Delrin®
ONLY BY DUPONT

acetal resin

Low wear low friction

DUPONT®
The miracles of science™

Low wear / low friction

Table of content

Page

DELRIN® low wear low friction grades in conveyor chains allow for a longer lifetime of chains and wear strips, smooth sliding of the conveyed goods, silent (squeak free) motion and lubrication free operations.

Introduction

Today, customers need more from suppliers than just materials. They require a resource that is willing and able to join in at the earliest stages of the product development process. One that can carry a project from concept through design, component analysis, material selection, prototyping, testing, quality control, and even commercialisation. A fully-fledged partner is a must.

DuPont can be that partner. DuPont believes that true partnership is a dynamic process of teamwork and sharing. And it is recognised that only through continued success will relationships thrive, to bring out the best in both parties.

By allowing DuPont to work with the customer from the initial design concept, and on through every stage from prototyping to full production, DuPont's unrivalled experience can be shared, and can help you choose the optimum engineering polymer for your needs. The result? A very competitive new product with time-proven success built in.

DuPont Engineering Polymers offers properties and benefits so important to giving your products that extra competitive edge: lightweight materials for light-weight parts and components; resistance to corrosion and abrasion; self lubrication; reduced moulding costs; integral colour; reduced finishing time; easier assembly, and greater customer satisfaction. All these advantages add up to new opportunities in design, manufacture and finished part cost.

1. DELRIN®... and tribology

Problems with wear, friction or noise? With DELRIN®, the solution can be found!

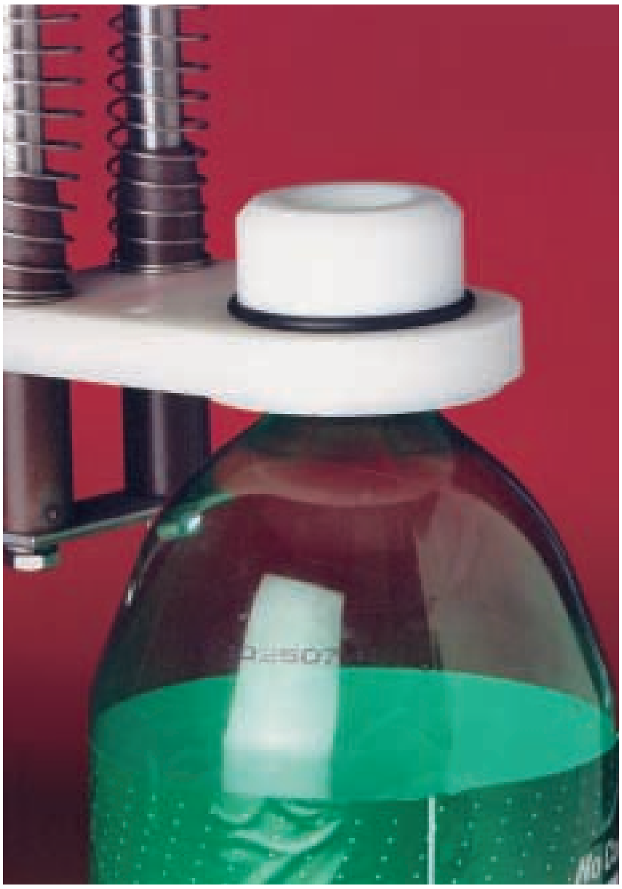
Wherever two surfaces slide, roll or rub against each other, one can be confronted with problems generated by worn surfaces, problems of high friction forces, frictional heat or problems of squeak.

DELRIN® offers a wide range of internally lubricated or wear resistant resins that can help to solve these problems.

An industry survey in the UK showed that the total annual savings that could be made through improved tribological practice can be split into the following portions:

Reduction in energy consumption from lower friction	5%
Reduction in manpower	2%
Savings in lubricant costs	2%
Savings in maintenance and replacement costs	45%
Savings in losses resulting from breakdowns	22%
Savings in investments through greater availability and higher efficiency	4%
Savings in investment through increase life spanof plant	20%

[I.M. Hutchings, TRIBOLOGY-Friction and wear of engineering materials, Edward Arnold, 1992]



DELRIN® 500AF, a TEFLON® fiber filled acetal resin, is used for the 2 bushings which slide up on the steel supports rods. They last longer than brass bushings owing to the material's low friction, low wear and resistance to corrosion by powerful bactericides.

Wear resistance and lubrication: the key to longer lifetime of parts

Wear resistant and/or lubricated grades of DELRIN® acetal resin bring added value to applications.

- **Parts have longer lifetime due to reduced wear**
  Excessive wear often leads to premature failure of the part. Higher wear resistant materials allow an increase of time before the need to change a critical part and reduce maintenance costs.
- **Moving systems have higher efficiency due to less energy loss through friction**
  A low coefficient of friction between two sliding surfaces reduces the amount of energy that is transformed into heat or noise instead of motion. The motion becomes smoother and more efficient.
- **Sliding surfaces can bear higher loads and run at higher velocities**
  By making the right choice of materials, the load bearing capacity is higher and the sliding speed can be increased, making the system more reliable and powerful.
- **System costs can be reduced by eliminating any external lubricant**
  An efficient internal lubrication of the resin can replace the need for external lubricant and guarantees the right lubrication over the lifetime of the parts.
- **Squeaking noise can be reduced below audible limit**
  The squeaking noise which did not allow the choice of the same resin for the two sliding surfaces can now be eliminated by choosing a grade with a low coefficient of friction.

Why choose DELRIN®?

