

Solution Pack

- Connectors with SKYPURA PCT

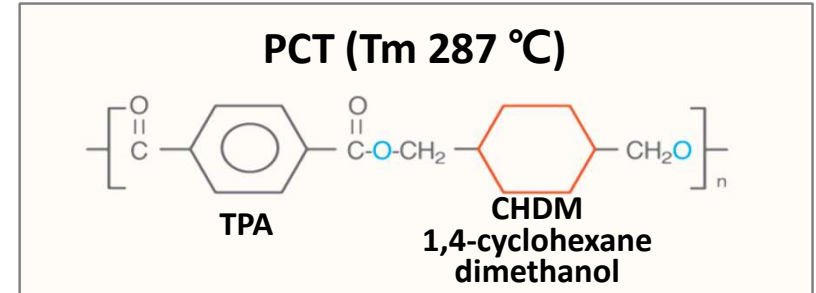
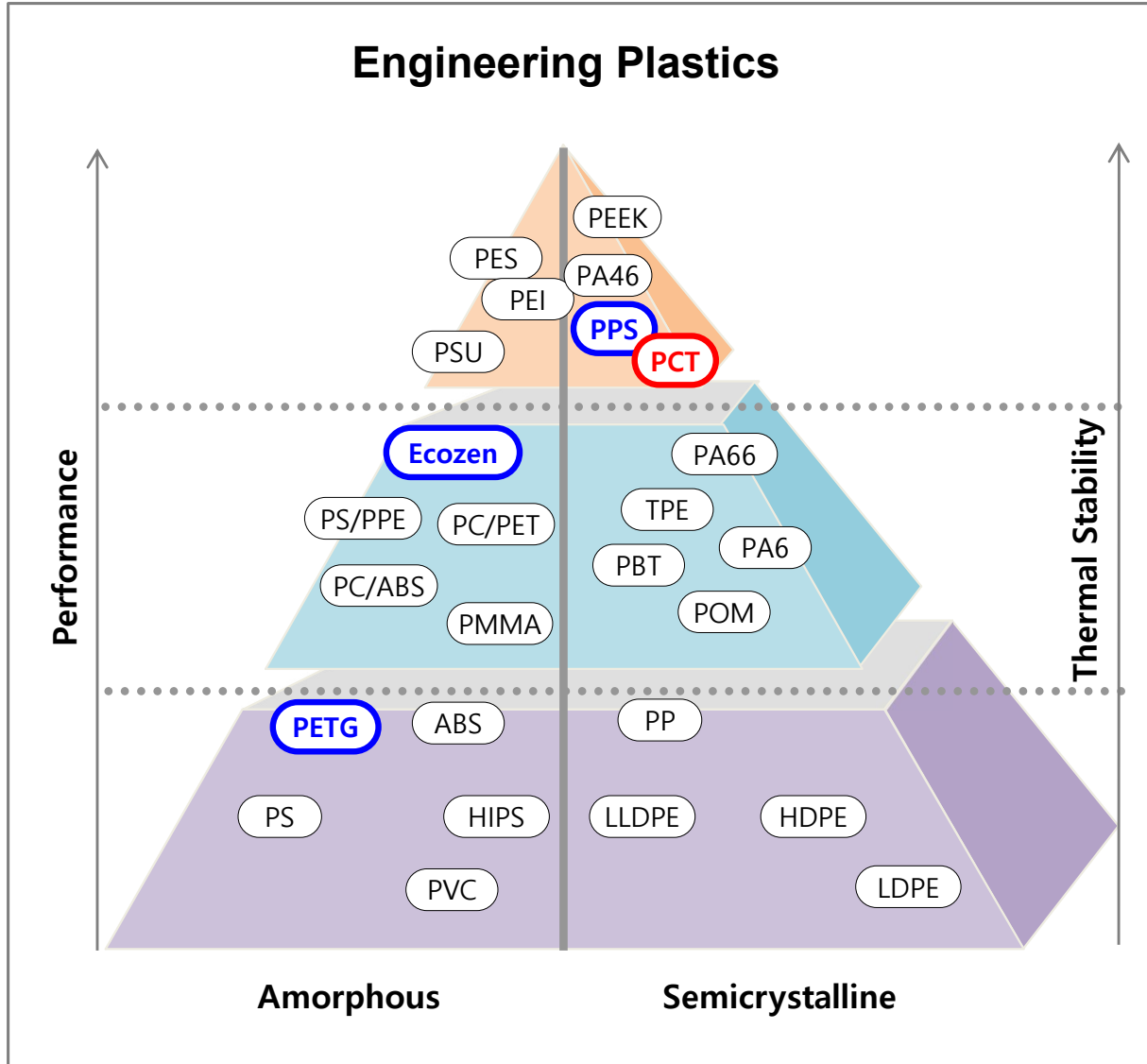
July. 2022

