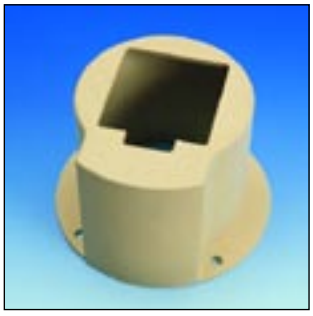
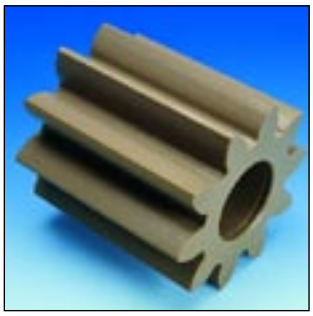
ERIKS plastics

Improving your application





Solutions in High Performance Plastics

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FOR MORE INFORMATION, PLEASE CALL:

(03) 829 27 50

(03) 828 39 59

ERIKS nv
Boombekelaan 3
B-2660 Hoboken, Belgium
info@eriks.be
www.eriks.be

www.solutions-in-plastics.info

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Introduction

In addition to its standard 'engineering plastics' (PA-POM-PETP), ERIKS offers you a total programme of High Performance thermoplastics and composites up to 1200 °C.

ERIKS offers you European products of the highest quality and provides the market with finished goods, made in the most modern production centers.

We distinguish:

1. High Performance thermoplastics

2. High Performance composites
   - electrical isolating
   - high temperature
   - high load resistant

3. Antistatic engineering plastics

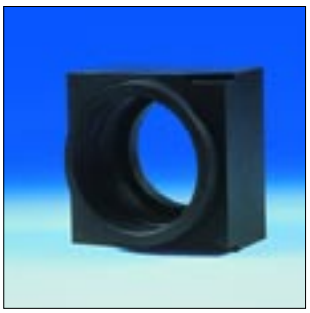
4. Anti-abrasion composites for bearing and sliding applications at high temperatures

All technical info on these plastics and composites you can find on our productwebsite:

www.solutions-in-plastics.info

Responisibility

All information published in this brochure was collected with the utmost care and precision.
Despite of this, ERIKS cannot and will not accept any liability claims, originating from possible incompleteness and/or inadequacy of the contents of this brochure.
All information included herein is subject to change without prior notice.



1. High Performance thermoplastics

°C

100 **TECAFORM AH GF25 POM**

Properties:
- glass fibre filled
- high mechanical values
- higher temperature resistance than POM

110 **TECAMID 6 GF30 PA**

Properties:
- glass fibre filled
- high mechanical values
- high UV-resistance
- black

110 **TECAMID 66 GF30 PA**

Properties:
- glass fibre filled
- high mechanical values
- high UV-resistance
- black

110 **TECAMID 66 CF20 PA**

Properties:
- reinforced with carbon fibre
- high mechanical values
- black
- high UV-resistance
- electrical conductive

110 **TECADUR PBT GF30**

Properties:
- glass fibre filled
- high mechanical values
- higher temperature resistance than PBT
- good dimensional stability

120 **TECANAT PC**

TECANAT PC is a transparent plastic with high electrical isolating properties.

Properties:
- can be glued and welded
- low water absorption
- high mechanical values
- TECANAT GF 30 PC is glass fibre filled to obtain higher mechanical values

130 **TECAMID 4.6 PA**

TECAMID 4.6 is a high temperature polyamide.

Properties:
- resistant up to 130 °C

130 **TECAMID 4.6 GF30 PA**

Properties:
- 30% glass fibre filled
- resistant up to 130 °C

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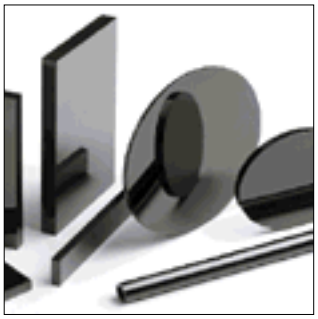


°C
140

1. High Performance thermoplastics

NEW

TECAMAX SRP:
self reinforced high performance plastics

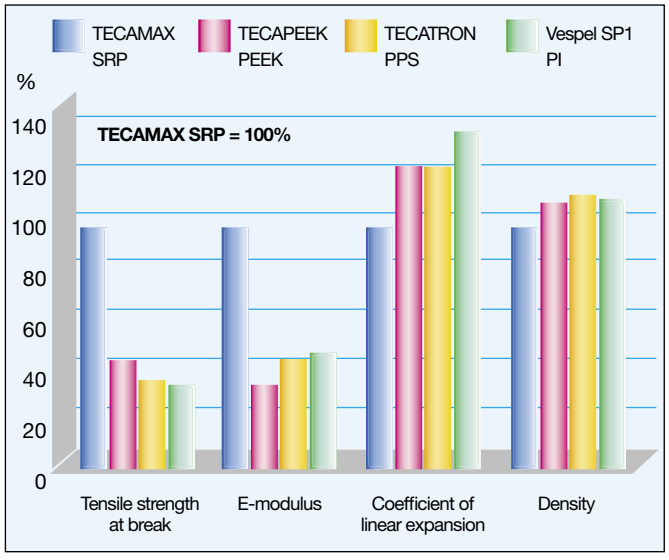
TECAMAX SRP is a self reinforcing thermoplast with superior high strength, stiffness and chemical resistance. Without reinforcement strength data are available as high as fibre reinforced thermoplastics.

Properties:

- very high strength and stiffness
- very good chemical resistance
- good properties in the cryogenic temperature range
- easily machined and polished
- excellent hardness and scratch resistance
- inherent low flammability (UL94 V-0)
- low thermal expansion coefficient

Applications TECAMAX:

- chemical engineering
- electronics/semiconductor industries
- machine construction
- cryogenics
- aircraft and aerospace industries
- medical technology
- automotive engineering
- bearings, gears, valve, valve seats, structural parts, connectors, thermal-electrical insulator



Thermal, chemical & mechanical properties

Properties	*TECAMAX*	*TECAPEEK*	*TECATRON PPS*	*Vespel SP1*
Mechanical properties	Tg 155°C	Tg 143°C	Tg 90°C	Tg 360-375°C
at high temperatures	HDT/A 150°C	HDT/A 140°C	HDT/A 110°C	HDT/A 360°C
	140°C long term	260°C long term	230°C long term	300°C long term
	150°C short term	300°C short term	260°C short term	360-400°C short term
Cryogenic properties	stable to approx. -270 °C	stable to approx. -50 °C	stable to approx. 0 °C	stable to approx. -270 °C
Flame resistance	V.0 (3,2 mm)	V.0 (1,45 mm)	V.0 (3,0 mm)	V.0 (0,75 mm)
Acid resistance	↑↑	↑	↑	↑
Base resistance	↑↑	↑↑	↑↑	→
Solvent resistance	↑	↑↑	↑↑	↑↑
Hot steam resistance	↑	↑↑	↑↑	↓
Stress fracture resist.	↑	↑↑	↑↑	↑
Radiocapacity	↑	↑↑	↑↑	↑↑

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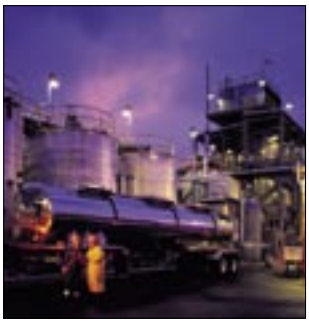

1. High Performance thermoplastics

°C

150

PVDF

Properties:
- higher mechanical values than PTFE
- high chemical resistance
- hydrolysis and sterilisation resistant
- FDA conformity
- resistant in air up to 150 °C
- no water absorption

Applications PVDF:
- chemical industry
- machine industry: pump parts
- electronic industry: isolating parts
- parts in food and pharma

155

PCTFE

Properties:
- highest mechanical values of all fluorplastics
- applicable **from -255 °C** up to 155 °C
- better mechanical properties than PTFE
- one of the best isolators

Applications PCTFE:
- medical technology
- parts for high temperature
- valve seats

160

TECASON S (polysulfon-PSU)

TECASON PSU is used up to 160 °C continuously in air and is extremely pure. TECASON PSU can be easily welded, is high frequency resistant and translucent.

TECASON S GF30 (polysulfon-PSU)

Properties:
- glass fibre filled
- very high E-modulus
- good electrical isolating properties

170

TECASON P-MT (polyphenylsulfon-PPSU)

Properties:

NEW

- resistant up to 170 °C
- resists sterilisation cycles
- excellent resistance to gamma radiation
- FDA conformity
- biocompatible acc. to USP Class VI
- good resistance to hydrolysis
- good resistance to detergents and desinfection solvents
- used in medical industries
- black or other colours

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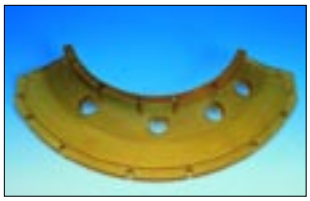

°C

170

1. High Performance thermoplastics

TECASON E (polyethersulfon-PES)

Properties:
- applicable up to 180 °C
- resistant to hydrolysis
- good electrical isolating properties
- FDA conformity

TECASON E GF30 (PES)

Properties:
- glass fibre filled
- very high E-modulus
- good electrical isolating properties
- applicable up to 180 °C

Applications TECASON:
- mechanical industry
- pharma industry
- sterilisation
- medical instruments
- medical technology

170

TECAPEI PEI (polyetherimide)-Ultem

TECAPEI is mechanically stable up to 170 °C and is inherently flame resistant. TECAPEI is the standard unfilled quality. Conform to FDA.