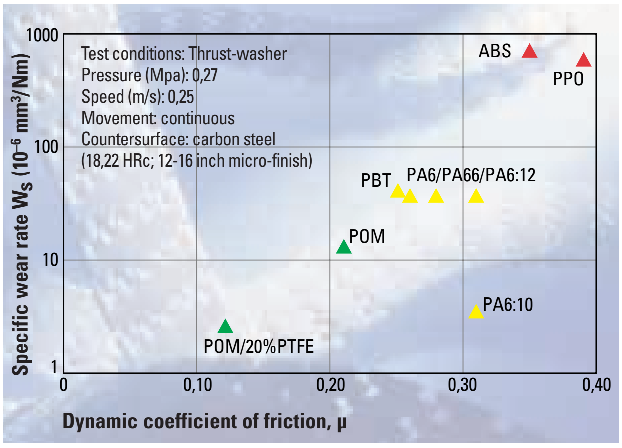


Fig. 1 **Specific wear rate and dynamic coefficient of friction against steel of various Polymers *(method: thrust washer)*.**

Choosing DELRIN® is a good starting point for applications in which wear and friction is a major issue. Figure 1 shows the specific wear rate vs. the dynamic coefficient of friction of different polymers against steel. Non-modified acetal has the lowest coefficient of friction and one of the lowest wear rates. Even further and significant improvements can be achieved by using DELRIN® modified with 20% PTFE.

In addition there are the benefits from the outstanding mechanical properties for which DELRIN® acetal resins are well known: a unique balance of strength, stiffness and toughness not available either in metals or other plastics.

2. Talking tribology: some definitions

Tribology is that field of science and technology concerned with "interacting surfaces in relative motion". Wear and friction are **not material properties but the properties of a tribological system.**

Wear is the progressive **loss of material** due to interacting surfaces in relative motion. It is quantitatively measured as the specific wear rate W_s (defined as volume loss per sliding distance and load [10^{-6} mm^3/Nm]) of a material. Numerous distinct and independent mechanisms are involved in the wear of a polymer.

These include:

- Abrasive wear – "cutting" caused by hard irregularities on the countersurface.
- Fatigue wear – failure of the polymer due to repeated stressing from hard irregularities on the countersurface.
- Adhesive wear – loss of polymer by transfer and adhesion to the countersurface.

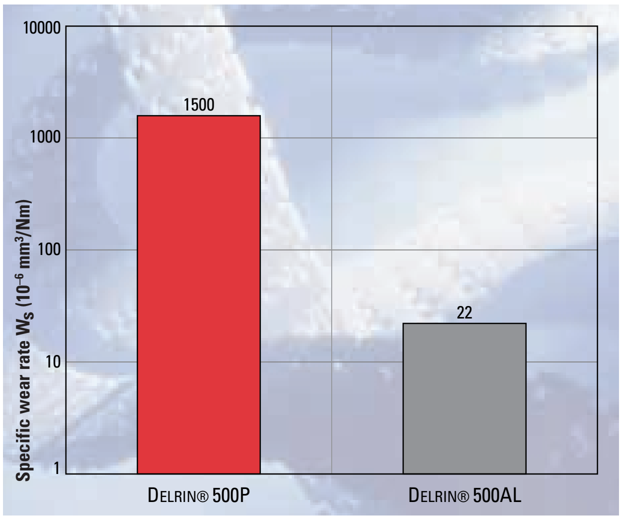
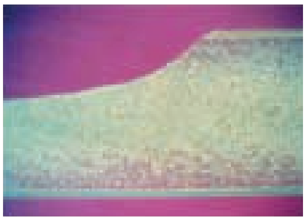
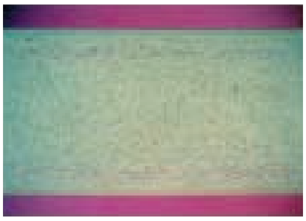


Fig. 2 **Specific wear rate and wear track of DELRIN® 500 and DELRIN® 500AL after wearing against itself: under equivalent test conditions, DELRIN® 500AL shows very little wear and consequently, no wear track can be seen.**



DELRIN® 500 after wear test (test specimen).



DELRIN® 500AL after wear test (test specimen).

Friction is a measure of the resistance to motion **(loss of energy)** of two interacting surfaces. The friction is quantitatively described by the *coefficient of friction μ* (dynamic/static). It is therefore a function of the real contact area between the two surfaces and the character and strength of the interaction, which can be described as:

- Adhesive.
- Ploughing.
- Deforming.

- **Squeaking** is generated through friction and is linked to the coefficient of friction. As a general rule one can say that if the dynamic coefficient of friction is higher than the static one, the movement between the two surfaces can get discontinuous (slip-stick phenomenon). The noise is perceived as squeaking, when this slip and stick happens at an audible frequency.

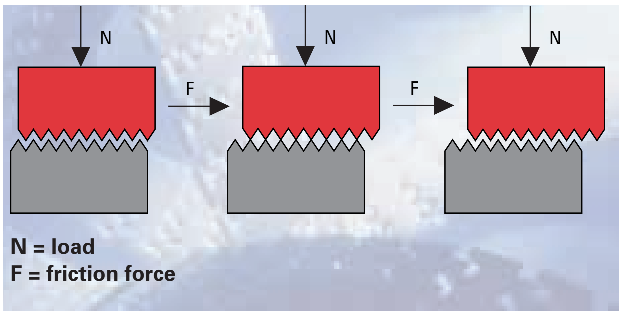


Fig. 3 **Schematic illustration of sliding friction. The coefficient of friction is defined as friction force F divided by the applied load N (μ = F/N) at a given sliding speed.**

