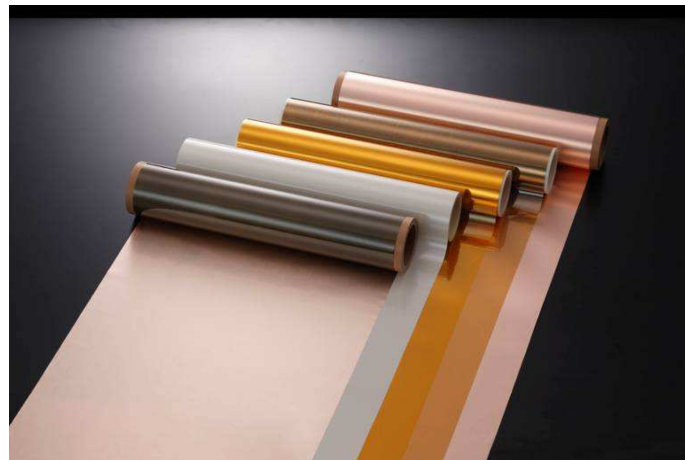
Panasonic
FELIOS

Proposal to Flexible PCB Materials



June, 2008

Confidential

Matsushita Electric Works, Ltd.

Contents

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FELIOS

1. Core Technology and Capability

2. Total Solution for FPC & Rigid Flex

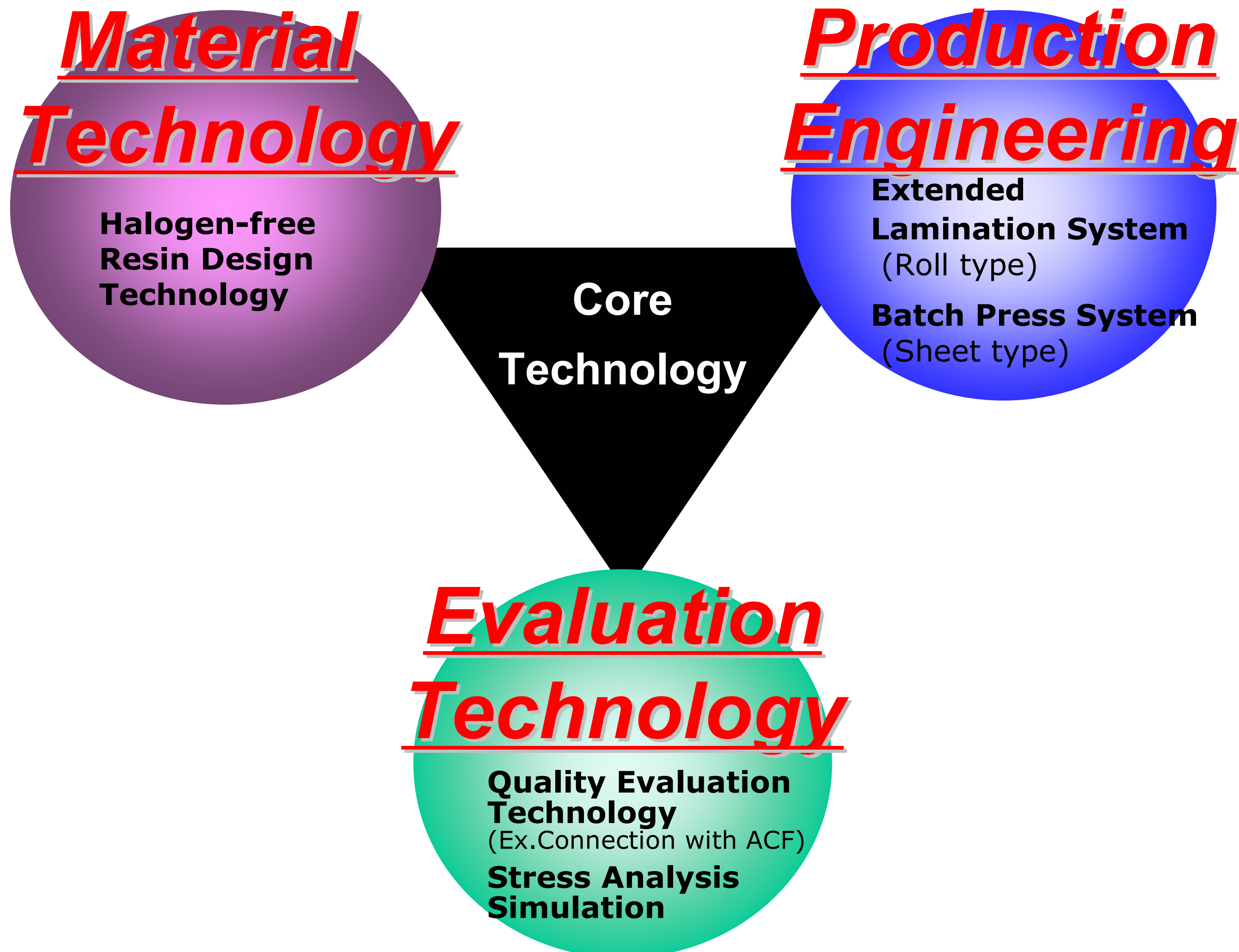
3. Technology and Product Advantage

4. Product Offering Availability

5. What’s New?

1.Core Technology and Capability

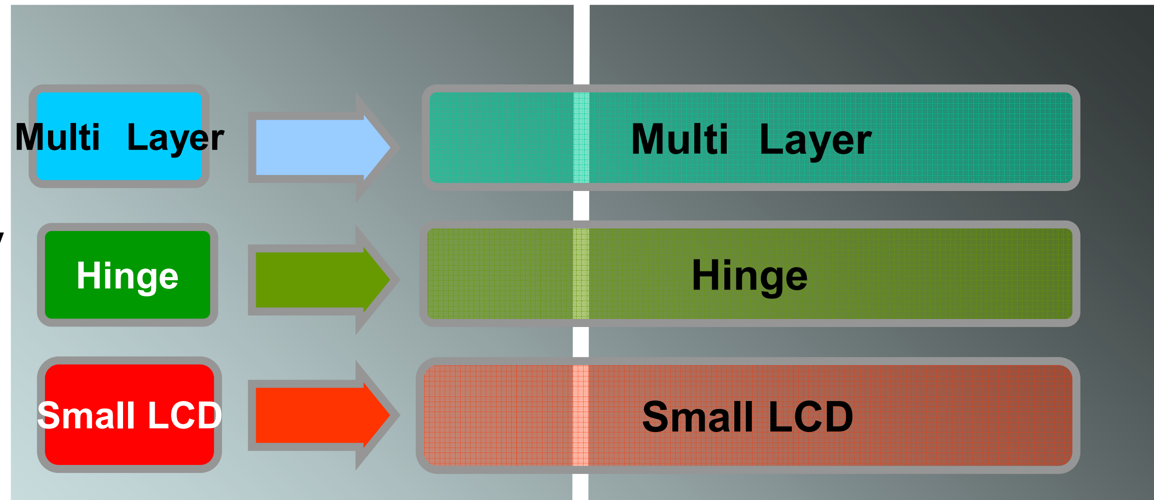
1-1. Core Technology



1-2. FPC Material Marketing Strategy

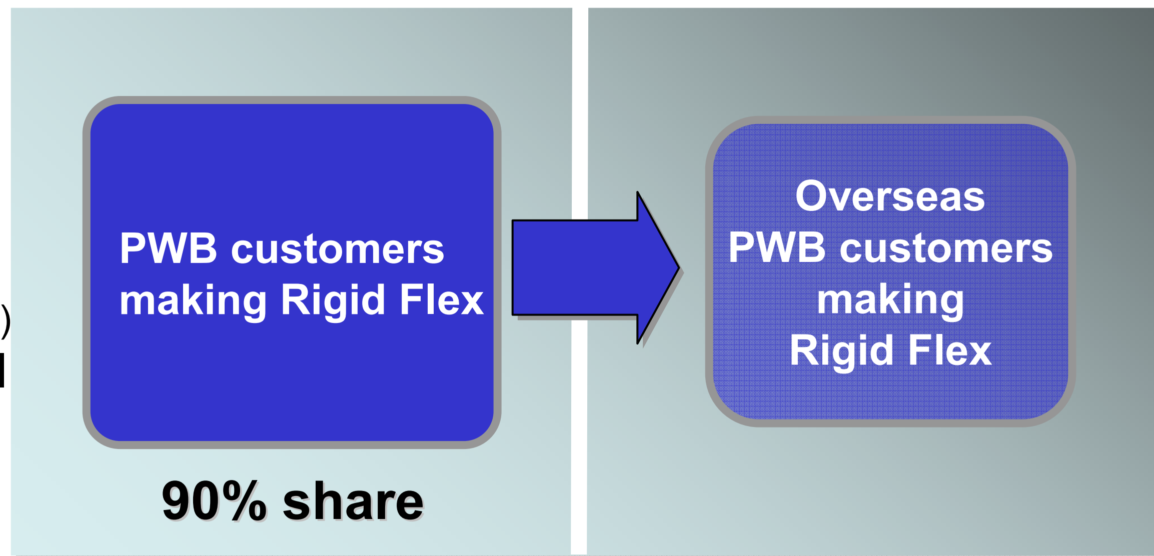
FPC Users

- **Focus Application**
- **Evaluation Technology**
  (Ex; Bending test method cooperative development with customer and OEM)



Rigid Flex Users

- **Total Solution**
  (All HF Materials -Rigid & FCCL)
- **Existing Sales Channel**



Japan Non Japan

1-3. 2Layer D/S FCCL Market

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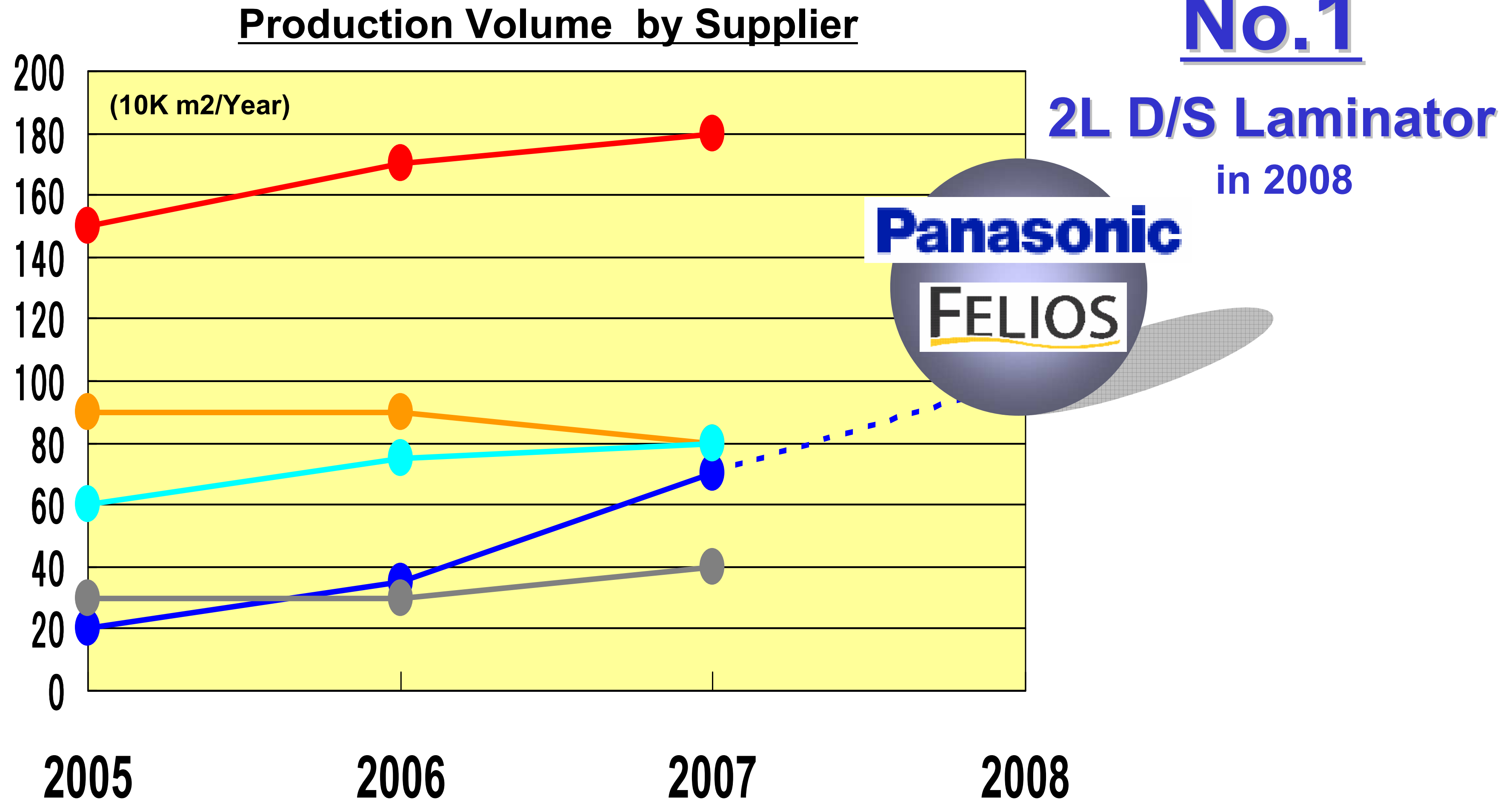

