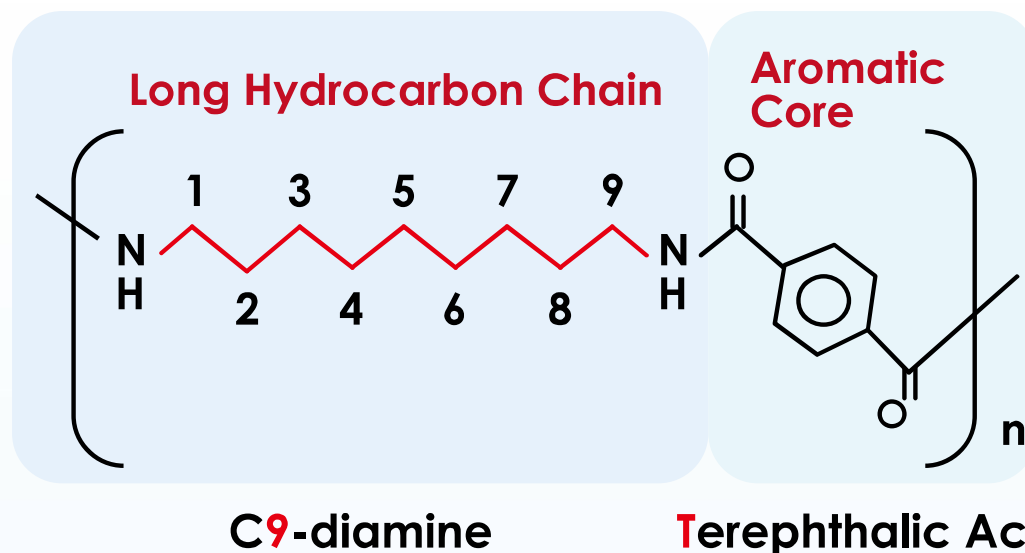


Genestar™

High Performance Polyamide : **PA9T**

for reliably efficient automotive parts

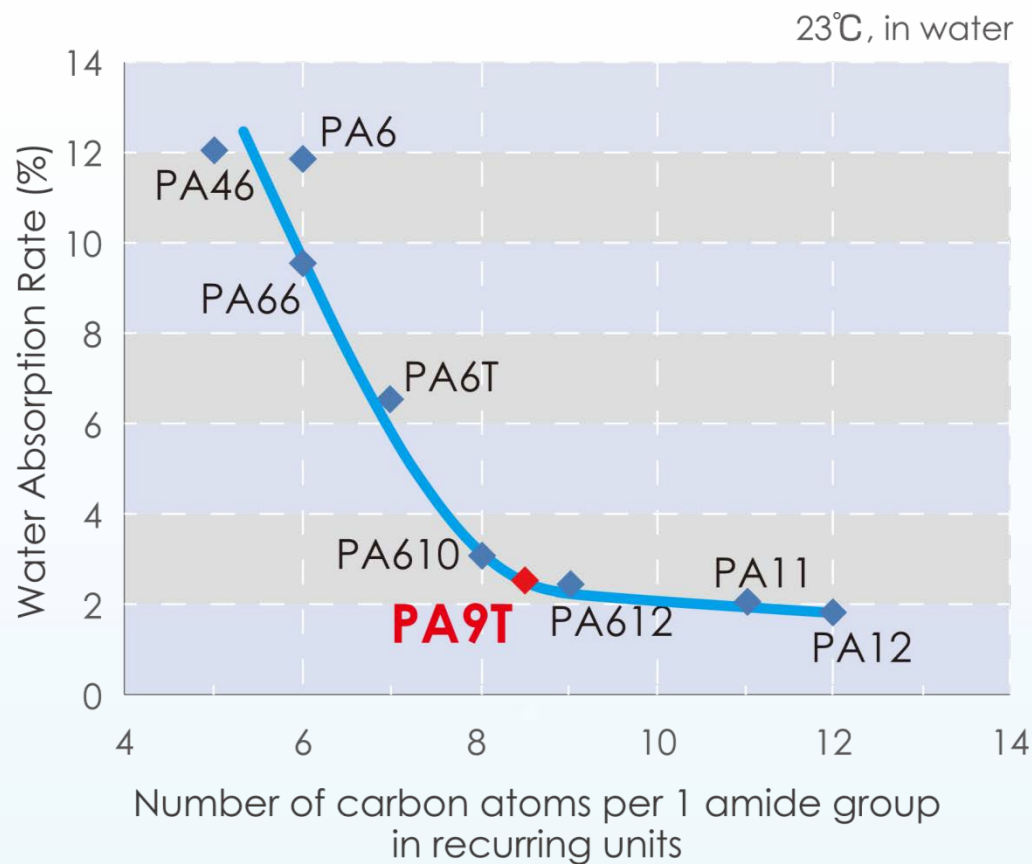




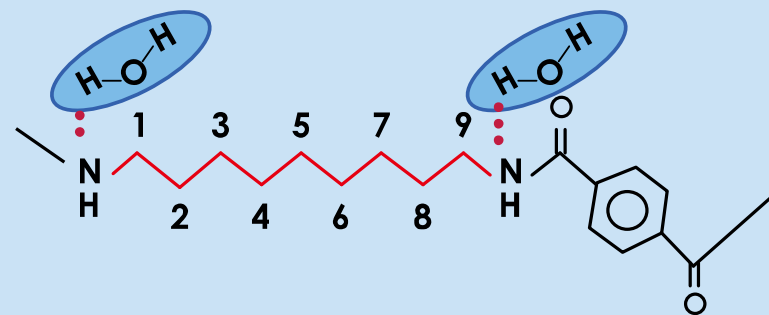
(Tm=300°C (Injection) 264°C (Extrusion) Tg=125°C)

- The lowest water absorption rate among high heat-resistant polyamides.
- Retains both dimensional stability and strength due to its low water absorption.
- Superb chemical and hydrolysis resistance.
- Excellent mechanical properties at high temperature and long term heat resistance.
(Tg: PA9T > PA46 > PA66)
- Outstanding fuel barrier properties.