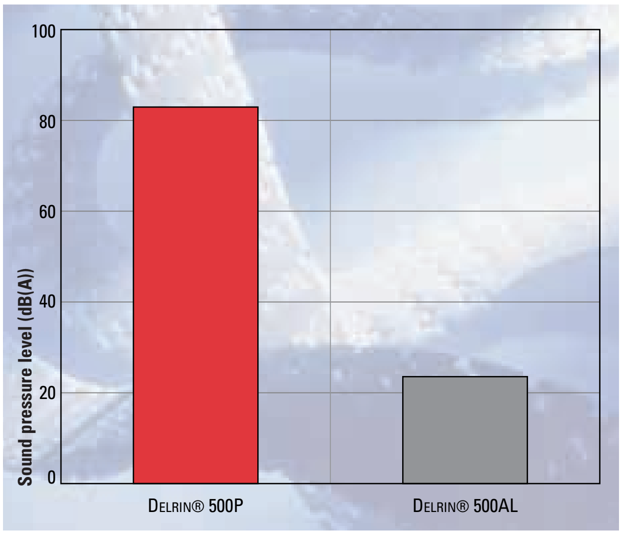


Fig. 4 **Squeaking noise measured for DELRIN® 500P sliding against DELRIN® 500P or DELRIN® 500AL. The sound pressure level is reduced from 83 dB(A) to 24 dB(A), which is perceived as a factor of 60 in noise reduction.**

The coefficient of friction between surfaces normally increases with increasing temperature and decreasing load. The energy lost in the friction phenomena can lead to an increase in temperature, to the emission of noise, and/or to deformation of the contact area. In almost all cases, a lower coefficient of friction will lead to a lower wear rate.

Noise

In many applications, where a part is sliding, the noise emitted by the system is undesired and has to be reduced. Noise is a difficult concept to define and therefore it is important to distinguish the two main types of noise which are encountered:

- **Mechanical** noise is in fact not related to friction but relates to impacts between moving parts. However, in the case of high frequency movements, this type of noise can sound like squeaking. An improved design (e.g. of teeth in gears) can often reduce the intensity of this noise. Another solution is to use softer materials with better damping properties.

Using DELRIN® 500AL, a performance resin with an advanced lubricant system, Lexmark was able to maximise the performance of a six-gear power train at minimum cost. The gear train is part of a laser printer toner cartridge. The lubricity of DELRIN® 500AL avoids the need for oil or grease that could contaminate toner and paper. The low wear helps to maintain high print quality over a long period. Its ability not to squeak provides a quiet and smooth operation.

Working environment: an important factor that influences the part performance

More than for other properties, the working environment has a strong influnce on friction, wear and noise. The main factors to consider are:

- Contact pressure (p) and contact force (load) at the surfaces.
- Relative velocity of the surfaces (v).
- Temperature of the surfaces.
- Geometry of motion (sliding, fretting, rolling).
- Nature of the motion (continuous, intermittent, reciprocating, etc.).
- Nature and finish (roughness) of the surfaces.
- Lubrication (initial, continuous, dry-running, moisture…).

Two important implications of this are that:

- Selection of an engineering polymer for an application requires a detailed understanding of the tribological system.
- Although standardised tests can give indications of the relative wear rates of polymers, prototype testing is an essential stage in application development.

Pressure (p) and sliding velocity (v)

Pressure (p) and sliding velocity (v) have a strong influence on the wear rate of a material. An increase in pressure generally leads to an increase in the wear rate and a decrease of the friction, whereas an increase in sliding speed results in an increase of both wear and friction. The product **p·v** is often used to describe the severity of a wear situation since, at a given temperature, it is roughly proportional to the wear rate.

The very strong influence of pressure and speed on wear as well as the improvements which can be achieved in this respect are shown in figure 5 and 6: the specific wear rate has been measured against steel at different combinations of speed and pressure. The graphs clearly demonstrate that the wear rate not only depends on the pv-product, but also if this pv is composed by high pressure/low speed or low pressure/high speed.

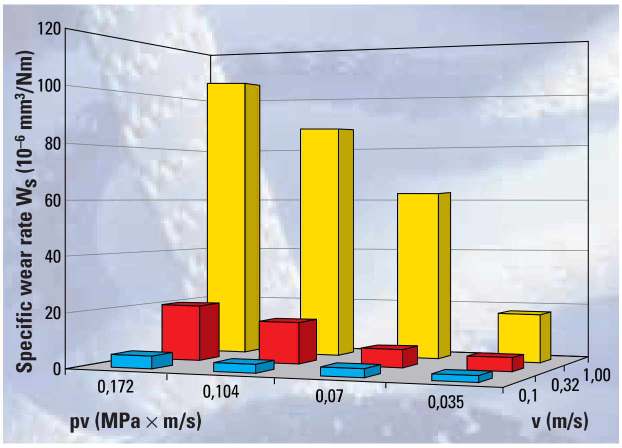


Fig. 5 **Specific wear rate of DELRIN® 500 against steel at different pv *(method: thrust washer).***

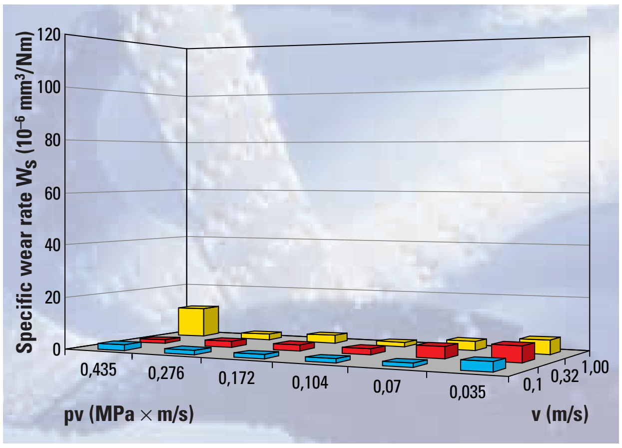


Fig. 6 **Specific wear rate of DELRIN® 520MP against steel at different pv *(method: thrust washer).***