*Source: Yano Economy Research Report with modification by MEW

1-4. Production Capacity

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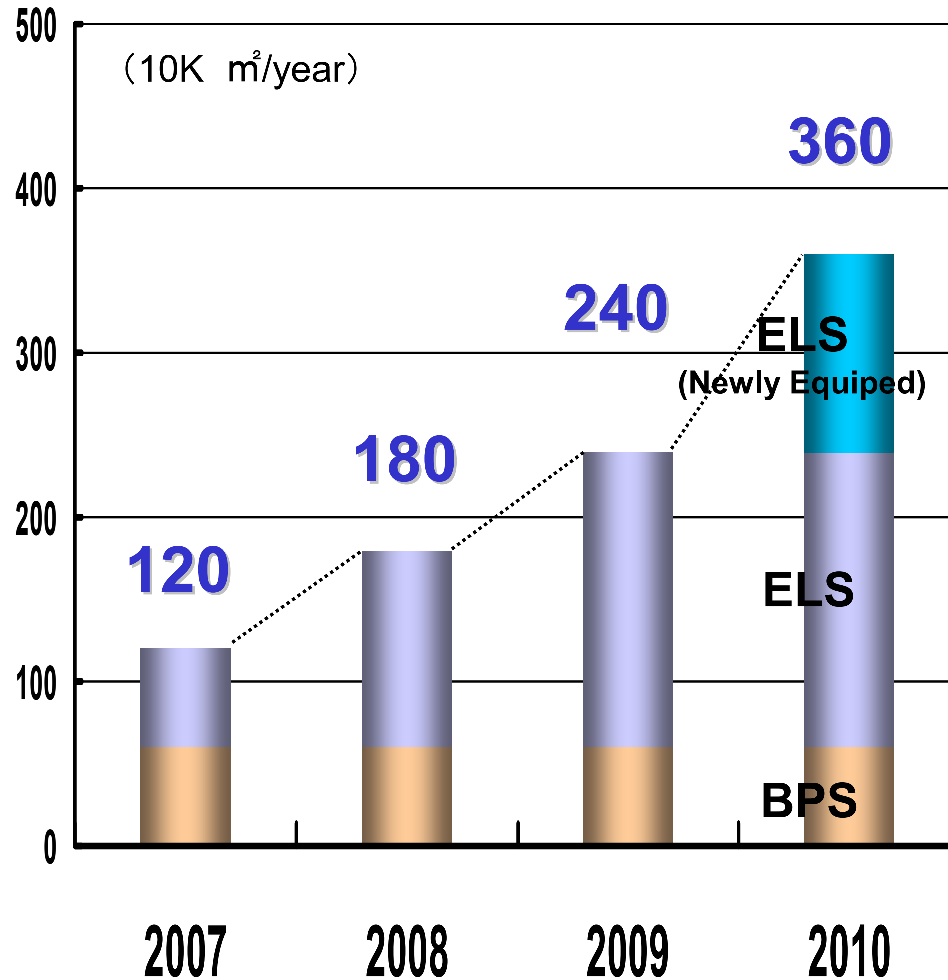
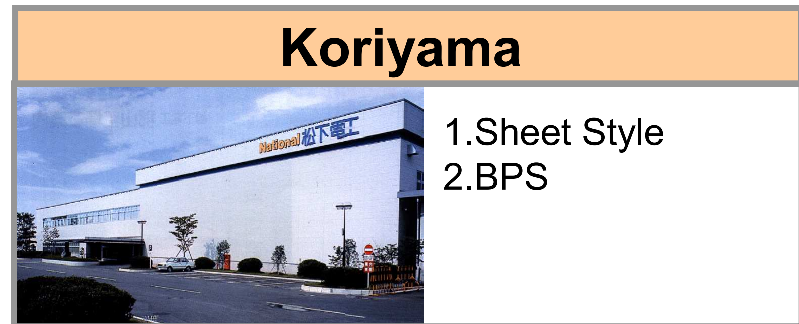


Yokkaichi

1.Roll Style
2.ELS

Koriyama



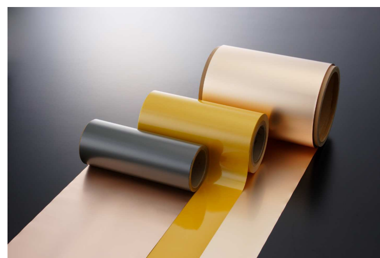
1.Sheet Style
2.BPS

1-5. ISO & Environmental Friendly

■ISO

【Koriyama Factory】	ISO9001	April 2005
	ISO14000	April 2005
	TS16949	May 2007
【Yokkaichi Factory】	ISO9001	August 2006
	ISO14000	February 2007
	TS16949	March 2007

■Environmental Friendly



FELIOS

eco ideas

All Halogen Free Type

2. Total Solution for FPC & Rigid Flex

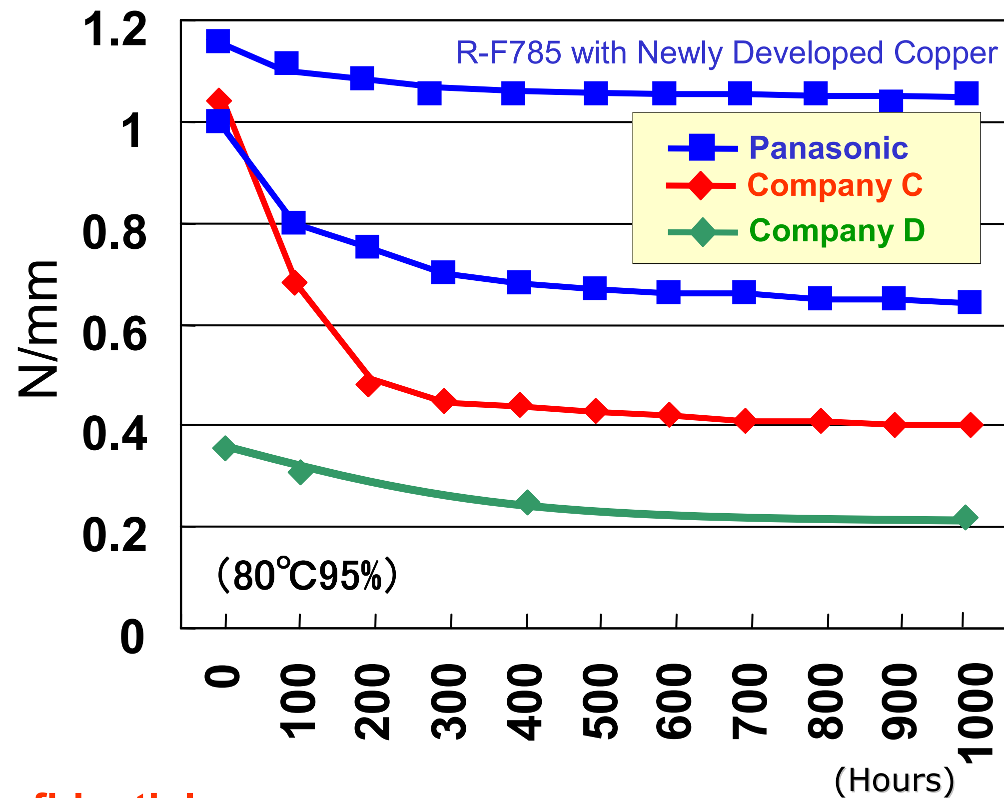
2-1. Total Solution for FPC

Panasonic FELIOS

Proposal for LCD Module with improved ACF connection

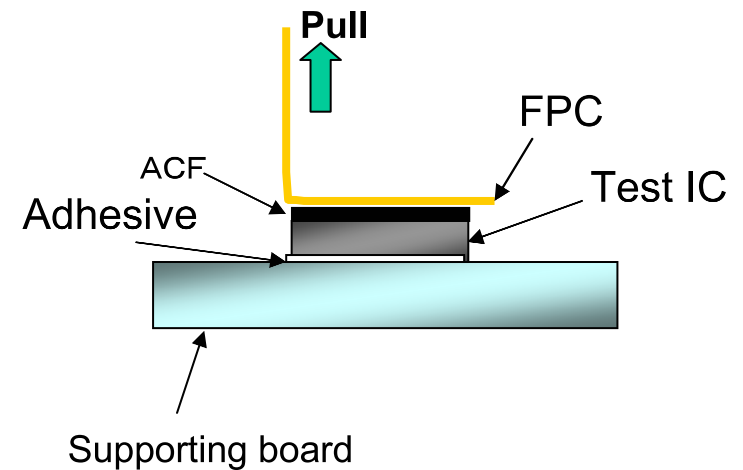
Newly developed Copper foil by collaboration with copper supplier

ACF Peel Strength



■Test Condition

1. Test IC and a FPC base material side are pasted up by ACF
2. After humidity & thermal stress, measure peel strength.



2-2. Total Solution for Rigid-Flex

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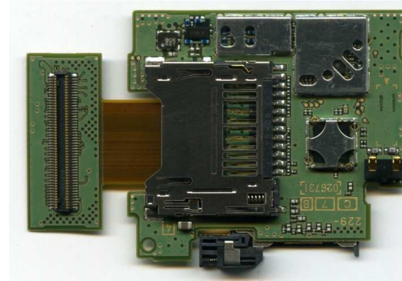
Flexible PCB part

