



**Testing the Limits**  
FOR PRODUCT SUCCESS

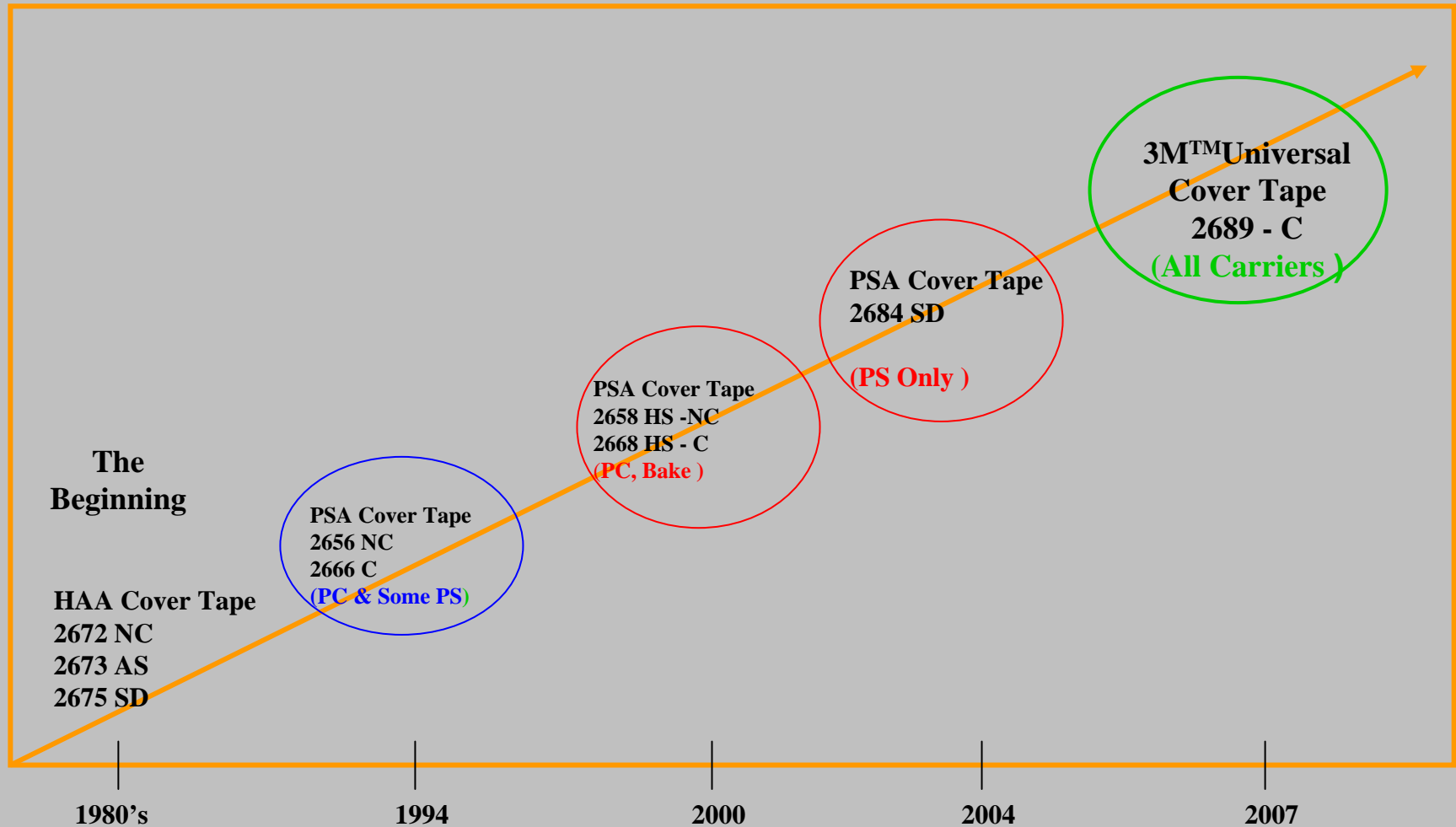
# Advanced Cover Tape Technology for Electronic Component Packaging 3M™ Universal Cover Tape (UCT)

**James T. Adams**  
Senior Application Engineer  
3M Electronic Solutions Division

# Overview

Leveraging core film and adhesive technologies, 3M has developed an innovative cover tape solution which combines value added design features and is designed to eliminate recurring disadvantages of both heat activated adhesive (HAA) and pressure sensitive adhesive (PSA) cover tapes for sealing surface mountable components in tape and reel.