The countersurface

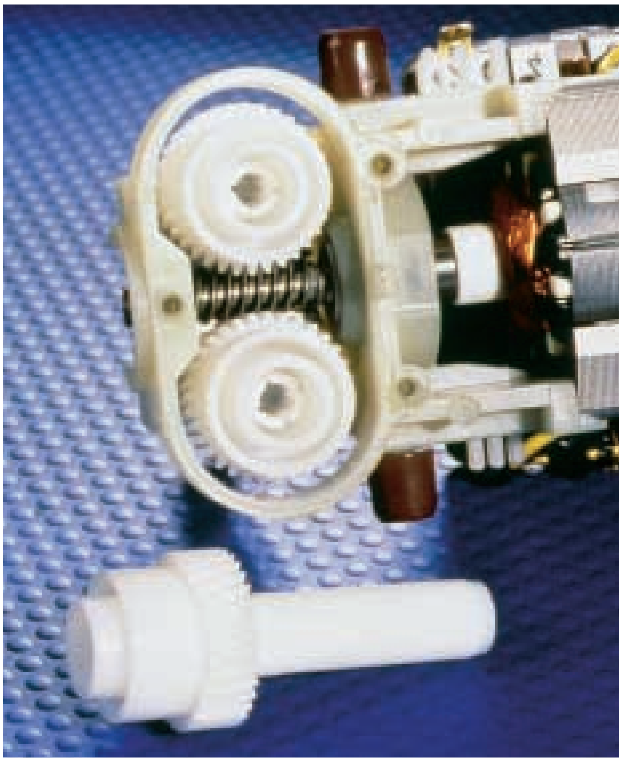
The nature and finish of the countersurface strongly affects wear and friction. Two parameters which define the finish of a surface and which can easily be controlled, are its **roughness** and its **hardness.**
For **metal as a countersurface,** one can express the following general rules:

- The harder the metal surface, the better the wear and friction behaviour of the system.
- The rougher the metal countersurface, the higher the wear.

As far as the coefficient of friction is concerned, there exists an optimum roughness: in case of a metal surface that is too smooth, the coefficient of friction can increase due to adhesion between metal and polymer; a surface that is too rough leads to a ploughing of the plastic part by the metal surface, resulting in a higher coefficient of friction.

3. Low wear / low friction grades of DELRIN®

The intrinsically good wear resistance and frictional behaviour of DELRIN® acetal often enables the use of a standard grade of DELRIN® without any internal or external lubrication.
Specific customer needs and technical requirements of the final application can make it necessary to further improve the properties of DELRIN®. By making use of different technologies (TEFLON® PTFE, Silicone, KEVLAR® aramid resin, chemical lubrication, etc.), DuPont Engineering Polymers offers a broad range of grades in DELRIN® which can help to reduce the wear or the friction in your application.
Even though the number of grades, and therefore the choice of the appropriate resin may seem complex, one can classify them according to their main characteristics like wear rate, $\mathbf{W_s}$, and dynamic or static coefficient of friction, μ. It is also important that all other parameters like counter-surface, sliding velocity, contact pressure, test method and environmental conditions are also controlled carefully.
All low wear/low friction grades of DELRIN® are classified in the graph below according to their specific wear rate and their coefficient of friction measured against either a steel counter-surface or against a counter-surface made in the same grade of DELRIN® (against "itself").
This overview not only shows the effect of the different technologies on wear rate and coefficient of friction, but also the effect of the counter-surface alone. Against steel, the wear rate as well as the coefficient of friction of unmodified DELRIN® is much lower compared to the values measured against itself.
The use of different ingredients, however, makes it possible to close the performance gap and therefore opens the possibility of using DELRIN® against other DELRIN® surfaces.



DELRIN® is the preferred material for gears due to its unique combination of mechanical properties. In addition to that, the low wear / low friction grades of DELRIN® can help to further increase the load and speed thanks to a higher efficiency, increase the lifetime of your gears, eliminate external lubricants and ensure a squeak free motion or power transmission

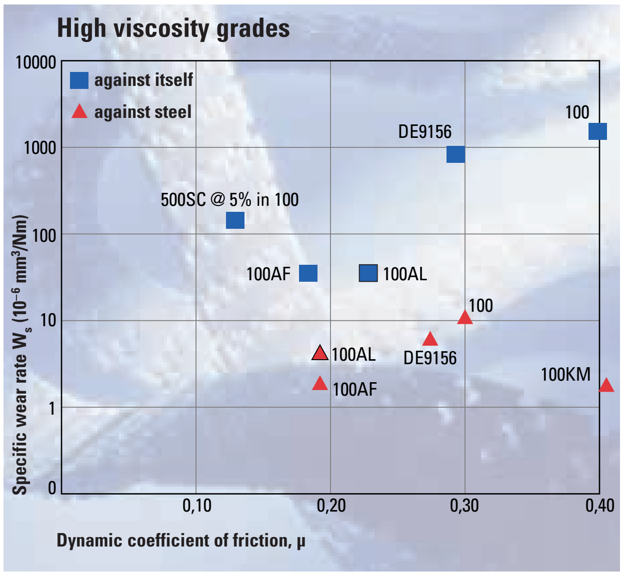


Fig. 7 **Specific wear rate and coefficient of friction against steel and against itself for DELRIN® acetal high viscosity grades.**

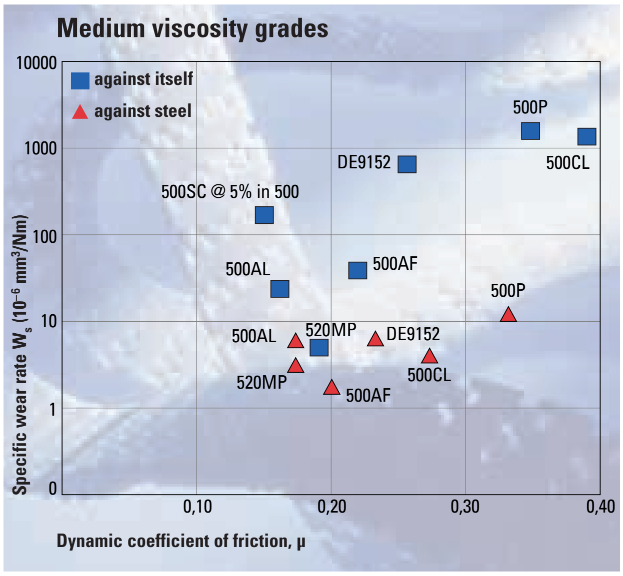


Fig. 8 **Specific wear rate and coefficient of friction against steel and against itself for DELRIN® acetal medium viscosity grades.**

