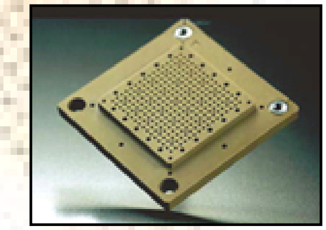
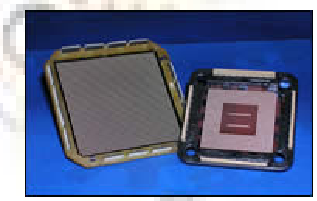
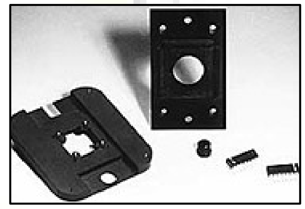
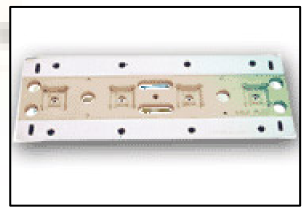
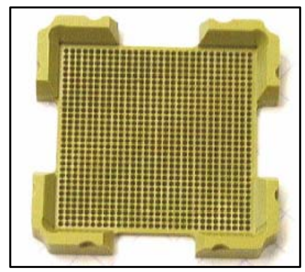






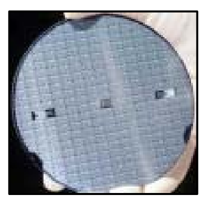




PROFESSIONAL PLASTICS, INC.

The Nation's Largest Supplier of High-Performance Engineering Materials

High-Performance Materials for IC Test Sockets, Nests & Boards



QUADRANT

SAINT-GOBAIN
PERFORMANCE PLASTICS

Next-generation chips have an ever-shrinking footprint in which to synchronize memory, logic, and digital signal processing. Fine-pitch semiconductor devices are the engines for giving cell phones and personal digital assistants more bells and whistles. As the market gravitates toward denser arrays and smaller IC packaging, designers of burn-in and test sockets (BiTS) must incorporate new materials to support pitch requirements of 0.5 mm and finer.

Sockets are critical to the back-end testing of finished and semifinished chips under a variety of highly stressed burn-in conditions. For example, failure testing can be accelerated by continually baking the devices in a 150°C (302°F) oven, then exhaustively testing them under these adverse conditions. (Newer protocols involve simultaneous baking and functional testing to save time and reduce costs.)

In other inspection testing, wafers and devices cycle through test fixtures where their circuits are probed and verified. Here environmental conditions can range from -55 to 155°C (-67 to 311°F). The rapid and continuous insertions and removals involved place extreme mechanical demands on the socket so that dimensional stability, wear, and compression all become issues. If the dimensional stability of the BiTS substrate is not sufficient, the holes can become misaligned with the pins of incoming devices, a situation that will quickly create havoc. Built-in stress, moisture absorption, and temperature changes are two leading causes of BiTS movement.

Material options

Many pragmatic factors bear on the selection of material from which to fabricate a socket. This is especially true for the more demanding requirements imposed by smaller and smaller pitch geometries as are common in MPU's and video graphics.

For many years, a primary material of choice for test sockets has been polyimide. This material offers excellent stability, wear rates, and electrical performance across a broad temperature range. At one time, virtually all BiTS were made from polyimide (typically Vespel SP-1). Today, Professional Plastics offers a full-line of polyimide shapes used for back-end testing applications including; Vespel ® SP-1, Meldin ® 7001, Plavis ®-N, Duratron®, and Cirlex ® laminated polyimide. These new options may provide costs and yield improvements which could make polyimide a viable option for certain applications.

If the socket will be used for burn-in, it obviously must have long-term thermal stability to maintain mechanical, electrical, and dimensional properties. The first two are given by data such as continuous-use temperature rating (CUTR), which indicates the maximum temperature at which a plastic will maintain tensile strength and electrical properties after 100,000 hr. These data may be found in sources such as the UL Yellow Card listing.

For a test socket, the temperatures are usually not as high nor are the durations of exposure as long. Here, factors such as coefficient of linear thermal expansion (CLTE) predict the amount of expansion and contraction expected from temperature changes. If the tolerances are extremely tight, the closer this value is to that of the silicon wafer or chip, the more accurately the hole alignment, which can be maintained. The CLTE may or may not be linear over all temperature ranges, especially crystalline materials where it increases at the glass-transition temperature (Tg).

