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Electronics Materials Solutions Division

3M™ Polycarbonate Carrier R series Introduction

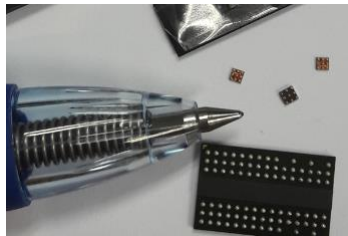
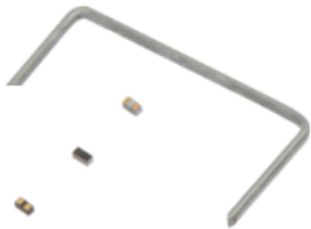
Update: Jan. 2022

Why did 3M™ introduce Polycarbonate Carrier 3000 R series?

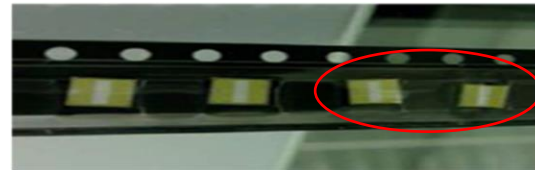
Development trends in semiconductor packages

Small outline profile (0603, 0402mm or below)

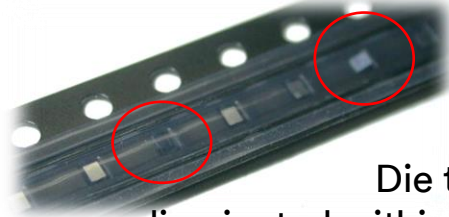
Thin die thickness (even below 0.1mm)



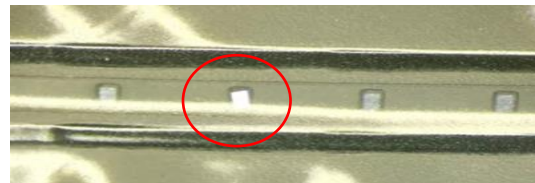
Common issues in T&R packaging



Die migrate out from pocket. Slipped die will be cracked easily



Die tilted or disoriented within pocket

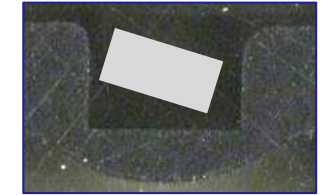
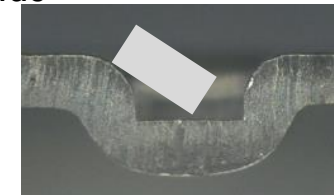


Die stuck in pocket

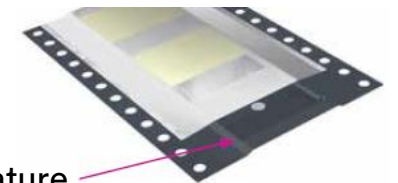
All result in pick up error

3M carrier R series Solution

Reduce pocket opening radius – helps minimize the space between the opening of top pocket & cover tape. Thin die slip out via the gap of open radius



Raised platform – design to create cover tape tension around top pocket edges & reduce gap with cover tap, measure to help prevent tilting or slippage