Rigid-Flex Board



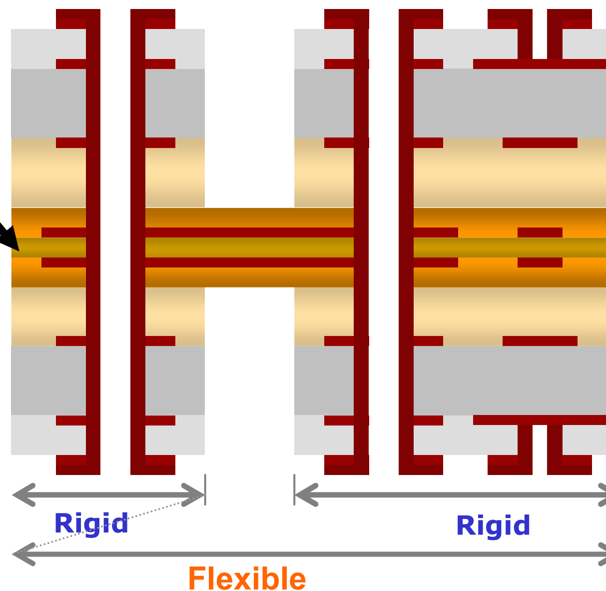
Rigid PCB part

Proposal 1 FELIOS

2Layer FCCL
- R-F775
- New R-F785
- New R-F705

Proposal 2 FELIOS PC

FCCL based Masslam
- C-F170,F175
- New C- F176,F156,F166



Proposal 3

Halogen-free FR-4 CCL
R-1566

Proposal 4

Low Flow Prepreg
R-1551L

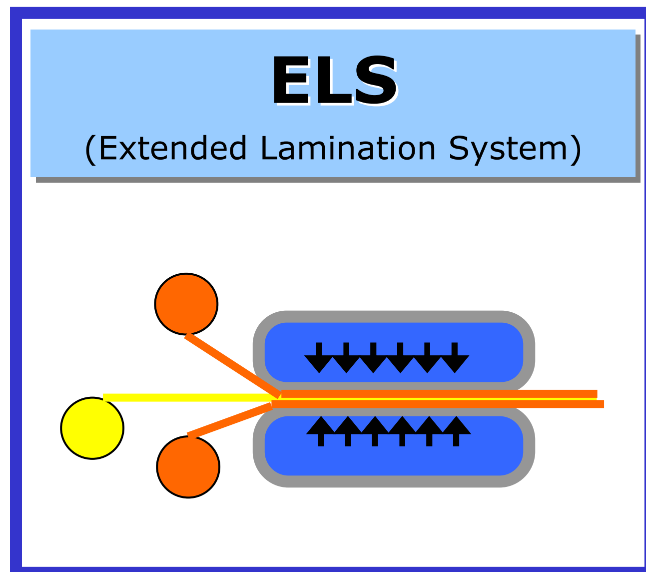
Proposal 5

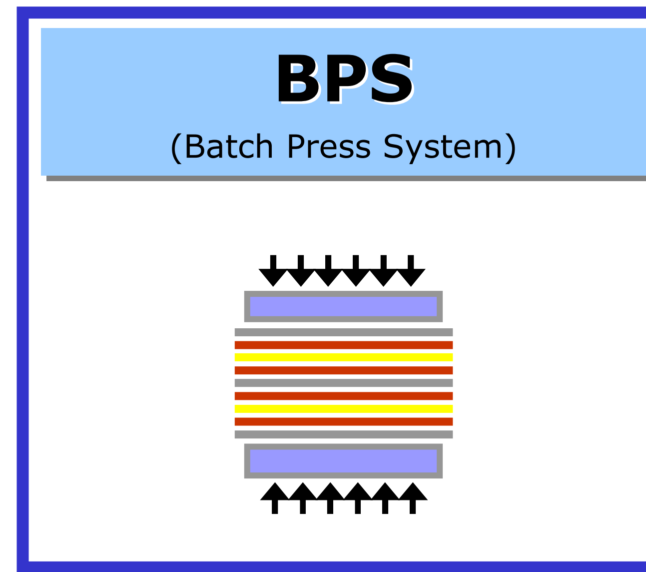
Materials for Build-Up
ARCC R-0582

3.Technology and Product Advantage

3-1-1. 2Layer FCCL (Face Lamination System)

R-F775,770 : Polyimide (Upilex)
New R-F785,780 : Polyimide (Pixeo)
New R-F705,700 : LCP (Vecstor)

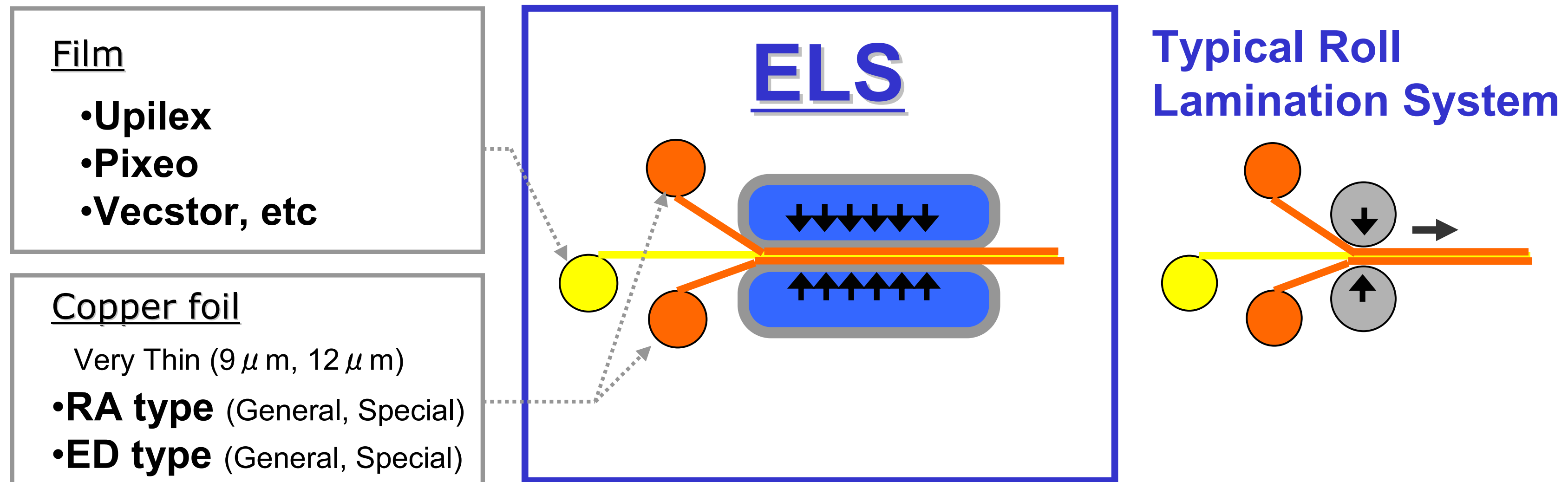




3-1-2. Panasonic ELS (Extended Lamination System)

Feature of Panasonic ELS

- **Stable Quality**
  - Uniform lamination by pressing with large area
  - ＜Class100 clean environment in ELS processing
- **ELS with various kinds of Films and Copper foils**



3-2-1. Excellent Dimensional Stability

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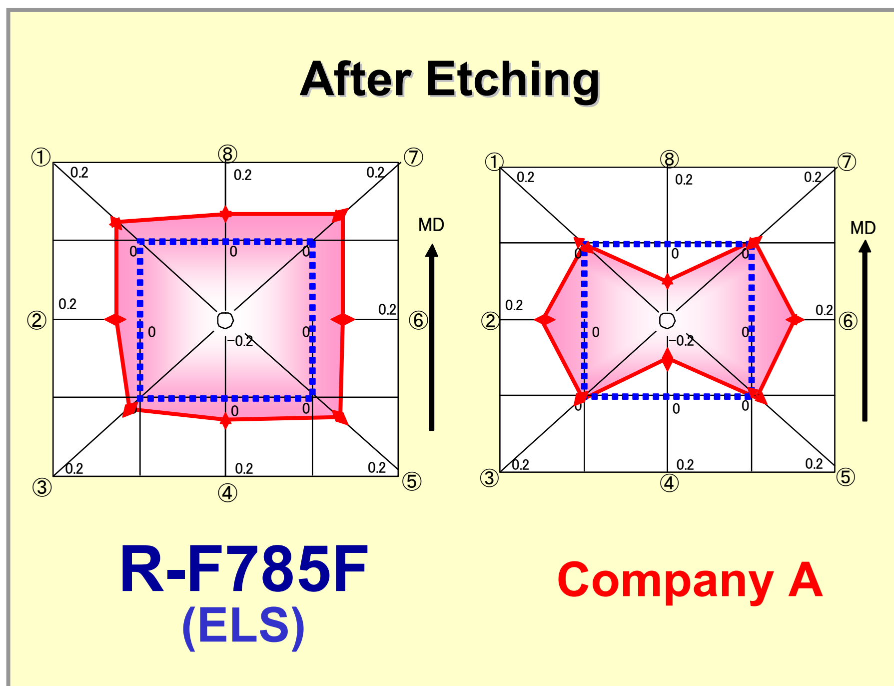
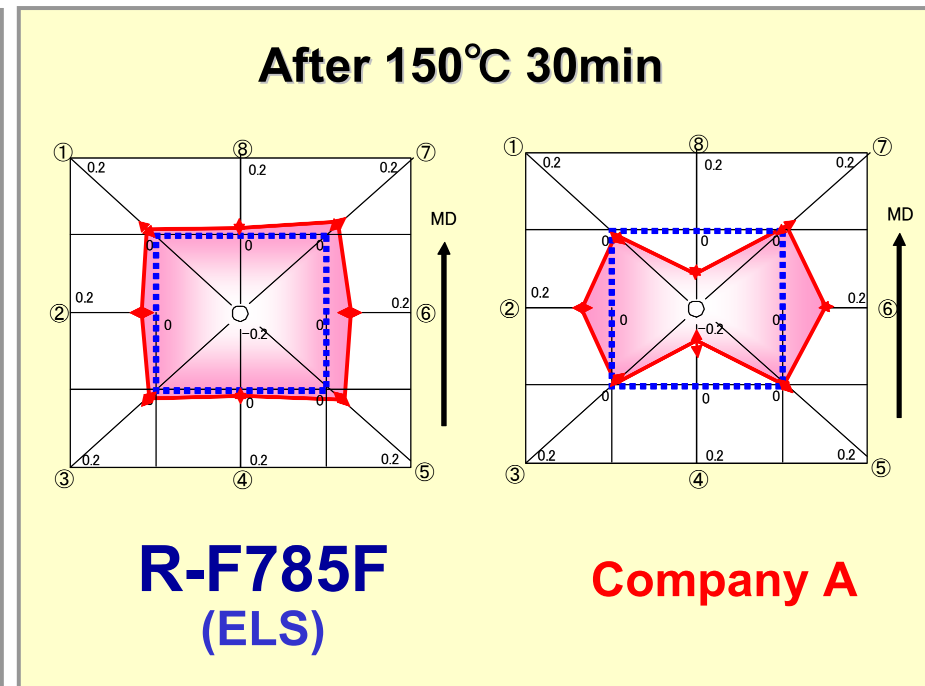
14μm PI based FCCL (R-F785F)

