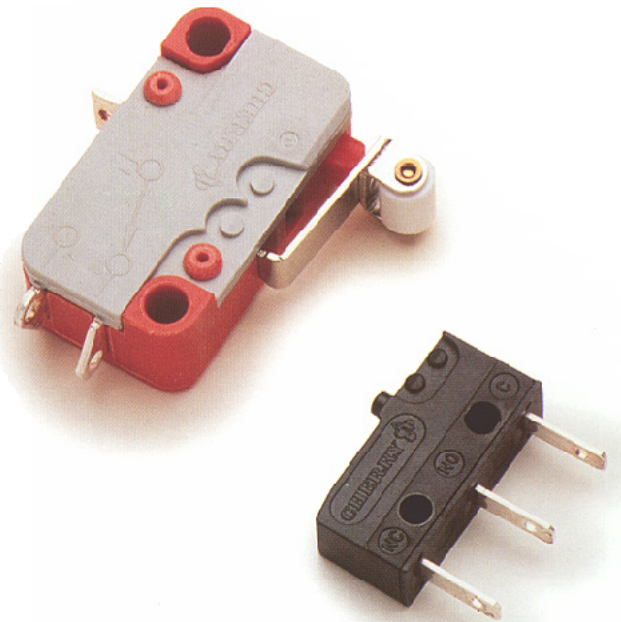
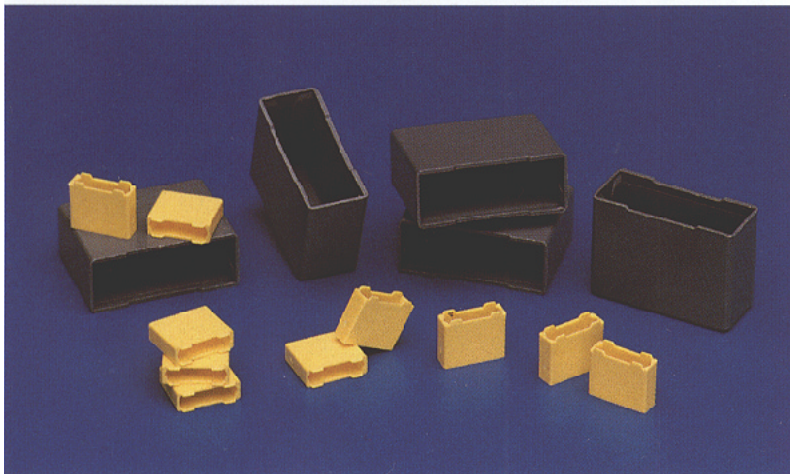
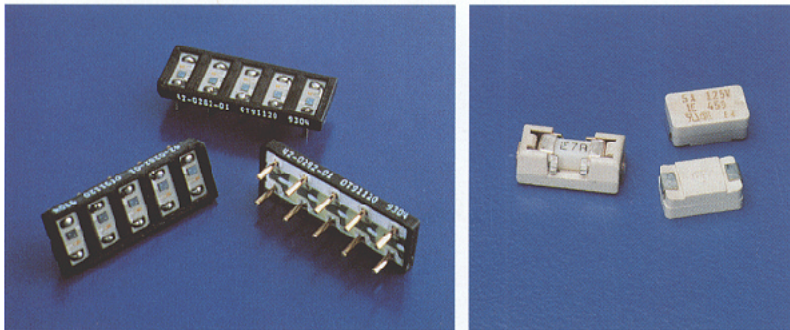
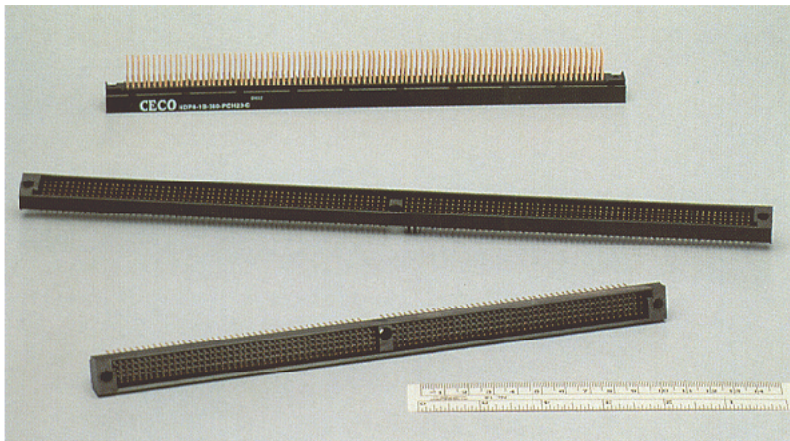




DuPont Engineering Polymers

Cost-Effective Solutions for Making Electronic Components



- ***The right material for the job***
- ***Strong technical support***
- ***Broad standards compliance***
- ***Global availability***

When Making Electronic Components Is the Issue, DuPont Has Solutions

When you're developing or upgrading board-mounted components or other molded electronic products, DuPont can put you over the top. You supply the product idea. We bring crucial ingredients so that you reach your performance, quality and cost targets sooner and for sure.

- **The right engineering plastic for the job**
- **Technical support, from design to production**
- **The fast track to worldwide standards compliance**
- **Global reach to serve you and your suppliers anywhere.**

Materials that perform

Whether the need is for SMT, hybrid or conventional components, DuPont has viable material solutions for just about any part design or board assembly process. Five families of engineering thermoplastics are available to meet a wide range of requirements. And if a standard grade doesn't fit your need, we may be able to tailor-make one that does.

