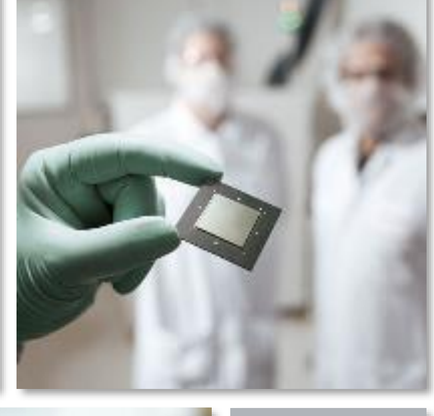
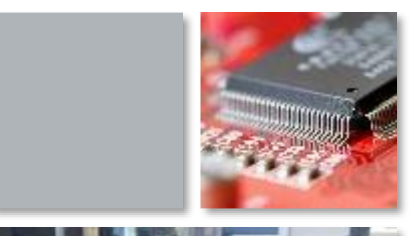
Backside Protection Film (BSP) Solutions

Irvine BSP Team
Nov 2017



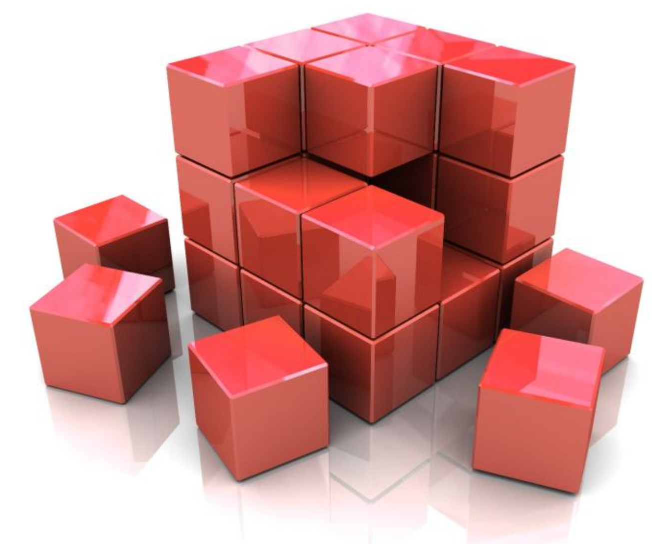


Contents

WLCSP – BSP Definition

BSP material Introduction

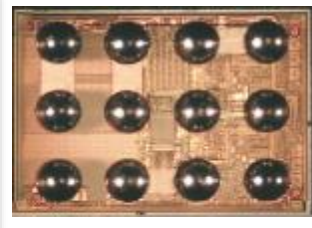
- Physical properties
- Process recommendations
- Performance
- Summary

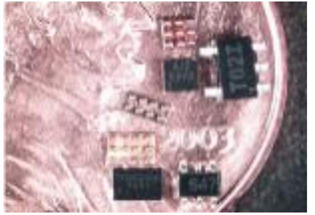


WLCSP – BSP Definition

Wafer Level Package is defined as :

- Die size package (up to 9x9 mm^2)
- Easier process-no substrate, no DA, no WB, and no molding
- Underfill is optional (lower cost)
- Assembled using standard SMT pitch & assembly equipment





