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Archive

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Enhancing OEE & Reducing Costs for KGD Handling using Universal Micro-Textured Carrier Strategies

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Mesa, Arizona • March 1–4, 2026

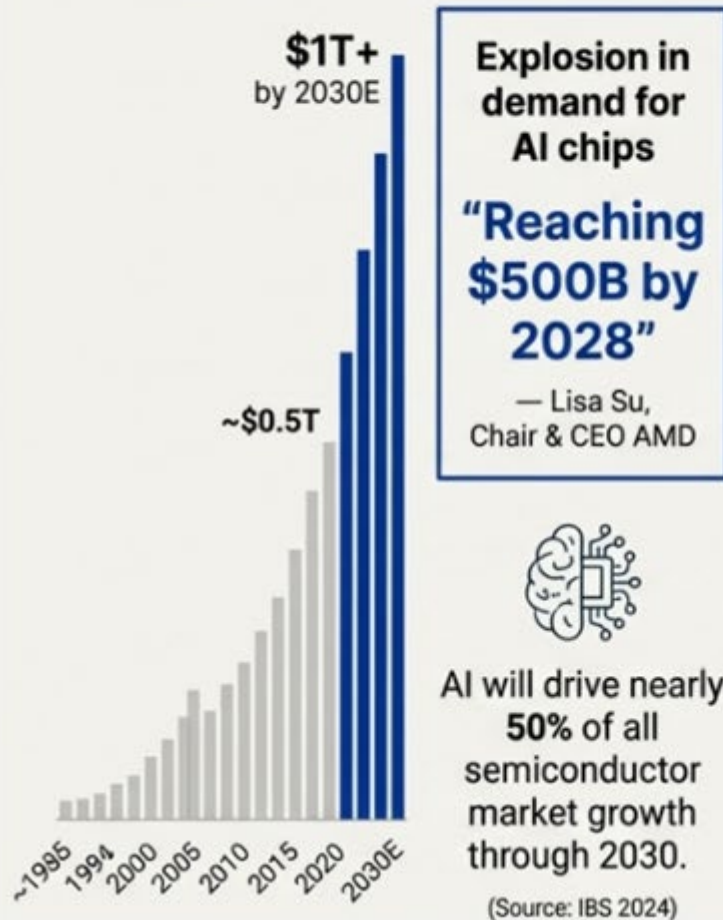


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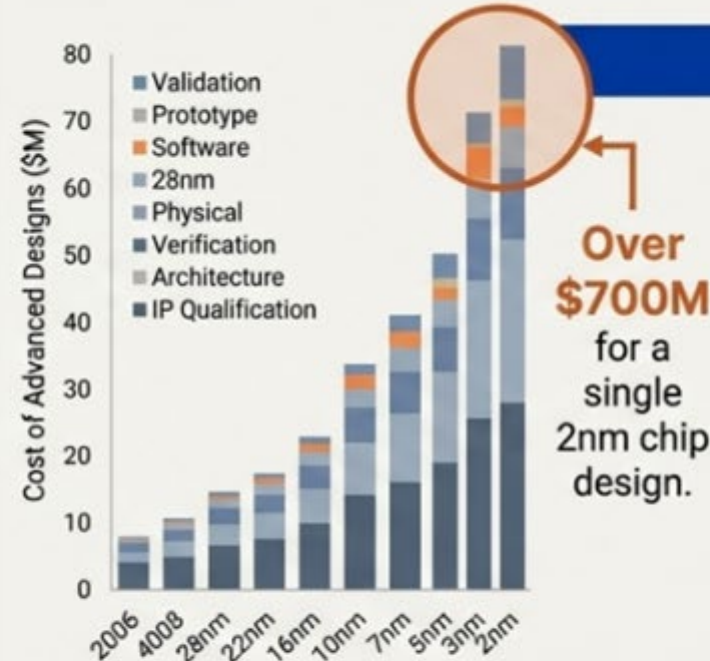
- Heterogeneous Integration at the Leading Edge
- Singulated Die Handling Requirements
- Addressing Die Handling Challenges
- Case studies: Universal Die Handler
- Summary and Key Take-Aways

Life Runs on Semiconductors (what we know)

Market Drivers

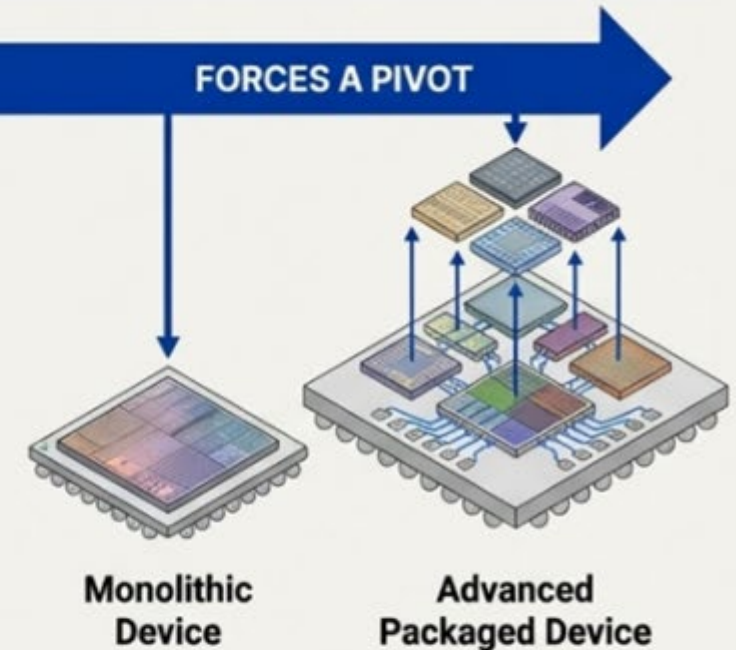


Economic Barriers



Development costs for advanced nodes have **increased by more than 20X**.

