DuPont Materials Solutions for Medical & Healthcare

25 March, 2021

DUPONT™

About the Presenters

Laurent Hanen
Healthcare Application Development Leader – EMEA
DuPont Mobility & Materials

Ned LeMaster
Healthcare Application Development Leader – Americas
DuPont Mobility & Materials

Ian Wands
Healthcare Application Development Leader – EMEA
DuPont Mobility & Materials

Agenda

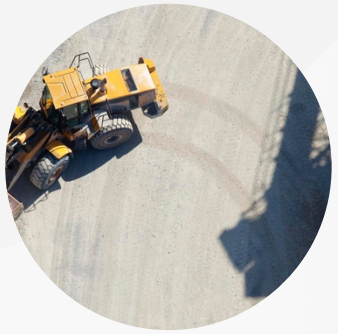
- About DuPont
- DuPont Engineered Polymers Portfolio
- Healthcare market trends
- DuPont Solutions
- Application Examples

DuPont brings solutions and technologies to an ever-changing world…

…enabled by leading brands, products, and technologies

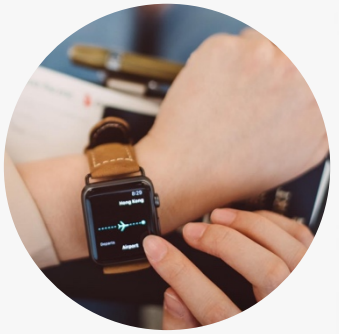
Mobility & Materials

We transform industries and improve lives through material science, delivering cutting-edge solutions and future technologies.



Water & Protection

Our purpose is clear, we create water, shelter and safety solutions for a more sustainable world.



Electronics & Industrial

Our industry-leading innovations, deep materials science expertise, and best-in-class manufacturing make next-generation technology a reality for our customers.

DUPONT™

How We Work

Communicate.

Through continuous dialogue with our customers. By listening to and understanding their needs and ambitions, we're able to think innovatively to address future business needs.

Collaborate.

Collaborative thinking means working in partnership with our customers to deliver innovative, targeted solutions. It's working together, sharing ideas and insight.

Create.

We build cutting-edge solutions and future technology. Creating ground-breaking product applications for our customers around the globe.

Global capability. Local solutions.

Innovation Centers

Mainland China
Japan
Russia
Switzerland
Taiwan

United States
- Auburn Hills, MI
- Silicon Valley, CA
- Wilmington, DE

Major R&D Centers

Canada
Mainland China
Japan
Korea
Switzerland
Taiwan

United States
- Wilmington, DE
- Marlborough, MA
- Midland, MI
- Silicon Valley, CA

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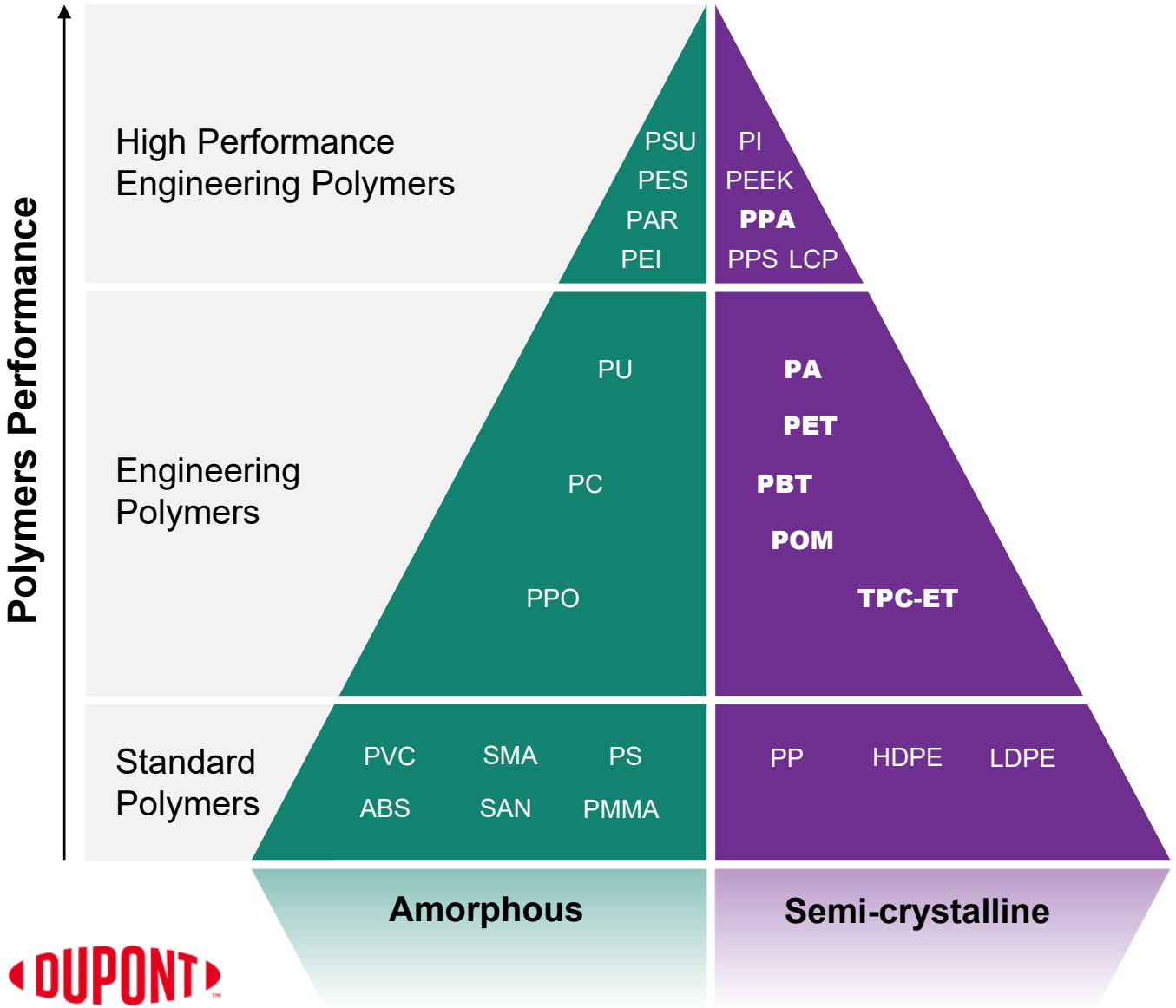
DuPont's Engineering Polymers Portfolio



Zytel® HTN: PPA and HPPA

Zytel® PLUS

Zytel® and Minlon®: Polyamides (PA6 and PA66)

Zytel® LCPA: Long Chain Polyamide

Rynite® : Polyethylene Terephthalate (PET)

Crastin® : Polybutylene Terephthalate (PBT)

Delrin® : Polyoxymethylene (POM)

Hytrel® : Thermoplastic Polyester Elastomer (TPC-ET)

