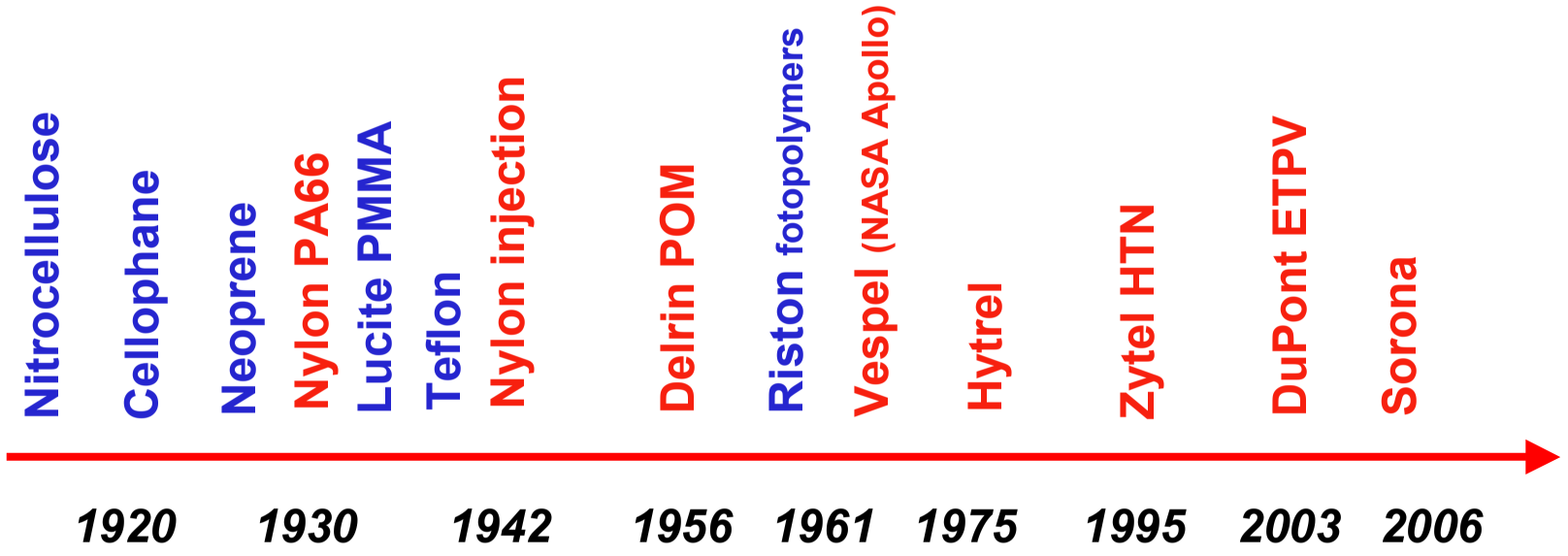
High Performace Products

Pushing the Limits

Milestones - DuPont Engineering Polymers



History of DELRIN Polyacetal

METAL

2000 years B.C.

Delrin® first acetal resin was invented by DuPont in the end of the 1950's.