Devices can be pressed onto the surface of the socket with a significant amount of force. So it's best to use a substrate with high compressive strength to better resist the spot pressures and minimize the formation of grooves. Dynamic mechanical analysis (DMA), a technique that measures the modulus as a function of temperature, shows that the modulus for a crystalline polymer (PPS, PEEK) drops significantly at the Tg whereas amorphous polymers (PEI, PAI, PI, or PBI) exhibit more linear change through higher temperatures.

The addition of reinforcing glass or carbon fibers improves both the CLTE and DMA data for crystalline materials, more so than for amorphous ones. Cleanliness of the materials is also important as much of the testing takes place in clean rooms. Candidate BiTs materials must have minimal particle generation and outgassing at elevated temperatures.

PAI boasts the highest strength to 260°C (500°F) and is dimensionally stable with a CLTE of 1.7×10^{-5}. It maintains 70% of its flexural strength when tested at 150°C (300°F).

Both PPS and PEEK are crystalline-advanced engineering polymers. PPS has strength combined with good heat and chemical resistance (no known solvents below 200°C (392°F). PPS absorbs essentially no moisture and has a low CLTE. PEEK offers chemical and hydrolysis resistance similar to PPS, but can operate at higher temperatures. Its continuous-use temperature is 250°C (480°F). However, the stiffness of all PEEK grades drops off significantly and expansion rate increases above its T_g of 150°C (300 °F).

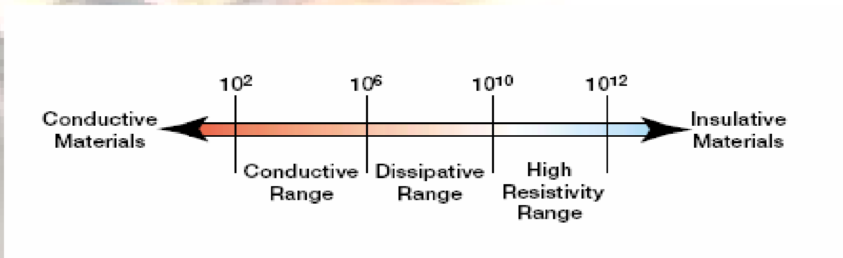
New high-density chips can also be quite sensitive to static charge. The socket material must not generate static charges and must safely dissipate any incoming static without destructive discharges.

A static dissipative PEI family called Semitron ESd has good mechanical performances to 275°C (525°F), can dissipate static charges of 5 kV in less than 2 sec, and has low molded-in stress which gives machined parts tight tolerances. There are several grades of Semitron ESd materials, whose choice depends on the combination of surface resistivity and required temperature.

Designers of semiconductor consumables are relying more and more on advanced machinable plastics to put 0.5-mm and finer-pitch ICs through their paces during back-end testing. One of the key properties for test sockets devices is ESd protection. Also important is mechanical strength, plus dimensional stability over the full range of temperature and environmental conditions. These properties let materials withstand significant insert loads over –65 to 311°F, a typical requirement for test sockets. Although the initial targets were higher, most fabs now want the surface resistivity to be between 1 X $10^6$and 1 X 10^9Ω/sq to provide decay rates of <0.1 sec. This helps ensure that the device will not be damaged by stray discharges during movement and testing in a socket.

In addition to polyimide, there are a wide variety of unfilled and glass-fiber-filled materials which have proven as successful alternatives & which provide solutions of their own. Torlon PAI (polyamide-imide) thanks to the latter's lower coefficient of linear-thermal expansion (CLTE) is one such material. Lower CLTE gave the sockets better dimensional stability, longer wear, and lower cost. Professional Plastics offers two proven PAI solutions: Torlon ® 4203 (unfilled PAI), and Torlon ® 5530 (30% glass-filled PAI). In addition to these materials, we offer alternatives when costs is a more primary factor than maximum top-end performance. These material options include: Ultem ® 1000 (unfilled polyetherimide), Ultem® 2300 (30% glass-filled polyetherimide), PEEK 450 (unfilled polyetheretherketone), PEEK GF30 (30% glass-filled polyetheretherketone), and PEEK CF30 (carbon-filled polyetheretherketone).