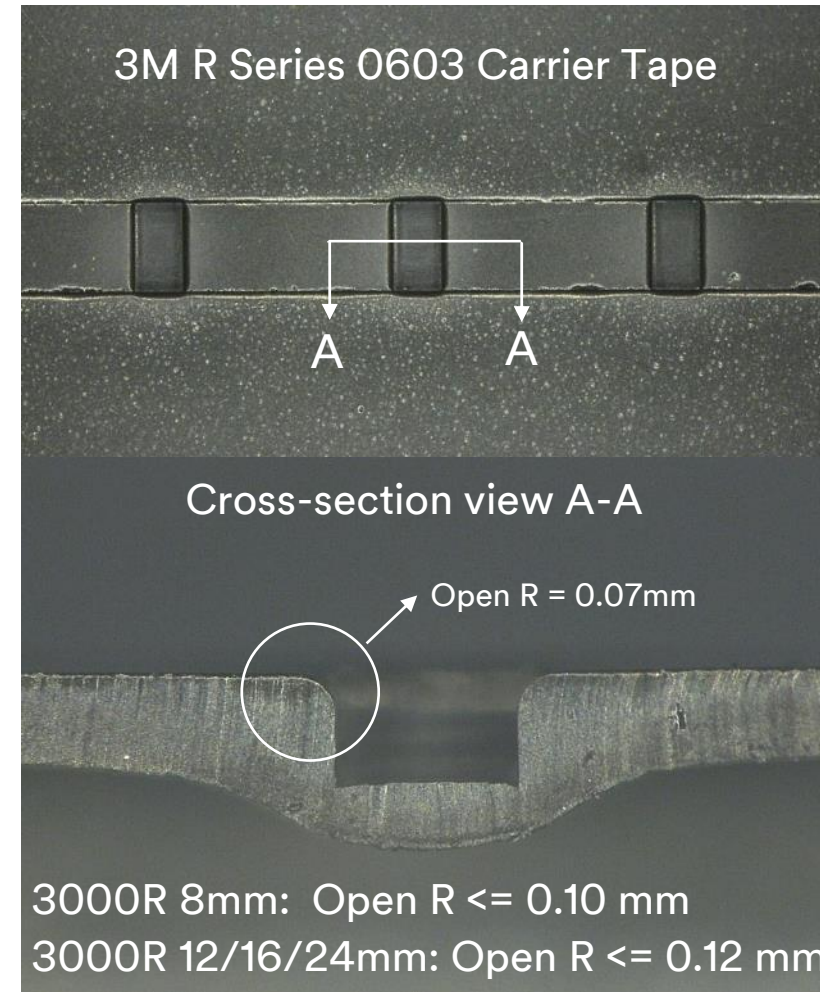
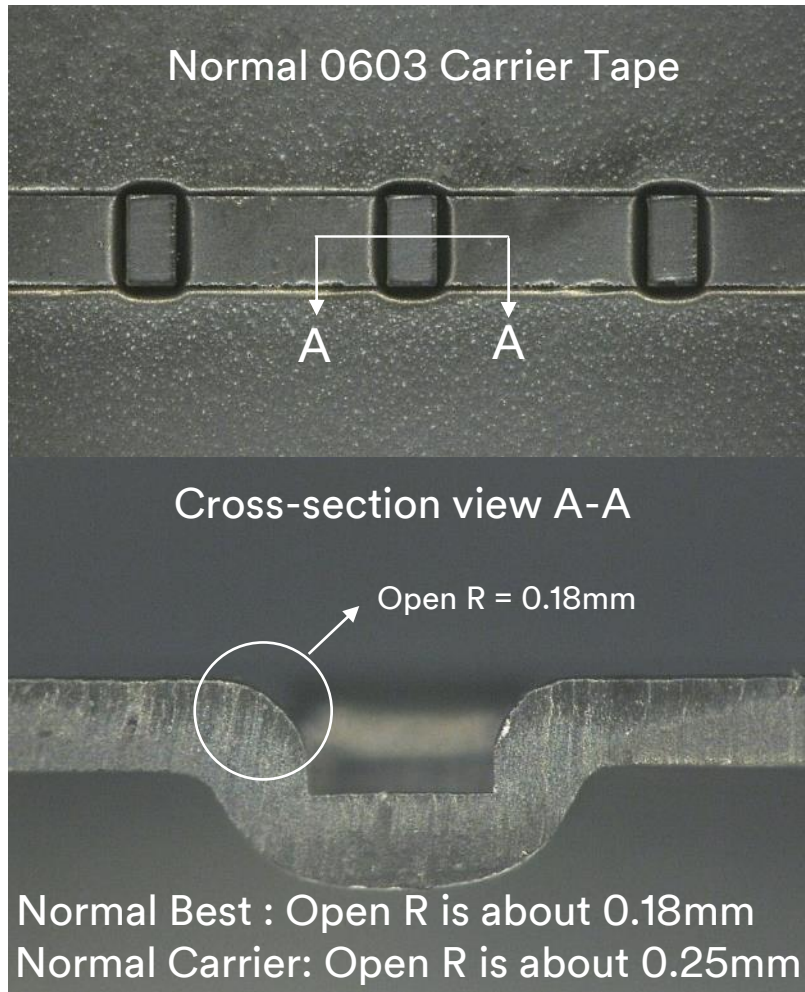


Raised feature

$\pm 0.03\text{mm}$ or $\pm 0.02\text{mm}$ pocket tolerance - minimize pocket variation that securely hold small or tiny die within, reducing tilting

➤ 3000R carrier tape solves the new packaging challenges of very thin die in T&R for customers & end users.