4. Working together with DuPont

DELRIN® 100KM, the chosen BMW solution to eliminate grease

DELRIN® 100KM, an abrasion resistant acetal resin modified with KEVLAR® is used as cladding on the door checks of BMW's Series 5 limousines and estates, ensuring that the doors open and close smoothly and silently without lubrication.

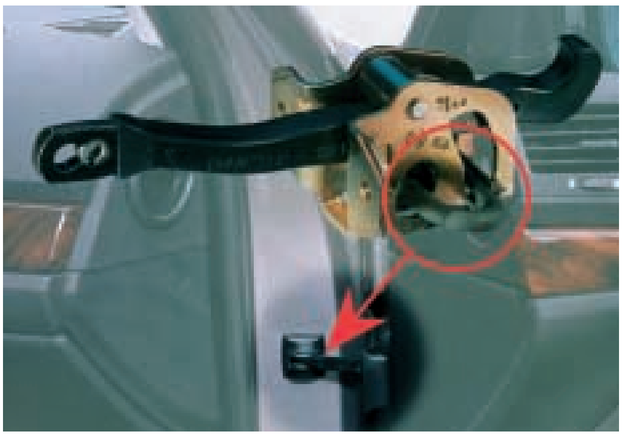
The standard all-steel door-check is lubricated with grease, to allow it to slide freely. While this design works well, it needs maintenance and the grease leaves marks on garments that come in contact with it.

So, in search of a cleaner solution, BMW decided to give the steel strip a permanent cladding of a plastic material.

The cladding had to be able to withstand considerable mechanical abuse from the pressure of the rollers on the strip, from the impact at the end of the door's swing, and from the abrasion caused by every door movement.

Together with systems supplier Ed. Scharwächter GmbH of Remscheid, BMW undertook extensive tests on several candidate materials. These tests showed that DELRIN® 100KM, a DuPont acetal modified with KEVLAR®, met the requirements between –40° C and +85° C better than all the other materials tested.

"The abrasion resistance as well as the good friction behavior of this special type of DELRIN®, and its ability to withstand mechanical abuse were decisive in our choice of material," says Werner Schmitt, project leader at Scharwächter. "The hook-shaped end of the door-check is particularly critical in this respect, because it has to stop a heavy swinging door abruptly when it reaches its maximum opening angle."



Automotive door check

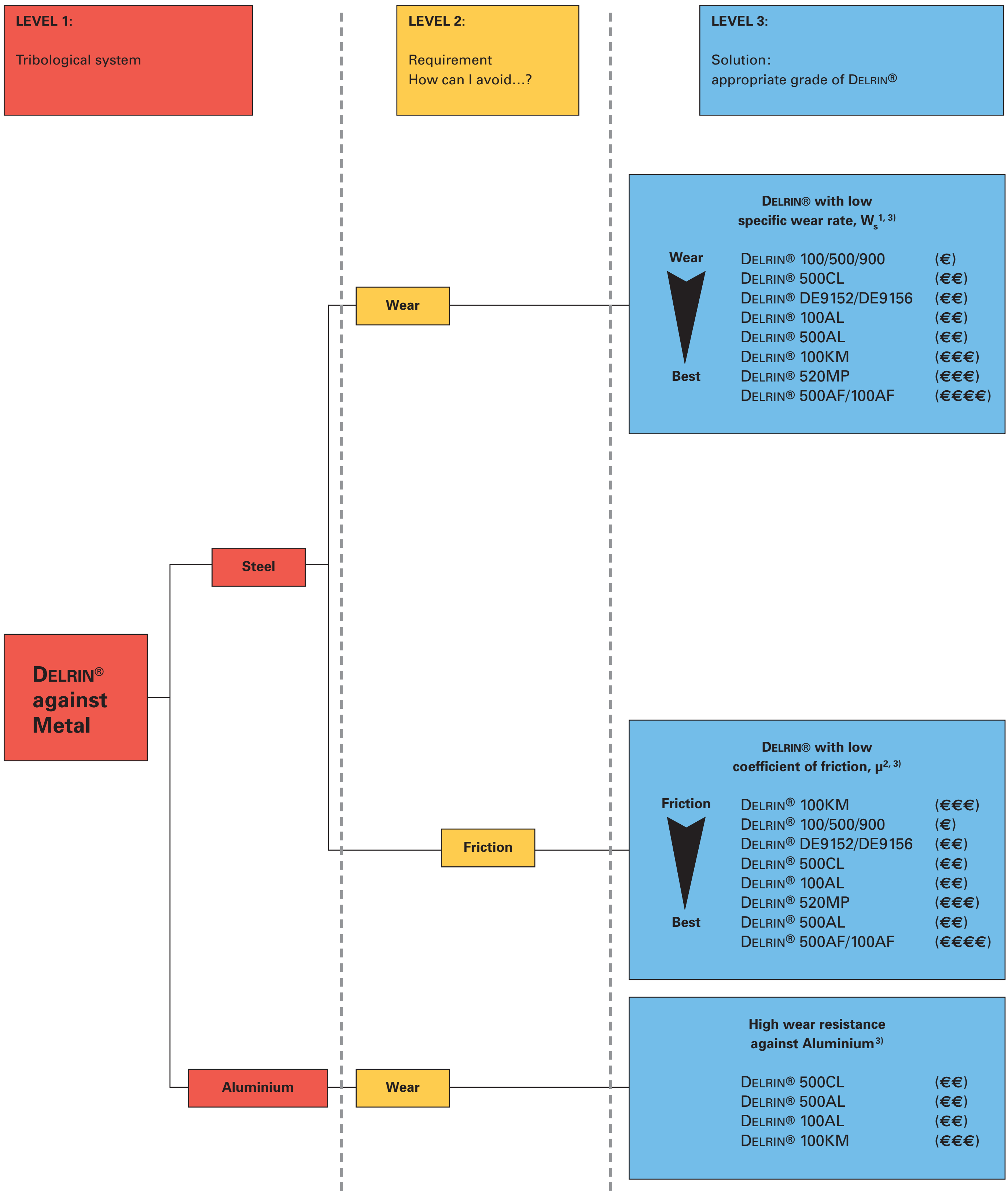
Why choose DuPont?

