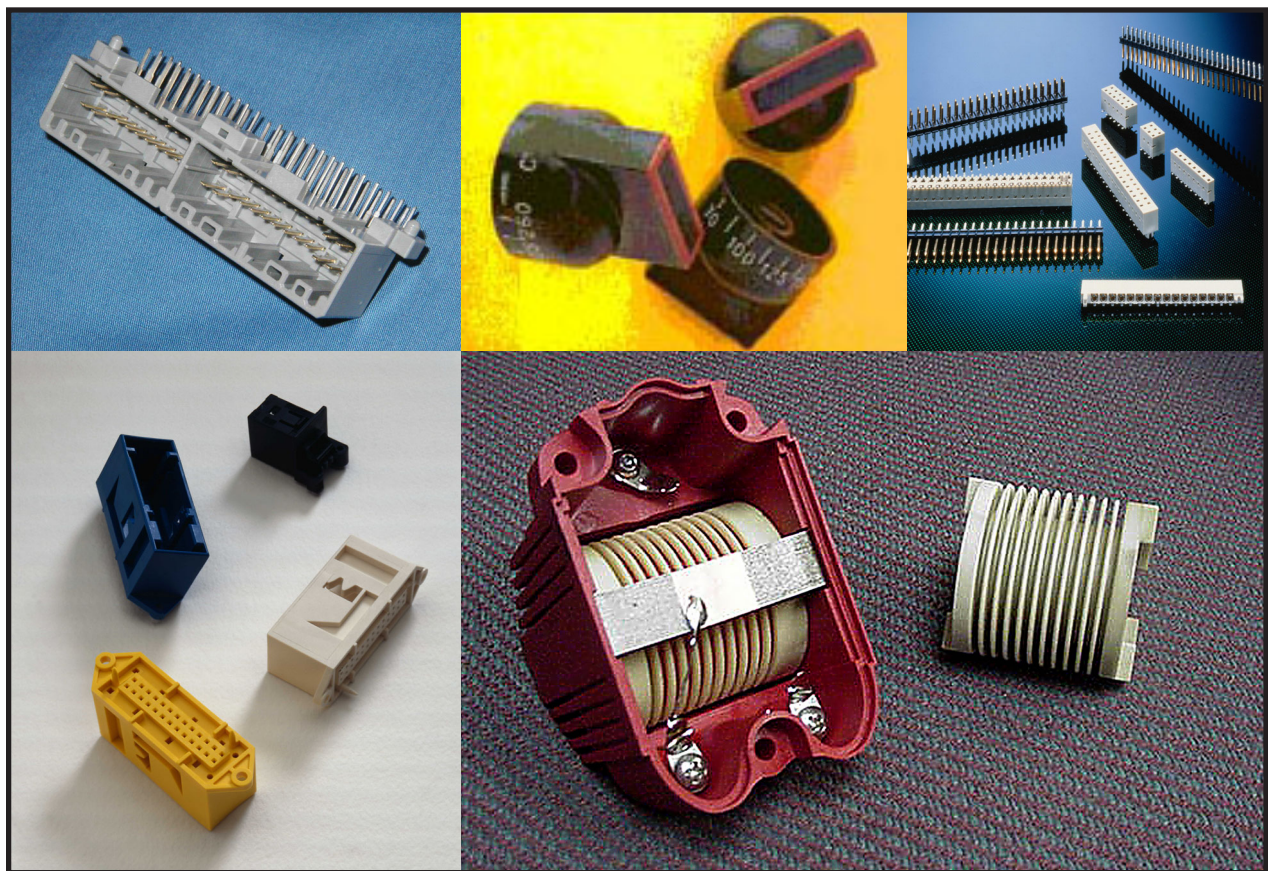


# DuPont™ Thermx® PCT

high performance polyester resin

## Product and Properties Guide



*The miracles of science™*

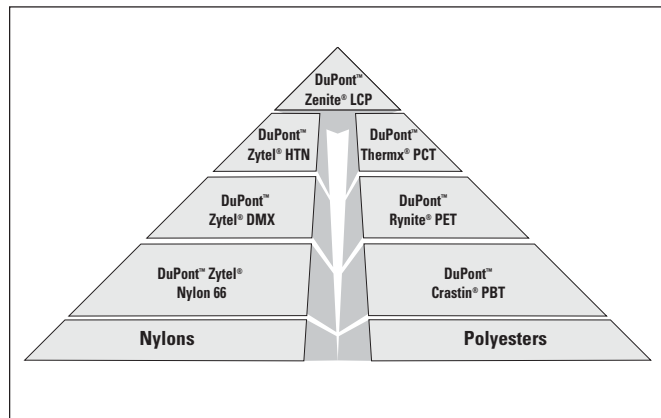


## Description

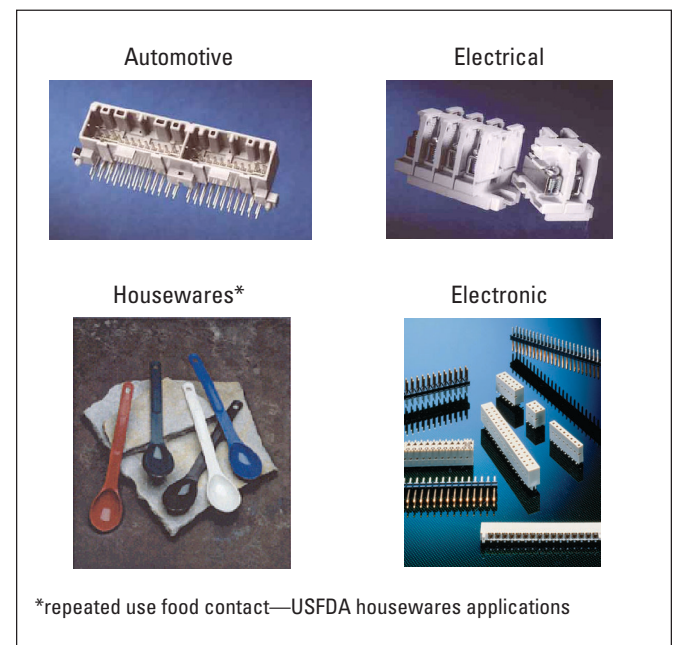
DuPont™ Thermx® PCT polyester is a high temperature polyester based on poly(cyclohexylene-dimethylene terephthalate) chemistry. In addition to possessing the desirable chemical resistance, processability, and dimensional stability of engineering polyesters like PET and PBT, Thermx® PCT polyester's added heat resistance makes it particularly well suited for demanding automotive and electrical/electronics applications. Thermx® PCT polyester offers superior performance and value through its improved heat resistance, fast molding cycles, and excellent processability. It's a valued member of the overall DuPont thermoplastic polyester offering and complements DuPont's other very high