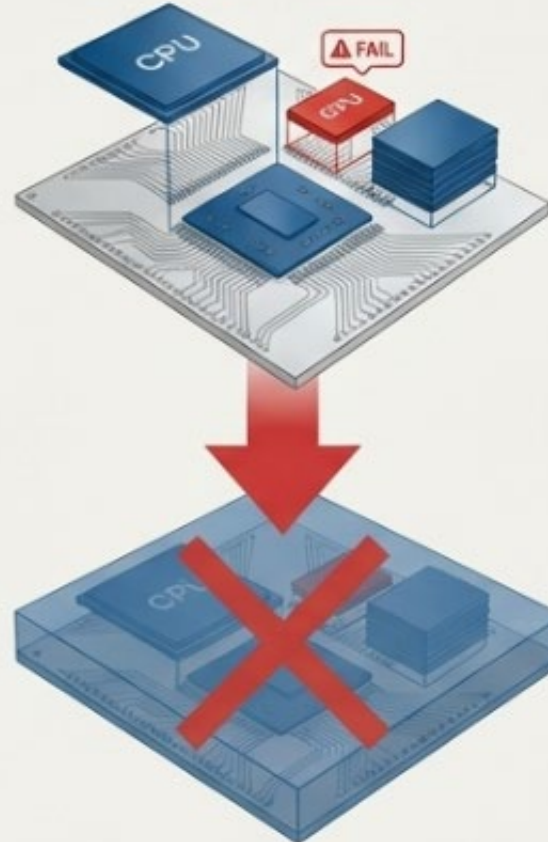
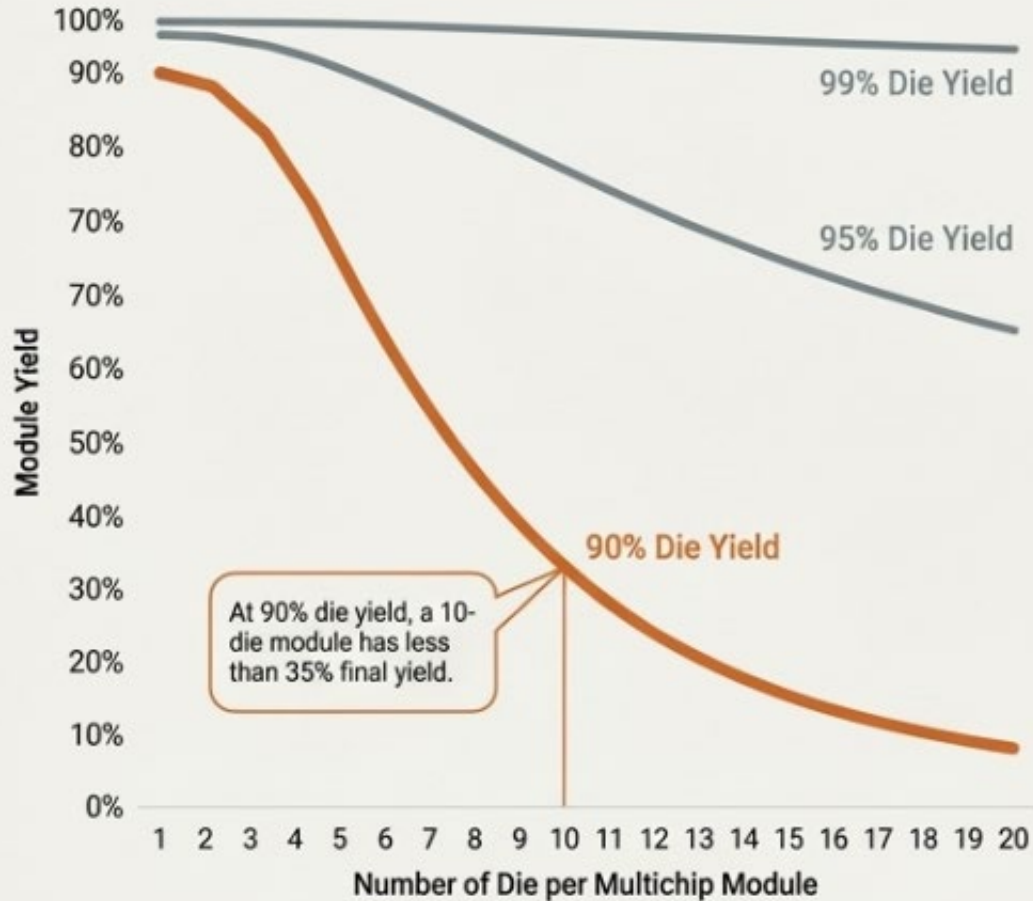
Heterogeneous Integration



"Best-in-class" IP assembled into a single advanced package.

Die Handling Challenges – HiR 2024

Multichip Module Yield vs. Single Die Yield



The Critical Bottleneck: Known-Good-Die (KGD) Handling



To mitigate yield loss, the industry must **'Shift Left'** to test every singulated die *before* assembly.

Future Solution. Significant R&D needed in carrier tech and automation.

- ✓ Cost-efficient test required for singulated and stacked die.
- ✓ Device handlers and test-cells must support singulated die testing.
- ✓ **Cost-effective methods to universally handle numerous die sizes** after saw, thin, and bump.
- ✓ Reduce scrapped die due to die migration and induced defects."

Conventional Carriers “Fail” for KGD & Die Test

Sticky Tapes (Dicing Film)

- **Single Use Only:** Once a device is picked it cannot be replaced for re-testing.
- **Uncontrolled Debonding:** Die ejector pins required that risk damaging thin, delicate die.
- **High pick force risk:** High tack adhesive can firmly hold the devices.



JEDEC Trays & Waffle Packs

- **Device Specific:** Custom-molded pockets require new tooling for change to IC dimension (>2000 different sizes exist).
- **Slow Time-to-Market:** New tooling takes 14 to 16 weeks.
- **Die Damage Risk:** Not suited for thin die, with high potential for die migration, cracking, flipping, during transport.



