MAGRIStalc

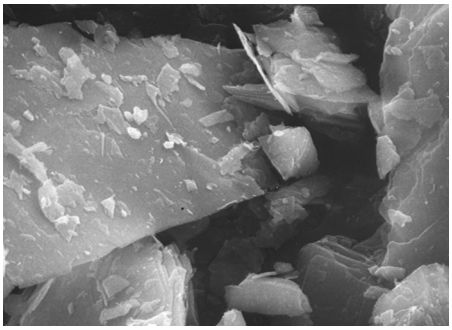
# Engineered Talc Solutions for TPO

- Optimized Balance between Flexural Modulus and Impact
- Light Weighting and Downgauging
- Improved Dimensional Stability
- Enhanced Automotive Performance Solutions

# Operations

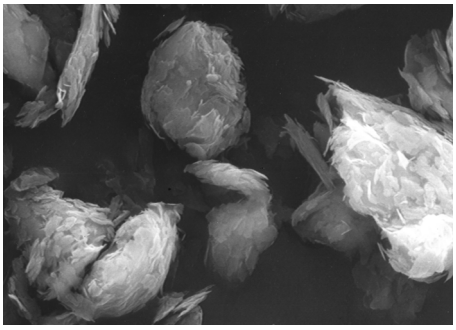
Magris Talc, leading supplier of macrocrystalline and microcrystalline talc products, with secured mineral resources which include three talc mines (Argonaut, VT; Yellowstone, MT; and Penhorwood, ON), six milling operations (Houston, TX; Ludlow, VT; Penhorwood and Timmins, ON; Sappington and Three Forks, MT), and three beneficiation operations (Ludlow, VT; Penhorwood, ON; Yellowstone, MT).

## Argonaut, Vermont



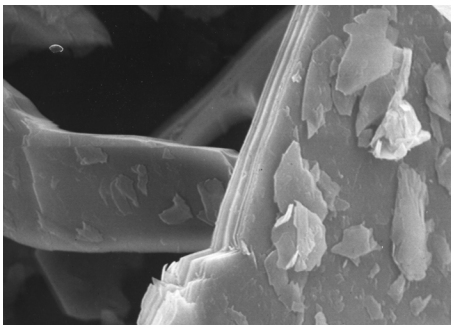
- Talc/Magnesite orebody averages 55%
- Dry separation beneficiation greater than 85% talc
- Highly lamellar talc ideally suited for polymer applications

## Yellowstone, Montana



- Largest talc mine in North America
- Opened in 1942
- 98% high purity ore does not require beneficiation

## Penhorwood, Ontario



- Talc/Carbonate (magnesite) averages 47% talc
- Beneficiation via flotation to >98% talc
- Highly lamellar, low calcium content and high brightness, ideal for catalyst and polymer applications

## Houston Milling

## Ludlow Milling

## Penhorwood Milling

## Three Forks Milling

## Timmins Milling

## Sappington Milling

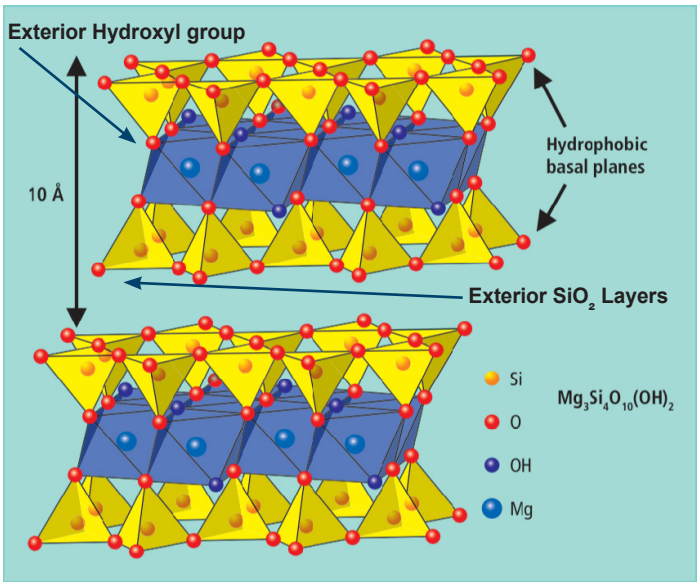
# Mineral Overview

## High Performance Solutions for TPO

Modifying neat thermoplastics with mineral reinforcements such as talc enables compounders to attain new levels of performance in their thermoplastic olefins (TPO), while reducing costs versus many other options.

Specific TPO applications can be cost effectively optimized by selecting the best fit grade based on the morphology, aspect ratio, top-size, color, and surface treatment.

Magris Talc encourages joint development with our customers to provide optimal stiffness and impact balance solutions from our product portfolio.



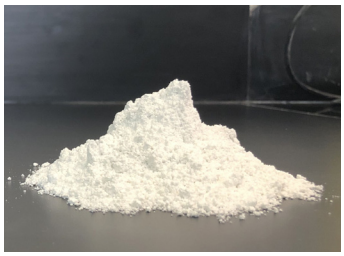

High purity talc is organophilic/hydrophobic with affinity to non-polar resins like polypropylene.

## Optimum Impact Performance is Achieved with Finest Top-Sized Talc

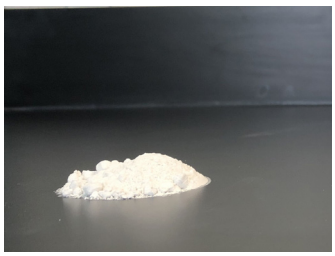
Impact strength of talc-reinforced polyolefins depends on fine particle size distribution, very fine top-size and the ability to homogeneously disperse talc. Proprietary Magris Talc micronization technology allows extremely fine particle size and top-size control; compaction quality is further optimized (see Fig. 1), to provide ease of handling and dispersion for maximum extrusion throughputs.