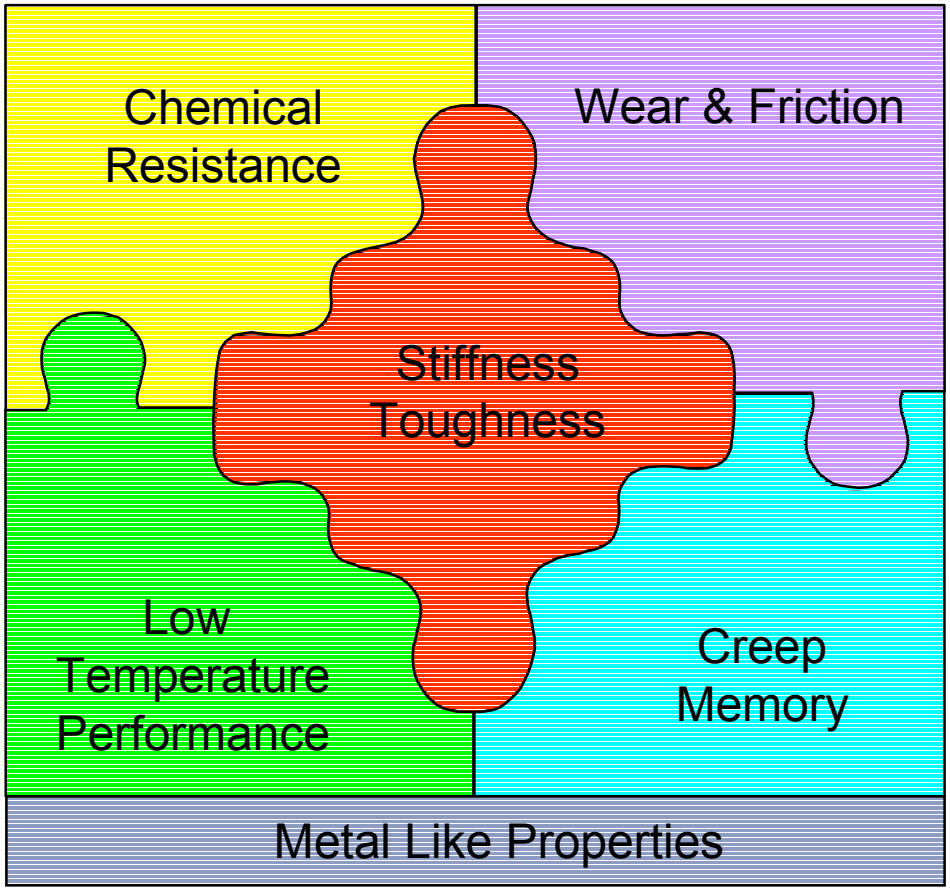
Polyamide was invented by Wallace Hume Carothers from the DuPont Company in 1934-1935, and was introduced to the public as Nylon in 1938.

Zenite® is a Liquid Crystal Polymer resin invented in 1970. It is anisotropic, self-reinforcing, and is based on an aromatic copolyester which has high crystallinity.

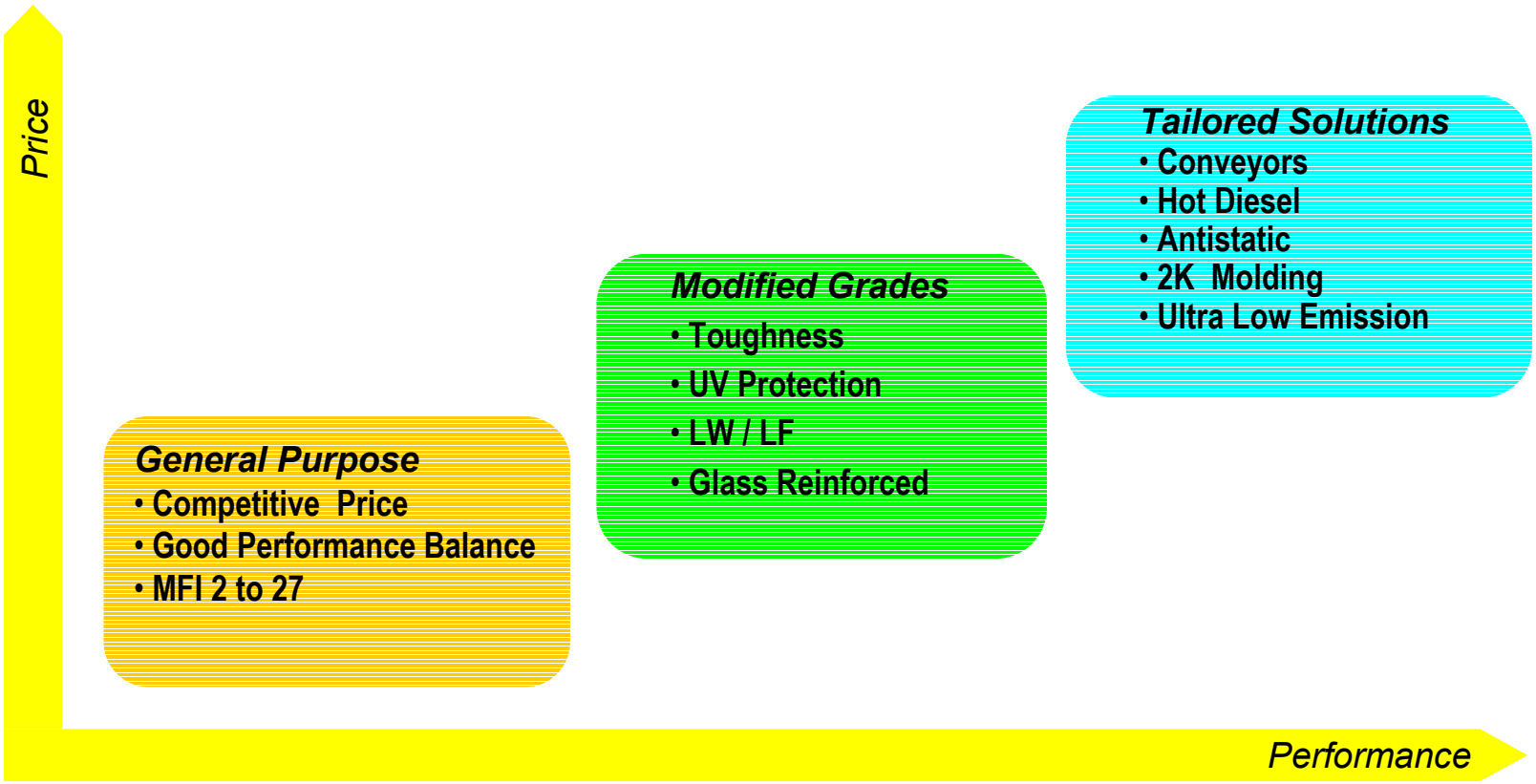
Product Positioning vs. Non In-Kind Competition