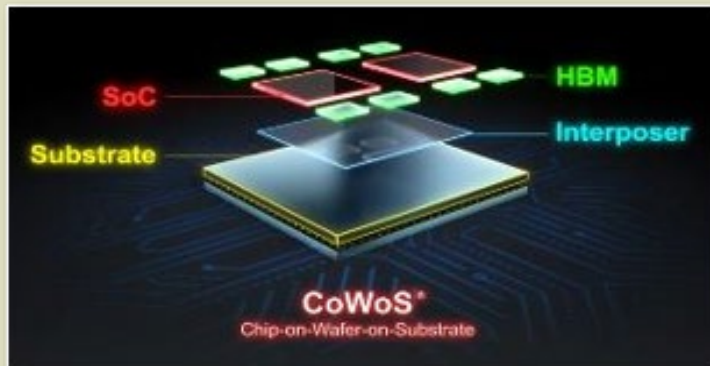
Tape & Reel

- **No Re-Pick Capability:** Pockets are sealed with a cover tape that can only be removed once, making it unsuitable for multi-stage testing.
- **Device Specific:** Custom-molded pockets require costly and slow tooling.
- **Risk of Migration:** Not suited for thin die, with high potential for die migration.

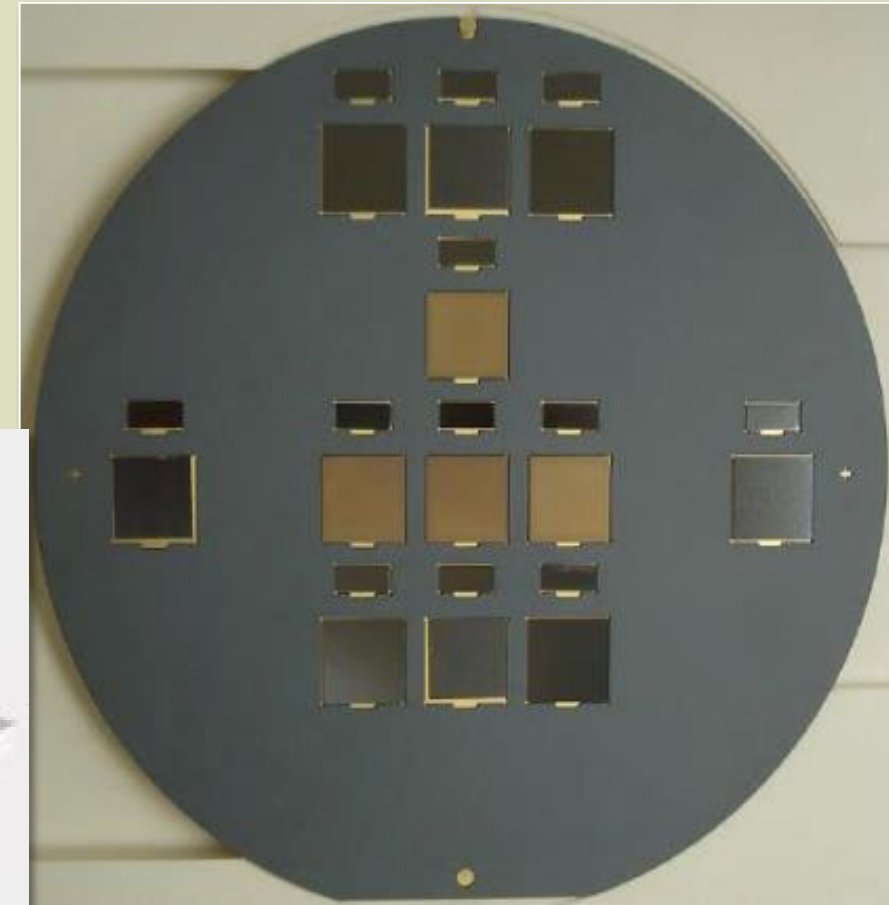
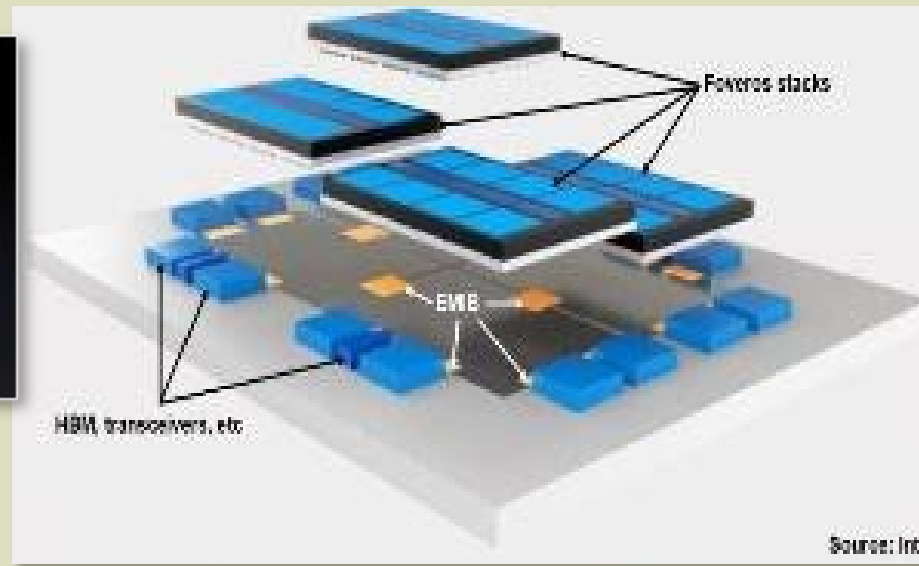


Conventional Carriers “Fail” for KGD & Die Test

- Can accept Broad Range of Device Sizes
 - Individual tooling is needed for each die size.
 - KGD achieves high yield in 2.5D and 3D Multi-Chip Module (MCM).
 - Wide Range of XY sizes and thicknesses need to be efficiently handled during test.