・Copper=Special RA 18 μm　・Test method :IPC-TM-650

After Etching



After 150℃ 30min

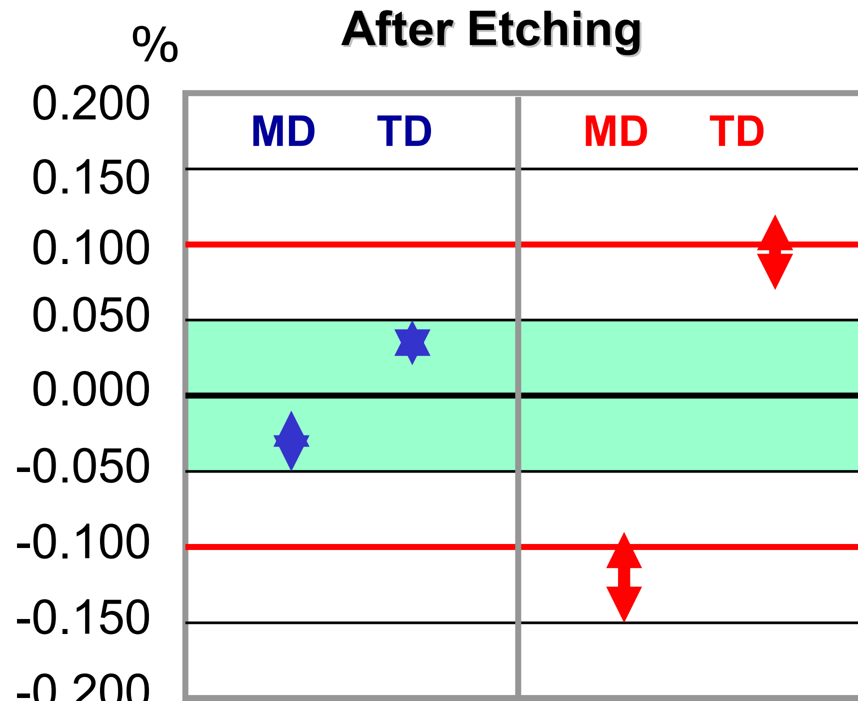


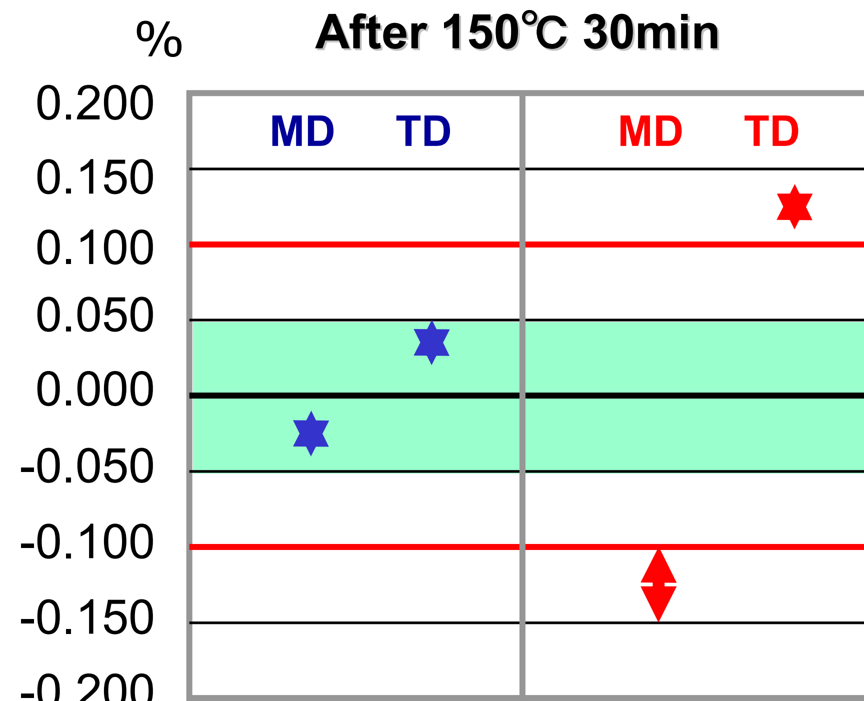
3-2-2. Excellent Dimensional Stability

Panasonic
FELIOS

14μm PI based FCCL (R-F785F)

・Copper=Special RA 18 μm　・Test method :IPC-TM-650



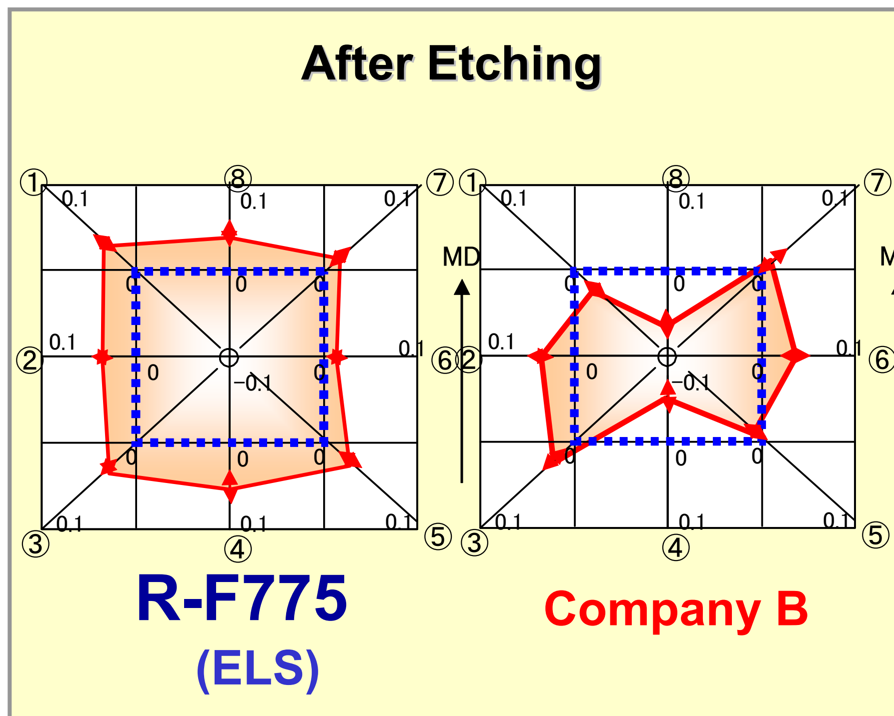


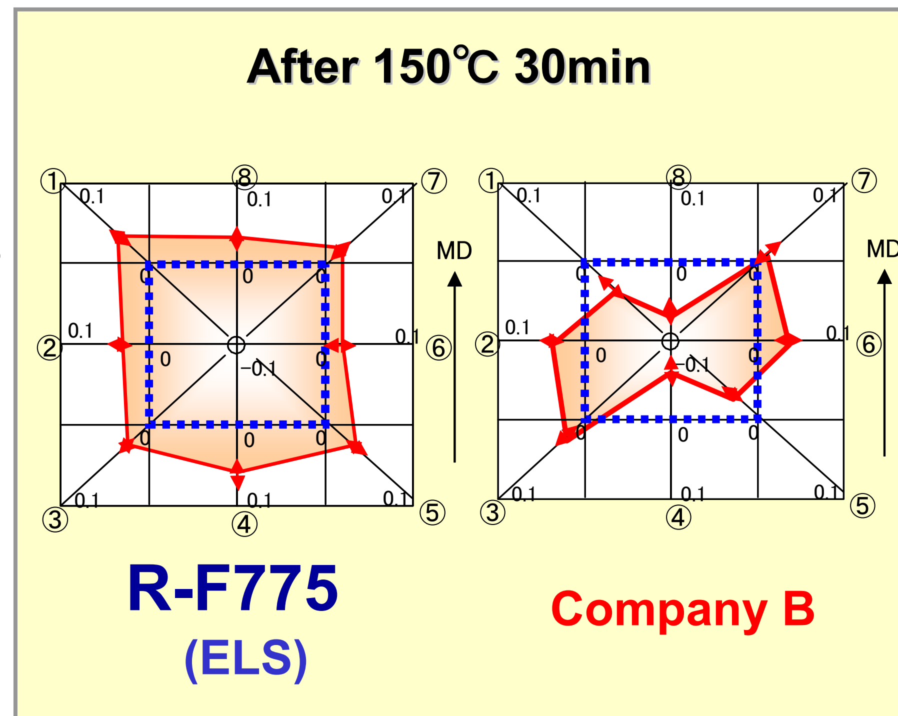
3-2-3. Excellent Dimensional Stability

Panasonic FELIOS

25μm PI based FCCL (R-F775)

・Copper=RA 18 μm　・Test method：Panasonic method



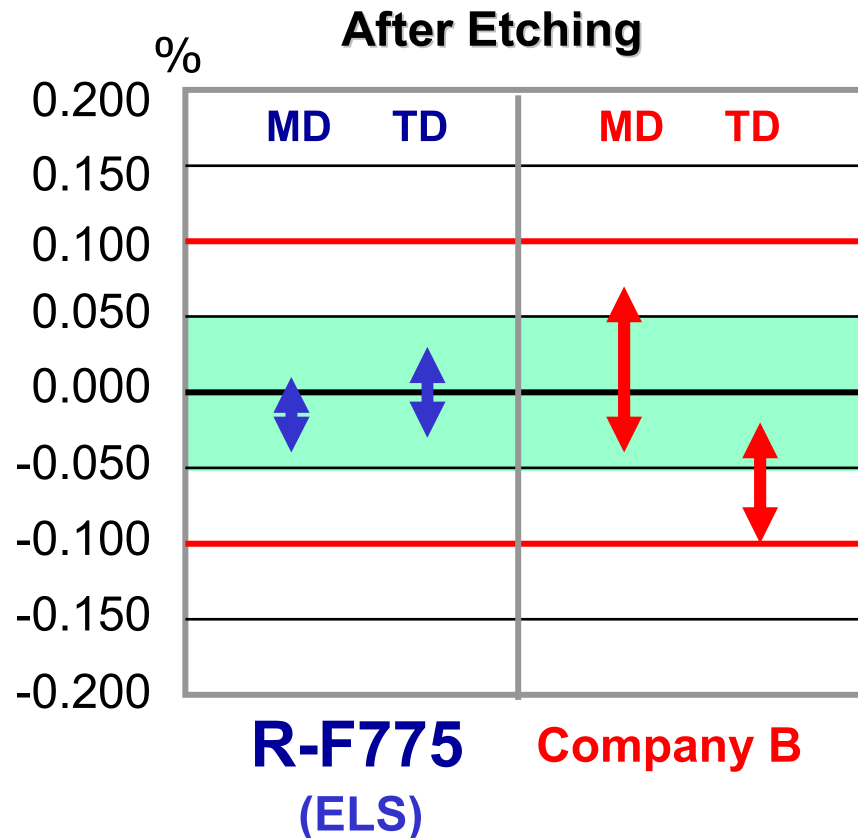


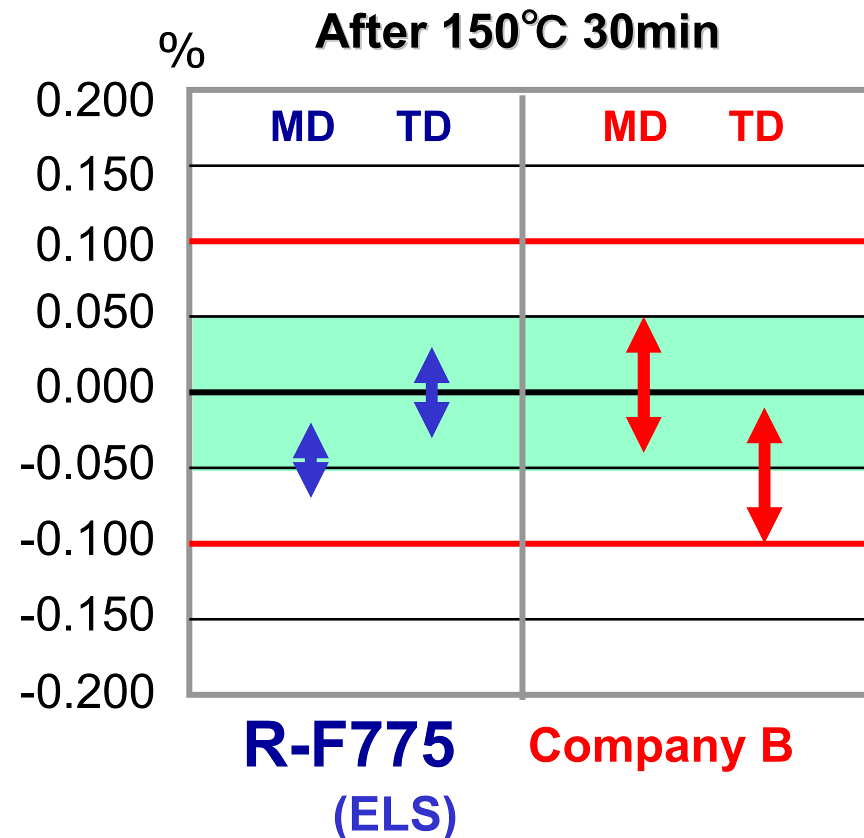
Panasonic FELIOS

3-2-4. Excellent Dimensional Stability

25μm PI based FCCL (R-F775)