TPSiV® : Thermoplastic Elastomer

Vamac® : Ethylene Acrylic Elastomer

Multiflex® : Thermoplastic Elastomer

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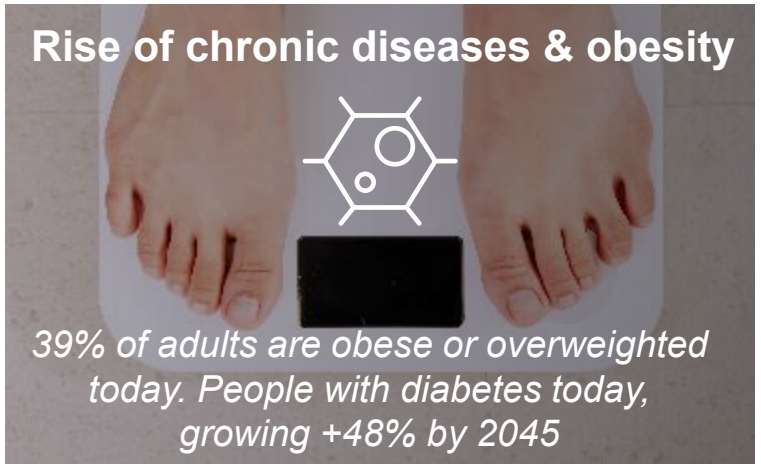
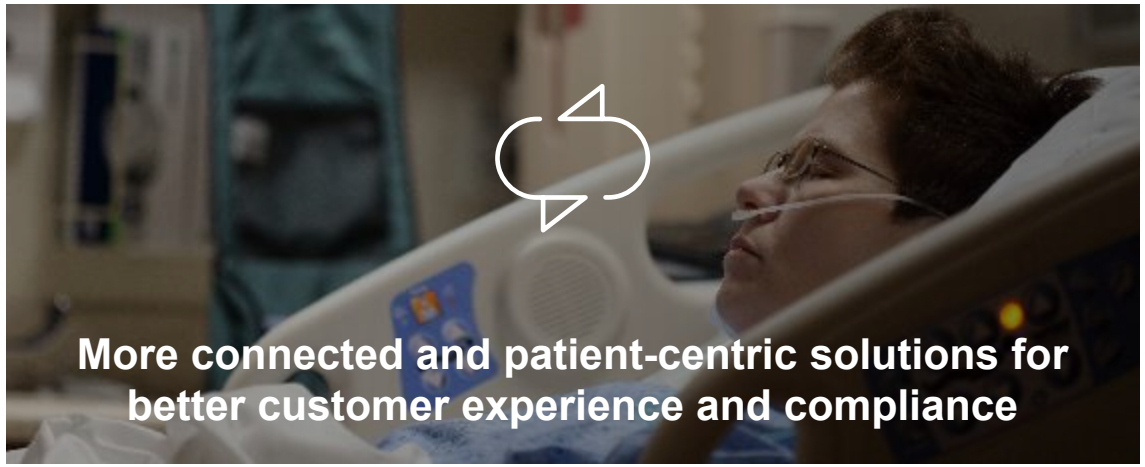
Addressing Megatrends

From "Sick Care" to "Smart Well Care"





[1] "An Aging World: 2015", US Census Bureau, 2015.

We Can Help

Long-term Commitment to Healthcare Industry

Improving Design Flexibility

Enhancing Performance and Durability

Facilitating Cost-effective Manufacturing

Technical, processing, application and regulatory expertise dedicated to smart, safe and sustainable healthcare

DUPONT™

Long-term Commitment to Healthcare Industry

- >30 years serving healthcare industry
- Dedicated product lines (>10 years)
- Supporting regulatory documentation
- Manufacturing quality controls
- Security of supply

Long-term Commitment to Healthcare Industry

Regulatory support matrix

	Standard	Special Control	Premium Control
FDA (21CFR)	No	Yes	Yes
EU Food	No	Yes*	Yes*
USP VI	No	Yes	Yes
ISO10993 (5 & 11)	No	Yes	Yes
Manufacturing Control	Standard	GMP (food) = ISO 9001 + HACCP	GMP (food) = ISO 9001 + HACCP
DMF and MAF	No	No	Yes

* Some Hytrel® grades may not have EU food contact statements

Crastin® PBT **Delrin® POM** **Hytrel® TPC-ET** **Zytel® Nylon**

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Enhancing Performance and Durability

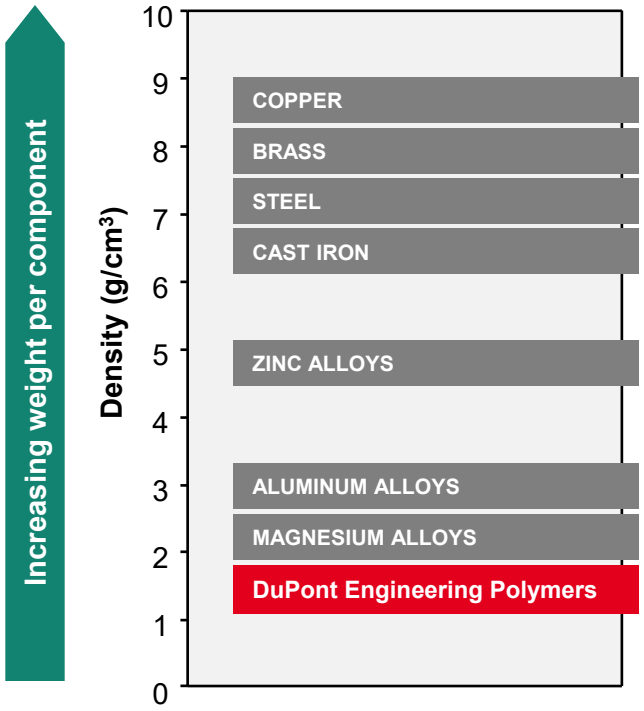
- High strength and toughness
- Creep resistance
- Low friction
- Soft and flexible
- Chemical compatibility

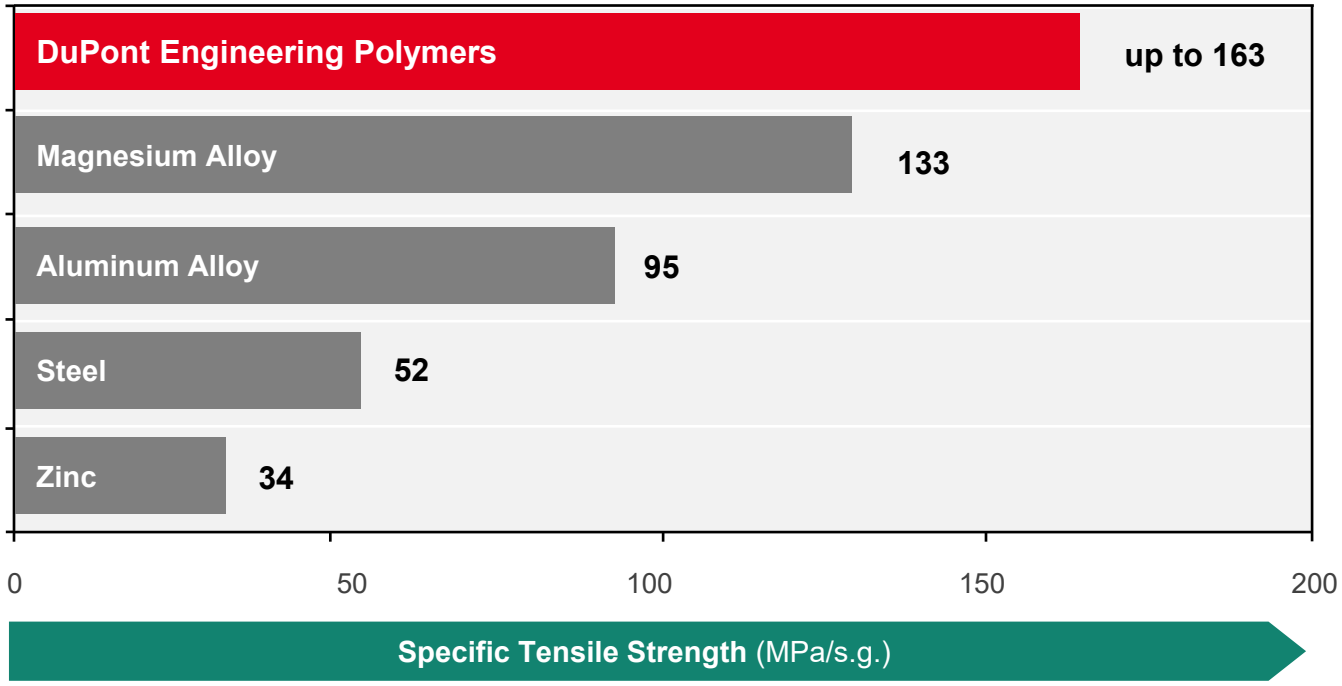
Enhancing Performance and Durability

Weight reduction leads to:

- Easier processing & part handling
- Reduced shipping costs

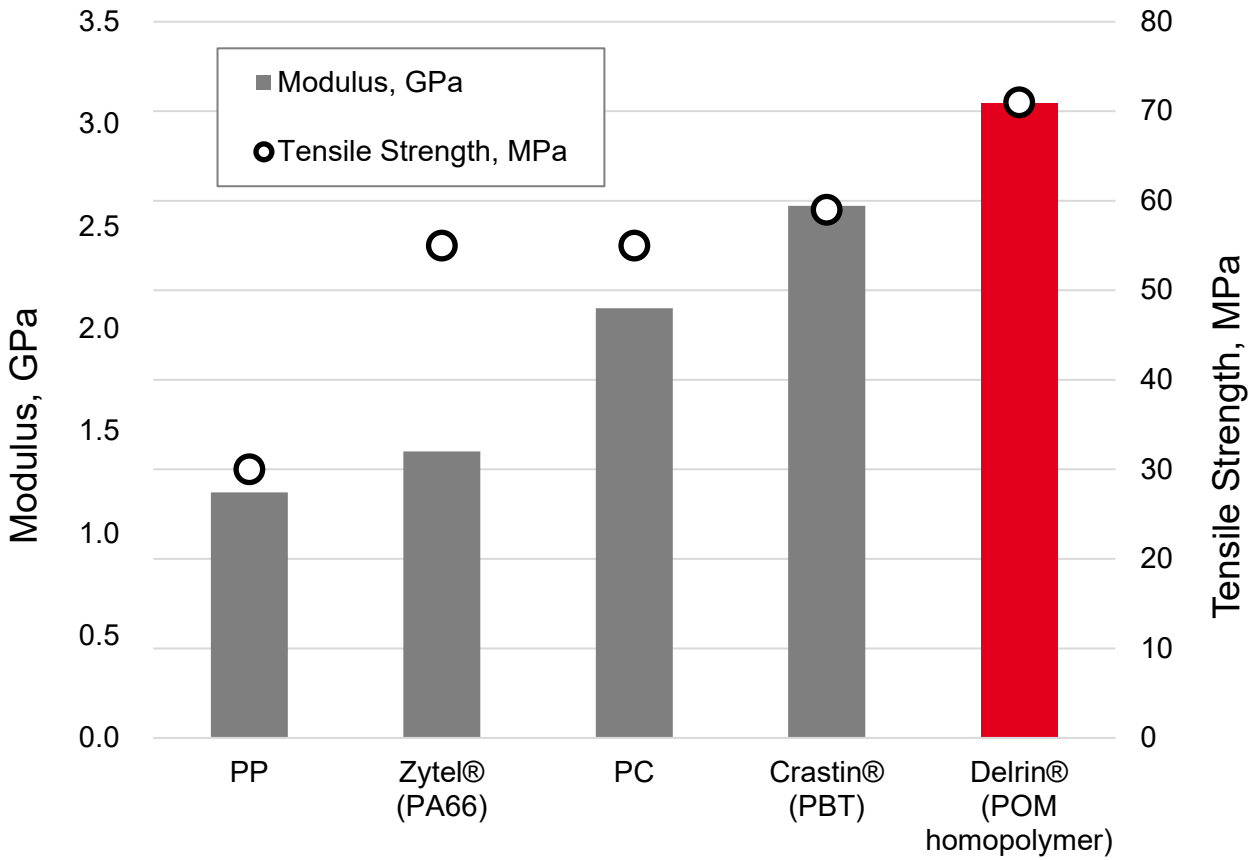
Take advantage of the outstanding strength of DuPont engineering polymers while reducing the density of your materials!





Enhancing Performance and Durability

Unreinforced properties



PA66 conditioned to 50% RH

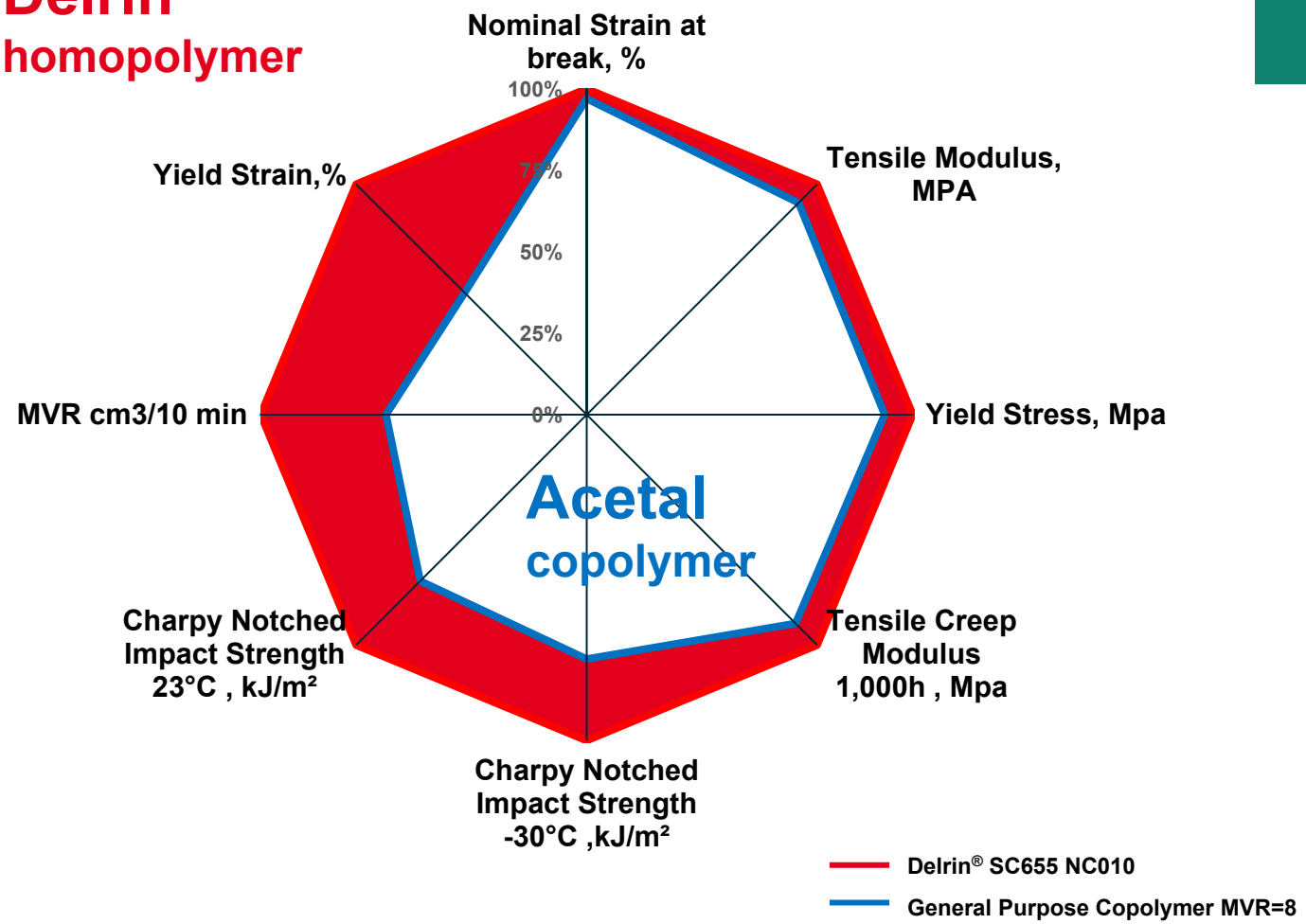
Delrin® acetal homopolymer

The stiffest and strongest unreinforced engineering polymer on the market

Image : LIMBS International

Enhancing Performance and Durability

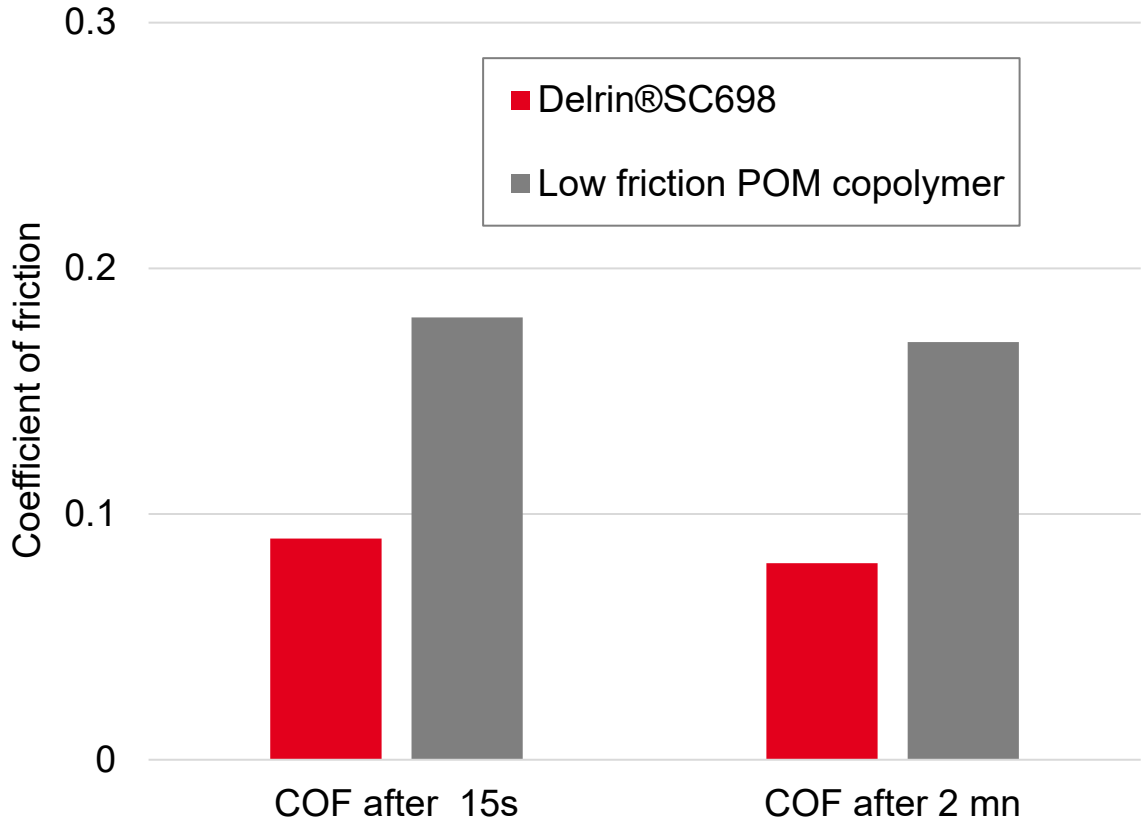
Delrin® homopolymer offers superior properties with better flow