	DELRIN® Product Advantages	Customer Benefits
Vs Metal	• Lower specific gravity • Final part ready to use • Part integration • Design freedom • Better surface finish • Snap fitting possible	• Lighter parts and lower fuel consumption • Lower cost • Multi-functional part • Innovation & new design • Very attractive parts for consumers • Easy assembly to other parts
Vs PBT	• Higher flexural modulus • Better wear & friction properties • Higher creep resistance & memory • Decoration including plating	• Stiffer parts or thinner and lighter parts • Longer lasting parts • Perfect part performance • All kind of finish possible
Vs PP	• Higher flexural modulus • Precision moulding • Excellent low tem. performance • Lower wear & friction • Better scratch resistance	• Stiffer parts without reinforcement • Design permitivity • Suitable for tough environmental cond. • Non greased systems possible • Long lasting aesthetic parts
Vs ABS	• Better UV resistance • Much better chemical resistance • Hard surface • Better wear & friction properties • Shorter moulding cycle time	• Predictable aesthetics • Usable in contact with aggressive food & chemicals • Moving & static part integration possible • Increase of productivity

DELRIN Addresses Key Customer Needs



DELRIN Performance Related Products



DELRIN Acetal - Properties

Advantages:

- ⇧ Stiffness (unreinforced)
- ⇧ Toughness
- ⇧ *Low influence on mechanical properties at variating service temperature*
- ⇧ Fatigue resistance
- ⇧ Creep resistance
- ⇧ Excellent spring properties
- ⇧ Dimensional stability
- ⇧ Resistance to solvents
- ⇧ Resistance to petrol
- ⇧ *Inherent low friction and wear*
- ⇧ Bright colour available
- ⇧ Food approved