Water absorption

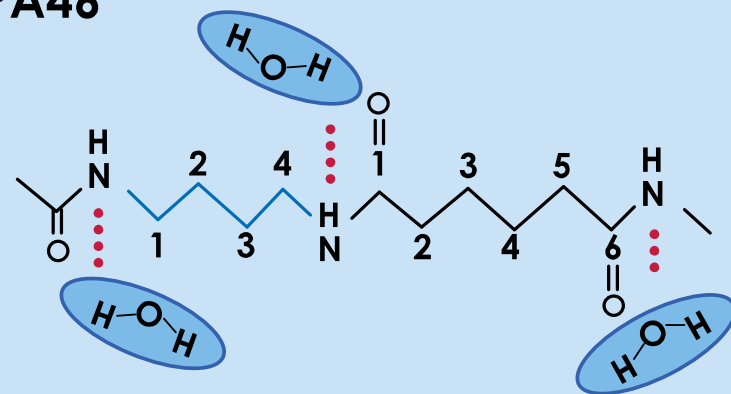


PA9T



Long-chain diamine structure (C9)

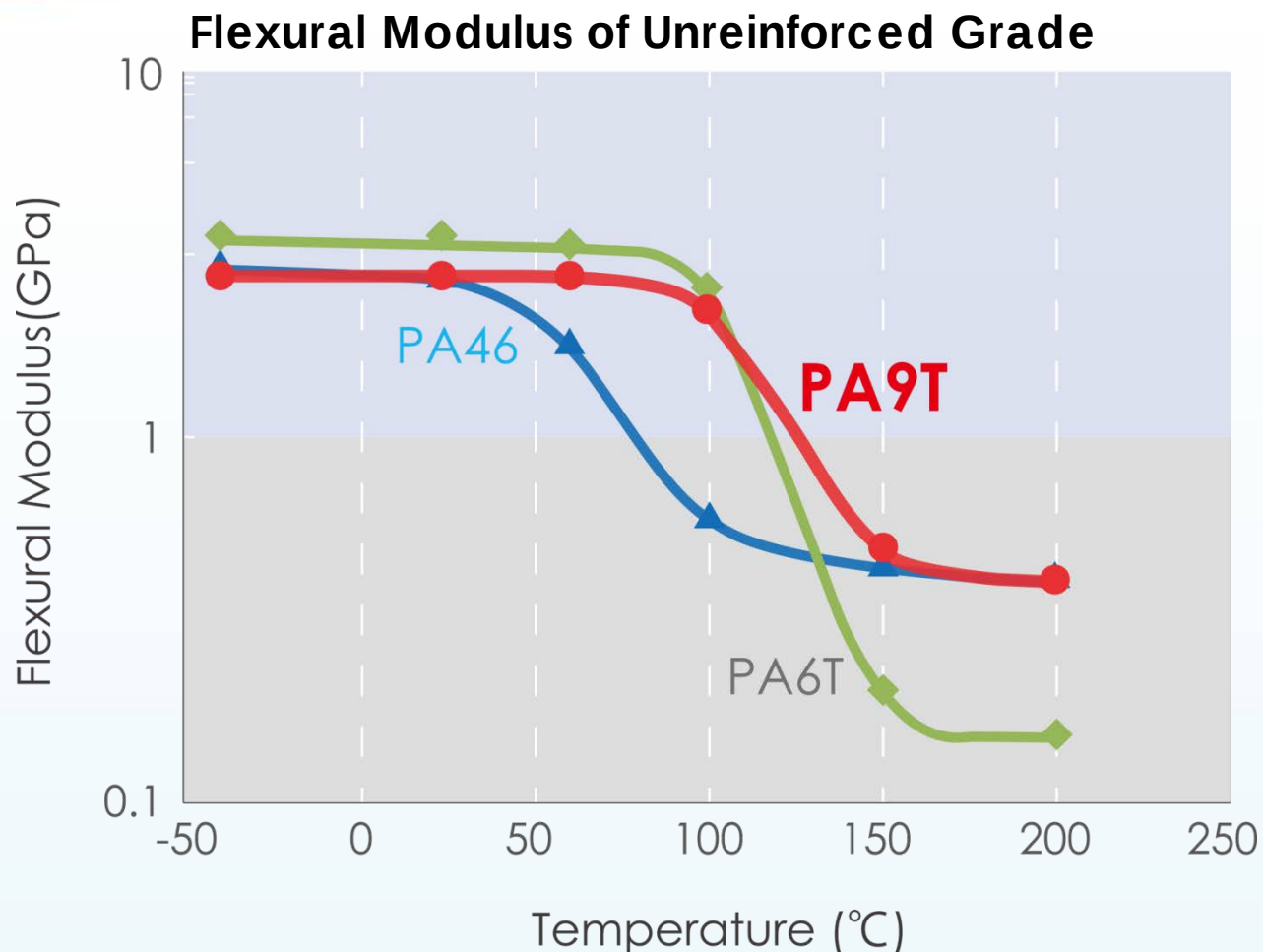
PA46



	Retention of tensile strength (%)				
	PA9T	PA6T	PA46	PA66	PPS
Gasoline	86	86	71	86	98
Engine oil	89	88	67	81	97
Methanol	72	35	54	39	98
Toluene	82	77	74	68	95
Chloroform	87	85	71	68	87
Hot water (80°C)	90	63	40	44	96
Sulphuric acid (10%aq.)	81	52	42	39	98
NaOH (50%aq.)	85	62	59	71	92
CaCl ₂ (50%aq.)	92	64	52	73	97