Additionally, our densification/compaction technologies effectively increase the bulk density of these fine and fluffy grades from 5 lbs/cu.ft. to 55 lbs/cu.ft. to improve ease of handling as well as further enhance processing efficiency in compounding.

**Fig. 1** 10 grams of ultra fine talc vs. 10 grams of ultra fine densified/compacted talc.



JetWhite 3CW at 5 lbs/cu.ft. Ultra fine talc using proprietary Magris Talc Micronization Technology

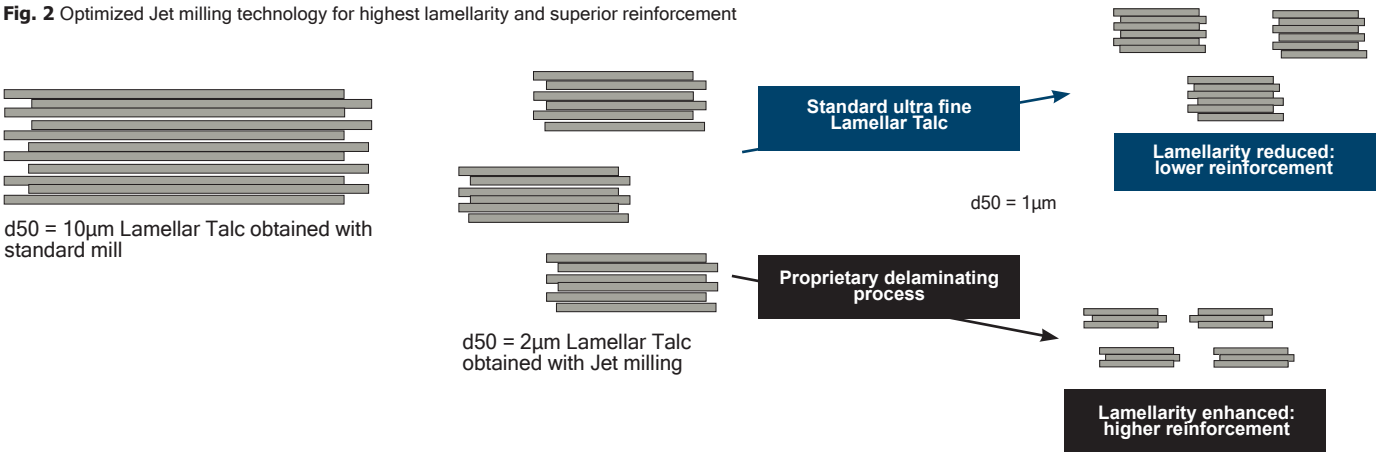


JetWhite 3CW at 55 lbs/cu.ft. Results from Magris Talc Compaction Technologies

## High Lamellarity for Optimum Reinforcement

The lamellarity of talc is key to reinforcement in thermoplastics applications. Micronization and classification techniques are now commonly used to produce very fine talcs. However, the lower the particle size distribution, the more difficult it is to maintain the lamellar structure with conventional jet milling process. We have therefore developed a unique processing technology that maintains the lamellarity of talcs with a d50 as low as 1 micron, as illustrated in Fig. 2 below.

**Fig. 2** Optimized Jet milling technology for highest lamellarity and superior reinforcement



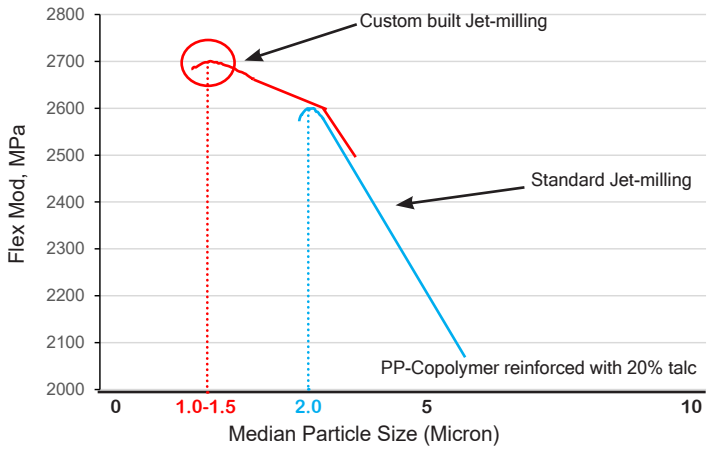
# Engineering Talcs for TPO

## Custom Talc Jet-Milling and Classification for Optimum Stiffness and Impact Performance

Magris Talc has beneficiated high brightness fine/ultrafine talc products sustainably mined from domestic Magris Talc ore sources, providing security of supply. Proprietary talc jet milling and classification for optimum stiffness/impact performance:

Reduction in median particle size (D50) as seen in Fig. 3, shows the resulting increase in flexural modulus.

**Fig. 3** Beneficiated high brightness Magris Talc




## High Performance HYPERPLATE™ Fine Talc

Magris Talc has developed a proprietary wet milling process resulting in high lamellarity talc (HYPERPLATE™), with aspect ratios ranging from 100-150 compared to conventional talc grades with aspect ratios of 30-35.

This improvement significantly enhances the performance of olefins by increasing stiffness, maintaining impact strength and lowering coefficient of linear thermal expansion (CLTE). These key benefits assist designers in achieving zero gap tolerancy as demonstrated in Fig. 4, 5, 6 and 7.