# Introduction – Evolution of Cover Tape



# Voice of Customer

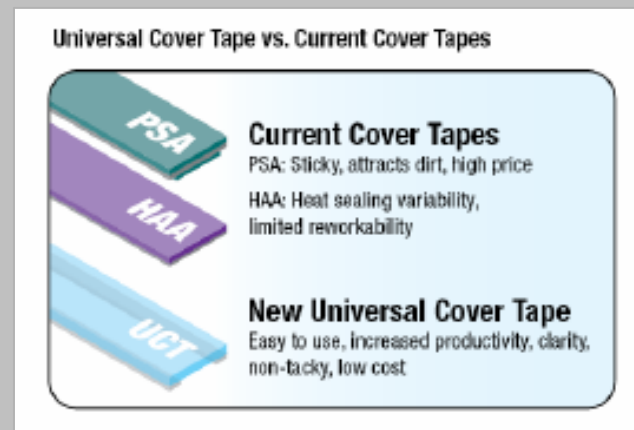
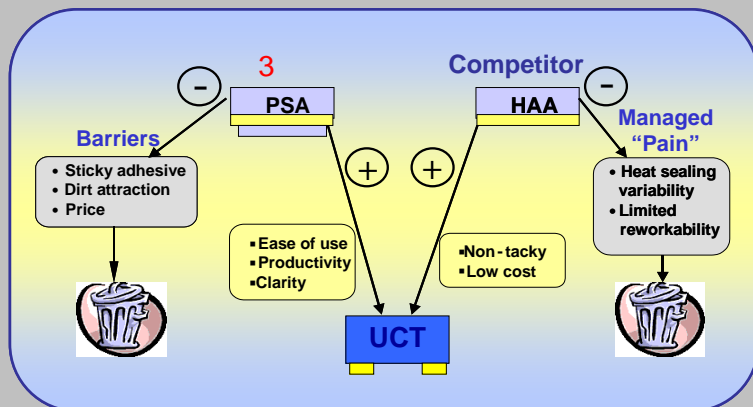
3M's approach in developing a better cover tape design was to conduct extensive interviews with component manufacturers and end users to clearly define the challenges and requirements associated with cover tape applications in the industry. Key attributes important to customers were captured in "voice of customer" (VOC) interviews:

- tighter peel ranges with **less variability**
- **elimination of adhesive transfer** to sealing and feeder equipment
- a single cover tape that **works on all carrier tapes**
- **reduced component migration** during cover tape removal from carrier
- **consistent surface resistance** (ESD) protection
- address future **small component packaging needs**
- **reduced contamination** (paper and embossed carrier tape users)
- **improved yields** associated with pick and place equipment operations
- **improved clarity**
- **competitively priced**

# 3M's Approach

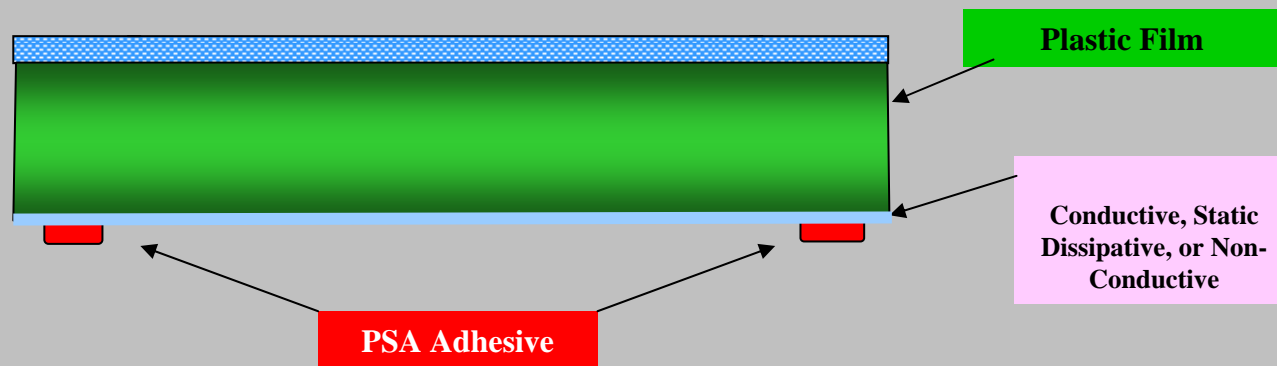
- Capturing key requirements from global VOC interviews and leveraging core film and adhesive technologies, 3M has developed an innovative cover tape solution which
- combines value added design features
  - is designed to eliminate recurring disadvantages of both heat activated adhesive (HAA) and pressure sensitive adhesive (PSA) cover tapes.