General Process Flow

Henkel

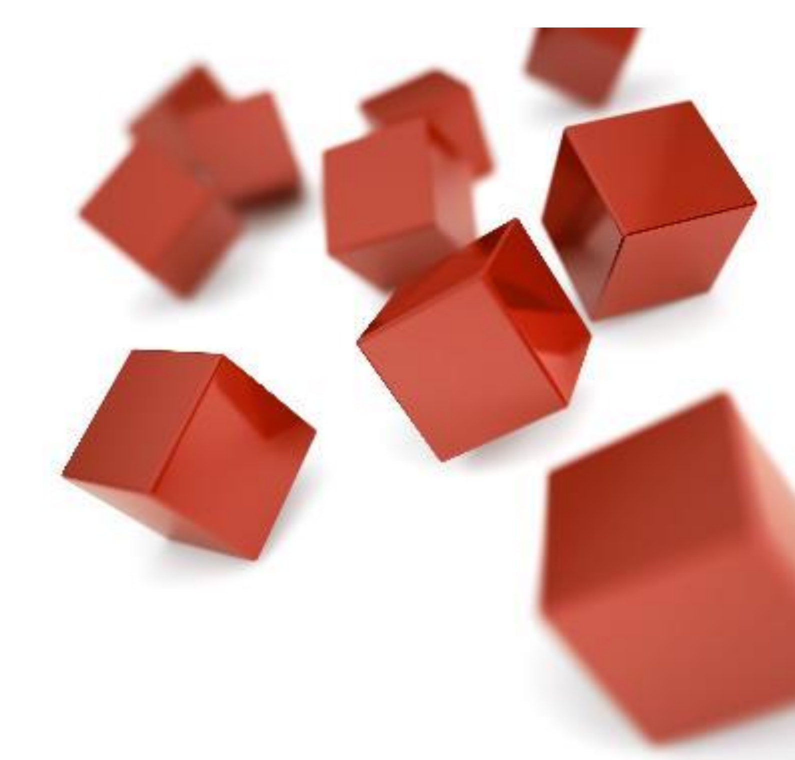
Wafer Level Chip Scale Package Backside Protection
Technical Requirements & Benefits

CTQs

- Re-workable after lamination
- Good laser marking performance
- Consistent bond line control
- High reliability

Benefits

- Thin wafer handling
  - No chip damage during dicing
  - Good pick up yield
- Clean dry process
  - Eliminated fillet and zero bleed
  - Low outgassing



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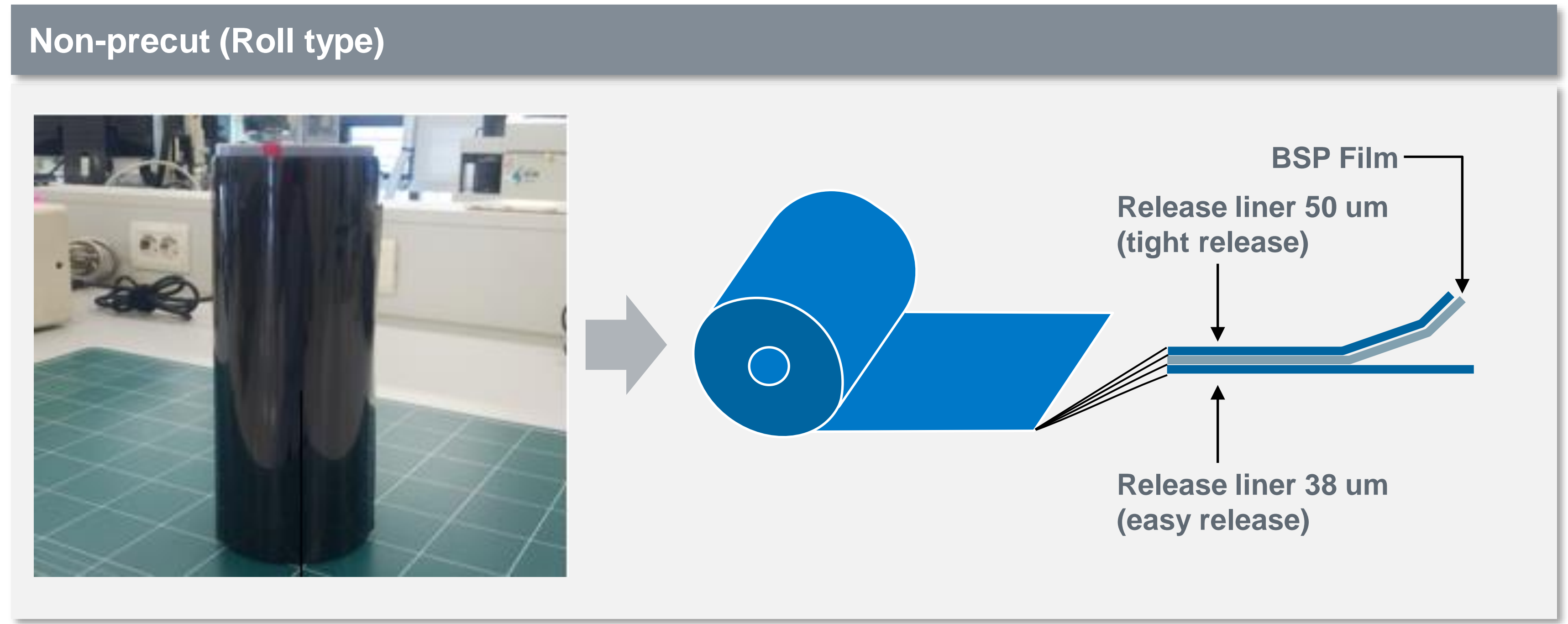
Product Format -Standalone