**Fig. 4** Unique Technology

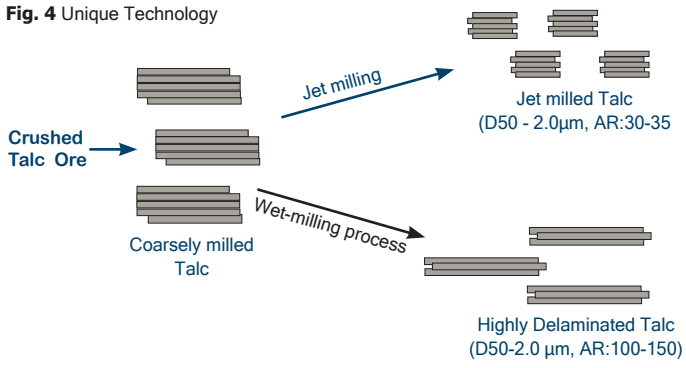



**Fig. 5** Superior Stiffness with HYPERPLATE™ Delamination Talc

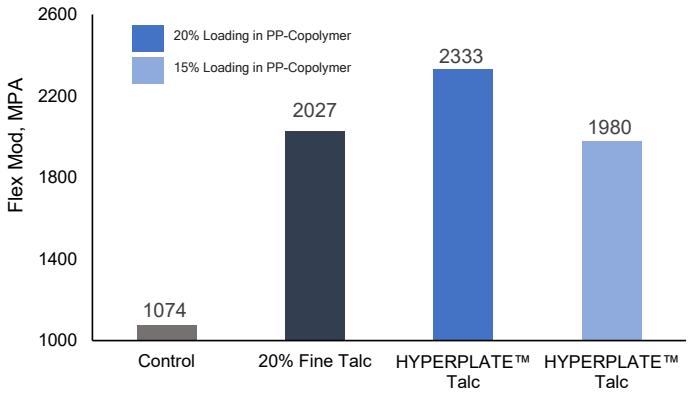



**Fig. 6** CLTE performance of HYPERPLATE™ Talc versus several talc grades (10% loading in copolymer)

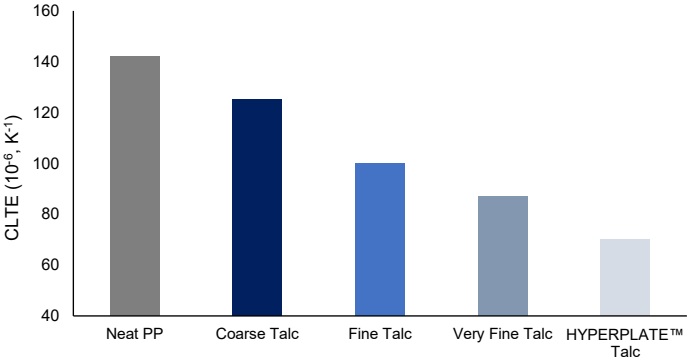
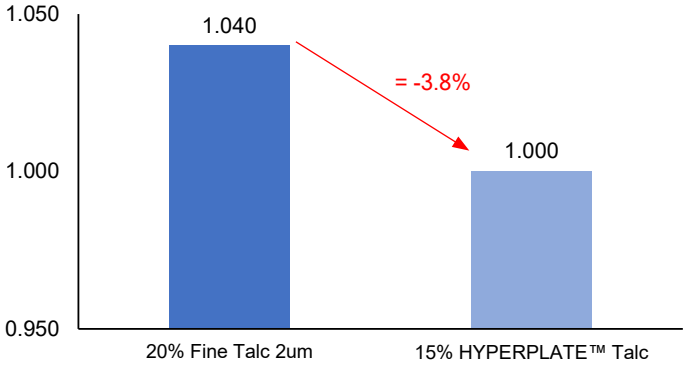



**Fig. 7** Compound Density in PP-Copolymer




# Growth of Talc Usage in Automobiles

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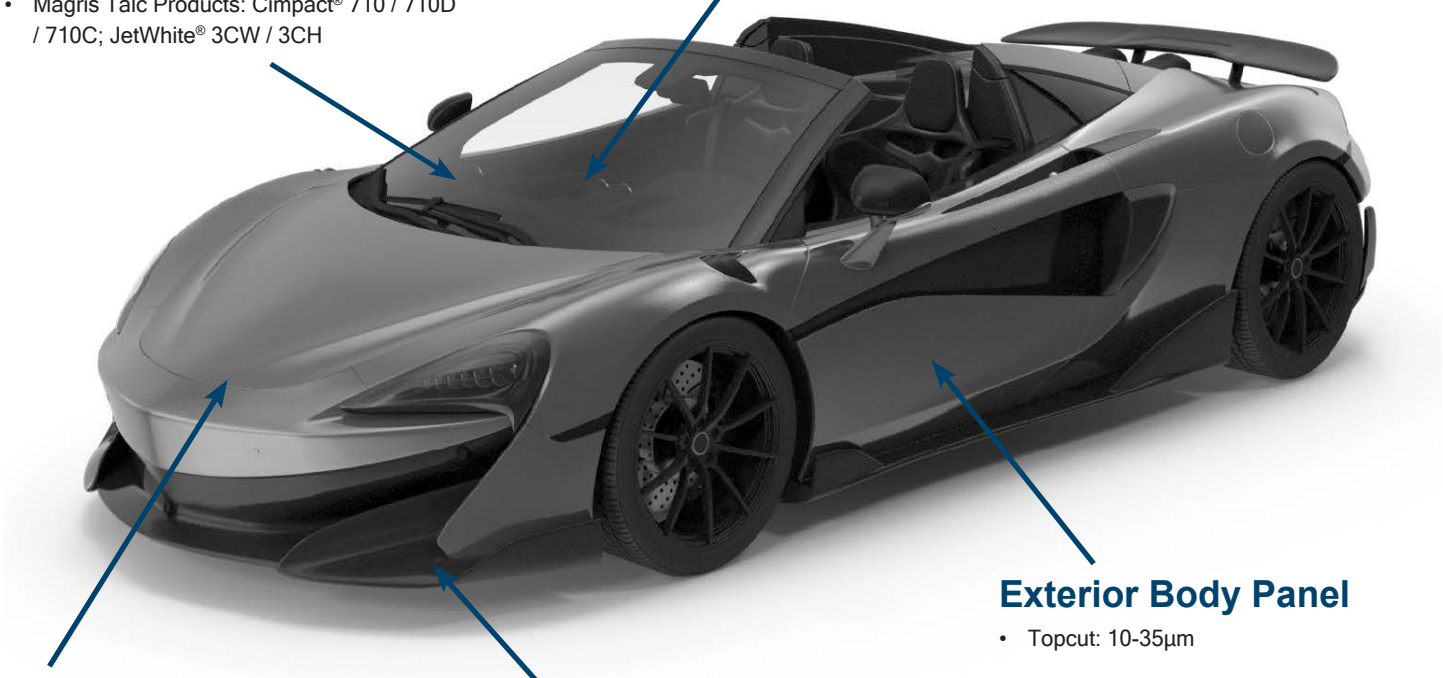
| 2006 Average | 2014 Average | 2021 Average |
|---|---|---|
| 9 Kg/Auto | 13 Kg/Auto | 25 Kg/Auto |