Key features of 3M™PC Carrier 3000 R series



- The **key feature** of 3000 R carrier is the open R (open radius) of the pocket.
- **RA** is the value of pocket open radius, 3M put “RA” in **COA** to control open radius (only for 3000R series).

What is 3M™ Polycarbonate Carrier 3000 R series?



1. Open R capability:

- 8mm width 3000R: **RA≤0.10mm**
 - 12mm/16mm/24mm width 3000R: **RA≤0.12mm**
- (RA is the value of pocket open radius, for normal 3000 carrier tape, the RA is around **0.25 mm**)

2. Precise dimension capability:


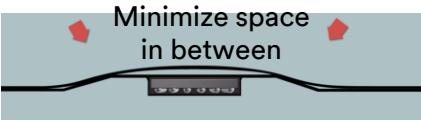

- Best pocket dimension tolerance : **± 0.02mm**
- (Best tolerance of 3000UP/UB: **±0.03mm**)

3. IP protection:

- 3000 R making process was granted as **3M trade secret**.
- 3000R's RA test method was taken as **3M confidential**.
- Raised platform design was granted as **global patent**.

- **Open R control capability:** 3000R series is made from a new process to control the pocket opening radius
- **Precise dimension capability:** 3000R series could provide tight pocket dimension tolerance when needed.

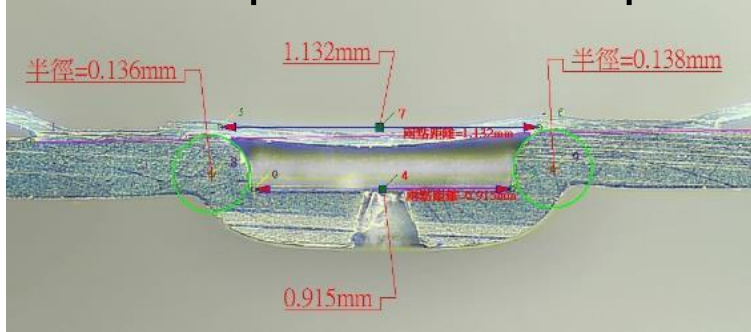
Understand the values of 3M™ Polycarbonate Carrier 3000 R series

Features	Advantages	Benefits
Pocket open radius control ≤ 0.1 mm /0.12 mm (depending on width)	Helps reduce the wideness and flatness of top pocket edge, especially important to shallow pocket depth	<ul style="list-style-type: none"> - Help reduce incidents of all kinds of die <ul style="list-style-type: none"> a. mispositioning (tilting, migration, disorientation, stuck or cracking) & b. missing (jumping out from pockets or stick), highly associated with small form and the growing tiny thin packages - In order to improve pick up rate at SMT pick & place operation
Available of ± 0.02 mm pocket tolerance	In addition to ± 0.03mm tolerance, ± 0.02 mm precision provide an option of narrower pocket variation to package even smaller or tiny thickness die	
Flat pocket bottom	 Prevent Z-axis movement or tilting	
Patented raised platform	 Minimize space in between Unique measure to minimize gap between cover tape & carrier	
Compatible with 3M™ Universal Cover Tape	 <ul style="list-style-type: none"> -Flat seal, prevent doming -Adhesive free in middle, no adhesive contact or contamination problems -Stable peel force, special peeling design has narrow peel range <10g 	