Engineered Polymer Team

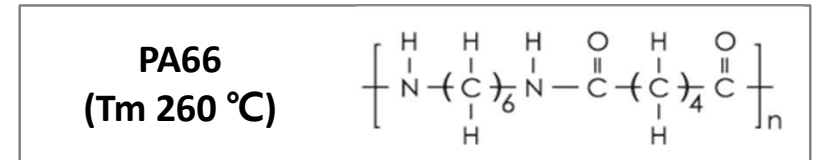
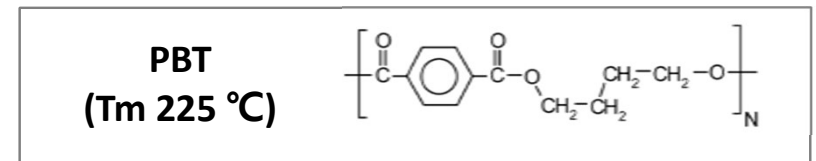
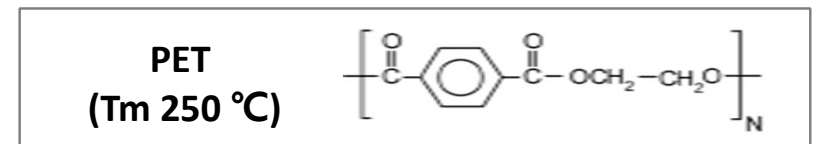
Introduction to SKYPURA PCT

Introduction to SKYPURA PCT

SKYPURA PCT is high performance polyester. It has excellent thermal, hydrolysis stability and electrical properties such as high break down voltage. It has outstanding thermal resistance property that can tolerate high temperature of SMT reflow process.



vs



Characteristics of SKYPURA PCT

Characteristics

- High heat resistance & stability
- Good chemical resistance
- Low moisture absorption & Good hydrolytic stability
- Good color stability
- Low oligomers
- Excellent Electrical Properties (CTI, GWT, etc)
- Excellent Metal adhesion

Typical Application Areas

Compounds :

- Connectors
- Food containers
- Automotive engine parts
- LED reflector

Film :

- Optical film (for high temp. treatment)
- Coating film for electronics
- Back sheet for Photovoltaic

Fiber :

- Iron back pad
- Paint roll brush
- Industrial bag filter

Connectors with SKYPURA PCT

Customer : Hyundai motors

- SKYPURA is commercialized for totally 4 connector application, replaced PBT usage



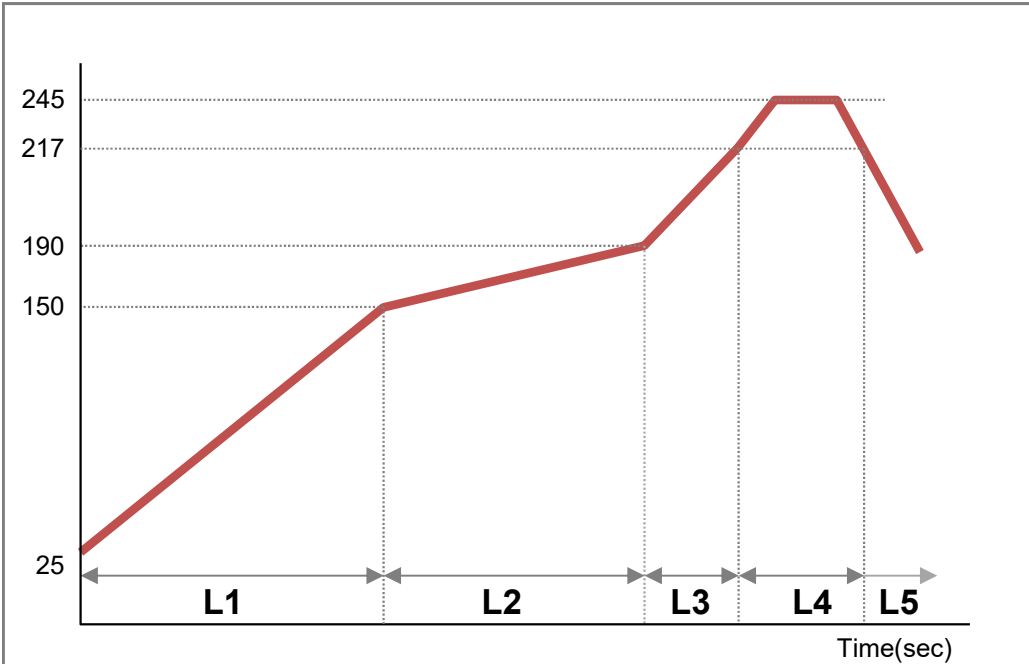
Voice of Customers about **PCT's strong point**

- Due to Soldering-Free, Thermal properties in mold is necessary to be increased from normal PBT circumstance
PCT has Substantial thermal stability within max 245°C, as well as -40°C
- Since the heat resistance is about 40°C higher than that of PBT, the SMT process at 265 °C is expected to be no problem.
- **Withstanding Chemical and Oil resistance**, against any Gasoline, break Oil, including Cleaning chemicals on PCB
- Strong **Humidity resistance**
- High **Electrical** performance (CTI & Arc resistance)
- Easy **Colorful** appearance (premium white)