## Dashboard

- Topcut: 10µm
- Whiteness: 88 to 92
- Magris Talc Products: Cimpact® 710 / 710D / 710C; JetWhite® 3CW / 3CH

## Interior Trims

- Topcut: 20µm
- Whiteness: 86 to 88
- Magris Talc Products: Cimpact® 610 / 610D / 610C; Nicron® 674C / 674DT2; JetFil® 625C / V625C / M625C



## Under the Hood

- Topcut: 30 to 40µm
- Whiteness: >75
- Magris Talc Products: JetFil® T290 / T390 / T590 / V390 / C575C / H590 / H390 / M500 / M400

## Bumper

- Topcut: 10-35µm
- Whiteness: >75
- Magris Talc Products: JetFil® 700C / V700C; Nicron® 674C / 674DT2; HYPERPLATE™ T77; JetFil® 625C / V625C / M625C; JetFil® 3CHE

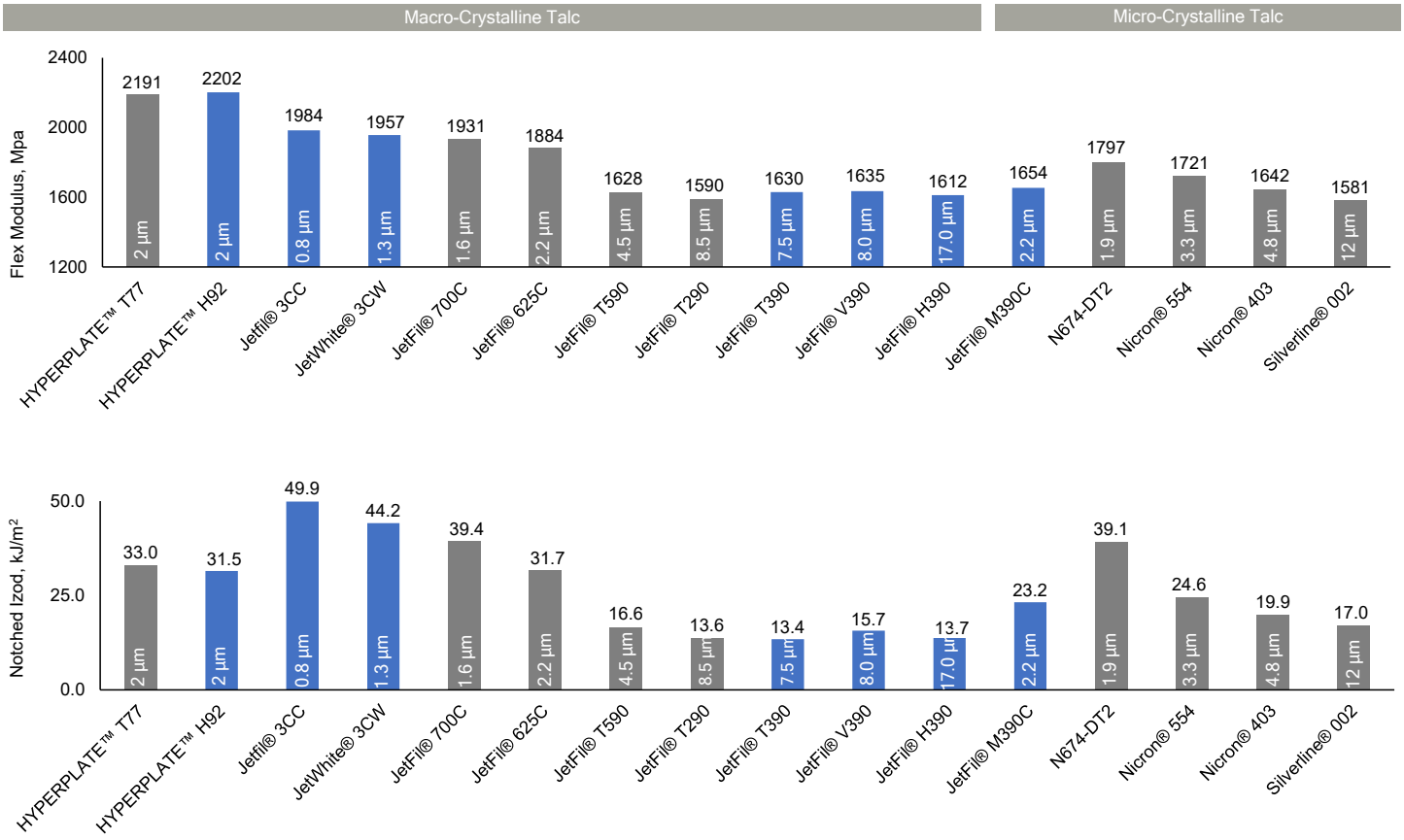
## Exterior Body Panel

- Topcut: 10-35µm
- Whiteness: >75
- Magris Talc Products: JetFil® 700C / V700C; Nicron® 674C / 674DT2; HYPERPLATE™ T77; JetFil® 3CHE; JetFil® M550C