TECAPEI MT (PEI)

Properties:
- standard colour is transparent
- coloured executions possible
- FDA conformity

TECAPEI GF30 (PEI)

Properties:
- 30% glass fibre filled
- very high E-modulus
- good electrical isolating properties

TECAPEI ESD7 (PEI)

Properties:
- antistatic execution

Applications TECAPEI:
- electrical isolators
- electrical connections
- semicon-industry

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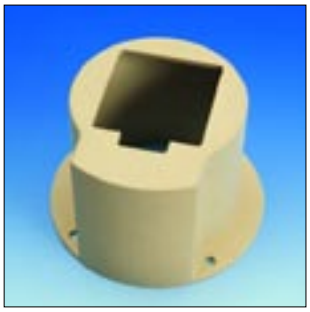

°C
230

1. High Performance thermoplastics

TECATRON PPS

TECATRON PPS is an economical alternative to other high performance plastics where the standard engineering plastics have low mechanical performance.

Properties:
- high mechanical values
- applicable up to 230 °C continuously and short term up to +260 °C
- good dimensional stability
- good chemical and hydrolysis resistance
- low coefficient of friction
- inherently flame resistant

TECATRON PPS GF40

Properties:
- very high E-modulus: 14.500 N/mm^2
- 40% glass fibre filled
- very good chemical resistance
- lower thermal expansion

TECATRON PVX (PPS)

Properties:
- filled with carbon fibre, graphite and PTFE
- black
- for bearings at high PV-values

Applications TECATRON:
- chemical industry
- isolation parts at high temperature
- food industry (ovens), not in direct contact with foodstuffs
- where low tolerances are necessary

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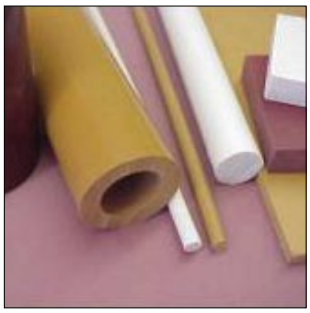

°C
260

1. High Performance thermoplastics

Eriflon PTFE

Eriflon PTFE is since 40 years a standard in the industry.

Properties:
- lowest coefficient of friction
- wide temperature resistance range (-200 °C / +260 °C)
- good resistance to hydrolysis and steam
- FDA and BGVV conformity
- good electrical isolating properties (unfilled)
- moderate mechanical properties

Types:
- Eriflon virgin PTFE: unfilled
- Eriflon + carbon: antistatic, better abrasion resistance
- Eriflon + bronze: better heat conducting properties
- Eriflon + graphite: higher abrasion resistance
- Eriflon + mica: low expansion coefficient, higher mechanical values
- Eriflon + glass fibre: higher compression strength

Applications Eriflon PTFE:
- chemical industry: seals, bearings, valve seats
- mechanical industry: seals, scrapers
- electronics: isolating parts
- parts in food and pharma

RULON® LR

RULON® LR is a 'maroon' coloured bearing material for extreme applications.

Properties:
- applicable for all metal hardnesses
- chemically inert (PTFE-basis) at high temperatures
- non lubricating bearings can resist up to 10.000 pV

Applications RULON®:
- pumps, mixers
- compressors, isolators

Other Rulon® qualities available. Consult our website:
www.solutions-in-plastics.info

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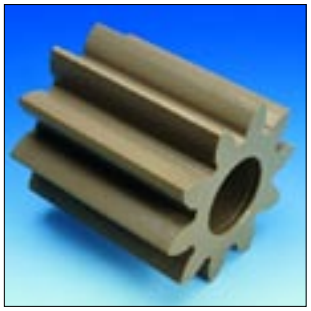

°C
260

1. High Performance thermoplastics

TECAPEEK

Properties:

- unfilled, high crystalline plastic
- high mechanical properties
- resistant up to 260 °C in air, short term up to 300 °C
- very stable
- excellent chemical and hydrolysis resistance up to +200°C
- extremely good radiaton resistance (gamma-Röntgen)
- FDA conformity

TECAPEEK HT (PEK)

Properties:

- very high abrasion resistance
- used in high pressure sliding applications
- very high chemical resistance

TECAPEEK PVX

Properties:

- modified PEEK with PTFE, graphite and carbon
- low coefficient of friction
- high PV-values (bearings)
- black
- high chemical resistance
- self lubricating

TECAPEEK GF30

Properties:

- glass fibre filled execution
- does not shrink
- very good mechanical stability
- low thermal expansion

TECAPEEK CF30

Properties:

- carbon filled
- mechanically higher resistant than PEEK GF30
- optimal abrasion resistance
- thermal conductible (0,92 W/mk)
- black
- low thermal expansion

TECAPEEK ELS

Properties:

- good electrical isolating properties
- carbon filled
- approvals in semicon and electronics

TECAPEEK TF10

Properties:

- PTFE filled
- lower coefficient of friction
- good electrical isolating properties
- FDA conformity

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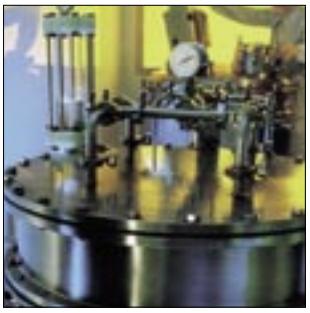

°C
260

1. High Performance thermoplastics

TECAPEEK MT black

Properties:

- black
- FDA conformity
- biocompatibility acc. to ISO 10993
- other colours possible, not acc. to ISO 10993
- resistant to sterilisation, up to 134 °C
- resistant to detergents and desinfection solvents

TECAPEEK CLASSIX

Properties:

- biocompatibility acc. to USP class VI
- FDA 21 CFR 177.2415 conformity
- delivered with certificate
- extremely resistant to hydrolysis
- can be sterilised with steam, gamma radiation and ethyleneoxyde
- standard colour is cream
- very high mechanical values
- suitable for many medical-technical applications: Examples are catheters, medication dosing systems, devices in contact with blood (dialysis), endoscopes, surgical instruments, analytical instruments, measurement probes in the pharmaceutical area and short-term implants. Further examples of use are for functional parts in production, filling and packaging plants for pharmaceuticals.

Applications TECAPEEK:

- back-up rings in seals
- scrapers in the food industry
- medical devices
- bearings in pumps for high pressure
- FDA conformity
- low smoke emission (V-0)

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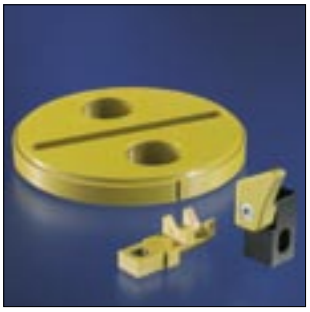


°C

270

300

1. High Performance thermoplastics

TECATOR PAI (polyamideimide)

TECATOR PAI belongs to the group of high performance plastics with excellent mechanical properties up to 270 °C. TACATOR has an excellent UV and radiation resistance.

TECATOR PAI 5013

Properties:
- standard quality is yellow/brown
- high impact resistance

TECATOR 5031 PVX PAI

Properties:
- PTFE-graphite filled
- high abrasion resistance
- very low stick-slip

Applications TECATOR:
- dry bearings
- parts with high compression strength
- electrical isolating parts
- seals

TECATOR PAI is verder:
- inherently flame resistant acc. to UL94 V-0
- resistant to radiation
- good dimensional stability
- cryogene resistant
- very good chemical resistance to acids and solvents

Vespel®

Vespel® Polyimide materials are dimensionally extremely stable. Resistant for short periods up to 482 °C.

Properties:
- extremely resistant to abrasion
- good electrical isaolating properties
- extremely resistant to high temperatures
- good resistance to acids
- extremely resistant to radiation
- high mechanical properties

Vespel® SP1 : unfilled
Vespel® SP21 : with 15% graphite, better resistance to abrasion
Vespel® SP22 : with 40% graphite, good dimensional stability
Vespel® SP211 : with 15% graphite and 10% PTFE, low coefficient of friction

Applications Vespel®:
- bearings at high PV-values
- seals, back-up rings
- mechanical engineering

Technical data at the end of this brochure.