Reflow Temp. Standard Profile (Peak Temp.245°C)

SMT setting Profile



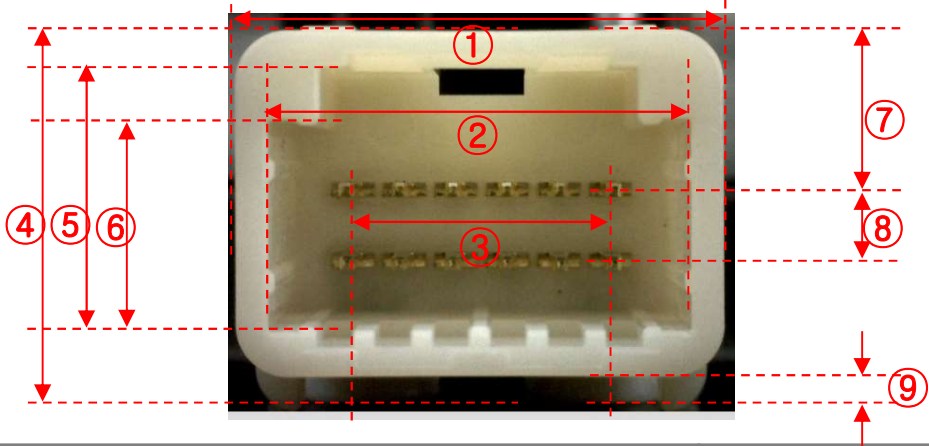
Zone	L1	L2	L3	L4	L5
function	Start to increase	Warm up	heating	Soldering	cooling
Temp(°C)	25~150	150~190	190~217	217~217	-
#1 Time(sec)	70	60~120	-	90~120	-
Peak Temp. - MAX 245°C, 10secMIN					

SMT Real Temp. Profile

The screenshot shows the SEF Mesy software interface. The main window displays a graph of Temperature [°C] vs. Time [s]. The y-axis ranges from 0 to 250, and the x-axis ranges from 0 to 300. A red line shows the real-time temperature profile, which closely matches the setting profile. The software interface includes a legend for Channel 1, Channel 2, and Channel 3, and a temperature cursor.

The photograph shows the SEF Pi-Fast 548-10G reflow oven, a white industrial machine used for SMT reflow. It is placed on a white table in a laboratory setting.

Customer standard



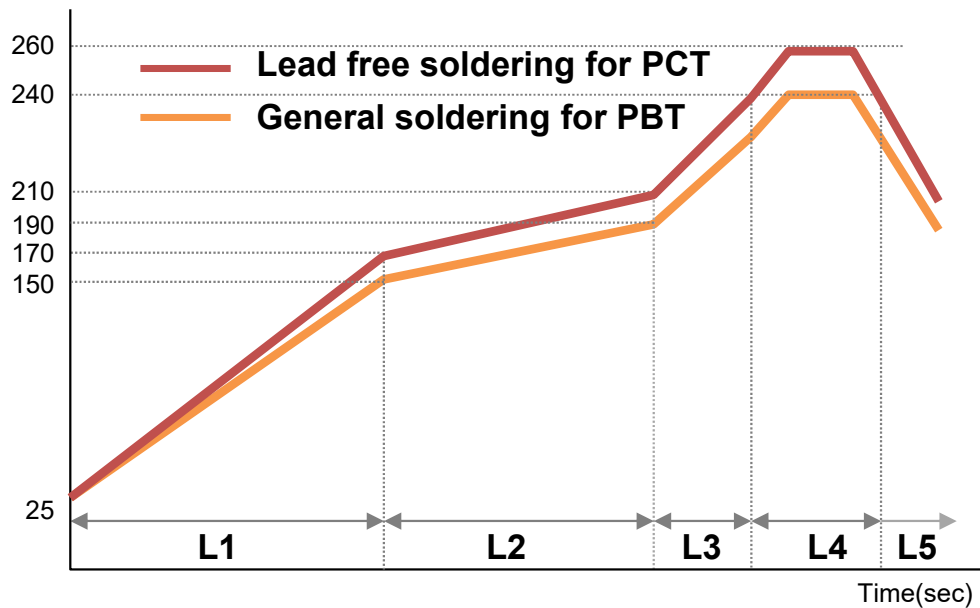
Point	Spec	Before Reflow					After Reflow				
		#1	#2	#3	#4	#5	#1	#2	#3	#4	#5
①	18.6±0.2	18.65	18.64	18.67	18.69	18.69	18.62	18.59	18.57	18.61	18.61
②	15.6±0.1	15.61	15.58	15.66	15.66	15.67	15.67	15.64	15.68	15.61	15.59
③	11.0±0.2	11.04	11.07	11.05	11.07	11.04	11.08	11.03	11.02	11.07	11.06
④	15.3±0.2	15.38	15.38	15.36	15.35	15.38	15.32	15.28	15.26	15.28	15.31
⑤	9.7±0.2	9.80	9.73	9.81	9.78	9.79	9.85	9.82	9.85	9.88	9.83
⑥	7.6±0.1	7.55	7.56	7.55	7.61	7.63	7.56	7.62	7.69	7.69	7.64
⑦	6.4±0.2	6.42	6.49	6.40	6.38	6.38	6.39	6.37	6.35	6.30	6.30
⑧	3.0±0.2	3.04	3.01	3.02	3.01	3.04	2.95	2.98	2.99	2.99	2.97
⑨	2.1±0.2	2.13	2.17	2.16	2.10	2.12	2.09	2.12	2.07	2.09	2.10