The concept illustration below shows 3M<sup>™</sup>Universal Cover Tape (UCT) consists of a combination of positive attributes from both PSA and HAA cover tapes while eliminating the negatives.



# Product Design Concept

3M™ Universal Cover Tape (UCT) consists of a single, transparent plastic film, with a synthetic, room temperature, pressure sensitive adhesive (PSA) zone. Additional features include single-sided, conductive, static dissipative, or non-conductive properties on the component side, with unique enhancements for peel applications.



**3M™ Universal Cover Tape (UCT) 2689, Conductive**

**3M™ Universal Cover Tape (UCT) 2688, Static Dissipative**

**3M™ Universal Cover Tape (UCT) 2680, Non-Conductive**

# Design Features

**3M™ Universal Cover Tape's (UCT) revolutionary design features address the “top ten” VOC concerns:**

- Instead of removing the entire width of cover tape from the carrier, **3M Universal Cover Tape (UCT) is designed to remove only the middle portion** which provides a smooth consistent peel with tight ranges and controlled variability. Peel-enabling features enhance peel initiation at removal.
- The **adhesive exposure region** is positioned away from the edge, therefore virtually eliminating the risk for adhesive transfer to sealing and feeder equipment. The adhesive properties provide a strong bond to polycarbonate, polystyrene, and paper carriers.
- Leveraging our core coating technologies, UCT is designed to provide **consistent surface resistance properties** that target less than  $10^5$  ohms per square for conductive versions and a static dissipative range equal to  $10^5$  but less than or equal to  $10^{11}$  ohms per square. Thus, consistent surface resistance properties provide stable ESD protection.
- This **unique cover tape removal force method** helps resolve existing component migration, flipping, vibration, and chip sticking concerns associated with bare die, chip scale packages, and many other small component devices.
- **Debris accumulation concerns are virtually eliminated** since the adhesive is positioned away from the edges. Therefore, no adhesive will adhere to adjacent surfaces or attract air born contaminants. For users of paper carrier, fiber contamination associated with clogging pick nozzles is reduced as the adhesive stays adhered to carrier during removal and the removal force applications consist of peeling only the center portion. Both factors **reduce risks associated with debris**.
- **UCT is compatible with all feeders** as the tape remains adhered to carrier during advancement and peel back. Disposal of the carrier will not dull chopping blades nor result in adhesive transfer to feeder tracks, collection bins, or take-up reels

## 3M™ Universal Cover Tape (UCT)

Illustration of Peel Enabling Design Feature / 5.4 mm Sample



# Product Performance

Laboratory evaluations were performed to provide initial performance attributes for 3M™ Universal Cover Tape (UCT) product constructions. Evaluations were based on samplings from our 3M™ Universal Cover Tape (UCT) 2689, Conductive version for:

- Visual
- Physical
- Electrical
- Environmental Aging - Environmental aging results (charts and raw data) depict typical 3M Universal Cover Tape adhesion to 3M™ Conductive Polycarbonate Carrier 3000 and 3M™ Non-Conductive Polycarbonate Carrier 2703 and competitor polystyrene (PS) carrier tapes at 52°C/95% relative humidity conditions for 30 Days.
- ***Note: Due to the unique design of 3M Universal Cover Tape, 3M will reference the term “removal force” (references removal of the middle section instead of full width) to replace peel forces.***

# Product Performance

## Visual

Property	Haze	Transmittance	Clarity
Average Results	11%	72%	64%
Number of Samples (1 Lot)	20	20	20
Test Method	ASTM-D1003	ASTM-D1003	ASTM-D1003