°C
300

1. High Performance thermoplastics

NEW

MELDIN 7000

MELDIN 7000 materials are dimensionally very stable at high temperatures. Tests show 0,04% variation at cycles of 23 °C up to 260 °C in two days. PV-values of self lubricating types obtain values of 1.000 000.

MELDIN 7001

Properties:

- unfilled
- high chemical resistance
- good electrical isolating properties

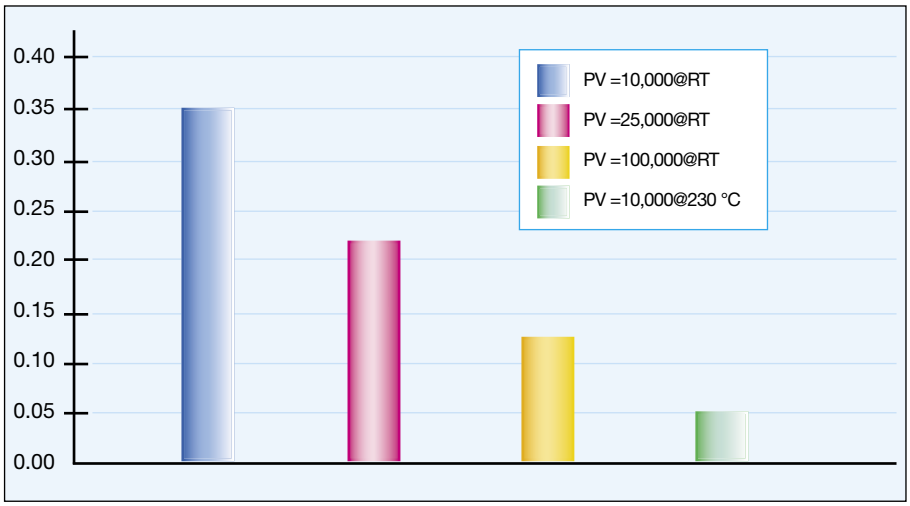
MELDIN 7021

Properties:

- filled with 15% graphite fibres
- low coefficient of friction
- ideal as bearing at high temperatures

Toepassingen MELDIN:

- bearings at high PV-values
- seals, back-up rings
- mechanical engineering



Coefficient of Friction - Meldin 7021

Technical data at the end of this brochure.

2. High Performance composites

°C

2.1. Electrical isolating composites

EPRATEX EPOXY

EPRATEX Epoxy is a combination of epoxy filled with high quality fibres.

Properties:

- low weight
- extremely high mechanical properties
- good electrical isolating properties
- good heat isolator

230

EPRATEX EPOXY High Temp 230

Properties:

- for use at high temperatures up to 230 °C
- dielectric strength 39 KV/3mm

250

EPRATEX EPOXY High Temp 250M

Properties:

- for use at high temperatures up to 250 °C
- maintains 80% of its original properties up to 250 °C
- dielectric strength 36 KV/3mm

Properties:

- electrical isolator in low and high voltage
- electrical isolator at high temperatures
- used as thermal isolator of moulds
- for high compressive strength applications
- inherently flame resistant types are available on demand

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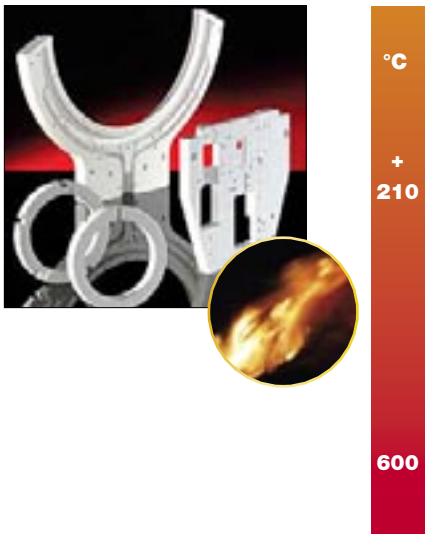


2. High Performance composites

2.2. High Temperature materials

Frathernit ™ - isolation sheets for moulds

Due to the higher working temperatures, heat isolation solutions in moulds for presses or injection moulding are becoming more and more popular in the industry. ERIKS offers you isolation sheets for specific solutions.
Advantages:

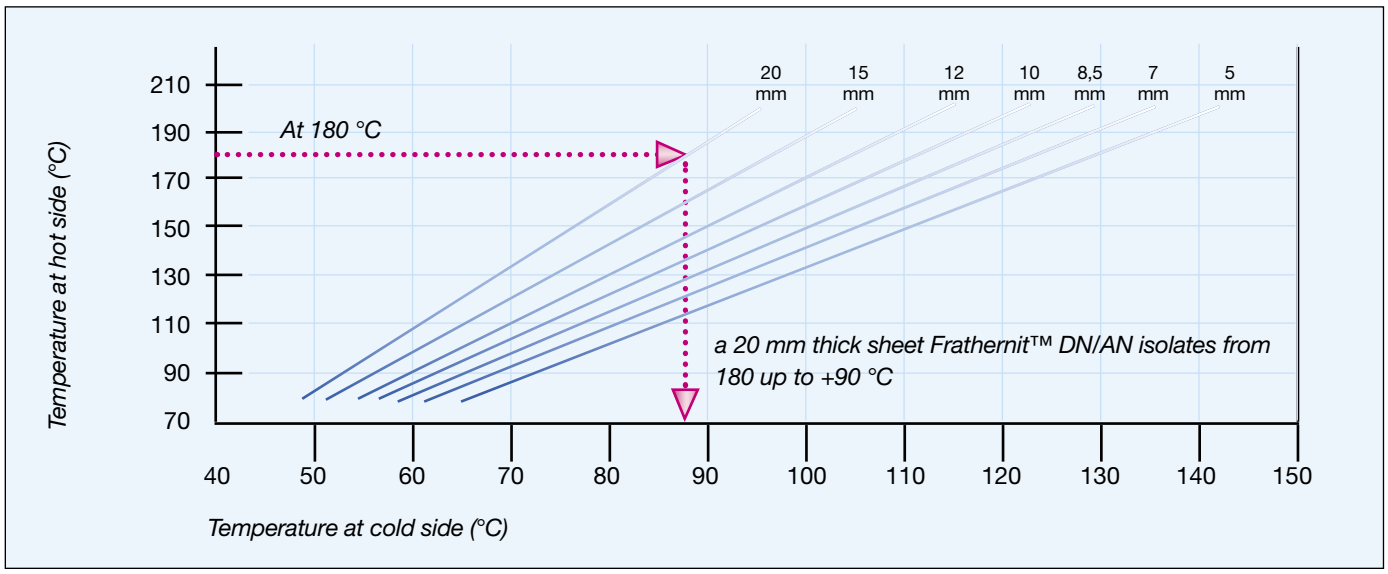
- easy to machine
- temperature resistant
- load and impact resistant
- no moisture absorption
- long lifecycle

In the table below the properties of these isolation sheets are shown.

Properties Frathernit™

Frathernit ™	*Temperature °C*		*Heat conductivity W/mK*	*Compression resistance MPa*	
	Time (h)	*Max*		*23 °C*	*200 °C*
Voor lage sluitkrachten					
DN	200	210	0,18	330	120
4000	200	230	0,13	300	100
Voor hoge sluitkrachten					
AN	200	210	0,19	600	350
AE3	250	260	0,23	470	250
Voor drukloze isolatie					
2000B	160	210	0,12	300	110
Voor luchtkanaalisolaties					
SG	500	600	0,35	400	250

Thickness of Frathernit™ isolation sheets



°C

500

600

800

2. High Performance composites

2.2. High Temperature materials

ERITHERM M

ERITHERM M is a construction material on mica basis. ERITHERM M shows a high temperature resistance, a low water absorption, high electrical isolation values and a high compression strength.