The newest generation test sockets have added protection from static discharge by incorporating new static-dissipative (ESD) materials. From a material standpoint, ESD protection is usually discussed in terms of surface resistivity and/or discharge rates. Surface resistivity (for electric current flowing across a surface) is the ratio of dc voltage drop per unit length to the surface current per unit width. It in effect is the resistance between two opposite sides of a square and is independent of the size of a square or its dimensional units. Surface resistivity is expressed in Ω/square.



Using the CLTE, engineers can predict how much expansion and contraction to expect during testing in test sockets used to evaluate 0.5-mm-pitch ICs. The extremely tight tolerances needed for the 0.5-mm-pitch ICs dictate socket materials have a CLTE close to that of the silicon chip. That's because the closer the CLTE match, the more accurately holes in the socket stay lined up during testing at temperature extremes.

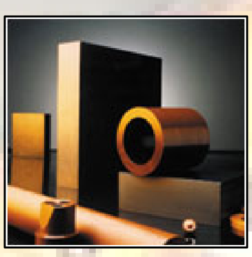
In some environments where humidity is high and poorly controlled, some polymers see a lot of dimensional change due to moisture absorption. It's too much for small, high precision parts such as sockets. This is particularly true for test sockets used in testing next-generation fine-pitch chips. We offer several new grades of low-moisture-absorbing materials. These materials offer ESD protection at least equivalent to current ESD materials and are dimensionally stable over the entire temperature range (–65 to 311°F).

Semitron ESd 420V, is based on PEI (polyetherimide). Its proprietary reinforcement technology provides high strength and stiffness to withstand high chip-insertion forces with no deflection. It also improves upon the overall stability of Quadrant's current PEI-based ESD materials and offers surface resistivity of 1 X $10^6$and 1 X 10^9Ω/sq. With a heat-deflection temperature of 420°F, the material provides a more cost-effective, high-strength alternative to other ultra-high-temperature resistant materials.   Furthermore, unlike crystalline materials in which the CLTE rises two to threefold at the glass-transition temperature, Semitron ESd 420V maintains its low CLTE to over 400°F. This is a significant advantage in maintaining dimensional stability and mechanical strength of a test socket throughout the full test temperature range.

In addition, the company has developed a new reinforced PEEK (polyetheretherketone) called Semitron ESd 480. The material also has a surface resistivity of 13 $10^6$and 1 X 10^9Ω/sq, but its heat-deflection temperature is 480°F. Its chemical resistance makes it suitable for wafer handling and other structural applications in wet process tools where static dissipation is important.

A major advantage of Semitron ESd 420V and 480 is that they maintain their dielectric performance even after repeated exposures to high voltages. In contrast, other typical carbon-fiber-enhanced products suffer dielectric breakdown and become irreversibly more conductive when exposed to moderate voltage. Thus they can't ensure continued ESD protection to the wafer or device. The new materials are also nonsloughing, and thus minimize contamination. This makes them ideal for machined nests, sockets, and contactors for test equipment and other electronic device handling and testing components.

* Note: Portions of the information contained herein are provided courtesy of Quadrant EPP



Vespel ® SP-1 Polyimide

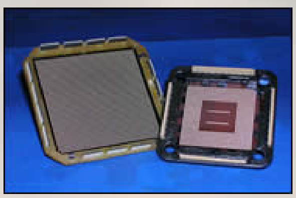
Vespel ® SP-1 polyimide offers a combination of temperature resistance, chemical resistance, mechanical toughness, natural lubricity, wear-resistance and insulation properties. This material provides operating temperatures from cryogenic to 300°C (570°F), great plasma resistance, plus a UL rating for minimal electrical and thermal conductivity. Vespel® SP-1 is the unfilled base resin grade. SP-1 provides maximum physical strength, elongation, and toughness as well as the best electrical and thermal insulation values. Vespel in manufactured in plates up to 10" x 10".

