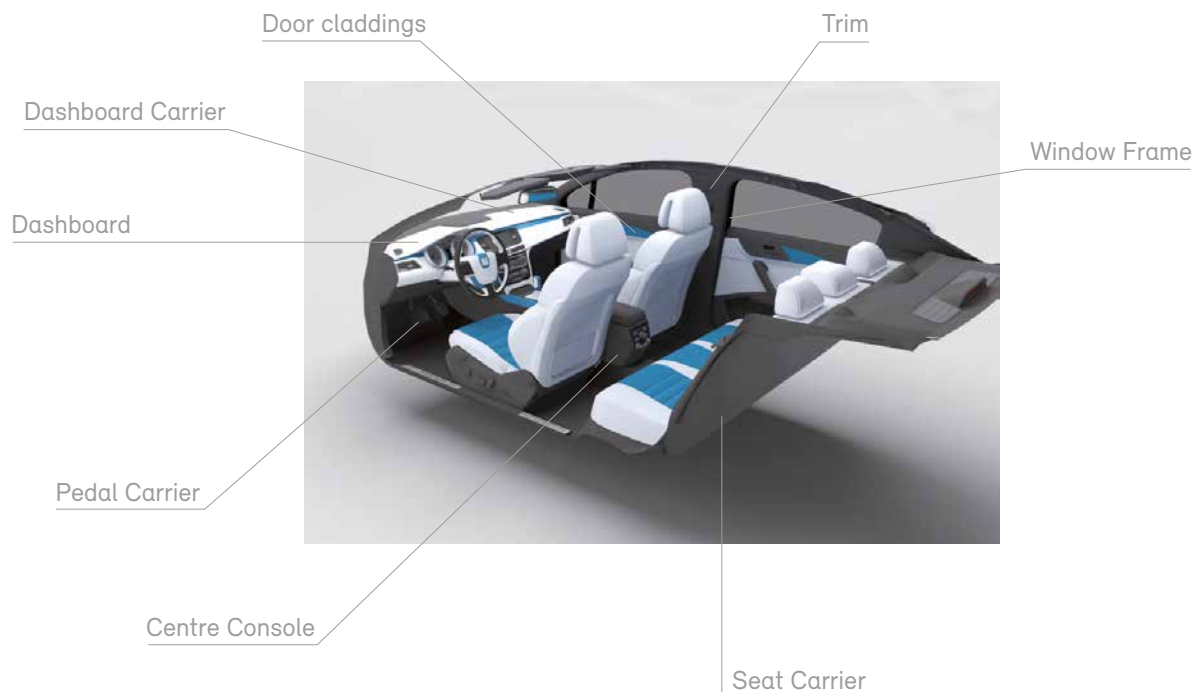
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## Dedicated to automotive solutions

For Borealis and Borouge, automotive is a business segment where we apply our specialist knowledge and decades of experience. We are focused on the development of 'creative innovation' polypropylene (PP) and thermoplastic polyolefin (TPO) solutions for automotive applications.

Whether you are producing dashboards, door panels, centre consoles, trims or structural components, Borealis

is the right partner. Our comprehensive range of PP and TPO polymers and compounds have properties that are balanced and tailored to precisely match the needs of the automotive industry. As such they add value through helping manufacturers to lower system costs, while providing reliable performance to the highest global industry standards, as well as enabling faster development-to-production cycles. And, no less importantly, they reduce both material and energy inputs for enhanced sustainability.



### Staying ahead of trends

Our close working partnerships with OEMs and Tier 1 suppliers over many years have given us a unique understanding of automotive value chain needs. Our ongoing dialogue with industry partners is of special importance, as it enables Borealis to identify and act on evolving market trends.

This allows us to focus the resources and scientific skill-sets of our Innovation Centres on ensuring optimal, differentiated and integrated solutions that meet tomorrow's needs, before they become tomorrow's challenges.

# Satisfying aesthetic and performance demands

Visual appearance is the first and dominant influence on the buyer's perception of vehicle quality. Our PP and TPO resins and compounds are developed to make a positive contribution to that perception through, for example, the

generation of appeal through low gloss, scratch resistant interior trims and cladding that emphasise style, as well as providing for the design freedom that complements aesthetic objectives.



The sense of touch has a special relationship to the way we connect with our surroundings and through it our appreciation of comfort. The haptic characteristics of our PP and TPO materials for passenger contact applications, such as smoothness, grained effect, soft-touch or

stiffness, are given special consideration in our material developments. No less attention is paid to the material's low emission and odour, non-fogging and sound dampening characteristics, which complete our perception of quality and the comfort of our driving experience.

