Mitsui Chemicals, Inc. “ARLEN® ”

Oct.4, 2010

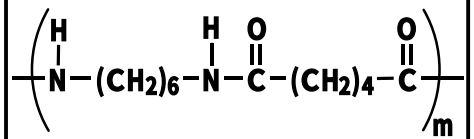
Mitsui Chemicals, Inc.

Introduction
ARLEN Base Polymer, PA6T

Mitsui Chemicals

Aliphatic PA

▶PA66, etc

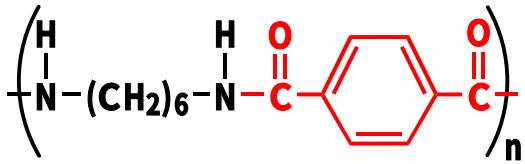


High temp. resistance

Low water absorption

Semi-aromatic PA

▶PA6T

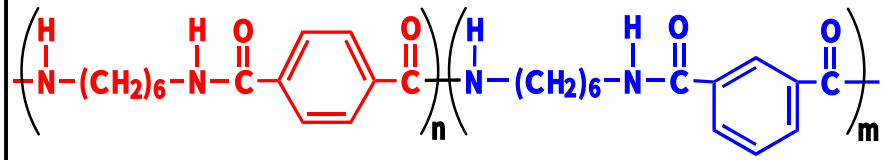


▶Tm (370 ℃) >Degradation temp.

Copolymerization to lower Tm

PA6I (Tm 220 ℃)

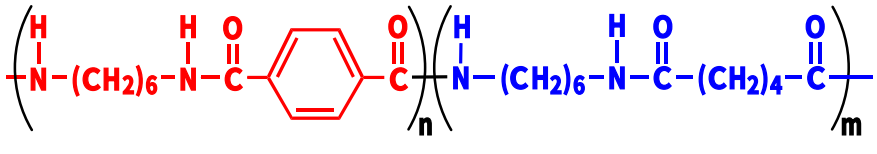
PA6T/6I



Tm 330℃ Tg 125℃

PA66 (Tm 264 ℃)

PA6T/66

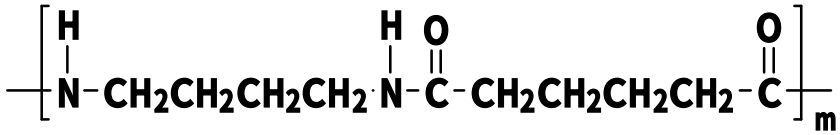
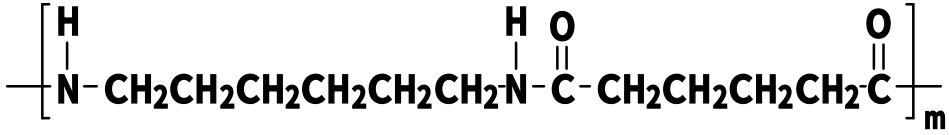
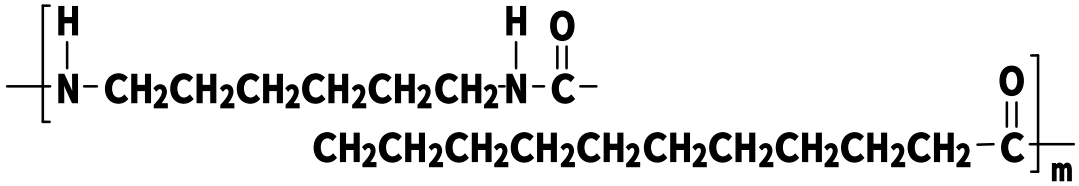
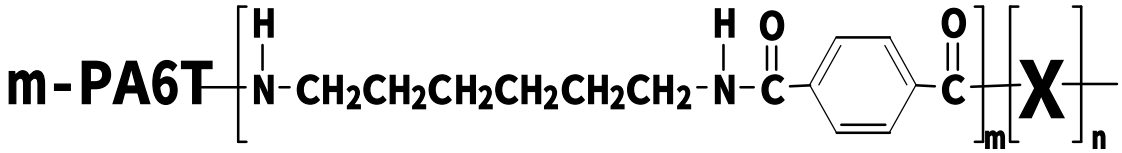


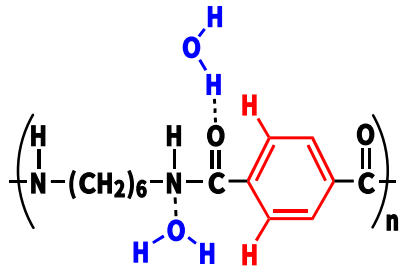
Tm 310～320℃ Tg 85～95℃

Introduction
ARLEN Base Polymer, PA6T

Mitsui Chemicals

Why does PA6T have the high temp. resistance and the low water absorption?

Polyamide	Structure	Tm/°C	Water absorption
PA46		295	High
PA66		260	
PA612		214	
m-PA6T		300 ~330	Low



Introduction
Competitor of ARLEN

Manufacture		
Du Pomt	Zytel HTN	High temperature Nylon=PA6T
Solvey	Amodel	PPA(Poly phthal amide)=PA6T
Ems	Gryvory	PPA(Poly phthal amide)=PA6T

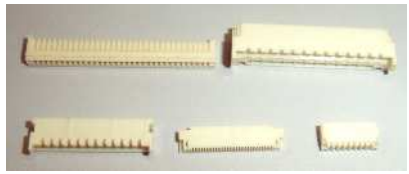
Kuraray	Genesta	PA9T

ARLEN E-Series
E-Series Line-Up

Mitsui Chemicals

E430N (GF30%)
- ▸Feature: Standard
- ▸Applications:

Spring connectors



Connectors

E430N(T5) (GF30%)
- ▸Features: High toughness (PA46 replacement)
- ▸Applications:

BtoB connectors

WtoB connectors

Jacks

E630N (GF30%)
- ▸Features: High toughness & high flowability (PA46 replacement)
- ▸Applications: Various connectors

E440N (GF40%)
- ▸Features: High strength (PPS replacement), 1.5 times higher flowability than PPS
- ▸Applications:

FPC's sliders (Actuators)

RLEN E-Series
E-Series Line-Up

Mitsui Chemicals

Physical properties		Units	ASTM	E430N	E430N(T5)	E630N	E440N
Glass fiber content		%	-	30	30	30	40
Specific gravity		-	D792	1.66	1.63	1.58	1.75
Mechanical properties							
Tensile strength		MPa	D638	180	190	210	190
Tensile elongation		%	D638[1)]	4	4	6	3
Flexural strength		MPa	D790	260	290	300	300
Flexural modulus		MPa	D790	11,800	11,800	11,700	15,000
Izod impact strength (notched)		J/m	D256	85	85	100	100
Rockwell hardness		M scale	D785	100	100	100	100
Thermal properties							
Melting point		°C	-	320	320	320	320
Glass transition point		°C	-	95	95	95	95
Deflection temp. under load (1.82 MPa)		°C	D648	305	305	310	300
Coefficient of	Flow direction	*10^{-5} °C	D696	2.2	2.1	1.6	1.8
Linear thermal expansion	Vertical direction			7.3	7.9	6.8	6.9
Electrical properties							
Volume resistivity		Ωm	D257	10^{15}	10^{15}	10^{15}	10^{15}
Dielectric constant (10^6 Hz)		-	D150	3.6	3.5	3.9	4.1
Dielectric dissipation factor (10^6 Hz)		-	D150	0.012	0.011	0.013	0.011
Dielectric breakdown voltage		kV/mm	D149	24	23	24	18
Other properties							
Mold shrinkage	Flow direction	%	D955	0.3	0.3	0.2	0.2
(2 mmt)	Vertical direction			0.9	0.7	0.8	0.6
Water absorption	23 °C	%	D570	0.3	0.3	0.3	0.2
(24 h in water, 2 mmt)	100 °C			2.7	2.7	2.7	2.1
Flammability		-	UL94	V-0	V-0	V-0	V-0

*) The above figures are just representative values and not specific values.
1) The elongation was measured between the chucks.

