DuPont Performance Materials delivers science-based, high quality thermoplastics to the healthcare industry. These thermoplastics are used in the manufacture of demanding components across many different healthcare segments.
DuPont draws on its long experience in materials research, application development, technology, safety and regulatory compliance to provide expert support to healthcare product manufacturers, backed by its global manufacturing and supply strength.

Depending on the specific application, DuPont can deliver an appropriate solution from its broad range of standard products, or from its portfolio of “Special Control” (SC) and “Premium Control” (PC) grades, which are differentiated by a greater degree of testing, manufacturing control and regulatory support.

The Key Properties Our Materials Can Offer Your Products

High Strength
First and foremost, designers are looking for an optimum balance of strength, stiffness and toughness with excellent molding characteristics. The right balance of these properties is the key to designing components for maximum reliability, safety and manufacturability.

DuPont™ Delrin® POM, having the most metal-like behavior of any unreinforced plastic due to its very high crystallinity, is often the first choice for designers.

DuPont also offers a wide range of reinforced engineering plastics for applications requiring even higher stiffness, strength and creep resistance (See Figure 1).

Figure 1: Strength and Stiffness*

*Zytel® conditioned to 50% RH
Low Friction
The selection of appropriate materials in a tribological system (whenever two surfaces rub against each other) is vital to ensure predictable performance and to avoid excessive or variable friction, stick-slip effects, squeaking or eventual total failure.

Secondary lubricants can address these issues but generally tend to be avoided by medical device manufacturers as they require added controls for quantity and placement, contamination control and add one more variable in manufacturing.

DuPont Performance Materials has extensive experience in product development and testing for low wear and friction applications across many industries and offers several grades for medical device manufacturers (See Figure 2).

Flexibility
For applications requiring maximum flexibility DuPont™ Hytrel®, a plasticizer-free thermoplastic polyester elastomer (TPC-ET) – is an innovative solution.

Hytrel® is super-resilient, providing excellent flex fatigue resistance and spring-like properties, and can be used over a wide range of temperatures while still retaining its flexibility and mechanical properties. It enables the design of a variety of parts and products that combine the best features of both high-performance rubbers and flexible plastic materials.

Available in the range of 30 to 82 Shore D hardnesses, Hytrel® is also economical to process, using a variety of molding or extruding technologies (See Figure 3).

Figure 2: Typical Dynamic Coefficient of Friction*

*Dynamic coefficient of friction values can be impacted by load, speed, surface roughness, etc.
**Chemical Inertness and Resistance**

One of the outstanding properties of semi-crystalline versus amorphous plastics is their resistance to many chemicals, which provides a major benefit in today’s healthcare industry where a wide range of substances is used for analysis, cleaning and disinfection, or as a drug carrier or conserving agent.

Since factors such as temperature, chemical concentration, exposure time, part surface to weight ratio and the plastic component’s stress level can all affect performance, it is highly recommended that a realistic end-use test be run to determine the suitability of a polymer grade in a particular application (See Figure 4).

**Figure 4: Chemical Resistance – Hospital Environment**

Barrier Properties

The ability of a package to protect its contents (whether in liquid, powder or gel form) against intrusion or loss of \( \text{O}_2 \), \( \text{H}_2\text{O} \) or any other relevant molecule, directly affects the product’s shelf life. A common way for packaging products to obtain the right barrier behavior balance is to use a multi-layer structure. However this solution is not always an option for injection molded products.

DuPont Performance Materials resins offer excellent barrier properties, demonstrating a unique combination of very low water vapor transmission and \( \text{O}_2 \) permeation.

Customers have sought solutions which protect healthcare personnel from patients’ viruses and projections of bodily fluids (blood). They require materials that provide protection but should not prevent the evaporation and evacuation of sweat moisture. Unlike microporous structures, polymeric monolithic membranes made in Hytrel® specialty resins have no pores that can become clogged, and can provide excellent water vapor transmission for increased comfort.
Sterilization Resistance

Sterilization is a vital day-to-day procedure in the Healthcare sector, both for single-use and multiple-use devices, so it is important that materials used in medical components are not affected by this process.

The broad range of materials offered by DuPont Performance Materials provides a suitable solution for nearly every sterilization approach as noted in the table below. This allows manufacturers to select the best material for their specific application requirements (See Table 1).