final there was no big difference between before and after of Reflow

Reflow Temp. Standard Profile (Peak Temp.265 °C)

Since the heat resistance is about **40°C** higher than that of PBT, the **SMT process at 265 °C is expected to be no problem.**

SMT setting Profile for PCT



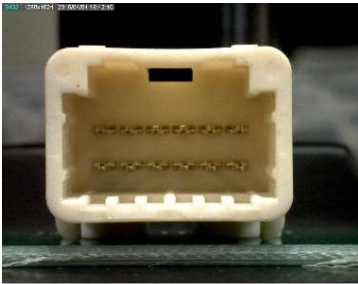
Zone	L1	L2	L3	L4	L5
function	Start to increase	Warm up	heating	Soldering	cooling
Temp(°C)	25~150 → 25~170	150~190 → 170~210	190~217 → 210~237	217~217 → 237~237	-
#1 Time(sec)	70	60~120	-	90~120	-
Peak Temp. - MAX 245 °C → 265 °C, 10sec Min.					

Appearance

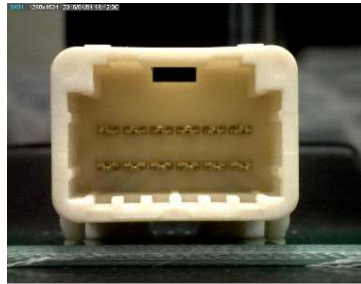
- Passed : there was no leak, rust, Burr, defect, deflect, and color change

SK PCT

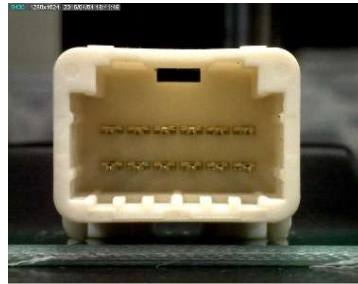
#1



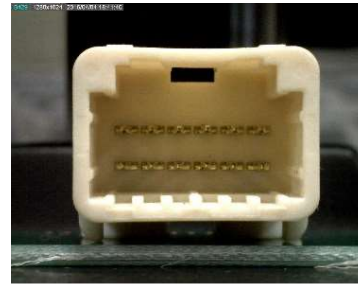
#2



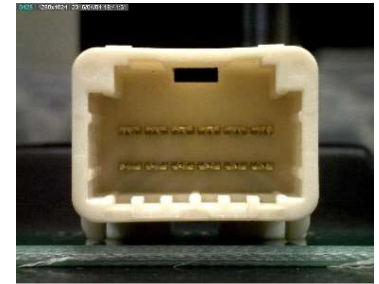
#3



#4



#5



OK

Connecting power when insert & extract

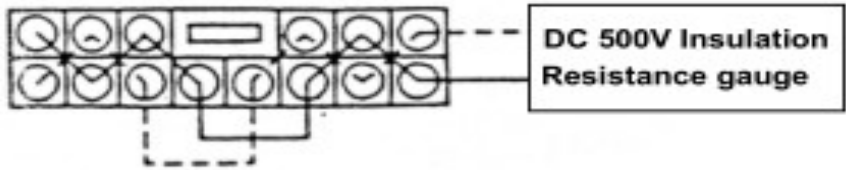
- Passed : creep performance is subsequently below than target Kgf, 18kgf when the connector insert and extract.

SK PCT	
Real Feature	

STEP III. Electrical - Insulation resistance

Analysis method :

During connecting, according to <10-1> and <10-2> , it is measured by insulation tester, DC 500V



< 10-1 >



< 10-2 >

Required performance

	initial	After endure
Non-waterproof type	Over 100 MΩ	Over 100 MΩ
Waterproof type	Over 200 MΩ	Over 100 MΩ

Unit : MΩ

	SK PCT 1 st case						SK PCT 2 nd case					
Real feature												
Result	x1	x2	x3	x4	x5	판정	x1	x2	x3	x4	x5	판정
	1000MΩ MIN	1000MΩ MIN	1000MΩ MIN	1000MΩ MIN	1000MΩ MIN	OK	1000MΩ MIN	1000MΩ MIN	1000MΩ MIN	1000MΩ MIN	1000MΩ MIN	OK