Meldin® 7001 Polyimide

A thermosetting polyimide, Meldin® 7001 is made from the unfilled base resin. This grade offers the maximum mechanical properties and high chemical resistance. Meldin® 7001 is ideal for electrical and thermal insulating applications. More ductile than ceramics, and lighter weight than metals. This polyimide material is formed using high-pressure mold presses, automatic resin-feeding systems, and computer-controlled hydraulics. Meldin 7001 series features operational temperatures of up to 600ºF for continuous operation and 900ºF for intermittent exposure, and tight tolerances of ±0.001 in. This product is produced in plates as large as 2" x 12" x 12" for maximum yields

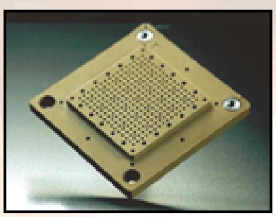
Protomid® S1 Polyimide Shapes

Protomid ® polyimide shapes provide superior high-temperature resistance, excellent wear and friction properties, good electrical and physical properties, and chemical inertness. Protomid® polyimide delivers outstanding resistance to creep and lubricated or unlubricated performance, ultra-low outgassing, excellent mechanical strength and impact resistance. Protomid® offers superior tensile strength and flexural modulus of temperature, and due to its outstanding creep resistance at high temperature, applied where very high temperature and excellent wear property is required. Available in direct-formed blanks 3.93" x 3.93" (note: mechanical properties of DF blanks may vary slightly from chart below)



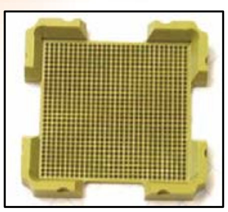
Cirlex® Laminated Polyimide Film

Cirlex® is an all-polyimide sheet material that offers material flexibility and an expanded range of thickness options unattainable with cast resins or laminated constructions using adhesives. Offering the excellent chemical, physical, thermal and electrical properties of Kapton® in thick sheet format is unique in today's material marketplace. Traditional laminates are notoriously unreliable at temperatures which exceed the Glass Transition (Tg) of the adhesives used in their constructions. You can count on Cirlex®'s integrity at extreme temperatures, from cryogenic [-269°C (-452°F)] to as high as 351°C (664°F); and it is readily modified/machined by laser cutting, drilling, machining and chemical etching.



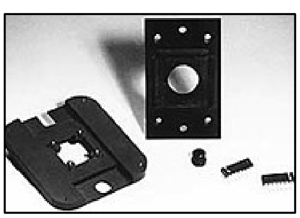
Sumika Super S1000

Sumika Sumika Super S1000 is a wholly aromatic polyester material that offers high temperature performance and dimensional stability. This material is commonly used for PolyBGA adapters used for testing of integrated circuits. S1000 has an operational temperature of 260° C and thermal resistance far exceeding that of other conventional engineering plastics. This material will not melt down or deform its shape even at 400° C. It is easy to process (milling, drilling) and it is a suitable material for manufacturing parts requiring tight tolerances. Sumika S1000 has a moisture resistance ten times greater than polyimide. It maintains dimensional stability even when exposed to moisture



Torlon ® 4203

Torlon® 4203 polyamide-imide offers excellent compressive strength and the highest elongation of the Torlon® grades. It also provides electrical insulation and exceptional impact strength. This grade is commonly used for electrical connectors and insulators due to its high dielectric strength. Testing integrated circuits is becoming increasingly complex, as the gaps between the fine wires and pins are incredibly small. Torlon 4203 displays the outstanding strength and dimensional stability to provide extended part life. This materials offers low CTE, high machinability, and excellent wear resistance.

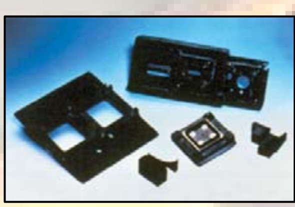


Torlon ® 5530

In addition to strength and dimensional stability, Torlon® 5030 is electrically insulative. It has exceptional dielectric strength- over 800-volt/ mil. It offers best- in- class radiation resistance, withstanding exposure to 10 x 9th rads*. Close tolerance components are produced from 5030 for its' excellent dimensional stability. By retaining dimensional stability over a broad temperature range, parts made from Torlon 5530 improve reliability of test connections and extend part life. Torlon 5530 is insulative with a surface resistivity of > 10^{13} Ω/sq

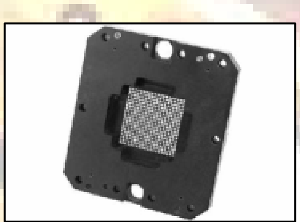
Techtron® PPS

Techtron® PPS offers the broadest resistance to chemicals of any advanced engineering plastic. They have no known solvents below 392°F (200°C) and are inert to steam, strong bases, fuels and acids. Minimal moisture absorption and a very low coefficient of linear thermal expansion, combined with stress-relieving manufacturing, make PPS ideally suited for precise tolerance machined components. Sockets made from Techtron ® PPS are used during high-power/ high-speed testing of semiconductor packages.



