Advanced Cover Tape Technology for Electronic Component Packaging

3M Universal Cover Tape (UCT)

by

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ABSTRACT:

Leveraging core film and adhesive technologies, 3M has developed an innovative cover tape solution which combines value added design features and eliminates recurring disadvantages of both heat activated adhesive (HAA) and pressure sensitive adhesive (PSA) cover tapes for sealing surface mountable components in tape and reel. The introduction of universal cover tape (UCT) in conductive, static dissipative and non-conductive formats, provide a unique design to seal electrical and electronic components into all carrier tapes.

As new component designs become smaller, thinner, and lighter, these innovative product offerings provide another “new to the world” cover tape product to enhance tape and reel packaging requirements and performance on end user pick and place equipment.

This paper will discuss the features, advantages, and benefits of UCT attributes, definitions, and applications to reduce component flipping, provide stable surface resistance properties, increase overall throughput, overcome challenges associated with inconsistent peel force ranges, as well as resolve concerns associated with pressure sensitive adhesives in terms of adhesive transfer to sealing and feeder equipment.

INTRODUCTION:

3M continues to provide innovative solutions to satisfy customer expectations for packaging surface mountable components in tape and reel. Our initial cover tape designs from the early 1980’s consisted of various heat activated adhesive (HAA) constructions designed to resolve HAA cover tape variable adhesion performance and high peel variability that reduce packaging efficiency.

In 1994, 3M introduced pressure sensitive adhesive (PSA) cover tapes 3M™ Conductive 2666 and 3M™ Non-Conductive 2658 products, to improve equipment set-up time, provide peel consistency in terms of ranges, average peel forces, and overall product performance attributes. This design eliminated delamination and peel variation concerns. Both products were considered “new to the world” and changed the basis of competition in terms of overall product design where the use of adhesive and blocker film provided an innovative method of sealing cover tapes to embossed carrier tapes. Heat was no longer required to seal cover tapes to carrier. PSA cover tape improved equipment setup procedures where the adhesion to carrier tapes required only proper alignment and adequate pressure.
3M™ Non-Conductive High Shear Pressure Sensitive Cover Tape 2658 and 3M™ Conductive High Shear Pressure Sensitive Cover Tape 2668 products were introduced in 2000 to address issues associated with narrow widths, and increase bake cycle requirements at temperatures not exceeding 125°C at 24 hour intervals. In 2004, a new 3M™ Static Dissipative Pressure Sensitive Cover Tape 2684 was introduced for polystyrene carriers, featuring a reduced adhesive exposure width and improved clarity.

3M™ Conductive 2689, 3M™ Static Dissipative 2688, and 3M™ Non-Conductive 2680 Universal Cover Tape (UCT) portfolio provides another “new to the world” cover tape design for sealing electrical and electronic components into all carrier tapes and eliminates the typical problems encountered by component manufacturers and end user applications (Chart 1).

This paper is presented to discuss features and applications of UCT compared to existing heat activated and pressure sensitive adhesive cover tapes.

Chart 1

**VOICE OF CUSTOMER:**

3M’s approach in determining the “best” 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 as follows:

1) tighter peel ranges with less variability  
2) elimination of adhesive transfer to sealing and feeder equipment  
3) a single cover tape that works on all carrier tapes  
4) reduced component migration during cover tape removal from carrier  
5) consistent surface resistance (ESD) protection  
6) address future small component packaging needs  
7) reduced contamination (paper and embossed carrier tape users)  
8) improved yields associated with pick and place equipment operations  
9) improved clarity  
10) competitively priced
These ten requirements were captured in 3M’s global assessment of existing heat activated adhesive and pressure sensitive adhesive cover tape users in the industry today. Splicing, chip sticking, tensile strength, aging characteristics, and rework were also mentioned.

In depth analysis of VOC feedback from component manufacturers reveal pressure sensitive adhesive tapes to be a life saver in terms of overall throughput. In rare instances some are willing to clean equipment daily to avoid adhesive transfer to rollers, seal shoes, and rails. However, end users are attempting to force the component manufacturers to switch to heat activated adhesives due to numerous complaints associated with pressure sensitive adhesive transfer to feeder collection bins, take-up reels, gears and tape jamming. Each complaint is considered a major contributor to excessive yield loss and machine downtime.

With heat activated adhesive tapes, component manufacturers seek to control component migration without having to seal close to the carrier pockets. In some cases, component migration is controlled as equipment manufactures modify feeders by installing mechanical assemblies to restrict component movement as they are presented to be picked and placed on printed circuit boards. However in some instances during cover tape removal, vibration and component flipping may continue to occur as cover tape is peeled back in feeders.

The second hurdle is to overcome stocking multiple products for one application. Some heat activated and pressures sensitive adhesive cover tapes do not seal properly to some carrier tapes due to deformities in seal regions or material incompatibility. Therefore a request for one cover tape to seal to all carrier tapes is desired for cost containment.