STEP III. Electrical – leakage current & voltage withstand

	Circuit diagram											Unit : μ A
photo												
results	SK PCT 1 st case						SK PCT 2 nd case					
	x1	x2	x3	x4	x5	final	x1	x2	x3	x4	x5	final
	0.05	0.02	0.03	0.08	0.04	OK	0.05	0.06	0.09	0.07	0.05	OK

	SK PCT 1 st case						SK PCT 2 nd case													
AC 1000V (1min)																				
Insulation breakdown	x1	x2	x3	x4	x5	Results	x1	x2	x3	x4	x5	results								
						OK						OK								
	none	none	none	none	none		none	none	none	none	none		none							

Step III. – Electrical resistance in Extreme outstanding circumstance

Main test	Test method	Results in 10 cases (average)
Cold resistance	During 120hrs in -40°C, drop test over 1.5m on to the 10T Steel	Temperature increase : 17°C / spec under 40°C
Thermal shock test	After 2hrs in -40°C, heat to 80°C~120°C instantly 2hrs	Voltage drop : 8.5 mΩ / spec under 50 mΩ
High temp. endurance	After 300hrs in 80 °C, leave it to room temp.	Voltage drop : 9.1 mΩ / spec under 50 mΩ
Humidity test	After 5 cycle in 25°C with 65% humidity, leave it until 2hrs in room temp.	Voltage drop : 8.5 mΩ / spec under 50 mΩ Leakage current : 0.1 μA / spec under 1 μA
Sulfur resistance	Sulfur gas condition: Density 10ppm, Humidity 90~95%, Temp. 40±3°C	Voltage drop : 12.3 mΩ / spec under 50 mΩ
Chemical and oil resistance	next page	

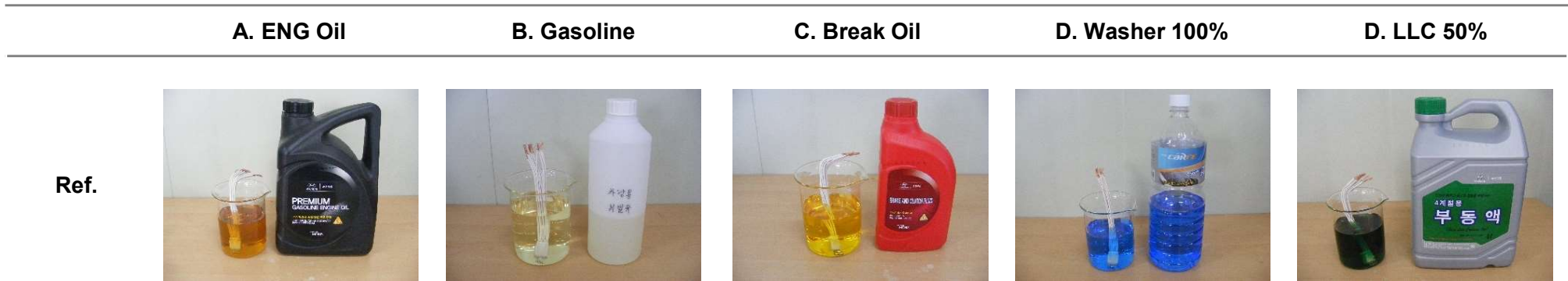
Comparison of Electrical resistance in Extreme outstanding circumstance

■ Reflow Temp. Standard Profile (Peak Temp.265°C)

Main test	Test Procedures	Measurement	Housing materials.		
			PCT	PA66	PA46
Cold resistance	During 96hrs in -40°C, Drop test over 1.5m on to the 10T Steel	Contact Resistance* < 50 mΩ	6.4	8.6	13.1
High temp. endurance	After 96hrs in 85 °C, Leave it to room temp.	Contact Resistance* < 50 mΩ	7.1	8.6	13.0
Thermal shock test	After 30 min. in -40°C, Heat to 85°C for 30min., 100 cycles. And then, leave it to room temp. for 2 hrs.	Contact Resistance* < 50 mΩ	7.3	8.9	13.4
Humidity test	During at 40°C Temperature. and 90% humidity for 96 hrs. Leave it until 2hrs in room temp.	Contact Resistance* < 50 mΩ	8.0	10.3	14.8
Chemical and oil resistance	next page				