- Parts that can withstand higher loads
- Greater safety margins
- Extended device life times
- Lighter weight components
- Higher molding productivity

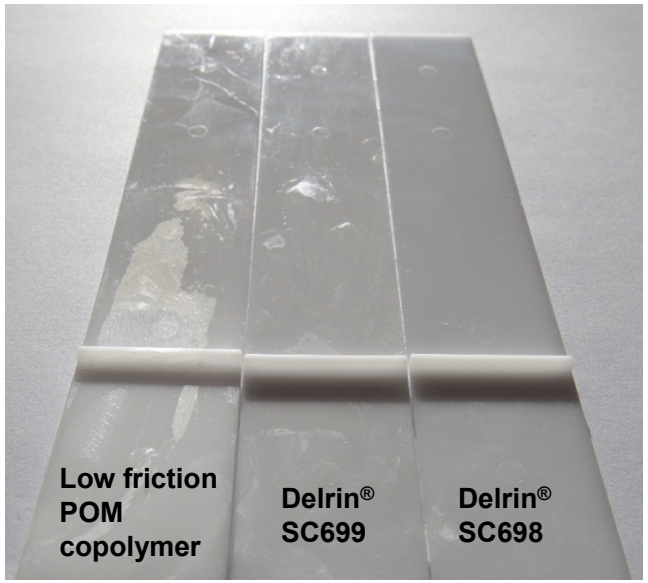
Enhancing Performance and Durability

The need for low friction



Delrin® SC698

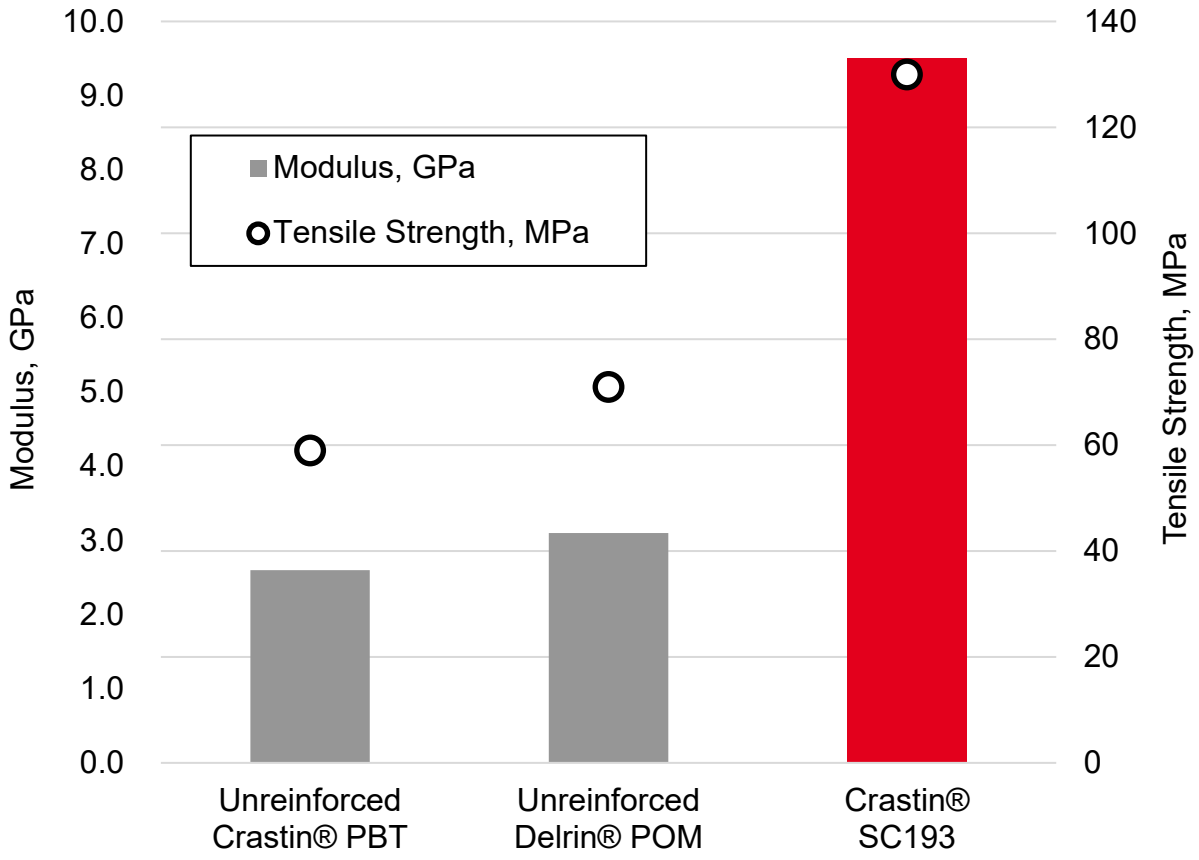
Delivering low friction for smooth and precise actuation of medical devices



- Excellent wear/friction performance
- Lower energy costs
- Removes need for external lubrication
- Enhanced surface finish

