DSM Engineering Plastic Products

global leader in engineering plastics for machining

General
Purpose
Plastic
Products

DSM

DSM Engineering Plastic Products' Mission

«AS THE GLOBAL MARKET LEADER IN ENGINEERING PLASTIC SHAPES, WE PURSUE STRONG PROFITABLE GROWTH DRIVEN BY CUSTOMER VALUE, OPERATIONAL EXCELLENCE, SELECTIVE DEVELOPMENT AND BEST PRACTISES OF QESH PRINCIPLES»

DSM

DSM Engineering Plastic Products,

FOR ENGINEERING DESIGN CONSULTANTS

DSM Engineering Plastic Products provides international application experience, supported by the reliability of a global group. Through its innovation and expertise, DSM Engineering Plastic Products is able to find the best solution for each application.

FOR DISTRIBUTORS

DSM Engineering Plastic Products offers its distributors the strength of recognised brands (through the quality and reputation of its materials), support in marketing and publicity, and close partnership within the market place.

FOR MACHINE SHOPS

DSM Engineering Plastic Products guarantees availability of materials from stock, across a wide range of shapes and sizes. Consistent manufacturing quality ensures optimum dimensional stability of machined parts.

FOR MANUFACTURERS

Supplier to thousands of companies across 5 continents, DSM Engineering Plastic Products offers an extensive range of materials (from standard to the most advanced grades) along with great expertise in design and manufacture of finished components.

DSM

global leader in engineering plastics for machining

GLOBAL PRODUCT QUALITY STANDARDS

Consistent quality standards have been established for the major shapes products coming from DSM Engineering Plastic Products' primary production sites worldwide. This assures our customers the same high level of performance and machinability lot to lot, regardless of where the product is manufactured. Our ability to offer reliable products and service levels is based on a total quality approach, the ISO 9002 standard and a highly qualified and skilled workforce, careful selection of raw materials and resins, "leading edge" process technologies, and top quality manufacturing standards.

GLOBAL PRODUCTION AND LOGISTICS

DSM Engineering Plastic Products is unique in its ability to serve all major regional markets in the world. Our unmatched- and ongoing- investment in production and logistics sites around the globe solidifies our commitment to world-class service, quality and market development for engineering plastics for machining. Our range of process technology includes casting, extrusion and compression moulding to deliver the widest range of engineering plastics shapes materials in the market.

GLOBAL TECHNICAL SERVICE AND APPLICATION DEVELOPMENT SUPPORT

Our teams of technical service and application development engineers are based in all major DSM Engineering Plastic Product's locations. Their sole mission is to help equipment manufacturers and machinists get the full performance benefits and cost efficiency from our materials. DSM Engineering Plastic Products has also invested in complete test facilities and the best technical data both in print and on the worldwide web (**www.dsmepp.com**) to support our customers on material selection.

GLOBAL PRODUCT LINE BRANDS

DSM Engineering Plastic Products' branding program integrates our products under a unified set of tradenames regionally and globally. This provides a clear and consistent identification of all products and makes them available through all distributor and fabricator partners worldwide.

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ERTALON® NYLATRON®

Within the polyamides, commonly referred to as “nylons”, we distinguish different types. The most important ones are: PA 6, PA 66, PA 11 and PA 12. The differences in physical properties which exist between these types are mainly determined by the composition and the structure of their molecular chains.

Main characteristics

- **High mechanical strength, stiffness, hardness and toughness** *– see figure 5 on page 8*
- **Good fatigue resistance**
- **High mechanical damping ability**
- **Good sliding properties** *– see figure 4 on page 7*
- **Excellent wear resistance** *– see figure 3 on page 6*
- **Good electrical insulating properties**
- **High resistance against high energy radiation (gamma- and X-rays)**
- **Good machinability**

➜ Applications

ERTALON & NYLATRON are used in a wide range of industrial components both for Original Equipment Manufacturing and maintenance.

Some examples: sleeve and slide bearings, wear pads, support and guide wheels, conveyor rollers, tension rollers, sleeves for wheels and rollers, pulleys and pulley-linings, cams, buffer blocks, hammer heads, scrapers, gear wheels, sprockets, seal-rings, feed screws, starwheels, cutting and chopping boards, insulators, etc.

ERTALON 66 SA “shaking rods” on wine-grape harvester.

EXTRUDED PRODUCTS

ERTALON 6 SA
natural (white) / black **[PA 6]**

This material offers an optimal combination of mechanical strength, stiffness, toughness, mechanical damping properties and wear resistance. These properties, together with a favourable electrical insulating ability and a good chemical resistance make ERTALON 6 SA a “general purpose” grade for mechanical construction and maintenance.

ERTALON 66 SA
natural (cream) / black **[PA 66]**

Material with a higher mechanical strength, stiffness, heat and wear resistance than ERTALON 6 SA. It also has a better creep resistance but its impact strength and mechanical damping ability are reduced. Well suited for machining on automatic lathes.

ERTALON 4.6
(reddish brown) **[PA 4.6]**

Compared with the conventional nylons, ERTALON 4.6 (STANYL®) features a better retention of stiffness and creep resistance over a wide range of temperatures as well as a superior heat ageing resistance. Therefore, applications for ERTALON 4.6 are situated in the “higher temperature area” (80 – 150 °C) where stiffness, creep resistance, heat ageing resistance, fatigue strength and wear resistance of PA 6, PA 66, POM and PET fall short.

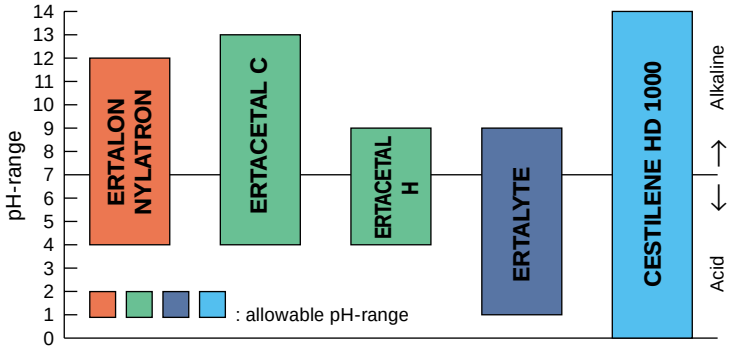
ERTALON 66-GF30
(black) **[PA 66-GF30]**

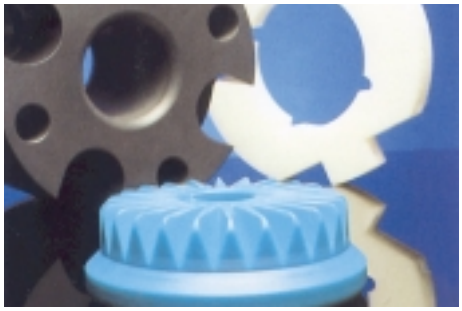
Compared with virgin PA 66, this 30 % glass fibre reinforced and heat stabilised nylon grade offers increased strength, stiffness, creep resistance and dimensional stability whilst retaining an excellent wear resistance. It also allows higher max. service temperatures.

NYLATRON GS
(grey-black) **[PA 66 + MoS_2]**

The addition of MoS_2 renders this material somewhat stiffer, harder and dimensionally more stable than ERTALON 66 SA, but results in some loss of impact strength. The nucleating effect of the molybdenum disulphide results into an improved crystalline structure enhancing bearing and wear properties.

Fig. 1 – **CHEMICAL RESISTANCE AT 23 °C**





CAST PRODUCTS

ERTALON 6 PLA natural (ivory) / black [PA 6]

Unmodified cast nylon 6 grade exhibiting characteristics which come very close to those of ERTALON 66 SA. It combines high strength, stiffness and hardness with good creep and wear resistance, heat ageing properties and machinability.

ERTALON 6 XAU+ (black) [PA 6]

ERTALON 6 XAU+ is a heat stabilised cast nylon grade with a very dense and highly crystalline structure. Compared with conventional extruded or cast nylons, ERTALON 6 XAU+ offers superior heat ageing performance in air (much better resistance to thermal-oxidative degradation), allowing 15 – 30 °C higher continuously allowable service temperatures. ERTALON 6 XAU+ is particularly recommended for bearings and other mechanical parts subject to wear which are operating in air for long periods of time at temperatures over 60 °C.

ERTALON LFX (green) [PA 6 + oil]

This internally lubricated cast nylon 6 is self-lubricating in the real meaning of the word. ERTALON LFX, especially developed for unlubricated, highly loaded and slowly moving parts applications, yields a considerable enlargement of the application possibilities of nylons. This because of its reduced coefficient of friction (up to – 50 %) and improved wear resistance (up to x 10).