※ Contact resistance* : Measured the resistance of mated connector

Appendix – Oil & Chemical resistance

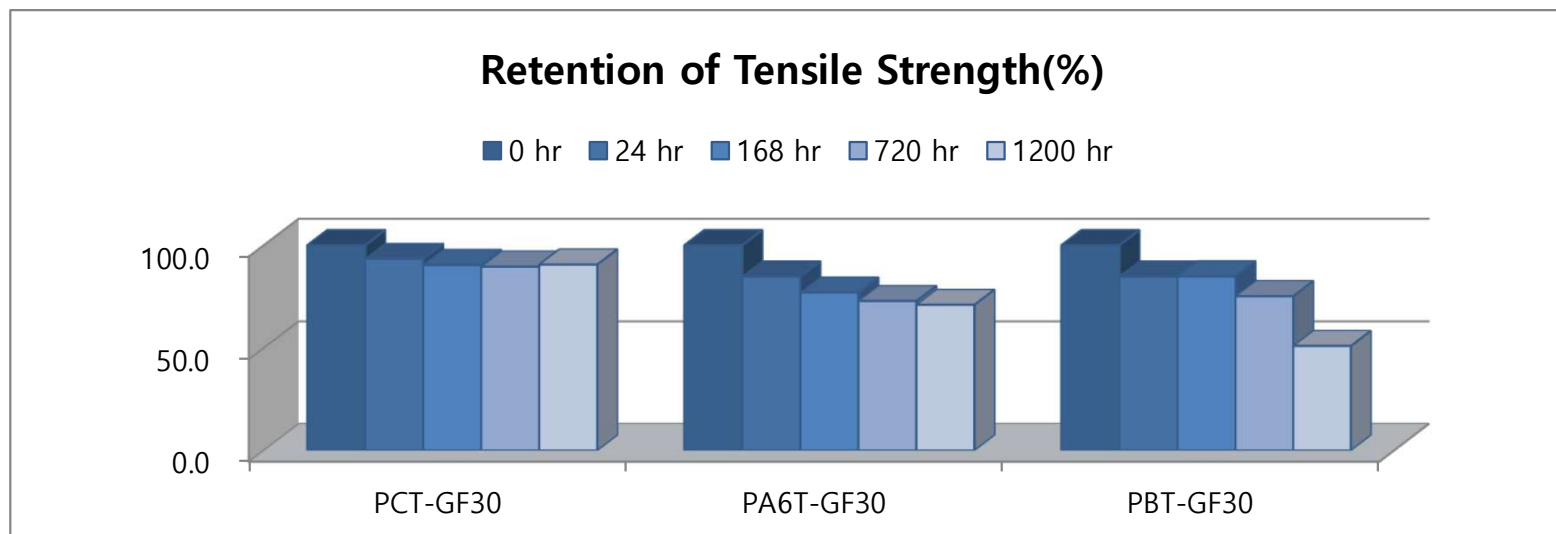
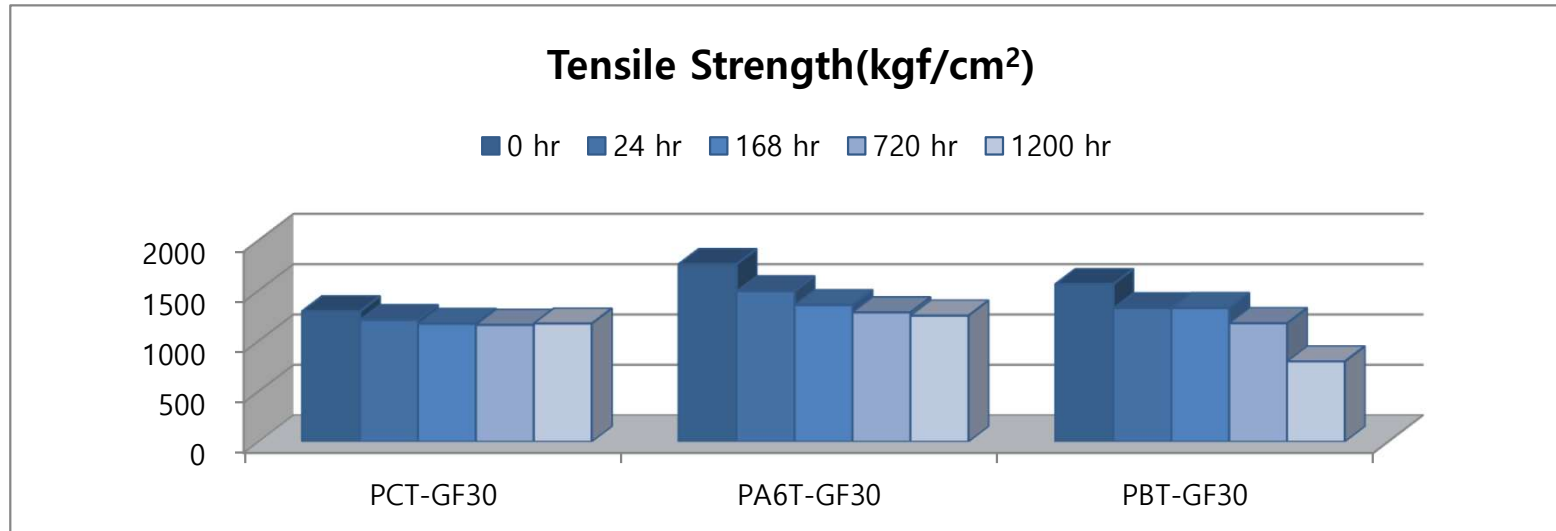