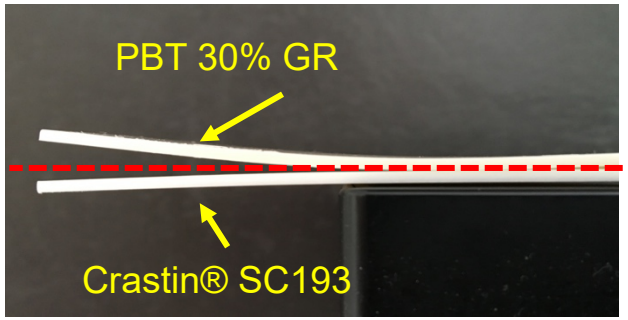
Enhancing Performance and Durability

Improving strength and stiffness



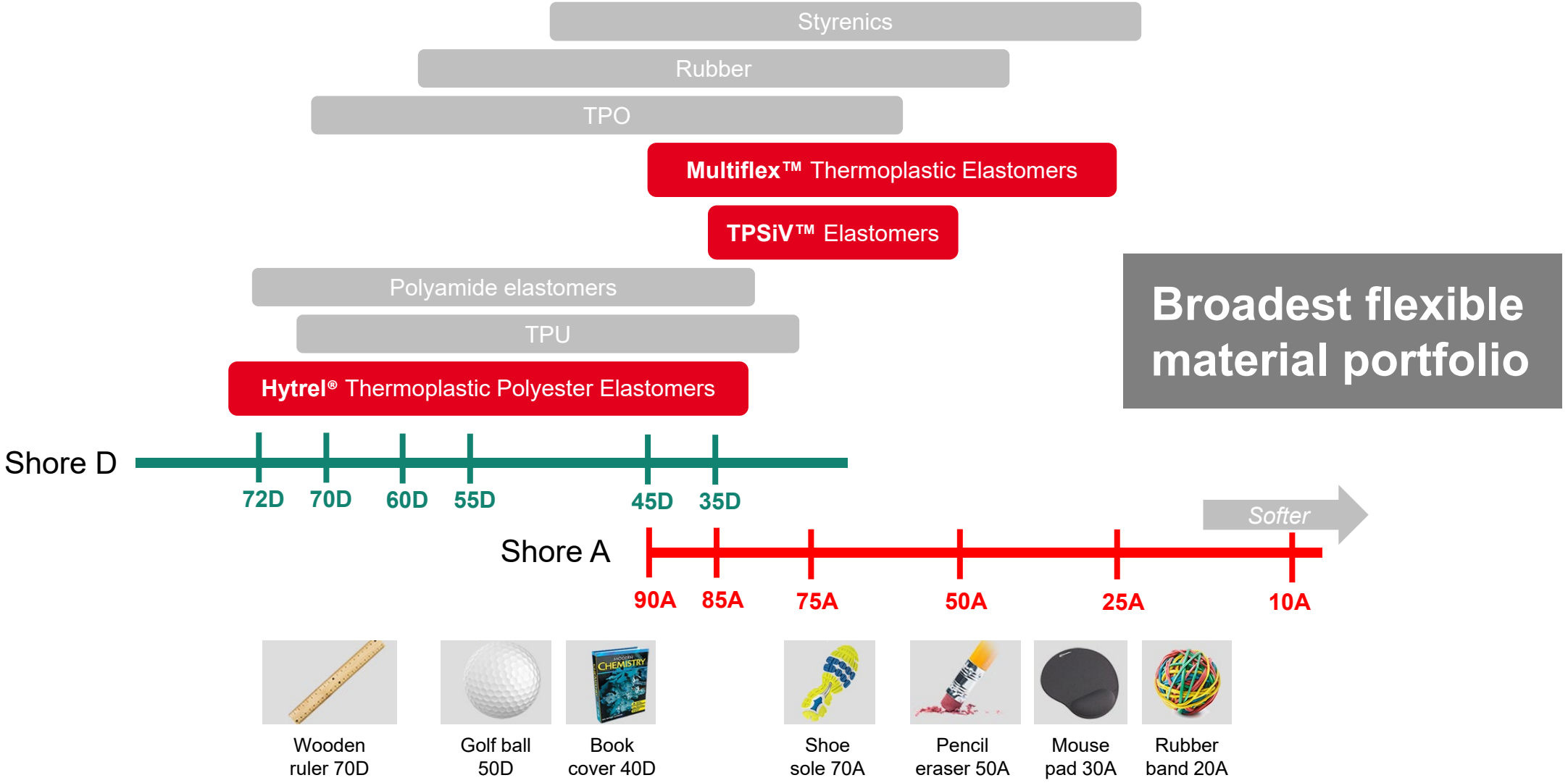
Crastin® SC193

Combining high stiffness and creep resistance with enhanced low warpage



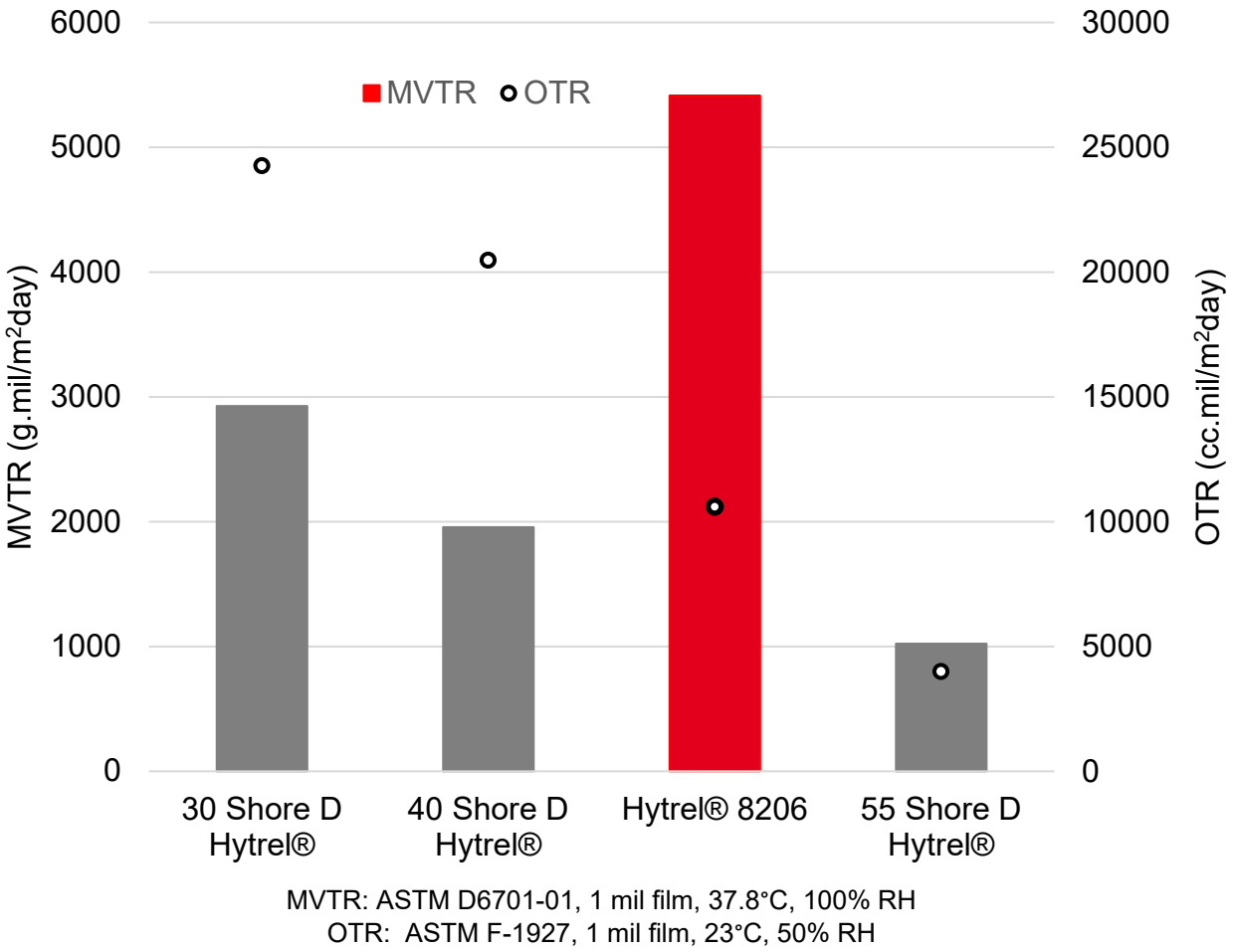
- Expanded design freedom vs. metal
- Minimal deflection of loaded parts
- Dimensionally stable
- Attractive finish for visual components

DuPont Flexible Solutions



Broadest flexible material portfolio

Enhancing Performance and Durability



MVTR: ASTM D6701-01, 1 mil film, 37.8°C, 100% RH
OTR: ASTM F-1927, 1 mil film, 23°C, 50% RH

Hytrel® TPC-ET

The flexibility of rubber with the strength and processability of thermoplastics

Films in Hytrel® can be processed in thin sections, offering versatile properties such as stretch recovery, tear resistance, clean cutting, chemical resistance & high breathability.

Enhancing Performance and Durability

Zytel®, Hytrel®, Crastin® and **Delrin®** have been proven to resist a variety of **harsh cleaning agents.**

Even when exposed to **alcohols, bleach, hydrogen peroxide and quaternary ammonium compounds**, our chemically resistant products offer reliable high performance – giving you and your customers peace of mind.