ERITHERM 500M

Properties:
- sintered material resists up to 500 °C
- basis: mica and glass powder

ERITHERM 600M

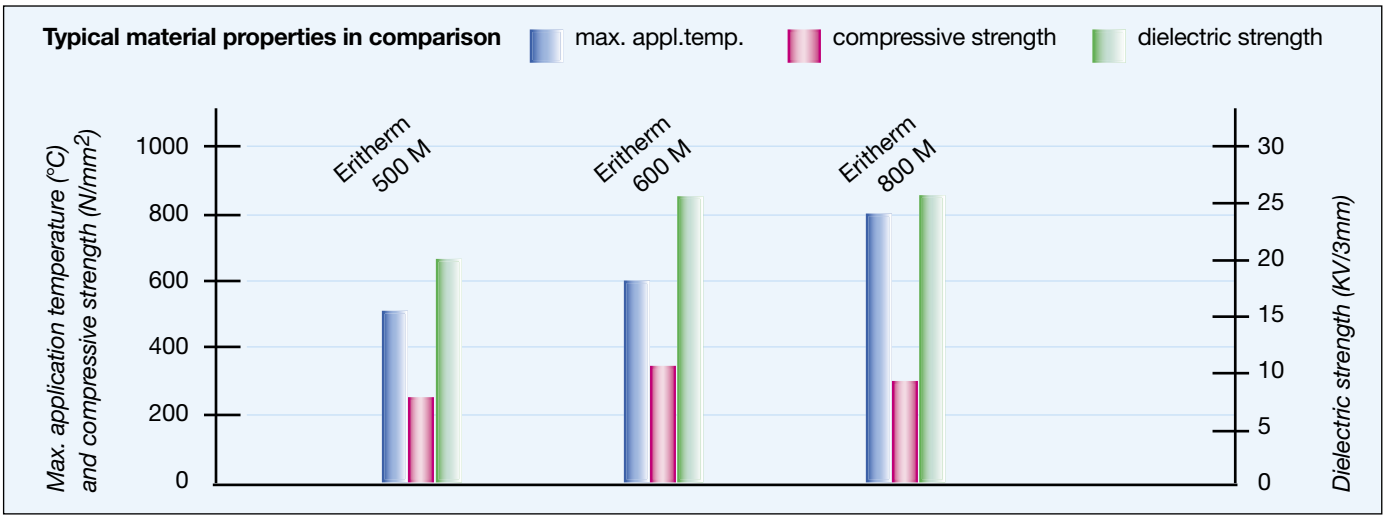
Properties:
- filled with Muscovite mica fibres
- resists temperatures up to 600 °C

ERITHERM 800M

Properties:
- filled with phlogophite mica fibres
- resists temperatures up to 800 °C

Properties ERITHERM M

Test Method	*Norm*		*Eritherm 500 M*	*Eritherm 600 M*	*Eritherm 800 M*
Density	ISO 1183	g/cm^3	2,7	2,2	2,2
Absorption of humidity	ISO 62	%	0	<0,1	<0,1
Continuous application temperature		°C	500	600	800
Coefficient linear expansion	10^{-6}	I/K	10	10	10
Thermal conductivity	DIN 52612	W/mK	0,75	0,26	0,26
Compressive strength	ISO 604	N/mm^2	250	350	300
Flexural strength	ISO 178	N/mm^2	110	180	140
Tracking resistance	IEC 112	class	CTI 600	CTI 500	CTI 525
Dielectric figure	DIN 53483		7	6,5	6
Arc resistance	DIN IEC 93		L3	L3	L3
Dielectric strength	VDE 0303	KV/3mm	20	25	25
Dimensions max.		mm	508x381	1200x1000	1200x1000
Thickness		mm	3-30	1-75	1-30



°C
600
700
1000
1200

2. High Performance composites

2.2. High Temperature materials

The high temperature materials ERITHERM 650 and 700 have enough mechanical strength for constructive purposes. For high temperature applications, where the mechanical strength is not important, ERITHERM 1000 is a perfect solution. For low thermal conductivity ERITHERM 1100 and 1200 are ideal.

ERITHERM 650 and 700

Properties:
- basis: cement and anorganic fibres
- compression resistance up to 12N/mm^2

ERITHERM 1000

Properties:
- compression resistance up to 18N/mm^2
- resists temperatures up to 1000 °C
- basis: van calciumsilicate and graphite fibres

ERITHERM 1100

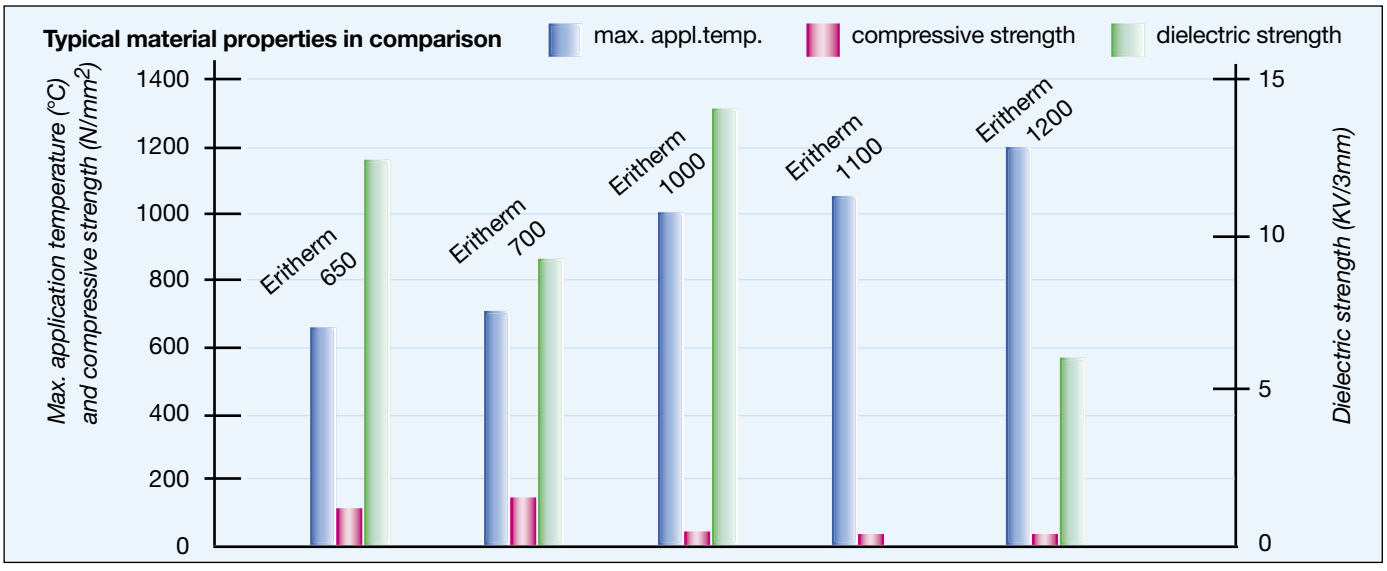
Properties:
- compression resistance up to 7N/mm^2
- resists temperatures up to 1000 °C
- filled with carbon fibres
- basis: van calciumsilicate and graphite fibres

ERITHERM 1200

Properties:
- compression resistance up to 0,6N/mm^2
- heat resistance: up to1200 °C
- very low thermal conductivity
- basis: anorganic fibres

Properties ERITHERM

Test Method	*Norm*		*Eritherm 650*	*Eritherm 700*	*Eritherm 1000*	*Eritherm 1100*	*Eritherm 1200*
Density	ISO 1183	g/cm^3	1,6	1,75	1,4	0,8	0,9
Absorption of humidity	ISO 62	%	6	15	23	20	85
Continuous application temperature		°C	650	700	1000	1100	1200
Coefficient linear expansion	10^{-6}	I/K	8,5	6	6,4	7	
Thermal conductivity	DIN 52612	W/mK	0,39	0,37	0,37	0,1	0,08
Shrinkage at max. temperature	24h	%	1	0,5	1	5	4
Compressive strength	ISO 604	N/mm^2	100	120	31	16	5-30
Flexural strength	ISO 178	N/mm^2	30	32	16	7	
Tracking resistance	IEC 112	class	CTI 600	CTI 600	CTI 600		
Dielectric figure	DIN 53483				4		
Arc resistance	DIN IEC 93		L6	L6	L4	L4	
Dielectric strength	VDE 0303	KV/mm	3,8	2,9	4,7		2
Dimensions max.		mm	2520x1240	1220x910	1500x1220	2570x1270	1000x1000
Thickness		mm	6-25	6-75	6-80	19-75	1-10



°C

130

200

2. High Performance composites

2.3. Anti abrasion composites for bearing and sliding applications

EPRATEX Bear

Epratex Bear high performance composites are materials with extreme abrasion resistance at high loads. Mostly used as bearings.

We distinguish 2 types:

- Epratex Bear T 100G for 130 °C
- Epratex Bear T 200G for 200 °C

Properties:

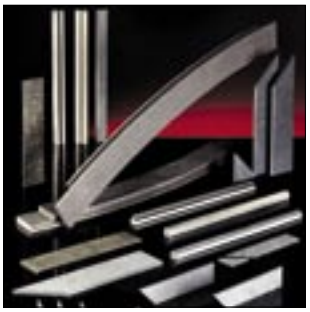
- suitable for extreme loadings
- extremely impact resistant
- extreme low coefficient of friction
- self lubrication possible (graphite-MOS_2-PTFE)

Applications EPRATEX Bear:

- forklifts, harvestingmills, civil engineering, food, fluid-handling, mining
- truck bearings, most support bearings
- rolling mill bearings, conveyer bearings, pump bearings
- scrapers in watertreatment plants
- cylinder wear rings
- guide strips in cilinders
- brake gear pads
- rudderbearings

Properties EPRATEX Bear

Test Method	*Epratex Bear T 100G*	*Epratex Bear T 200G*
Density	1,25-1,48	1,25-1,48
Tensile strength		
Lengthwise	90 N/mm^2	90 N/mm^2
Crosswise	76 N/mm^2	76 N/mm^2
Flexural strength		400
Lengthwise	138 N/mm^2	138 N/mm^2
Crosswise	107 N/mm^2	107 N/mm^2
Shear strength	134 N/mm^2	240
Compressive strength		
Flatwise	345 N/mm^2	345 N/mm^2
Edgewise	138 N/mm^2	138 N/mm^2
SWL	55 N/mm^2	-
Water absorption	< 0,1%	< 0,1%
Max. constant operating temp.	130 °C	200 °C
Fluxural Modulus	0,32 (M/mx10^4)	0,32 (M/mx10^4)
Lubricant	Graphite	Graphite
Coefficient of friction, against stainless steel	dry 0,19 water 0,01 oil 0,02	dry 0,19 water 0,01 oil 0,02
Bearing pressure	15,5 N/mm^2	15,5 N/mm^2
Surface speed	2,20 m/sec	2,20 m/sec



2. High Performance composites

2.3. Anti abrasion composites for bearing and sliding applications

ERITHERM slide

Where other materials fail due to thermal mechanical forces, 'Eritherm slide' is the solution in applications for bearings that require a low coefficient of friction and a high abrasion resistance up to 600 °C.