Remark	SK PCT 1 st case				
	A	B	C	D	E
Appearance					
Voltage dip/sag(mΩ)	9.9	10.1	9.8	9.7	10.5
Results	👉 no problem				

Remark	SK PCT 2 nd case				
	A	B	C	D	E
Appearance					
Voltage dip/sag(mΩ)	10.6	10.8	10.7	10.9	11.2
results	👉 no problem				

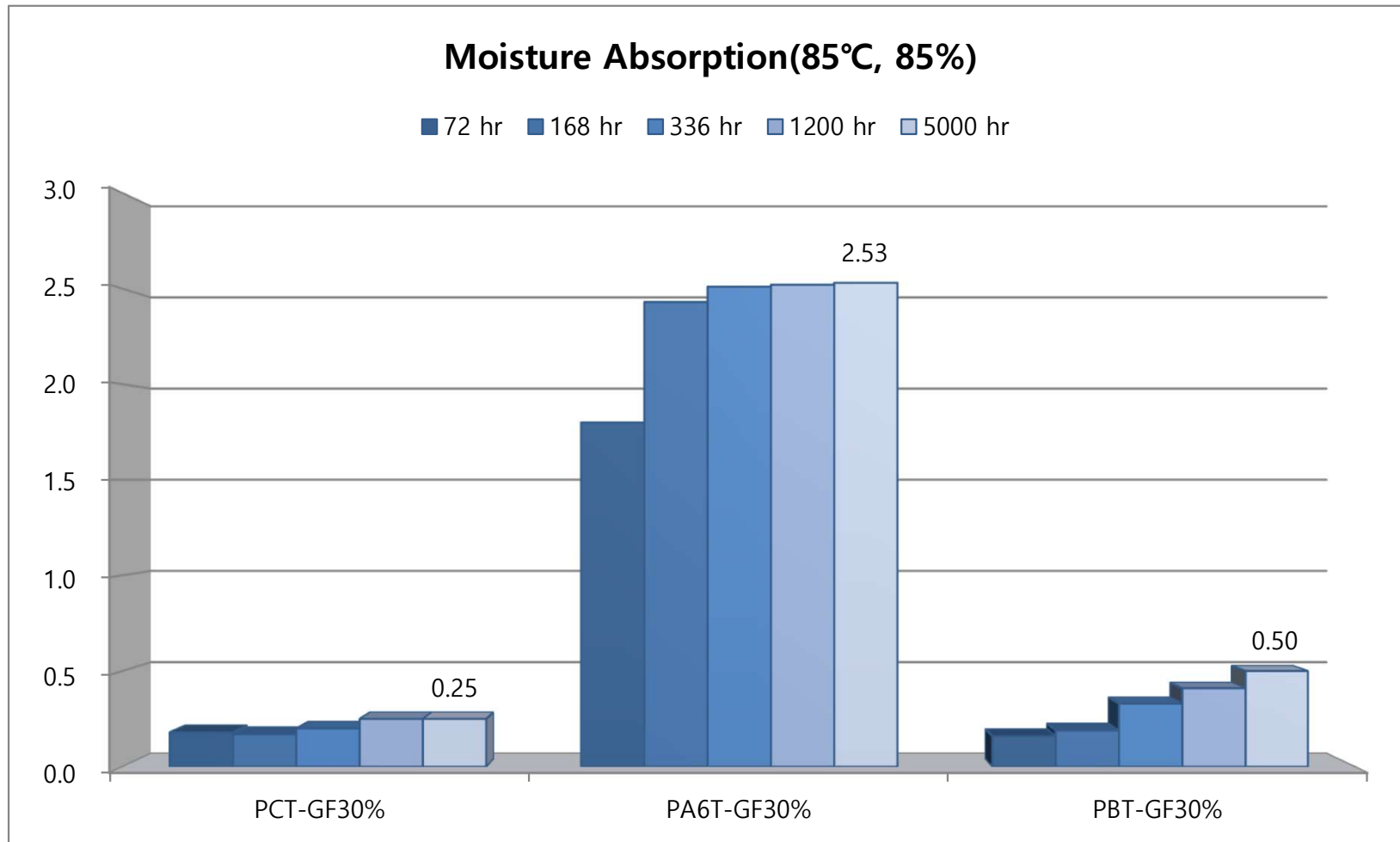
Appendix – Hydrolytic Stability

SKYPURA PCT has better hydrolytic stability than PA6T and PBT (85°C, 85% humidity). It retains 90% of its original tensile strength to 1200hrs, while other plastics show drastic degradation of their properties.



Appendix – Moisture Absorption

- ◆ SkyPURA PCT shows lower moisture absorption than PA6T and PBT, which is important for dimensional stability and hydrolytic stability.