- **New Zenite™ LCP** liquid crystal polymer resins
- **New Zytel® HTN** high temperature nylon resins
- **New Crastin® PBT** thermoplastic polyester resins
- **Rynite® PET** thermoplastic polyester resins
- **Zytel®** nylon resins

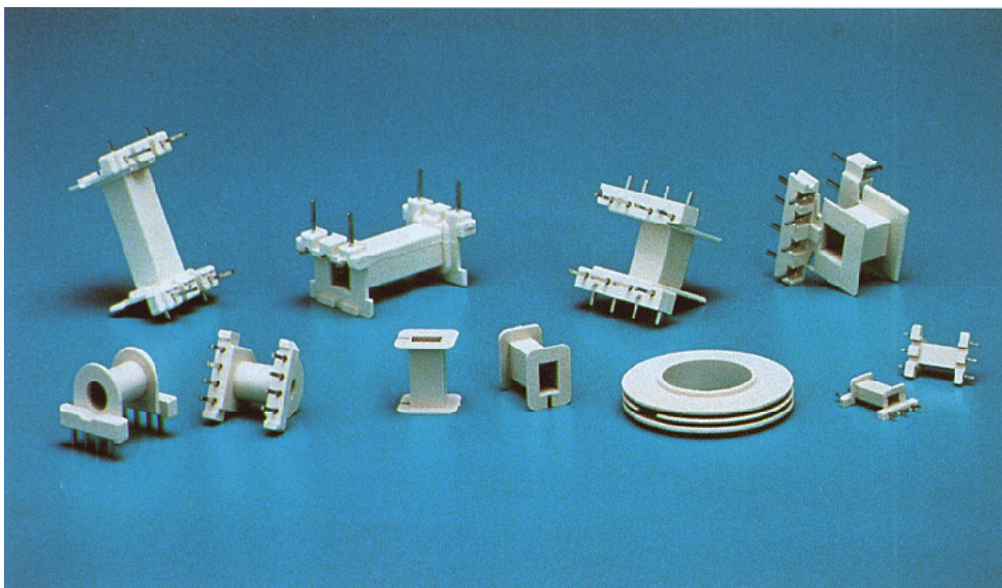
For descriptions and key properties of each resin family, see pps. 4, 5 and 6.

In choosing DuPont engineering thermoplastics over thermosets, you can save space on the board, cut costs and avoid environmental problems related to VOC (volatile organic compound) emissions.

Cut development time, save money

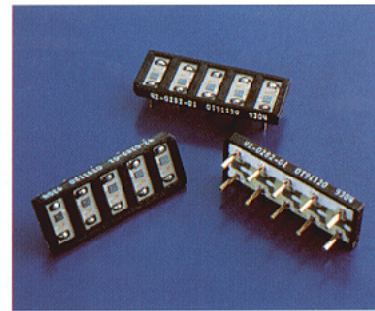
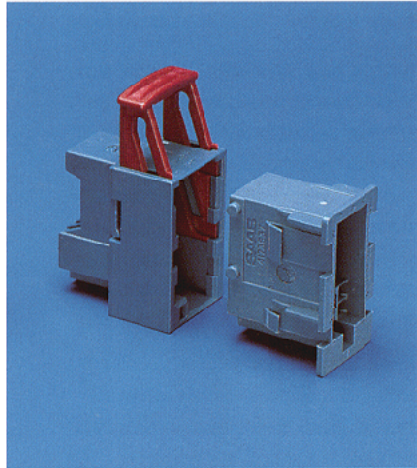
Expert assistance. You can rely on DuPont's experienced designers and engineers to help you save on development costs and time. We can provide valuable input at every stage: part design, tooling, resin selection, prototyping and molding process optimization. And that support is available at your production sites practically anywhere in the world.

Standards compliance. You're on the fast track for UL listings and compliance with international standards with our pre-tested, pre-approved Electrical Insulation Systems. They can save you months and many dollars in testing costs. And use of our systems is free for any application made with our material.



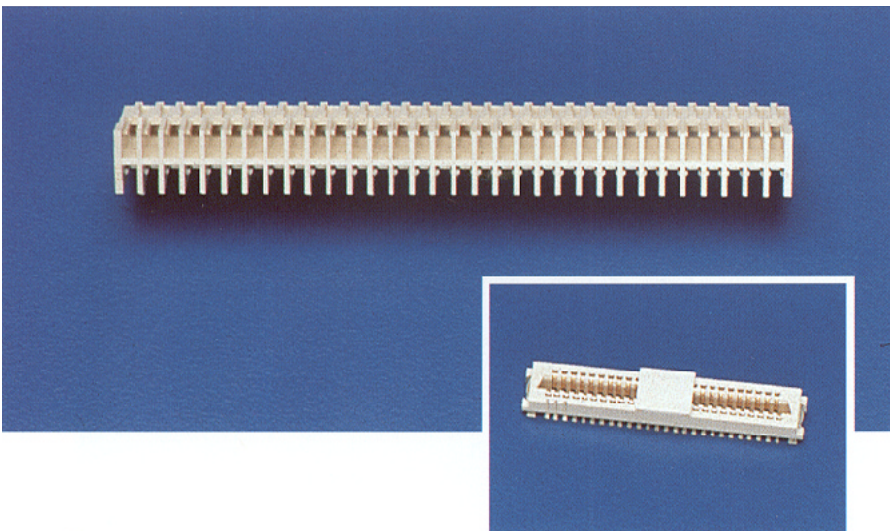
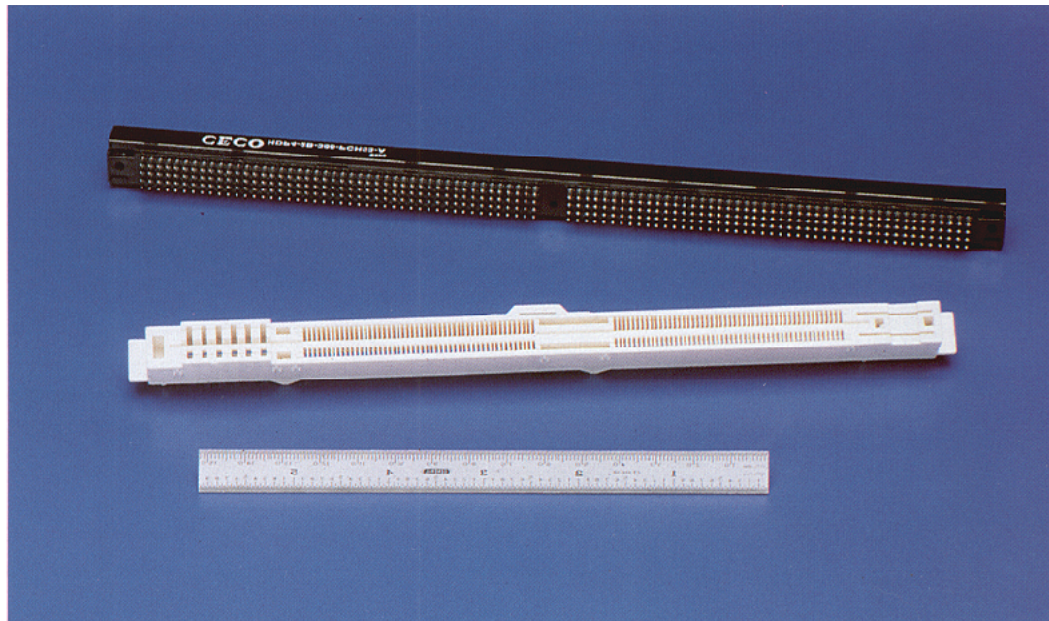
Coil forms gain precision, temperature resistance with Zenite™ LCP. With the dimensional stability and strength of Zenite™ LCP, compact coil forms gain precise coplanar positioning and excellent retention for pins. During SMT and conventional soldering, the high temperature properties of Zenite™ LCP help the forms resist deformation and pin drift. These forms require less board space than thermoset forms yet provide the same winding space because Zenite™ LCP provides much greater toughness in thin sections. Manufacturer: United Technical Products.