NYLATRON MC 901 (blue) [PA 6]

This modified cast nylon 6 grade with its distinctive blue colour exhibits higher toughness, flexibility and fatigue resistance than ERTALON 6 PLA. It has proved to be an excellent material for gear wheels, racks and pinions.

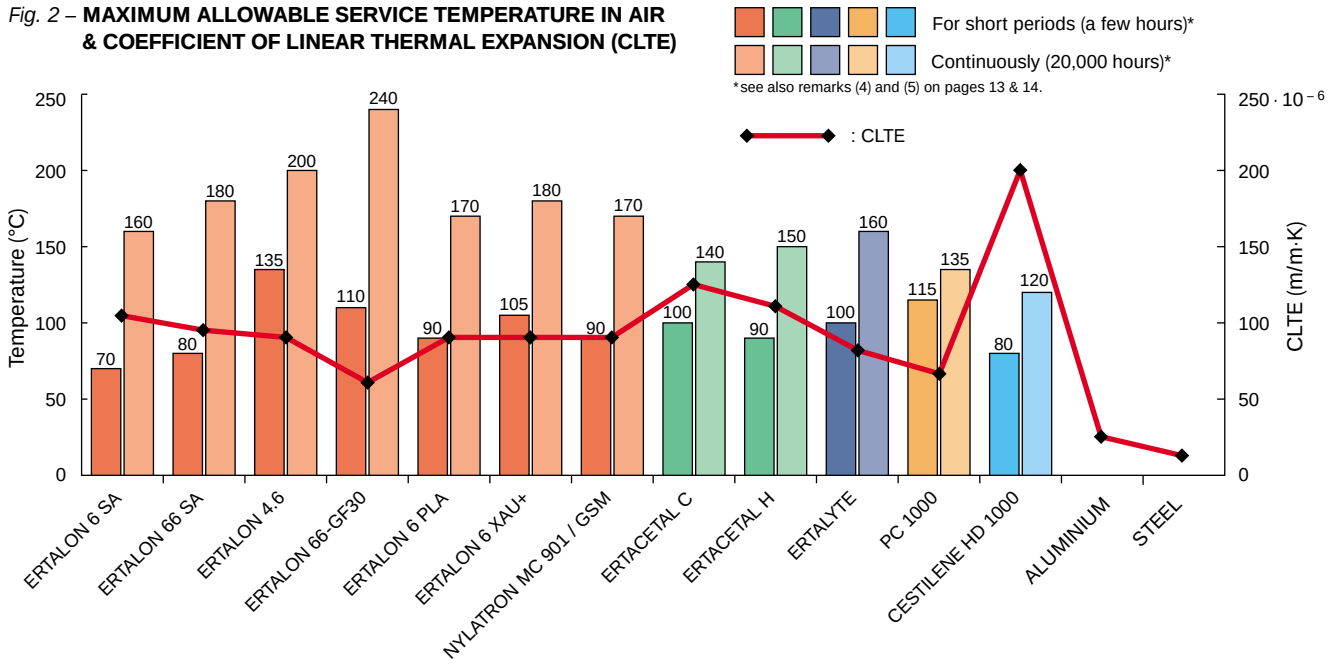
NYLATRON GSM (grey-black) [PA 6 + MoS_2]

NYLATRON GSM contains finely divided particles of molybdenum disulphide to enhance its bearing and wear behaviour without impairing the impact and fatigue resistance inherent to unmodified cast nylon grades. It is a very commonly used grades for gears, bearings, sprockets and sheaves.

NYLATRON NSM (grey) [PA 6 + solid lubricants]

NYLATRON NSM is a proprietary cast nylon 6 formulation containing solid lubricant additives which grant this material self-lubricity, excellent frictional properties, superior wear resistance and outstanding Pressure-Velocity capabilities (up to 5 times higher than conventional cast nylons). Being particularly suited for higher velocity, unlubricated moving parts applications, it is the perfect complement to the oil-filled grade ERTALON LFX.

Fig. 2 – **MAXIMUM ALLOWABLE SERVICE TEMPERATURE IN AIR & COEFFICIENT OF LINEAR THERMAL EXPANSION (CLTE)**



ERTACETAL®

Main characteristics

- **High mechanical strength, stiffness and hardness** *– see figure 5 on page 8*
- **Excellent resilience**
- **Good creep resistance**
- **High impact strength, even at low temperatures**
- **Very good dimensional stability (low water absorption)**
- **Good sliding properties and wear resistance** *– see figures 3 and 4 on pages 6 and 7*
- **Excellent machinability**
- **Good electrical insulating and dielectric properties**
- **Physiologically inert (suitable for food contact)** *– see table 1 on page 8*
- **Not self-extinguishing**

➜ Applications

Some examples: gear wheels with small modulus, cams, heavily loaded bearings and rollers, bearings and gears with small clearances, valve seats, snapfit assemblies, all kinds of dimensionally stable precision parts for machine construction, insulating components for electrical engineering, parts which operate continuously in water of 60 – 80 °C (ERTACETAL C).
ERTACETAL is very well suited for machining on automatic lathes and is particularly recommended for mechanical precision parts.

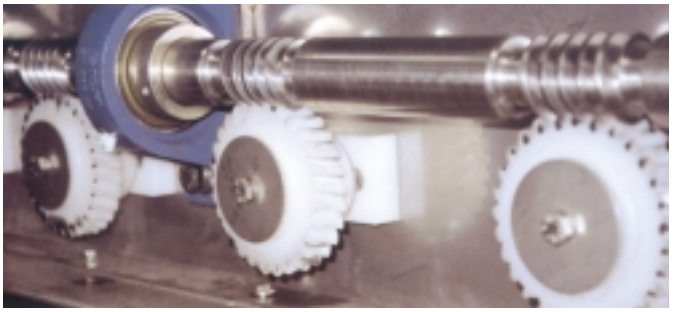
ERTACETAL

ERTACETAL C & H **natural (white) / black** **[POM-C & POM-H]**

These are DSM Engineering Plastic Products' virgin copolymer and homopolymer acetal grades. The acetal copolymer is more resistant against hydrolysis, strong alkalis and thermal-oxidative degradation than the acetal homopolymer. The latter, however, has higher mechanical strength, stiffness, hardness and creep resistance as well as a lower thermal expansion rate and often it also presents a better wear resistance.

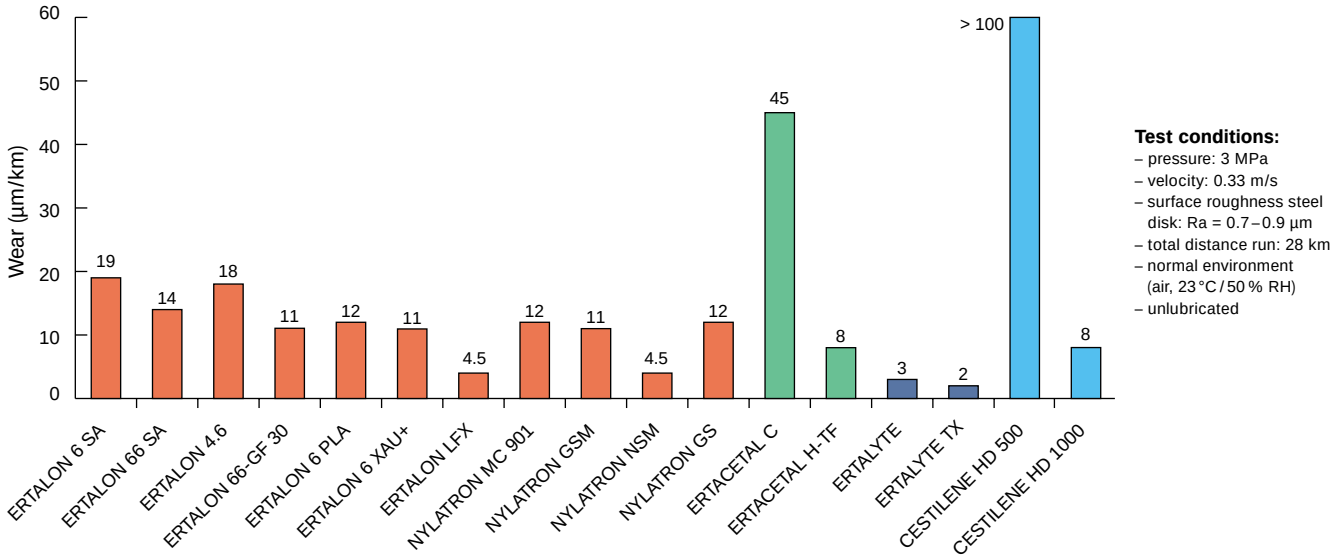
ERTACETAL H-TF **(deep brown)** **[POM-H + PTFE]**

ERTACETAL H-TF is a DELRIN® AF Blend, a combination of TEFLON® fibres evenly dispersed in a DELRIN acetal resin. Much of the strength that is inherent in ERTACETAL H is retained. Some properties change due to the addition of TEFLON fibre which is softer, less stiff and slipperier than virgin acetal resin.
Compared with ERTACETAL C and H, this material offers superior sliding properties. Bearings made of ERTACETAL H-TF show low friction, long wear and are essentially free of stick-slip behaviour.