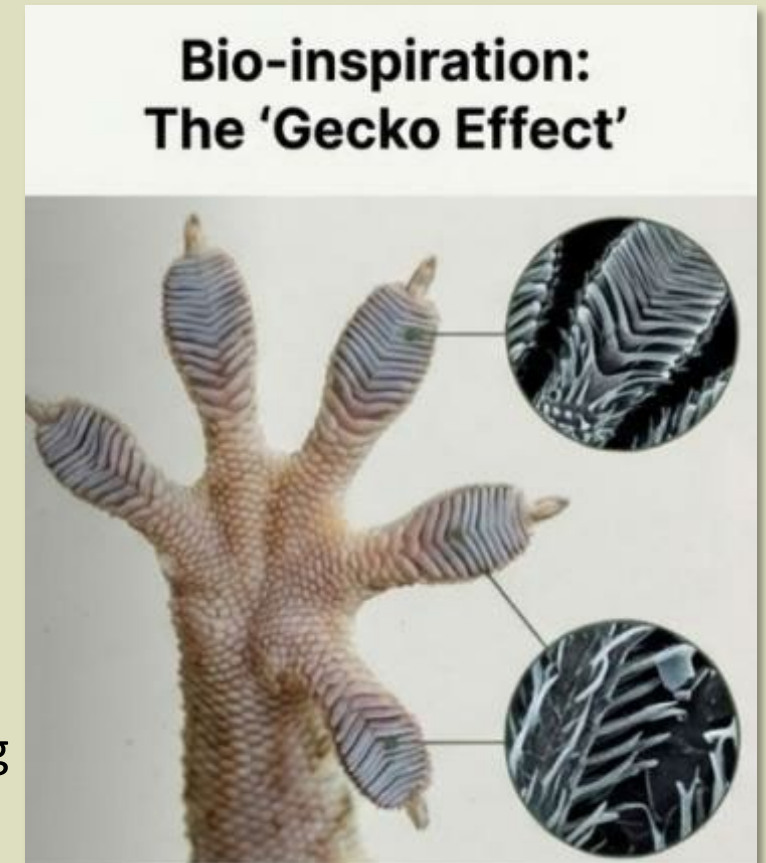
* Known-Good-Die (KGD) test methods for large, thin, high-power digital devices, International Test Conference, D. Armstrong (Advantest Inc.), G Maier (IBM), 2016



Singulated die handler from TEL

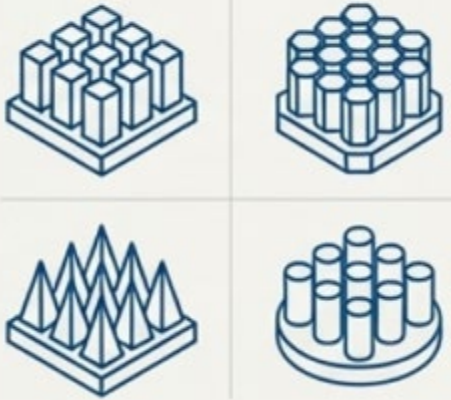
Defining a Universal Carrier for KGD & Die Test

- Universal and Flexible
 - Adaptable to any die size (replace >2000 existing pocket designs)
 - Eliminate customer tooling costs with each design
 - Accelerate time to market (reduce from 14 to 16 weeks)
- High Yield and Damage Free
 - Optimize for singulated die transport to ensure KGD
 - Securely immobilize and protect thin, fragile die from damage
 - Allow for multiple re-pick cycles
- HVM-Ready and Clean
 - “Drop-in-solution” JEDEC format for existing PnP and SMT tooling
 - Positive impact on UPH rates
 - Residue free to prevent contamination



From Bio-Inspiration to High Volume Manufacturing

Texture Engineering



Materials Engineering

Over 20 formulations explored, including:

- Acrylic
- Styrenic
- Isoprene
- Isobutylene
- TPEs

Rigorous Testing



HVM Ready Product



- **Single optimized texture with three distinct, engineered tack levels to suit different applications.**