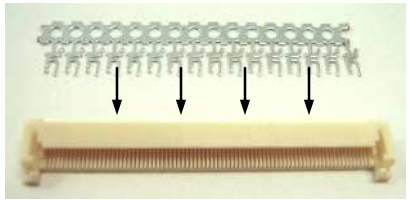
ARLEN E-Series
Important Properties for SMT Resin

Mitsui Chemicals

①Injection Molding

High **Flowability**:
Assists in making a full shot.

②Assembly

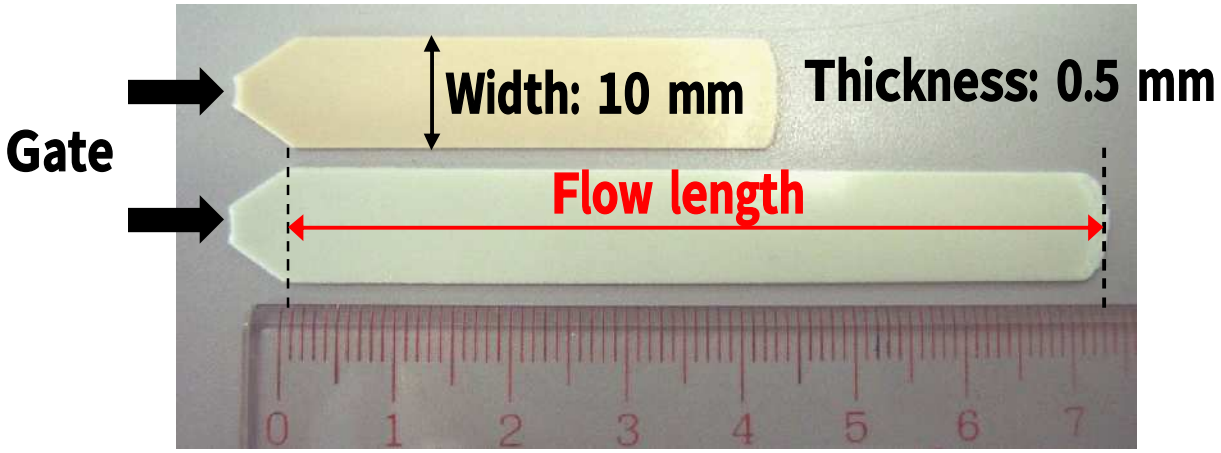


High **Toughness**:
Prevents cracking when inserting contact pins.

③Mounting (SMT)

High **Reflow Resistance Temperature**:
Avoids blistering in reflow soldering process.

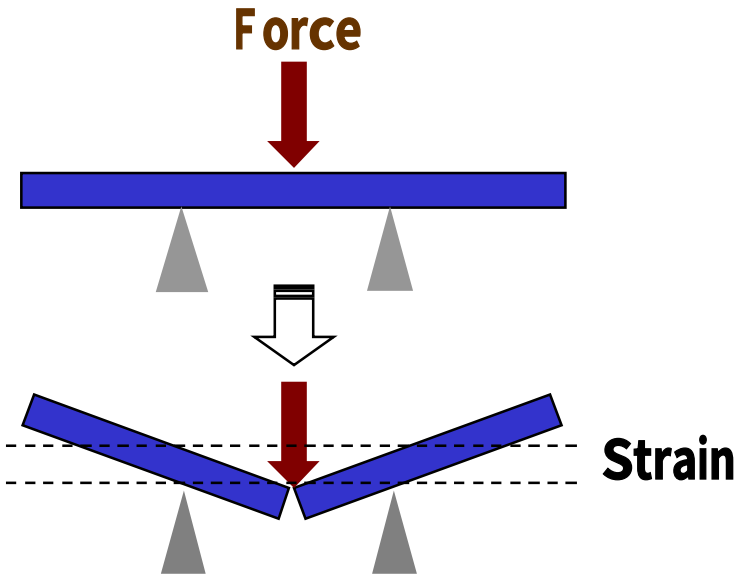
Flowability Evaluation



- ▸Barrel temp.: Tm + 10 ℃ (+α)
- ▸Mold temp.: 120 ℃

Toughness Evaluation

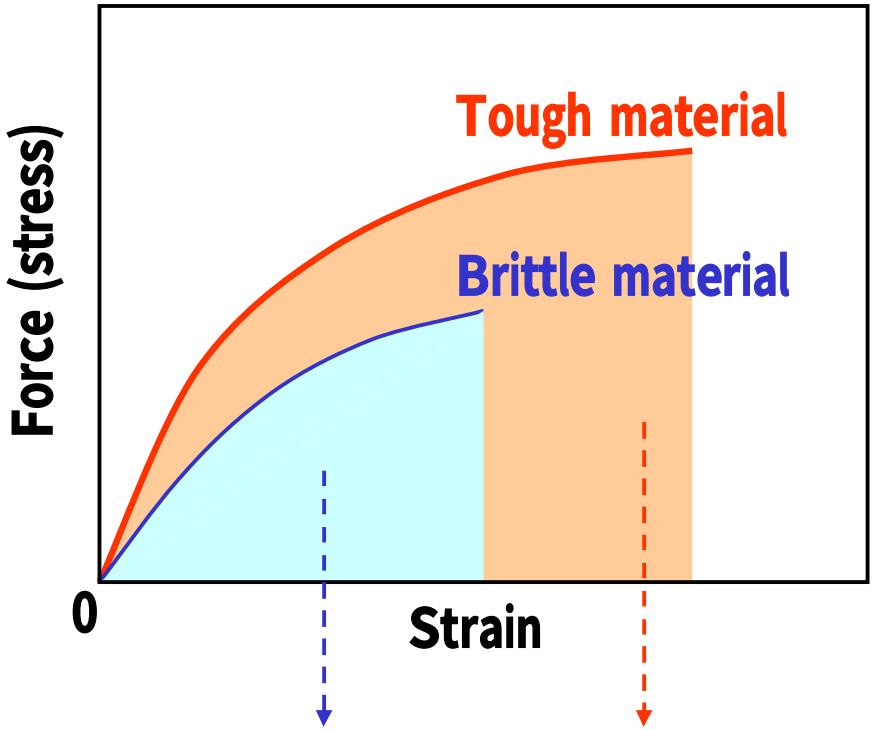
◆Test Procedure



◆Measured properties

- ▶Flexural strength
- ▶Flexural modulus
- ▶Breaking energy: Toughness
- ▶Strain

◆Specimen size: 64×6×0.8 mm



These areas are “breaking energy”.

- ▶Tough material needs more energy to break it.
- ▶Brittle material needs less energy to break it.