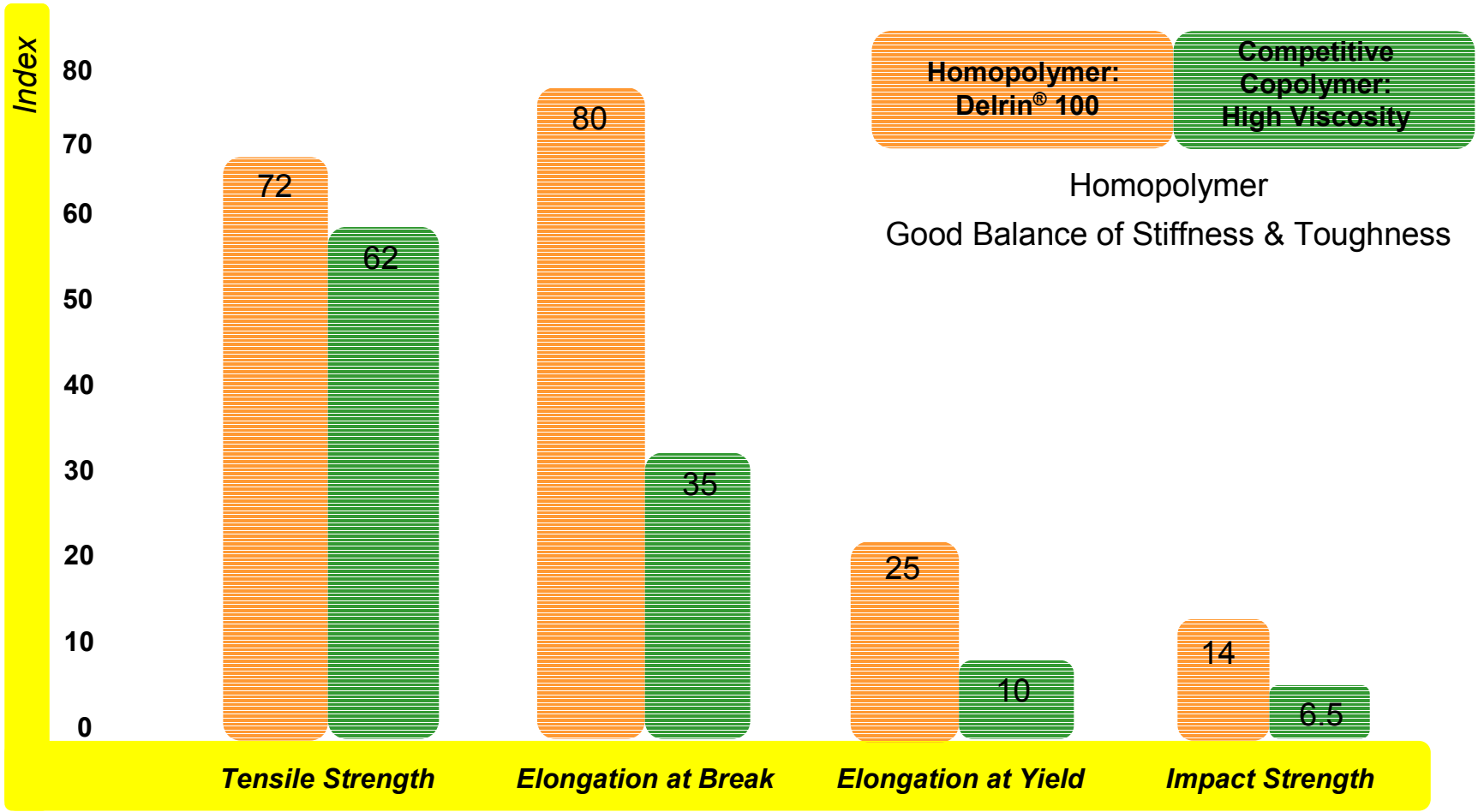
Limitations:

- ⇩ Max service temp < 90 / 120 °C
- ⇩ Flame retardant impossible
- ⇩ Hydrolysis resistance (hot water)
- ⇩ Resistance to strong acids and bases
- ⇩ Squeaks against itself (unmodified)

Replaces:

- ⇗ Metals weight, spring properties, friction)
- ⇗ Polyamide (dimensional stability)
- ⇗ *Acetal homopolymer is a **PROBLEM SOLVER** when copolymer fail in mechanical properties*

Acetal Homopolymer vs Copolymer



Homopolymer

Good Balance of Stiffness & Toughness

List of DELRIN grades

Standard

100 High viscosity
100P High viscosity, easy processing.
111P High viscosity, easy processing, improved stability
311DP Medium viscosity, easy processing
500 Medium viscosity
500P Medium viscosity, easy processing
511P Medium viscosity, easy processing, improved stability
900P Low viscosity, easy processing
911P Low viscosity, easy processing, improved stability

Toughened

100ST Super tough, high viscosity
100T Toughened, high viscosity
500T Toughened, medium visc.

Decoration solutions

DS100 High viscosity
DS500 (M) Medium viscosity
DS900 (M) Low viscosity

Low wear / friction

100AL Advanced Lubricant
120MP 20% PTFE micropowder
520MP 20% PTFE micropowder
500AF 20% PTFE fibres
500CL Chemical Lubricant
500AL Advanced Lubricant
500TL 1,5% PTFE micropowder
900SP Special Polymer
500SC Silicone Concentrate
100KM Kevlar® Modified

There are more than 50 commercial Delrin® grades

UV stabilized

127UV High viscosity, best UV
527UV Medium viscosity, best UV
927UV Low viscosity, best UV
107 High viscosity, UV
507 Medium viscosity, UV

Low emission Copolymer

460E Medium viscosity, low emission
1260E Low viscosity. Low emission
100PE High viscosity, low emission
500PE Medium viscosity, low emission
127UVE UV protected, low emission
527UVE UV protected, low emission