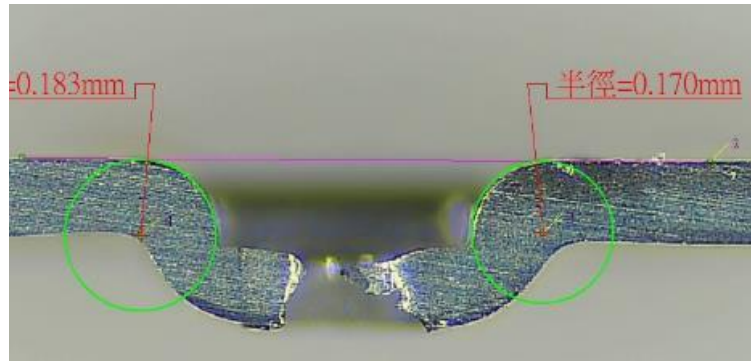
- 3M carrier R series was developed to help eliminate small & ultra thin packages movement & migration out of or within pockets, helps reduce undesired pick-up failure at end user level.

Understand competitiveness and FABs

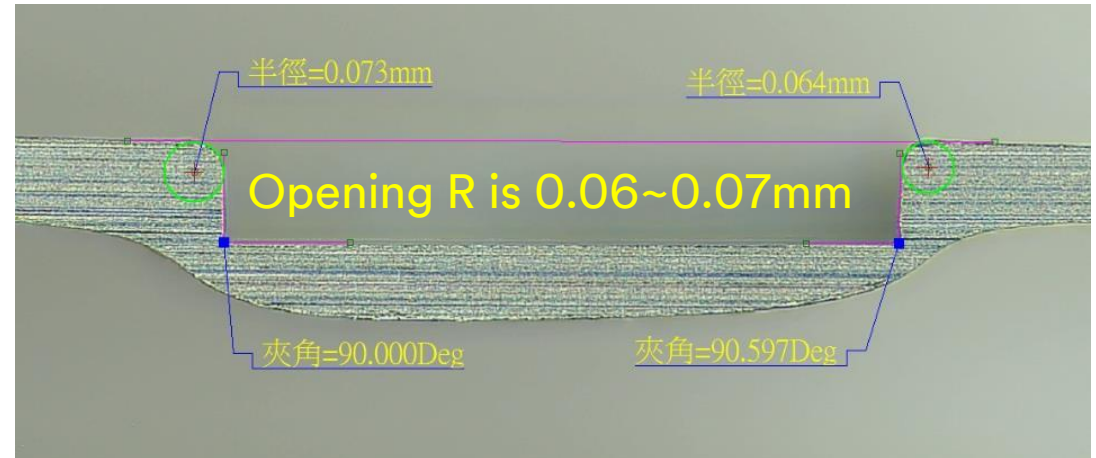
Main competitor's best: open R \approx **0.13 mm**



Traditional 3M's best: \approx **0.18 mm**



3000R's typical open R \approx **0.07 mm**



Product Feature

- Good opening R control
- Precise pocket dimension and smaller tolerance

Performance Advantage

- Better die protection capability
- Enlarge customer's process window
- Less pocket nesting issue after winding

Benefit to Customer

- Solve the die migration and crack issues
- Enhance productivity through easy and efficient application

What are under 3M™ Polycarbonate Carrier 3000 R series?

	3000XPR	3000XBR	3000UPR	3000UBR	3000NBR	3000BDR
Carrier width / pitch	Width: 8 mm (Preferred pitch: 4 mm)				Width: 12/16/24mm	
Pocket tolerance (Ao, Bo, Ko)	± 0.02 mm		± 0.03 mm		Ao/Bo ±0.05mm & Ko ± 0.03 mm	
Clean room compatible	No	Cleanroom	No	Cleanroom	No	Cleanroom
Pocket open radius (RA)	<=0.10mm				<=0.12mm	
Raised platform (height)	Required		Prefer raised platform or raised crossbar		Preferred	
Raised cross bar (height)	No				Optional	
Ao, Bo, Ko range	0.14mm<=Ko<=0.23mm; 0.25mm<=Ao<=2.0mm; 0.5mm<=Bo<=2.4mm;				0.14mm<=Ko<=0.25mm	
D1 size*	Prefer D1>=0.2mm				Prefer 1.0 mm	
Surface resistance (in ohms)	1.0E4 ohms<= SR < 1.0E11 ohms					

- 3000R carrier tape had been categorized by carrier tape width, dimension tolerance and clean room requirement.