Reflow Resistance Temp. Evaluation

◆Test Procedure

①Exposure
- Specimen: 64×6×0.8 mm
- Conditions: 40 ℃×95% RH×96 h

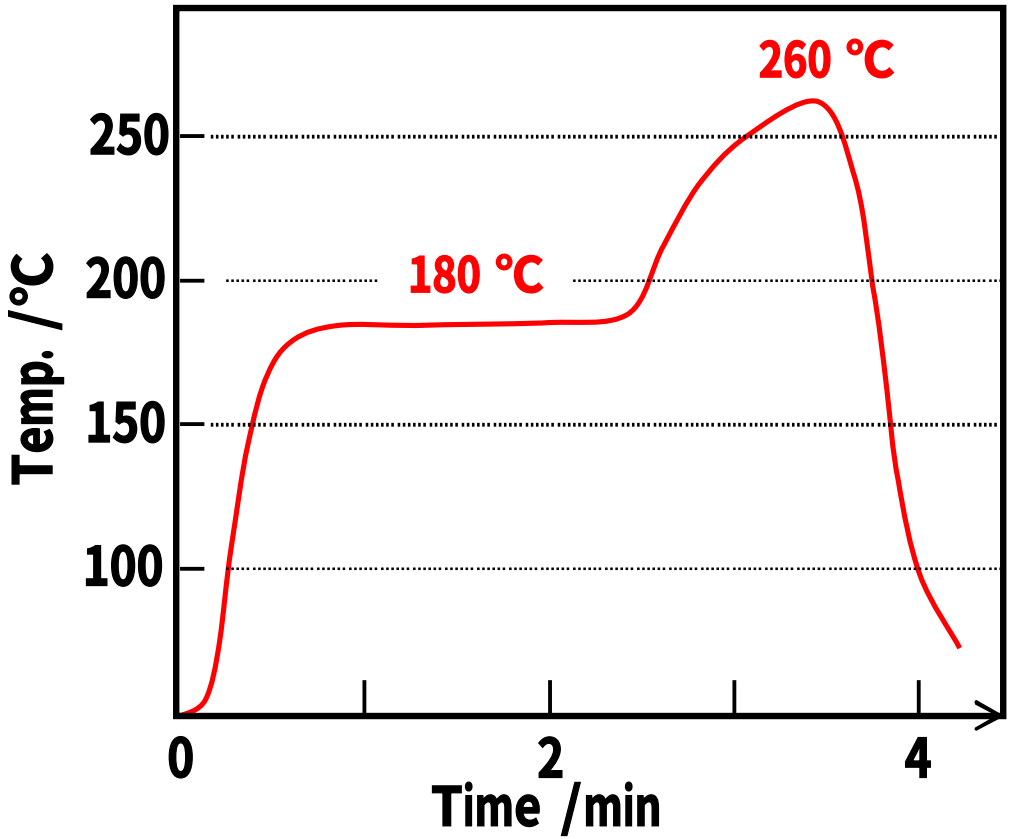
②Reflow
- Instrument：Eightech Tectron Co., Ltd., AIS-20-82C
- Heat method：Hot air (8 zones)

③Check specimen

Peak temp.	Specimen
260 ℃	
265 ℃	 Blisters

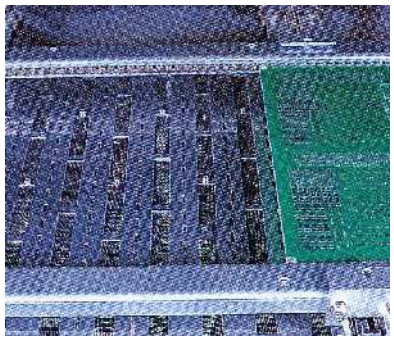
Reflow resistance temp.: 260 ℃

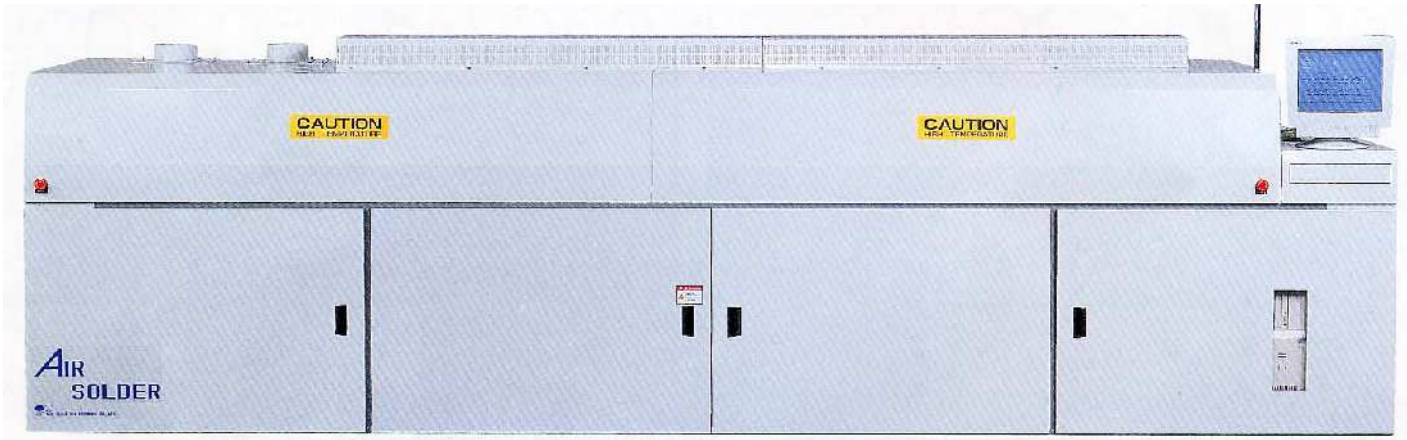
◆Example of reflow profile



Reflow Resistance Temp. Evaluation

◆Reflow instrument





Features of SMT Application

Properties	*Standard* E430N	*High Toughness* E430N(T5)	*Ultra-High Toughness* E630N	*High Strength* E440N
Flow length /mm (Cylinder temp. /°C)	56 (330)	62 (330)	74 (330)	52 (330)
Flexural strength /MPa	240	260	275	280
Flexural modulus /MPa	13,000	12,700	12,500	17,000
Braking energy /mJ	42	53	63	45
Strain /mm	3.2	3.7	4.0	2.9
Reflow resistance temp. /°C (Water absorption[1] /%)	260 (1.9)	260 (2.0)	265 (2.1)	260 (1.4)

1) Conditions: 40 °C * 95% RH * 96 h.