HD & Conductive

300AS Anti-static, high viscosity
300ATB Conductive, high viscosity
560HD Hot diesel grade

Glass Reinforced/Filled

510 GR 10%GR
525 GR 25%GR
570 20%GF
577 20%GF, UV resistant

2C Moulding

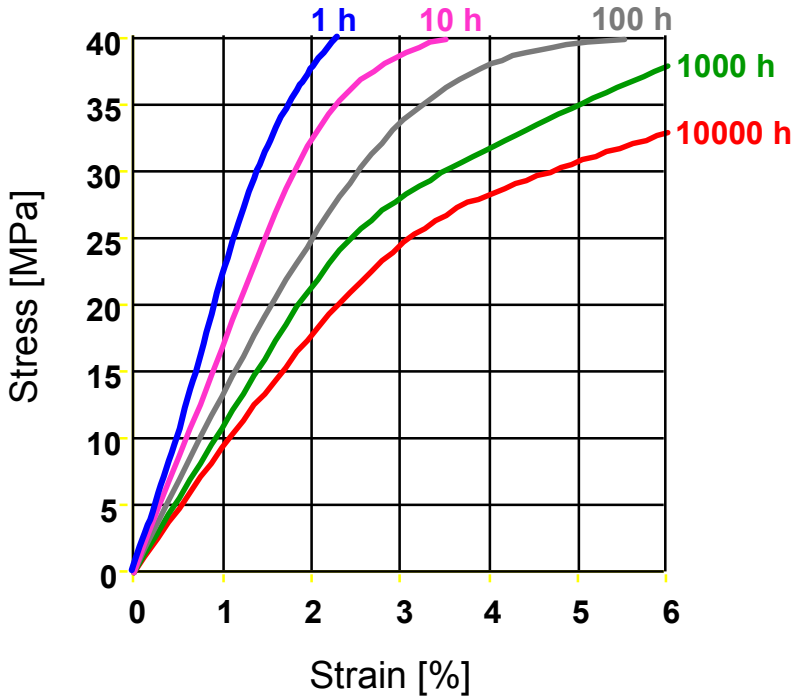
142CM High viscosity
542CM Medium viscosity

DUPONT

DELRIN® 111 P Creep Resistance

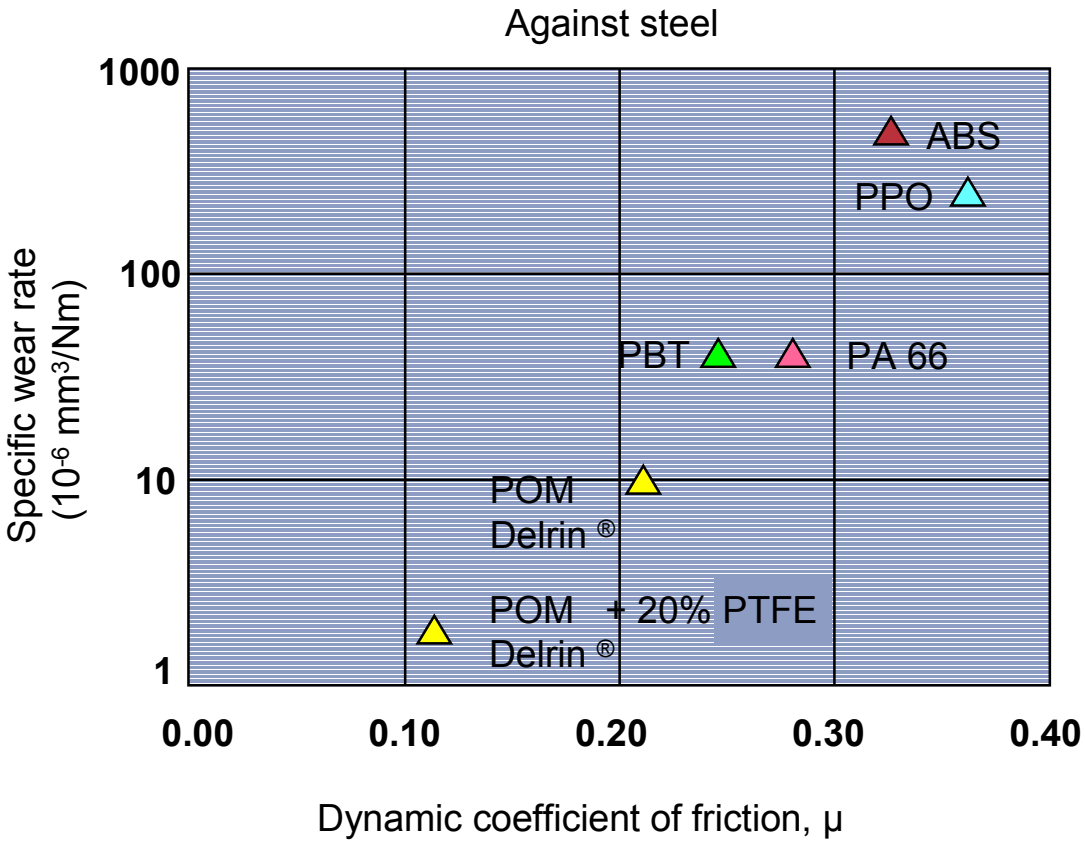
Stress [MPa] to reach 2% strain after the time [h]		
t [h]	Delrin® 111 P	Copolymer
1	37	32
10	33	27
100	25	23
1000	22	20
10000	18	18