We distinguish 3 types:

ERITHERM slide DBG180/DBG260/DBG300

Properties:
- basis: organic fibres and special thermo harders, modified with lubrificants
- applicable up to 180/260 and 300 °C

ERITHERM slide GA/GA450

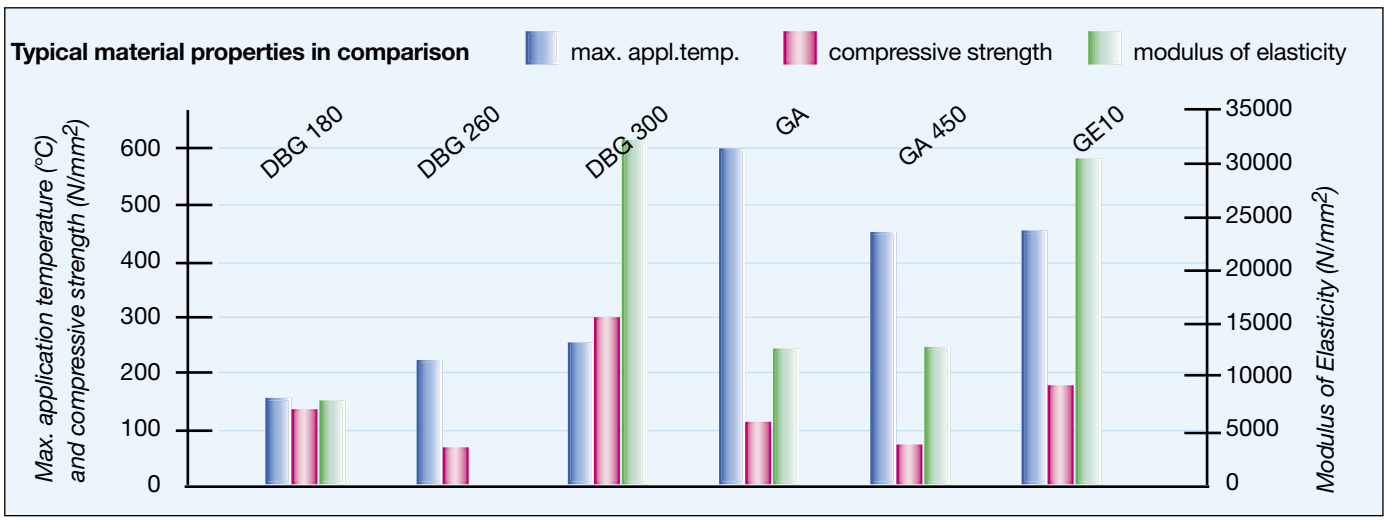
Properties:
- basis: fine graphite
- applicable up to 450 °C

ERITHERM slide GE10

Properties:
- basis: graphite and carbon fibres
- heat resistance up to 600 °C

Properties ERITHERM slide

Test Method	*Norm*		*DBG180*	*DBG260*	*DBG300*	*GA*	*GA450*	*GE10*
Density		g/cm^3	1,4	1,9	2,0	1,83	1,76	1,36
Flexural strength		N/mm^2	75	25	140	45	35	110
Compressive strength		N/mm^2	140	80	300	110	75	180
Volume Resistivity	DIN 53482	Ω x cm	10^{12}	-	10^{14}	0,0021	0,0014	-
Sliding Friction			0,2	0,14	0,2	0,1	0,1	0,25
Modulus of Elasticity		N/mm^2	7000	-	31000	12000	12000	30000
Thermal Expansion Coefficient		10^{-6}/K	30	17	8	3,4	3,0	0,5
Thermal conductivity	100°C	W/mK	0,35	<0,45	0,28	3,4	3,0	3,0
Temperature Duration		°C	160	220	240	600	450	450
Temperature Short		°C	180	260	300	-	-	600
Shrinkage	24h/150°C	%	0,5	<0,1	-	-	-	-
Water Absorption	24h	%	1,1	3,0	-	-	-	-
Oil/Fat Resistance	24h	%	resistant	resistant	resistant	-	-	-



antistatische en geleidende kunststoffen

3. Antistatic and conductive plastics

There are 2 methods to obtain conductivity:

Ionic conductivity (on a basis of elektrolytes)
- surface by coatings

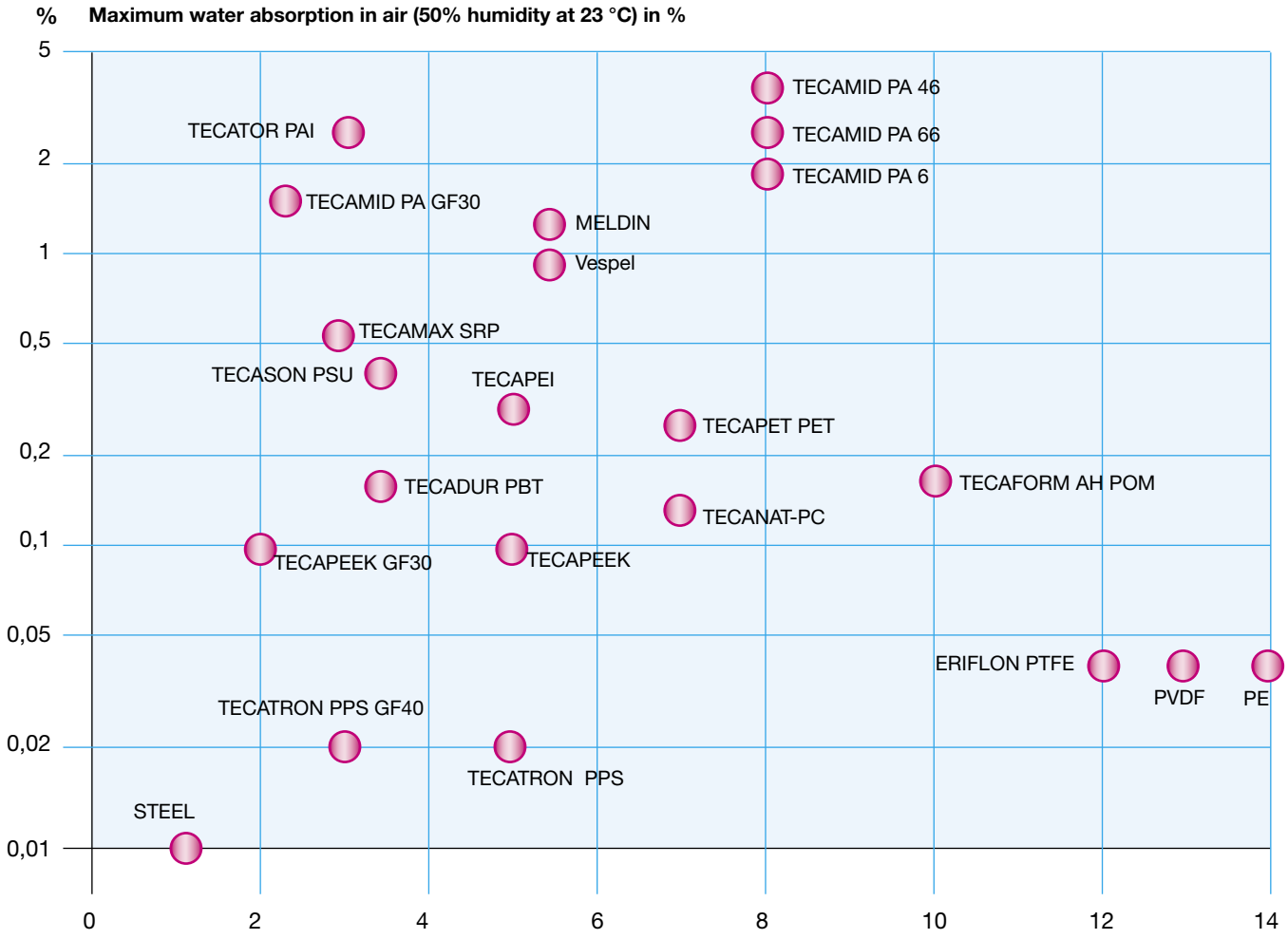
Electron conductivity (on a basis of carbon)
- by incorporating graphite, carbon fibres or carbon nanotubes