What are the recommended applications?

Application recommendation:

- Thin, small & thin components with **die thickness $\leq 0.15\text{mm}$** , which are subjected to die slipping & migration easily
- Component types, example:
 - WLCSP (bump type)
 - Bare die
 - Mini-LED

Product recommendation, depend on

- Component size
- Tolerance required
- Cleanroom requirement
- Check with carrier design team for the best proposal

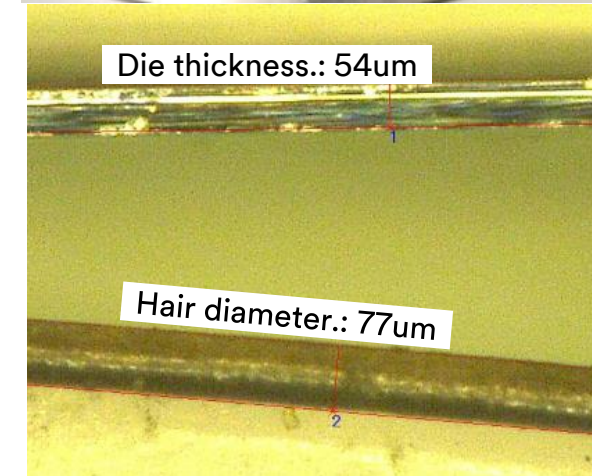
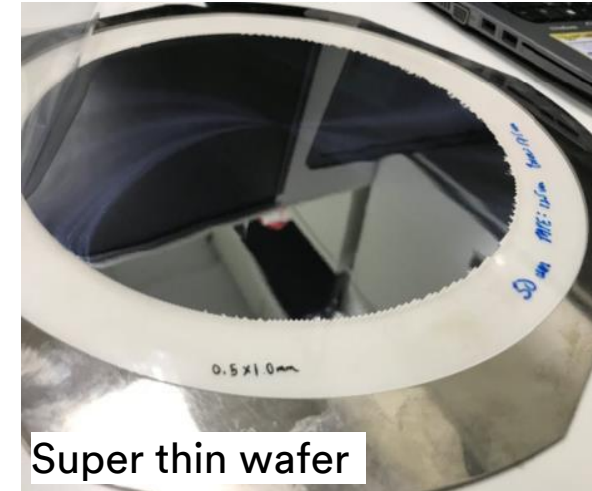
Examples of product recommendation

3000XPR	3000XBR	3000UPR	3000UBR	3000NBR	3000BDR
Require pocket tolerance ± 0.02 mm (Ideal for $\leq 0402\text{mm}$ &/or total die thickness $\leq 0.15\text{mm}$)		Require pocket tolerance ± 0.03 mm (Ideal for $\geq 0603\text{mm}$ &/or total die thickness $\leq 0.15\text{mm}$)		Require Ko tolerance ± 0.03 mm (For big & thin die which die thickness $\leq 0.15\text{mm}$)	
No cleanroom requirement	With cleanroom requirement (for WLCSP)	No cleanroom requirement	With cleanroom requirement (for WLCSP)	No cleanroom requirement	With cleanroom requirement (for WLCSP)

Understand performance of 3M™ Polycarbonate Carrier 3000 R series

Test conditions:

- The ultra-thin die samples were provided by US vendors, the component size was: 1.47 mm x 1.47mm x 0.05mm
- Two kinds of carrier tape had been made to package the thin die, both of the carrier tape had the same pocket size 1.55 mm x 1.55 mm x 0.17 mm
 - A reel of 3M carrier 3000UPR (opening radius is about 0.07mm)
 - A reel of 3M carrier 3000 control sample (opening radius is about 0.25mm)
- The 50 microns thin die had been taped into the two kinds of carrier tape with the same condition by another 3rd party US vendor.
- The two kinds of the packages had been shipped from US vendor to SH lab.
- Before the inspection, the two packages underwent vibration and drop test (1m height).