Semitron ® ESd 410C - Conductive Ultem ®

Semitron ESd 410C (black) – static dissipative/conductive PEI. Having an excellent mechanical performance up to 210°C, Semitron ESd 410 provides ESd- solutions at higher temperatures. This material has a surface resistivity of 1 X 10^4 and 1 X 10^6 Ω/sq. Additionally, Semitron ESd 410 exhibits excellent dimensional stability (low coefficient of linear thermal expansion and small water absorption), ideal for handling equipment in the electrical/electronic or semiconductor industries. Semitron ESd 410C is conductive with a surface resistivity of 10^4 1 - 10^6 Ω/sq



Semitron® ESd 420 - ESd PEI (Ultem)

Semitron® ESd 420 - Static Dissipative PEI is the only, truly dissipative plastic product for use in high temperature applications. ESd 420 has a unique combination of properties: static dissipation, low coefficient of expansion, high strength and heat resistance and is non-sloughing. ESd 420 has a tensile modulus of 550,000 psi, a heat deflection temperature (at 264 psi) of 420°F, and a surface resistivity in the intermediate range of 1 X 10^6 and 1 X 10^9 Ω/sq. Semitron® ESd 420 is also ideal for use in equipment for handling components in the hard-drive manufacturing and assembly processes. Also available in **Semitron® ESd 420v - ESd PEI (Ultem)** resistivity target range of 1 X 10^6 and 1 X 10^9 Ω/sq. Unlike crystalline materials in which the CLTE rises two to threefold at the glass-transition temperature, Semitron ESd 420V maintains its low CLTE to over 400°F. This is a significant advantage in maintaining dimensional stability and mechanical strength of a test socket throughout the full test temperature range.

Semitron® ESd 480 ESd PEEK

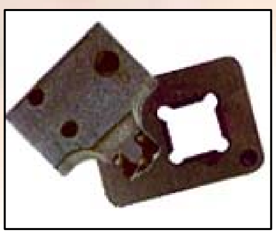
Semitron® ESd 480 is static-dissipative, carbon fiber reinforced PolyEtherEtherKetone for use where the properties of PEEK are needed, but protection from static discharge is a requirement. This material is available in sheets and rods and is black in color.
Semitron ESd 480 has a surface resistivity of 1 X 10^6 and 1 X 10^9 Ω/sq, but its heat-deflection temperature is 480°F. Its chemical resistance makes it suitable for wafer handling and other structural applications in wet process tools where static dissipation is important. CLTE is 1.7 X 10*–5 in./in./°F

Semitron® ESd 490HR ESd PEEK

Semitron® ESd 490 is a slightly higher temperature PEEK based material that offers similar physical poperties as Semitron ESd 480 and a surface resistivity of 1 X 10^9 and 1 X 10^{11} Ω/sq

Semitron® ESd 500HR - ESd PTFE

Semitron ESd 500HR (white) – static dissipative PTFE Reinforced with a proprietary synthetic mica, Semitron ESd 500HR offers an excellent combination of low frictional properties, good dimensional stability and electrostatic dissipation. Whenever virgin PTFE causes electrical discharge problems, Semitron ESd 500HR will provide a controlled bleed-off of static charges while maintaining typical PTFE-properties such as broad chemical resistance and low coefficient of friction.