Appendix – Comparison with other resins

Properties

	Method	Unit	PCT		PBT	PA46		PA9T		HTN (PA66, PA6T)		LCP
			7122T	7121F	BASF, B4300 G6	TS256F 6	TS250F 6	GN233 0	G1300 H	70G33L	FR52G 30NH	Celane se E130i
Density	ISO 1183	g/cm ³	1.45	1.62	1.53	1.56	1.68	1.62	1.37	1.39	1.44	1.61
Moisture	ISO 62	%			0.40%	1.45%	1.50%	1.00%	1.60%	1.20%	-	0.03%
Mold Shrinkage	ISO 294-4	MD	0.3	0.3	0.34	0.3	0.4	0.1	0.2	0.3	0.3	0.1
		TD	0.9	0.9	1.07	1.0	1.1	0.6	0.8	1.1	1.0	0.5
Tensile Properties	ISO 527	Strength	121	111	135	170	125	185	160	140	130	150
		Strain	2.6	1.4	2.5	2.0	3.5	4.0	4.0	5.0	2.0	1.6
		Modulus	7,000	10,800	10,000	12,000	8,000	-	-	8,000	10,500	15,000
Flexural Properties	ISO 178	Strength	180	155	260	-	-	240	205	200	200	225
		Modulus	7,000	10,800	10,000	10,000	7,300	11,000	8,500	6,000	10,000	15,000
Impact Charpy	ISO 179	Notched	11	6	11	8	11	10	11	17	7	22
		Unnotched	55	30	67	-	-	-	-	100	-	43
HDT	ISO 75	@0.45Mpa	265	268	220	290	290	-	-	261	-	-
		@1.82Mpa	255	250	215	290	290	285	290	252	283	275

※ Data from catalogue

Appendix – Comparison with other resins

Properties

	Method	Unit	PCT		PBT	PA46		PA9T		PA6,6	PA6T	LCP	
			7122T	7121F	BASF, B4300 G6	DSM, TS256F 6	DSM, TS250F 6	GN233 0	G1300 H	DuPont 70G33	DuPont FR52G 30NH	E130i	
Flammability	@ 0.4 mm	UL94	-	HB	-	-	-	-	-	-	V-0	-	
	@ 0.8 mm		-	HB	V-2	HB	V-0	V-0	V-0	HB	HB	V-0	-
	@ 1.6 mm		-	HB	V-0	HB	V-0	-	V-0	HB	HB	V-0	V-0
Melting	ISO 11357	°C	280	280	225	295	295	306	306	262	310	335	
C.T.I. (Comparative Tracking Index)	IEC 60112	PLC	0 (> 600V)	1 (> 400V)	2 (>250V)	-	1	1	0	0	0	3 (>175V)	
Dielectric Constant	@ 1GHz	IEC 60250	-	3.0	3.0	3.8	-	-	-	-	4.0	3.7	3.3
	@ 100 Hz		-	3.1	3.1	4.0	-	-	-	-	4.2	-	4.0
	@ 10 Hz		-	3.2	3.2	-	-	3.4	3.4	3.3	-	-	4.2
Dielectric Strength	IEC 243	kV/mm	16	20	100	30	30	30	30	23	36	32	
Dissipation Factor	@ 1GHz	IEC 60250	-	0.010	0.009	0.017	-	-	-	-	0.015	0.012	0.025
	@ 100 Hz		-	-	-	0.003	-	-	-	-	0.010	0.007	0.010

Appendix – Processing Guide

Dehumidifying Drying Condition

- Drying Temperature / Time : 120 ± 10 °C (6 hrs)
- Air Flow of Dry Air : > 0.065 m³/min per kg/h(1cfm per bl/h)
- Dew Point of Dry Air : < -30°C, -40 °C is better for good drying
- Residual Moisture Contents : < 0.05% (500ppm)

Problems Caused by Insufficient Drying

- Molecular weight(I.V. or M.V.) decrease the polymer and degradation of any additives.
- Adverse effect of color of the final product
- Difficult control of the processing parameters such as melt pressure, rheology, and power consumption
- Bubble and silver streaks

General Guideline

- Screw Speed : General screw speed of 50~150 rpm
- Cushion Size : Minimum cushion size (~3%/Total)
- Back Pressure : 0.2 ~ 0.7Mpa (2 ~ 7 bar)
- Shot to Cylinder Size : 30 ~ 70% (Medium ~ High speed)
- Injection Time / Holding Time : 0.5 ~ 3 sec. / 8 ~ 12 sec.
- Cooling Time : 10 ~ 20 sec.

Screw Design

- General purpose screw type
- Compression ratio: 2.5:1 ~ 3.5:1
- L/D: OVER 18:1 ~ 20:1
- Ring type non-return valve is preferred

Typical processing condition

- Melt Temperature : 290 ± 20 °C (Max.)
- Cylinder Temperature

Part	Mold	Nozzle	C3	C2	C1	Feeding
°C	150	290~300	290~310	280~290	270~280	< 50



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Healthcare, Earthcare

686 Sampyeong-dong, Bundang-gu, Seongnam-si, Gyeonggi-do 463-400 Korea
JH Cho, Manager / Phone: +82-2-2008-2455 / E-mail: j.h.cho@sk.com Fax: +82-2-2008-2319