ARLEN E-Series
Comparison of E630N with Other SMT Resins

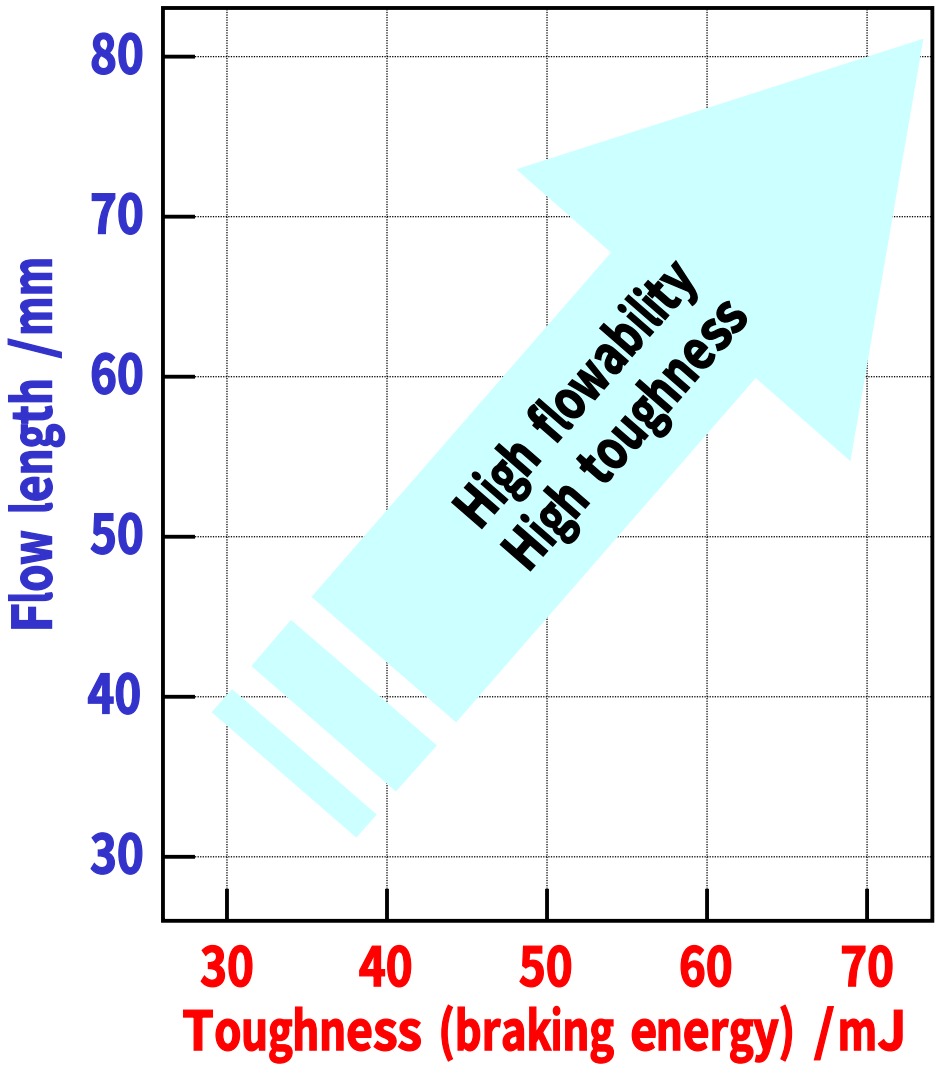
Mitsui Chemicals

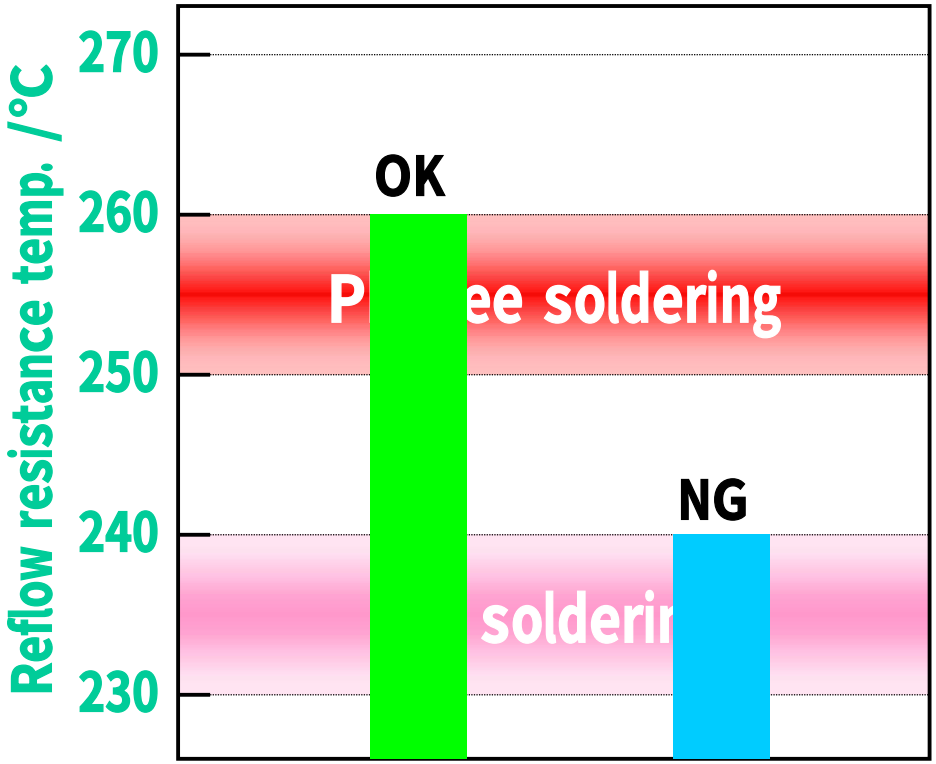
vs. PA46

Properties	E630N	E430N(T5)	PA46
Flow length /mm (Cylinder temp. /°C)	74 (330)	62 (330)	60 (310)
Flexural strength /MPa	275	260	250
Flexural modulus /MPa	12,500	12,700	12,000
Braking energy /mJ	63	53	59
Strain /mm	4.0	3.7	3.9
Reflow resistance temp. /°C (Water absorption[1] /%)	265 (2.1)	260 (2.0)	<230 (3.9)

1) Conditions: 40 °C * 95% RH * 96 h.