Isochronous stress-strain curves under tensile load at 23°C



DELRIN Low Wear & Low Friction

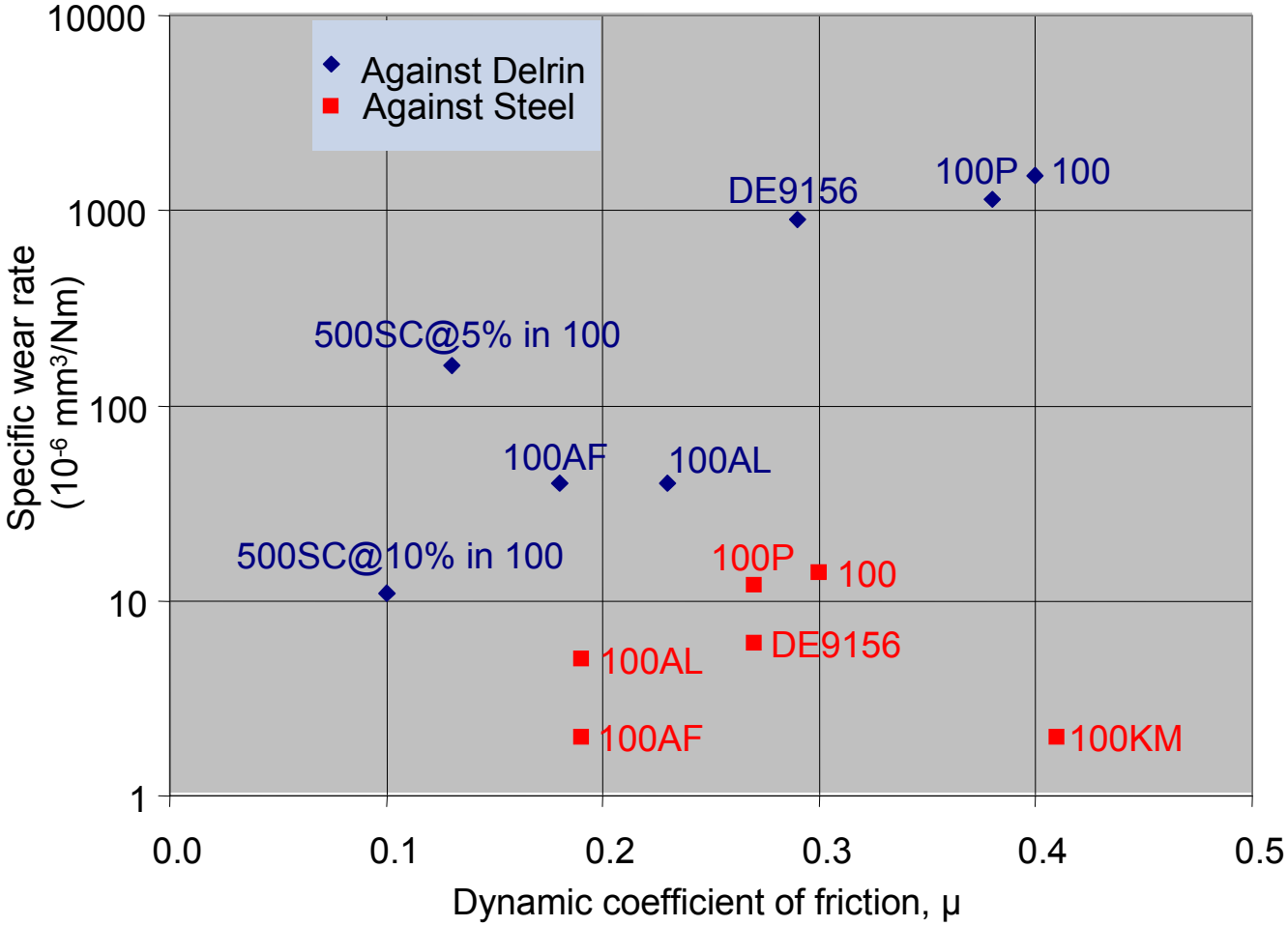
Choosing Delrin® is an ideal starting point for applications in which wear and friction are major issues.