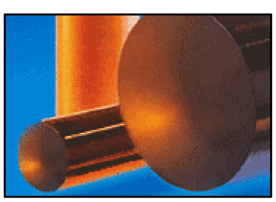


Semitron® ESd 520HR - ESd PAI

Semitron® ESd 520HR has an industry first combination of electrostatic dissipation (ESd), high strength and heat resistance. This new ESd material is ideal for making nests, sockets and contactors for test equipment and other device handling components. The key features of 520HR are its unique ability to resist dielectric breakdown at high voltages (>100V). Typical carbon fiber enhanced products become irreversibly more conductive when exposed to even moderate voltage.
Semitron ESd520HR has a surface resistivity of 1 X 10^{10} and 1 X 10^{12} Ω/sq

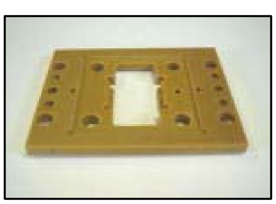
Profine® Test Socket Plate (specially-filled PPS)

Profine® Test Socket Plate boasts excellent dimensional stability and is specially designed for precision hole drilling. Producing holes with a diameter of several tens of micron in conventional engineering plastics is associated with various problems caused by the flash, the need for post processing, probe pin errors, and other factors. So far, only a limited number of wholly aromatic polyester resigns could be used for plates and other parts requiring ultra fine holes. Special resin treatment and proprietary molding technology make Profine is a super engineering plastic that largely eliminates flash related problems during precision machining. Consequently, there is now a wider choice of materials for applications requiring ultra-fine precision holes.



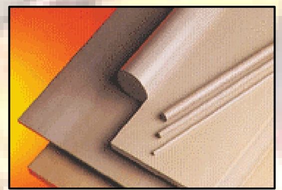
Ultem ® 1000 Polyetherimide

Ultem® 1000 (standard, unfilled polyetherimide) offers excellent chemical resistance, high dielectric strength, natural flame resistance, and extremely low smoke generation. Ultem's® exceptionally high mechanical properties and ease of fabrication including bonding make it an easy choice when exceptional performance is required. Suface resistivity is > 10^{13} Ω/sq.



Ultem® 2300 - 30% Glass-Filled

Ultem® 2300 PEI is an extruded 30% glass reinforced polyetherimide. It is an amorphous, high-performance polymer with exceptional flame and heat resistance. It performs continuously to 340°F (171°C), making it ideal for high strength/high heat applications, and those requiring consistent dielectric properties over a wide frequency range. It is hydrolysis resistant, highly resistant to acidic solutions and capable of withstanding multiple autoclaving cycles. Ultem® 2300 provides greater rigidity and improved dimensional stability while maintaining many of the useful characteristics of unfilled Ultem.



PEEK 450G - Virgin

PEEK is an abbreviation for PolyEtherEther-Ketone, a high performance engineering thermoplastic. PEEK grades offer chemical and water resistance similar to PPS (PolyPhenylene Sulfide), but can operate at higher temperatures. PEEK can be used continuously to 480°F (250°C) and in hot water or steam without permanent loss in physical properties. For hostile environments, PEEK is a high strength alternative to fluoropolymers. PEEK carries a V-0 flammability rating and exhibits very low smoke and toxic gas emission when exposed to flame.

CeramaPEEK ® Ceramic-Filled

CeramaPEEK ® is a proprietary ceramic filled compound created to meet the requirements for tight tolerance, high frequency chip socket test fixtures. Features include: Exceptional dimensional stability: low moisture absorption, low creep, high modulus, metal-like CLTE, low coefficient of hygroscopic expansion. Machinable to very tight tolerances: low burring, compatible with tight pitch and fine diameter holes. Good abrasion resistance and ductility: maintains tolerances after 100,000 chip insertions, good impact properties. Very stable electrical properties: low moisture absorption and intrinsically good electrical insulator. Thermal stability: Compatible with wide temperature range, maintains physicals with after heat aging. CeramaPEEK ® is available in large 24" x 24" (610mm x 610mm) plates and is more economical than competing injection-molded products.