Our JetFil® and HYPERPLATE™ range of talc offerings represent the finest and most efficient grades to meet increasingly demanding impact resistance and dimensional stability specifications, especially for automotive applications.

# Test Results

**Fig. 8** Effects of talc morphology and particle size




Composition: 20% mineral loading in Braskem PP Copolymer and 20% by wt, Baseline Braskem PP Copolymer Flex Modulus: 850 MPa, Notched Izod - No Break

As we can see in Fig. 8 and the Magris Talc Product List on pages 9-10, talc grade selection involves color, purity, morphology/aspect-ratio, particle size distribution, top-size, etc., in the end, our customers are interested largely in achieving their end performance requirements at a cost effective price. Test results and product benefits have been shown to demonstrate particular attributes of our talc products:

- Wide range of performance in TPO; from general purpose applications to TPO formulations optimized for impact ductility at -30°C
- Enhanced reinforcement achieved with HYPERPLATE™ Talc products; for maximum stiffness and low shrinkage/CLTE, resulting in design capacity for Light Weighting, Downgauging and Zero Gap Tolerancing of automotive parts (Interior, Exterior, UTH) (see Fig.5, 6, 7 and 8).
- Results show excellent multiaxial puncture impact ductility at low temperature of -30°C with the Ultrafine talc products, thanks to our custom built talc jet-milling and classification technology for controlled and clean top sizing of particulates (see Fig. 9 and 10.)
- Optimum stiffness and best overall impact ductility (-30°C, 6.6 m/s) for color sensitive applications (Interior, Exterior) with JetWhite® 3CW (see Fig. 10),
- Scratch performance enhancement with JetFil® 3CC, together with excellent stiffness / impact balance (Interior) (see Fig. 11).
- Cost effective stiffness and impact ductility (-30°C, 2.2 and 4.4 m/s) and color sensitive applications (Interior, Exterior) with JetFil® 625C / V625C and 700C / V700C from our Magris Talc Canadian and Vermont Operations respectively. Similar performance and excellent pigment efficiency with our Cimpact 710C / 610C from our Magris Houston Plant.
- Cost effective stiffness and impact strength from our Montana microcrystalline Nicron 674C / 674DT2 for interior and exterior automotive applications; also cost effective general purpose automotive applications such as UTH with JetFil® M550 / M400. Similar performance and cost effectiveness from our Canada / Vermont / Houston offerings JetFil® T390 / V390 / H390 and JetFil® T590 / V575C / H590 series.

# Test Results

**Fig. 9** Composition: 10% mineral loading in Braskem CoPP and h-PP.

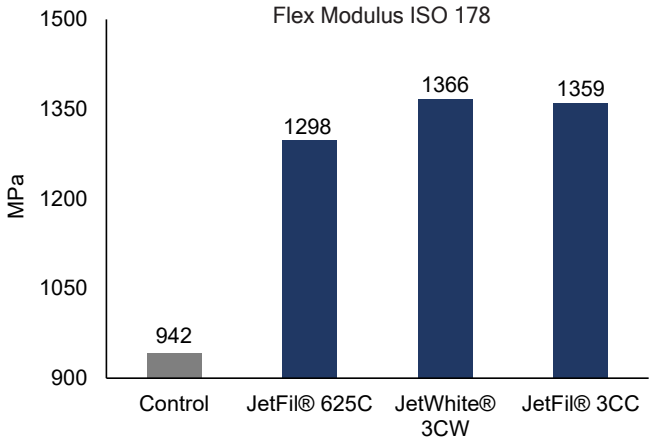
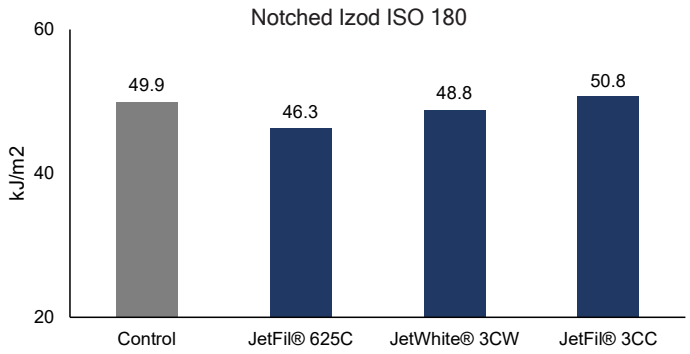


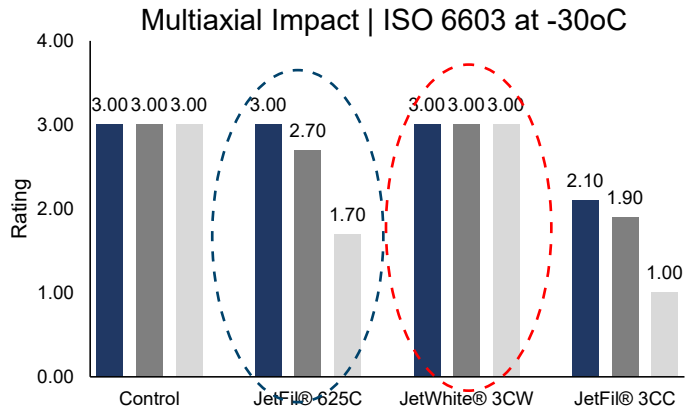

**Fig. 10** Composition: 10% mineral loading in Braskem CoPP and h-PP, Pinnacle CoPP, POE and AO.




**Ductility is achieved with the Ultrafine talc products: Optimum performance is achieved by our JetWhite® 3CW per below test plaques.**