thermally capable Zenite® LCP and Zytel® HTN (High Temperature Nylon) resins in applications where thermal needs are greater than PBT, PET and PA66 can provide. Its relative performance position compared to other DuPont polyester and DuPont nylon products is shown in **Figure 1**.

Key application areas for Thermx® are in the electrical/electronic and automotive electronic markets. In addition, Thermx® AG grades, which have excellent surface appearance, are suitable for repeated-use food-contact US FDA housewares applications (see **Figure 2**).

**Figure 1. DuPont Engineering Polymers E/E Performance Triangle**

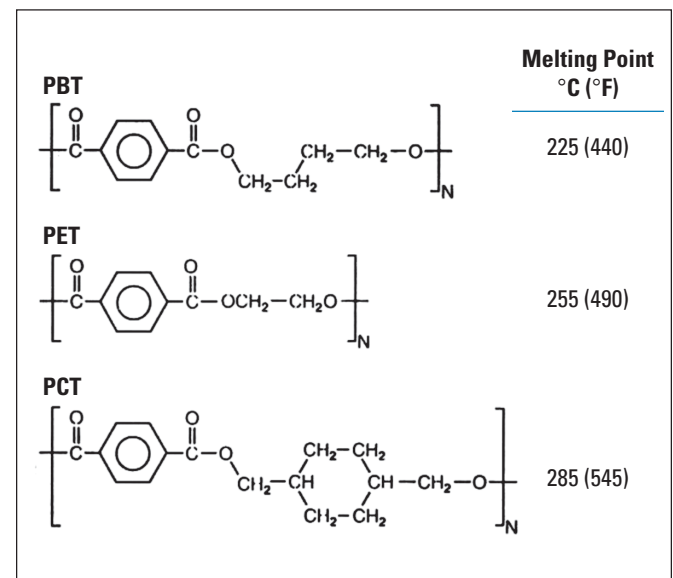


**Figure 2.**



Thermx® PCT is chemically similar to Crastin® PBT and Rynite® PET (see **Figure 3**), and shares similar advantages due to its low moisture pickup. Low sensitivity of dimensions and electrical properties with changing environmental conditions is a key Thermx® advantage.