## Lightweight structural components

For application such as structural carriers, requiring optimal stiffness/toughness balance our reinforced PP compounds provide the strength and durability to replace metals. In doing so, they enable significant vehicle weight savings and greater fuel economy without any compromises in mechanical properties. Moreover, they give reliable, corrosion-free performance throughout a vehicle's lifespan.



**Fibremod™ GB215HP**  
**BMW**

BMW 7 series dashboard carrier in foamed Fibremod GB215HP, a 20% long glass fibre reinforced PP compound.

### Benefits

- 20% weight saving replacement of a previous 2-component construction
- Compatible with BMW's SGI injection technology
- High stiffness and strength
- Excellent warpage behaviour
- Lower system costs



**Fibremod™ GE277AI**  
**VW**

VW Golf A7 IP carrier in Fibremod GE277AI, a 20% short glass fibre reinforced PP compound.

### Benefits

- Specifically designed to be processed with Structural Foam Injection Moulding (SFIM)
- Combines high flowability with a high stiffness/impact ratio
- High dimensional stability
- High weld strength



**Fibremod™ GD302HP**  
**BMW**

BMW rear seat carrier in Fibremod GD302HP, a 30% short glass fibre reinforced PP compound.

### Benefits

- 35% weight saving replacement of a hybrid steel-PUR concept
- Lower system costs
- Excellent impact behaviour
- Low warpage and high dimensional stability

## Delivering premium surfaces

Vehicle interior surfaces have a major influence on buyers' perception of quality. Where a quality feel and finish was once considered the preserve of expensive, high-end brands, today it is a common goal across a car manufacturer's model range.

Interior aesthetics are therefore an important opportunity for car makers to differentiate their offering in an increasingly competitive market.

**Borealis and Borouge PP and TPO materials meet OEM objectives with optimised solutions that deliver surfaces exhibiting:**

- Non-stickiness
- Low gloss
- High scratch resistance
- Absence of flow marks (tiger stripe-free)



## Cosmetic surfaces

Borealis has launched a number of new grades based on a proprietary PP matrix exhibiting flow mark free performance. The existing grade portfolio has also been upgraded to take advantage of this Borealis innovation, contributing to the avoidance of flow marks on applications across a very broad processing window.

## Odour under control

Borealis' materials are optimized regarding odour, however the conversion temperature has a major impact on odour generation. New PP resins from Borealis allow for a much broader processing range, enabling part production without surface defects at much lower temperatures versus conventional compounds used in the automotive interior. This results in an improved odour performance.

## An optimal fit

Moreover, the visual and haptic aesthetics of interior surfaces are supported by the excellent dimensional stability of PP grades and advanced reactor Thermoplastic Polyolefins (rTPO) offering a low Coefficient of Linear Thermal Expansion (CLTE). When a design calls for parts made from materials with dissimilar mechanical properties to be fitted in close proximity, narrower gap tolerances are possible allowing for more visually attractive finishes.

## Underwritten by safety

While the aesthetics of parts made of our PP and TPO solutions are important, their safety performance is paramount. In the event of a collision, the impact resistance and non-splintering behaviour of panels and fascias contribute to driver and passenger safety – adding a further level of comfort.

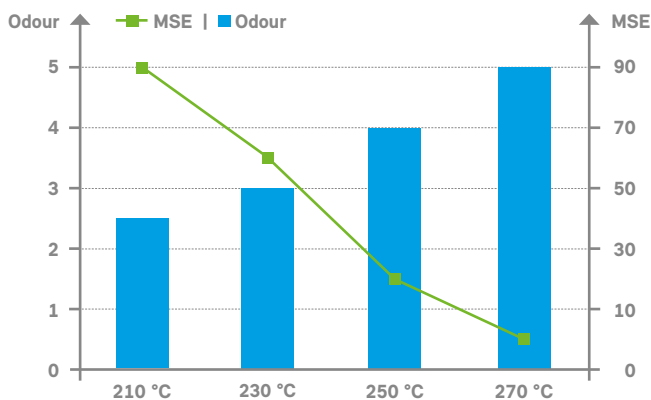
## Maximising ambient lighting

Enhanced ambient light to increase appeal to the style conscious buyer, as well as driver and passenger convenience, is becoming a popular trend in automotive interior design. As an answer to this, a growing number of automakers are turning to translucent PP. Borealis' advanced PP solutions maximise ambient light to create brighter, differentiated interiors, without design or cost penalties.