・Copper=RA 18 μm ・Test method : Panasonic method





3-3-1. Bending Flexibility

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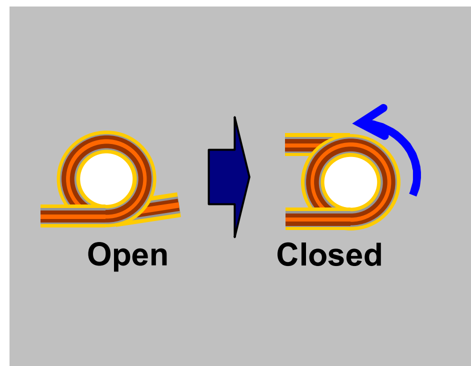
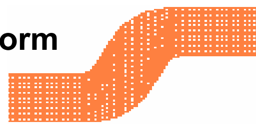
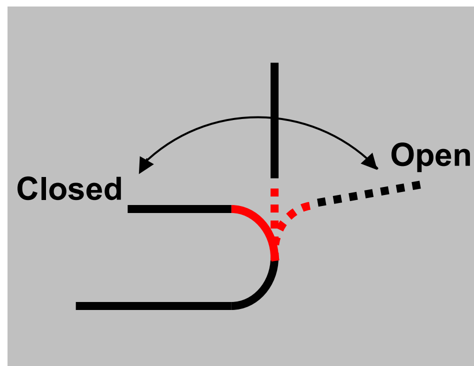
α Bending



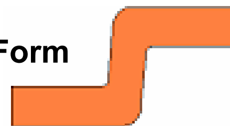
FPC Form



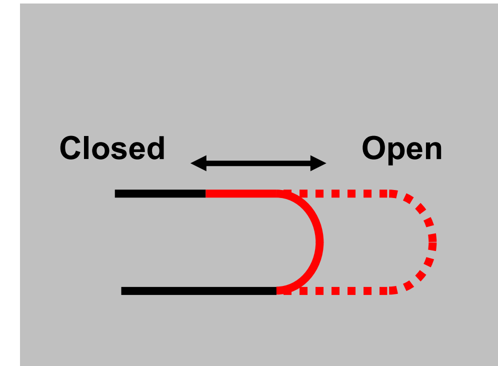
Crank Bending



FPC Form



Slide Bending



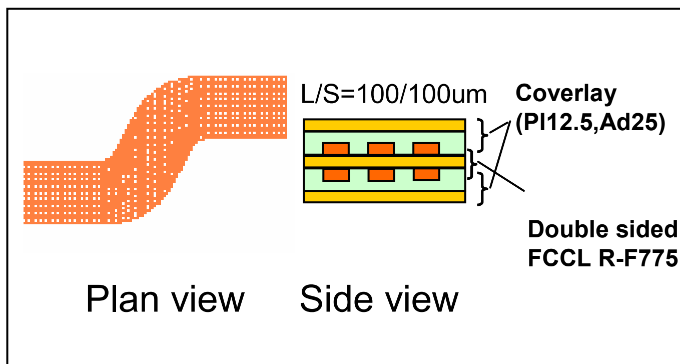
FPC Form

3-3-2. Enhanced Flexibility (α Bending)

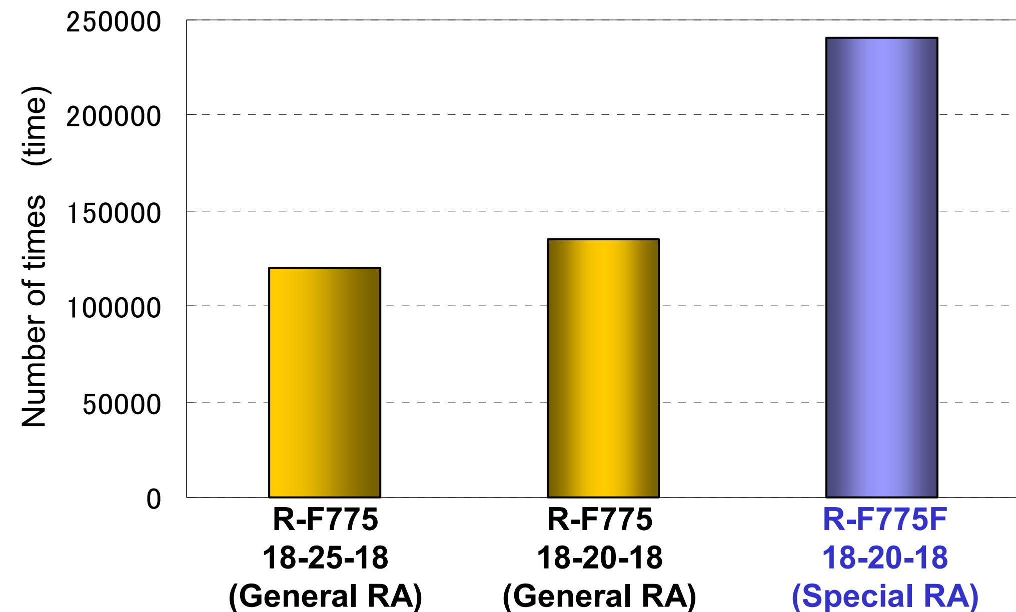
Panasonic FELIOS

■ Test condition

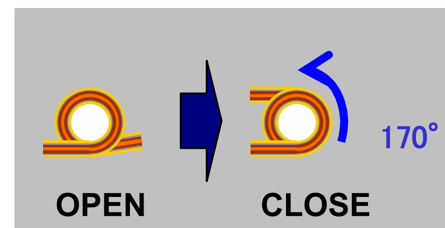
Test machine



■ Test result



Note) Cover-lay (PI12.5,Ad25 μm) was used for the testing.



- Angle: 0 ⇔ 170 °
- Frequency: 60rpm
- α-bending diameter :8Φ

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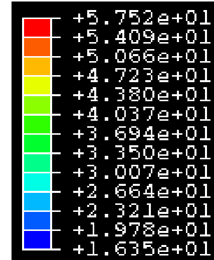
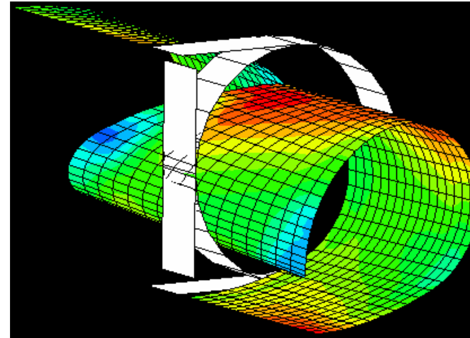
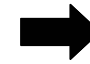
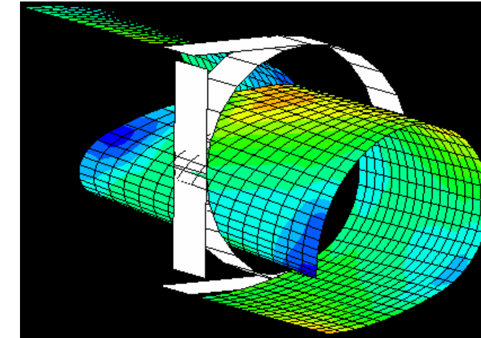
3-3-3. Finite Element Method (α Bending)

Analysis ① Thin copper (18 μm ⇒ 12 μm)



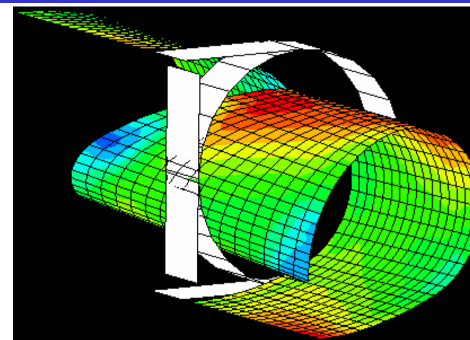


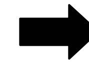


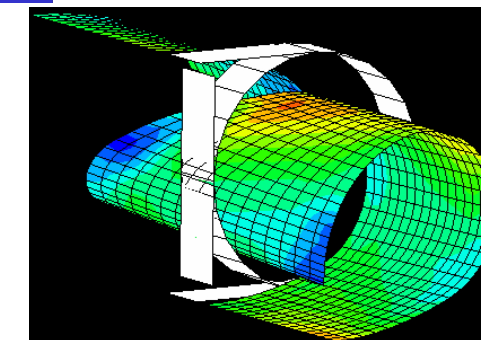


Cu−Film−Cu (μm)	18−25−18	12−25−12
stress	57.52 MPa	50.45 MPa

Analysis ② Thin Film (25 μm ⇒ 20 μm)



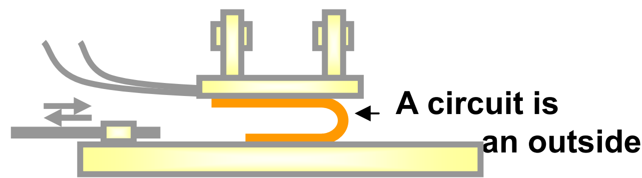




Cu−Film−Cu (μm)	18−25−18	18−20−18
stress	57.52 MPa	51.95 MPa

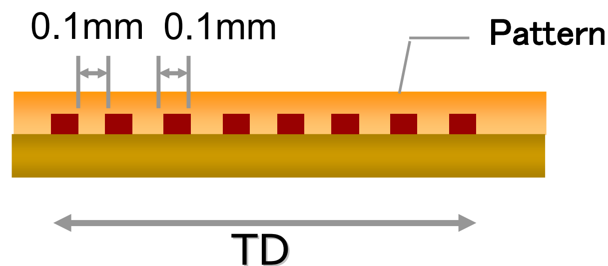
3-3-4. Enhanced Flexibility (Slide Bending)

■Test Method

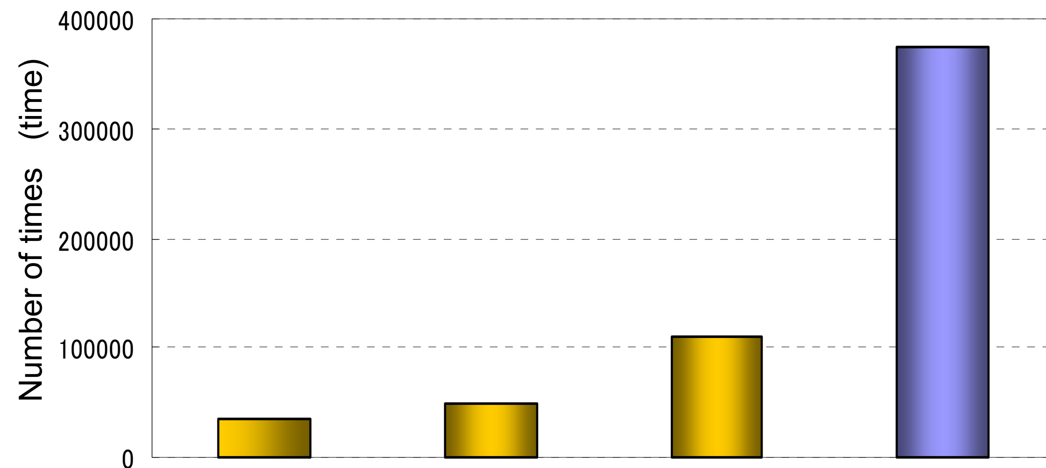


-Stroke	:50mm
-Speed	:60rpm
-Temperature	:room temp
-Radius of curvature	:1.0mm
-Life judging	:20%UP