ERTACETAL® worm gears driving the conveyor-system of a deepfreeze tunnel.

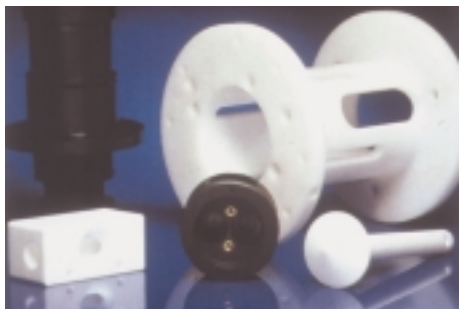
Fig. 3 – **WEAR RESISTANCE measured on a "plastics pin on rotating steel disk" – tribo system**



Test conditions:
– pressure: 3 MPa
– velocity: 0.33 m/s
– surface roughness steel disk: Ra = 0.7–0.9 µm
– total distance run: 28 km
– normal environment (air, 23 °C / 50 % RH)
– unlubricated

ERTALYTE®

DSM Engineering Plastic Products' stock shapes made of crystalline thermoplastic polyester, are marketed under the trade names ERTALYTE (virgin grade) and ERTALYTE TX (filled grade).



Main characteristics

- **High mechanical strength, stiffness and hardness** – *see figure 5 on page 8*
- **Very good creep resistance**
- **Low and constant coefficient of friction** – *see figure 4 on page 7*
- **Excellent wear resistance (comparable with or even better than nylon grades)** – *see figure 3 on page 6*
- **Very good dimensional stability (better than polyacetal)**
- **Excellent stain resistance**
- **Better resistance to acids than nylon and polyacetal** – *see figure 1 on page 4*
- **Good electrical insulating properties**
- **Physiologically inert (suitable for food contact)** – *see table 1 on page 8*
- **Good resistance against high energy radiation (gamma- and X-rays)**

ERTALYTE

ERTALYTE **natural (white) / black** **[PET]**

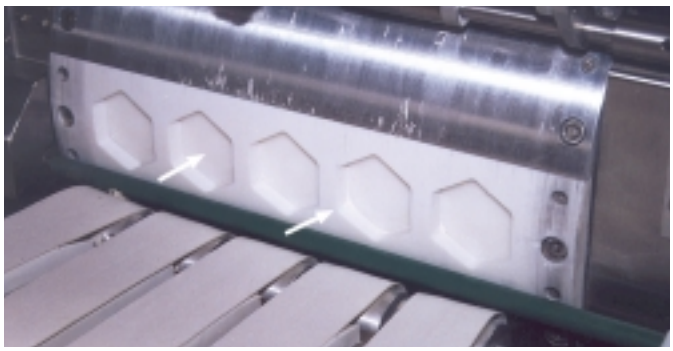
The specific properties of this virgin crystalline PET make it specially suitable for the manufacture of mechanical precision parts which have to sustain high loads and/or are subject to wear.

ERTALYTE TX **(pale grey)** **[PET + solid lubricant]**

ERTALYTE TX is a polyethylene terephtalate compound incorporating a uniformly dispersed solid lubricant. Its specific formulation yields a premium, internally lubricated bearing-grade.
ERTALYTE TX has not only an outstanding wear resistance, but offers in comparison with ERTALYTE an even lower coefficient of friction as well as higher Pressure-Velocity capabilities.

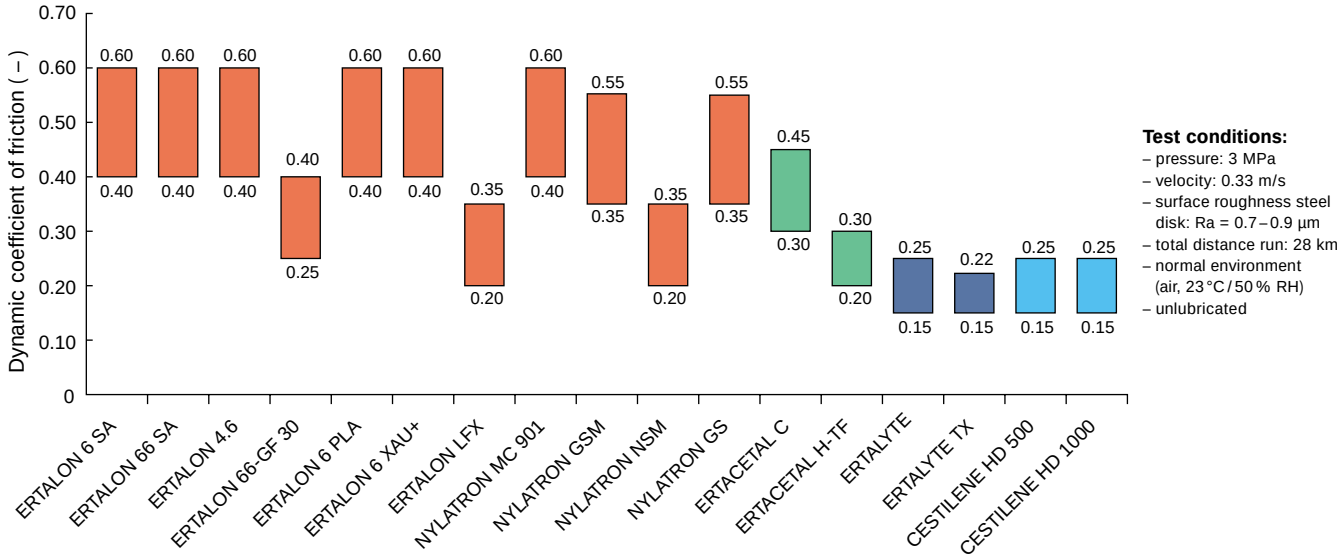
➜ Applications

Some examples: heavily loaded bearings (bushings, thrust washers, guides, etc.), dimensionally stable parts for mechanisms of precision (bushings, slideways, gears, rollers, pump components, etc.) and insulating components for electrical engineering.



ERTALYTE® paste portioning mould and ejector pistons on a bakery machine.

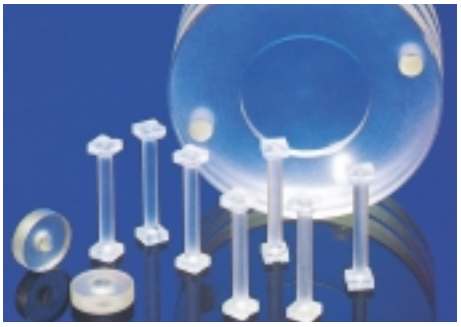
Fig. 4 – **DYNAMIC COEFFICIENT OF FRICTION measured on a "plastics pin on rotating steel disk" – tribo system**



Test conditions:
– pressure: 3 MPa
– velocity: 0.33 m/s
– surface roughness steel disk: Ra = 0.7 – 0.9 µm
– total distance run: 28 km
– normal environment (air, 23 °C / 50 % RH)
– unlubricated

PC 1000

DSM Engineering Plastic Products is marketing non-UV-stabilised polycarbonate stock shapes under the trade name PC 1000 (virgin grade). It is a “non-optical” industrial quality.



Main characteristics

- **High mechanical strength**
- **Good creep resistance**
- **Very high impact strength, even at low temperatures**
- **Stiffness retention over a wide range of temperatures** *– see figure 5 on page 8*
- **Very good dimensional stability (very low water absorption and low coefficient of linear thermal expansion)** *– see figure 2 on page 5*
- **Natural colour (clear; translucent)**
- **Good electrical insulating and dielectric properties**
- **Physiologically inert (suitable for food contact)** *– see table 1 on page 8*