**Fig. 11** Multiaxial Impact (Composition: 20% mineral loading in Braskem CoPP and h-PP, Pinnacle CoPP, POE and AO).

Average Peak Energy: 4.6 - 20.7 Joules
Average Total Energy: 4.8 - 32.05 Joules




# Test Results

Thanks to Magris Talc ore resources and proprietary milling capabilities, we can provide various cost effective, high-performance Macro (JetWhite® 3CW/3CH, JetFil® 3CHE) and Micro-crystalline (JetFil® M625C) solutions for Automotive applications. Below Flex Modulus (Fig. 12) and Notched Izod (Fig. 13) graphs indicate comparable results for micro and macro crystalline options while the color (Fig. 14) graph shows Magris Talc cost saving options for non-color sensitive applications with JetFil® 3CHE/M625C.

**Fig. 12** Flex Modulus

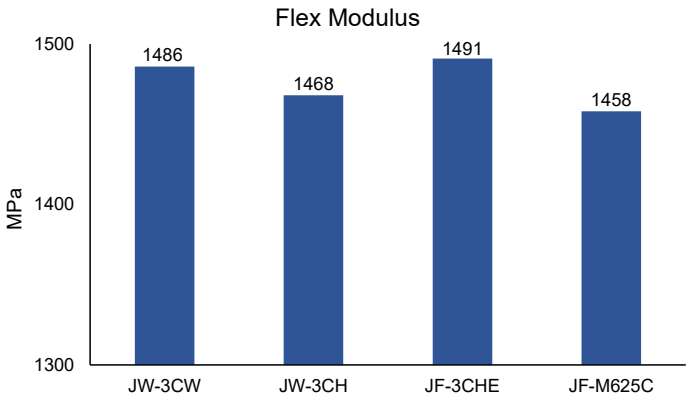



**Fig. 13** Notched Izod

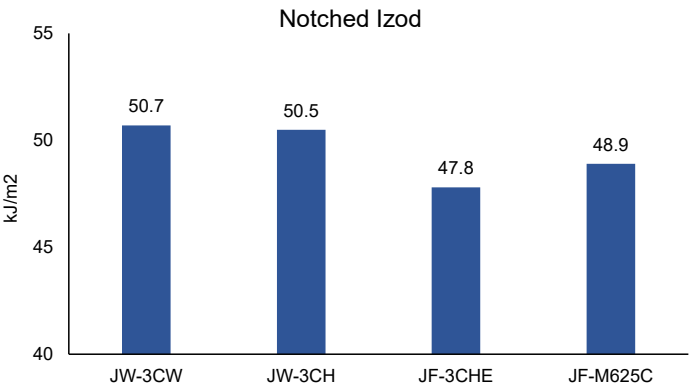
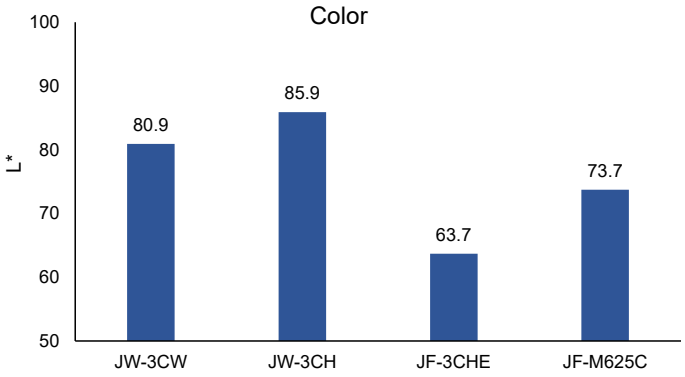
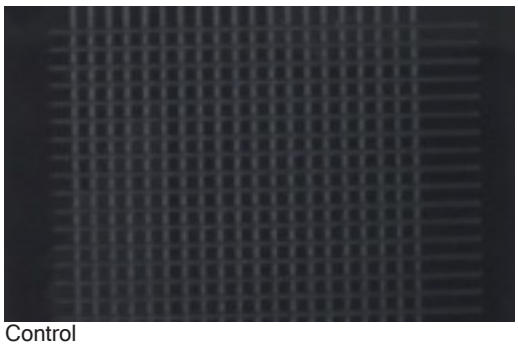