Automotive connectors stand up in rough service. Molded from Crastin® PBT thermoplastic polyester resin, these electrical receptacles have what it takes to perform under-the-hood: high-temperature resistance, strength, and fast, easy molding to keep costs in line. Integrally molded snap-fit features simplify assembly. Manufacturer: AMP.



Snap-fit toughness plus solder-temperature resistance. Molded from Zytel® HTN high temperature nylon resin, the frame on this optical sensor array combines toughness and strong weld lines to permit snap-fit assembly. The parts are wave soldered at 160°C and are compatible with SMT processes. Manufacturer: PMC.

Long fill, precision pin positioning. Crastin® PBT keeps contacts precisely positioned and flows easily for consistent fill of molds for headers up to 15 in. (381 mm) long and board edge connector bodies. Thanks to the strength, stiffness and toughness of Crastin® PBT, contacts remain accurately positioned through many insertion cycles. Manufacturers: header, CECO; board edge connector, T & B.



Intricate, thin-wall precision. In molding intricate connector bodies, Zenite™ LCP liquid crystal polymer resin consistently fills molds through extremely thin sections, only 0.22 mm (0.009 in.) thick in the case of the microminiature connector at the lower right. And because Zenite™ LCP has better combination of melt stability and HDT than other LCP's we've evaluated, there is more time/temperature latitude for SMT assembly without blistering. Manufacturers: top, AMP; inset, Berg Electronics.

DuPont Engineering Plastics For Electronic Components

DuPont offers materials tailored for fast molding cycles, warp resistance, good melt flow to fill small features and other performance characteristics crucial to efficient molding of electronic components.

Zenite™ LCP liquid crystal polymer resin

New Zenite™ LCP is an excellent choice for connectors, coil forms for board-mounted inductors and other components that must withstand SMT soldering temperatures. Its versatility in performance and molding allows Zenite™ LCP to replace several materials and gain the benefits of inventory reduction.

Compared with other LCPs, Zenite™ LCP offers a unique combination of exceptional flow, high heat deflection temperature, and high toughness, impact and fatigue resistance. Zenite™ LCP meets requirements for a V-0 rating under UL 94 without flame retardants.

Zenite™ LCP offers excellent chemical and solvent resistance, and it provides outstanding dimensional stability, thanks to its low coefficient of thermal expansion.

Zytel® HTN high temperature nylon resin

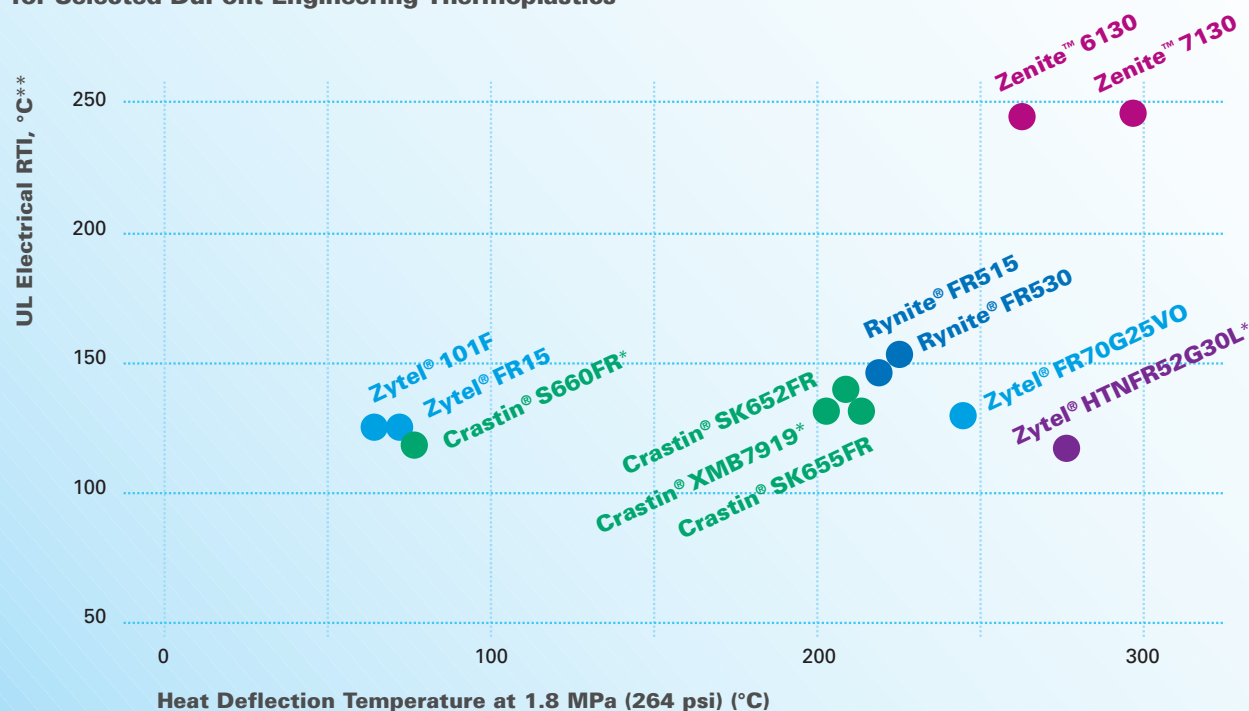
New Zytel® HTN provides strength, toughness, and resistance to SMT temperatures for connectors, coil forms and other components.