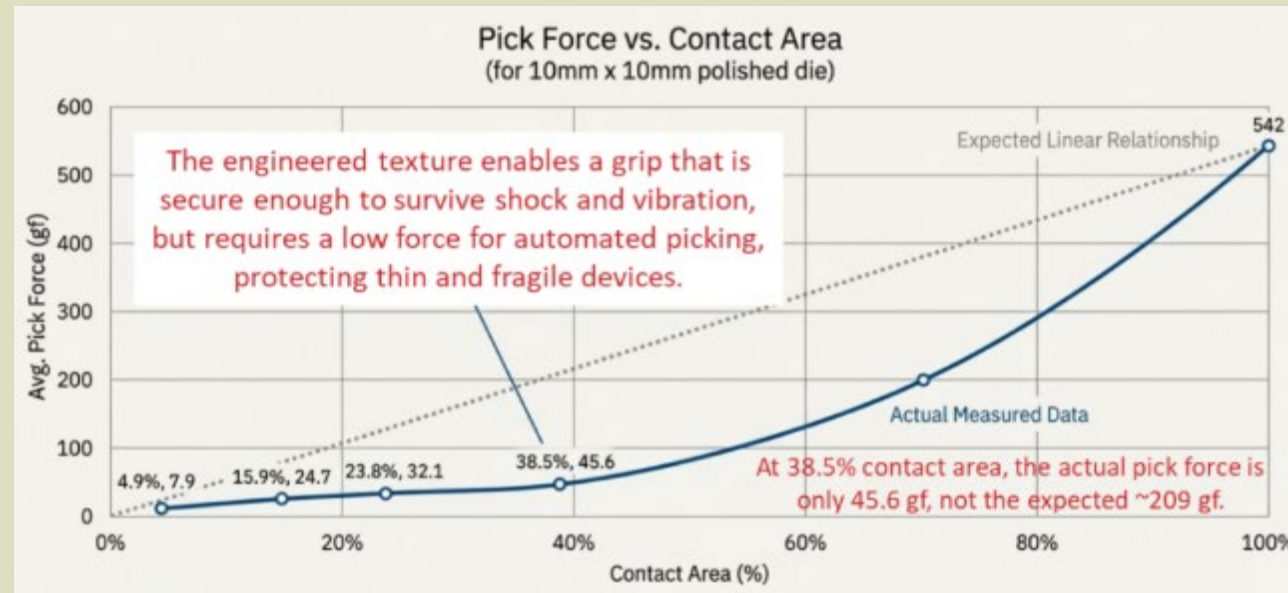
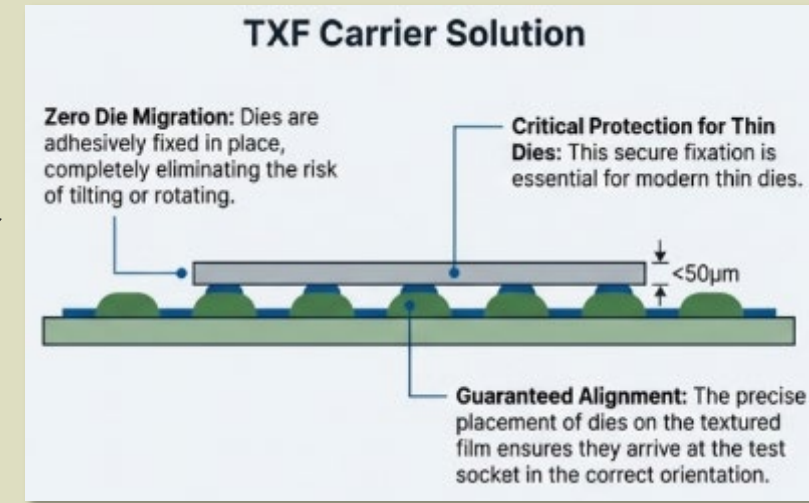
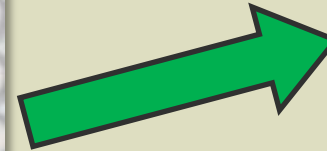
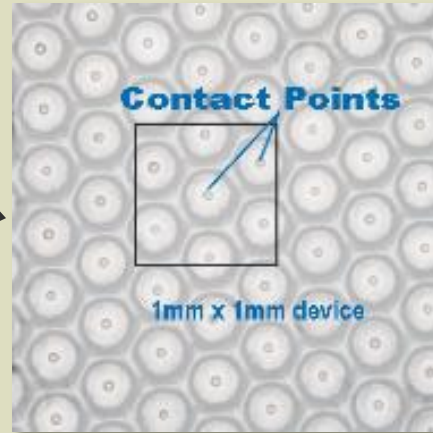
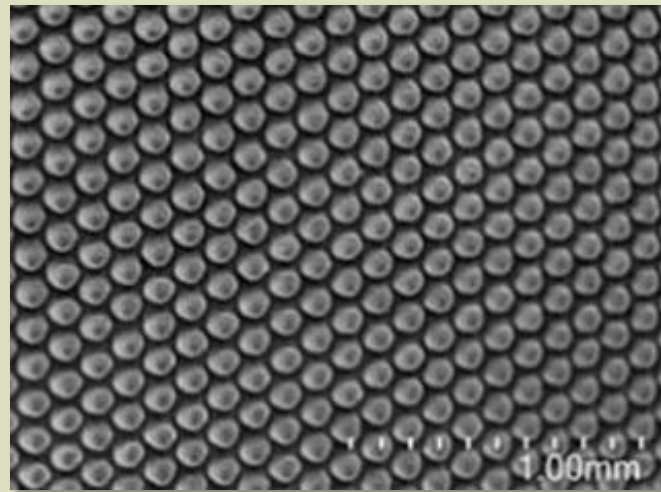
- Low tack: In-process use
- Medium tack: bare die shipping & transport
- High tack: packaged device handling

- **Critical Properties**

1. Minimal Surface Contact & No Residue
2. Vacuum-Free" High-Speed Pick & Place
3. Universal "Pocketless" Design
4. Thermal Stability

Gel-Pak Micro-Texture

How Does It Work?