Material Surface Resistivity Spectrum

Surface Resistivity	*Electrostatic Property*	*Recommended Materials*
Ω		
10^{18}	Insulating Materials	
10^{17}	(Basic Resin)	Sintimid, TECATRON,
10^{16}		TECANAT (PC), TECAPEEK
10^{15}		TECADUR PET/PBT
10^{14}		TECAFORM AH (POM-C)
10^{13}		TECAMID (PA)
10^{12}		
10^{11}		TECAFORM AH SD
10^{10}		
10^{9}	Static Dissipative Plastics	Multilene 500 AST, Multilene 2000 DryRun
10^{8}		TECAPEEK ESD, TECAPEI ESD7
10^{7}	ESD	TECANAT PC ESD 7 , Multilene1000 AST
10^{6}	PC KASI-AS coated	
10^{5}		TECAPEEK ELS
10^{4}	ELS	TECAFORM AH ELS, Multilene1000 CBlack
10^{3}		TECAFLON PVDF AS
10^{2}		TECAFINE PP ELS, TECAMID 12 ELS
10^{1}	Conductive Materials	
10^{0}		
10^{-1}		Electrically Conducting Carbon Black
10^{-2}		Carbon Fibres, Carbon Nano Tubes
10^{-3}		
10^{-4}		Metals
10^{-5}		
10^{-6}		

4. Technical know-how for your application

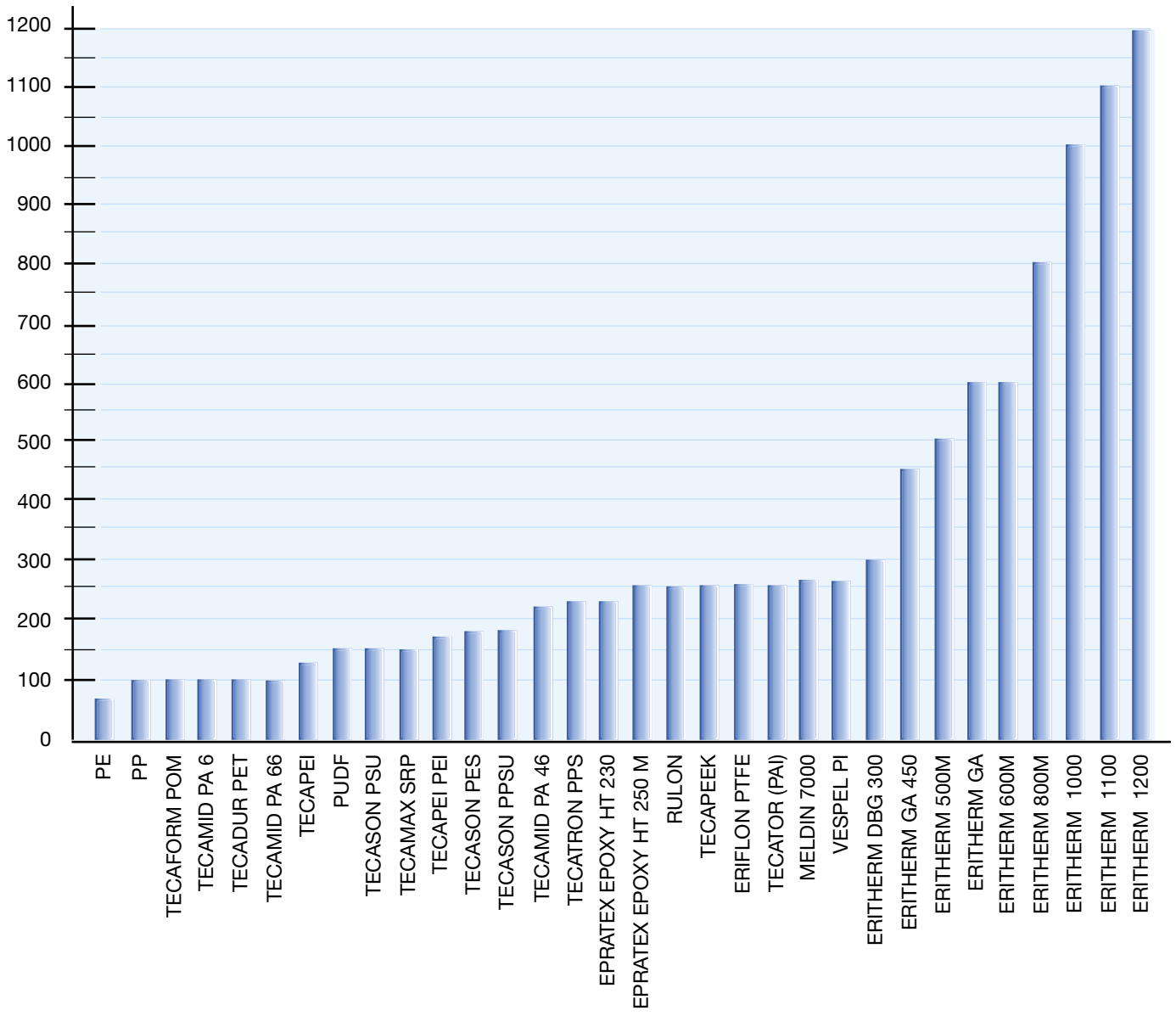
4.1. Water absorption



Polyamides have a high water absorption in comparison to other engineering plastics.
This leads to dimensional changes at machined parts and to other electrical properties.