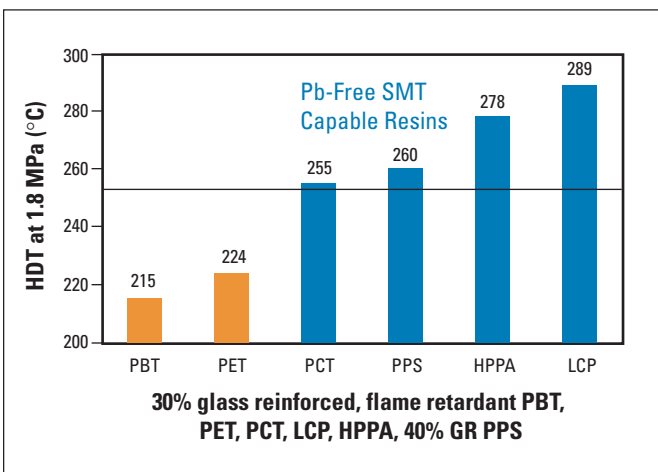
**Figure 3.**



## Specific Thermx® Benefits

- Low moisture absorption
  - properties constant with humidity
  - resistance to blistering
- Long-term heat resistance
- Can be a PBT drop-in replacement
  - potential high-temp drop-in with no tooling changes
- Low-flash processing
- Chemical resistance to automotive fluids and printed circuit board cleaning chemicals
- Hydrolysis resistance
  - relatively good for a polyester without significant modification
- Potential reflow and lead-free soldering resin (see **Figure 4**)
- High CTI and arc resistance
- Dielectric Strength retained to 150°C+
  - CGT33 and CG033 dielectric strength at 150°C = 25 kV/mm (1.5 mm)
- Low Dielectric Constant and Dissipation factor  
FR grade CG933:
  - $dielectric\ constant = 3.6$
  - $dissipation\ factor = 0.020$
  - at 2.6 GHz, 25 °C, 42% RH

**Figure 4. Heat Deflection Temperature**



## Grades of Thermx®

All Thermx® grades are reinforced, semi-crystalline polymers. They can be classified into three types as shown in **Table 1**. General purpose products include 20%, 30%, and 40% glass-reinforced grades, CG053, a modified grade containing glass and mineral reinforcement, and CGT33, a 30% glass-reinforced grade with added toughness. The second type of products are flame retardant and have achieved V-0 flammability classifications. FR grades are available as 20%, 30%, and 40% glass-reinforced products. AG grades are the third type of Thermx® products and are those that are suitable for repeated-use, food-contact, US FDA housewares applications. Typical AG products include a 20% glass-reinforced grade as well as 20% and 30% glass-reinforced grades with added toughness.

**Table 1  
Key Thermx® Grades**

Type	Modification	Product
General Purpose (non FR or "HB")	20% Glass	CG023
	30% Glass	CG033
	40% Glass	CG043
	28% Glass/Mineral	CG053
	30% Glass/Toughened	CGT33
Flame Retardant (FR)	20% Glass	CG923
	30% Glass	CG933
	40% Glass	CG943
Copolyester	20% Glass	AG220*
	20% Glass/Toughened	AG320*
	30% Glass/Toughened	AG330*

\*residential housewares—FDA approved

## Chemical Resistance

Thermx® PCT polyesters are resistant to automotive fluids and chemicals used for printed circuit board cleaning. **Table 2** shows the resistance to common automotive fluids after 30 days of immersion. The crystallinity on the surface of parts molded from Thermx® PCT resins is determined by mold temperature and section thickness. It is the amount of crystallinity that will determine the solvent resistance characteristics. Because of this, the data shown in **Table 2** can be used as an indication of the favorable chemical resistance of Thermx® PCT resins, but end-use testing is highly recommended to understand how Thermx® resins will perform in a particular application.