## Physical

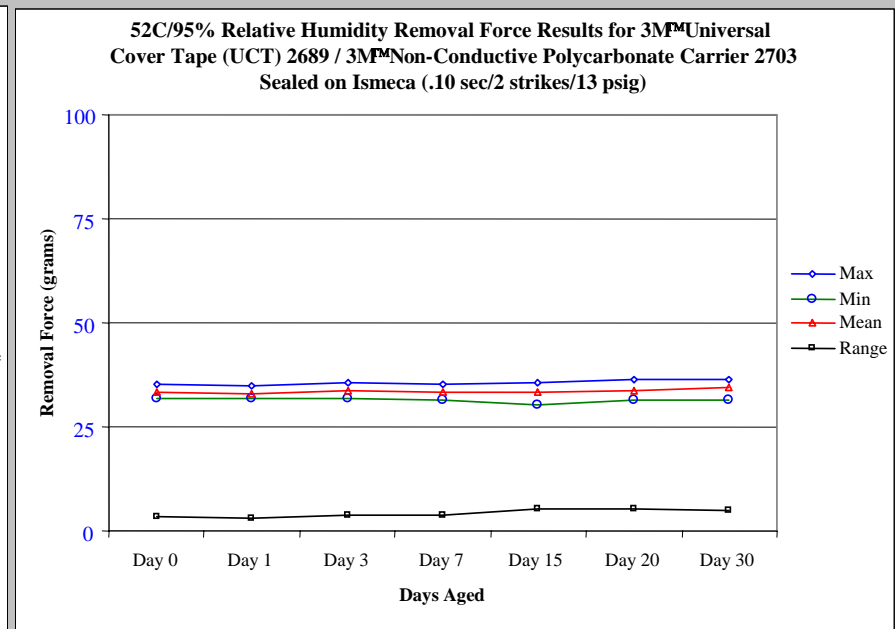
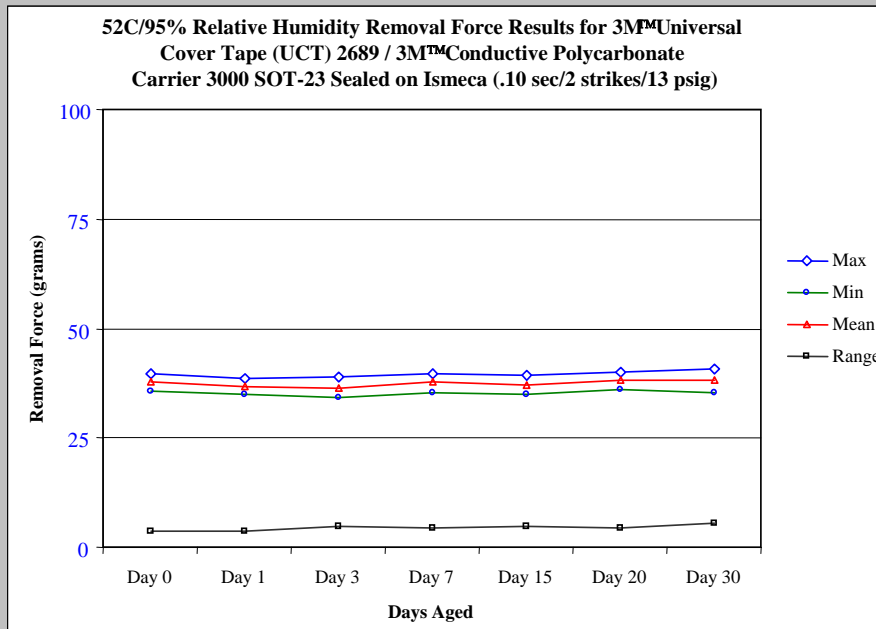
Property (3.8 mm Middle Section)	Tensile (Max/Load)	Elongation (atBbreak)
Average Results	6.0 N/mm	342%
Standard Deviation	0.23	19.33
Number of Samples Tested	20	20
Test Method	ASTM D-3759	ASTM D-3759