ARLEN E-Series
Comparison of E630N with Other SMT Resins



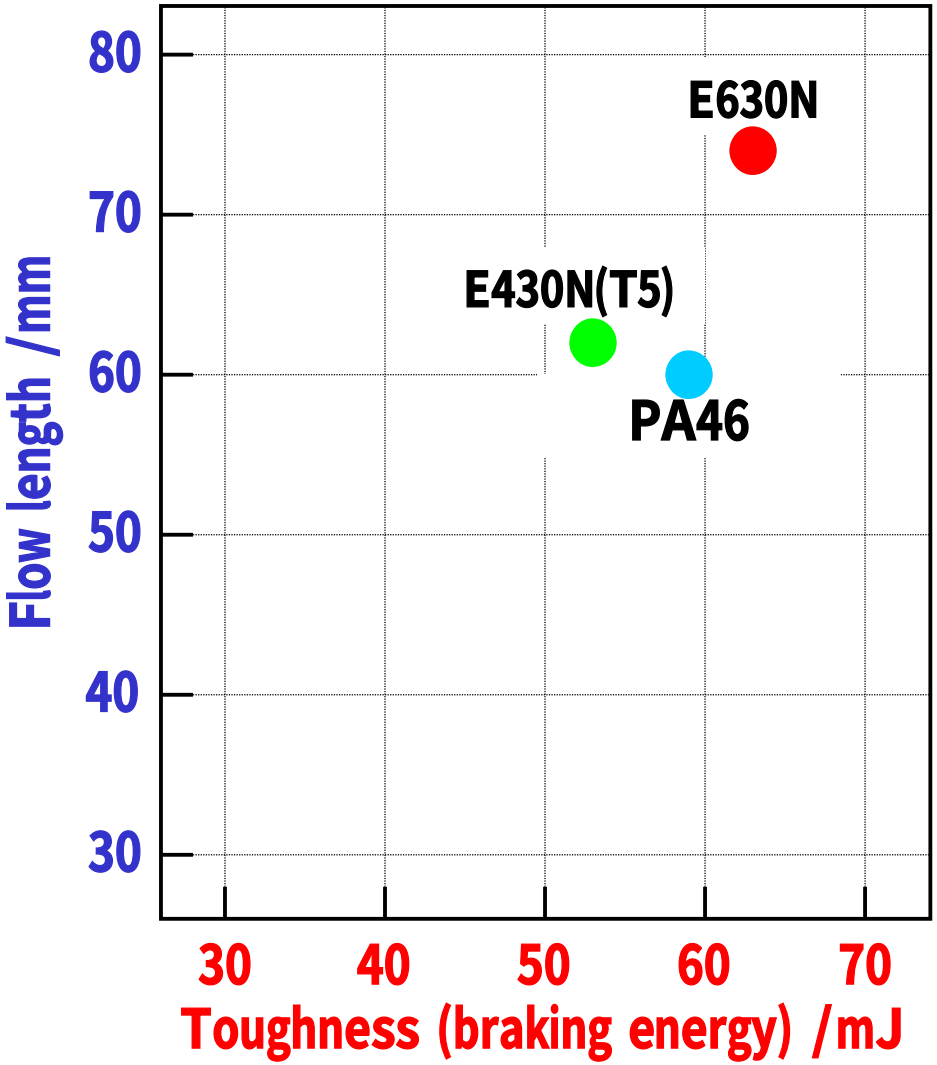


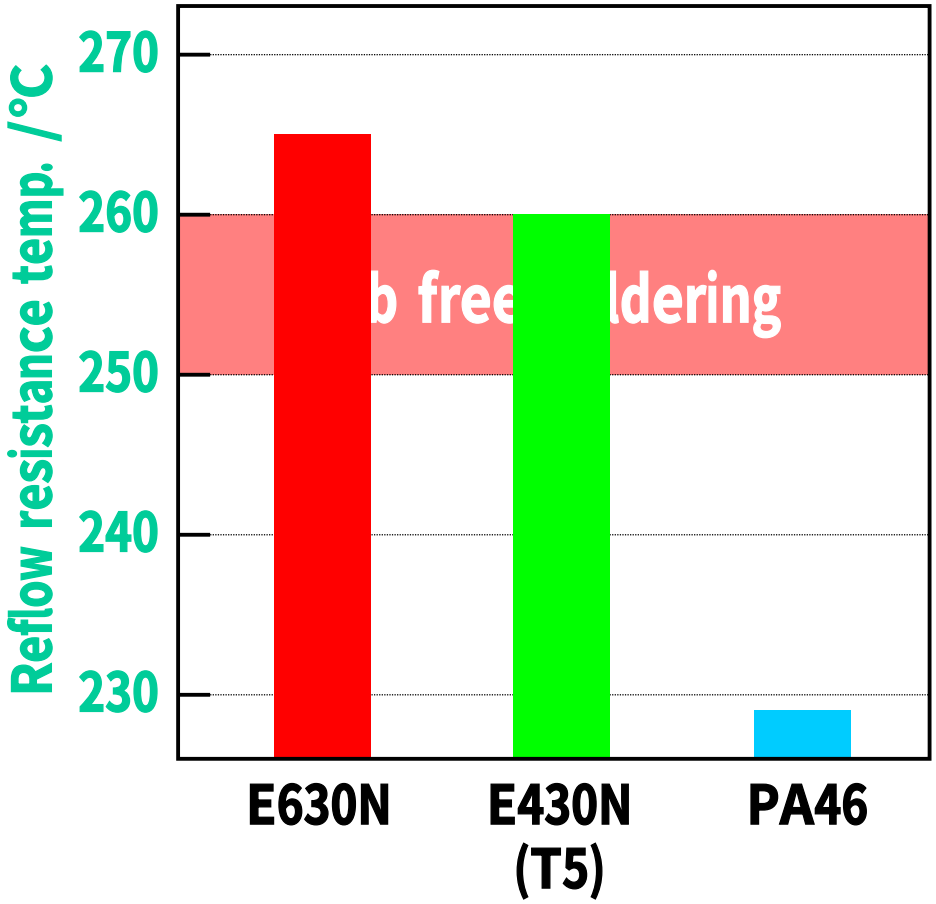
★Reflow resistance temp. depends on connector designs, molding conditions, etc.

ARLEN E-Series
Comparison of E630N with Other SMT Resins

Mitsui Chemicals

vs. PA46





ARLEN E-Series
Comparison of E630N with Other SMT Resins

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Mitsui Chemicals

vs. HTN, PA9T

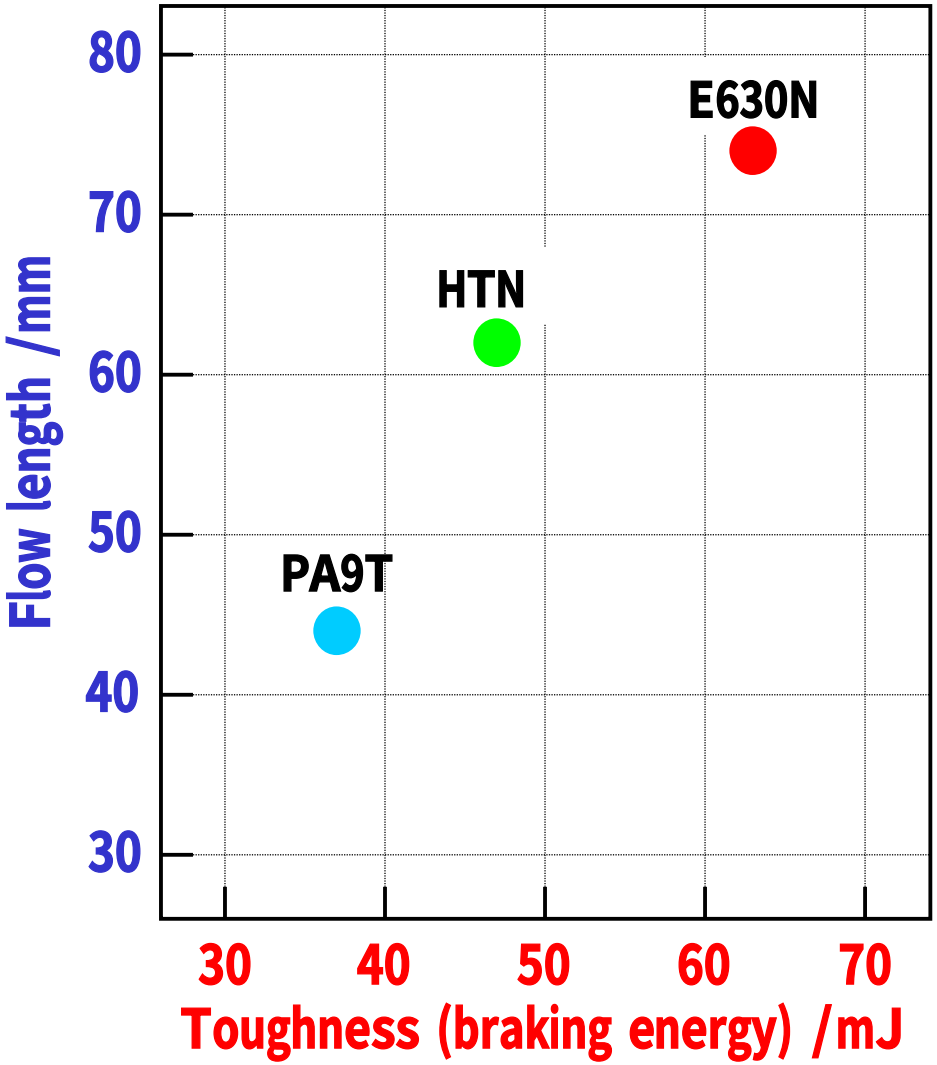
Properties	E630N	HTN	PA9T
Flow length /mm (Cylinder temp. /°C)	74 (330)	62 (325)	44 (320)
Flexural strength /MPa	275	240	240
Flexural modulus /MPa	12,500	12,000	13,300
Braking energy /mJ	63	47	37
Strain /mm	4.0	3.4	2.9
Reflow resistance temp. /°C (Water absorption[1] /%)	265 (2.1)	260 (2.1)	270 (0.8)