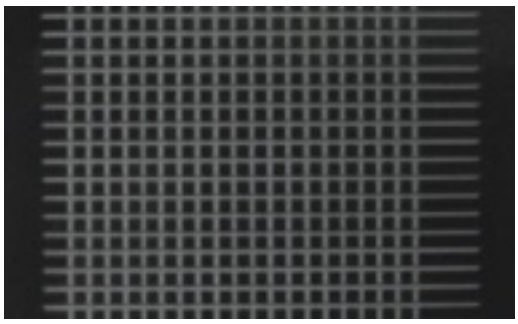

**Fig. 14** Color

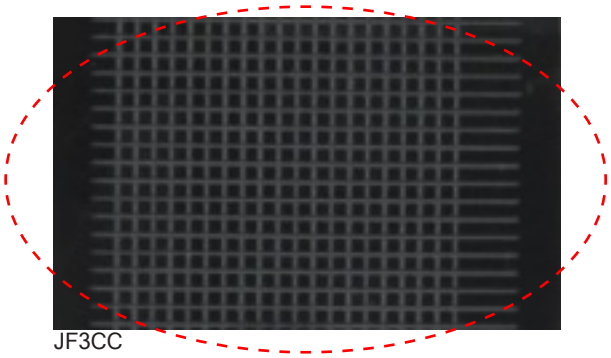


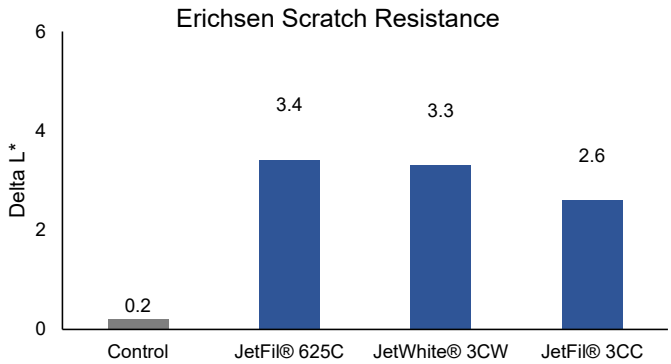

Composition: 20% mineral loading in Braskem CoPP and h-PP.

**Fig. 15** Erichsen scratch resistance (GMW METHOD 10N)




JetFil® 3CC shows excellent scratch performance due to its Ultrafine grind and color.

Composition: Braskem CoPP and h-PP, Pinnacle CoPP, POE, AO and 10% mineral (GMW Method 10N).

# Talc Products

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| Canada Sourced Products | Applications | Median Particle Size Sedigraph µ | Top Size Hegman | Y Brightness |
|---|---|---|---|---|
| JetWhite® 3CW | Interior & Exterior TPO | 1.3 | 7.5 (~6.25 microns) | 91 |
| JetFil® 3CC | Improved Scratch - TPO/PP | 0.9 | 7.5 (~6.25 microns) | 88 |
| JetFil® 700C | Exterior TPO | 1.5 | 7.0 (~12.5 microns) | 88 |
| JetFil® 625C | Exterior TPO | 2.2 | 6.5 (~18.75 microns) | 88 |
| JetFil® 575P / JetFil® 575C | General PP & PVC Applications | 3.4 | 5.75 (~28.13 microns) | 87 |
| JetFil® 575C-HB | Color Sensitive Applications | 3.0 | 5.75 (~28.13 microns) | 89 |
| JetFil® P500 | Appliances | 4.5 | 5.0 (~37.5 microns) | 85 |
| JetFil® P350 | General Purpose | 7.5 | 4.25 (~46.88 microns) | 84 |
| JetFil® P200 | General Purpose | 8.5 | 2.0 (~75.0 microns) | 83 |
| JetFil® T590 | Packaging, UTH* | 4.5 | 5.0 (~37.5 microns) | 83 |
| JetFil® T490 | Packaging, UTH* | 5.5 | 4.5 (~43.75 microns) | 81 |
| JetFil® T390 | Under the hood (UTH) | 7.5 | 4.25 (~46.88 microns) | 81 |
| JetFil® T290 | UTH*, WPC** | 8.5 | 3.0 (~62.5 microns) | 78 |

| Houston Production Grades | Applications | Median Particle Size Sedigraph µ | Top Size Hegman | Y Brightness |
|---|---|---|---|---|
| JetWhite® 1H/HC Series | Nucleation | 1.1 | 7.5 (~6.25 microns) | 90 |
| JetWhite® 7H/HC Series | Nucleation | 1.9 | 7.0 (~12.5 microns) | 91 |
| JetWhite® 6H/HC Series | Nucleation | 2.4 | 6.0 (~25.0 microns) | 91 |
| JetWhite® 4H Series | General Purpose | 5.7 | 4.0 (~50.0 microns) | 90 |
| JetWhite® 2H Series | General Purpose | 11 | 2.0 (~75.0 microns) | 87 |
| JetWhite® R7 | PC/ABS | 1.8 | 7.0 (~12.5 microns) | 91*** |
| Cimpact® 710HS | TPO - Odor Sensitive/Heat Aging | 1.8 | 7.0 (~12.5 microns) | 93*** |
| Cimpact® 710C / 710D | Interior TPO | 1.8 | 7.0 (~12.5 microns) | 93*** |
| Cimpact® 650C / 650D | Exterior TPO | 2.2 | 6.5 (~18.75 microns) | 92*** |
| Cimpact® 610C / 610D | Exterior TPO | 3.2 | 6.0 (~25.0 microns) | 91*** |
| Cimpact® 550C / 550D | Appliances | 3.4 | 5.75 (~28.13 microns) | 88*** |
| JetWhite® 3CH | Interior and Exterior TPO | 1.2 | 7.5 (~6.25 microns) | 94 |
| JetFil® 3CHE | Exterior TPO | 1.2 | 7.5 (~6.25 microns) | 82 |
| JetFil® T1H | Exterior TPO | 1.8 | 7.0 (~12.5 microns) | 80 |
| JetFil® T1HB | Interior TPO | 1.8 | 7.0 (~12.5 microns) | 89 |
| Mistroblock® 1H/1HT/1HTC Series | Antiblock | 1.1 | 7.5 (~6.25 microns) | 91 |
| Mistroblock® 7H/7HT/7HTC Series | Antiblock | 1.9 | 7.0 (~12.5 microns) | 91 |
| Mistroblock® 6H/6HT/6HTC Series | Antiblock | 2.4 | 6.0 (~25.0 microns) | 91 |
| Mistroblock® H/HT/HTC Series | Antiblock | 3.5 | 5.75 (~28.13 microns) | 90 |
| Stellar® 510 | Appliances | 5 | 5.5 (~31.5 microns) | 88*** |
| Stellar® 420 | Appliances | 12 | 4.0 (~50.0 microns) | 87*** |
| JetWhite® 8230 | Appliances | 10 | 4.0 (~50.0 microns) | 92*** |
| JetFil® H590 | Packaging, UTH* | 5 | 5.5 (~31.5 microns) | 77 |
| JetFil® H390 | UTH*, WPC** | 8.5 | 4.5 (~43.75 microns) | 74 |