With good high-temperature stiffness and low creep, Zytel® HTN fills the price/performance gap between standard engineering plastics such as thermoplastic polyesters or conventional nylons and Zenite™ LCPs.

Zytel® HTN provides very good high-temperature electrical performance and broad chemical resistance. HTN's dimensional stability is excellent, much better than that of standard nylons. The product line includes toughened, glass-reinforced and flame-retarded, UL 94 V-0 grades.

Figure 1:

Electrical Relative Thermal Index (UL 746B) vs. Heat Deflection Temperature (ASTM D648) for Selected DuPont Engineering Thermoplastics



*Based on minimum anticipated RTI value.

**Refer to UL yellow cards for thickness and color recognition for each product.

Rynite® PET thermoplastic polyester resin

Rynite® PET is widely used for coil forms for transformers, relays and solenoids and for relay cases. It provides resistance to through-hole soldering conditions, with high strength, stiffness and thermal and dimensional stability.

Rynite® PET is also ideal for encapsulation. Unlike many thermosets used for encapsulation, Rynite® PET emits practically no volatile organic compounds (VOCs) during processing, and production cycles are faster.

Grades of Rynite® PET are designed for specific application benefits. All grades are reinforced with glass fiber, and some have both glass fiber and mineral reinforcement. Several grades offer UL 94 V-0 ratings.

Crastin® PBT thermoplastic polyester resin

New Crastin® PBT is well suited for molding connectors, headers, switches and fuseholders. It provides stiffness, toughness, low long-term creep, low warpage, excellent electrical insulating properties and resistance to moisture and solvents and good melt flow. Crastin® PBT withstands through-hole soldering conditions. Parts have excellent surface appearance.

Components molded from Crastin® PBT have a high degree of dimensional stability, an asset for connectors requiring maintenance of close tolerances.

Both unreinforced and glass-reinforced grades are available with properties tailored specifically for electronic applications including enhanced toughness, and resistance to arc tracking. UL 94 V-0 recognized resins are available.

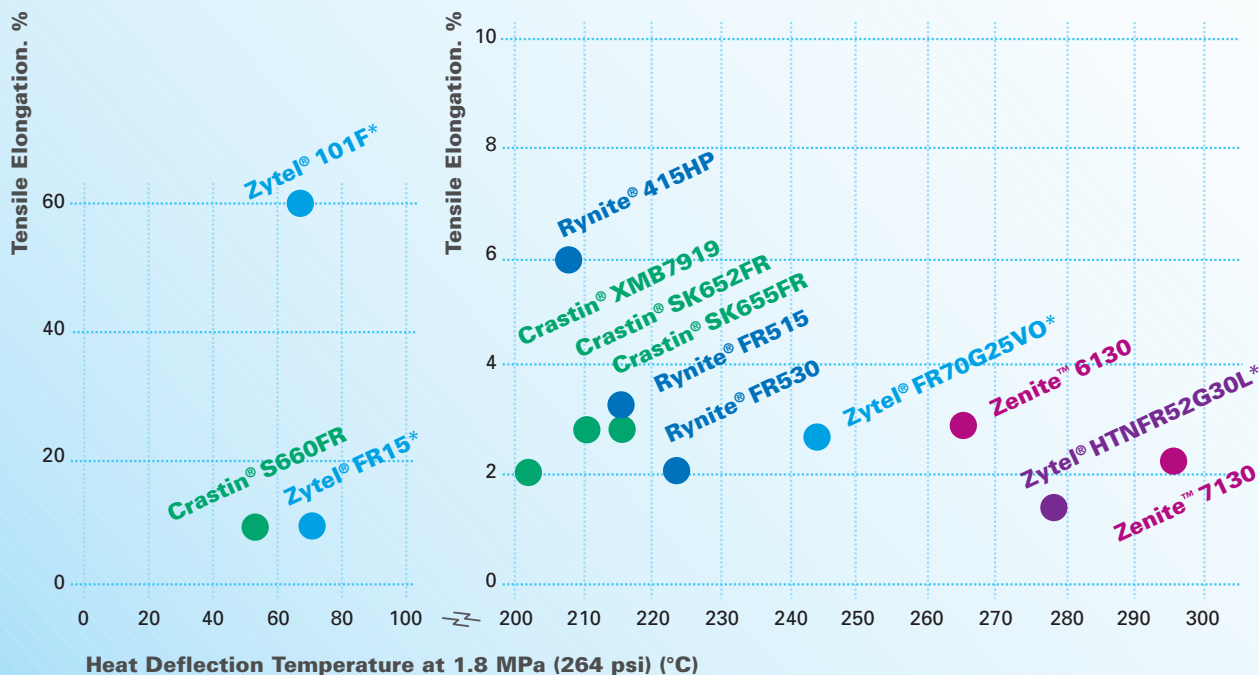
Zytel® nylon resin

Zytel® is a proven material for connectors, terminal block housings, coil forms and other components. Parts withstand through-hole soldering processes.

With the toughness and abrasion resistance of Zytel®, components resist damage during assembly operations and use. Performance-tailored grades have been developed to meet needs for electronic components. These include flame-retardant V-0 materials containing no halogenated additives. Other grades offer increased heat stability and/or impact resistance. Both unreinforced and glass- and/or mineral-reinforced resins are available.

Figure 2:

Tensile Elongation (ASTM D 638) vs. Heat Deflection Temperature (ASTM D 648) for Selected DuPont Engineering Thermoplastics



*Dry as molded.