■Test Sample



■ Test result

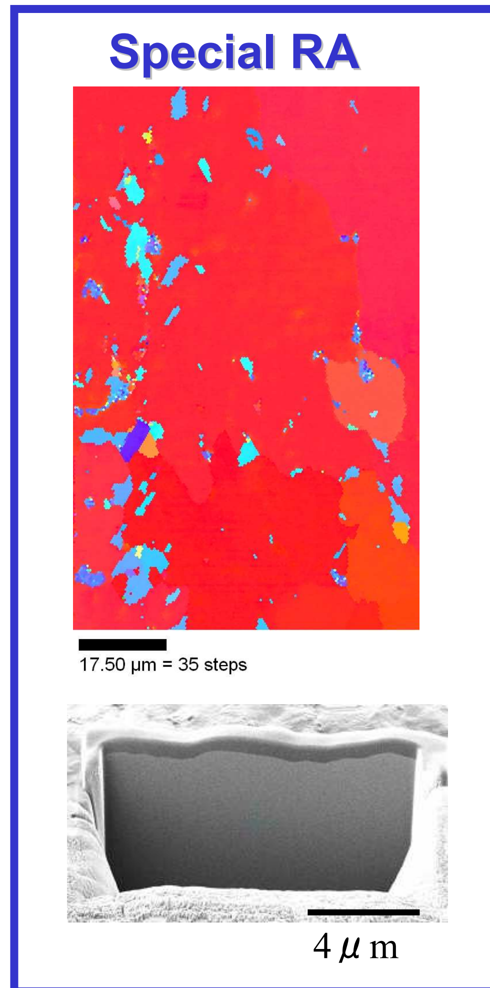


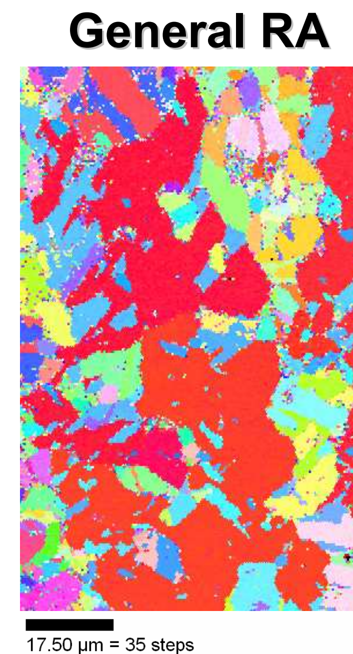
R-F775 18-25-18 (General RA)	R-F775 18-20-18 (General RA)	R-F785 18-14-18 (General RA)	R-F785F 18-14-18 (Special RA)

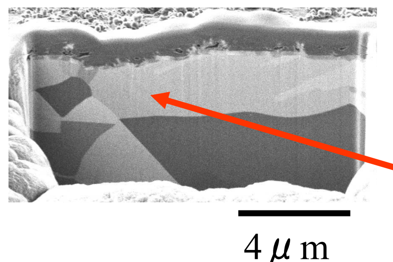
Note) Cover-lay (PI12.5,Ad15 μ m) was used for the testing.

3-3-5. Special RA copper pressed by ELS FELIOS

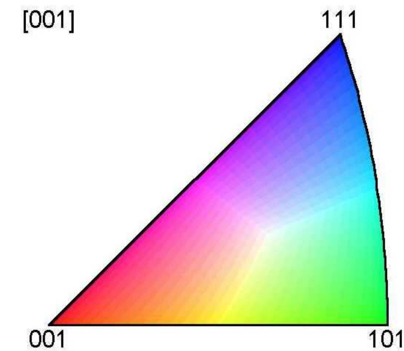
Special RA, pressed by ELS, is re-crystallized,
and features superior performance for slide hinge.







Crack formation along
grain boundary

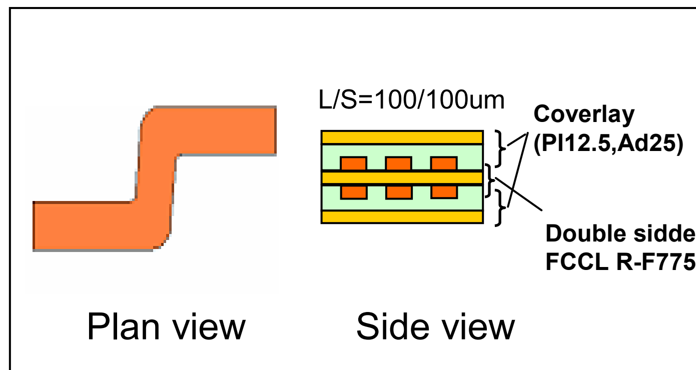


3-3-6. Enhanced Flexibility (Crank Bending)

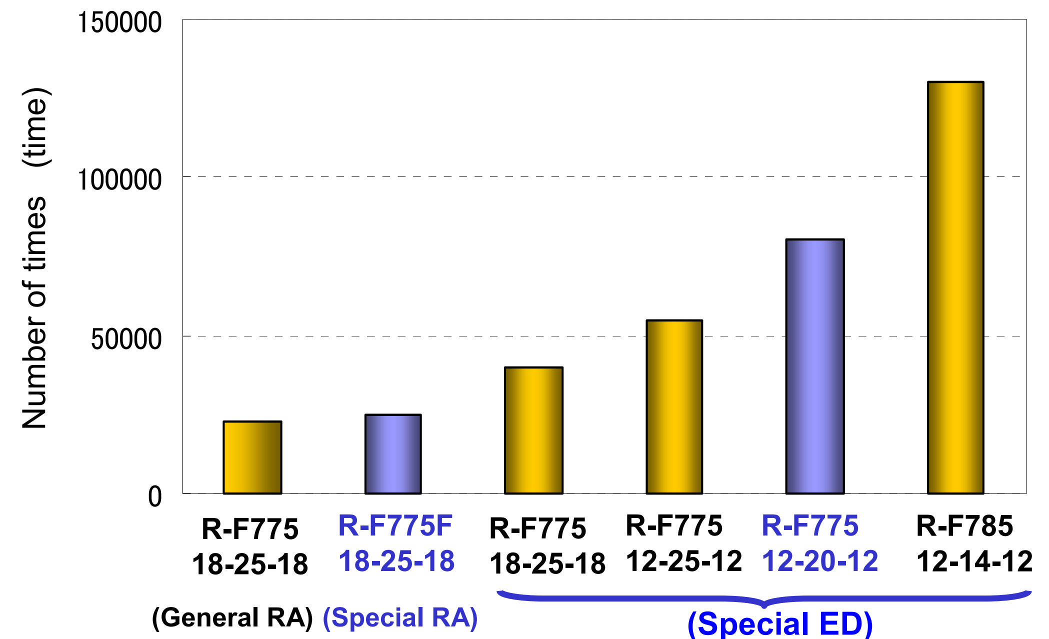
Panasonic
FELIOS

■ Test condition

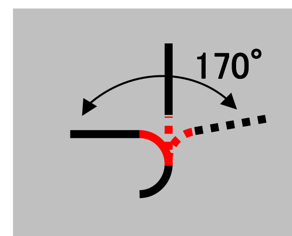
Test machine



■ Test result



Note) Cover-lay (PI12.5,Ad25 μ m) was used for the testing.



- **Angle :0 <=> 170°**
- **Frequency : 60rpm**
- **Circuit :Both side**
- **Judgment**
  Resistance 10%UP

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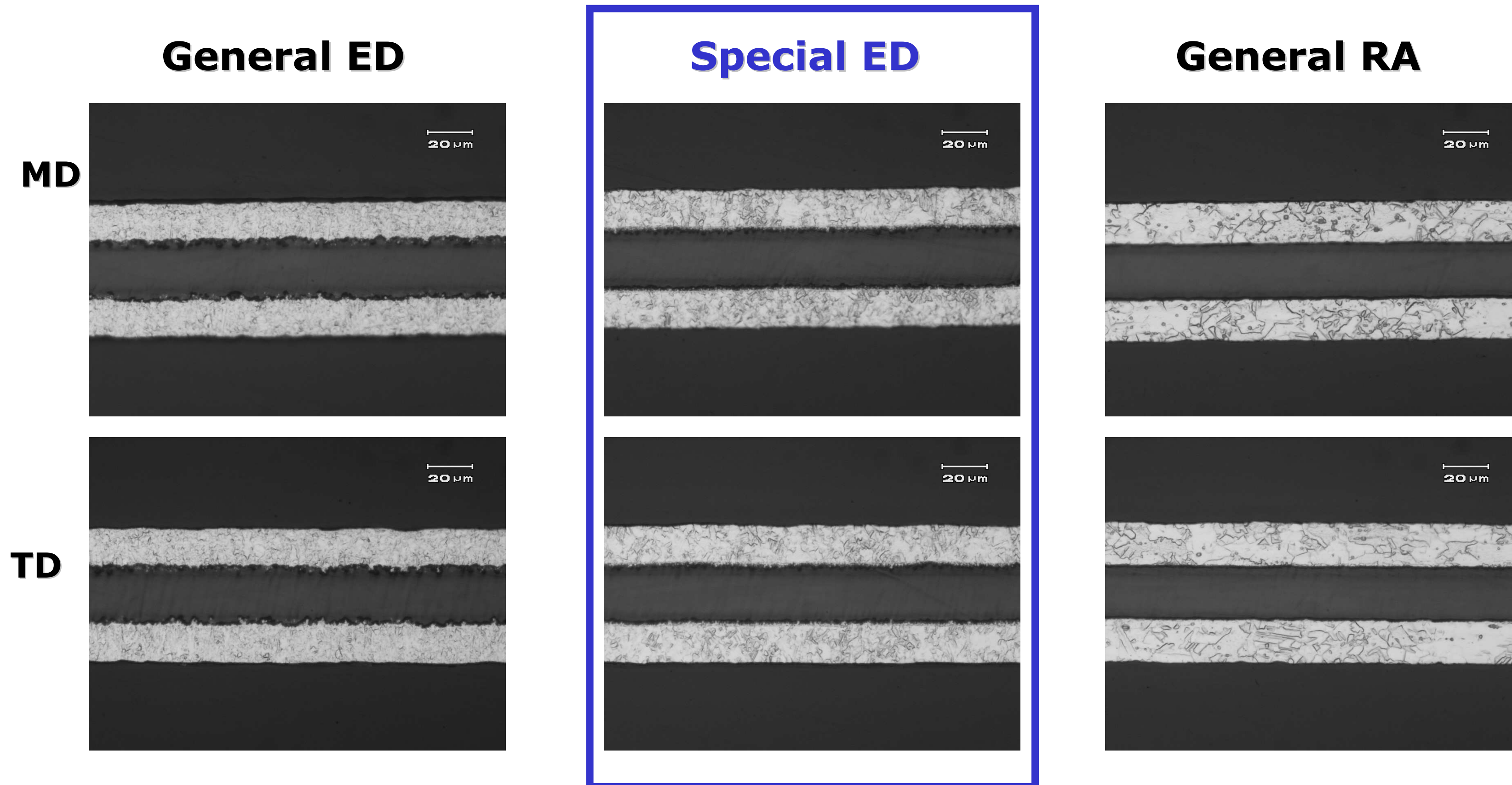
3-3-7. Special ED copper pressed by ELS

Special ED, pressed by ELS(<300℃), is re-crystallized, and has the almost same crystal structure as General RA's.