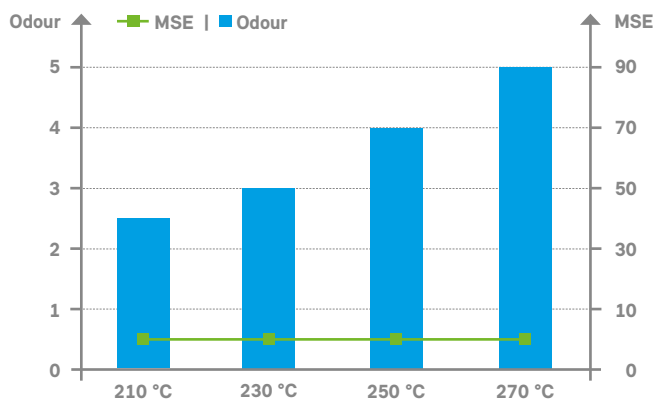
Flow mark testing equipment at Innovation Headquarters, Linz, Austria.

## Conventional TPO Compound



Mean Square Error [MSE]: Value from Borealis test method of the grey value distribution of injected moulded plaque.

## Daplen TPO Compound



# Processing for optimal property balancing

Borealis and Borouge PP and TPO solutions for interior components are formulated to provide the characteristics necessary for enhanced processing, including:

- A broad processing window
- High flow – enabling ease of filling complex geometries and long, thin wall constructions
- Low shrinkage
- Faster cycle times for increased machine utilisation and productivity

However, Borealis offers processing guidelines that can unlock the fuller potential of Borealis tailor-made solutions. For example, creating PP that exhibits very low gloss can lead to the unwanted effect of reducing the material's scratch resistance. Within the auto industry this often means that the performance level of one property is exchanged for the increased performance of another,

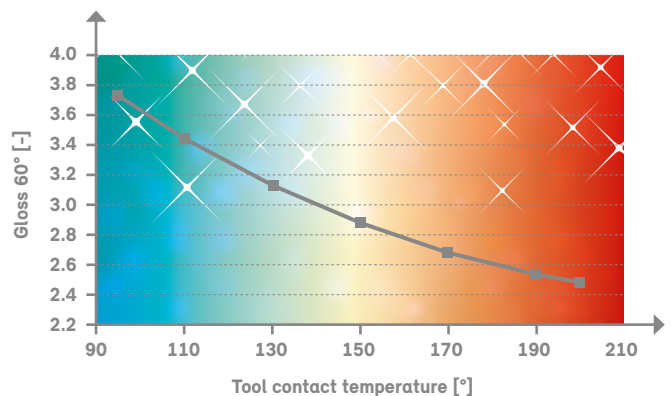
## Tooling for sustained appearance and performance

To ensure that interior components, like dashboard fascias, inner door panels and pillar trims maintain a high aesthetic appearance over the long-term, material scratch resistance is especially important to protect against abrasions and marring.

However, interior mouldings predominantly use grained surfaces, determined by the tool used, and these can

whereas the contribution of both is essential and of equal value to the finished part.

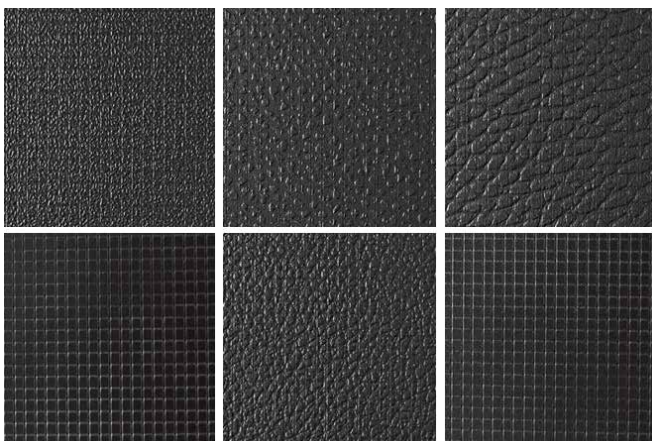
Borealis has developed specific processing parameters for its own PP materials that allow very low gloss to be achieved with no negative influence on scratch resistance.



Gloss in relationship to temperature of flow front

have a negative impact on scratch resistance properties. Therefore, Borealis materials for interior applications have been developed specifically to deliver improved grain effect in combination with superior resistance to scratching.