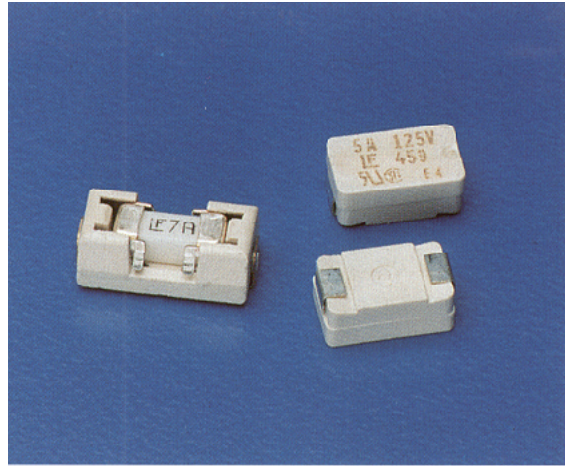
Table 1:

Properties of Typical DuPont Engineering Thermoplastics for Electronic Components

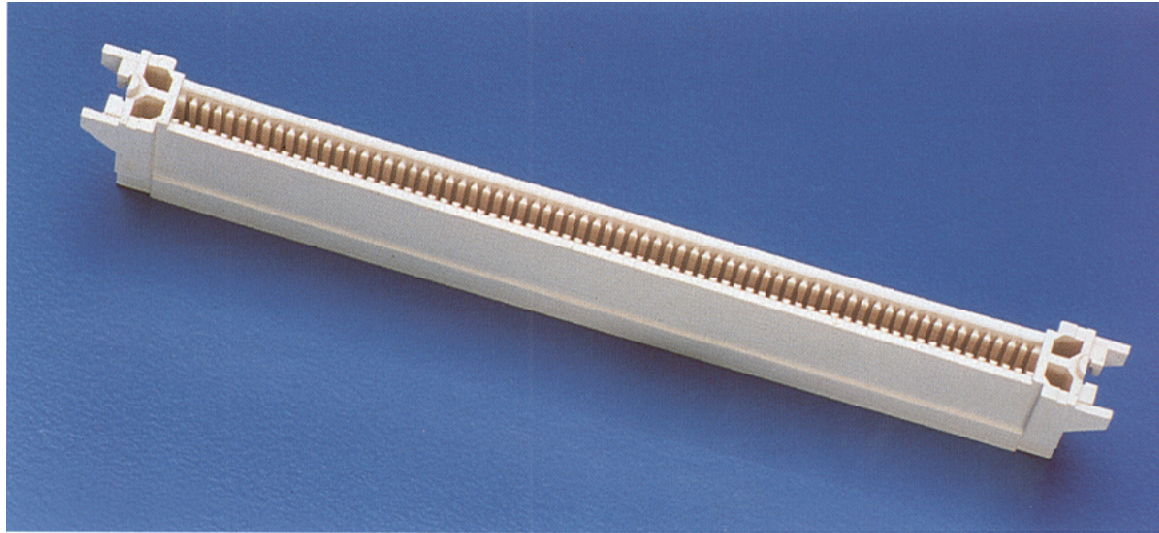
			TENSILE STRENGTH	ELONGATION AT BREAK	FLEXURAL MODULUS	HEAT DEFLECTION TEMP.	MELTING POINT	FLAMM- ABILITY
Test Methods and Conditions			ASTM D 638 23°C (73°F)	ASTM D 638 23°C (73°F)	ASTM D 790 23°C (73°F)	ASTM D 648 1.8 M Pa (264 psi)	ASTM D 3814	UL-94 ^C
Grade	Description/Units		MPa (kpsi)	%	GPa (kpsi)	°C (°F)	°C (°F)	
Zenite™ LCP	6130, 6130L	Excellent toughness, superior flow, 30% glass	125 (18.2)	2.7	12 (1700)	265 (509)	335 (635)	V-0
	7130	Excellent toughness, higher HDT, 30% glass	145 (21.0)	2.2	13 (1800)	295 (563)	352 (666)	V-0
Zytel® HTN ^b	FR52G30L	High-temperature nylon, flame-retarded, 30% glass	145 (21.0)	1.6	10.3 (1490)	278 (532)	310 (590)	V-0
Crastin® PBT	SK652FR	Good flow, impact resistance, flame-retarded, 15% glass	98 (14.2)	2.4	6.2 (900)	210 (410)	225 (437)	V-0
	SK655FR	Good flow, impact resistance, flame-retarded, 30% glass	141 (20.5)	2.4	9.6 (1400)	215 (419)	225 (437)	V-0
	S660FR	Flame-retarded, unreinforced	52 (7.5)	10	2.7 (390)	53 (127)	225 (437)	V-0
	XMB7919 ^a	Good dimensional stability, low warpage, flame-retarded 30% glass and mineral	88 (12.8)	2.0	10.3 (1500)	203 (397)	225 (437)	V-0
Rynite® PET	FR515	Excellent balance of electrical and mechanical properties, flame-retarded, 15% glass	107 (15.5)	2.6	5.9 (850)	215 (419)	254 (489)	V-0
	FR530	Outstanding properties, excellent flow, flame-retarded, 30% glass	138 (20.0)	2.1	10.3 (1500)	224 (435)	254 (489)	V-0
	415 HP	Fast processing, superior combin- ation of toughness and stiffness, 15% glass	79 (11.5)	6.0	3.6 (525)	207 (405)	250 (482)	HB
Zytel® Nylon ^b	101L/F	Fast molding, general purpose, unreinforced	83 (12.0)	>50	2.8 (410)	65 (149)	263 (505)	V-2
	FR15	Unreinforced, high flow, non-halogenated flame retardant	85 (12.3)	10	3.4 (500)	70 (158)	263 (505)	V-0
	FR70G25VO	Heat-stabilized, flame-retarded, 25% glass	138 (20.0)	2.3	8.0 (1160)	243 (470)	263 (505)	V-0

^a Preliminary data.
^b Mechanical properties measured with test specimens dry as molded.
^c This small-scale test does not indicate combustion characteristics under actual fire conditions.
Refer to UL yellow cards for each product for thickness and color recognition.