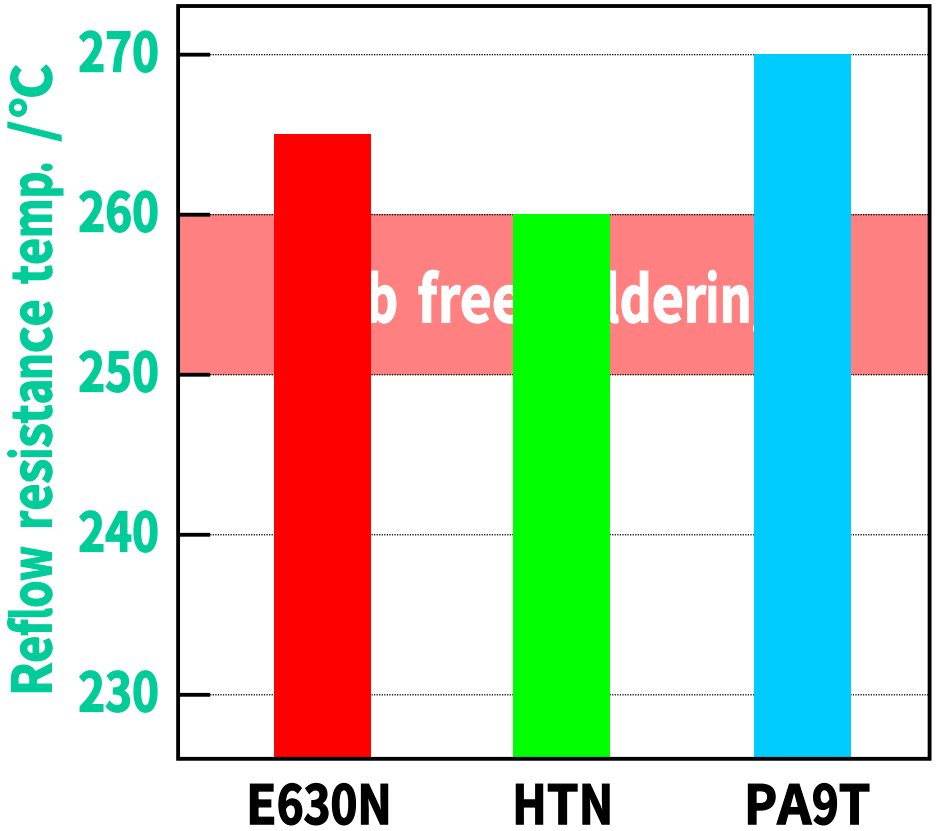
1) Conditions: 40 °C * 95% RH * 96 h.

ARLEN E-Series
Comparison of E630N with Other SMT Resins

Mitsui Chemicals

vs. HTN, PA9T





ARLEN E-Series
Comparison of E630N with Other SMT Resins

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Mitsui Chemicals

vs. LCP

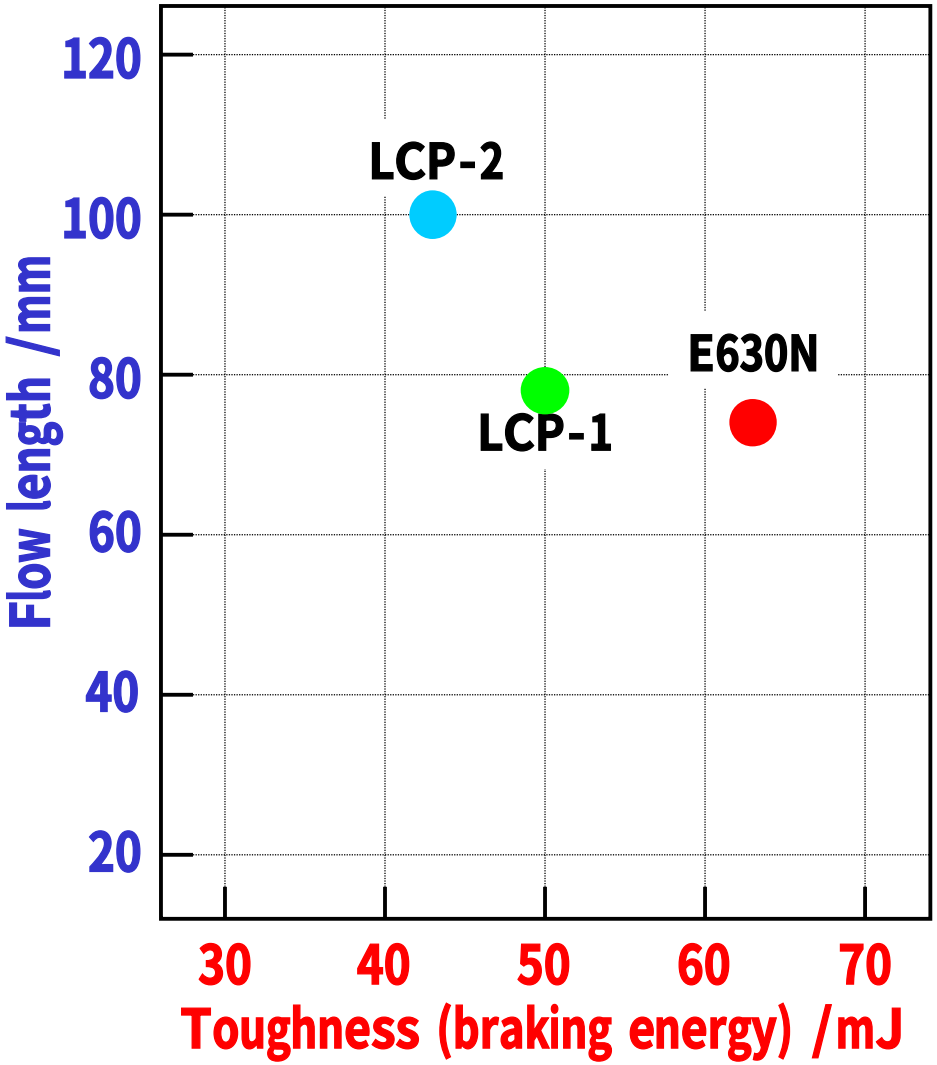
Properties	E630N	LCP-1 (GF30)	LCP-2 (GF40?)
Flow length /mm (Cylinder temp. /°C)	74 (330)	78 (340)	100 (340)
Flexural strength /MPa	275	240	180
Flexural modulus /MPa	12,500	20,000	19,000
Braking energy /mJ	63	50	43
Strain /mm	4.0	3.3	2.6
Reflow resistance temp. /°C (Water absorption[1] /%)	265 (2.1)	>280 (0.1)	>280 (0.1)

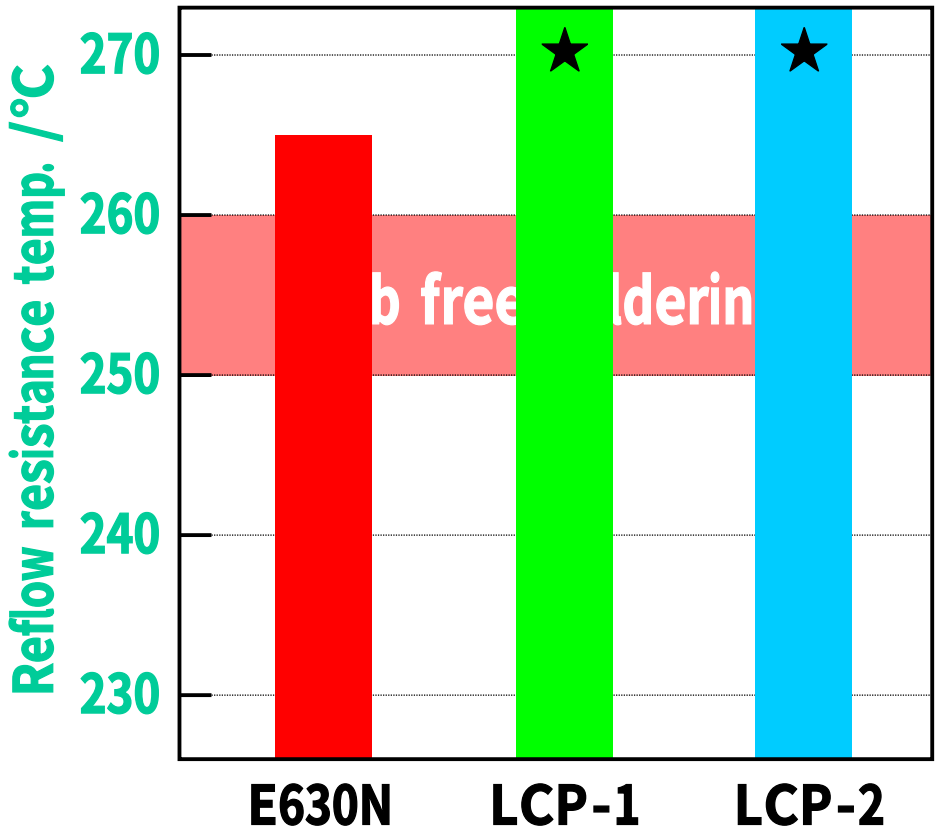
1) Conditions: 40 °C * 95% RH * 96 h.