Prototype testing is important!

DELRIN Low Wear & Low Friction

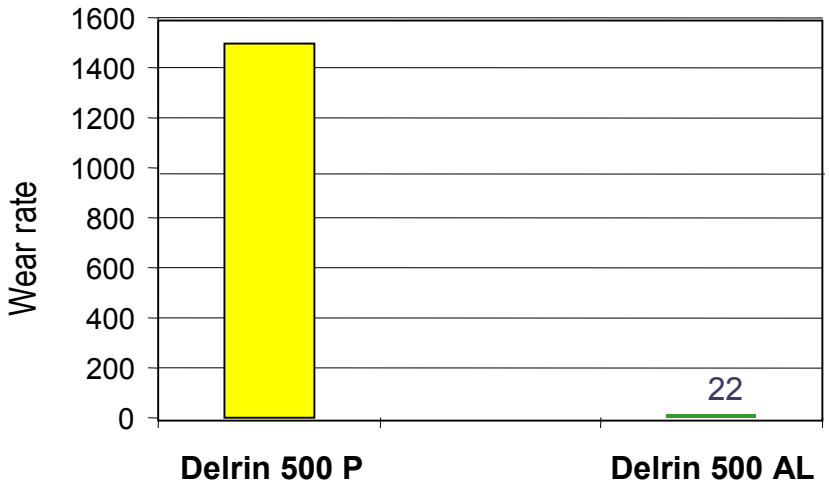
Specific wear rate (W_r) vs coefficient of friction (μ)
Delrin against itself and Delrin against steel



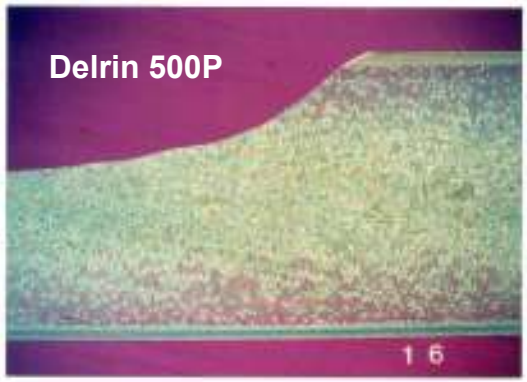
For metal as a counter surface, the harder the surface the better the wear and friction behaviour of the system. Aim for a hardness of greater than 50 HRC

DELRIN Low Wear & Low Friction

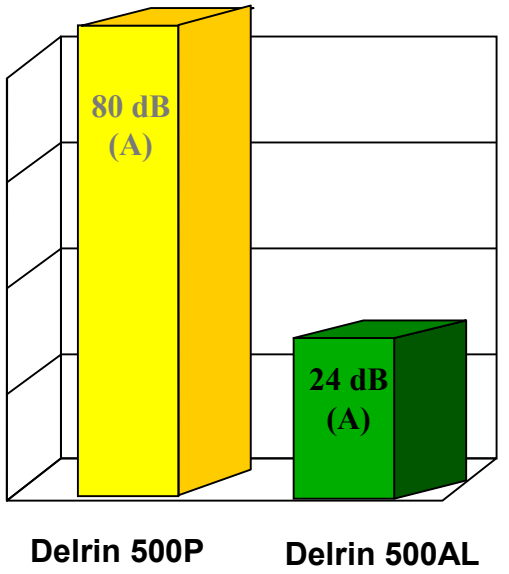
The wear rate and its corresponding wear track



Specific wear rate against steel



Quieter too!
Certain grades reduce noise (squeak) dramatically compared with standard grades



Success Stories

Rowenta Lighter (Delrin® 542CM+Ponaflex)

- Multifunctional component.
- Cost reduction vs 2 components matching stiffness and sealing demanded by the application.
- Easy assembly and cost reduction in assembly line.