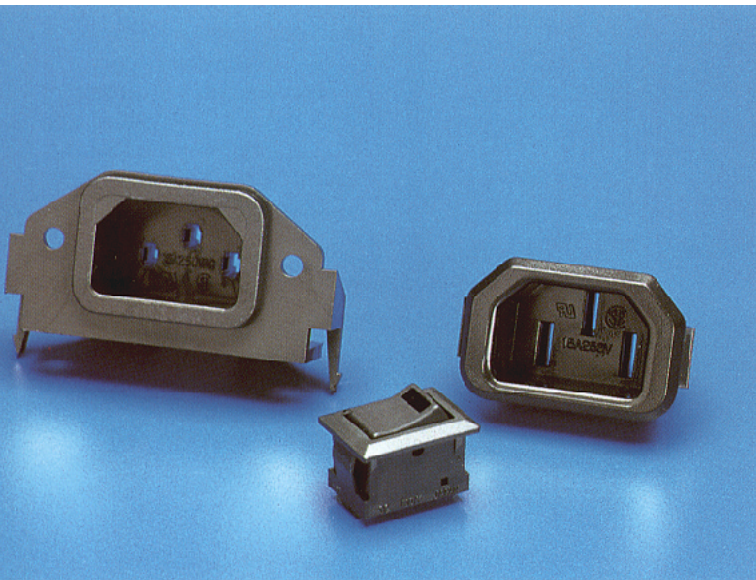
Fuse components withstand SMT processes. This fuse holder is molded in Zenite™ LCP, and the glass fuse is encapsulated in the same material. They can be directly soldered on boards, due to the thermal resistance of Zenite™ LCP. For the fuse holder, the LCP resin provides toughness and strength to grip fuses and resist breaking when fuses are changed. Manufacturer: Littelfuse.



Molding productivity, precision, solder assembly. For this board-mounted connector, Zenite™ LCP meets Molex's exacting requirements for high-speed molding, low warpage, part tolerances as close as 38 microns (0.0015 in.) and precise coplanar pin positioning. Manufacturer: Molex.



Tough parts, fast molding cycles. Exposed on the outside of business machine housings, these power connectors and this switch are engineered to take a beating. They're molded from tough, flame-retarded grades of DuPont Zytel® nylon resins. In addition to withstanding rugged use, they comply with electrical safety norms and meet Eko E/E's profit objectives with fast molding cycles and low mold deposit for minimum downtime. Manufacturer: Eko E/E.



There's a DuPont Engineering Thermoplastic To Meet Almost Any Molding Requirement

DuPont has designed its engineering thermoplastics for molding efficiency and versatility as well as exceptional end-use performance. Figure 3 shows melt flow vs. injection pressure for typical DuPont plastics.

Zenite™ LCP: Zenite™ LCP has outstanding melt flow to fill thin sections and small features that are difficult or impossible to mold with other materials. Good flow also allows lower molding pressures, a key factor in avoiding molding flash. Runners and sprues can be reground in the shop and recycled with virtually no loss of performance. Zenite™ LCP typically molds components at lower injection pressures, so it can provide faster, more productive molding cycles than other LCPs.

Zytel® HTN: This high-temperature nylon is easier to mold than many other high-temperature materials. It has excellent flow and melt stability.

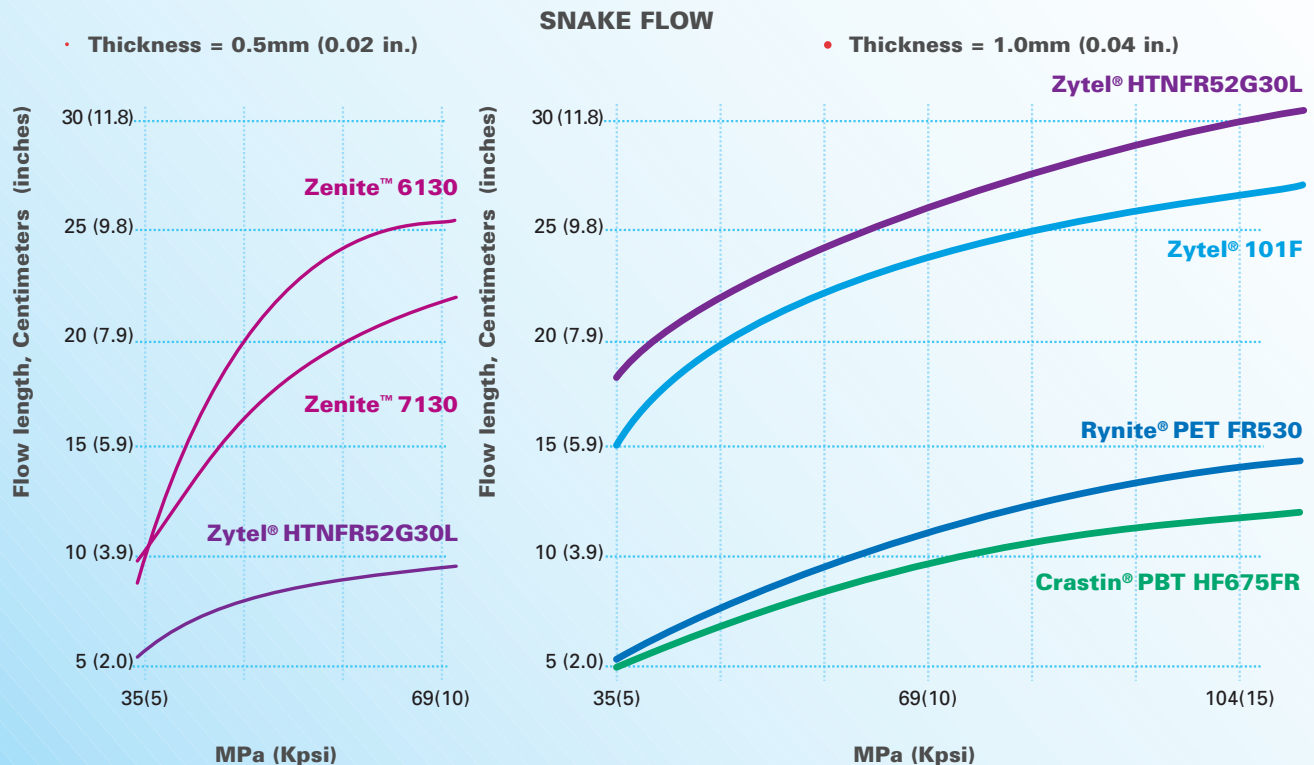
Rynite® PET: With excellent melt flow, Rynite® PET is a good choice for molding fine details and thin sections with close tolerances. Its rapid crystallization allows very fast molding cycles. Grades featuring low warp are available.