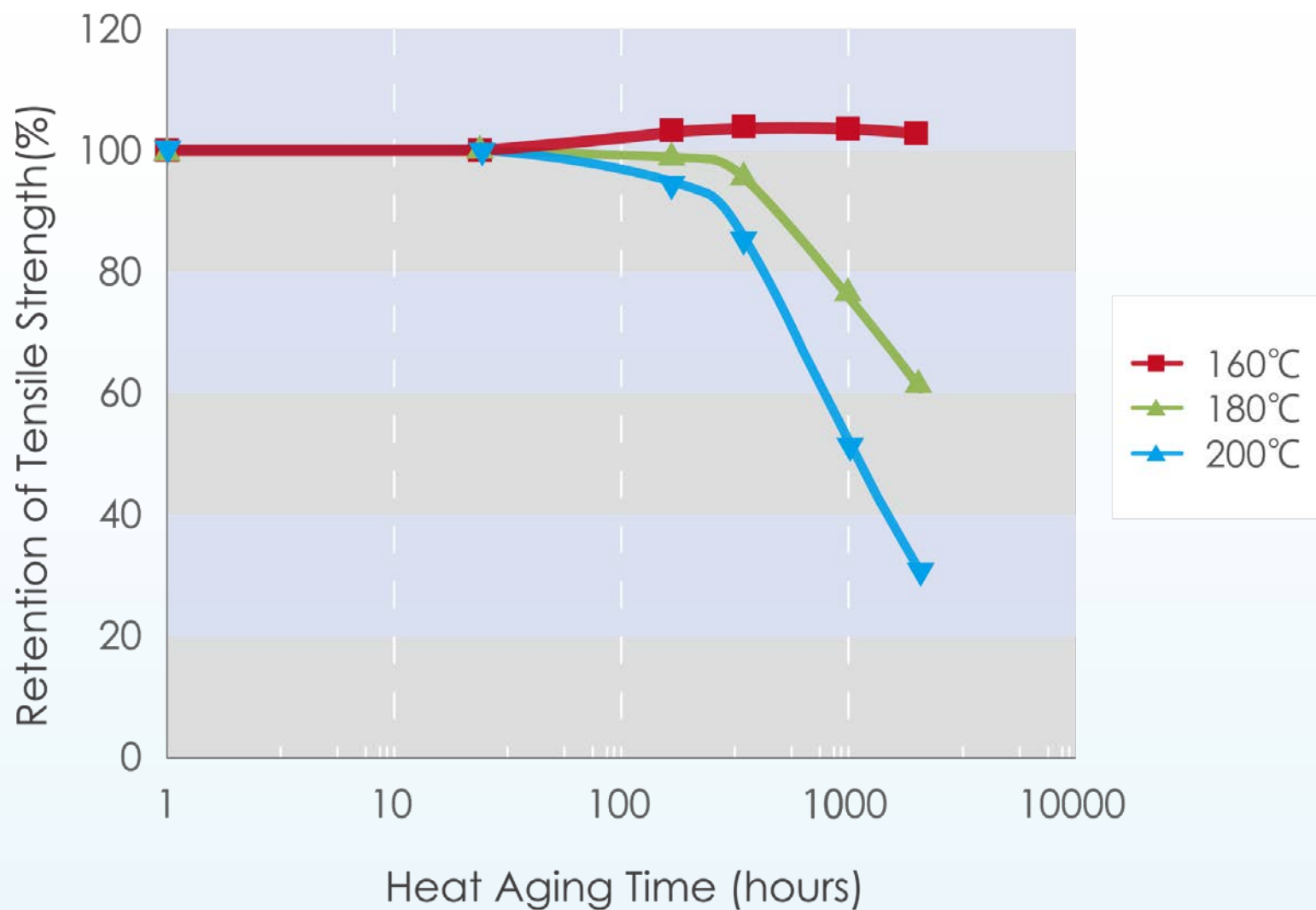
Retention(%) of strength after dipping in solvent at 23°C for 7 days
 Thickness of specimen : 0.2mmt