ARLEN E-Series
Comparison of E630N with Other SMT Resins

Mitsui Chemicals

vs. LCP



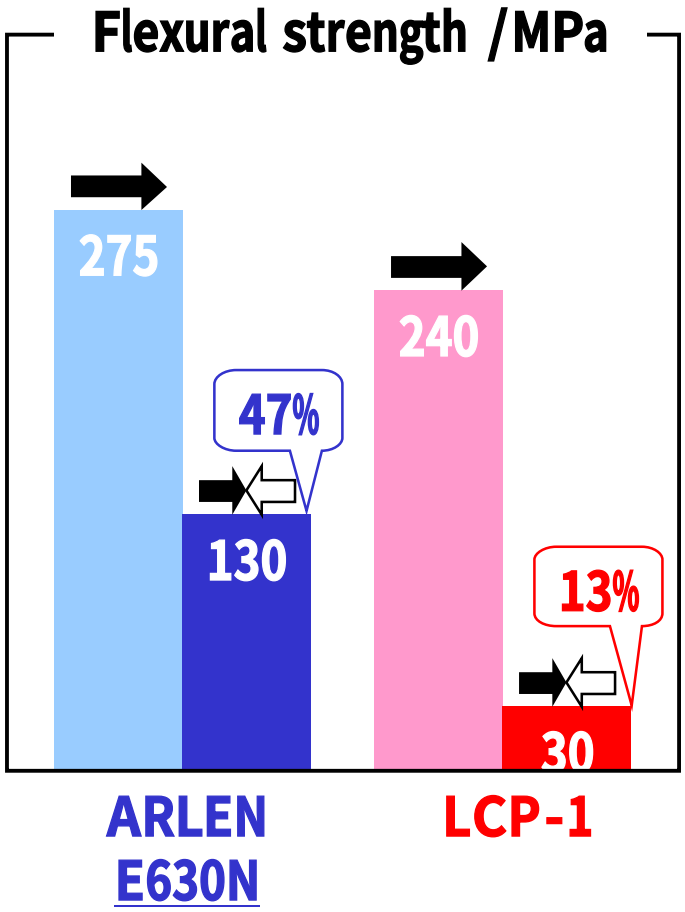


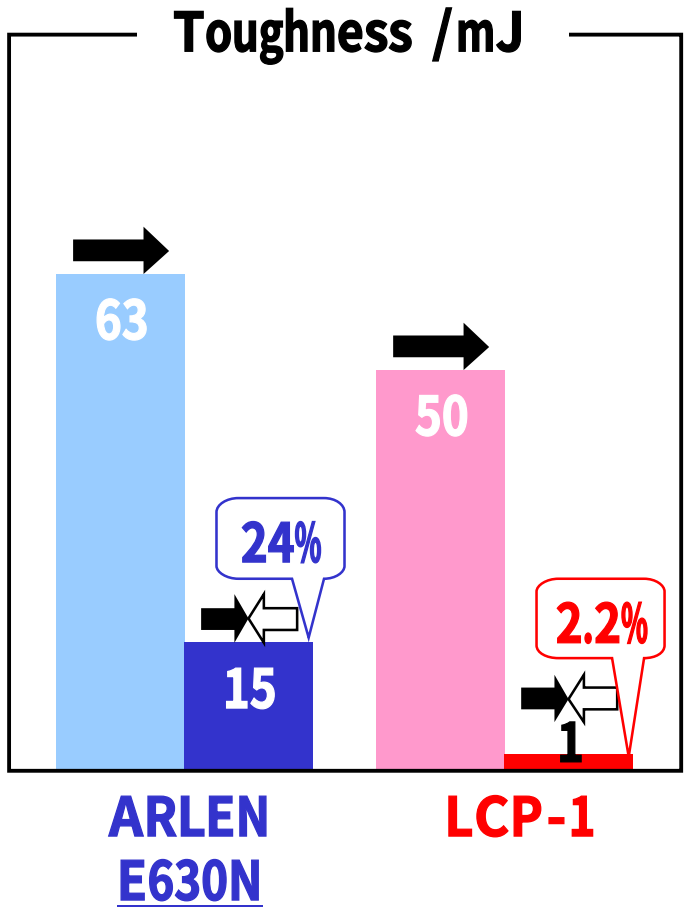
★Reflow performance depends on connector designs, molding conditions, etc.

ARLEN E-Series
Comparison of E630N with Other SMT Resins

Mitsui Chemicals

vs. LCP





: Without weld line

: With weld line

ARLEN E-Series
Comparison of E440N with Other SMT Resins

Mitsui Chemicals

vs. PPS

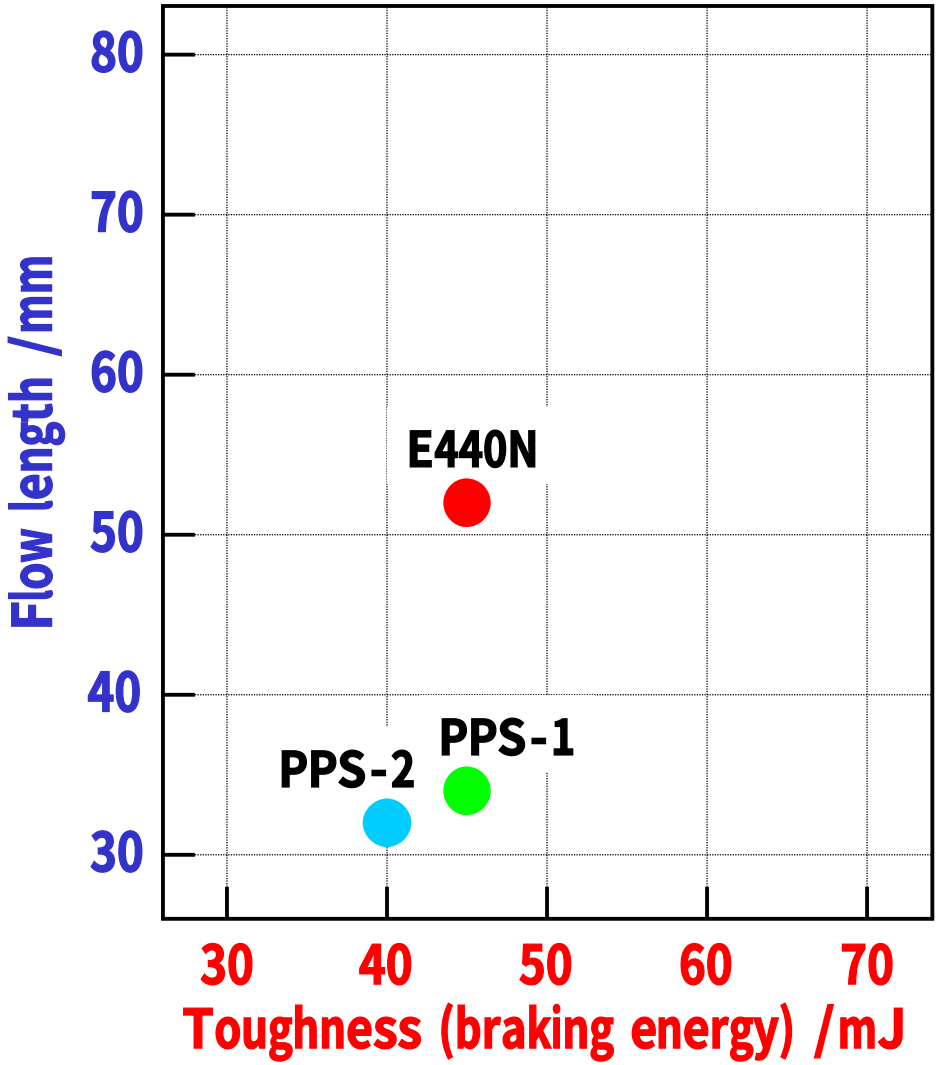
Properties	E440N (GF40)	PPS-1 (GF40)	PPS-2 (GF40)
Flow length /mm (Cylinder temp. /°C)	52 (330)	34 (320)	32 (320)
Flexural strength /MPa	280	280	250
Flexural modulus /MPa	17,000	16,000	16,300
Braking energy /mJ	45	45	40
Strain /mm	2.9	3.0	2.8
Reflow resistance temp. /°C (Water absorption[1] /%)	260 (1.4)	260 (0.1)	260 (0.1)