Crastin® PBT: With excellent melt flow, Crastin® PBT molds well in thin sections and with short cycle times, and long cavities fill completely. The resin's molding performance is highly consistent for superior yields. It has good thermal stability.

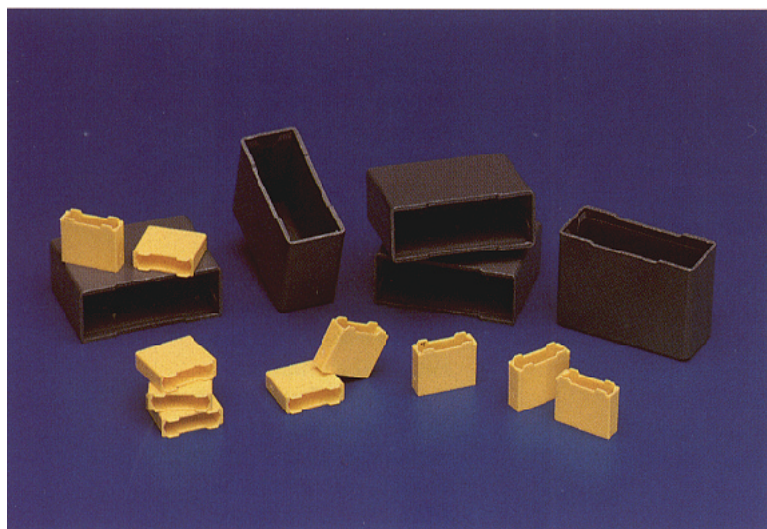
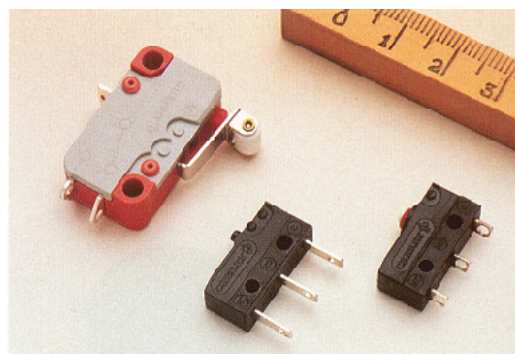
Zytel®: Special grades provide faster molding cycles and additional desirable molding characteristics. Lubricated grades provide improved machine feed and mold release performance.

Figure 3:

Melt Flow vs. Injection Pressure for Typical DuPont Engineering Thermoplastics.

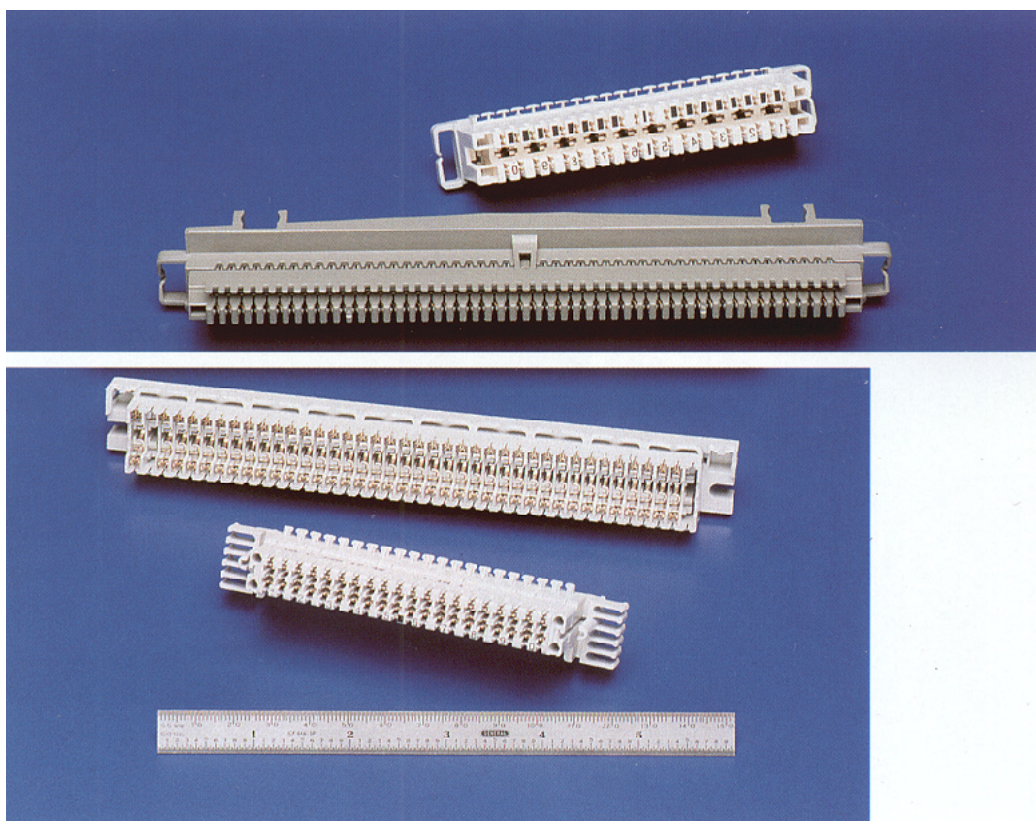


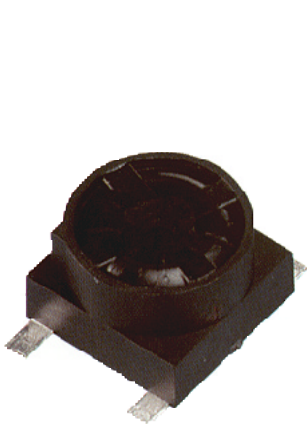
Molds last longer with Rynite® PET. For these microswitches, non-corroding Rynite® PET thermoplastic polyester replaced another material with additives that attack molds. Rynite® also helps meet requirements for arc-tracking resistance and 150°C service temperatures. Manufacturer: Cherry.