4. Technical know-how for your application

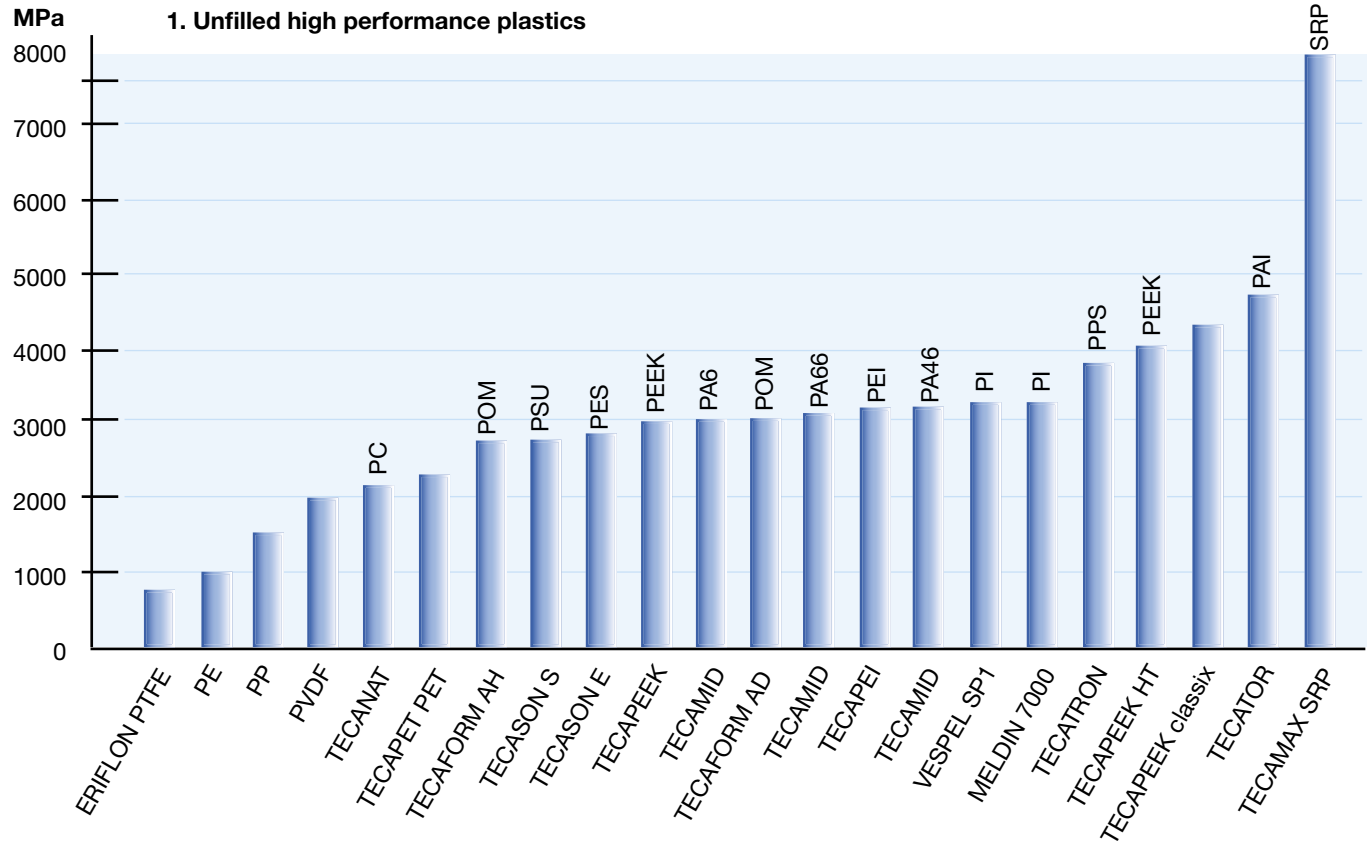
4.2. Temperature resistance, long term

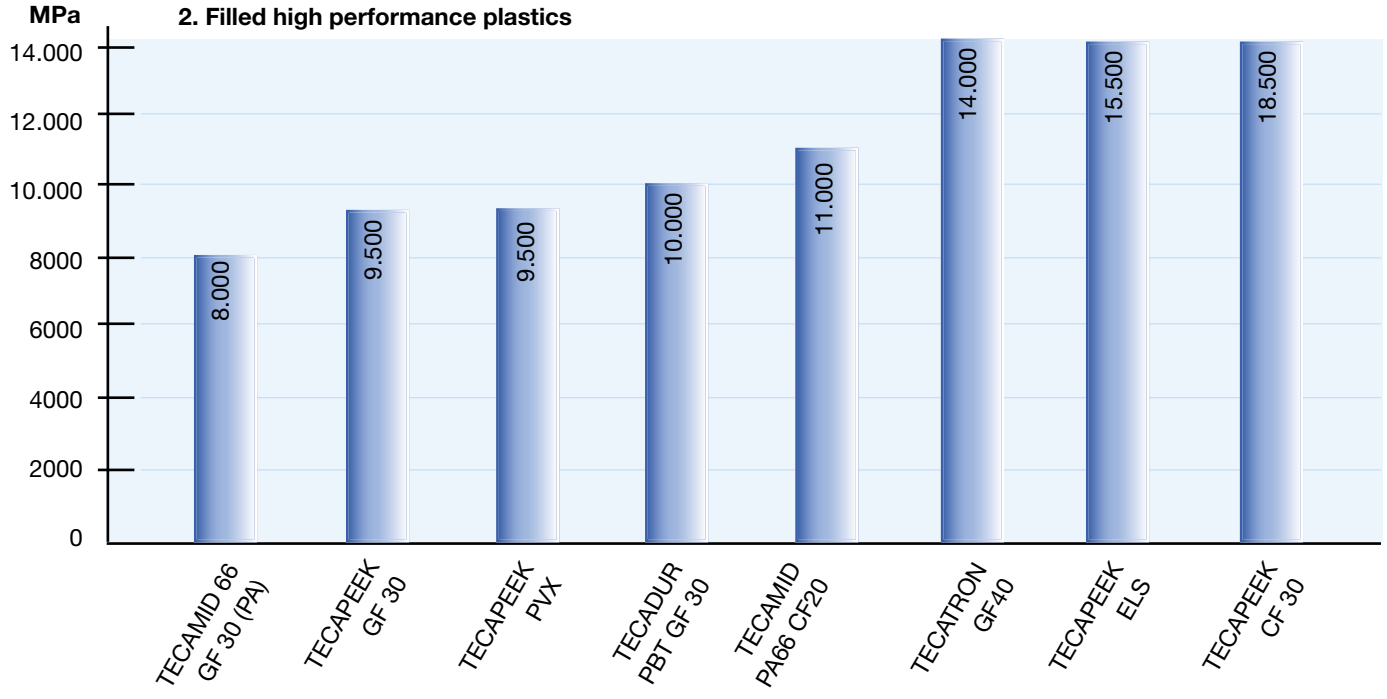


The long term temperature resistance values are those temperatures above which material decomposition takes place.
Please note that the properties at these temperatures are very different from those at room temperature.

4. Technical know-how for your application

4.3 E-Modulus at room temperature in MPa (dry, +23°C/50% RH)





4. Technical know-how for your application

4.4. Flame protection classification

High standards are set for flame protection in various plastic applications.
The classification of materials is generally made according to the UL Standard 94. The classification into different fire classes is achieved using two test set-ups:

Horizontal flame experiment acc. to UL 94 HB
Material which is classified according to UL 94 HB may nog exceed a maximum combustion rate of 76.2 mm/min at a wall thickness of less than 3.05 mm and with horizontal clamping. At a wall thickness of 3.05 - 12.7 mm this value should not exceed maximum 38.1 mm/min. Materials classified in this way are easily flammable and therefore hardly meet the requirements of other flammability tests.

Vertical flam experiment acc. to UL 94
In this experiment a flame is held for ten seconds against the vertically clamped test specimen and then removed. The time taken for the last flame to extinguish itself is measured, and this experiment is repeated ten times. Apart from the combustion time, the classification also takes into consideration whether burning droplets are formed. The various criteria are listed in the following table.

1. Classification according to UL 94

	V-0	*V-1*	*V-2*
burning time after each flaming	≤10s	≤30s	≤30s
burning time after 10 repetitions	≤50s	≤250s	≤250s
formation of droplets	no	no	yes

2. Oxygen index according to ASTM D2863
The oxygen index of a material is defined as the minimum concentration of oxygen, expressed in vol.-% of an oxygen/nitrogen mixture, which maintains combustion of a defined material sample.

3. Survey

Material	*DIN description*	*Classification acc.to UL94*	*Oxygen index acc. to ASTM D2863*
VESPEL	PI	V-0 (3.2 mm)	49
TECATOR	PAI	V-0 (3.2 mm)	
TECAPEEK HT	PEK	V-0 (1.6 mm)	40
TECAPEEK	PEEK	V-0 (1.45 mm)	35
ERIFLON PTFE	PTFE	V-0 (3.2 mm)	95
TECATRON	PPS	V-0 (3.2 mm)	
TECATRON GF40	PPS	V-0 (0.4 mm)	
TECASON E	PES	V-0 (1.6 mm)	39
TECASON PMT	PPSU	V-0 (0.8 mm)	
TECASON S	PSU	V-0 (4.5 mm)	32
PVDF	PVDF	V-0 (0.8 mm)	43
TECANAT	PC	V-2 (3.2 mm)	
TECANAT GF30	PC	V-1 (3.2 mm)	
TECAPET	PET	HB (3.2 mm)	

4. Technical know-how for your application

4.5. Applications in electrical engineering

It is often required of plastics used in electrical engineering applications that they discharge or conduct static electricity. This is achieved by the specific addition of eletrically active substances, such as special conducting carbon blacks, carbon fibre, conducting micro-fibres with nanostructures or inherently conducting substances. Conducting carbon blacks are used only for applications outside of clean-room production, where the actual semi-conductor structures are closed and sealed. Carbon fibres, nanotubes and inherently conducting substances are more abrasion-resistant and tend to lead to considerably less contamination.
The electrical paramaters can thus be kept within better defiable limits.
A material with a surface resistance of 10^6 Ω to 10^{12} Ω is considered to discharge static electricity. If the surface resistance is smaller than 10^6 Ω, then the material is said to be electrically conducting.

4.6. Applications in foodstuffs and medical technology

Special requirements are necessary in the areas of foodstuffs and medical technology with regard to physiological suitability and resistance.

FDA conformity: The American Food and Drug Administration (FDA) checks the suitability of materials with regard to their contact with foodstuffs. Raw materials, additives and properties of plastics are specified by the FDA in the 'Code of Federal Regulation' CFR 21. Materials which fulfil the respective requiremetns are considered to conform to FDA.

Biocompatibility: The biocompatibility describes the compatibility of a material to the tissue or the physiological system of the patient. The assessment is performed using various tests acc. to USP (US Pharmacopoeia) Claas VI or acc. to ISO 10993. Resistance to different sterilisation procedures and chemicals: multiple-use equipment in medical technology has to have good resistance towards preparatory procedures such as sterilisation and disinfection. The requirements are best met with high-performance plastics.

The table below gives a summary of the FDA CFR 21, ISO10993 and USP Class VI materials.