*Yellow cells show that maintains 80% of initial property

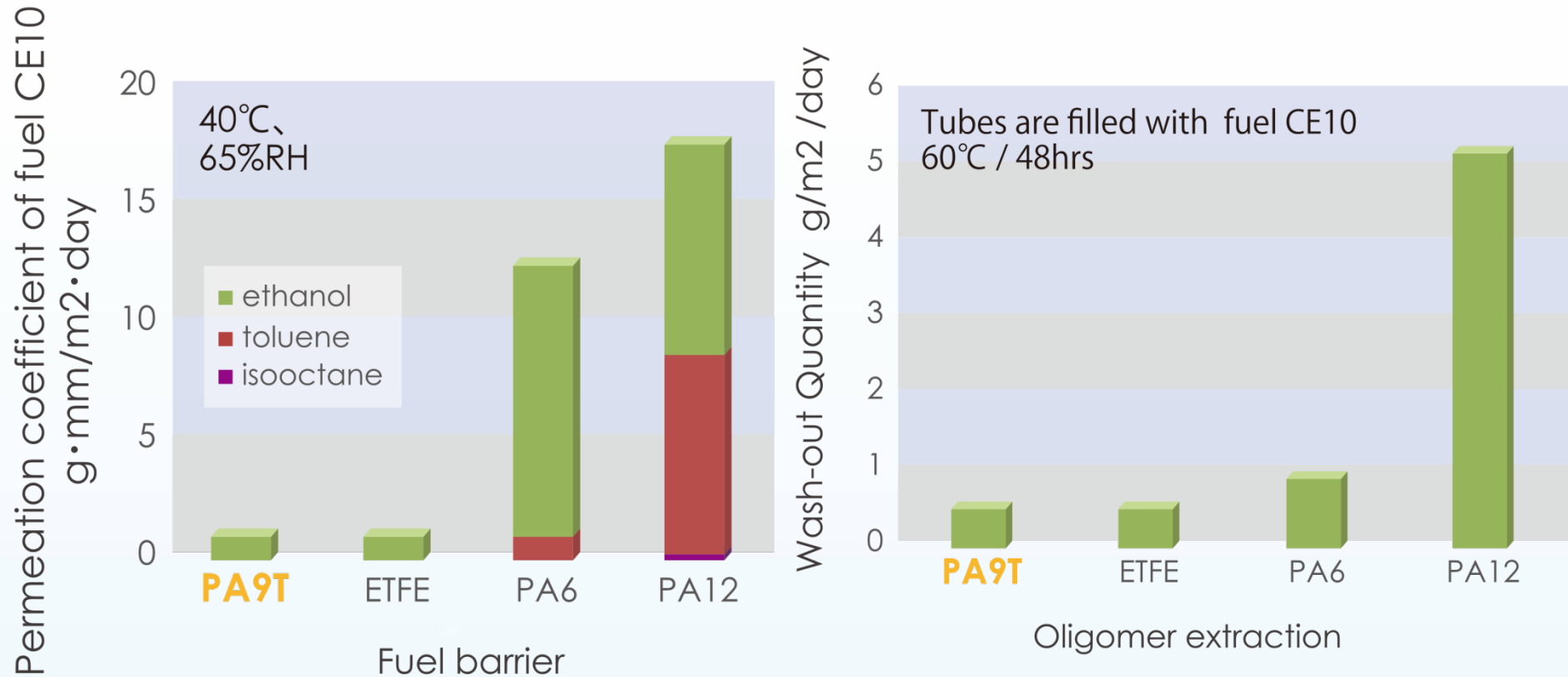


T_g : PA9T ≅ PA6T > PA46

Crystallinity : PA9T ≅ PA46 > PA6T



Fuel resistance properties

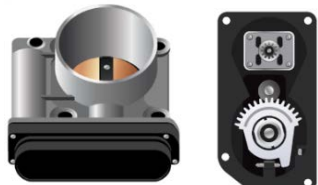


Fuel CE10: isooctane/toluene/ethanol = 45/45/10 vol.%

- Sliding
- Cooling
- Fuel
- Air Intake



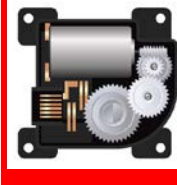
EGR Valve Motor Insulator



ETB Gear



Thermostat Housing



HVAC gear



Window Wiper Motor Gear



CAC Tank



Bearing Retainer



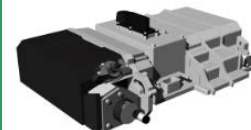
AFS system Gear



Wire Harness



Cable Tie



Fuel Cell Stack Parts



Lock Nut



Quick Connector



Fuel Tube

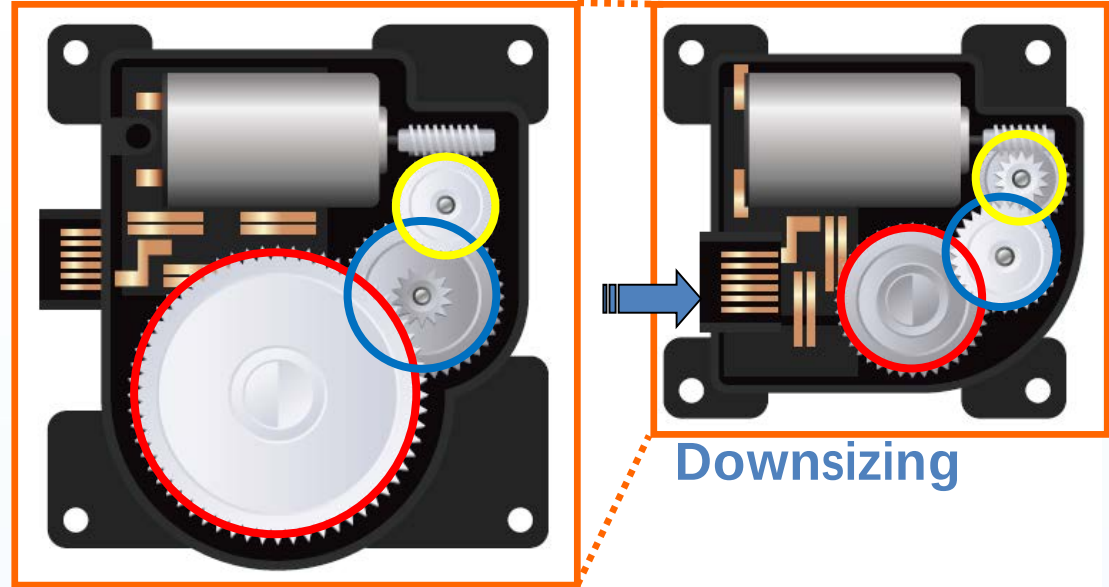
- Heat resistance
- Dimensional stability
- Chemical resistance
- Fuel barrier

©HVAC actuator gear : Low water absorption, strength at high temp.

Genestar™



Grade : G1300A, N1000A



【Conventional Materials】 POM, PA66

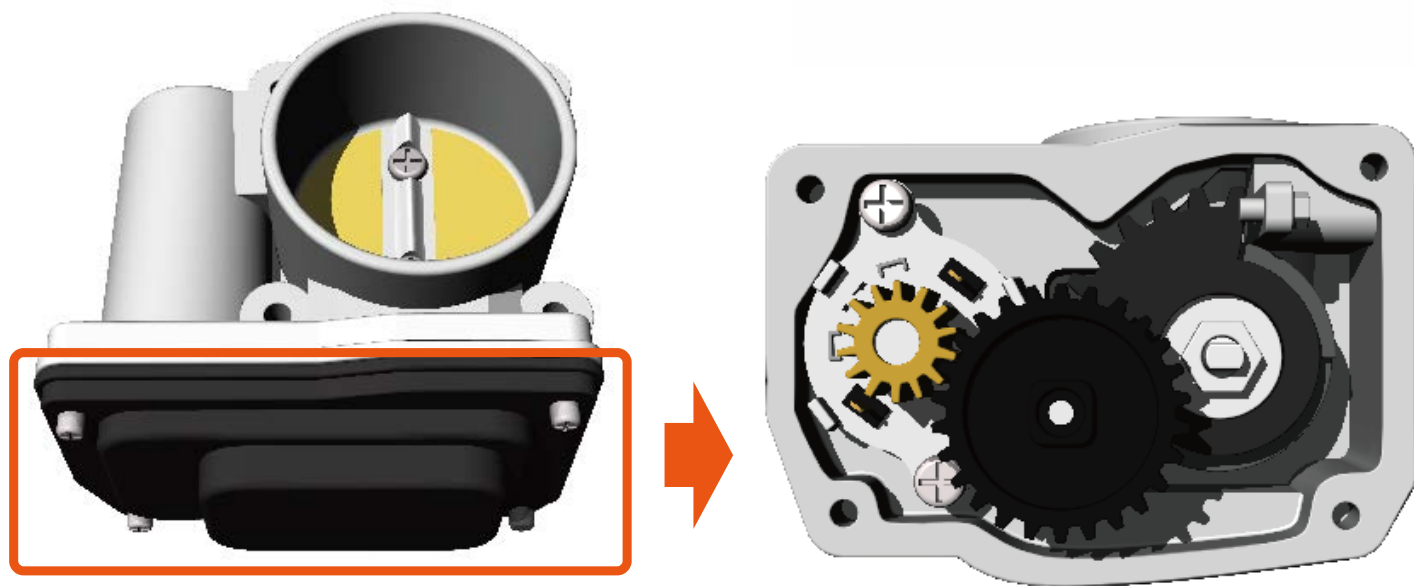
【Problems】Decrease in strength and dimensional stability due to water absorption and high heat conditions