**Table 2**  
**Chemical Resistance—Automotive Fluids\* After 30 Days Immersion—Thermx® Polyesters CG033 and CGT33**

Fluid	Temperature, °C (°F)	Break Strength, % Retained		Change in Weight, %	
		CG033	CGT33	CG033	CGT33
Calcium chloride (aq, saturated)	23 (73)	102	102	-0.1	0.0
Diesel fuel	23 (73)	99	103	-0.1	0.0
Gasohol (10% ethanol)	23 (73)	99	98	0.3	0.5
Motor oil, 0% strain	150 (302)	97	111	-0.7	-0.3
Motor oil, 1% strain	150 (302)	87	104	-0.6	-0.3
Power steering fluid	49 (120)	99	104	0.0	0.0
Brake fluid	49 (120)	99	101	0.2	0.4
Transmission fluid, 0% strain	150 (302)	100	98	-0.6	0.1
Transmission fluid, 1% strain	150 (302)	91	90	-0.6	0.0
Unleaded gasoline	23 (73)	100	99	0.2	0.3
Windshield washer fluid	23 (73)	97	98	0.6	0.4

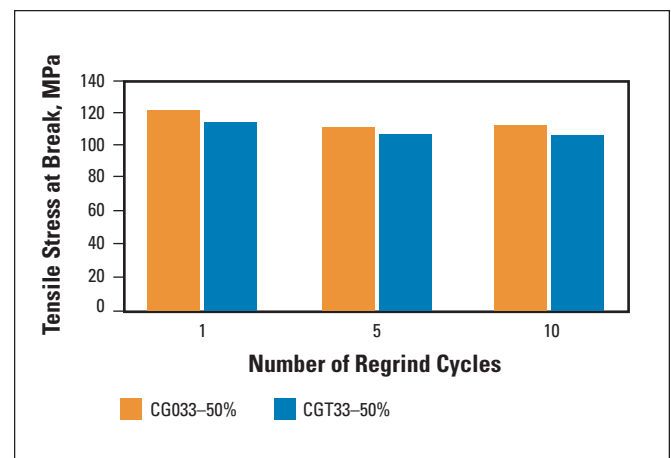
\*Testing was conducted according to ASTM D543

### Processing Thermx®

Thermx® polyesters can be easily processed on conventional injection molding equipment with appropriate desiccant drying systems. The viscosities of Thermx® PCT polyesters are similar to comparable PBT, PA, and PPS formulas. Optimum molded parts will achieve 100% of their obtainable crystallinity, resulting in optimum dimensional stability. Specific processing recommendations are shown in **Table 3**. In addition, to achieve optimum physical properties, preferred barrel residence time for Thermx® PCT is less than 4 minutes.

When Thermx® polyesters are properly processed, up to 50% regrind can be utilized without significant property loss (see **Figure 5**).

**Figure 5. Tensile Stress at Break vs. Regrind Cycles for Thermx® Polyester\***



\* Note that regrind material was added to virgin pellets and predried before molding test specimens

**Table 3**  
**Injection Molding Conditions for Thermx® PCT Polyesters**

Condition	CG023, CG033, CG043, CGT33, CG923, CG933, CG943	CG053	AG220, AG320, AG330
	Drying temperature*, °C (°F)	95 (200)	120 (250)
Drying time, hr	4–6	4–6	4–6
Processing melt temperature, °C (°F)	295–310 (565–590)	295–310 (565–590)	295–310 (565–590)
Mold temperature, °C (°F)	80–120 (175–250)	95–120 (200–250)	150–175 (300–350)

\* Desiccant dryers with an air dew point of -29°C (-20°F) or less should be used.