Applications in food/pharma technologies

Material	*DIN description*	*FDA conformity*	*USP class VI conform*	*ISO 10993*	*Sterilisation*	
					Steam 134 °C	*Gamma radiation*
TECAPEEK MT black	PEEK	X		X	+	+
ERIFLON PTFE	PTFE	X			+	-
TECASON E	PES	X			0	+
TECASON P	PPSU	X	X		+	+
TECASON S	PSU	X	X		0	+
PVDF	PVDF	X			+	+
TECANAT	PC	X			-	+
TECAMID 66	PA 66	X			-	0
TECAPET	PET	X			-	+
TECAFORM AH MT	POM-C	X			0	-
MULTILENE	HMPE	X			-	0
TECAPRO MT	PP (stab)	X			0	-
TECAPEEK	PEEK	X	-	X	-	
TECAPEEK classix	PEEK	X	X	X	+	+

X FDA conformity and biocompatibility / + resistant / 0 medium resistant / - not resistant

4. Technical know-how for your application

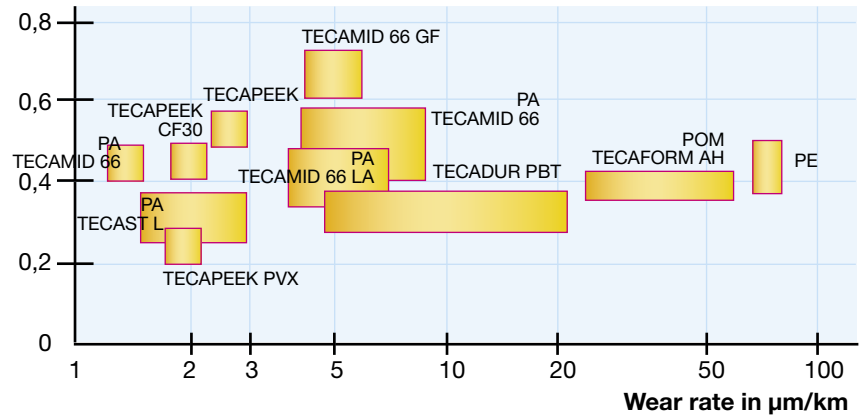
4.7. Sliding and abrasive characteristics

Plastics have proven to be useful in various applications as sliding materials. Particularly advantageous are their dry running properties, low noise and maintenance characteristics, chemical resistance and electrical insulation.
The sliding and abrasive behaviour is in this respect not a material property, but is determined specifically by the tribological system with various parameters such as material combination, surface roughness, lubricant, load, temperature, etc.
The inherently good sliding properties of plastics can also be modified to specific requirements by the use of additives.

Additives such as glass fibre, glass beads or mineral filters normally act abrasively on the sliding parts.
Cast polyamides are frequently used for slide bearing applications, which is why a large numbe of dynamic friction-optimised materials are also available.
If bearings also have to work at high temperatures, high speeds or strong contact pressures, high temperature plastics are used. In the following diagrams, the tribological properties of various materials used for sliding bearings with different degrees of surface roughness are compared.

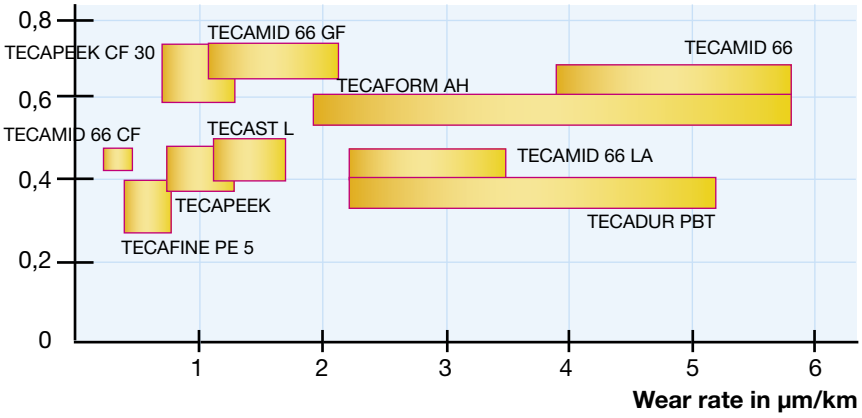
Conditions:
- Load: 1 mPa
- Speed: 0,5 m/s
- Against steel with R_2 = 2,5 µm

Coefficient of friction µ



Conditions:
- Load: 1mPa
- Speed: 0,5 m/s
- Against steel with R_2 = 0,2 µm

Coefficient of friction µ



4. Technical know-how for your application

4.8. Radiation resistance of plastics

Plastics can come into contact with different types of radiation, depending upon the area of application, which affect the structure of the material. The spectrum of electromagnetic radiation ranges from radio frequencies, with long wave-lengths, to normal daylight with short wave-length UV-radiation to very short wave-length X-rays and gamma radiation. The shorter the wave-length of the radiation the more easily it can damage the plastic.

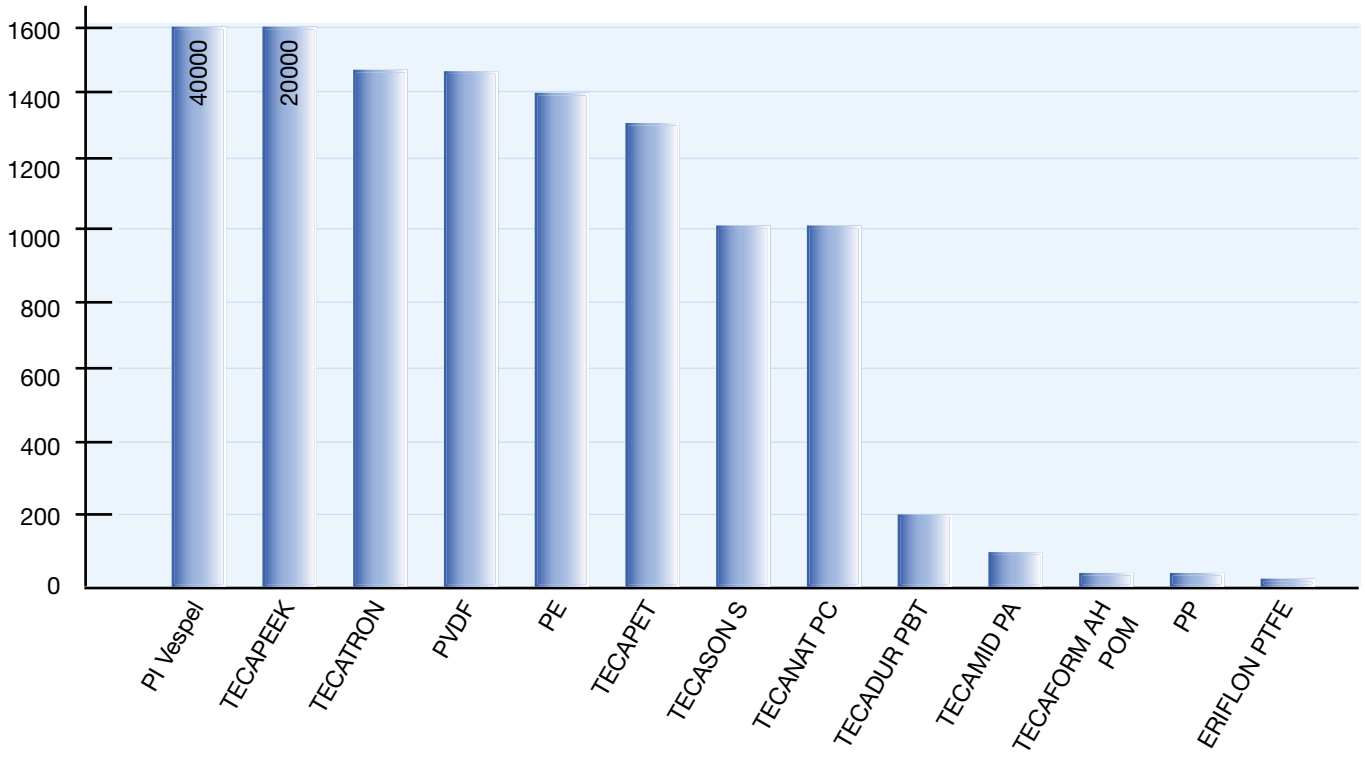
Ultraviolet radiation

UV-radiation from sunlight is particularly effective in unprotected open-air applications. Plastics which are inherently resistant are to be found in the group of fluorinated polymers, e.g. unsurpassed are PTFE and PVDF. Without respective protective measures, various plastics begin to yellow and become brittle depending upon the level of irradiation.
UV protection is achieved using additives (UV stabilizers) or protective surface coatings (paint, metallization). The addition of carbon black is cost-effective, frequently used and is a very effective method.
An important characteristic value in connection with electromagnetic radiation is the dielectric loss-factor, which describes the amount of energy absorbed by the plastic.
Plastics with high dielectric loss-factors strongly heat up in an alternating electrical field and are therefore not suitable as high frequency and micro-wave insulating materials.

Gamma radiation

Gamma and X-ray radiation are frequently to be found in medical diagnostics, radiation therapy, in the sterilisation of disposable articles and also in the testing of materials and in test instrumentation.
The high energy radiation often leads in these applications to a decrease in the expansion characteristics and the development of brittleness. The overall service life is dependent upon the total amount of radiation absorbed.
PEEK HT, PEEK, PI and the amorphous sulphur-containing polymers, for example, have been proved to have very good resistance towards gamma radiation and X-rays. On the other hand, PTFE and POM are very sensitive and therefore are practically unsuitable for this purpose.

Radiation dose in kGy which reduces elongation by less than 25%.



5. Marktsegments

- medical industry
- food industry
- mechanical engineering
- life science industry
- electronics
- steel industry
- glass industry
- construction of presses
- semicon industry
- aero space industry
- nanotechnology

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