When DuPont is involved early in the process as part of the design team, access to a wealth of resources becomes available:

- The widest range of engineering polymers to meet precise requirements.
- Technical support for design, moulding expertise from a global network of interlinked technology laboratories.
- Long experience in testing and selecting materials for tribological applications.
- World wide support for polymer research and development, with more than 50 years experience and innovation in engineering polymers.
- A broad knowledge of the global market and in all industry segments.

DELRIN® 500AF, a TEFLON® fiber filled acetal resin, is used in the black sliding part in the head of this touring binding from Fritschi AG. It was chosen for its easy processing and good low wear and low friction performance against other plastics surfaces.

5. Choosing the right grade of DELRIN® against metal



1) Resins are ranked by decreasing wear rate based on results from different test geometries and test conditions.
2) Resins are ranked by decreasing coefficient of friction based on results from different test geometries and test conditions.
3) Price categorisation by €-signs.

Choosing the right grade of DELRIN® against DELRIN®

LEVEL 1: Tribological system	LEVEL 2: Requirement How can I avoid…?	LEVEL 3: Solution: appropriate grade of DELRIN®

DELRIN® against DELRIN®[1)]

Squeak

Non-squeaking grades[2)] of DELRIN®

DELRIN® 500SC @ 10%	(€€)
DELRIN® 500AL	(€€)
DELRIN® 100AL	(€€)
DELRIN® 900SP	(€€)
DELRIN® 520MP	(€€€)
DELRIN® 500AF/100AF	(€€€€)

Wear

DELRIN® with low specific wear rate, W_s[3, 5)]

Wear → Best

DELRIN® DE9156/9152	(€€)
DELRIN® 500SC @ 5%	(€)
DELRIN® 500AF/100AF	(€€€€)
DELRIN® 100AL	(€€)
DELRIN® 500AL	(€€)
DELRIN® 900SP	(€€)
DELRIN® 500SC @ 10%	(€€)
DELRIN® 520MP	(€€€)

Friction

DELRIN® with low coefficient of friction, μ[4, 5)]

Friction → Best

DELRIN® DE9156/9152	(€€)
DELRIN® 100AL	(€€)
DELRIN® 500AF/100AF	(€€€€)
DELRIN® 520MP	(€€€)
DELRIN® 500AL	(€€)
DELRIN® 500SC @ 5%	(€)
DELRIN® 900SP	(€€)
DELRIN® 500SC @ 10%	(€€)

Impact – noise or – failure

DELRIN® toughened grades[6)]
(external lubrication needed)

DELRIN® 100T	(€)
DELRIN® 500T	(€)
DELRIN® 100ST	(€€)

1) Surface and countersurface are consisting of the same grade of DELRIN®.
2) For all resins listed, the noise emitted at 16 kHz is below 60 dB(A) (audible limit) at a sliding speed of 0,084 m/s and a pressure of 0,624 MPa in a reciprocating movement.
3) Resins are ranked by decreasing wear rate based on results from different test geometries and test conditions.
4) Resins are ranked by decreasing coefficient of friction based on results from different test geometries and test conditions.
5) Price categorisation by €-signs.
6) Resins ranked by increasing toughness (ISO179:1993(E) 1eA: notched charpy impact strength).

6. Properties of DELRIN®

	Property		Test method ISO	Units	Grades: High viscosity 100	High viscosity 100KM	High viscosity 100AF	High viscosity DE9156	High viscosity 100AL
MECHANICAL	Yield stress [1]		527-1/2	MPa	71	60	54	71	70
	Yield strain [1]		527-1/2	%	25	15	14	22	18
	Strain at break [1]		527-1/2	%	70	15	18	51	71
	Nominal strain at break [1]		527-1/2	%	45	9	15	30	47
	Tensile modulus [2]		527-1/2	MPa	3100	2900	2800	3200	2700
	Charpy notched impact strength-edgwise impact		179/1eA	kJ/m^2	15	4,5	4,5	10	9
FRICTION AND WEAR	Specific wear rate against itself [3]		–	$(10^{-6}\ mm^{-3}/Nm)$	1500	92	40	900	41
	Dynamic coefficient of friction against itself [3]		–	–	0,4	0,31	0,18	0,29	0,23
	Noise (squeak) against itself [3]		–	–	yes	yes	no	yes	no
	Specific wear rate against steel [4]		–	$(10^{-6}\ mm^{-3}/Nm)$	14	2	2	6	2
	Dynamic coefficient of friction against steel [4]		–	–	0,30	0,41	0,19	0,27	0,19
MISCELLANEOUS	Melt Flow Rate (= MFI)		1133	g/10 min	2,3	2	–*	2,4	2,2
	Melting temperature		3146 method C2	°C	178	178	178	178	178
	Density		–	g/cm^3	1,42	1,41	1,54	1,43	1,40
	Shrinkage	parallel	294-4	%	2,1	1,8	2,1	–	2,0
		normal	294-4	%	1,9	1,5	1,5	–	1,8