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3-4-1. Excellent Peel Strength

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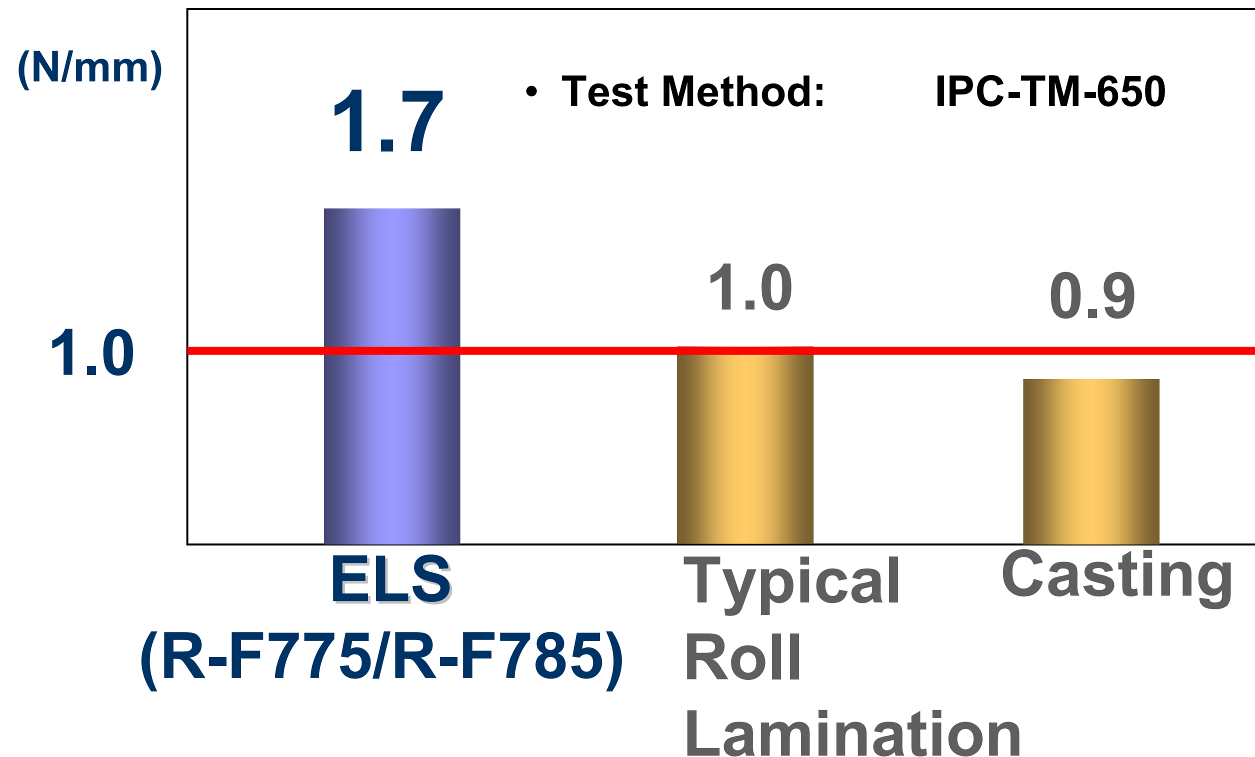
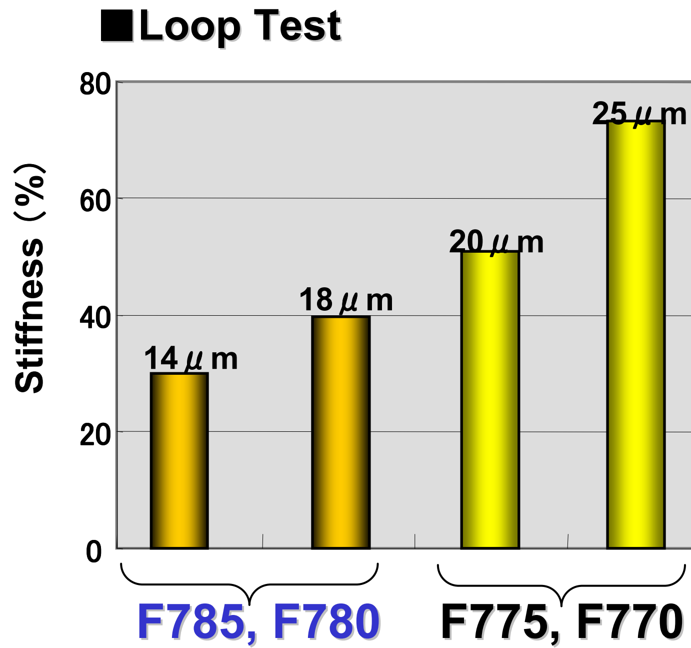
1.7N/mm (ELS) vs 0.9-1.0N/mm (Other system)



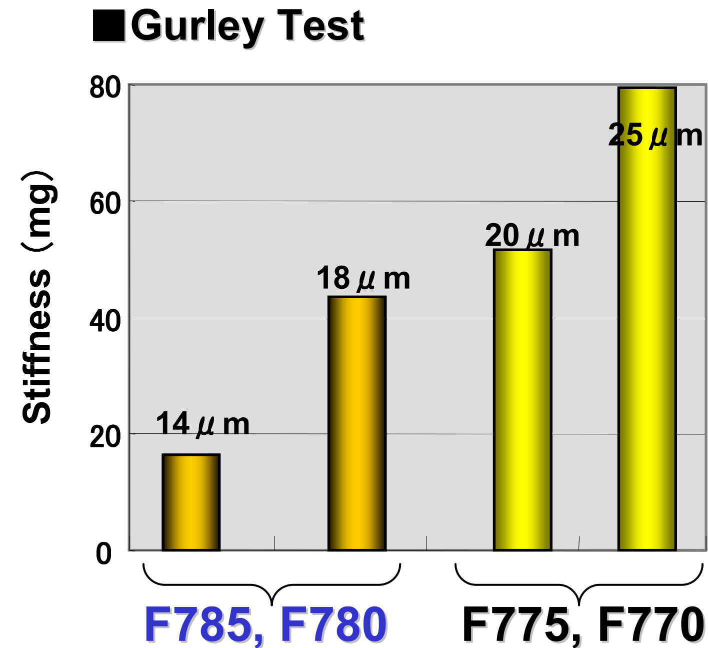
3-5. Spring Back Performance

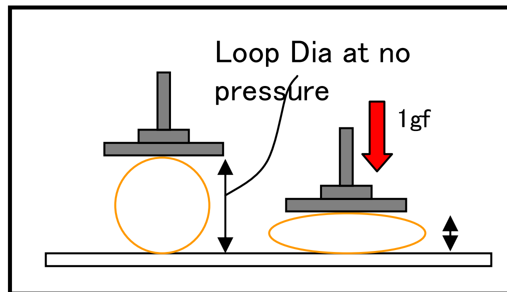
Panasonic FELIOS

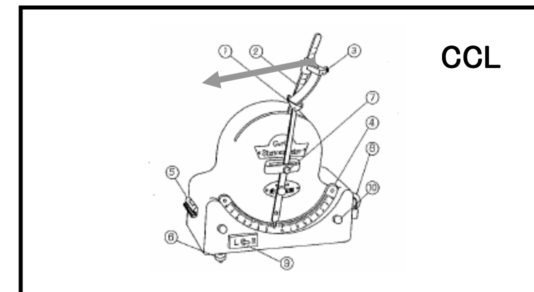
■Loop Test



■Gurley Test







4.Product Offering Availability

4-1. Product Offering Availability

Panasonic FELIOS

■ Part Number

	Double Sided	Single Sided	14 μ	18 μ	20 μ	25 μ	50 μ
	R-F775	R-F770	-	-	○	○	○
New	R-F785	R-F780	○	○	-	-	-

(Polyimide Thickness: 14 μ – 50 μ)

Product Size

Type	TD (width)
Roll	250㎜ 500㎜, 510㎜
Sheet	Max 510㎜

Copper foil

	9μm (1/4oz)	12μm (1/3oz)	18μm (1/2oz)	35μm (1oz)
ED	○	○	○	-
RA	○	○	○	○

5.What’s New

5-1. LCP based FCCL (Liquid Crystal Polymer)

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FELIOS

R-F705

■General Properties

Property	Test Condition	Unit	R-F705 LCP50 μm, Cu18 μ	R-F775 PI25 μm, Cu18 μ	Test Method
Surface Resistivity	A	Ω	**4.9E+14**	**4.0E+13**	JIS C6471
Dielectric Constant (Dk)	A 2GHz	-	**3.0**	**3.2**	IPC-TM650 Method2.5.5.5
	A 10GHz		**3.0**	**3.2**	
Dissipation Factor (Df)	A 2GHz	-	**0.0008**	**0.0015**	IPC-TM650 Method2.5.5.5
	A 10GHz		**0.0016**	**0.0027**	
Moisture Absorption	25℃/50h dipping	%	**0.04**	**1.0**	-
Peel Strength	A 260℃ Solder for 5 sec	N/mm	**0.8**	**1.7**	IPC-TM-650
Frame Resistant（UL）	A and E-168/70	-	**94VTM-0**	**94V-0**	-
Chemical Resistance	HCl 2mol/l 23℃ for 5min NaOH 2mol/l 23℃ for 5 min IPA 23℃ for 5 min	-	**No abnormality**	**No abnormality**	JIS C6471
Solder Heat Resistance	260℃ solder float for 1 min	-	**No abnormality**	**No abnormality**	
	288℃ solder float for 1 min	-	**No abnormality**	**No abnormality**	Internal Method
Water Absorption Solder Heat Resistance	C-96/40/90 260℃ solder float for 1 min	-	**No abnormality**	**No abormality**	
Dimensional Stability	After etching (MD direction)	%	**0.001**	**-0.007**	IPC-TM650
	After etching (TD direction)		**-0.005**	**0.016**	
	E-0.5/150 (MD direction)		**0.014**	**-0.023**	
	E-0.5/150 (TD direction)		**0.019**	**0.000**	

Note) The above data are our actual values and not assured values.