【Requirements】Low water absorption, low friction, strength at high temp.

Advantages

- Low water absorption
- Low friction and wear
- Strength at high temp.

Gear: 60% weight reduction Actuator: 40% size reduction



Grade : G1352A

【Conventional Material】PA46

【Problem】Dimensional stability

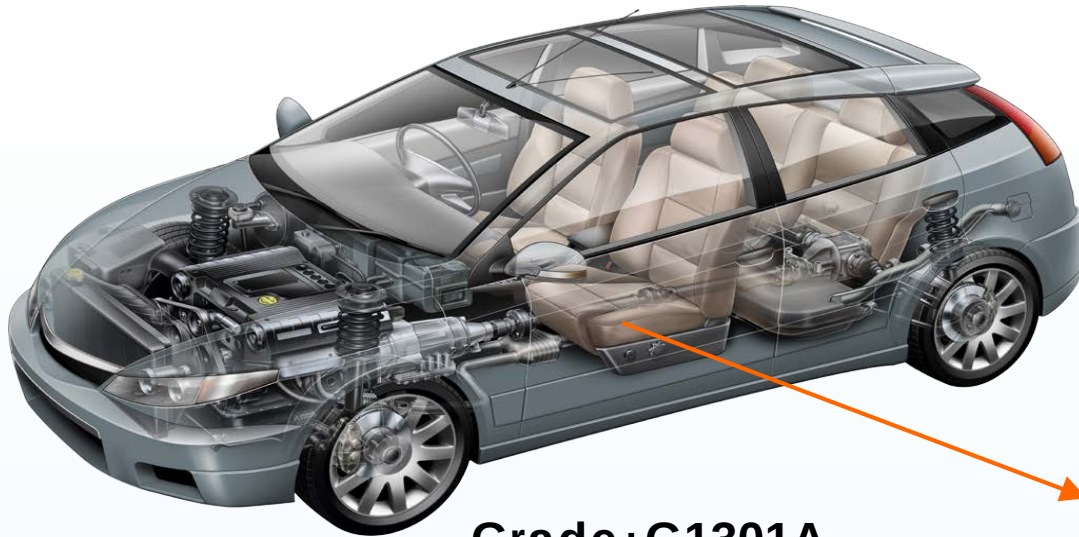
【Requirements】Low water absorption, low friction, strength at high temp.

Advantages

- Low water absorption
- Low friction and wear
- Strength at high temp.

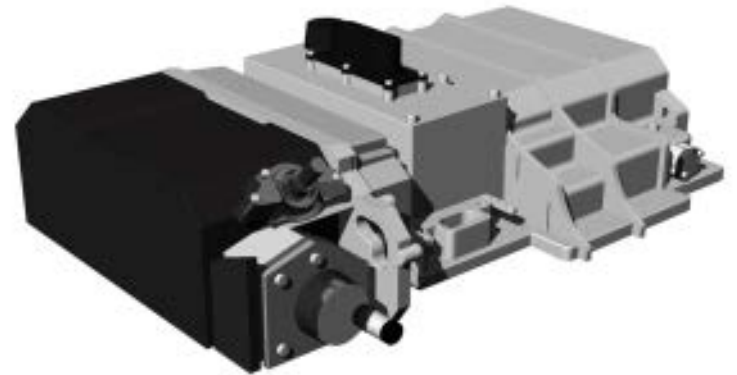
◎Cooling module for fuel cell stack :
Low water absorption, electrical insulation

Genestar™



Grade : G1301A

Fuel Cell Stack



【Conventional Material】 New part

【Requirements】 Insulation property after water absorption,
acid & LLC resistance

Advantages

- Better insulation property retention after water absorption



Grade : G1350A

【Conventional Material】 PPS

【Problems】 Heavy, low impact resistance

【Requirements】 LLC resistance, low specific gravity, ductility

Advantages

- Low specific gravity
- Less brittle
- Forced extraction

20% weight reduction (vs. PPS)