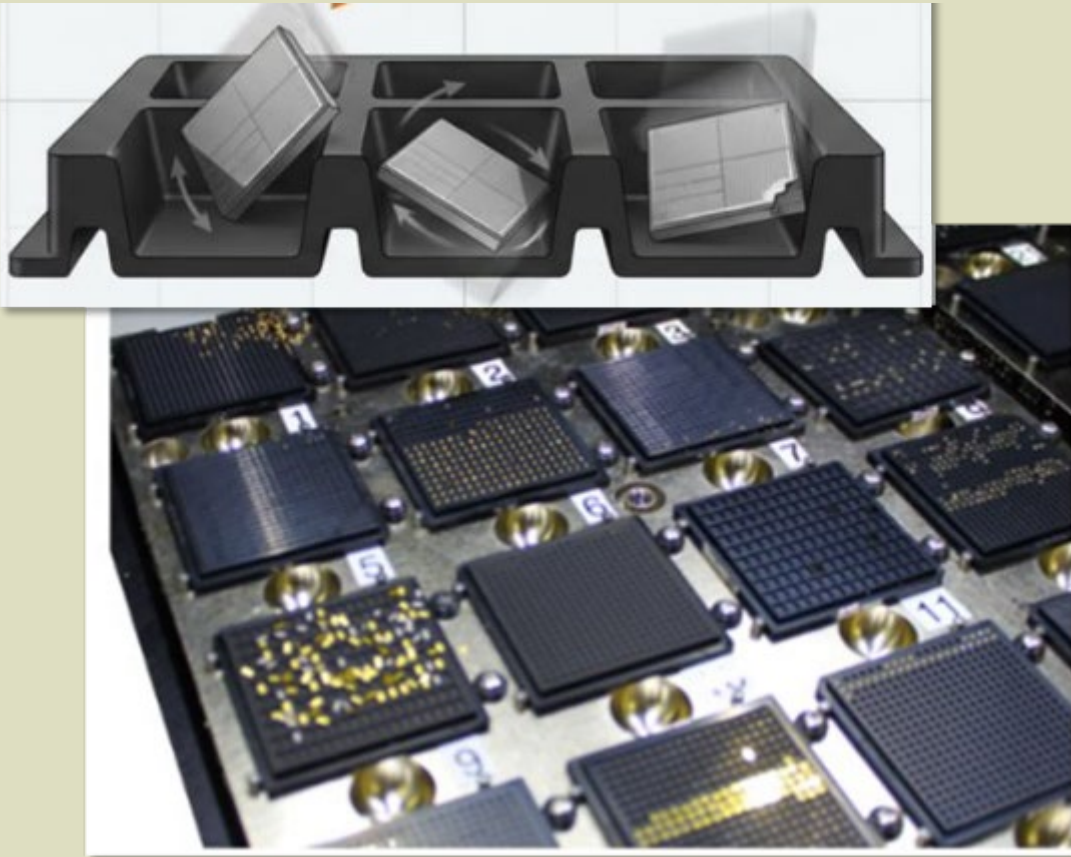


Universal Carrier vs. Conventional Carriers

Feature	Universal Carrier (BTXF)	JEDEC Trays / Waffle Pack	Tape & Reel	Sticky Tapes (Dicing Film)
Device Size Flexibility	Yes Universal surface handles high mix of die sizes	No Custom-molded pockets	No Custom-sized pockets	Yes Flat surface
Pick & Re-Pick Capability	Yes Reversible adhesion allows >250 pick/re-pick cycles	Yes (if not too thin)	No Single-use cover tape	No Single pick only
Thin/Fragile Die Handling	Excellent Securely immobilizes die, mitigating cracks	Poor Risk of flipping/damage	Poor Risk of migration	Fair High pick force risk
Adhesion Mechanism	Controlled, Bio-Inspired Dry Adhesion	Mechanical (Pockets)	Mechanical (Pockets)	Uncontrolled Wetting
Residue/Contamination	None	Low	Low	Potential Adhesive Residue
Tooling for New Devices	Not Required Zero tooling time	Required Costly & slow	Required Costly & slow	Not Required

Customer Case Study | Die Migration

High Risk Handler Jams



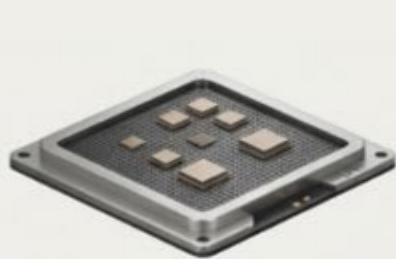
Zero Die Migration



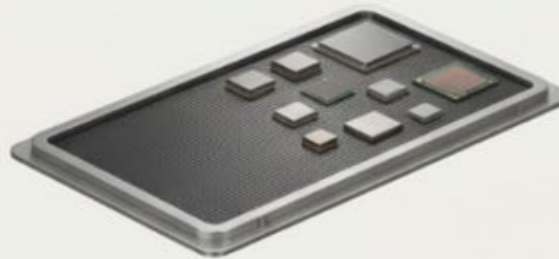
Scalability for Waffle Pak, JEDEC Trays, and Wafers

Essential Requirement	Concept	Engineered Materials
Universal Surface	No need for custom molding. Accepts broad range of die sizes and shapes	Easily installed film for generic trays, film frames, and 200mm / 300mm SEMI wafers
Precision Die Handling	Open access format. Easily move, replace, discard devices	<u>Pocketless</u> for any device footprint and thickness
Protect Devices	Stress free, and no transference pick-and-place	Temporary adhesion to restricts device movement with minimal stresses
No Vacuum Needed	No mechanical and vision latency for instant release. No supplement backside vacuum required.	Dry Adhesion ... (the Gecko Effect).
Meets Standards	Compatibility for use with existing waffle pack, JEDEC tray, and wafers handling tools.	Compatible with existing handling formfactor

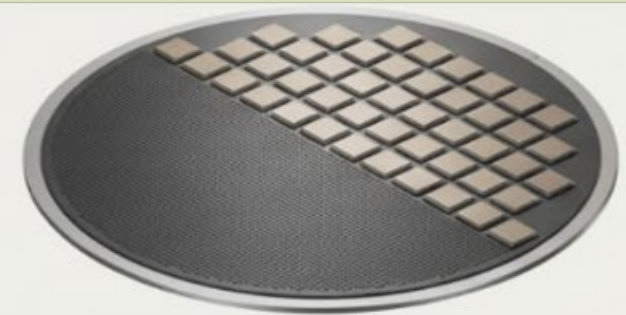
Scalability and versatility for multiple formfactors