Comparative Data Sheets

Property	Units	Test Method ASTM	Vespel ® SP-1 Polyimide	Meldin® 7001 Polyimide	Protomid® S1 Polyimide	Sumika Super S1000	Torlon ® 4203	Torlon ® 5530
Specific Gravity	g/cm^3	D-792	**1.43**	**1.43**	**1.41**	**1.35**	**1.41**	**1.61**
Tensile Strength, 73 F	psi	D-638	**12,500**	**12,500**	**13,300**	**9,964**	**18,000**	**15,000**
Tensile Modulus of Elasticity, 73 F	psi	D-638	**-**	**-**	**-**	**-**	**600,000**	**900,000**
Tensile Elongation, 73 F	%	D-638	**7.5**	**7.5**	**7.5**	**8.0**	**10**	**3.0**
Flexural Strength 73 F	psi	D-790	**15,900**	**15,900**	**18,200**	**14,500**	**24,000**	**20,000**
Flexural Modulus of Elasticity, 73 F	psi	D-790	**450,000**	**450,000**	**458,000**	**469,922**	**600,000**	**850,000**
Shear Strength, 73 F	psi	D-732	**13,000**	**13,000**	**13,100**	**-**	**16,000**	**-**
Compressive Strength	psi	D-695	**19,300**	**19,300**	**-**	**20,885**	**24,000**	**27,000**
Compressive Modulus of Elasticity, 73 F	psi	D-695	**350,000**	**350,000**	**352,000**	**-**	**478,000**	**600,000**
Hardness, Rockwell, 73 F	-	D-785	**E45-60**	**E45-60**	**M85-100**	**-**	**E80 (M120)**	**E85 (M125)**
Coefficient of Linear Thermal Expansion	In/in/F	D-696	**5.1×10^{-5}**	**5.1×10^{-5}**	**5.6×10^{-5}**	**5.1×10^{-5}**	**1.7×10^{-5}**	**2.6×10^{-5}**
Deflection Temperature 264 psi	F	D-648	**680**	**680**	**680**	**572**	**532**	**520**
Melting Point	F	D-789	**No melt**	**No melt**	**No Melt**	**No Melt**	**n/a**	**n/a**
Continuous Service Temp. in Air (Maximum)	F	-	**550**	**550**	**550**	**500**	**500**	**500**
Dielectric Strength, Short Term	V/mil	D-149	**560**	**560**	**560**	**458**	**580**	**700**
Dielectric Constant, 60 Hz	-	D-150	**-**	**-**	**-**	**-**	**-**	**-**
10 Hz	-	D-150	**-**	**-**	**-**	**-**	**-**	**-**
10x6 Hz	-		**3.55**	**3.55**	**2.91**	**-**	**4.2**	**6.3**
Water Absorbtion – 24 hrs	%	D-570	**0.24**	**0.24**	**-**	**0.04**	**0.4**	**0.3**
- Saturation	%	D-570	**0.72**	**0.72**	**0.95**	-	1.7	**1.5**
Surface Resistivity at 50% RH	**Ohm s/sq**	D-257	**10^{14}- 10^{15} Ω/sq**	**10^{14}- 10^{15} Ω/sq**	**10^{14}- 10^{15} Ω/sq**	**10^{14} Ω/sq**	**> 10^{16} Ω/sq**	**> 10^{13} Ω/sq**

Property	Units	Test Method ASTM	Profine ® Specially Filled PPS	Semitron ® ESd 410C ESd PEI	Semitron® ESd 420 ESd PEI	Semitron® ESd 480 ESd PEEK	Semitron® ESd 490HR ESd PEEK	Semitron® ESd 520HR ESd PAI
Specific Gravity	g/cm^3	D-792	-	1.41	1.34	1.47	1.50	1.58
Tensile Strength, 73 °F	psi	D-638	5,888	9,000	11,500	14,500	14,000	12,000
Tensile Modulus of Elasticity, 73 F	psi	D-638	-	850,000	640,000	940,000	940,000	800,000
Tensile Elongation, 73 °F	%	D-638	0.8	2.0	2.0	1.5	2.3	3.0
Flexural Strength 73 °F	psi	D-790	11,748	12,000	14,500	21,000	21,000	20,000
Flexural Modulus of Elasticity, 73 F	psi	D-790	1,582,361	850,000	650,000	1,000,000	950,000	850,000
Shear Strength, 73 °F	psi	D-732	-	9,000	8,020	-	-	12,600
Compressive Strength	psi	D-695	-	19,500	23,800	26,500	26,000	30,000
Compressive Modulus of Elasticity, 73 F	psi	D-695	-	600,000	370,000	570,000	600,000	600,000
Hardness, Rockwell, 73 F	-	D-785	R114	M115 (R125)	M118	M107 (R122)	M105 (R123)	M108
Coefficient of Linear Thermal Expansion	In/in/ F	D-696	3.5×10^{-5}	1.8×10^{-5}	1.95×10^{-5}	1.7×10^{-5}	2.8×10^{-5}	2.8×10^{-5}
Deflection Temperature 264 psi	°F	D-648	347	410	410	500	500	520
Melting Point (crystalline) peak	°F	D-789	532	N/A	N/A	644	644	N/A
Continuous Service Temp. in Air (Maximum)	°F	-	-	338	340	475	475	500
Dielectric Strength, Short Term	V/mil	D-149	-	N/A	-	-	-	475
Dielectric Constant, 10^6 Hz	-	D-150	5.1	3.0	5.63	-	<2 sec	5.76
Water Absorbtion – 24 hrs	%	D-570	0.02	0.3	0.5	0.18	0.18	0.6
- Saturation	%	D-570	-	1.1	2.9	1.65	1.65	4.6
Surface Resistivity at 50% RH	Ohms/ sq	D-257	-	10^4 1 - 10^6 Ω/sq	10^6 - 10^9 Ω/sq	10^6 - 10^9 Ω/sq	10^9 - 10^{11} Ω/sq	10^{10} - 10^{12} Ω/sq