Grade	Characteristics
High viscosity DELRIN®	
DELRIN® 100	High viscosity Standard resin, best combination of stiffness and toughness. Very good creep resistance.
DELRIN® 100KM	DELRIN® 100 grade with 5% KEVLAR®.
DELRIN® 100AF	DELRIN® 100 grade with 20% TEFLON® PTFE fibers.
DELRIN® DE9156	DELRIN® 100 grade with 1,5% TEFLON® PTFE micropowder.
DELRIN® 100AL	DELRIN® 100 grade, Advanced lubrication. General purpose low wear and low friction grade.
Medium viscosity DELRIN®	
DELRIN® 500	Medium viscosity resin. Optimum combination of flow and physical properties.
DELRIN® 500AF	DELRIN® 500 grade with 20% TEFLON® PTFE fibers.
DELRIN® 520MP	DELRIN® 500 grade with 20% TEFLON® PTFE micropowder.
DELRIN® DE9152	DELRIN® 500 grade with 1,5% TEFLON® PTFE micropowder.
DELRIN® 500AL	DELRIN® 500 grade, Advanced lubrication. General purpose low wear and low friction grade.
DELRIN® 500CL	DELRIN® 500 grade, Chemically Lubricated.
Low viscosity DELRIN®	
DELRIN® 900SP	DELRIN® 900 grade, Special Polymer lubricated.
Masterbatch	
DELRIN® 500SC	Masterbatch of DELRIN® 500 grade containing 20% of silicone oil.

A is DELRIN® 100 grade with 5% of DELRIN® 500SC.

B is DELRIN® 500 grade with 5% of DELRIN® 500SC.

Medium viscosity	Medium viscosity	Medium viscosity	Medium viscosity	Medium viscosity	Medium viscosity	Low viscosity	Masterbatch 500SC	
500	**500AF**	**520MP**	**DE9152**	**500AL**	**500CL**	**900SP**	**A**	**B**
72	50	54	72	63	70	67	68	68
15	12	16	12	11	14	10	24	15
45	12	16	34	35	45	35	70	51
30	14	13	40	24	23	23	48	34
3200	2900	2800	3200	3100	3100	3000	3000	3200
9	3	4	7	7	8	6	11	7
1600	40	5	700	22	1200	20	160	214
0,35	0,22	0,19	0,26	0,16	0,36	0,1	0,13	0,15
yes	no	no	yes	no	yes	no	yes	no
13	2	3	6	6	4	3	13	12
0,33	0,20	0,18	0,23	0,18	0,27	0,27	0,22	0,21
14	–*	–*	13	14	15	23	2,6	23
178	178	178	178	178	178	178	–	–
1,42	1,54	1,54	1,43	1,39	1,42	1,41	1,41	1,41
2,1	2,1	2,0	–	1,9	1,9	1,9	–	–
2,0	1,5	1,5	–	1,8	1,9	1,8	–	–

1) Testing speed 50 mm/min.
2) Testing speed 1 mm/min.
3) Surface and countersurface are consisting of the same grade of Delrin®. The specific wear rate was measured at low speed (0,084 m/s) with a contact pressure of 0,624 MPa in a reciprocating motion (total sliding distance: 1,52 km).
The coefficient of friction was measured at a similar speed (0,08 m/s) with a contact pressure of 0,196 MPa, also in a reciprocating motion.
4) Surface roughness Ra [µm]: 0,10 and hardness HRB: 93. The specific wear rate was measured at low speed (0,084 m/s) with a contact pressure of 0,624 MPa in a reciprocating motion (total sliding distance: 4,25 km).
The coefficient of friction was measured at a high speed (0,5 m/s) with a load of 10 N in a sliding motion (Block-on-Ring).
* Melt Flow Rate not appropriate due to high Teflon® PTFE content

Delrin® is widely used in the furniture industry to reduce noise and vibration, and to overcome the slip-stick effect

For further information on Engineering Polymers contact:

Internet location: http://www.dupont.com/enggpolymers/europe

Belgique / België
Du Pont de Nemours (Belgium)
Antoon Spinoystraat 6
B-2800 Mechelen
Tel. (15) 44 14 11
Telex 22 554
Telefax (15) 44 14 09

Bulgaria
Serviced by Biesterfeld Interowa
GmbH & Co. KG.
See under Österreich.

Česká Republika a
Slovenská Republika
Du Pont CZ, s.r.o.
Pekarska 14/268
CZ-155 00 Praha 5 – Jinonice
Tel. (2) 57 41 41 11
Telefax (2) 57 41 41 50-51

Danmark
Du Pont Danmark A/S
Skjøtevej 26
P.O. Box 3000
DK-2770 Kastrup
Tel. 32 47 98 00
Telefax 32 47 98 05

Deutschland
Du Pont de Nemours
(Deutschland) GmbH
DuPont Straße 1
D-61343 Bad Homburg
Tel. (06172) 87 0
Telex 410 676 DPD D
Telefax (06172) 87 27 01

Egypt
Medgenco International Trade Co.
13, El Bostan Street
ET-Cairo
Tel. (02) 392 78 66
Telex 93 742 MK UN
Telefax (02) 392 84 87

España
Du Pont Ibérica S.A.
Edificio L'Illa
Avda. Diagonal 561
E-08029 Barcelona
Tel. (3) 227 60 00
Telefax (3) 227 62 00

France
Du Pont de Nemours (France) S.A.
137, rue de l'Université
F-75334 Paris Cedex 07
Tel. 01 45 50 65 50
Telex 206 772 dupon
Telefax 01 47 53 09 67

Hellas
Ravago Plastics Hellas ABEE
8, Zakythou Str.
GR-15232 Halandri
Tel. (01) 681 93 60
Telefax (01) 681 06 36

Israël
Gadot
Chemical Terminals (1985) Ltd.
22, Shalom Aleichem Street
IL-633 43 Tel Aviv
Tel. (3) 528 62 62
Telex 33 744 GADOT IL
Telefax (3) 528 21 17

Italia
Du Pont de Nemours Italiana S.r.L.
Via Volta, 16
I-20093 Cologno Monzese
Tel. (02) 25 30 21
Telefax (02) 25 30 23 06

Magyarország
Serviced by Biesterfeld Interowa
GmbH & Co. KG.
See under Österreich.