Tensile strength after 96 hour exposure (>80% retention)

- 2.5% Bleach Solution
- 3% Peroxide Solution
- Ethanol
- Quaternary Ammonium Solution
- Clorox® Healthcare Bleach Spray
- Lysol® Mold and Mildew
- Sani-Hypercide® Spray
- Sani-Cloth® AF3 Wipes
- Virex® Tb

DUPONT™

Enhancing Performance and Durability

Solutions for nearly every **sterilization** method across single-use and multiple-use medical devices

Sterilization Process	Autoclave <25 cycles	Autoclave 25-100 cycles	Gamma 1 cycle	Ebeam 1 cycle	EtO 1 cycle
Zytel® PA66	●	●	●	●	●
Zytel® PA612	●	●	●	1	●
Delrin® POM	●		●	●	●
Hytrel® TPC-ET	2 ●	2 ●	●	●	●
Crastin® PBT	● ●		●	●	●

● 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

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Facilitating Cost-effective Manufacturing

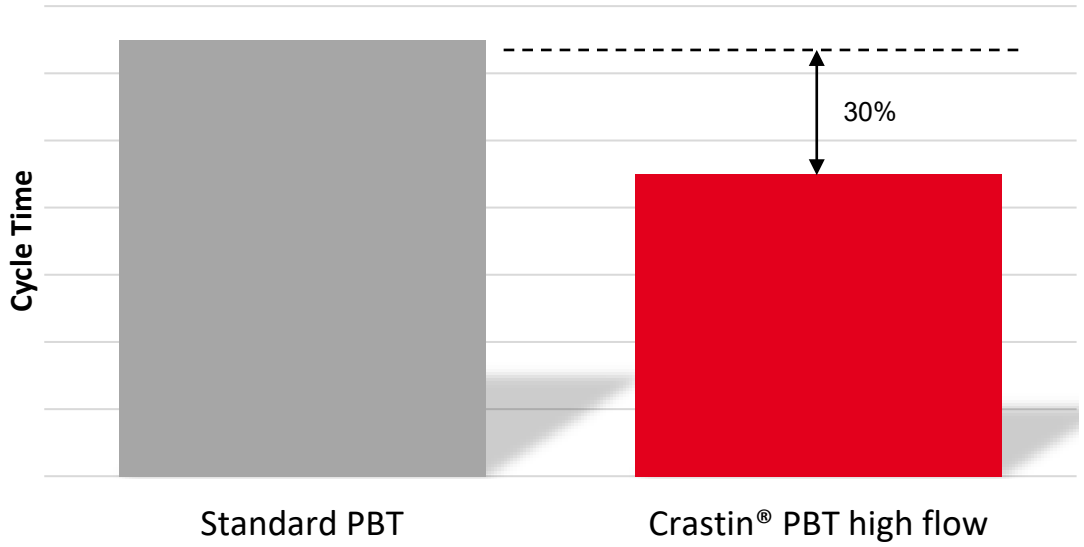
- Reduced downtime and lower reject rates
- Faster cycle times
- Optimized part design

DUPONT™

Facilitating Cost-effective Manufacturing

Fast Cycling

30% Reduction of cycle time with easier flow grades.



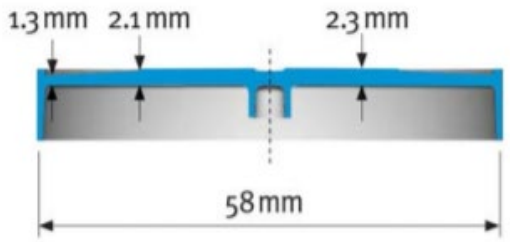
- Wider processing window
- Energy savings
- Longer tool life (lower filling pressure)

Lower cost solution

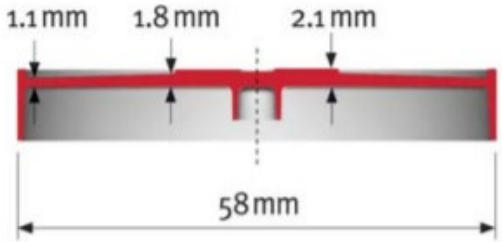
Facilitating Cost-effective Manufacturing

Optimized Design

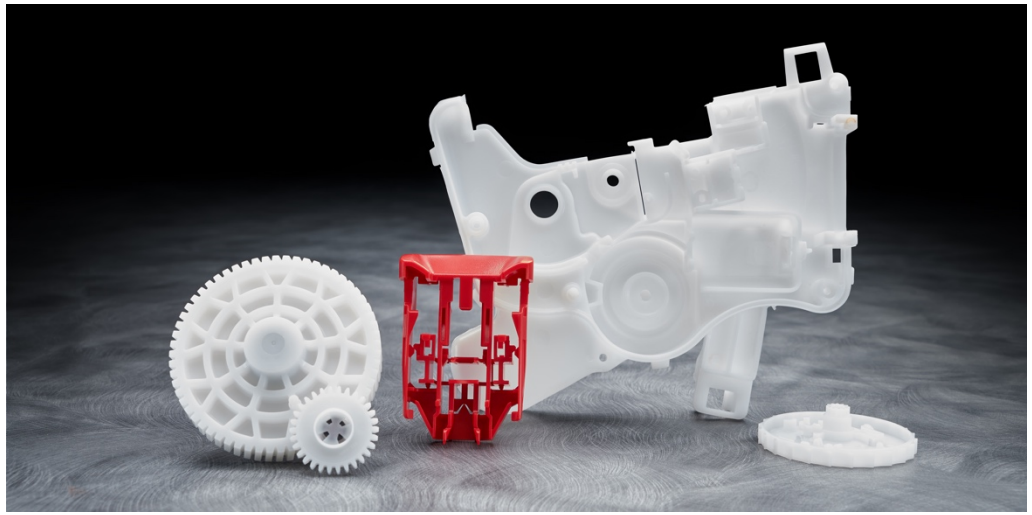
20% Reduction of part weight by re-design to fully benefit from superior mechanical properties.



Original design in acetal copolymer: 8.8 g



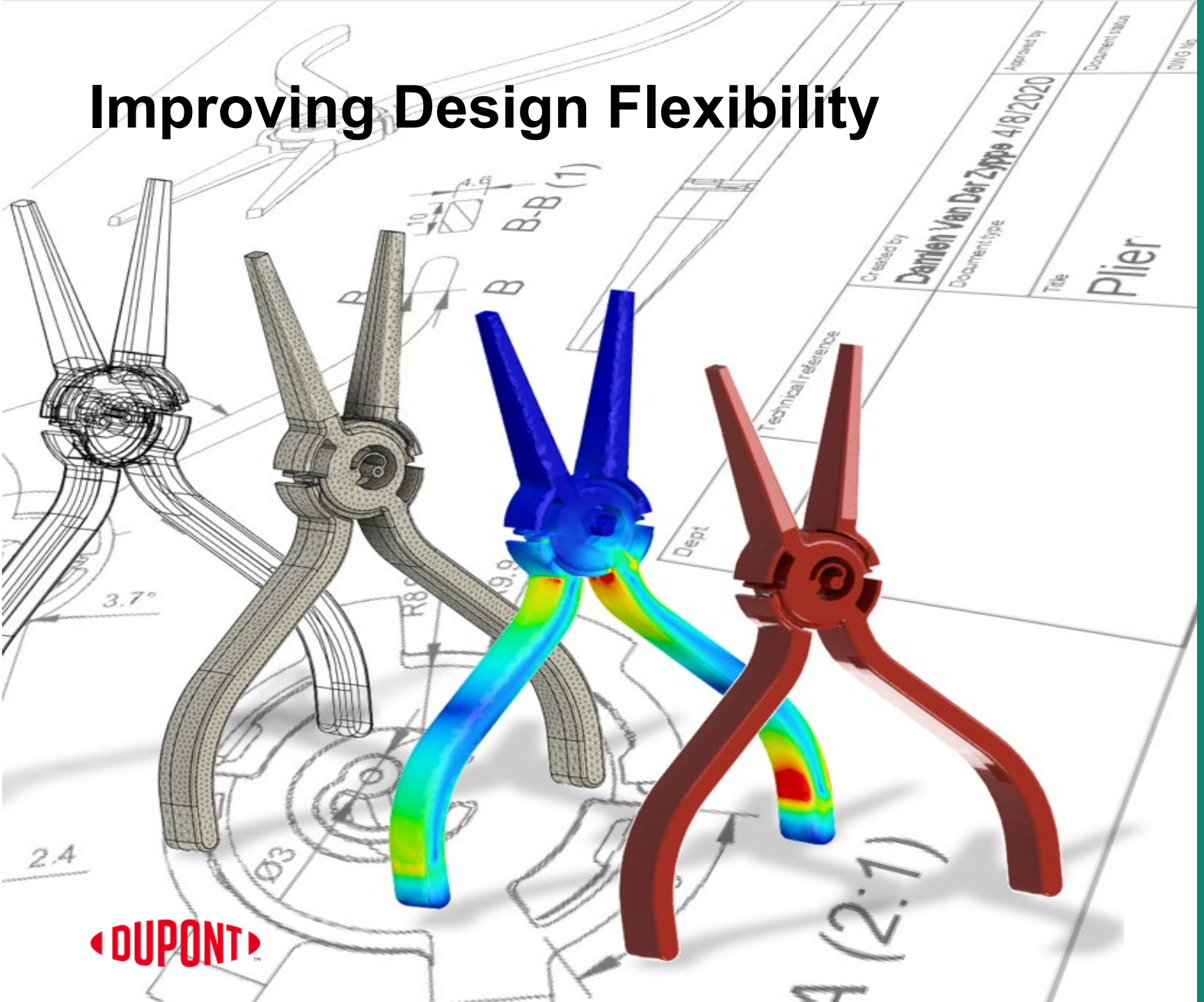
New design with Delrin® : 7.0 g



- Less material usage
- No compromise on performance
- Faster cycle times

Lower cost solution

Improving Design Flexibility



- Extended shelf life of devices
- Support greater loads on parts
- Consistent performance for reusable systems