Grade : N1001A, N1006A

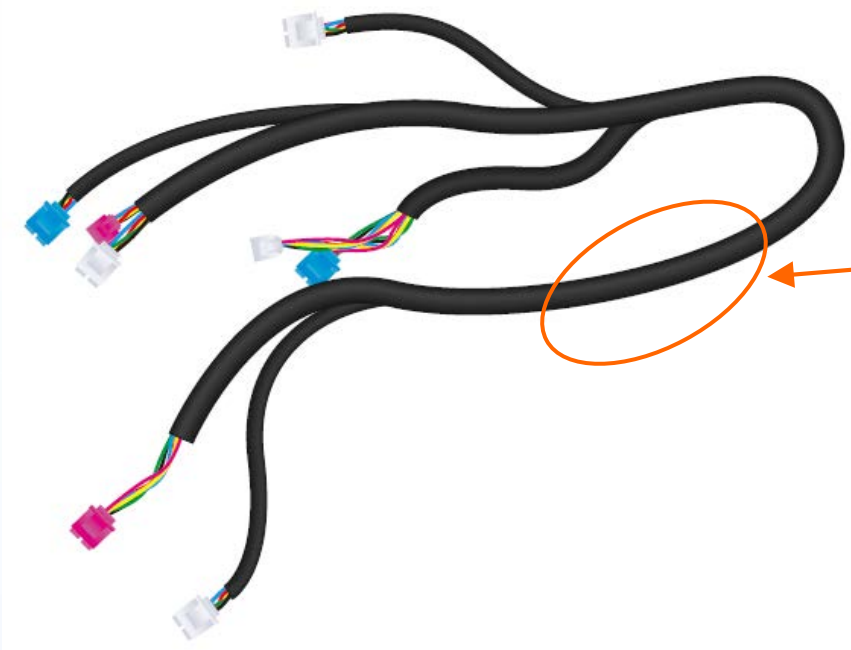
【Conventional Material】 PA46

【Problem】 Degenerated by calcium chloride

【Requirements】 Calcium chloride resistance, long term heat resistance

Advantages

- Calcium chloride resistance
- Retention of strength due to its low water absorption rate



Grade : N1006D

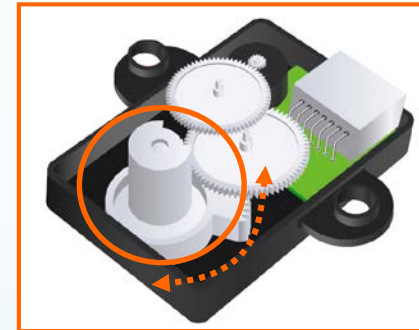
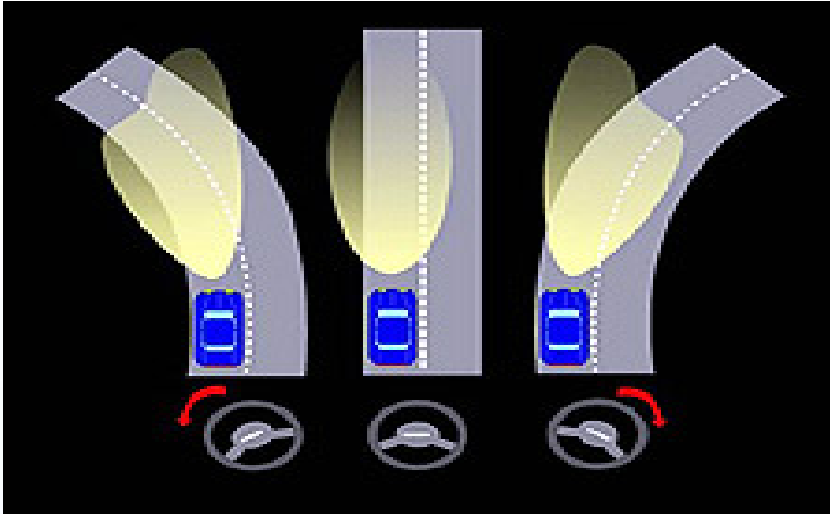
【Conventional Material】 PA46

【Problem】 Degenerated by calcium chloride

【Requirements】 Calcium chloride resistance, long term heat resistance

Advantages

- Calcium chloride resistance



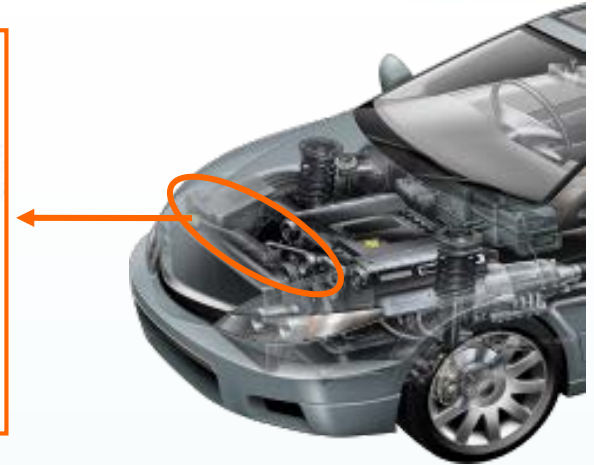
Aaptive Front Lighting System
Grade : G1300A

【Conventional Material】 New part

【Requirements】 Low friction and retention of strength under high Temp.

Advantages

- Low friction and wear
- Strength at high temp.



Grade: G1300A, G1500A, GX1500A

【Conventional Material】 Aluminum die-cast, PA46, PA66

【Problems】 Heavy, lack of chemical resistance, Long-term high-heat Resistance, Acid resistance (LPL-EGR)

【Requirements】 Chemical resistance, long-term high heat resistance, acid resistance (LPL-EGR)

Advantages

- Heat resistance
- Thermal fatigue property
- Chemical resistance

40% weight reduction (vs. Aluminum die-cast)



Fuel tank

Locknut

Grade : N1001A

【Conventional material】POM

【Requirements】Acid resistance, creep resistance

30% weight reduction (vs. POM)



Fuel tube

Grade : N1001D

【Conventional material】PA12, ETFE

【Requirements】Resistance, barrier property and low oligomer extraction against fuel

30% weight reduction (vs. ETFE)



Quick connector

Grade : G1300A, G1301A, GC1201A

【Conventional material】PA12

【Requirements】Resistance and low oligomer extraction against fuel

Typical properties of unreinforced grades

* Table shows typical values, which are not specified values.