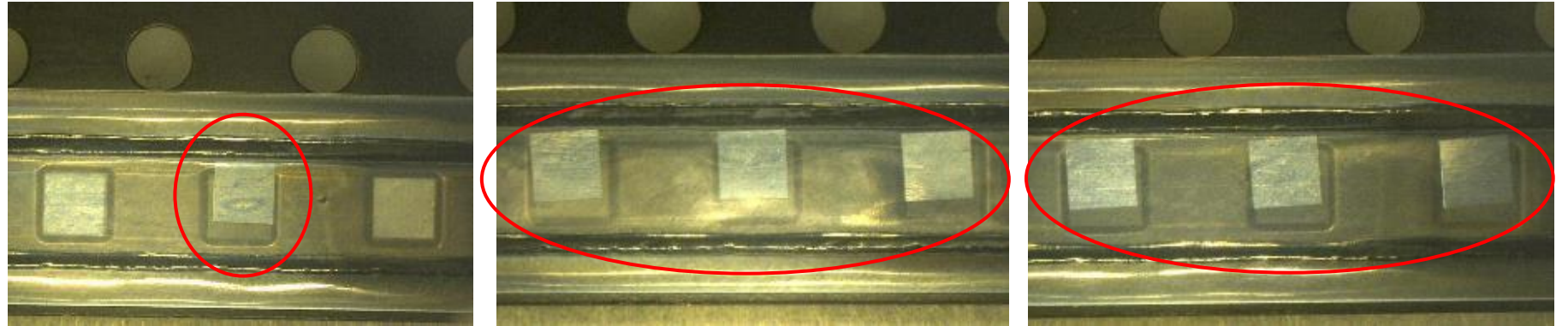


- A simulation test was conducted to demonstrate the effectiveness of 3M carrier R series in addressing the T&R issues and impressive result was achieved.

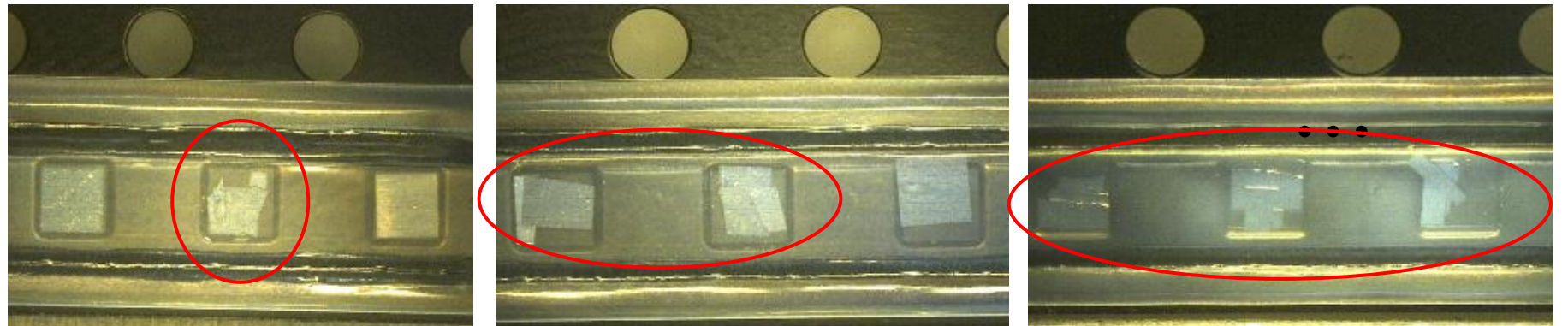
Understand performance of 3M™ Polycarbonate Carrier 3000 R series

Control samples' failure pictures:

Control samples'
die stuck rate
>50%



Control samples'
die crack rate was
6%

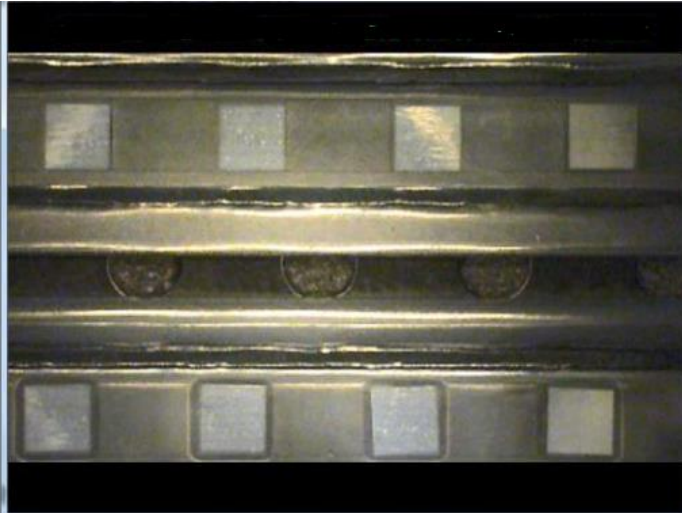


- To see the effect in extreme scenario, the **super thin die** (1.47*1.47*0.05 mm) were selected for the study.
- Eliminating the influence from reel package, control samples showed **very high defect rate**, while there is **no defect** found in 3000R samples.

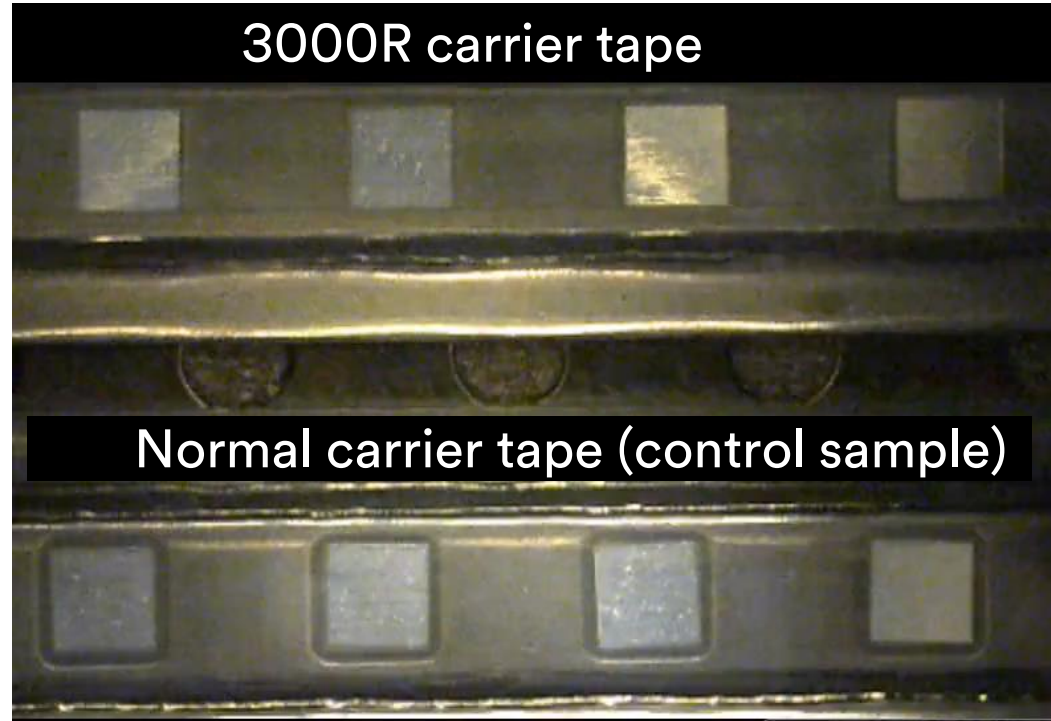
Understand performance of 3M™ Polycarbonate Carrier 3000 R series

Video of the shaking test

Before shaking



3000R carrier tape



Normal carrier tape (control sample)

After shaking



- 3000R carrier tape and control sample which had same pocket dimension were used to package the same super thin die (1.47*1.47*0.05 mm).
- RA (open radius) was about 0.07mm for 3000R sample, and about 0.2mm for 3000 samples.
- The effect of 3000R carrier tape could be demonstrated clearly by a simple shaking test.

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