Improving Design Flexibility

Image : Niagara Prosthetics & Orthotics

Hytrel® TPC-ET is used in the Niagara Foot™ prosthetic foot design. Its energy-return design relies on the stiff – yet flexible – properties of this specialty polymer

- Low flex fatigue and high stress resistance
- Ease of flow to fill and pack thick sections
- Range of hardnesses for comfort and durability

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Improving Design Flexibility

Spring loaded parts – case study

- Higher viscosity drugs = greater spring loads on components
- Need for enhanced creep resistance
- Supporting material data required to shorten development times
- Greater confidence in performance throughout product lifetime

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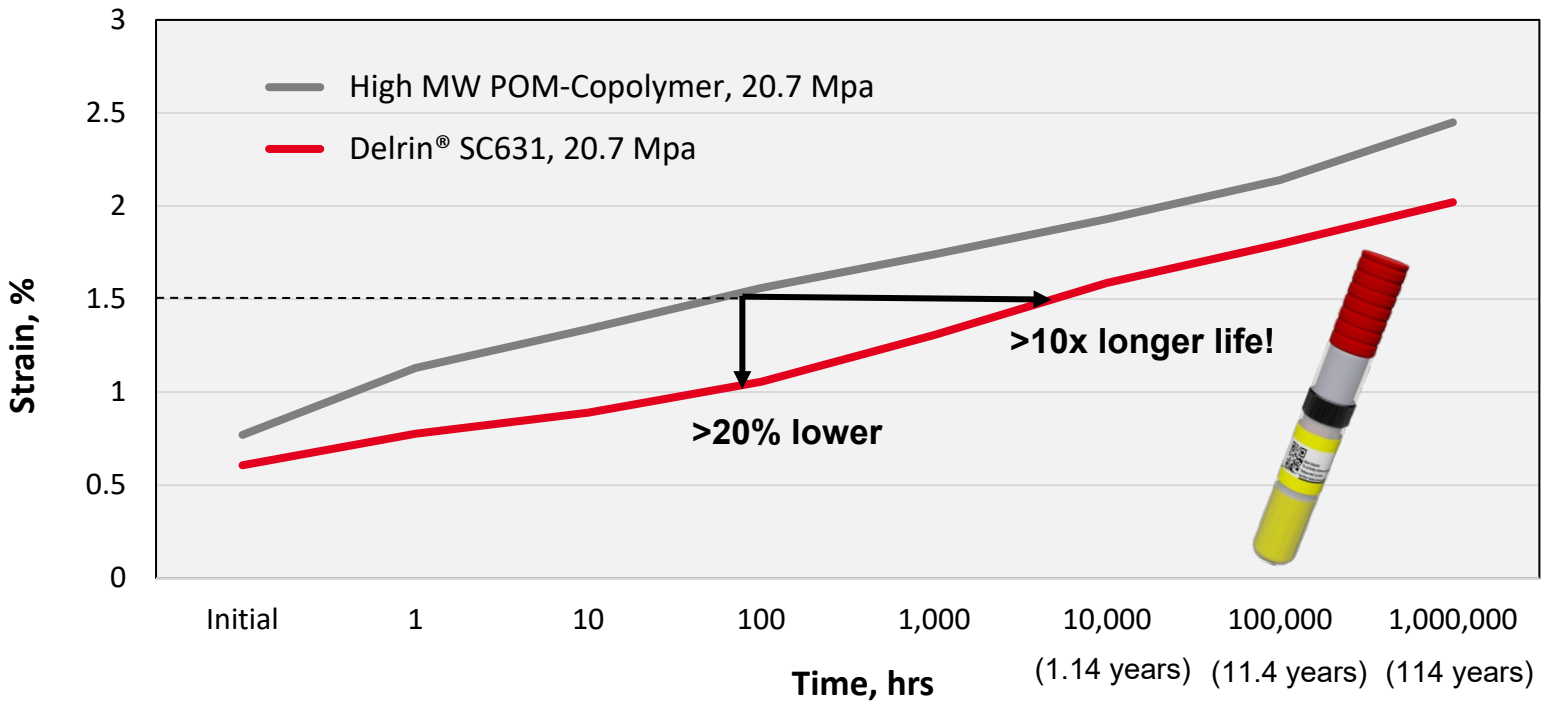
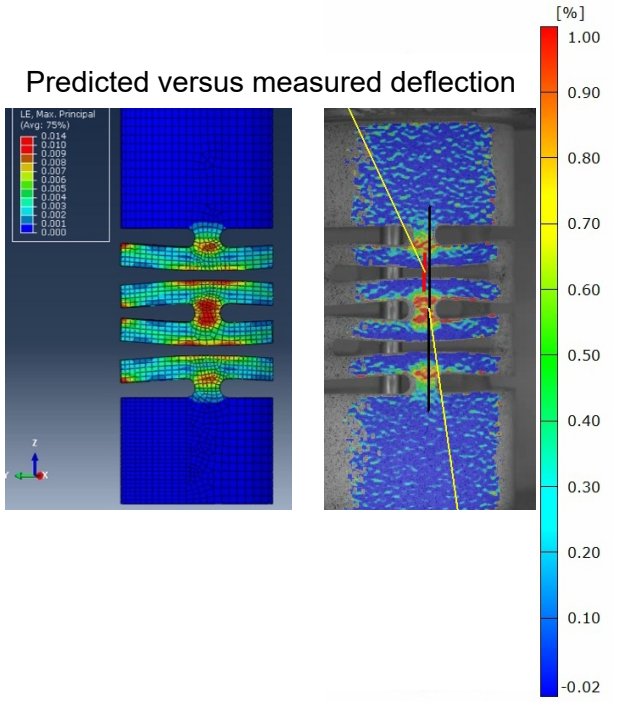
Improving Design Flexibility

Spring loaded parts – case study



Accelerated Flexural Creep at 23°C using DMA.
For reference purposes only.

Predicted versus measured deflection



Delrin® acetal homopolymer not only offers extended device lifetime performance but is supported with relevant, reliable and accurate test data to ensure the analysis is trustworthy

We Contribute to Our Customer's Sustainability Journey By Offering:

Sustainable Solutions

A broad portfolio of products

- Hazardous substance-free materials
- Materials that extend a product's serviceable lifetime
- Significant reduction in weight or friction
- Materials that help to deliver a lower or carbon neutral footprint
- Recycled based materials
- Bio-based high performance materials

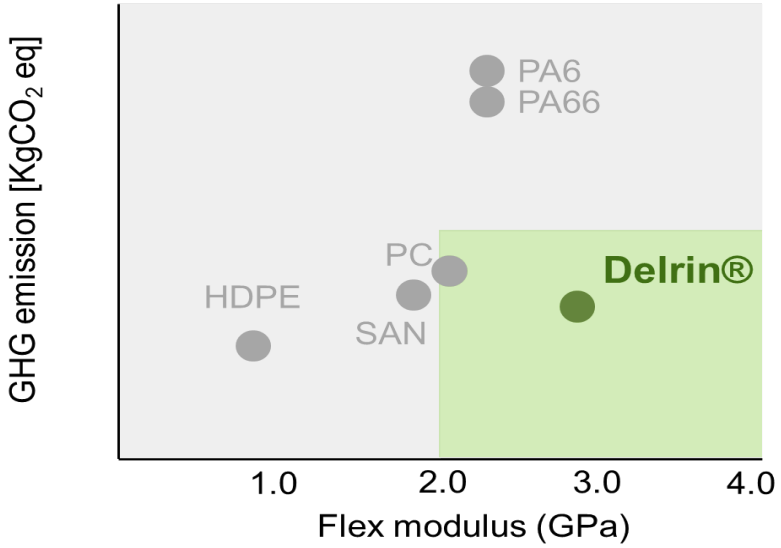
And world-class customer services:

- Application development and CAE support that enables design for sustainability
- Molding process support to reduce waste/scraps
- Product stewardship that ensures product safety and data transparency

Delrin® Advancing Sustainability

Favorable eco-profile compared to other resins

Sustainable Solutions



Indicative comparison using cradle-to-gate data from PlasticsEurope. Average tensile modulus of non-reinforced resins, extracted from public database (Campus)

Balance

Demanding technical requirements and environmental impact

Save CO_2

And fossil resources when using Delrin® versus other resins.