Thin-wall capacitor cases. Made with fast-molding grades of Crastin® PBT, these capacitor cases are right on target for dimensional tolerances and more. The resin also provides the required dielectric properties, resistance to board cleaning chemicals, toughness and strength. Manufacturers: yellow cases, Thomson; green cases, Rodenstain; gray cases, Arcotronics.

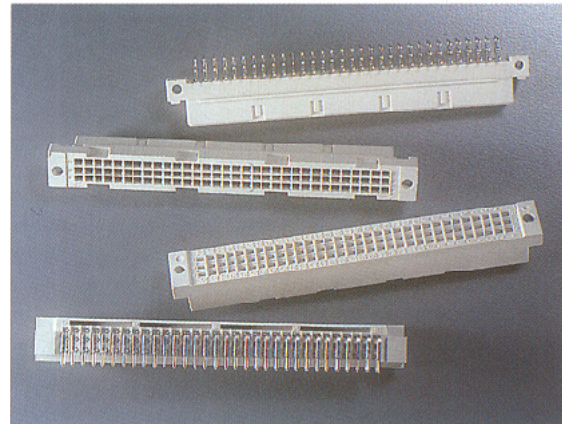
Network connection blocks gain precision with Crastin® PBT. For termination blocks for voice and data networks, Crastin® PBT provides precision, thin-wall molding for compact high-density components. The resin's dielectric properties allow designs that meet industry standards for use in high-speed data systems, and formulations are available that meet UL 94 V-0 requirements. Manufacturers: units at top, Krone; bottom parts, Quante.





Zytel® improves toroid encapsulation.

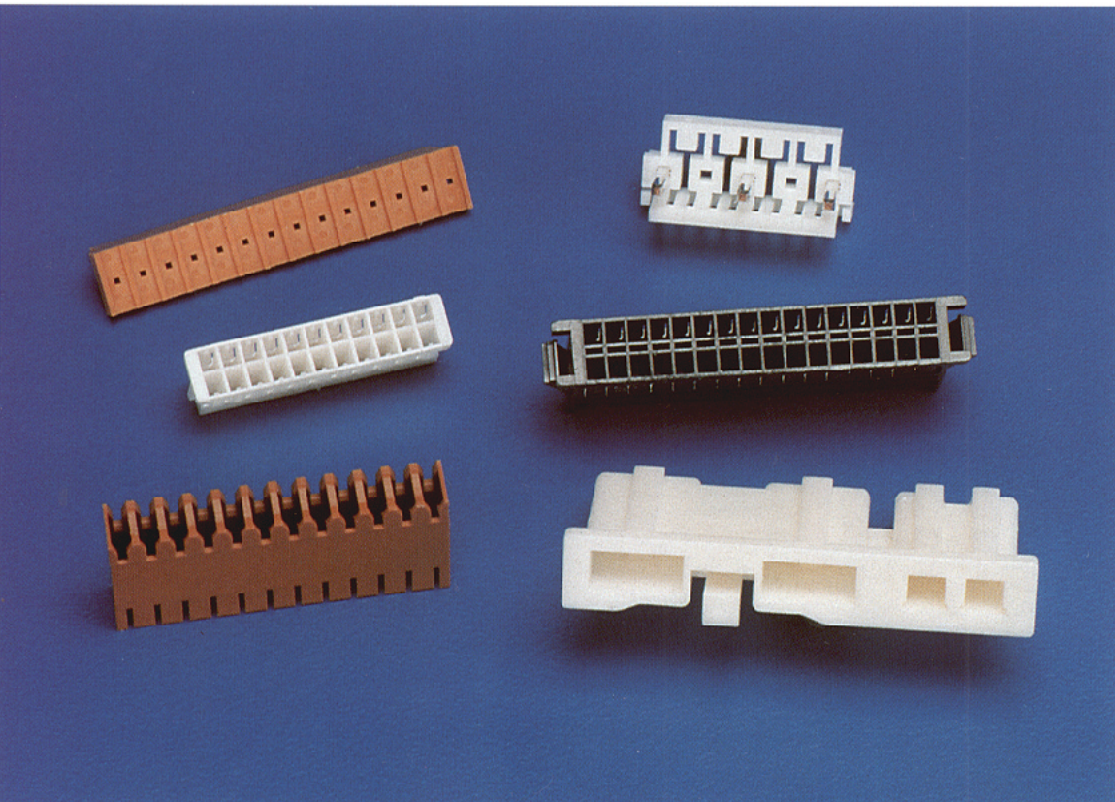
Small toroidal choke coils for power filtering applications are encapsulated in Zytel® for protection. Compared with thermoset encapsulation, Zytel® offers lower costs, much shorter cycle times, recycling of sprues and runners and virtual elimination of volatile organic compound (VOC) emissions during processing. The manufacturer reports that the encapsulated coils can be soldered to boards using surface-mount processes. Manufacturer: Standex Electronics.



Crastin® PBT consistently fills intricate features.

These DIN connectors have sections as thin as 0.012 in. (0.3 mm), and the connectors are 95 mm long.

Unlike other PBT resins evaluated, Crastin® PBT consistently fills the connector tool's thin, intricate areas. The grade of Crastin® PBT selected has a UL94 V-0 rating, a key requirement for these connectors. Manufacturer: ERNI Components, Inc.



High molding productivity in FR nylon.

Video connector at lower right and board-mounted connectors shown are all molded from flame-retarded grades of Zytel® nylon. In addition to meeting electrical safety requirements, the resins provide the high melt flow needed for rapid molding with complete filling of small features.

**Put DuPont Engineering
Polymers to Work for You**

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