Waffle Pack



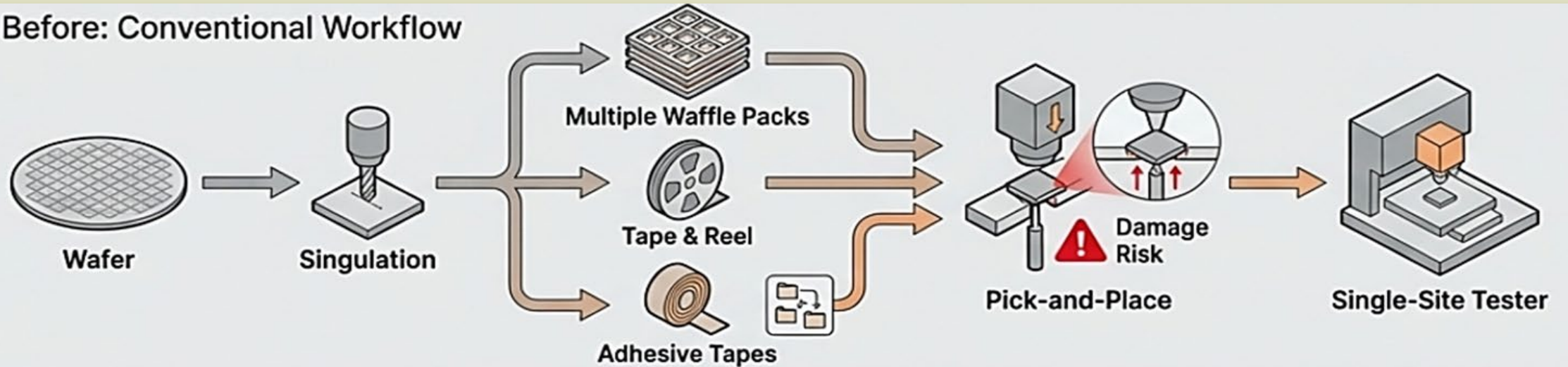
Standard JEDEC Tray



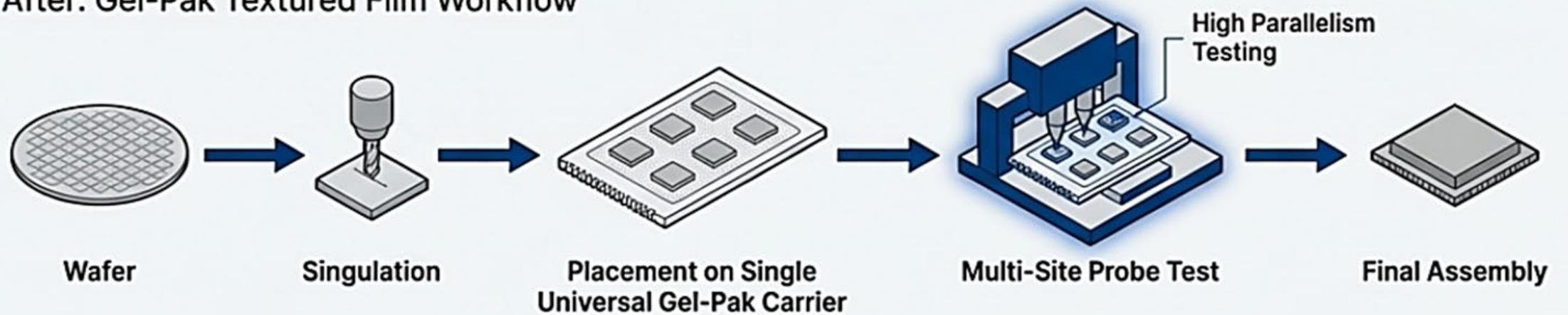
300mm SEMI Wafer

Customer Case Study | UPH Improvement

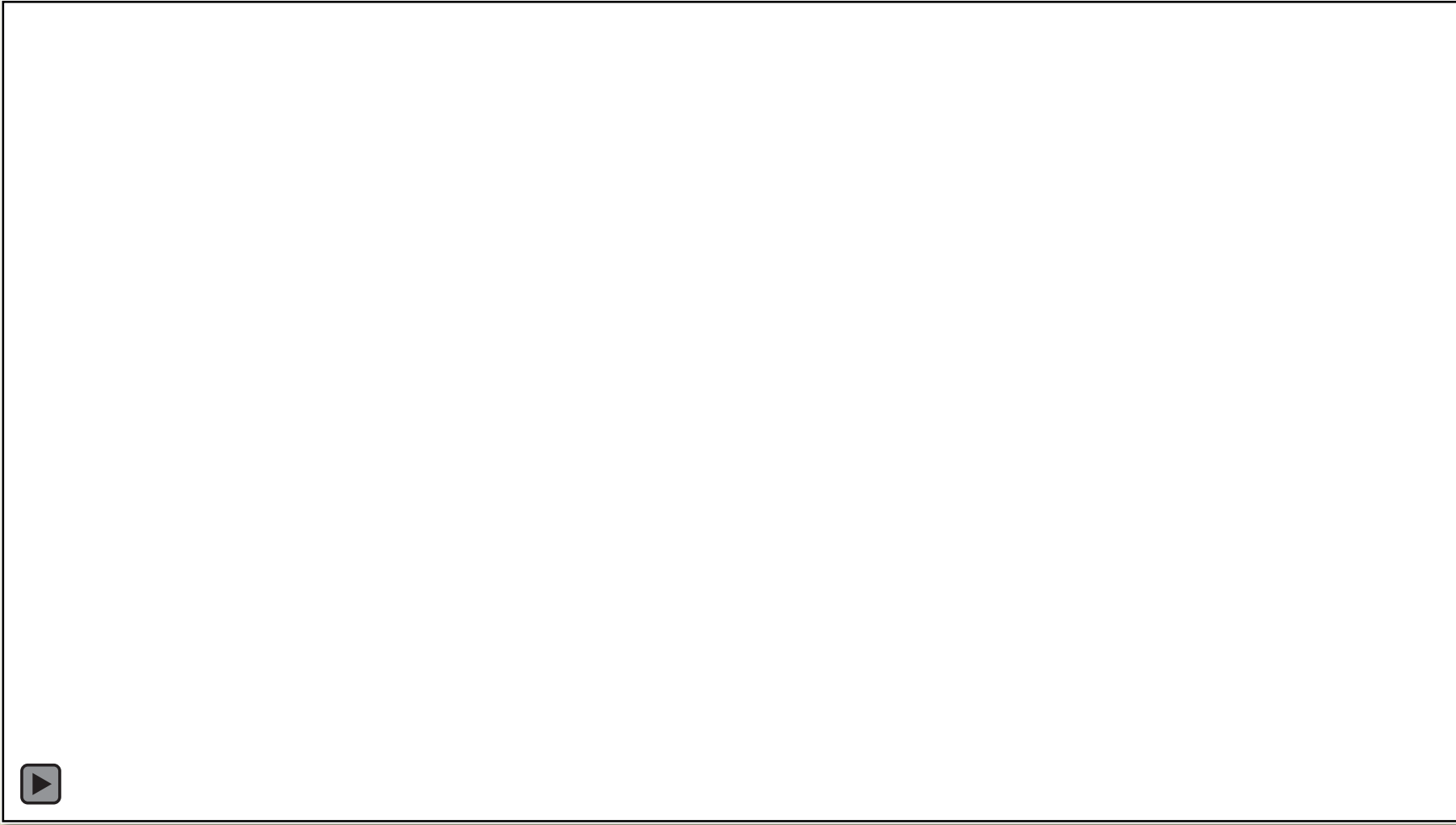
Before: Conventional Workflow



After: Gel-Pak Textured Film Workflow



Customer Case Study | UPH Improvement



Customer Case Study | UPH Improvement

Process Step	Standard JEDEC Tray	BTXF Textured Film	UPH Impact
Release Latency	0ms Pneumatic / 0.5–1.5s Mechanical	0 seconds (Instant)	High
Vision Alignment	100ms – 300ms (Searching for shifted die)	<50ms (Fixed grid)	Moderate
Pick Success Rate	98.5% – 99%	>99.8%	Variable by machine
Z-Axis Travel	Longer (Must clear pocket walls)	Shorter (Flat surface)	Minor/Individual