Table 1: DuPont Performance Materials Resistance to Sterilization

<table>
<thead>
<tr>
<th>Sterilization Process*</th>
<th>Autoclave &lt;25 Cycles</th>
<th>Autoclave 25 – 100 Cycles</th>
<th>Gamma 1 Cycle</th>
<th>E-Beam 1 Cycle</th>
<th>EtO 1 Cycle</th>
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</thead>
<tbody>
<tr>
<td>DuPont™ Zytel® PA66</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>DuPont™ Zytel® PA612</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td>1</td>
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<tr>
<td>DuPont™ Delrin® POM</td>
<td>2</td>
<td></td>
<td>1</td>
<td></td>
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<tr>
<td>DuPont™ Hytrek® TPC-ET (from 30 to 82 Shore D)</td>
<td>2</td>
<td>2</td>
<td>1</td>
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<tr>
<td>DuPont™ Crastin® PBT</td>
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</table>

- Appropriate
- Limited
- Not Recommended
- 1 – Yellowing
- 2 – Softer Grades

* Steam: Ultrasonic wash at 87 °C + 3 min at 134 °C, Gamma: 40 kGy, E-Beam: 50 kGy, ETO: 50 °C, 2 hr exp.
DuPont Performance Materials... a broad range of advanced solutions for healthcare components

DuPont Performance Materials... Typical Properties of “SC” and “PC” Grades

These products are manufactured according to Good Manufacturing Practice (GMP) principles and generally accepted in food contact applications in Europe* and the USA when meeting applicable use conditions. These products are also tested against ISO 10993-5 and -11 and selected parts of USP Class VI. For details, individual compliance statements are available from your DuPont representative. Table 2 is a condensed version. For a complete datasheet, please contact your DuPont representative.

The data contained herein reflects typical historical properties for our products and should not be used to establish specification limits.

Table 2: Special Control and Premium Control Grades for Health Care Applications

<table>
<thead>
<tr>
<th>Property</th>
<th>Tensile Modulus (Mpa)</th>
<th>Yield Stress (Mpa)</th>
<th>Yield Strain (%)</th>
<th>Strain at break (%)</th>
<th>Charpy Impact (notched) (kJ/m2)</th>
<th>Density (g/cm3)</th>
<th>Mass Flow Rate (g/10 min)</th>
<th>Temperature of Deflection under load (°C)</th>
<th>Vicat Softening Temperature (°C)</th>
<th>Melt Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Condition</td>
<td>23 °C</td>
<td>23 °C</td>
<td>23 °C</td>
<td>23 °C</td>
<td>30 °C</td>
<td>2.16 kg</td>
<td>1.8 MPA</td>
<td>10N, 50 °C/h</td>
<td>10 °C/min</td>
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</tr>
<tr>
<td>Test Standard</td>
<td>ISO 527/-1/-2</td>
<td>ISO 527/-1/-2</td>
<td>ISO 527/-1/-2</td>
<td>ISO 179/1eA</td>
<td>ISO 179/1eA</td>
<td>ISO 1183</td>
<td>ISO 1133</td>
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<table>
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<tr>
<th>Product Family</th>
<th>Grade (Natural Color)</th>
<th>Description</th>
<th>Unit (Mpa)</th>
<th>(at 10% strain)</th>
<th>Test Condition</th>
<th>Test Standard</th>
<th>Property</th>
<th>Tensile Modulus (Mpa)</th>
<th>Yield Stress (Mpa)</th>
<th>Yield Strain (%)</th>
<th>Strain at break (%)</th>
<th>Charpy Impact (notched) (kJ/m2)</th>
<th>Density (g/cm3)</th>
<th>Mass Flow Rate (g/10 min)</th>
<th>Temperature of Deflection under load (°C)</th>
<th>Vicat Softening Temperature (°C)</th>
<th>Melt Temperature (°C)</th>
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<tr>
<td>Hytrel®</td>
<td>TPC-ET</td>
<td>SC088/PC088</td>
<td>30D dunneter</td>
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<td>No Break</td>
<td>1.07</td>
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<td>80</td>
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<td>PC045**</td>
<td>40D dunneter</td>
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<td>&gt;300</td>
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<td>No Break</td>
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<td>5.6</td>
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<td>SC048/PC048</td>
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<td>145(P)</td>
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<td>PC066**</td>
<td>63D dunneter</td>
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<td>120(P)</td>
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<td>120(P)</td>
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<td>71</td>
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<td>1.06</td>
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<td>PBT</td>
<td>SC164/PC164</td>
<td>high flow</td>
<td>2400</td>
<td>55</td>
<td>4</td>
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<td>SC193</td>
<td>30% glass reinforced, low warp</td>
<td>9500</td>
<td>130</td>
<td>(at break)</td>
<td>2.5</td>
<td>10</td>
<td>9</td>
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</tbody>
</table>

* Homopolymer
(P) Partial Break.
* Condtioned values for Zytel® (to 50% RH).
** Identified Grades of Hytrel® do not have food contact support in Europe.