## Electrical

Aging Condition	0 Hours - $R_s \Omega$	12 Hours - $R_s \Omega$	72 Hours - $R_s \Omega$	Sample Size
23°C/50% RH	1.60E+03	3.59E+03	3.54E+03	(n) = 7 sheets
52°C/05% RH	1.69E+03	3.64E+03	4.33E+03	(n) = 8 sheets
60°C	1.50E+03	3.0E+03	2.80E+03	(n) = 5 sheets

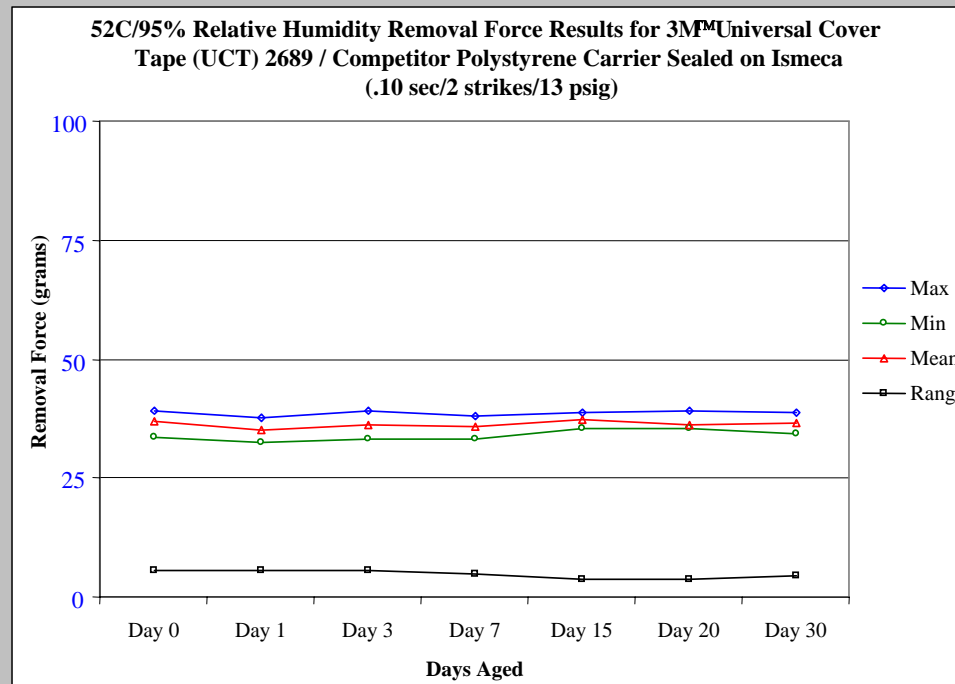
# Aging Results

**52°C/95% RH Removal Forces for 3M™ Universal Cover Tape (UCT) 2689, Conductive Sealed to 3M™ Conductive Polycarbonate Carrier 3000 and 3M™ Non-Conductive Polycarbonate Carrier 2703**

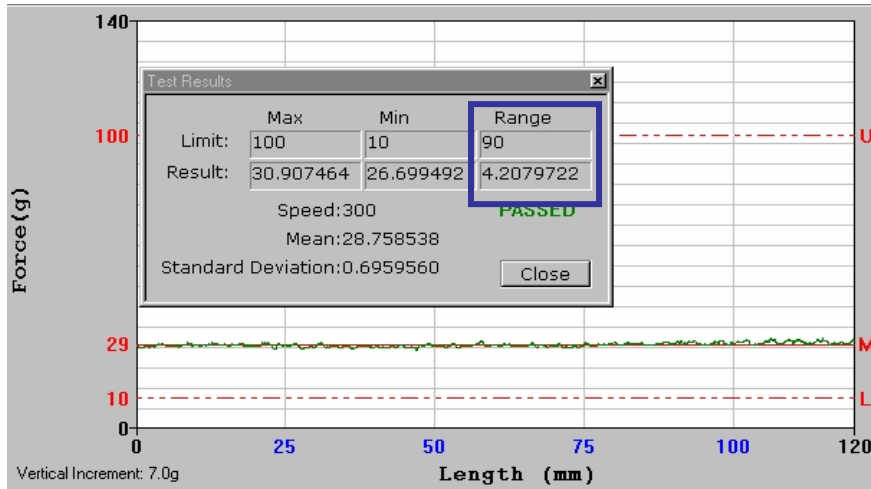


# Aging Results

52° C/95% RH Removal Forces for 3M™ Universal Cover Tape (UCT) 2689,  
Conductive Sealed to Competitor (PS) Carrier