Delrin® produces substantially less CO_2 and uses less non-renewable energy during production, maintaining outstanding mechanical properties.

When Delrin® is produced instead of PA6, at the production gate:

50 %

Less CO_2 is emitted in the atmosphere

33 %

Less fossil resources are used

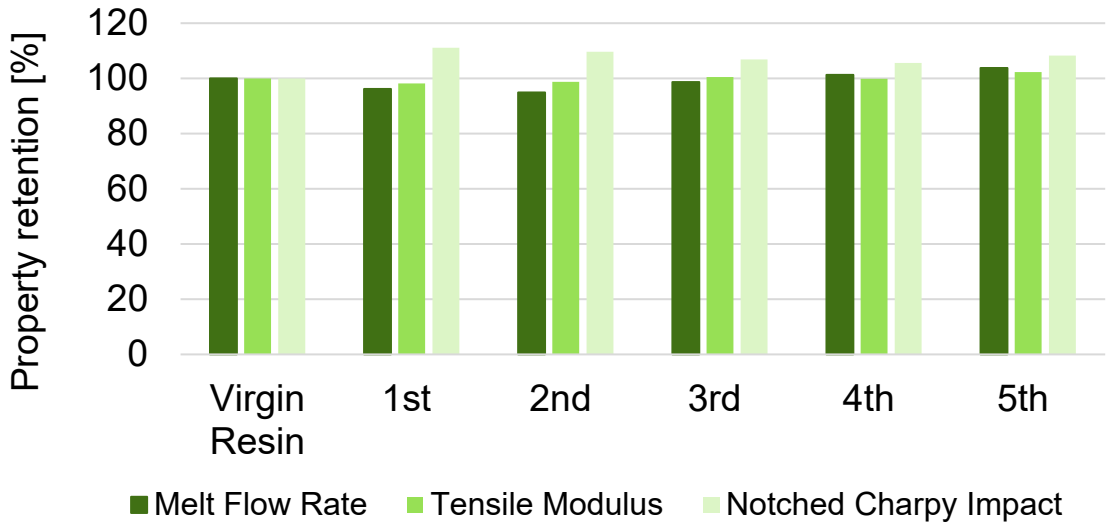
DUPONT™

An ideal solution for circular economy

Sustainable Solutions

100% Mechanical properties retention after 5 passes of 100% regrind

Unique ability to reveal process window limits.



Reduce

Your material in use and your waste

Increase

Your internal recycling of material, with financial and environmental benefits

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

For a Delrin® consumption of 1000 ton/year, when a 20% regrind is introduced, you save*:

640 ton CO_2 /year

* Estimated from PlasticsEurope EPD for POM

Recycling **220 ton** of waste instead of landfilling

Taking out of the road **135 cars** for 1 year

Planting **~2.6 km²** of forest

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Healthcare Solutions by Application

Drug Delivery Devices

Zytel® for lead screws, plungers and bearings

Crastin® for casings, counter dials and running surfaces

Delrin® for gears, spring loaded parts and clip features

Hytrel® for seals and dampening parts

Benefits include:

- Reliable performance across broad temperature range (cold chain storage)
- Drop test resistant
- User experience through haptics
- Reliable activation force
- Metered dosing
- Form, Fit, and Function with other components
- Safety/tamper resistant to prevent accidental mis-fires

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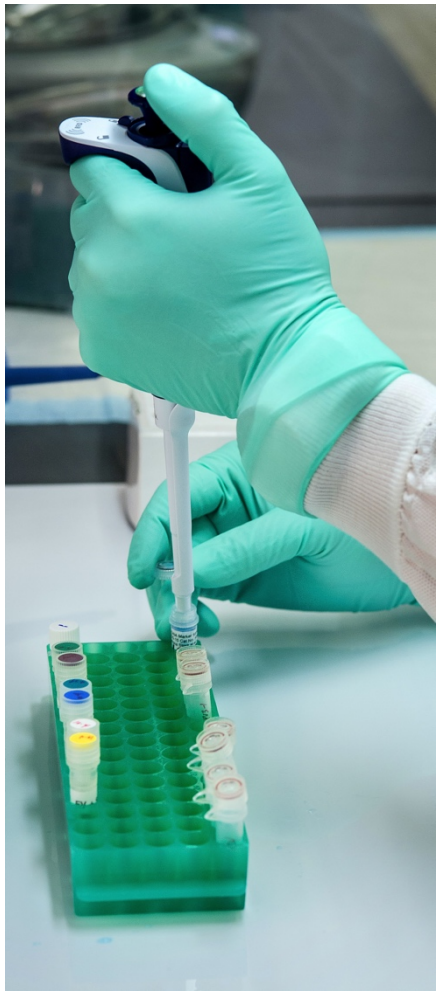
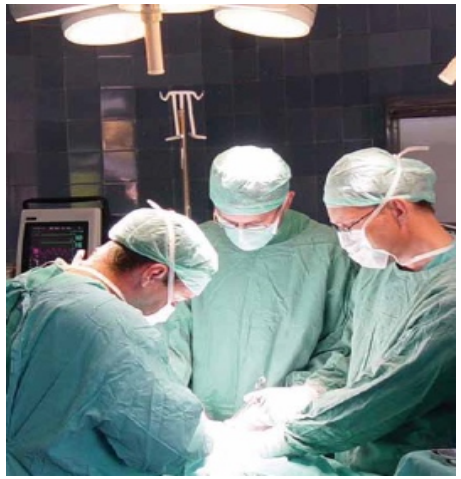
Medical and Surgical Equipment

Crastin®, **Delrin®** and **Zytel®** for clamps, connectors, retractors, gears, bearings, casings, triggers and containers

Benefits include:

- Ergonomics through rigid lightweight designs
- Reliable function and activation forces
- Functionality through low noise moving components
- Form, Fit, and Function with other components
- Safety/tamper resistant features to prevent accidental activation





Hytrel® for covers, grip handles, tubing, gowns and advanced wound care

Benefits include:

- Comfort through lightweight breathability and moisture-wicking
- Protection from environment (bloodborne pathogens, etc.)
- Flexible, puncture and tear resistant.
- High productivity through processability and output
- Material compatibility allows for multilayer structures and connectors/fittings

DUPONT™

Wearable Technology

Crastin® and **Delrin®** for applicators, gear systems and housings

Hytrel® for fixtures, casings and clips

TPSiV® for fitness straps and earbuds

Benefits include:

- Reliable application force
- Lightweight
- Functional micro-components
- Dependable metered dosing
- Low noise
- User experience through haptics
- Extended wear times/reduced skin sensitization

Prosthetics and Patient Assistance

Hytrel® for seals and dampening parts

Delrin® and **Zytel®** for feet, elbows, knees, and hands

TPSiV® for straps

Benefits include:

- Natural range of motion for millions of cycles (running, walking, jumping, kneeling, etc.)
- Low noise during movement
- Lightweight, durable, and load bearing
- Waterproof and cleanable
- Aesthetic appearance through design and processing
- Extended wear times/reduced skin sensitization

DUPONT™

We Can Help

Long-term Commitment to Healthcare Industry

Our dedicated medical grades portfolio, regulatory compliance support, GMP and long-term supply guarantee make DuPont a trusted global leader in the healthcare industry

Enhancing Performance and Durability

Our specialty medical grades bring the benefits of dimensional stability, superior mechanical properties, long term creep/fatigue endurance and sterilization resistance

Facilitating Cost-effective Manufacturing

Our high flow resins enable multicavity tooling, fast cycle production and minimal downtime for thin wall medical parts

Improving Design Flexibility

Broad solutions ranging from high stiffness polymers to flexible elastomers enable next-generation innovations that enhance the patient experience

Technical, processing, application and regulatory expertise dedicated to smart, safe and sustainable healthcare

Questions?