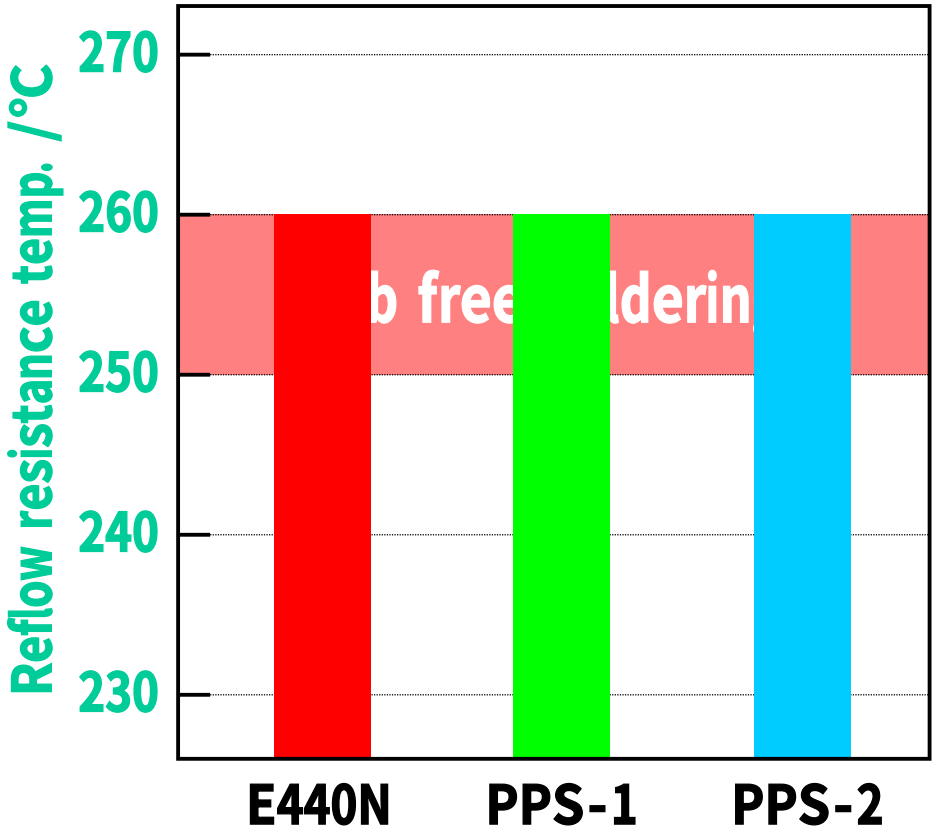
1) Conditions: 40 °C * 95% RH * 96 h.

ARLEN E-Series
Comparison of E440N with Other SMT Resins

Mitsui Chemicals

vs. PPS





ARLEN E-Series
Comparison of E440N with Other SMT Resins

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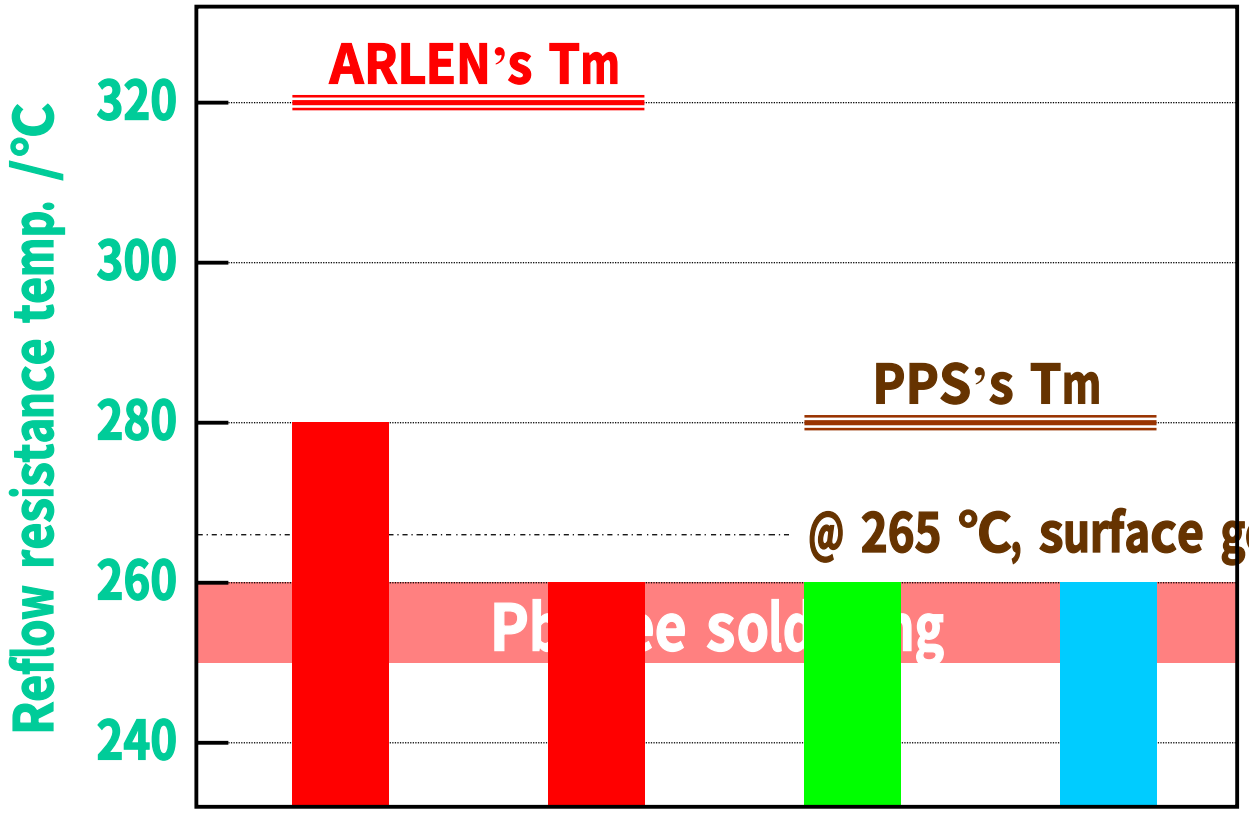
Mitsui Chemicals

vs. PPS



ARLEN E-Series Summary

Mitsui Chemicals

	Toughness	Flowability	Reflow Resistant (Pb-free solder)	Weld Line Strength	Flash
ARLEN	++	+	+	+	+
HTN	+	+	+/-	+	+
PA9T	-	-	+	+	+
PA46	++	+	-	+	+
PPS	+/-	-	+, -	+	-
LCP	+/-	++	++ (-)	-	++

*) ++: Excellent, +: Good, +/-: Acceptable, -: Bad

Mitsui Chemicals

- ARLEN E630N and E440N are suitable molding material for Pb-free soldering process.
- Special features of ARLEN E630N for SMT (Pb-free) connector are,
  i) high toughness
  ii) high flowability
- Special features of ARLEN E440N for SMT (Pb-free) connector are,
  i) high rigidity
  ii) high flowability (compared to PPS)