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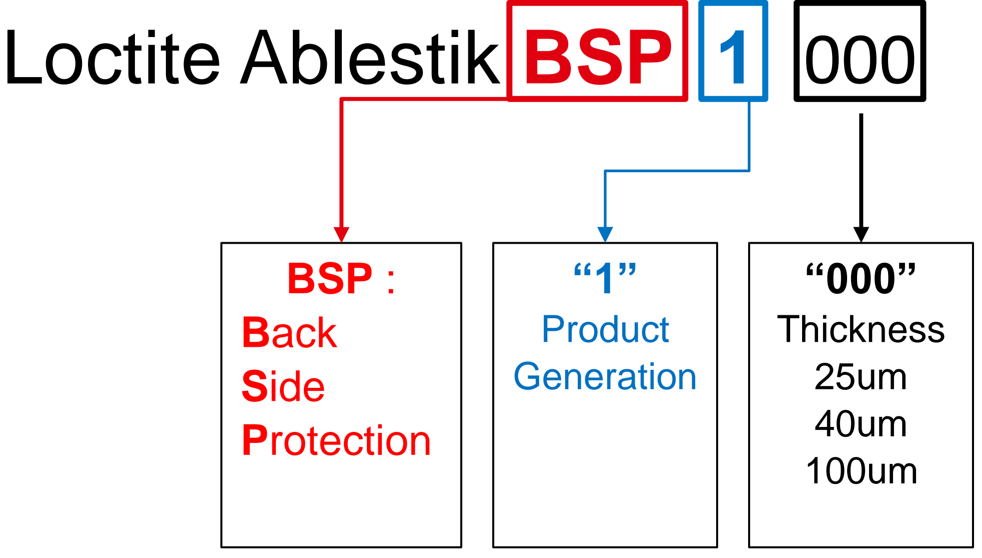
Product Nomenclature

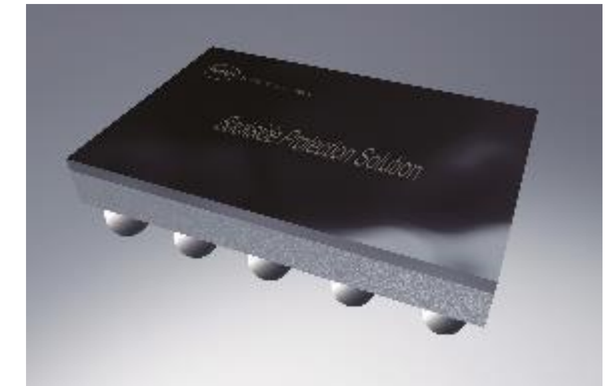


Physical Property

Physical Property	unit	Standalone Format
		Loctite Ablestik BSP 125, 140, 1100
Color		Black
Filler	%	57
CTE1	ppm/°C	40
CTE 2	ppm/°C	120
Tg (DMA)	°C	162
Modulus @ RT	GPa	8.5
Modulus @ 150°C	GPa	1.8
Modulus @ 250°C	MPa	165
Moisture absorption (85°C/85RH)	%	1.1 - 1.2