➜ Applications

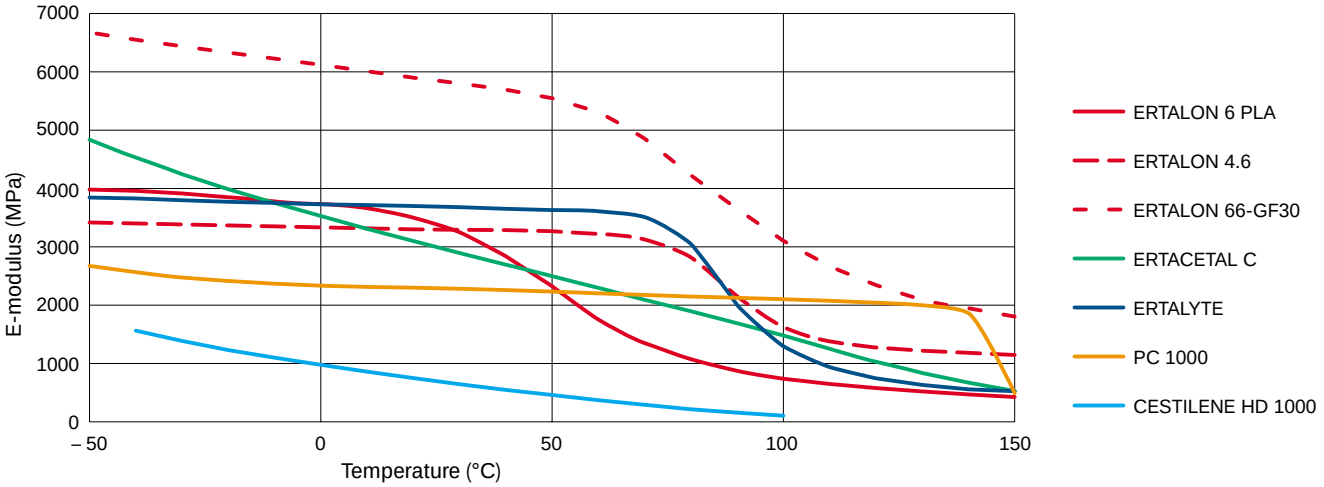
Some examples: components for precision engineering, safety glazing, insulating parts for electrical engineering, parts in contact with foodstuffs, components for medical and pharmaceutical devices.

Table 1: **Food compatibility of the raw materials used for the production of GPPP stock shapes.**

GENERAL PURPOSE PLASTIC PRODUCTS	FOOD COMPATIBILITY (1)	
	EU	FDA
ERTALON 6 SA natural and black	+	+
ERTALON 66 SA natural and black	+	+
ERTALON 4.6	–	–
ERTALON 66-GF30	–	–
ERTALON 6 PLA natural	+/–	+/–
other cast nylon grades	–	–
NYLATRON GS	–	–
ERTACETAL C natural	+	+
ERTACETAL C black	+	–
ERTACETAL H natural	+	+
ERTACETAL H black	–	–
ERTACETAL H-TF	–	–
ERTALYTE natural	+	+
ERTALYTE black	+	–
ERTALYTE TX	+	+
PC 1000	+	+
CESTILENE HD 500 natural	+	+
CESTILENE HD 500 black	+	–
CESTILENE HD 1000 natural	+	+
CESTILENE HD 1000 black	+	–
CESTIDUR	+	–
CESTILITE ASTL	+	–

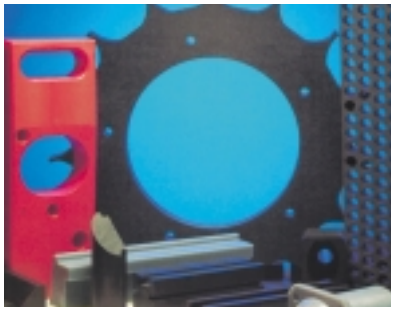
(1) This table gives the compliance of the ***raw materials*** used for the manufacture of DSM Engineering Plastic Products' stock shapes with respect to their composition, as set out in the regulations that apply in the EU and the USA for plastics materials used for the fabrication of finished articles intended to come into contact with foodstuffs.
EU : food compatibility according to European Union directive 90/128/EEC and its amendments.
FDA : food compatibility according to the American FDA Code of Federal Regulations.
+ : complies with the regulations
– : does not comply with the regulations
+/– : complies with the regulations but the monomer content of the stock shapes has to be checked.

Fig. 5 – **STIFFNESS VERSUS TEMPERATURE (derived from DMA-curves).**



>> (ULTRA) HIGH MOLECULAR WEIGHT POLYETHYLENE [PE-(U)HMW]

CESTILENE - CESTICOLOR CESTIDUR® - CESTILITE



These are the trade names of DSM Engineering Plastic Products for its extensive range of virgin, partially reprocessed, coloured and filled High Density Polyethylene stock shapes, manufactured by extrusion and compression moulding.

Main characteristics

- **Good wear and abrasion resistance (particularly PE-UHMW)** *– see figure 3 on page 6*
- **High impact strength, even at low temperatures (particularly PE-UHMW)**
- **Excellent chemical resistance** *– see figure 1 on page 4*
- **Low coefficient of friction** *– see figure 4 on page 7*
- **Excellent release properties**
- **Very low water absorption**
- **Moderate mechanical strength, stiffness and creep resistance** *– see figure 5 on page 8*
- **Very good electrical insulating and dielectric properties (except for CESTILITE)**
- **Excellent machinability**
- **Physiologically inert (most grades are suitable for food contact)** *– see table 1 on page 8*
- **Good resistance against high energy radiation (gamma- and X-rays)**
- **Not self-extinguishing**

➜ Applications

Some examples: gears; bearings; wear plates; support-, tension- and deflecting rollers; rope pulleys; chain sprockets; guide strips for conveyor belts and chains; bumpers; scraper blades; piston rings and packings; seals; valves; hammerheads; conveyor screws; star wheels and bends; pumps; filter plates; electroplating drums; pickers; beater caps; linings for bunkers, silos, chutes and funnels for bulk materials; punching plates; cutting and chopping boards; …

CESTILENE - CESTICOLOR CESTIDUR - CESTILITE

CESTILENE HD 500 natural (white) / black [PE-HMW]

Molecular weight of about 500,000 g/mol.
This grade exhibits a good combination of stiffness, toughness, mechanical damping ability with wear- and abrasion resistance and can easily be welded. CESTILENE HD 500 is a versatile polyethylene grade used mainly in the food industry (meat and fish processing) but it is also put to use in all kinds of mechanical, chemical and electrical applications.

CESTILENE HD 500 R (black / green) [PE-HMW]

Molecular weight of about 500,000 g/mol.
This grade is partially composed of reprocessed HD 500 material. CESTILENE HD 500 R is used for those applications where its slightly reduced physical properties are overruled by its economical advantage.

CESTICOLOR HD 500 [PE-HMW]

green, red, yellow, king's blue, sky blue, salmon, orange and chestnut
Molecular weight of about 500,000 g/mol.
The CESTICOLOR HD 500 range of materials offers a series of homogeneous, attractive and food compliant colours which find particular outlet in the food and leisure industry. The property profile of these grades is practically identical to the one of CESTILENE HD 500.

CESTILENE HD 1000 natural (white) / black / green [PE-UHMW]

Molecular weight of about 4,500,000 g/mol.
Of all ultra high molecular weight polyethylene grades, CESTILENE HD 1000 exhibits the best balanced property profile. It combines an excellent wear and abrasion resistance with an outstanding impact strength, even at temperatures below – 200 °C. Its main fields of application are: general mechanical construction; bottling-, canning- and packaging machinery; chemical and electroplating industry; cryogenic equipment; textile industry and storage systems for bulk materials.

CESTILENE HD 1000 R (black / green) [PE-UHMW]

Molecular weight of about 4,000,000 g/mol.
This grade, partially composed of reprocessed HD 1000 material, has an overall lower property level than the virgin CESTILENE HD 1000 and a lower cost. Compared with CESTILENE HD 500, however, it has a much better impact strength and wear resistance. CESTILENE HD 1000 R is an economical PE-UHMW grade for use in material handling equipment.

CESTIDUR (blue grey) [PE-UHMW]

Molecular weight of about 6,000,000 g/mol.
The higher molecular weight and the particular manufacturing process of this material result in a PE-UHMW grade with superior wear and abrasion resistance. CESTIDUR has proven to be able to deal with the toughest bearing and wear jobs in all kinds of industries.

CESTILITE ASTL (black) [PE-UHMW + additives]

Molecular weight of about 7,000,000 g/mol.
CESTILITE ASTL has been specifically developed for the toughest anti-abrasion applications. The additives used also confer this material static dissipative (anti-static) and UV-stabilised properties. This reduces the risk of explosions when handling certain bulk materials on the one hand and make the material suitable for outdoor use on the other hand.

INSTRUCTIONS FOR MACHINING DSM GENERAL

The DSM 'General Purpose Plastic Products' can be easily machined on ordinary metalworking and, in some instances, woodworking machines. However, there are a few points, which are worth noting to obtain improved results.

In view of the poor thermal conductivity and the relatively low melting points of thermoplastics, the generated heat must be kept to a minimum, therefore avoiding build up of temperature within the product. This is in order to avoid colour changes or even melting.

Therefore:

- **tools must be kept sharp and smooth at all times;**
- **tools must have sufficient clearance so that the cutting edge only contacts the plastic material;**
- **a good swarf removal from the tool must be assured;**
- **coolants should be applied for operations where plenty of heat is generated (e.g. drilling).**

Machining forces

Machining forces are lower for engineering plastics than for metals, therefore clamping pressures should be reduced. But as these materials are not as rigid as metals, it is essential to support the work adequately during machining in order to prevent deflection, e.g. thin walled bushings, often require an internal plug for accurate machining of the outside diameter.