Ultimate performance, however, is highly dependent on tooling design as different grains exert varying influences on the finished component's degree of scratch resistance.



same material, test method and load  
→ different resistance

# Natural fibre reinforcement

A next step in 'lightweighting' vehicles is the replacement of traditional glass fibres and minerals in structural parts with even lighter-weight, lower density fillers such as Natural Fibre Compounds (NFC), for example hemp and flax, and Wood Fibre Compounds (WFC). Moreover, as renewable resources they can make a positive contribution to sustainability within the automotive industry. Building on this potential, Borealis is engaged in the development of a new generation of injection moulding PP WFC grades for visible and non-visible interior parts.

## Customer values

- Sustainable, renewable sourced modifier
- Light weight potential (8–10% weight saving)
- High surface aesthetics (low gloss, excellent scratch and good haptic characteristics)
- New design effects
- Energy efficient in processing

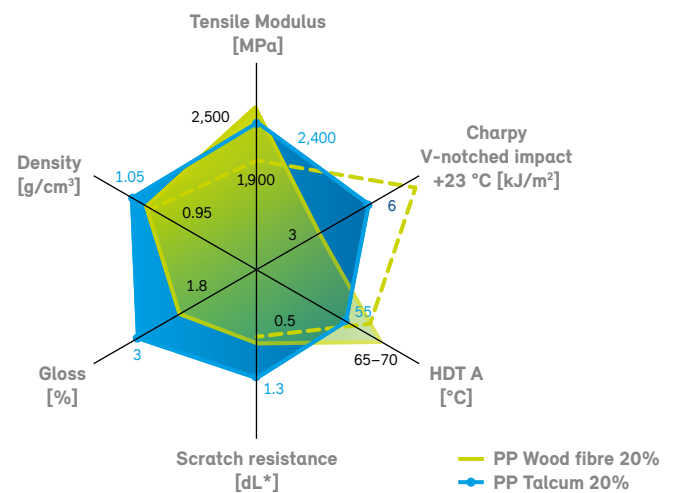
## Product benefits versus conventional 20% mineral filled PP copolymer

- 15 °C higher heat distortion temperature
- Better scratch resistance and lower gloss
- Equivalent shrinkage

Borealis PP WFC and NFC grades bridge the performance needs between mineral and glass fibre reinforced PP.

These materials have an ideal fit in applications ranging from centre consoles and dashboards to door inner panels and pillar covers.

## Physical properties



# Solutions for interior applications

Grade	Density [kg/m <sup>3</sup> ]	MFR 230 °C/ 2.16 kg [g/10 min]	Flexural modulus [MPa]	Tensile stress at yield [MPa]	Impact, Charpy notched 23 °C [kJ/m <sup>2</sup> ]	Impact, Charpy notched -20 °C [kJ/m <sup>2</sup> ]	HDT B (0.45 MPa) [°C]	Typical applications
<b>Copolymers</b>								
BE677AI	905	14	1,450	26	8	4	100	Door claddings, interior claddings
Daplen EG066AI	905	22	1,000	20	38	8	83	Door claddings, interior claddings
Borcom BG055AI	920	22	1,850	35	3.5	1.5	108	Climate control housings
<b>Homopolymers mineral filled</b>								
MD231U	1,050	6	2,700	36	3	1.2	125	Climate control parts
ME212U	1,050	13	3,100	32	3	1.5	120	Climate control parts, interior trims
PS65T20	1,050	23	2,700	32	2.5	1.5	110	Door inserts, claddings
MS64T20	1,070	22.5	3,200	32	2.5	1.2	120	Interior claddings
MD441U	1,220	6	4,700	32	2.4	1.2	132	Structural parts
<b>Copolymers mineral filled</b>								
MG160AI	985	22	1,950	25	7.5	3.5	110	Interior trims
Daplen EF267AI	1,040	16	2,500	27	6.5	2.8	105	Interior trims
ME268AI	1,050	12	2,400	26	6	2.5	100	Interior trims
ME266U	1,050	12	2,500	28	6	2.5	115	Structural interior parts
FSC65T30	1,150	5	3,000	23	7	2.5	125	Structural parts
<b>TPO Compounds</b>								
Daplen EE168AI	960	14	1,750	20	25	5	97	Dashboards, door claddings
Daplen EF098HP	960	20	1,800	22	20	4	95	Dashboards, door claddings
Daplen EE189HP	1,000	13	1,750	21	26	3.5	94	Dashboards, door claddings
Daplen EF198HP	1,020	17	2,000	22	20	4	95	Dashboards, door claddings
Daplen EG273HP	1,020	20	2,000	22	20	4	110	Dashboards, door claddings
Daplen EE250AI	1,040	13	2,000	22	30	3.5	94	Dashboards, door claddings
Daplen EF261AI	1,040	14	1,800	18	45	4.6	94	Dashboards, door claddings
Daplen EG265HP	1,040	21	1,800	18	55	6	97	Dashboards, door claddings
<b>Natural fibre reinforced</b>								
Fibremod NJ200AI	975	18	2,500	33	4	1.5	136	Non visible interior parts
Fibremod NJ201AI	975	23	2,150	30	4	1.5	126	Visible interior parts
<b>Short glass fibre reinforced</b>								
Fibremod GB205U	1,040	2	4,400	80	11	8	154	Bumper brackets, engine covers, fans and shrouds, pump housings; <b>Special property:</b> UL-listing, high heat stabilised
Fibremod GE277AI	1,040	12	4,200	85	11	9.5	155	Instrument panel carriers
Fibremod GB311U	1,120	2	6,200	97	11	9	159	Structural parts, air filter housings, lamp housings