## Removal Force Comparison for 3M™ Universal Cover Tape versus Typical Heat Activated Cover Tape



### Typical UCT Peel

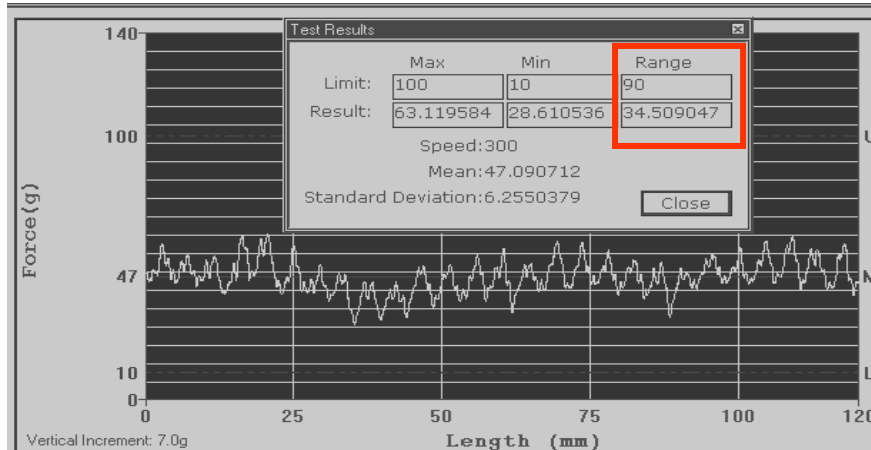
Smooth Flat Peel

Tight range (typical < 12 grams)

### EIA Peel Force Specification

8 mm carrier: 10 gram Min, 100 gram Max.

12 mm & above: 10 gram Min, 130 gram Max.



### Typical HAA Peel

Uneven Peel

Wide Range (typical 20 – 40 grams)

# Case Study #1

Brief synopses of 3M<sup>™</sup>Universal Cover Tape (UCT) evaluations are captured to demonstrate current success stories.

## *Passive Component Manufacturer*

- 3M<sup>™</sup>Static Dissipative Clear Polycarbonate Carrier: 2705, 8 mm, 3M 058271
- (Ao 1.3, Bo 2.3, Ko 1.23mm)
- 3M<sup>™</sup>Universal Cover Tape (UCT): 2689, 5.4 mm PSA (tantalum cap. only)
- Taping machine: intermittent mode with metal shoe (made in Japan)
- Peel force machine: in-house model
- Peel force specification: 10 to 50 grams

## *Initial feedback direct from Production line study*

- Pass peel force test
- Pass re-work (pass peel force test and no tape break)
- Pass inspection (good transparency)
- No machine adjustment required (direct drop in, switch out heat)

## Case Study #2

### Bump Die Manufacturer

- 3M<sup>TM</sup>Conductive Polycarbonate Precision Carrier: 3000BD 8 x 4 mm
- 3M<sup>TM</sup>Universal Cover Tape (UCT): 2689, 5.4 mm
- Taping machine: metal seal shoe application from vendor in Singapore
- Peel force machine: GPD global model

**Peel force specification: Max: 80 grams, Min: 20 grams**

Sample	Max (grams)	Min (grams)	Mean (grams)	Range (grams)
1	35	29	32	6
2	35	26	31	9
3	35	27	32	8

### Initial feedback direct from production line study (20 Nov 06)

- Pass peel force test
- Pass inspection (good transparency)
- No machine adjustment required (direct drop in, switched off heat, switched off cover tape unwind motor)

# Case Study #3

## Pick and Place Manufacturer

	3M™ Universal Cover Tape (UCT) 2689, Conductive Cover Tape			PSA Standard Product
Test Conditions	With Splicing Tape (10 Position)	Rework with Heat (10 Position)	Rework Normal (10 Position)	Rework Normal (10 Position)
Pick and Place Quantity	2880	480	480	1920
Mis-Pick Defects	0	0	0	0
Stand Up Defects	0	0	0	1*