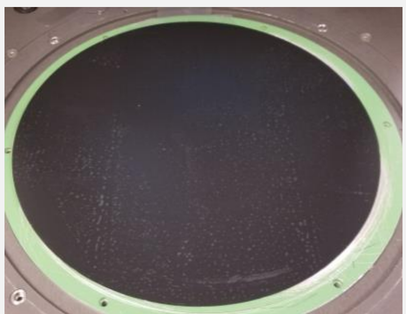
General Process Condition

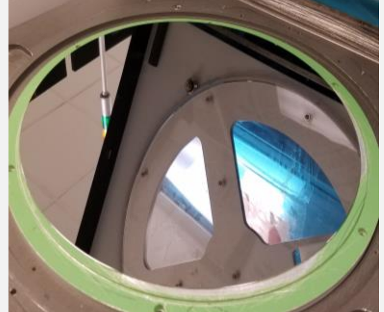
Process	Loctite Ablestik BSP 125, 140, 1100
Format	Roll with 25um, 40um, 100um thickness
Work life	1 month
Shelf life	1 year (100um under testing)
Wafer Lamination	50~70°C, 30psi, 2~8 fpm
Rework Tape	High adhesion or UV Tape (eg. USI 1027R)
Curing	30min ramp to 150°C and hold 1hr at 150°C
Alternate Curing	30min ramp to 130°C and hold 2hr at 130°C
Mount onto dicing tape	RT with PSA dicing tape
Dicing	25mm/sec with Disco, TSK



Re-workablity Performance

- Wafer lamination: 70ºC/30psi/2fpm
- Wafer thickness: 600um
- Laminate supporting tape at RT to remove BSP





Henkel Material Shows Excellent Re-workability with no residue

Laser Marking Performance
After Cure vs. After Reflow

	After cure	After reflow
Loctite Ablestik BSP	12345 12345 12345	12345 12345 12345

Internal microscope & direct light

Henkel Material Shows Excellent Laser Marking Before and After Reflow with Excellent Contrast and Sharp Letters.

Laser Marking Performance

After Reflow with VX K-250 Microscope

Main image	3D image	Main image	3D image

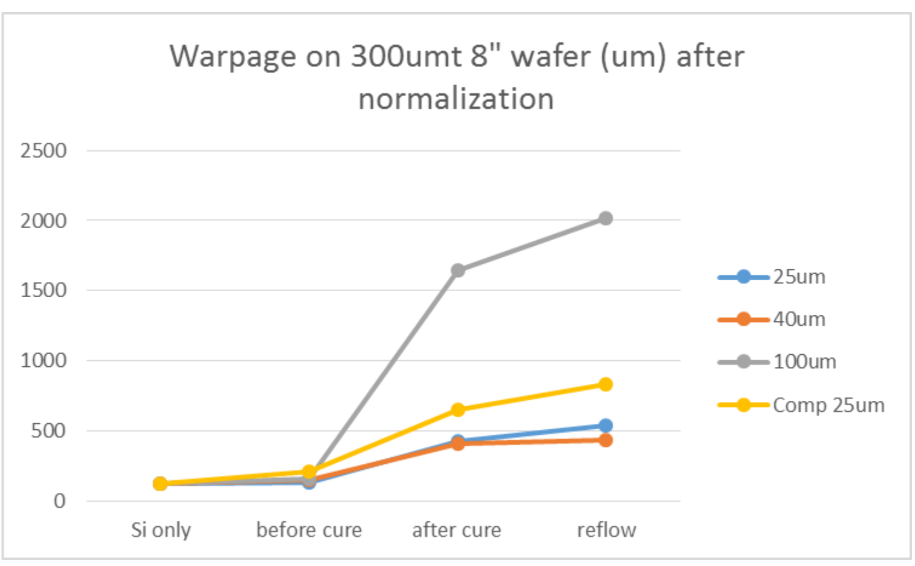
Note: internal testing with green laser. Microscope light is 408 nm wavelength violet laser

Wafer Warpage Performance
Various BSP Thickness

- Wafer size: 8" Si wafer, 300umt
- Cured: 150ºC/60min 30min ramp

	BSP thickness	Si only	before cure	after cure	after reflow
BSP 100	25	112.5	120.5	407.5	404
	40	121	148	415	442
	100	105	150	1585	1940
Comp	25	132	230	719	916

Unit: um
Equipment: Nikon VMR 6555 laser scanner



Warpage performed on bare silicon

Henkel Material Displays Good Warpage Performance when compared to competitor

Die Shear (Henkel BSP Method)