Grade	Density [kg/m <sup>3</sup> ]	MFR 230 °C/ 2.16 kg [g/10 min]	Flexural modulus [MPa]	Tensile stress at yield [MPa]	Impact, Charpy notched 23 °C [kJ/m <sup>2</sup> ]	Impact, Charpy notched -20 °C [kJ/m <sup>2</sup> ]	HDT B (0.45 MPa) [°C]	Typical applications
Fibremod WE380HP	1,130	10	4,400	60	11	9	155	Gear housings, engine covers, structural carriers and parts, armrest and visible parts
Fibremod GD310U	1,130	10	6,200	105	10	9	162	Structural parts, Under the Bonnet part
Fibremod GD302HP	1,140	3	5,100	65	25	15	150	Seat structures, interior structural carriers
Fibremod GB477HP	1,230	2.5	9,000	130	12	11	162	Seat structures, pedal carriers
<b>Long glass fibre reinforced</b>								
Fibremod GB215HP	1,040	2	4,600	105	20	20	154	Instrument panel carriers, door module carriers, air bag housing, structural carriers
Fibremod GB303HP	1,120	2	6,500	125	25	26	165	Instrument panel carriers, door module carriers, fans and shrouds, structural carriers
Fibremod GB402HP	1,240	2	8,400	140	28	32	166	Frontend modulus, tailgate carriers, structural carriers
Fibremod GB601HP	1,470	n.r.	14,100	135	25	20	167	PP-LGF concentrate, Instrument panel carriers, structural carriers, door module carriers, air bag housing
<b>Long glass fibre dilution</b>								
Daplen EE002AE	905	11	1,000	20	65	9	76	Base polymer for PP-LGF dilution
HK060AE	905	125	1,550	35	1	0.9	91	Base polymer for PP-LGF dilution
BJ400HP	908	90	1,500	28	4	2	95	Base polymer for PP-LGF dilution
<b>Carbon fibre reinforced</b>								
Fibremod CB201SY	990	6	12,000	110	5	30	-	Door module carriers, structural seat parts, engine components, tailgate carriers
Fibremod CB301SY	1,060	4	15,000	105	5	25	-	Door module carriers, structural seat parts, engine components, tailgate carriers
Fibremod CB401SY	1,130	2	19,000	100	6	17	-	Door module carriers, structural seat parts, engine components, tailgate carriers

## Grade nomenclature

Daplen EE198HP					
Pos. 1 (Polymer type)	Pos. 2 (MFR range)	Pos. 3 (Filler content)	Pos. 4-5 (Numerical index)	Pos. 6-7 (Application index)	Pos. 8 (Production Location)
H – Homopolymer R – Random copolymer B – Block copolymer T – Terpolymer E – Elastomer modified G – Glass fibre C – Carbon fibre reinforced M – Mineral filled W – Other or combinations	B: > 0.8–2.5 C: > 2.5–5 D: > 5–10 E: > 10–15 F: > 15–20 G: > 20–30 H: > 30–40 J: > 40–100	0: 0–9% 1: 10–19% 2: 20–29% 3: 30–39% 4: 40–49% 5: 50–59%		AE: Automotive exterior AI: Automotive interior UB: Under the Bonnet HP: High Performance SY: Sustainability SF: Short Glass Fibre LF: Long Glass Fibre	B: South America C: Asia U: North America





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**Borealis AG**

Wagramer Straße 17–19 · A-1220 Vienna · Austria

Tel. +43 1 22 400 000 · Fax +43 1 22 400 333

[www.borealisgroup.com](http://www.borealisgroup.com)

[www.borealisdrivingtomorrow.com](http://www.borealisdrivingtomorrow.com)

[www.borouge.com](http://www.borouge.com)

[automotive@borealisgroup.com](mailto:automotive@borealisgroup.com)

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