	Unit	Test method	Genestar Unreinforced Grades					
Grade		(ISO)	N1000A	N1001A	N1002A	N1006A	N1006D	N1001D
			Standard	Abrasion resistance		Toughened	Extrusion	
Glass fiber content	%	—	0	0	0	0	0	0

Physical properties

Specific gravity	g/cm ³	118A	1.14	1.11	1.17	1.06	1.06	1.08
Water absorption(23°C in water,24hrs)	%	62	0.25	0.25	0.25	0.25	0.25	0.25

Mechanical properties

Tensile strength	MPa	527	85	80	80	50	50	60
Tensile elongation	%	527	4	12	5	20	40	15
Flexural strength	MPa	178	115	105	115	70	60	75
Flexural modules	GPa	178	2.5	2.3	2.5	1.5	1.4	1.7
Charpy impact strength (notched)	kJ/m ²	179/1eA	5	9	5	65	NB	NB

Thermal properties

Melting point	°C	11357-3	300	300	300	300	264	264
Glass transition	°C	—	125	125	125	125	125	125
DTUL(1.82MPa)	°C	75Af	125	120	125	110	105	110

Dimentional characteristics

Molding shrinkage :in direction of flow (2mmt) :at right angles to flow	%	294-4	1.4	1.4	1.4	1.4	1.7	1.5
	%	294-4	1.5	1.5	1.5	1.5	1.7	1.7

Abrasion properties

Critical PV value	kg/cm ² ·cm/sec	JIS K7218-A	850	1000	1150	1000	750	650
Coefficient of Friction P=10kgf/cm ²	—		0.45	0.15	0.25	0.25	0.15	0.15
Wear P=10kgf/cm ²	mg		200	20	5	50	180	170

Typical properties of reinforced grade

* Table shows typical values, which are not specified values.

	Unit	Test method	Genestar Reinforced Grades						
Grade		(ISO)	G1300A	G1500A	GX1500A	G1350A	G1352A	G1301A	GC1201A
			Standard		Low warpage	Hydrolysis resistance	Abrasion resistance	Toughened	Conductive
Glass fiber content	%	—	30	50	50	35	35	30	—

Physical properties

Specific gravity	g/cm ³	118A	1.37	1.58	1.58	1.40	1.50	1.34	1.22
Water absorption (23°C in water, 24hrs)	%	62	0.19	0.13	0.13	0.19	0.14	0.19	0.19

Mechanical properties

Tensile strength	MPa	527	190	250	250	200	200	175	170
Tensile elongation	%	527	2.5	2.0	2.0	2.5	2.5	3.0	3.0
Flexural strength	MPa	178	270	370	370	285	290	250	260
Flexural modulus	GPa	178	8.8	15.3	15.5	10.0	10.7	8.2	9.4
Charpy impact strength (notched)	kJ/m ²	179/1eA	10	17	17	12	13	17	12

Thermal properties

Melting point	°C	11357-3	300	300	300	300	300	300	300
Glass transition	°C	—	125	125	125	125	125	125	125
DTUL (1.82MPa)	°C	75Af	270	275	280	270	270	270	265

Dimensional characteristics

Molding shrinkage :in direction of flow (2mmt) :at right angles to flow	%	294-4	0.3	0.2	0.1	0.3	0.2	0.3	0.2
	%	294-4	0.9	0.8	0.5	0.9	0.8	0.9	0.7

Abrasion properties

Critical PV value	kg/cm ² ·cm/sec	JIS K7218-A	1025	1050	—	—	1500	1000	—
Coefficient of Friction P=10kgf/cm ²	—		0.40	0.30	0.30	—	0.30	0.30	—
Wear P=10kgf/cm ²	mg		40	60	50	—	10	15	—