Tools

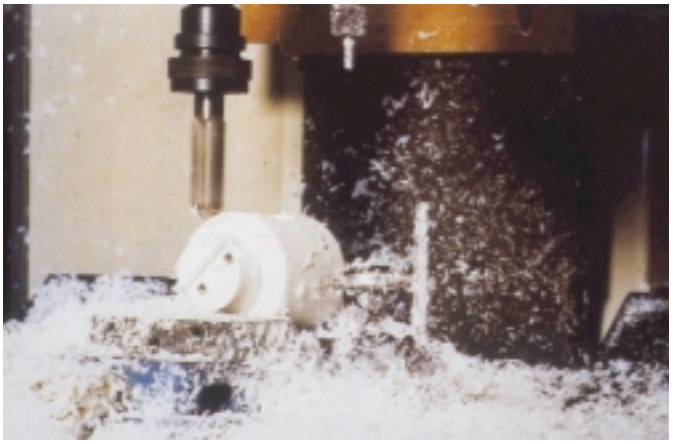
Carbon or high speed steel and hard metal tools can be used. However, tungsten carbide tipped tools or diamond bit tools are preferred for long production runs and are a must when machining glass or carbon fibre reinforced materials.

Coolants

When the use of coolants is required, cooling liquids of the soluble oil type do generally very well. They should, however, not be used when machining amorphous thermoplastics, such as PC 1000, which materials are susceptible to environmental stress-cracking. For these materials the most suitable coolants are pure water or compressed air.

Machining tolerances

The machining tolerances required for thermoplastic parts are generally considerably larger than those normally applied to metal parts. This is because of the higher coefficient of thermal expansion, eventual swelling due to moisture absorption (mainly with nylons) and possible deformations caused by internal stress-relieving during and after machining. The latter phenomenon mainly occurs on parts where machining causes asymmetric and/or heavy section changes. In these cases, a thermal treatment (stress-relieving) after premachining and prior to final machining of the part might prove necessary.
As a rule of thumb, for turned or milled parts, a machining tolerance of 0.1 to 0.2 % of the nominal size can be applied without taking special precautions (min. tolerance for small sizes being 0.05 mm). In this respect, the ISO 2768, the DIN 7168 as well as the Swiss VKI-Recommendation "Toleranzen spanend hergestellter Kunststoff-Fertigteile" ("Tolerances for machined plastic parts") can be used as a guide.



Turning

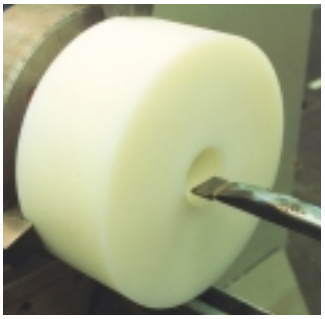
See table 2 for tool geometry, speeds and feeds.

Milling

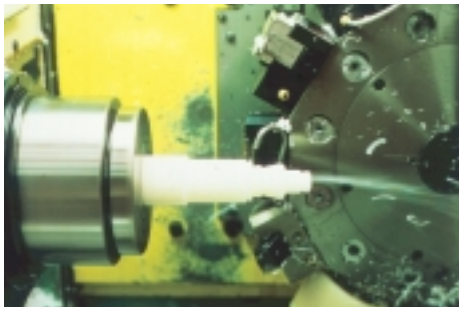
Milling cutters for light metals can be used but fly cutters are preferred because of the much better swarf removal.

Drilling

High speed steel twist drills work well but plenty of heat is generated so a cooling liquid should be applied. In order to improve heat and swarf removal, frequent pull-outs ("peck drilling") are necessary, especially for deep holes. For large diameter holes, it is advised to use drills with a thinned web in order to reduce friction and consequently heat generation. It is also recommended for large holes to drill step-wise; e.g. a bore diameter of 50 mm should be made by drilling successively with ∅ 12 and ∅ 25 mm, then expanding the hole further with larger diameter drills or with a single point boring tool.
For ERTALON 66-GF30, ERTALYTE and ERTALYTE TX rods over 100 mm diameter as well as for ERTALON / NYLATRON rods over 200 mm diameter, it is even recommended in order to avoid cracks, not to use high speed twist drills at all but to "bore" the holes on a lathe using a rigid, flat boring tool with its cutting edge perfectly set on centre-height (see picture below).
When drilling or boring through-holes, feed should be reduced at the bottom of the cut to prevent the drill or flat boring tool from pulling through at the exit-side, causing chipping or breaking out. Hand feeding the drill is not recommended since this may cause the drill to "grab" and stress the material.



PURPOSE PLASTIC PRODUCTS



Sawing

Band saws, circular saws or reciprocating saws that have widely spaced teeth in order to assure good chip removal can be used. They should also have enough set to minimise the friction between the saw and the work and to avoid close-in behind the cutting edge causing excessive heat build-up and even blocking of the saw.
Proper clamping of the shapes on the worktable is required to avoid vibrations and consequent rough cutting, or even rupture.
IMPORTANT: Reinforced materials, such as ERTALON 66-GF30, are preferably cut with a band saw that has a tooth pitch of 4 - 6 mm. Do not use circular saws as it often results in cracks.

Safety

To avoid any risks, the general industrial safety recommendations should be followed as well as the eventual specific ones you can find in the DSM Engineering Plastic Products “Material Safety Data Sheets”.

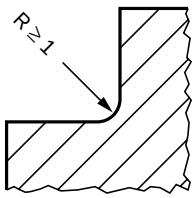


Fig. 6

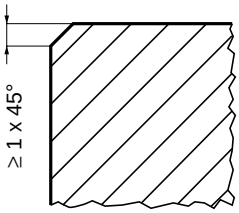


Fig. 7

ERTALYTE / ERTALYTE TX

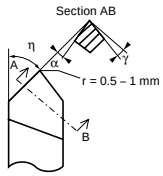
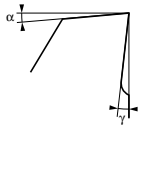
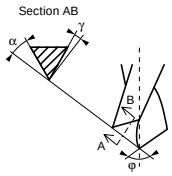
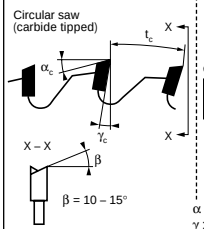
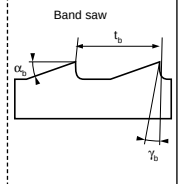
With respect to their hardness and moderate toughness, it is recommended that additional machining and design rules have to be observed next to what already has been said earlier some additional machining / design rules have to be observed. This should prevent premature failure of these materials. In design and assembly, stress concentrations should be avoided and particularly during sawing and drilling operations, a gentle machining approach is required.

Some tips:

- Always use light to moderate clamping forces. Never try to force the plastics part.
- Avoid sharp “internal” corners. The radius of curvature should be at least 1 mm. Refer to figure 6.
- To avoid chipping the edges during turning, boring or milling, chamfered edges are advantageous, providing a smoother transition between the cutting tool and the plastics work. Refer to figure 7.
- Sharp V-threads should be avoided (plenty of notch-sensitive areas); threads with a rounded root should be applied whenever possible.
- The use of thread cutting and thread forming screws is not recommended. Particularly the latter create tremendous stresses around the hole and are most likely to cause cracking at that point.
- When tapping threads or assembling bolts in blind holes, care should be taken not to force the bottom of the holes by the tap-or bolt-tip since this is likely to induce cracking.

More information about the machining of DSM ‘Engineering Plastic Products’ can be given on request.

