Ultra High Molecular Weight Polyethylene (UHMWPE)
UTEC is the trade name of the Ultra High Molecular Weight Polyethylene (UHMWPE) developed and produced by Braskem with our own catalyst and production technology.

UTEC has a molecular weight about 10 times higher than High Density Polyethylene (HDPE) resins. The ultra high molecular weight of UTEC results in excellent mechanical properties such as high abrasion resistance, impact strength and low coefficient of friction. These special properties allow the product to be used in several high performance applications.

UTEC is sold in powder form in grades according to the molecular weight and average particle size. The molecular weight may be in the low range (3 million g/mol), medium range (5 million g/mol) or high range (7 to 10 million g/mol). Products with these different molecular weights are available in small (average diameter around 150 μm) or large particle sizes (average diameter around 205 μm).
## Control Properties

<table>
<thead>
<tr>
<th>Method</th>
<th>Units</th>
<th>Intrinsic Viscosity</th>
<th>Molecular Weight</th>
<th>Density</th>
<th>Average Particle Size D50</th>
<th>Tensile Strength at Break</th>
<th>Charpy Impact Strength*</th>
<th>Hardness (Shore D) (15s)</th>
<th>Abrasion Index (ISO 15527 reference set to 100)</th>
<th>Kinetic Friction Coefficient</th>
<th>Melt Temperature</th>
<th>Coefficient of Linear Thermal Expansion (between -30 ºC and 100 ºC)</th>
<th>Specific Heat @ 23 ºC</th>
<th>Specific Melt Enthalpy</th>
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<td>3.0 x 10⁶</td>
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Applications which require high impact resistance – technical and porous parts, filters, compression molded sheets and pipes.

Applications which require a good combination between impact and wear resistance and use of pigments and/or additives – technical and porous parts, filters, compression molded sheets.

Applications which require a good combination between impact and wear resistance – technical and porous parts, filters, compression molded sheets and pipes.

Applications which require high wear resistance and use of pigments and/or additives – technical parts, RAM extruded and compression molded sheets, rods, profiles and battery separators.

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* Calculated using Margolies’ equation.  
* Determined with double-notched specimens (14° v-notch on both sides) in accordance with ISO 11542-2. Braskem does not recommend the use of its products for manufacturing packages, pieces or any other type of product that will be used for storing of or be in contact with parenteral solutions or that will have any type of internal contact with the human body, except when explicitly indicated otherwise.
Impact Strength

UTEC is the best solution because of its remarkable impact strength compared to other materials. Figure 1 compares the impact strength of the most important commodities resins and engineering plastics with UTEC.

![Figure 1 – Notched Izod Impact Strength (ASTM D 256): UTEC vs. other materials. Data source: HARPER, CHARLES A. Modern Plastics Handbook. 1999.]

Coefficient of Friction

UTEC is an excellent material for sliding applications (low coefficient of friction), working as a self-lubricating material. Figure 2 compares the static and dynamic coefficient of friction of UTEC with other engineering thermoplastics, where it can be seen that, even without additives, UTEC is still the best performance solution for sliding applications.

![Figure 2 – Static and Dynamic Coefficient of Friction of UTEC and other materials. Data Source: CRAWFORD, R.J. Plastics Engineering. 3rd edition, 1998.]

Figure 3 – Comparing polyethylenes for injection, blow and extrusion molding with UTEC® UHMWPE polymeric chain
**Chemical Resistance**

UTEC is extremely resistant to a wide variety of substances. The material is almost totally inert, therefore it can be used in the most corrosive or aggressive environments at moderate temperatures. Even at high temperatures, UTEC is resistant to several solvents, except aromatic, halogenated hydrocarbons and strong oxidizing materials, such as nitric acid.

Compatibility tests between a product sample and the chemical environment are strongly recommended to verify satisfactory part performance, at the same conditions, for a period of time equal to the life time expected, for each new application. Even substances classified with high attack or absorption characteristics show good practical results.

**Abrasion Wear Resistance**

Another outstanding UTEC property is the abrasion wear resistance. This makes UTEC suitable for replacing metals in applications that require high abrasion resistance and, while providing light-weighting benefits as well.

Figure 4 compares the relative wear resistance of UTEC with other materials used in high wear applications such as tubes, liners, silos, containers and other equipment.

In the UHMWPE technology, it is well-known that the abrasion wear decreases with molecular weight as shown in Figure 5.

![Figure 4 – Relative abrasion wear of UTEC grades and various materials, STEEL SAE 1020 = 100. The pictures show the tested parts. Measured by Braskem internal sand slurry method.](image)

![Figure 5 – Abrasion Index (Braskem internal sand slurry method) as a function of the Molecular Weight for the UTEC technology, measured according to ISO 15527 (ISO reference set as 100).](image)

*Calculated using Margolis’ equation*
Molecular Structure

The UTEC molecular structure has direct impact on its physical and thermal properties as well as processing performance. There are some characterization methods which can be used to measure the molecular weight of polymers. In the case of UHMWPE resins, the viscosity of polymer diluted solutions is widely used for that purpose.

![Molecular Weight Distribution Graph](image)

Figure 6 – typical UTEC technology MWD (Molecular Weight Distribution) curves measured by GPC (Gel Permeation Chromatography) method.

Processing

It is not possible to process UTEC through conventional methods such as injection, blow or extrusion molding, because this material does not flow even at temperatures above its melting point. It requires special processing techniques, the most common are RAM extrusion and compression molding. These processes are generally used to produce semi-finished parts such as rods and sheets. UTEC can also be sintered into porous parts (filters) by calendering of thin porous sheets battery separators for the automotive industry are produced. UTEC can also be used to produce separators for a variety of battery applications.

Those semi-finished parts can then be machined into parts for a wide range of applications. It is possible to use the same machining techniques as those used for wood or metal, such as sawing, milling, planing, drilling and turning. Other conversion processes may also be used.

For more information, visit [www.braskem.com/utec](http://www.braskem.com/utec)
With a human-oriented global vision of the future, Braskem strives every day to improve people’s lives by creating sustainable solutions with chemicals and plastics.

Braskem is the largest producer of thermoplastic resins in the Americas and the leading producer of biopolymers in the world, creating more environmental-friendly, intelligent and sustainable solutions through chemicals and plastics. Braskem exports to clients in approximately 100 countries and operates 41 industrial units, which are located in Brazil, United States, Germany and Mexico, the latter in partnership with the Mexican company Idesa.

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