Asia-Pacific

Keiichi Ota

〒461-0005, NTP Plaza 5F., 2-13-30

Higashisakura, Higashi-ku,

Nagoya-shi, Aichi, Japan

TEL : 052-933-2226

FAX : 052-933-9235

Email : Keiichi.Ota@kuraray.com

North America

Sean Cuevas

2625 Bay Area Blvd., Suite 600

Houston, TX 77058, USA

Phone : +1-281-283-1777

Fax : +1-281-283-1722

Email : sean.cuevas@kuraray.com

Europe/Middle East/Africa

Denissen, Wim

Haven 1053, Nieuwe Weg – Bus 10

B-2070 Zwijndrecht (Antwerp), Belgium

Phone : +32-3-250-9737

Fax : +32-3-250-9745

Email : Wim.Denissen@kuraray.com

South America

Vanilda Marques de Lima

Av. Paulista, 1636 – sala 405- CEP 01310-200 –

São Paulo – SP – Brasil

Phone : +55-11-2615-3531

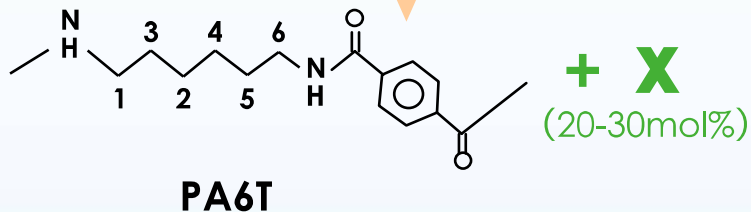
Fax : +55-11-2615-3529

Email : vanilda.lima@kuraray.com

Melting Points of Polyterephthalamides

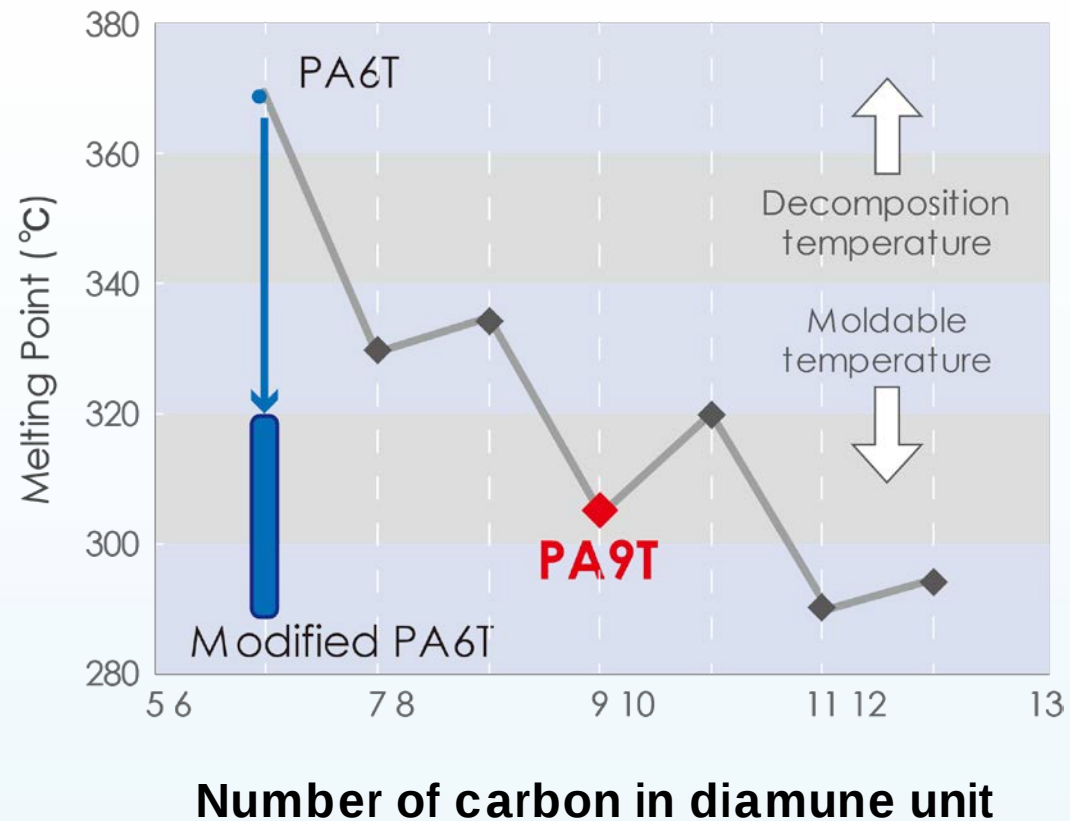
PA6T homopolymer

Co-polymerization
ex) adipic acid
isophthalic acid
methyl pentanediamine



Modified PA6T

- Lower chemical resistance
- Poor moldability
- Lower abrasion resistance



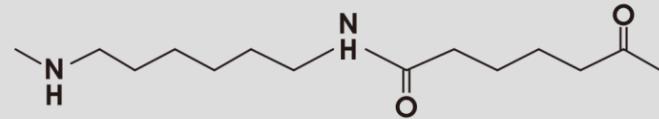
Materials (brand name, Producer)		Chemical structure	Thermal Properties
PA6-6		$\left[\text{N}(\text{H})-(\text{CH}_2)_6-\text{N}(\text{H})-\text{C}(=\text{O})-(\text{CH}_2)_4-\text{C}(=\text{O}) \right]_n$ C6 diamine adipic acid	Tm=255°C Tg=50°C
PA4-6 (Stanyl, DSM)		$\left[\text{N}(\text{H})-(\text{CH}_2)_4-\text{N}(\text{H})-\text{C}(=\text{O})-(\text{CH}_2)_4-\text{C}(=\text{O}) \right]_n$ C4 diamine adipic acid	Tm=290°C Tg=78°C
modified PA6-T	PA6-6T (Amodel A-4000, Solvay) (Zytel HTN52, Dupont)	$\left[\text{N}(\text{H})-(\text{CH}_2)_6-\text{N}(\text{H})-\text{C}(=\text{O})-(\text{CH}_2)_4-\text{C}(=\text{O})-\text{C}(=\text{O})-\text{C}_6\text{H}_4-\text{C}(=\text{O}) \right]_n$ C6 diamine adipic acid terephthalic acid	Tm=310°C Tg=80°C
	PA6-IT (Grivory, HT1, EMS)	$\left[\text{N}(\text{H})-(\text{CH}_2)_6-\text{N}(\text{H})-\text{C}(=\text{O})-\text{C}_6\text{H}_4-\text{C}(=\text{O})-\text{C}(=\text{O})-\text{C}_6\text{H}_4-\text{C}(=\text{O}) \right]_n$ C6 diamine isophthalic acid terephthalic acid	Tm=310°C Tg=80°C
	PA6-6IT (Amodel A-1000, Solvay)	$\left[\text{N}(\text{H})-(\text{CH}_2)_6-\text{N}(\text{H})-\text{C}(=\text{O})-(\text{CH}_2)_4-\text{C}(=\text{O})-\text{C}(=\text{O})-\text{C}_6\text{H}_4-\text{C}(=\text{O})-\text{C}(=\text{O})-\text{C}_6\text{H}_4-\text{C}(=\text{O}) \right]_n$ C6 diamine adipic acid isophthalic acid terephthalic acid	Tm=310°C Tg=126°C
	PA6M-T (Zytel HTN51, Dupont)	$\left[\text{N}(\text{H})-(\text{CH}_2)_6-\text{N}(\text{H})-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{N}(\text{H})-\text{C}(=\text{O})-\text{C}_6\text{H}_4-\text{C}(=\text{O}) \right]_n$ C6 diamine methylpentane diamine terephthalic acid	Tm=305°C Tg=135°C
PA9T (Genestar, Kuraray)		$\left[\text{N}(\text{H})-(\text{CH}_2)_9-\text{N}(\text{H})-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{N}(\text{H})-\text{C}(=\text{O})-\text{C}_6\text{H}_4-\text{C}(=\text{O}) \right]_n$ C9 diamine methyloctane diamine terephthalic acid	Tm=263~306°C Tg=125°C

PA : PolyAmide (Nylon)



C9-diamine + Terephthalic acid

PA66 (66Nylon)



C6-diamine + adipic acid

	Commodity Plastics	Engineering Plastics	High Performance Plastics
Crystalline	PE PP PET	POM PA66 PBT	PA9T PA46 PA6T PPS LCP PEEK PAI
Amorphous	PVC PS ABS PMMA	PC m-PPE	PES PSF PAR PEI