Table 2 – **TOOL GEOMETRY, SPEEDS AND FEEDS FOR SAWING, TURNING, MILLING AND DRILLING.**

	TURNING					MILLING				DRILLING					SAWING							
	 α : side clearance angle (°) γ : rake angle (°) η : side cutting edge angle (°) v : cutting speed (m/min) s : feed (mm/rev.)					 α : relief angle (°) γ : rake angle (°) v : cutting speed (m/min) s : feed (mm/tooth)				 α : relief angle (°) γ : rake angle (°) φ : top angle (°) v : cutting speed (m/min) s : feed (mm/rev.)					 c : circular saw b : band saw  α : relief angle (°) γ : rake angle (°) t : pitch (mm) v : cutting speed (m/min)							
	α	γ	η	s	v	α	γ	s	v	α	γ	φ	s	v	α_c	γ_c	t_c	v_c	α_b	γ_b	t_b	v
ERTALON NYLATRON CESTILENE	5 - 15	0 - 10	0 - 45	0.05 - 0.5	200 - 500	5 - 15	0 - 15	up to 0,05	200 - 500	10 - 15	3 - 5	90 - 120	0.1 - 0.3	50 - 100	10 - 15	0 - 15	8 - 45	1,000 - 3,000	25 - 40	0 - 8	4 - 10	50 - 500
ERTACETAL	5 - 15	0 - 10	0 - 45	0.05 - 0.5	200 - 500	5 - 15	0 - 15	up to 0.05	200 - 400	5 - 10	3 - 5	90 - 120	0.1 - 0.3	50 - 100	10 - 15	0 - 15	8 - 45		25 - 40	0 - 8	4 - 10	50 - 500
ERTALYTE ERTALYTE TX PC 1000	5 - 15	0 - 10	0 - 45	0.05 - 0.5	200 - 400	5 - 15	0 - 15	up to 0,05	150 - 300	5 - 10	3 - 5	90 - 120	0.1 - 0.3	50 - 80	10 - 15	0 - 15	8 - 25		25 - 40	0 - 8	4 - 10	50 - 400

PHYSICAL PROPERTIES: ERTALON, NYLATRON, ERTACETAL, ERTALYTE AND PC stock shapes (Indicative values)

PROPERTIES		Test methods ISO/(IEC)	Units	ERTALON 6 SA	ERTALON 66 SA	ERTALON 66 SA-C	ERTALON 4.6	ERTALON 66-GF30
Colour		—	—	natural (white) / black	natural (cream) / black	natural (white)	reddish brown	black
Density		1183	g/cm³	1.14	1.14	1.14	1.18	1.29
Water absorption:								
– after 24/96 h immersion in water of 23 °C (1)		62	mg	86/168	40/76	65/120	90/180	30/56
		62	%	1.28/2.50	0.60/1.13	0.97/1.79	1.30/2.60	0.39/0.74
– at saturation in air of 23 °C / 50 % RH		—	%	2.6	2.4	2.5	2.8	1.7
– at saturation in water of 23 °C		—	%	9	8	8.5	9.5	5.5
Thermal Properties (2)								
Melting temperature		—	°C	220	255	240	295	255
Glass transition temperature (3)		—	°C	—	—	—	—	—
Thermal conductivity at 23 °C		—	W/(K·m)	0.28	0.28	0.28	0.30	0.30
Coefficient of linear thermal expansion:								
– average value between 23 and 60 °C		—	m/(m·K)	$90 \cdot 10^{-6}$	$80 \cdot 10^{-6}$	$85 \cdot 10^{-6}$	$80 \cdot 10^{-6}$	$50 \cdot 10^{-6}$
– average value between 23 and 100 °C		—	m/(m·K)	$105 \cdot 10^{-6}$	$95 \cdot 10^{-6}$	$100 \cdot 10^{-6}$	$90 \cdot 10^{-6}$	$60 \cdot 10^{-6}$
Temperature of deflection under load:								
– method A: 1.8 MPa	+	75	°C	70	85	75	160	150
Max. allowable service temperature in air:								
– for short periods (4)		—	°C	160	180	170	200	240
– continuously: for 5,000 / 20,000 h (5)		—	°C	85/70	95/80	90/75	155/135	120/110
Min. service temperature (6)				– 40	– 30	– 30	– 40	– 20
Flammability (7):								
– "Oxygen Index"		4589	%	25	26	24	24	—
– according to UL 94 (3 / 6 mm thickness)		—	—	HB/HB	HB/V-2	HB/HB	HB/HB	HB/HB
Mechanical Properties at 23 °C (8)								
Tension test (9):								
– tensile stress at yield / tensile stress at break (10)	+	527	MPa	76/—	90/—	86/—	100/—	—/100
	++	527	MPa	45/—	55/—	50/—	55/—	—/75
– tensile strain at break (10)	+	527	%	> 50	> 40	> 50	25	5
	++	527	%	> 100	> 100	> 100	> 100	12
– tensile modulus of elasticity (11)	+	527	MPa	3,250	3,450	3,300	3,300	5,900
	++	527	MPa	1,400	1,650	1,450	1,300	3,200
Compression test (12):								
– compressive stress at 1/2/5 % nominal strain (11)	+	604	MPa	24/46/80	25/49/92	24/47/88	23/45/94	28/55/90
Creep test in tension (9):								
– stress to produce 1 % strain in 1,000 h ($\sigma_{1/1,000}$)	+	899	MPa	18	20	19	22	26
	++	899	MPa	7	8	7.5	7.5	18
Charpy impact strength – Unnotched (13)	+	179/1eU	kJ/m²	no break	no break	no break	no break	≥ 50
Charpy impact strength – Notched	+	179/1eA	kJ/m²	5.5	4.5	5	8	6
Izod impact strength – Notched	+	180/2A	kJ/m²	5.5	4.5	5	8	6
	++	180/2A	kJ/m²	15	11	13	25	11
Ball indentation hardness (14)	+	2039-1	N/mm²	150	160	155	165	165
Rockwell hardness (14)	+	2039-2	—	M 85	M 88	M 87	M 92	M 76
Electrical Properties at 23 °C								
Electric strength (15)	+	(243)	kV/mm	25	27	26	25	30
	++	(243)	kV/mm	16	18	17	15	20
Volume resistivity	+	(93)	Ω·cm	$> 10^{14}$	$> 10^{14}$	$> 10^{14}$	$> 10^{14}$	$> 10^{14}$
	++	(93)	Ω·cm	$> 10^{12}$	$> 10^{12}$	$> 10^{12}$	$> 10^{12}$	$> 10^{13}$
Surface resistivity	+	(93)	Ω	$> 10^{13}$	$> 10^{13}$	$> 10^{13}$	$> 10^{13}$	$> 10^{13}$
	++	(93)	Ω	$> 10^{12}$	$> 10^{12}$	$> 10^{12}$	$> 10^{12}$	$> 10^{12}$
Relative permittivity ε_r: – at 100 Hz	+	(250)	—	3.9	3.8	3.8	3.8	3.9
	++	(250)	—	7.4	7.4	7.4	7.4	6.9
– at 1 MHz	+	(250)	—	3.3	3.3	3.3	3.4	3.6
	++	(250)	—	3.8	3.8	3.8	3.8	3.9
Dielectric dissipation factor tan δ:– at 100 Hz	+	(250)	—	0.019	0.013	0.013	0.009	0.012
	++	(250)	—	0.13	0.13	0.13	0.13	0.19
– at 1 MHz	+	(250)	—	0.021	0.020	0.020	0.019	0.014
	++	(250)	—	0.06	0.06	0.06	0.06	0.04
Comparative tracking index (CTI)	+	(112)	—	600	600	600	400	475
	++	(112)	—	600	600	600	400	475

Note: 1 g/cm³ = 1,000 kg/m³; 1 MPa = 1 N/mm²; 1 kV/mm = 1 MV/m.

Legend:

+ : values referring to dry material
++ : values referring to material in equilibrium with the standard atmosphere 23 °C / 50 % RH (mostly derived from literature)
(1) According to method 1 of ISO 62 and done on discs ∅ 50 x 3 mm.
(2) The figures given for these properties are for the most part derived from raw material supplier data and other publications.
(3) Values for this property are only given here for amorphous materials and not for semi-crystalline ones.
(4) Only for short time exposure (a few hours) in applications where no or only a very low load is applied to the material.
(5) Temperature resistance over a period of 5,000 / 20,000 hours. After these periods of time, there is a decrease in tensile strength of about 50 % as compared with the original value. The temperature values given here are thus based on the thermal-oxidative degradation which takes place and causes a reduction in properties. Note, however, that, as for all thermoplastics, the maximum allowable service temperature depends in many cases essentially on the duration and the magnitude of the mechanical stresses to which the material is subjected.
(6) Impact strength decreasing with decreasing temperature, the minimum allowable service temperature is practically mainly determined by the extent to which the material is subjected to impact. The values given here are based on unfavourable impact conditions and may consequently not be considered as being the absolute practical limits.
(7) These estimated ratings, derived from raw material supplier data, are not intended to reflect hazards presented by the materials under actual fire conditions. There are no UL-yellow cards available for these stock shapes.
(8) The figures given for the properties of dry material (+) are for the most part average values of tests run on test specimens machined out of rods ∅ 40 - 60 mm.
Considering the very low water absorption of ERTACETAL, ERTALYTE and PC 1000, the values for the mechanical and electrical properties of these materials can be considered as being practically the same for dry (+) and moisture conditioned (++) test specimens.
(9) Test specimens: Type 1 B
(10) Test speed: 20 mm/min (5 mm/min for ERTALON 66-GF30, ERTACETAL H-TF and ERTALYTE TX).
(11) Test speed: 1 mm/min.
(12) Test specimens: cylinders (∅ 12 x 30 mm)
(13) Pendulum used: 15 J.
(14) 10 mm thick test specimens
(15) Electrode configuration: 25 / 75 mm coaxial cylinders; in transformer oil according to IEC 296; 1 mm thick natural coloured test specimens. It is important to know that the electric strength of black extruded material (ERTALON 6 SA, ERTALON 66 SA, ERTACETAL and ERTALYTE) can be as low as 50 % of the value for natural material. Possible microporosity in the centre of polyacetal stock shapes also significantly reduces the electric strength.
(16) The property-values given below do not apply to the ERTALYTE sheets.