Scheffenacker Mirror Components (Delrin® 311 DP)

- Lower reject rates due to better impact resistance than COP formerly used.
- Tighter tolerances because of higher precision moulding.
- Cost reduction:
  - parts reduction & function integration
  - easier assembly.

Ski Boots Components (Delrin® 100)

- Safe performance even at low temperatures at hard skiing conditions.
- Perfect aesthetics parts as per consumer demand.
- Tight tolerances due to low water absorption.

Antistatic Clip Raymond (Delrin® 300ATB)

- Safe parts, meets conductivity required.
- Lower reject rate during assembly (excellent elongation at break).
- Productivity gains due to wider processing window than other competitive materials.

Success Stories

Conveyor Regina (Delrin® 100 KM)

- Longer service life because of
  - low wear
  - low friction
  - scratch resistance.
- Noise reduction vs metal
- Dry systems vs metal with lubrication

Safety Restrain Systems(SRS) (Delrin® 100)

- Tight tolerances due to low water absorption.
- Cost reduction :
  - parts reduction & function integration
  - easier assembly
- Safer parts vs PP components due to excellent mechanical performance.

Cosmetic Applications (Delrin® DS900 M)

- Product line differentiation.
- Cost reduction > 15% vs POM+ABSl.
- Multifunctional + aesthetics parts.
- Design freedom.
- Chemical resistance to alcohol and grease.

Weener Mint Dispenser (Delrin® 900P)

- Differentiation through new spring design.
- Attractive appearance with excellent part performance due to better flex fatigue and scratch resistance vs. PP or PS.

Success Stories – PEDALITE – DELRIN 100P

- Differentiation through new design.
- Attractive appearance with excellent part performance due to better flex fatigue and scratch resistance.
- Corrosion resistant.
- Self-lubrication.

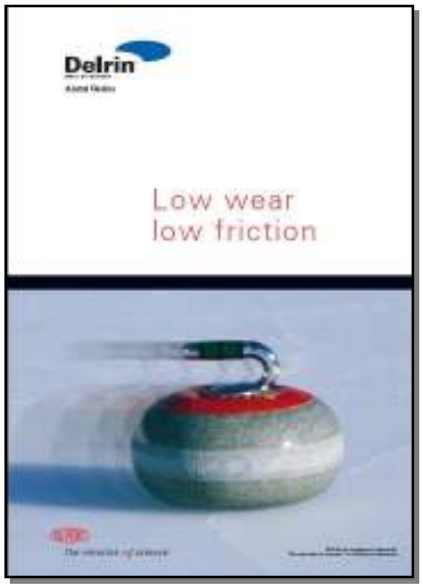
Success Stories – Side Seat Support - DELRIN 100KM – L&P

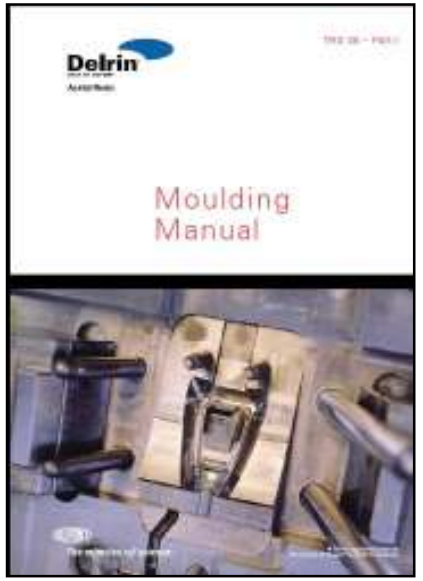
Integrated in the front seats of the sporting models from BMW, the electronically-controlled system uses signals from the ESP sensors to adjust the angle between the backrest and its side cushions according to the style of motoring.

Success Stories - BOCEMIX Bone Cement Mixer - Bidoia

Delrin good elongation at yield makes it possible to mould a leaf-spring as an integral part of the trigger lever, thus eliminating the need for a metal return-spring and related assembly operations. The C-shaped antiscrew pull tab is held in place with a snap-fit, made possible by the acetal's combination of toughness and stiffness. The ribbed driving shaft relies on the inherent lubricity of Delrin together with its high modulus and strength, which the ribbing requires; the mixing blades perform their task thanks to the material's flex modulus. The rotary piston is also made of Delrin.

More about Delrin®:





Thank You

www.plastics.dupont.com