**Typical Properties\* of Thermx® PCT (Metric Units)**

Property		Test Method	Units	CG023	CG033	CG043	CG053	CGT33	CG923	CG933	CG943	AG220	AG320	AG330
Mechanical	Tensile Strength at Break	ASTM D638	MPa	100	117	128	108	117	99	120	130	76	87	97
	Elongation at Break	ASTM D638	%	2.7	2.3	1.9	2.9	2.8	2.1	2	1.7	2.1	3.3	3.1
	Flexural Modulus	ASTM D790	MPa	5900	8500	11000	7000	7500	6750	9600	12400	5800	4760	6770
	Flexural Strength	ASTM D790	MPa	155	180	200	170	180	140	180	190	123	142	157
	Izod Impact, 23°C	ASTM D256	J/m	60	75	75	61	110	45	90	93	37	110	150
	Unnotched Impact, 23°C	ASTM D4812	J/m	520	730	800	730	950	430	690	610	320	920	910
Thermal	HDT 0.45 MPa	ASTM D648	°C			280	276		272	276	277		264	268
	HDT 1.8 MPa	ASTM D648	°C	256	262	265	251	259	234	255	261	232	194	221
Processing Recommendation	Melt Temperature Range		°C	295–310	295–310	295–310	295–310	295–310	295–310	295–310	295–310	295–310	295–310	295–310
	Mold Temperature Range		°C	80–120	80–120	80–120	95–120	80–120	80–120	80–120	80–120	150–175	150–175	150–175
	Drying Time, Dehumidified Dryer		hours	4–6	4–6	4–6	4–6	4–6	4–6	4–6	4–6	4–6	4–6	4–6
	Drying Temperature		°C	95	95	95	120	95	95	95	95	120–150	120–150	120–150
Other	Specific Gravity	ASTM D792		1.39	1.46	1.55	1.42	1.42	1.58	1.63	1.71	1.37	1.33	1.41
	Mold Shrinkage, Parallel, 2 mm	ISO 294-4	%					.3		.3				
	Mold Shrinkage, Normal, 2 mm	ISO 294-4	%					.8		.8				
Electrical	Dielectric Strength, Short Time, 500 V/s, 3.2 mm	ASTM D149	kV/mm	19.7	16.1		19.3	16.4	20.7	20.4	19.8			
	CTI, 3 mm	IEC	V		560			>600	295	440	380			
Flammability	Flammability Classification, 1.5 mm	UL 94			HB			HB	V-0	V-0	V-0			
Temperature Index	RTI, Electrical, 1.5 mm	UL 746B	°C						150	150	150			
	RTI, Impact, 1.5 mm	UL 746B	°C						130	150	140			

**Typical Properties\* of Thermx® PCT (English Units)**

Property		Test Method	Units	CG023	CG033	CG043	CG053	CGT33	CG923	CG933	CG943	AG220	AG320	AG330
Mechanical	Tensile Strength at Break	ASTM D638	kpsi	14.5	16.9	18.5	15.7	16.9	14	17.4	18.9	11	12.6	14.1
	Elongation at Break	ASTM D638	%	2.7	2.3	1.9	2.9	2.8	2.1	2	1.7	2.1	3.3	3.1
	Flexural Modulus	ASTM D790	kpsi	860	1200	1610	1020	1090	980	1400	1800	840	690	980
	Flexural Strength	ASTM D790	kpsi	22.5	26.1	29	24.7	26.1	20	26.1	27.6	17.8	20.6	22.7
	Izod Impact, 73°F	ASTM D256	ft-lb/in	1.1	1.4	1.4	1.1	2.1	0.8	1.7	1.7	0.7	2.2	2.8
	Unnotched Impact, 73°F	ASTM D4812	ft-lb/in	9.8	13.7	15	13.7	17.8	8.1	13	11.4	6.1	17.3	17.1
Thermal	HDT 0.45 MPa	ASTM D648	°F			536	529		522	529	531		507	514
	HDT 1.8 MPa	ASTM D648	°F	493	504	510	484	498	453	491	502	450	381	430
Processing Recommendation	Melt Temperature Range		°F	565–590	565–590	565–590	565–590	565–590	565–590	565–590	565–590	565–590	565–590	565–590
	Mold Temperature Range		°F	175–250	175–250	175–250	200–250	175–250	175–250	175–250	175–250	300–350	300–350	300–350
	Drying Time, Dehumidified Dryer		hours	4–6	4–6	4–6	4–6	4–6	4–6	4–6	4–6	4–6	4–6	4–6
	Drying Temperature		°F	200	200	200	250	200	200	200	200	250–300	250–300	250–300
Other	Specific Gravity	ASTM D792		1.39	1.46	1.55	1.42	1.42	1.58	1.63	1.71	1.37	1.33	1.41
	Mold Shrinkage, Parallel, 2 mm	ISO 294-4	%					.3		.3				
	Mold Shrinkage, Normal, 2 mm	ISO 294-4	%					.8		.8				
Electrical	Dielectric Strength, Short Time, 500 V/s, 3.2 mm	ASTM D149	V/mil	500	409		490	413	526	518	503			
	CTI, 3 mm	IEC	V		560			>600	295	440	380			
Flammability	Flammability Classification, 1.5 mm	UL 94			HB			HB	V-0	V-0	V-0			
Temperature Index	RTI, Electrical, 1.5 mm	UL 746B	°F						302	302	302			
	RTI, Impact, 1.5 mm	UL 746B	°F						266	302	284			

\* Colorants or other additives of any kind may alter some or all of these properties. The data listed is for natural color resins, with the exception of CG923 data which is for a black CG923 grade, and AG220 data which is for a white AG220 grade.

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