▶ This table is a valuable help in the choice of a material. The data listed here fall within the normal range of product properties. **However, they are not guaranteed and they should not be used to establish material specification limits nor used alone as the basis of design.**
It has to be noted that ERTALON 66-GF30 is a fibre reinforced, and consequently anisotropic material (properties differ when measured parallel and perpendicular to the extrusion direction).

ERTALON 6 PLA	ERTALON 6 XAU+	ERTALON LFX	NYLATRON MC 901	NYLATRON GSM	NYLATRON NSM	NYLATRON GS	ERTACETAL C	ERTACETAL H	ERTACETAL H-TF	ERTALYTE (16)	ERTALYTE TX	PC 1000
natural (ivory) / black	black	green	blue	grey-black	grey	grey-black	natural (white) / black	natural (white) / black	deep brown	natural (white) / black	pale grey	natural (clear, translucent)
1.15	1.15	1.135	1.15	1.16	1.15	1.15	1.41	1.43	1.50	1.39	1.44	1.20
44 / 83	47 / 89	44 / 83	49 / 93	52 / 98	40/76	46 / 85	20 / 37	18 / 36	16 / 32	6 / 13	5 / 11	13 / 23
0.65 / 1.22	0.69 / 1.31	0.66 / 1.24	0.72 / 1.37	0.76 / 1.43	0.59 / 1.12	0.68 / 1.25	0.24 / 0.45	0.21 / 0.43	0.18 / 0.36	0.07 / 0.16	0.06 / 0.13	0.18 / 0.33
2.2	2.2	2	2.3	2.4	2	2.3	0.20	0.20	0.17	0.25	0.23	0.15
6.5	6.5	6.3	6.6	6.7	6.3	7.8	0.85	0.85	0.72	0.50	0.47	0.35
220	220	220	220	220	220	255	165	175	175	255	255	—
—	—	—	—	—	—	—	—	—	—	—	—	150
0.29	0.29	0.28	0.29	0.30	0.29	0.29	0.31	0.31	0.31	0.29	0.29	0.21
$80 \cdot 10^{-6}$	$80 \cdot 10^{-6}$	$80 \cdot 10^{-6}$	$80 \cdot 10^{-6}$	$80 \cdot 10^{-6}$	$80 \cdot 10^{-6}$	$80 \cdot 10^{-6}$	$110 \cdot 10^{-6}$	$95 \cdot 10^{-6}$	$105 \cdot 10^{-6}$	$60 \cdot 10^{-6}$	$65 \cdot 10^{-6}$	$65 \cdot 10^{-6}$
$90 \cdot 10^{-6}$	$90 \cdot 10^{-6}$	$90 \cdot 10^{-6}$	$90 \cdot 10^{-6}$	$90 \cdot 10^{-6}$	$95 \cdot 10^{-6}$	$90 \cdot 10^{-6}$	$125 \cdot 10^{-6}$	$110 \cdot 10^{-6}$	$120 \cdot 10^{-6}$	$80 \cdot 10^{-6}$	$85 \cdot 10^{-6}$	$65 \cdot 10^{-6}$
80	80	75	80	80	75	85	105	115	105	75	75	130
170	180	165	170	170	165	180	140	150	150	160	160	135
105 / 90	120 / 105	105 / 90	105 / 90	105 / 90	105 / 90	95 / 80	115 / 100	105 / 90	105 / 90	115 / 100	115 / 100	125 / 115
– 30	– 30	– 20	– 30	– 30	– 30	– 20	– 50	– 50	– 20	– 20	– 20	– 60
25	25	—	25	25	—	26	15	15	—	25	25	25
HB / HB	HB / HB	HB / HB	HB / HB	HB / HB	HB / HB	HB / HB	HB / HB	HB / HB	HB / HB	HB / HB	HB / HB	HB / HB
85 / —	83 / —	70 / —	81 / —	78 / —	76 / —	92 / —	68 / —	78 / —	— / 55	90 / —	— / 76	70 / —
55 / —	55 / —	45 / —	50 / —	50 / —	50 / —	55 / —	68 / —	78 / —	— / 55	90 / —	— / 76	70 / —
25	25	25	35	25	25	20	35	35	10	15	7	> 50
> 50	> 50	> 50	> 50	> 50	> 50	> 50	35	35	10	15	7	> 50
3,500	3,400	3,000	3,200	3,300	3,100	3,500	3,100	3,600	3,200	3,700	3,450	2,400
1,700	1,650	1,450	1,550	1,600	1,500	1,675	3,100	3,600	3,200	3,700	3,450	2,400
26 / 51 / 92	26 / 51 / 92	22 / 43 / 79	24 / 47 / 86	25 / 49 / 88	23 / 44 / 81	25 / 49 / 92	19 / 35 / 67	22 / 40 / 75	20 / 37 / 69	26 / 51 / 103	24 / 47 / 95	18 / 35 / 72
22	22	18	21	21	18	21	13	15	13	26	23	17
10	10	8	9	9	8	9	13	15	13	26	23	17
no break	no break	≥ 50	no break	no break	≥ 100	no break	≥ 150	≥ 200	≥ 30	≥ 50	≥ 30	no break
3.5	3.5	4	3.5	3.5	4	4	7	10	3	2	2.5	9
3.5	3.5	4	3.5	3.5	4	4	7	10	3	2	2.5	9
7	7	7	7	7	7	9	7	10	3	2	2.5	9
165	165	145	160	160	150	165	140	160	140	170	160	120
M 88	M 87	M 82	M 85	M 84	M 81	M 88	M 84	M 88	M 84	M 96	M 94	M 75
25	29	22	25	24	25	26	20	20	20	22	21	28
17	19	14	17	16	17	17	20	20	20	22	21	28
$> 10^{14}$	$> 10^{14}$	$> 10^{14}$	$> 10^{14}$	$> 10^{14}$	$> 10^{14}$	$> 10^{14}$	$> 10^{14}$	$> 10^{14}$	$> 10^{14}$	$> 10^{15}$	$> 10^{15}$	$> 10^{15}$
$> 10^{12}$	$> 10^{12}$	$> 10^{12}$	$> 10^{12}$	$> 10^{12}$	$> 10^{12}$	$> 10^{12}$	$> 10^{14}$	$> 10^{14}$	$> 10^{14}$	$> 10^{15}$	$> 10^{15}$	$> 10^{15}$
$> 10^{13}$	$> 10^{13}$	$> 10^{13}$	$> 10^{13}$	$> 10^{13}$	$> 10^{13}$	$> 10^{13}$	$> 10^{13}$	$> 10^{13}$	$> 10^{13}$	$> 10^{14}$	$> 10^{14}$	$> 10^{15}$
$> 10^{12}$	$> 10^{12}$	$> 10^{12}$	$> 10^{12}$	$> 10^{12}$	$> 10^{12}$	$> 10^{12}$	$> 10^{13}$	$> 10^{13}$	$> 10^{13}$	$> 10^{14}$	$> 10^{14}$	$> 10^{15}$
3.6	3.6	3.5	3.6	3.6	3.6	3.8	3.8	3.8	3.6	3.4	3.4	3
6.6	6.6	6.5	6.6	6.6	6.6	7.4	3.8	3.8	3.6	3.4	3.4	3
3.2	3.2	3.1	3.2	3.2	3.2	3.3	3.8	3.8	3.6	3.2	3.2	3
3.7	3.7	3.6	3.7	3.7	3.7	3.8	3.8	3.8	3.6	3.2	3.2	3
0.012	0.015	0.015	0.012	0.012	0.012	0.013	0.003	0.003	0.003	0.001	0.001	0.001
0.14	0.15	0.15	0.14	0.14	0.14	0.13	0.003	0.003	0.003	0.001	0.001	0.001
0.016	0.017	0.016	0.016	0.016	0.016	0.020	0.008	0.008	0.008	0.014	0.014	0.008
0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.008	0.008	0.008	0.014	0.014	0.008
600	600	600	600	600	600	600	600	600	600	600	600	350 (225)
600	600	600	600	600	600	600	600	600	600	600	600	350 (225)

PHYSICAL PROPERTIES: CESTILENE, CESTICOLOR, CESTIDUR and CESTILITE stock shapes (Indicative values▸)