1 Homopolymer
(P) Partial Break.
* Condtioned values for Zytel® (to 50% RH).
** Identified Grades of Hytrel® do not have food contact support in Europe.
Special Control Grades

- Manufacturing according to GMP principles
- Food contact statements (EU/FDA)†
- Testing against selected parts USP Class VI
- Testing against relevant parts ISO 10993
- Sterilization data
- Global availability

Products

- Hytrel® SC938 NC010, 30 Shore D hardness
- Hytrel® SC948 NC010, 40 Shore D hardness
- Hytrel® SC956 NC010, 55 Shore D hardness
- Hytrel® SC969 NC010, 63 Shore D hardness
- Hytrel® SC976 NC010, 72 Shore D hardness
- Hytrel® SC988 NC010, 82 Shore D hardness
- Delrin® SC631 NC010, medium flow, nucleated, POM homopolymer
- Delrin® SC652 NC010, medium flow, lubricated, POM homopolymer
- Delrin® SC655 NC010, medium flow POM homopolymer
- Delrin® SC690 NC010, high flow, POM homopolymer
- Delrin® SC699 NC010, high flow, highly lubricated, POM homopolymer
- Zytel® SC310 NC010, high flow PA66
- Zytel® SC315 NC010, high flow PA6/12
- Crastin® SC164 NC010, high flow PBT
- Crastin® SC193 NC010, 30% glass reinforced, lower warpage, PBT

Premium Control Grades

- Manufacturing according to GMP principles
- Extended batch to batch quality control
- Food contact statements (EU/FDA)†
- Testing against selected parts of USP Class VI
- Testing against relevant parts of ISO 10993
- Sterilization data
- Global availability
- FDA drug master files available (DMF)

Products

- Hytrel® PC938 NC010, 30 Shore D hardness
- Hytrel® PC945 NC010, 40 Shore D hardness
- Hytrel® PC948 NC010, 40 Shore D hardness
- Hytrel® PC952 NC010, 55 Shore D hardness
- Hytrel® PC956 NC010, 55 Shore D hardness
- Hytrel® PC966 NC010, 63 Shore D hardness
- Hytrel® PC988 NC010, 82 Shore D hardness
- Delrin® PC650 NC010, medium flow POM homopolymer
- Delrin® PC652 NC010, medium flow, lubricated, POM homopolymer
- Delrin® PC690 NC010, high flow, POM homopolymer
- Delrin® PC691 NC010, high flow, nucleated, POM homopolymer
- Delrin® PC699 NC010, high flow lubricated‡, POM homopolymer
- Zytel® PC310 NC010, high flow PA66
- Crastin® PC164 NC010, high flow PBT

Hytrel®, plasticizer free thermoplastic polyester elastomer

* DuPont reserves the right not to sell Special Control and Premium Control products for selected applications.
† Some Hytrel® grades may not have EU food contact statements, please check with your DuPont representative.
‡ Contains silicone oil for enhanced frictional/wear performance
CAUTION: DO NOT USE DUPONT MATERIALS IN MEDICAL APPLICATIONS INVOLVING PERMANENT IMPLANTATION IN THE HUMAN BODY OR PERMANENT CONTACT WITH INTERNAL BODILY FLUIDS OR TISSUES. DO NOT USE DUPONT MATERIALS IN MEDICAL APPLICATIONS INVOLVING BRIEF OR TEMPORARY IMPLANTATION IN THE HUMAN BODY OR PERMANENT CONTACT WITH INTERNAL BODILY FLUIDS OR TISSUES UNLESS THE MATERIAL HAS BEEN PROVIDED DIRECTLY BY DUPONT UNDER A CONTRACT THAT EXPRESSLY ACKNOWLEDGES THE CONTEMPLATED USE.

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Customer Applications of DuPont Performance Materials:

- Valves and Pumps
- Dry Powder Inhalers
- Safety Devices for Syringes
- Peninjectors
- Surgical Instruments
- Fluid and Gas Handling
- Diagnostics
- Woundcare
- Prosthetic

Contact DuPont at the Following Regional Locations

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<tr>
<th>Region</th>
<th>Contact Information</th>
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<td>800-222-8377</td>
</tr>
<tr>
<td>Greater China</td>
<td>+86-400-8851-888</td>
</tr>
<tr>
<td>Latin America</td>
<td>+0800 17 17 15</td>
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<tr>
<td>ASEAN</td>
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<tr>
<td>Europe, Middle East, Africa</td>
<td>+41 22 717 51 11</td>
</tr>
<tr>
<td>Japan</td>
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