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5-2. Dimensional Stability (LCP based FCCL)

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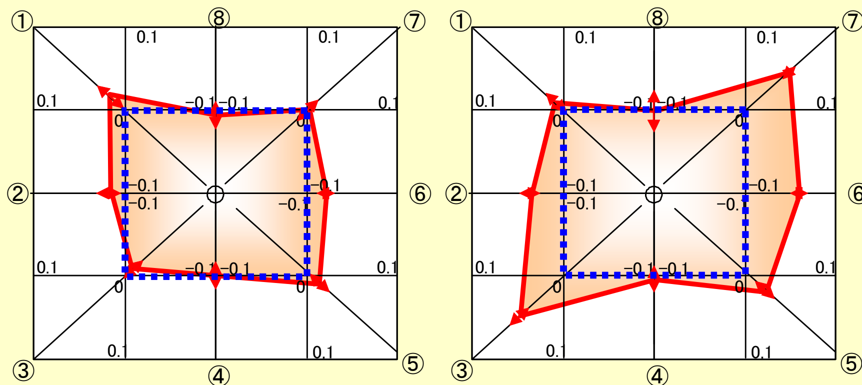
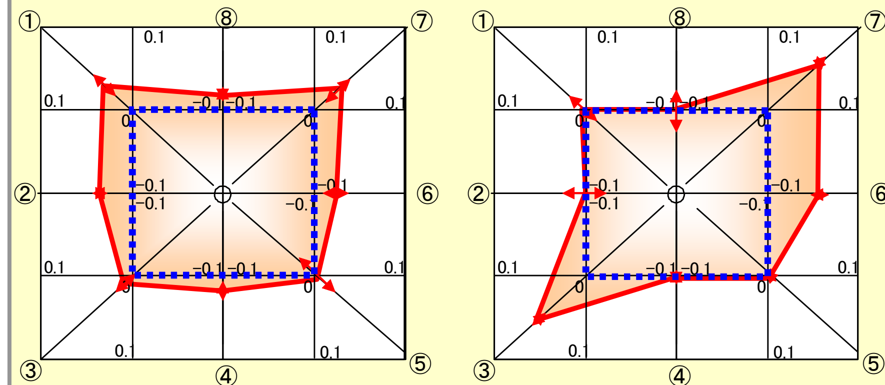
ELS vs Typical Roll Lamination

・LCP=50μm、Copper=ED 18 μm ・Test method：Panasonic method

After Etching



After 150℃ 30min

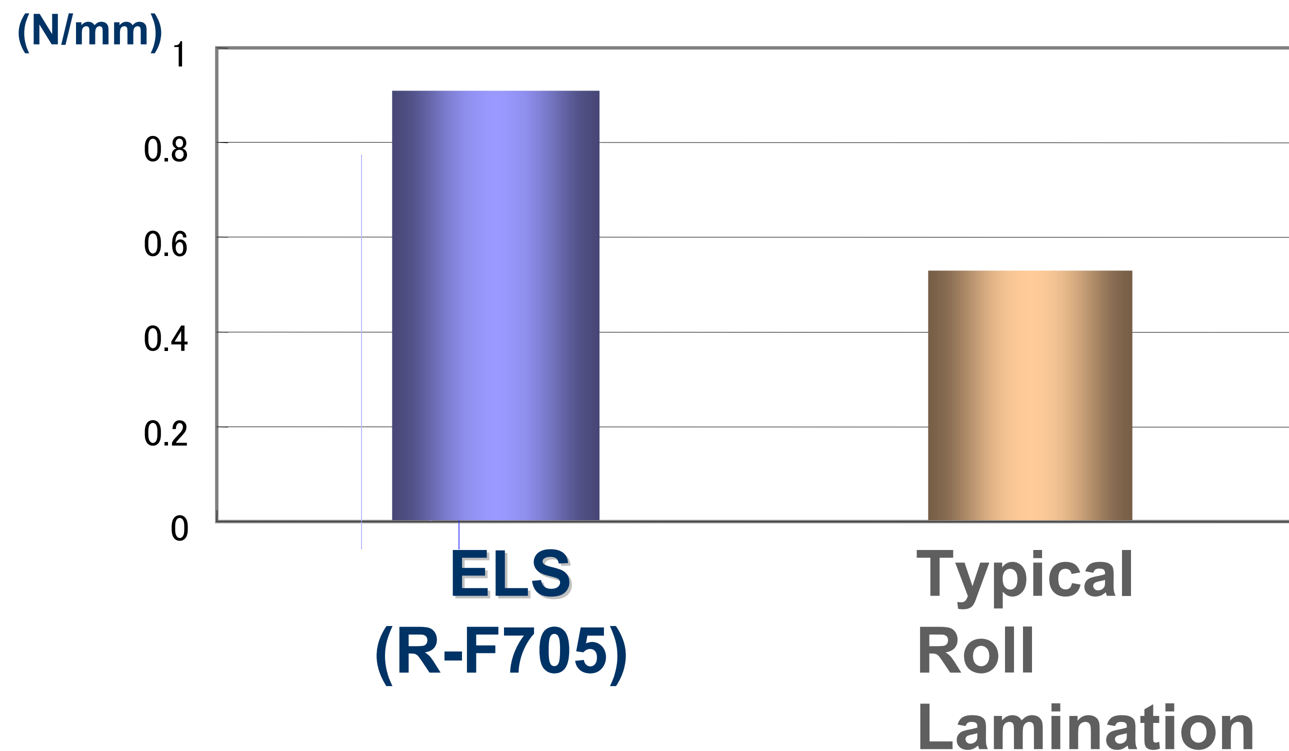


5-3. Peel Strength (LCP based FCCL)

Panasonic
FELIOS

ELS vs Typical Roll Lamination

・LCP=50μm、Copper=ED 18 μm　・Test method：IPC-TM-650



5-4. Dk/Df (LCP based FCCL)

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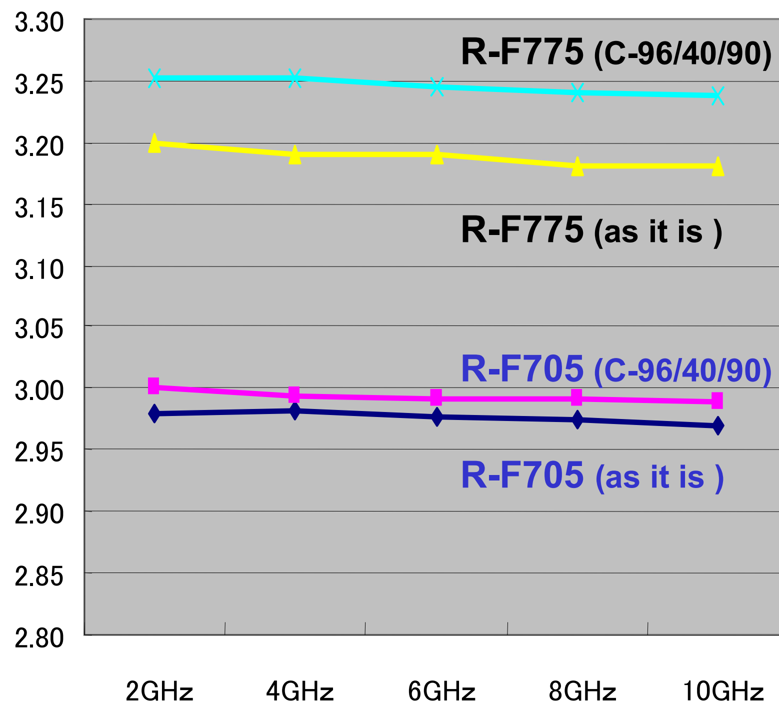
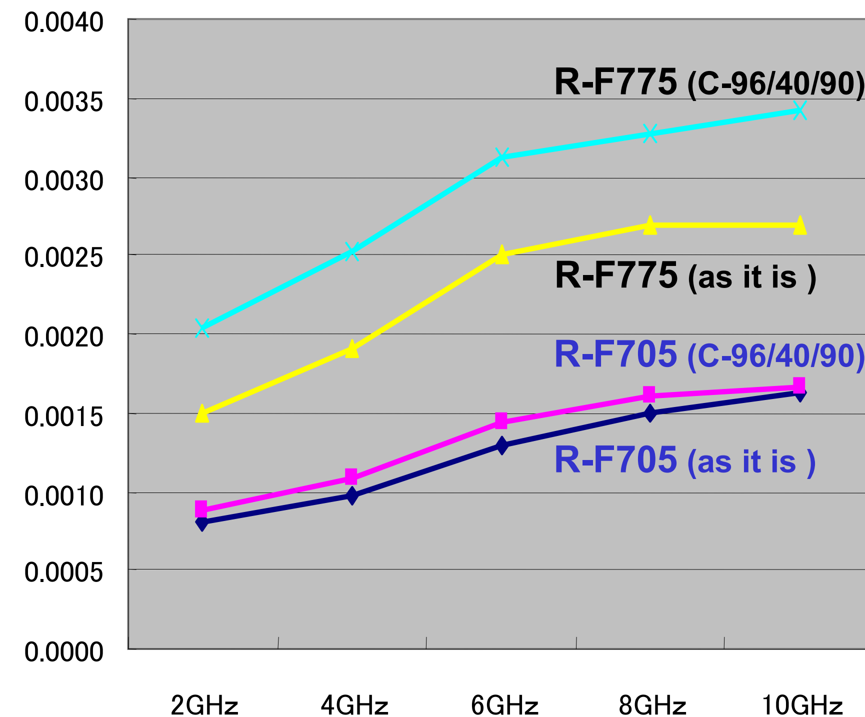
Dk/Df is very stable against the moisture uptake.

Dk (ε r)



Df (tan δ)



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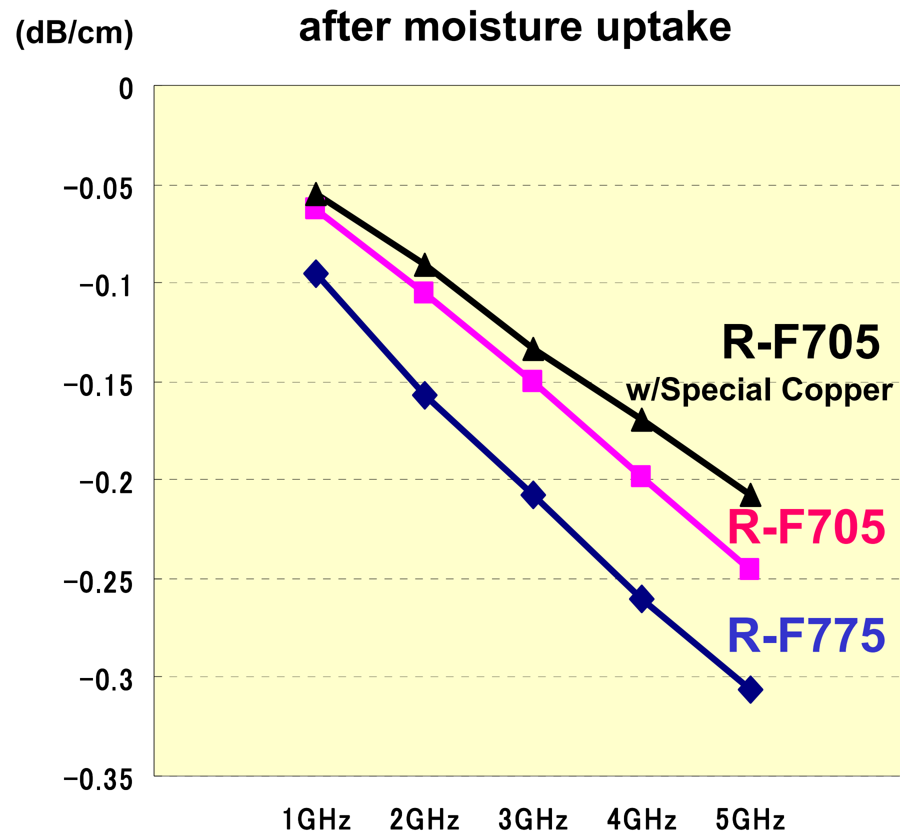
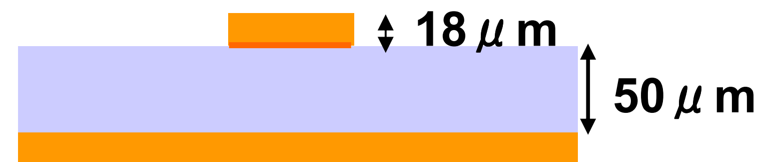
5-5. Transmission Loss (LCP based FCCL)

■Transmission Loss



■Test Sample



- LCP film: 50 μ m
- Copper foil: 18 μ m
- Characteristic Impedance: 50 Ω
- Preconditioning: C-96/40/90

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Matsushita Electric Works, Ltd.

Thank you!