Property	Units	Test Method ASTM	PEEK - Virgin	CeramaPEEK ® Ceramic-filled PEEK	Techtron ® PPS	Ultem ® 1000 Unfilled PEI	Ultem ® 2300 30% GF PEI
Specific Gravity	g/cm^3	D-792	1.32	1.51	1.35	1.27	1.51
Tensile Strength, 73 °F	psi	D-638	14,500	13,000	13,500	15.2	17,000
Tensile Modulus of Elasticity, 73 F	psi	D-638	490,000	650,000	500,000	430,000	800,000
Tensile Elongation, 73 °F	%	D-638	50	-	15	60	3
Flexural Strength 73 °F	psi	D-790	24,600	23,000	21,000	21,000	30,000
Flexural Modulus of Elasticity, 73 °F	psi	D-790	590,000	650,000	575,000	480,000	900,000
Shear Strength, 73 °F	psi	D-732	7,690	-	9,000	15,000	-
Compressive Strength	psi	D-695	20,000	17,000	21,500	20,300	32,000
Compressive Modulus of Elasticity, 73 °F	psi	D-695	450,000	-	430,000	420,000	620,000
Hardness, Rockwell, 73 °F	-	D-785	R126	-	M95 (R125)	M109	M114 (R127)
Coefficient of Linear Thermal Expansion	In/in/ F	D-696	2.6×10^{-5}	2.0×10^{-5}	2.8×10^{-5}	3.45×10^{-5}	1.1×10^{-5}
Deflection Temperature 264 psi 66 psi	 °F °F	 D-648 D-648	 320 -	 > 500	 250 -	 392 410	 410
Melting Point	°F	D-789	640	-	540	-	-
Continuous Service Temp. in Air (Maximum)	°F	-	480	-	425	340	340
Dielectric Strength, Short Term	V/mil	D-149	480	400	540	830	770
Dielectric Constant, 60 Hz	-	D-150	3.2	-	-	3.15	-
10 Hz	-	D-150	-	-	-	3.15	-
10x6 Hz	-		3.3	3.5	3.0	-	3.7
Water Absorbtion – 24 hrs	%	D-570	0.15	0.2	0.01	0.25	-
- Saturation	%	D-570	0.50	-	0.03	1.25	-
Surface Resistivity at 50% RH	Ohms /sq	D-257	> 10^{13} Ω/sq	> 10^{13} Ω/sq	> 10^{13} Ω/sq	> 10^{13} Ω/sq	3 x 10^{16} Ω/sq

Note: The information contained herein is based on typical properties and values for reference and comparison purposes only. This information should not be used as the sole basis for design and specification. Furthermore, it should not be used as a basis for quality control or considered as minimum performance characteristics. Actual performance data may vary. All values at 73 F (23 C) unless otherwise noted. Data is submitted in good faith, but no warrantee on behalf of Professional Plastics, Inc, or any supplier is implied herein. In the event of any errors or inconsistencies, Professional Plastics shall not be held liable for damages whether implied or actual. Professional Plastics does not claim to directly represent, or act as an agent for all manufacturers listed on this website. Products listed on this website are intended for the material design and specification process, as well as, an overview of typical materials offered for sale. All information is provided free of charge and without liability.

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