- **Pick Speed:** saving **~0.5 to 1.5 sec per pick** translates to UPH gains of around **20-25%**
- **Consistency:** "First Pass Yield" of the PnP tool increases, i.e., fewer "failed picks" or "misalignments".
- **Significant UPH Gains**
 - Low-Volume & Manual: ~5 to 10% ... (Mostly from easier handling).
 - High-Volume Automated: ~15 to 30% ... (Due to elimination of vacuum cycles and faster vision alignment).
 - Small/Fragile Die (<1mm): Up to 50% ... (Standard trays are inefficient for ultra-small components)

Enhancing OEE for Reduced Cost of Test

OEE Pillar	Loss Category	Standard JEDEC Tray	BTXF Textured Film	Impact / Benefit
Availability <i>Often lost to Setup and Adjustments</i>	Setup / Changeover Time	High (Tray swaps required)	Low (Universal fit)	5–10% increase in Availability due to reduced setup time and fewer "nuisance" stops
	Unplanned Stops	Frequent (Die migration/OOP)	Rare (Non-slip grip)	
Performance <i>Limited by Minor Stops and Speed Loss</i>	Cycle Time	Limited by mechanical and vision latency in pocket walls	Optimized (Instant release)	10–20% increase in Performance , especially on high-speed pick-and-place
	Minor Stops	Vision "search" for shifted die	Fixed grid (Instant snap)	
Quality <i>Due to Die Damage and contamination</i>	Yield Loss	Edge chipping, stiction, and debris in pockets.	No-contact edges; no residue; <2% Surface Contact.	1–3% increase in Quality yield, represent major ROI for high-value dies
OEE		~60% – 70%	~80% – 90%	OEE gain 15 to 20%

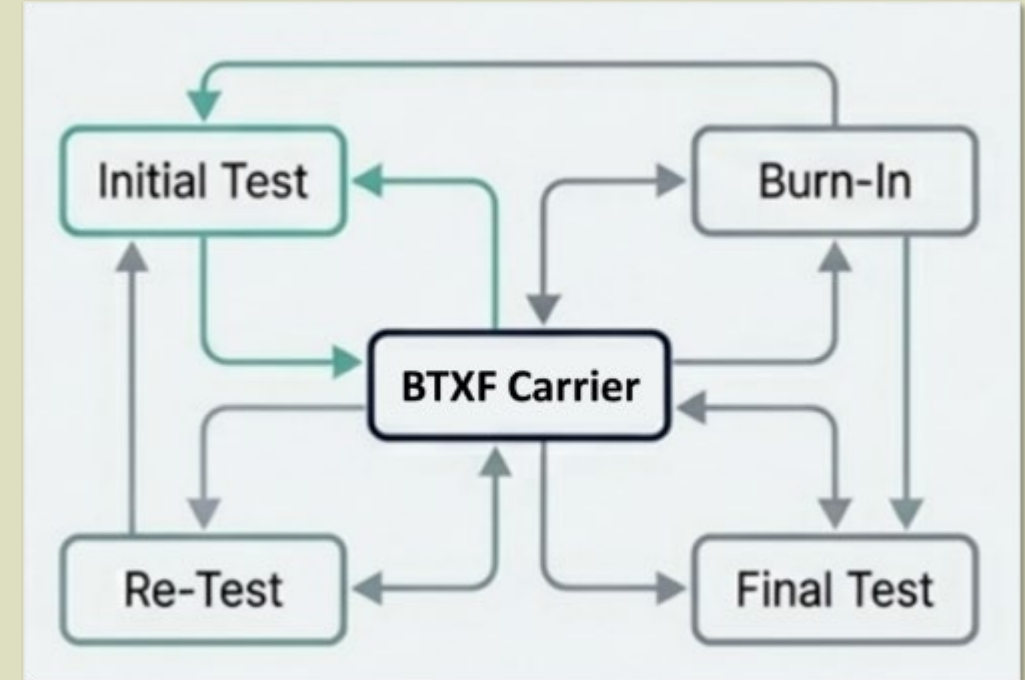
Overall Cost Reduction

- **Low / Zero Tooling Costs:** A single JEDEC tray footprint with universal, pocketless surface replaces hundreds (thousands) of customer trays.
- **Immediate Availability:** New die design handling does not require a carrier design, NRE costs, and fabrication cycle (14 to 16-weeks).
- **Unlimited Access:** die can be picked, placed, and repicked from any location and in any order.
- **High Reusability:** Universal carrier is cleanable and re-usable, withstanding numerous PnP cycles without degradation.
- **Simplified Inventory:** drastically reduce SKU complexity and inventory management.



Summary

- Singulated die test and “shift left” exposes the critical limits of conventional carriers (Waffle Pack, JEDEC Tray, and Tape & Reel) for meeting requirements for Singulated Die Test.
- Universal, pocketless textured media (BTXF product family) meets the handling challenges associated with next generation of singulated die, advanced packages, and KGD.
- A universal, efficient carrier solution can create a total OEE lift of 15 to 20%, effectively giving "free" capacity with existing tooling without buying new equipment.



Acknowledgements

- Thanks to our industry validation partners.

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- Thanks to our end-customers that must remain nameless.

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