*\*Indicated failure was attributed to tomb stoning. Disclaimer: 3M Does Not Recommend Rework of UCT taped carrier, however it is known that some customers are performing rework on finish product. Results reflect evaluations per customer request and method.*

Total units picked from pockets for 3M™ Universal Cover Tape (UCT) taped to carrier; 3840

Reject parts per million = 0

Total units picked from pockets for standard PSA taped to carrier; 1920, Reject parts per million = 521

### Additional Results:

- a) No chip stick issues
- b) No chip rotation
- c) No machine stoppage due to reworked areas
- d) No splice failures due to breakage
- e) No jamming in gears or collection bins

Yield loss as a result of de-taping Universal Cover Tape was **ZERO**.

## Conclusion

- 3M™ Universal Cover Tape (UCT) is truly a “new to the world” cover tape concept offering solutions to both component manufacturer and end user applications for packaging and transporting electronic and electrical components in tape and reel. 3M Universal Cover Tape (UCT) provides the best overall performance on many key the attributes regardless of width, carrier material, and equipment which ultimately improves productivity and throughput.
- **Printed circuit board assemblers** benefit from improved stability for component placement during cover tape de-taping applications in feeders (smooth flat peels), along with reduced risks associated with chip sticking, migration, and rotation challenges associated with packaging thin, ultra small component devices.
- **For component manufacturers**, Universal Cover Tape reduces the need for stringent control and monitoring at taping stations, reduces operator error, minimizes risk associated with sealing equipment set-ups and indexing errors, maintains standard PSA adhesion characteristics (no heat is required), and is compatible with all carriers (including paper).

## 3M™ Universal Cover Tape (UCT) Value Proposition

Key Attributes	Heat Seal Std. System	Cold Seal 3M PSA System	Cold Seal 3M UCT System
Average peel force range	Variable (above 50 grams)	Less variable (below 50 grams)	Least variable (consistent averages above 20 grams)
Peel force range (min – max)	Above 30 grams	Below 30 grams	Below 12 grams
Sealing process window	Small process window; high degree of control required; peel force dependent on operator, equipment, carrier and cover tape	Large process window; only pressure setting and alignment; peel force dependent on carrier and cover tape adhesive exposure width	Removal force is controlled only by 3M Universal Cover Tape cover tape design.
Equipment running / maintenance cost	Output down time due to thermocouple module failure / maintenance (calibration, shoe cleaning, startup, alignment, heat shoe stabilization time)	Zero down time; heat is not required; pressure and cover tape alignment is only requirement; instant startup	Zero down time, heat is not required
ESD protection	Medium (surface resistance 10E5 – 10E11 ohms/square)	High (surface resistance 10E4 – 10E6 ohms/square)	Highest (2689 conductive property has surface resistance below 10E5 ohms square)
Chip stick for small lightweight components	High (tight wind tension, static dissipative level)	Intermittent (due to tight wind tension, adhesive exposure, specific feeder designs)	None (true conductive properties); no issue with adhesive or feeder design
Tensile strength	Medium	Highest (100% higher due to product design)	High (50% higher than traditional HAA designs)
Transparency	Medium (baseline)	High	High
Cover tape risk due to sealing	High (dependant on equipment setup and seal shoe condition)	Low (2 layer construction)	Low (control built into design)
Energy savings	Heat is required, additional electricity cost to heat shoe	Zero cost – No heat is required	Zero cost – No heat is required
Carrier tape compatible	Material dependent	Material dependent	UNIVERSAL - works on PS, PC and paper materials

# Thank You

## **Important Notice**

Before using this product, you must evaluate it and determine if it is suitable for your intended application. You assume all risks and liability associated with such use.

## **Warranty; Limited Remedy; Limited Liability.**

3M's product warranty is stated in its Product Literature available upon request. **3M MAKES NO OTHER WARRANTIES INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.** If this product is defective within the warranty period stated above, your exclusive remedy shall be, at 3M's option, to replace or repair the 3M product or refund the purchase price of the 3M product. **Except where prohibited by law, 3M will not be liable for any indirect, special, incidental or consequential loss or damage arising from this 3M product, regardless of the legal theory asserted.**