PROPERTIES	Test methods ISO / (IEC)	Units	CESTILENE HD 500	CESTILENE HD 500 R	CESTICOLOR HD 500	CESTILENE HD 1000	CESTILENE HD 1000 R	CESTIDUR	CESTILITE ASTL
Colour	—	—	natural (white) / black	black / green	8 colours	natural (white) / black / green	black / green	blue grey	black
Average molar mass (average molecular weight) (1)	—	10^6 g/mol	0.5	0.5	0.5	4.5	4	6	7
Density	1183	g/cm³	0.96	0.96	0.96	0.93	0.93	0.93	0.95
Water absorption at saturation in water of 23 °C (2)	—	%	0.01	0.01	0.01	0.01	0.02	0.01	0.05
Thermal Properties (3)									
Melting temperature (DSC, 10 °C/min)	3146	°C	130–135	130–135	130–135	130–135	130–135	130–135	130–135
Thermal conductivity at 23 °C	—	W/(K·m)	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Average coeff. of linear therm. exp. between 23 and 100 °C		10^{-6} m/(m·K)	200	200	200	200	200	200	200
Temperature of deflection under load:									
– method A: 1.8 MPa	75	°C	44	44	44	42	42	42	42
Vicat softening temperature – VST/B50	306	°C	80	80	80	80	80	80	83
Max. allowable service temperature in air:									
– for short periods (4)	—	°C	120	120	120	120	120	120	120
– continuously: for 20,000 h (5)	—	°C	80	80	80	80	80	80	80
Min. service temperature (6)	—	°C	– 100	– 60	– 100	– 200 (7)	– 150	– 200 (7)	– 150
Flammability (8):									
– "Oxygen Index"	4589	%	< 20	< 20	< 20	< 20	< 20	< 20	< 20
– according to UL 94 (1.6 mm thickness)	—	—	HB	HB	HB	HB	HB	HB	HB
Mechanical Properties at 23 °C (9)									
Tension test (10):									
– tensile stress at yield (11)	527	MPa	28	28	28	19	22	19	20
– tensile strain at yield (11)	527	%	10	10	10	15	13	15	15
– nominal tensile strain at break (11)	527	%	> 50	> 50	> 50	> 50	> 50	> 50	> 50
– tensile modulus of elasticity (12)	527	MPa	1,350	1,300	1,350	750	950	710	770
Compression test (13):					≥				
– compressive stress at 1/2/5 % nominal strain (12)	604	MPa	9/15/23	9/14.5/22	9/15/23	4.5/8/14	6/10.5/18	4/7.5/13.5	5/9/15
Charpy impact strength – Unnotched (14)	179/1eU	kJ/m²	no break	no break	no break	no break	no break	no break	no break
Charpy impact strength – Notched (15)	179/1eA	kJ/m²	105 P	85 P	105 P	110 P	_ 90 P	105 P	80 P
Charpy impact strength – Notched (double 15° notch) (16)	DIS 11542-2	kJ/m²	≥ 25	≥ 20	≥ 25	≥ 170	≥ 80	≥ 120	≥ 90
Ball indentation hardness	2039-1	N/mm²	45	45	45	36	38	35	37
Shore hardness D (3/15 s)	868	—	66/64	66/64	66/64	62/60	63/61	62/60	63/61
Relative abrasion loss (test in "sand/water-slurry"), CESTILENE HD 1000 = 100	internal test	—	350	350	350	100	180	90	85
Electrical Properties at 23 °C (3)									
Electric strength (17)	(243)	kV/mm	≤ 45	≤ 45	≤ 45	≤ 45	—	≤ 45	—
Volume resistivity	(93)	Ω·cm	> 10^{14}	> 10^{13}	> 10^{14}	> 10^{14}	—	> 10^{14}	< 10^6
Surface resistivity	(93)	Ω	> 10^{13}	> 10^{12}	> 10^{13}	> 10^{13}	—	> 10^{13}	< 10^6
Relative permittivity ε_r: - at 100 Hz	(250)	—	2.4	2.4	2.4	2.1	—	2.1	—
- at 1 MHz	(250)	—	2.4	2.4	2.4	3	—	3	—
Dielectric dissipation factor tan δ: - at 100 Hz	(250)	—	0.0002	0.0002	0.0002	0.0004	—	0.0004	—
- at 1 MHz	(250)	—	0.0002	0.0002	0.0002	0.0010	—	0.0010	—
Comparative tracking index (CTI)	(112)	—	600	600	600	600	—	600	—

Note: 1 g/cm³ = 1,000 kg/m³; 1 MPa = 1 N/mm²; 1 kV/mm = 1 MV/m.

Legend:

(1) Calculated by means of the Margolies-equation $M = 5.37 \times 10^4 \times [\eta]^{1.49}$, with [η] being the Staudinger index derived from a viscosity measurement using decahydronaphtalene as a solvent (concentration of 0.0005 g/cm³ for PE-HMW and 0.0003 g/cm³ for PE-UHMW).

(2) Measured on 1 mm thick test plates.

(3) The figures given for these properties are for the most part derived from raw material supplier data and other literature.

(4) Only for short time exposure (a few hours) in applications where no or only a very low load is applied to the material.

(5) Temperature resistance over a period of 20,000 hours. After this period of time, there is a decrease in tensile strength of about 50 % as compared with the original value. The temperature values given here are thus based on the thermal-oxidative degradation which takes place and causes a reduction in properties. Note, however, that, as for all thermoplastics, the maximum allowable service temperature depends in many cases essentially on the duration and the magnitude of the mechanical stresses to which the material is subjected.

(6) Impact strength decreasing with decreasing temperature, the minimum allowable service temperature is practically mainly determined by the extent to which the material is subjected to impact. The values given here are based on unfavourable impact conditions and may consequently not be considered as being the absolute practical limits.

(7) Because of its outstanding toughness, this material withstands even the temperature of liquid helium (– 269 °C) at which it still maintains a useful impact resistance without shattering.

(8) These estimated ratings, derived from raw material supplier data, are not intended to reflect hazards presented by the materials under actual fire conditions. There are no UL-yellow cards available for these stock shapes.

(9) The figures given for these properties are average values of tests run on test specimens machined out of 20 mm thick plates.

(10) Test specimens: Type 1 B

(11) Test speed: 50 mm/min.

(12) Test speed: 1 mm/min.

(13) Test specimens: cylinders (∅ 12 x 30 mm)

(14) Pendulum used: 15 J.

(15) Pendulum used: 5 J.

(16) Pendulum used: 25 J.

(17) Electrode configuration: 25/75 mm coaxial cylinders; in transformer oil according to IEC 296; 1 mm thick test specimens.
It is important to know that the electric strength of coloured materials can be considerably lower than the value for natural material.

▸ This table is a valuable help in the choice of a material. The data listed here fall within the normal range of product properties. **However, they are not guaranteed and they should not be used to establish material specification limits nor used alone as the basis of design.**

DELIVERY PROGRAMME
Summary

MATERIALS → / SHAPES ↓	ERTALON®						NYLATRON®	
	6 SA	**66 SA**	**4.6**	**66-GF30**	**6 PLA**	**6 XAU+ LFX**	**GS**	**MC 901 GSM / NSM**
ROUND RODS ∅ (mm)	5 – 320	5 – 250	5 – 60	8 – 200	50 – 500	50 – 500	6 – 50	50 – 500
PLATES Thicknesses (mm)	0.5 – 100	2 – 100	10 – 50	10 – 100	10 – 100	8 – 100	8 – 50	10 – 100
TUBES O.D. (mm)	20 – 100	20 – 100	—	—	50 – 600	50 – 600	20 – 66	50 – 600

MATERIALS → / SHAPES ↓	ERTACETAL®			ERTALYTE®	ERTALYTE® TX	PC 1000
	C	**H**	**H-TF**			
ROUND RODS ∅ (mm)	3 – 320	5 – 200	10 – 100	10 –210	10 – 200	6 – 200
PLATES Thicknesses (mm)	0.5 – 100	8 – 50	12 – 50	2 – 100	8 – 100	15 – 50
TUBES O.D. (mm)	20 - 350	20 - 100	—	20 - 200	20 - 200	—

MATERIALS → / SHAPES ↓	CESTILENE				CESTICOLOR	CESTIDUR®	CESTILITE
	HD 500	**HD 500 R**	**HD 1000**	**HD 1000 R**	**HD 500**		**ASTL**
ROUND RODS ∅ (mm) **extruded**	30 – 200	—	20 – 200	—	—		—
pressed & turned	20 – 140	—	20 – 240	—	20 – 140	20 – 240	20 - 240
PLATES Thicknesses (mm) **skived**	—	—	1 – 10	—	—	1 – 10	1 – 10
extruded	2 –15	—	—	—	—	—	—
pressed	8 – 150	8 – 150	8 – 250	8 – 150	8 – 150	8 – 250	8 – 250

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