After Cure @ 150^{0}C/1hr, Shear @ RT

thickness	BSP			Comp (25um)
	25um	40um	100um	
1	967.1	1211.1	2315.5	533.1
2	801.1	1176.5	2273.4	531.9
3	906.8	1184.6	2357	544.1
4	894.4	1188	2263.3	503.5
5	866.4	799	2612.2	523.2
6	695.8	811.1	2388.5	384.8
7	1026.1	1359.8	2297	489.3
8	902.6	1389.2	2155.5	436.2
9	796.5	1324.4	2239.5	485.2
10	797.2	1313.8	2262.6	427.1
Avg (g)	**865.4**	**1175.8**	**2308.6**	**485.8**
std dev	**95.7**	**210.0**	**118.7**	**53.3**

Die Shear (Henkel BSP Method)

After Cure @ 130ºC/2hr, Shear @ RT

thickness	BSP			Comp (25um)
	25um	40um	100um	
1	846.8	939.9	1850.9	516.1
2	926.5	1208.3	1882.8	458.8
3	708.8	779.4	1892	586.7
4	837.7	1146.2	1868	535.9
5	832.9	1051.7	1932.4	444.5
6	775.6	1167.1	1942.8	629.1
7	946.7	709.8	1942.2	601.2
8	791.1	1165.4	2100	539.1
9	955.9	1213.6	2033.3	485.6
10	850.1	701.8	2011.6	446.7
Avg (g)	835.1	1008.3	1954.6	519.5
std dev	**84.8**	**209.0**	**76.1**	**64.8**

Reliability Performance

5mm x 5mm die

Die size: 5x5mm, 600um bare silicon
BSP: 25/100um BSP cured150°C/60min 30min ramp

	Initial	After MSL1	TC "B" 1000cyc
BSP125			
BSP 1100			

Henkel Material Displayed no Delamination After MSL 1 and Temperature Cycling

Reliability Performance
2mm x 2mm die

Die size: 2x2mm, 600um bare silicon
BSP: 25/100um BSP cured150^{o}C/60min 30min ramp

	Initial	After MSL1	TC "B" 1000cyc
BSP 125			
BSP 1100			

Henkel Material Displayed no Delamination After MSL 1 and Temperature Cycling

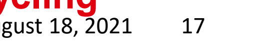
Reliability Performance

1mm x 1mm die

Die size: 1x1mm, 600um bare silicon
BSP: 25/100um BSP cured150°C/60min 30min ramp

	Initial	After MSL1	TC “B” 1000cyc
BSP 125			
BSP 1100			

Henkel Material Displayed no Delamination After MSL 1 and Temperature Cycling



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Reliability Performance - PCT
5mm x 5mm die

Die size: 5x5mm, 600um bare silicon
BSP: 25/100um BSP cured150^{o}C/60min 30min ramp
PCT: 121°C/100%RH/2atm for 168hrs