Maroc
Deborel Maroc S.A.
40, boulevard d'Anfa – 10°
MA-Casablanca
Tel. (2) 27 48 75
Telefax (2) 26 54 34

Norge
Distrupol Nordic
Niels Leuchsvei 99
N-1343 Eiksmarka
Tel. 67 16 69 10
Telefax 67 14 02 20

Österreich
Biesterfeld Interowa GmbH & Co. KG
Bräuhausgasse 3-5
A-1050 Wien
Tel. (01) 512 35 71
Telex 112 993 IROWA A
Telefax (01) 512 35 71 12/
512 35 71 31

Polska
Du Pont Poland Sp. z o.o.
ul. Prosta 69
PL-00-838 Warszawa
Tel. (022) 691 09 01
Telefax (022) 691 09 10

Portugal
ACENYL
Rua do Campo Alegre, 672 – 1°
P-4100 Porto
Tel. (2) 69 24 25/69 26 64
Telex 23 136 MACOL
Telefax (2) 600 02 07

Romania
Serviced by Biesterfeld Interowa
GmbH & Co. KG.
See under Österreich.

Russia
E.I. du Pont de Nemours & Co. Inc.
Representative Office
B. Palashevsky Pereulok 13/2
SU-103 104 Moskva
Tel. (095) 797 22 00
Telex 413 778 DUMOS SU
Telefax (095) 797 22 01

Schweiz / Suisse / Svizzera
Dolder AG
Immengasse 9
Postfach 14695
CH-4004 Basel
Tel. (061) 326 66 00
Telefax (061) 322 47 81
Internet: www.dolder.com

Slovenija
Serviced by Biesterfeld Interowa
GmbH & Co. KG.
See under Österreich.

Suomi / Finland
Du Pont Suomi Oy
Box 62
FIN-02131 Espoo
Tel. (9) 72 56 61 00
Telefax (9) 72 56 61 66

Sverige
Du Pont Sverige AB
Box 23
SE-164 93 Kista (Stockholm)
Tel. (8) 750 40 20
Telefax (8) 750 97 97

Türkiye
Du Pont Products S.A.
Turkish Branch Office
Sakir Kesebir cad. Plaza 4
No 36/7, Balmumcu
TR-80700 Istanbul
Tel. (212) 275 33 82
Telex 26541 DPIS TR
Telefax (212) 211 66 38

Ukraine
Du Pont de Nemours
International S.A.
Representative Office
3, Glazunova Street
Kyiv 252042
Tel. (044) 294 96 33/269 13 02
Telefax (044) 269 11 81

United Kingdom
Du Pont (U.K.) Limited
Maylands Avenue
GB-Hemel Hempstead
Herts. HP2 7DP
Tel. (01442) 34 65 00
Telefax (01442) 24 94 63

Argentina
Du Pont Argentina S.A.
Avda. Mitre y Calle 5
(1884) Berazategui-Bs.As.
Tel. +54-11-4229-3468
Telefax +54-11-4229-3117

Brasil
Du Pont do Brasil S.A.
Al. Itapecuru, 506 Alphaville
06454-080 Barueri-São Paulo
Tel. (5511) 7266 8229

Asia Pacific
Du Pont Kabushiki Kaisha
Arco Tower
8-1, Shimomeguro 1-chome
Meguro-ku, Tokyo 153-0064
Tel. (03) 5434-6935
Telefax (03) 5434-6965

South Africa
Plastamid (Pty) Ltd.
43 Coleman Street
P.O. Box 59
Elsies River 7480
Cape Town
Tel. (21) 592 12 00
Telefax (21) 592 14 09

USA
DuPont Engineering Polymers
Barley Mill Plaza, Building #22
P.O. Box 80022
Wilmington, Delaware 19880
Tel. (302) 999 45 92
Telefax (302) 892 07 37

Requests for further information from countries not listed above should be sent to:

Du Pont de Nemours
International S.A.
2, chemin du Pavillon
CH-1218 Le Grand-Saconnex/Geneva
Tel. (022) 717 51 11
Telex 415 777 DUP CH
Telefax (022) 717 52 00

The information provided in this documentation corresponds to our knowledge on the subject at the date of its publication. This information may be subject to revision as new knowledge and experience becomes available. The data provided fall within the normal range of product properties and relate only to the specific material designated; these data may not be valid for such material used in combination with any other materials or additives or in any process, unless expressly indicated otherwise. The data provided should not be used to establish specification limits nor used alone as the basis of design; they are not intended to substitute for any testing you may need to conduct to determine for yourself the suitability of a specific material for your particular purposes. Since DuPont cannot anticipate all variations in actual end-use conditions DuPont makes no warranties and assumes no liability in connection with any use of this information. Nothing in this publication is to be considered as a license to operate under or a recommendation to infringe any patent rights.

Caution: Do not use this product in medical applications involving permanent implantation in the human body. For other medical applications see "DuPont Medical Caution Statement", H-50102.

Delrin® ONLY BY DUPONT

DUPONT® The miracles of science™

L-12259 04.01 ® DuPont registered trademark The miracles of science™ is a DuPont trademark Printed in Switzerland