** Under the hood*

*** Wood Plastic Composites*

**** Brightness measurements in GEB*

# Talc Products

| Montana Sourced Products | Applications | Median Particle Size Sedigraph µ | Top Size Hegman | Y Brightness |
|---|---|---|---|---|
| JetFil® M625C | Exterior TPO | 1.3 | 6.5 (~18.75 microns) | 87*** |
| Nicron® 674 DT2 / Nicron® 674C | Exterior TPO, Polyamides | 1.9 | 7.0 (~12.5 microns) | 87*** |
| JetFil® M700 / JetFil® M700C | Exterior TPO | 1.9 | 7.0 (~12.5 microns) | 83 |
| JetFil® M600 / JetFil® M600C | Exterior TPO | 2.3 | 6.0 (~25.0 microns) | 83 |
| JetFil® M550 / JetFil® M550C | Exterior TPO/Appliances | 2.2 | 5.5 (~31.5 microns) | 83 |
| JetFil® M500 | Appliances | 3.2 | 5.0 (~37.5 microns) | 81 |
| JetFil® M400 | General Purpose, PVC | 4.7 | 4.0 (~50.0 microns) | 81 |
| JetFil® M300 | General Purpose | 7.5 | 3.0 (~62.5 microns) | 79 |
| JetFil® M200 | WPC | 10 | 2.0 (~75.0 microns) | 78 |
| Nicron® 665 | Nucleation | 1.2 | 6.5 (~18.75 microns) | 87*** |
| Mistron® ZSC | Foam Nucleation | 2 | 6.0 (~25.0 microns) | 87*** |
| MistroFoam™ | Foam Nucleation | 2.2 | 5.5 (~31.5 microns) | 82 |
| Nicron® 604 | PVC Sheet, Antiblock | 2.3 | 6.0 (~25.0 microns) | 85*** |
| Mistron® NT / Mistron® NTC | Antiblock | 3.5 | 5.75 (~28.13 microns) | 85 |
| Mistron® 400C / 400CT | Antiblock | 4 | 5.5 (~31.5 microns) | 88 |
| Silverline® 002 | WPC** | 9 | 3.0 (~62.5 microns) | 78*** |
| Silverline® 303 | WPC** | 6.1 | 3.0 (~62.5 microns) | 78*** |

| Vermont Sourced Products | Applications | Median Particle Size Sedigraph µ | Top Size Hegman | Y Brightness |
|---|---|---|---|---|
| JetFil® V625C | Exterior TPO | 2.2 | 6.25 (~21.88 microns) | 84 |
| JetFil® V575C | General PP, PVC | 3.3 | 5.0 (~37.5 microns) | 82 |
| JetFil® V390 | UTH*, WPC** | 8.5 | 4.0 (~50.0 microns) | 77*** |

| Specialty, High Aspect Ratio Grades | Applications | Median Particle Size Sedigraph µ | Top Size Hegman | GEB Brightness |
|---|---|---|---|---|
| HYPERPLATE™ T77 | Exterior TPO, Polyamides, FR† | 2 | 5.25 (~34.63 microns) | 79 |
| HYPERPLATE™ H92 | Exterior TPO, Color Sensitive, Polyamides, FR† | 2 | 5.25 (~34.63 microns) | 92 |
| Mistron® HYPERPLATE™ | Exterior TPO, Polyamides, FR,† | 1.1 | 6.5 (~18.75 microns) | 80 |

** Under the hood*

*** Wood Plastic Composites*

**** Brightness measurements in GEB*

*† Flame Retardancy*

## About Magris Talc

Magris Talc is one of the world's leading talc producers, supplying around 15 percent of world demand from our mines and processing plants in Canada and the United States. We are the acknowledged leaders in product quality, supply reliability and technical support – the services that create value for our customers and set us apart from competitors.

## About Talc

Talc is a surprisingly versatile, functional mineral which possesses a unique combination of properties. Talc is soft, water repellent, chemically inert and highly platy and has a marked affinity for certain organic chemicals. Our industry experts have harnessed these properties to bring customers improved performance in a wide range of applications such as paper, paints, plastics, rubber, ceramics, agriculture, food, pharmaceuticals, cosmetics and soap.

## Meeting Today's Needs. Securing Tomorrow's.

We believe that running a successful business and sustaining quality of life and the environment go hand in hand. From implementing behavior-based safety training to rehabilitating the land, we think it's important that future generations' needs are not compromised by our actions today.

## Our Fundamental Sustainability Principles are:

**Safety** – We promote the health and safety of employees, contractors, customers, neighbors and consumers through active caring.

**Partnership** – We seek to understand the issues that are important to our neighbors, and to make a lasting contribution to the communities in which we operate.

**Environmental Protection** – We work to minimize our environmental footprint by using natural resources efficiently, preventing pollution, complying with applicable laws and regulations and continually improving our performance.

**Accountability** – We conduct business in an accountable and transparent manner, relying on external auditing and reporting to understand and reflect our stakeholders' interests.

**Magris Talc**
www.magristalc.com
For more information, contact our team at sales@magristalc.com
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