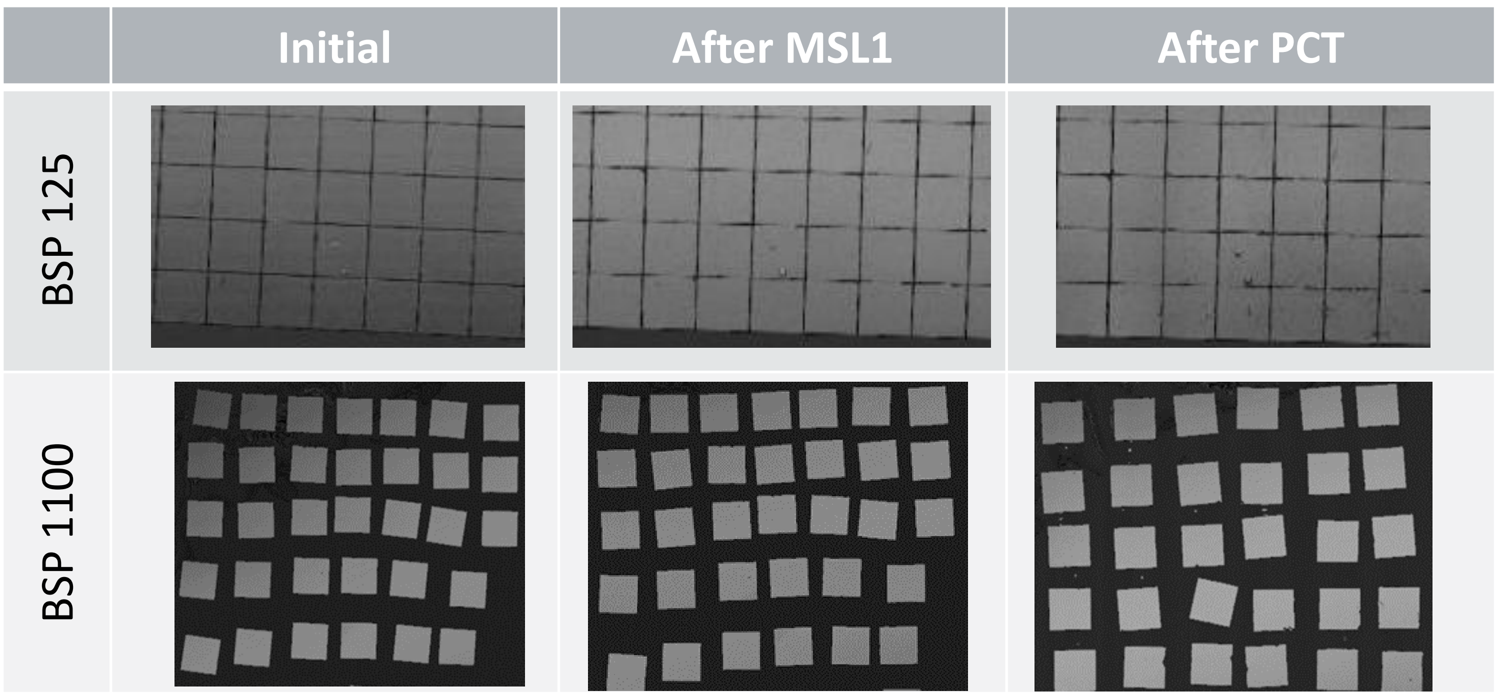
	Initial	After MSL1	After PCT
BSP 125			
BSP 1100			

Henkel Material Displayed no Delamination After MSL 1 and PCT

Reliability Performance - PCT

2mm x 2mm die

Die size: 2x2mm, 600um bare silicon
BSP: 25/100um BSP cured150^{o}C/60min 30min ramp
PCT: 121°C/100%RH/2atm for 168hrs



Henkel Material Displayed no Delamination After MSL 1 and PCT

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Reliability Summary

Test Items		5mmx5mm		2mmx2mm		1mmx1mm	
		BSP125/1100	Comp	BSP125/1100	Comp	BSP125/1100	Comp
MSL1 x3 reflow at 260°C		Passed	Passed	Passed	Passed	Passed	Passed
TC “B”	500 cycles	Passed	Passed	Passed	Passed	Passed	Major delam
	1000 cycles	Passed	Passed	Passed	Major delam	Passed	Major delam
PCT 168hr		Passed	Passed	Passed	Major delam	Passed	Major delam

TC ‘B’: -55°C to 125°C

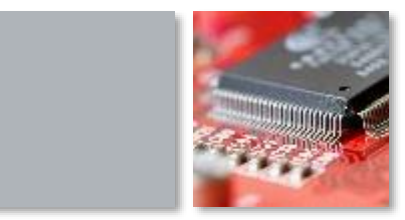
Passed
Major delam

Competitor 25um based on customer comments

Summary & Path Forward

- Henkel's material has excellent re-workability, laser marking legibility, and reliability – confirmed by internal testing as well as Beta site feedback
- Henkel Value Proposition
  - Low warpage
  - Robust re-workable performance
  - Excellent laser marking
  - Better reliability
- Samples available with 25µm, 40µm, 100µm thicknesses
  - 8"- 220mm, 230mm
  - 12"- 330mm

Thank you!



Henkel Die Shear Test Method

BSP

Si

Laminate strips of BSP at 65°C

Side view

Top view

cure @ 150C/60min

Laminate on dicing tape and dice 1.6mmx16mm

Top view

Remove Si die from dicing tape

Top view

Jig

Stopper

16mm

Test speed: 250um/s
Shear height: 2um