Paper tape users express concerns of generating debris during cover tape removal for small component packages. Here the issue is focused on small pick nozzles, where small fibers could ultimately restrict air flow and cause excessive yield loss do to mis-picks and or placement errors.

3M’s APPROACH:

Capturing key requirements from sixteen global VOC interviews, and leveraging core film and adhesive technologies, 3M has developed an innovative cover tape solution which combines value added design features and eliminates recurring disadvantages of both heat activated adhesive (HAA) and pressure sensitive adhesive (PSA) cover tapes. Figure 1 illustrates a combination of positive attributes from both PSA and HAA cover tapes while eliminating the negatives.

Thus, 3M’s revolutionary cover tape concept will bridge the gap between PSA and HAA cover tape barriers.

Figure 1
PRODUCT CONSTRUCTION:

3M™ Universal Cover Tape (UCT) consists of a single, transparent polypropylene 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 (Figure 2).

Figure 2

[Diagram of Universal Cover Tape]

DESIGN FEATURES:

3M™ UCT revolutionary design features address the “top ten” VOC concerns as follows:

a) Instead of removing the entire width of cover tape from carrier, 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.

b) As shown in Figure 2, the adhesive exposure region is positioned away from the edge, therefore eliminating the risk for adhesive transfer to sealing and feeder equipment. The adhesive properties provide a strong bond to polycarbonate, polystyrene, and paper carriers. This allows customers the advantage of stocking one cover tape product that works with all carriers (Universal). As with most PSA cover tapes, adequate pressure and proper alignment continue to enhance equipment set-ups (a drop-in system that is user friendly).

c) Leveraging our core coating technologies, UCT provides consistent surface resistance properties that target less than $10^5$ ohms per square for conductive versions and static dissipative range less than or equal to $10^5$ but greater than or equal to $10^{10}$ ohms per square. Thus, consistent surface resistance properties provide stable ESD protection.

d) Removal force equals the total peel strength of cover tape removed (middle section only) from carrier when pulled in the opposite direction of carrier tape travel. This unique cover tape removal 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.

e) Debris accumulation concerns are eliminated since the adhesive is positioned away from the edges. Therefore, no adhesive will adhere to adjacent surfaces or attract air born contaminates. 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 risk associated with debris.

f) UCT is compatible with all feeders as the tape remains adhered to carrier during advancement and peel back. Disposal of carrier will not dull chopping blades nor result in adhesive transfer to feeder tracks, collection bins, or take-up reels.

3M has patents pending on 3M™ UCT constructions having features that address many of these concerns.
Key Definitions:

- **Peel Initiation** – the separation of cover tape from carrier tape at leader in the opposite direction of carrier tape travel toward a peel enabling design feature at a 180° angle.

- **Removal Force** – equals the total peel strength as cover tape is removed (middle portion only) from carrier when pulled in the opposite direction of carrier tape travel.

PRODUCT PERFORMANCE:

Detailed laboratory evaluations were performed to provide initial performance attributes for UCT product constructions. Evaluations were based on sampling from our 3M™ Conductive Universal Cover Tape 2689 (UCT) version. Results and test methods are provided in tables that follow. Additional end user applications in terms of splicing, rework, and feeder compatibility with supporting field case studies are provided to verify product conformance to VOC expectations.

Visual Properties - Haze, Transmittance, and Clarity:

<table>
<thead>
<tr>
<th>Property</th>
<th>Haze</th>
<th>Transmittance</th>
<th>Clarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Results</td>
<td>11%</td>
<td>72%</td>
<td>64%</td>
</tr>
<tr>
<td>Number of samples (1 Lot)</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

Test Method: ASTM-D1003

| Equipment                        | BYK-Gardner Haze-Guard Plus Transmission Meter Model 4735 and related calibration standards for each attribute. |

Physical Properties – Tensile & Elongation (of middle section only):

<table>
<thead>
<tr>
<th>Property (3.4 mm Middle Section)</th>
<th>Tensile (Max/load)</th>
<th>Elongation (at break)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Results</td>
<td>6.0 N/mm</td>
<td>342%</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>0.23</td>
<td>19.33</td>
</tr>
<tr>
<td>Number of Samples Tested</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Test Method</td>
<td>ASTM D-3759</td>
<td>ASTM D-3759</td>
</tr>
</tbody>
</table>

Test Method:

Tensile Strength is the maximum tensile stress sustained by the specimen before break. Likewise, the percentage of elongation is the maximum strain sustained by the material before the specimen breaks. Tensile is reported in Newton per millimeter (N/mm) width of the material, and elongation in percentages.

Results for 3M™ Conductive 2689 Universal Cover Tape consist of the average performance from one lot of material. Samples were tested based on the ASTM D-3759 test method using an Instron with a crosshead speed of 5 inches per minute and 1 inch jaw separation at an ambient room temperature environment of 23°C and 50% relative humidity.
Electrical Properties - Surface Resistance:

<table>
<thead>
<tr>
<th>Aging Condition</th>
<th>0 Hours - R_s, Ω</th>
<th>12 Hours - R_s, Ω</th>
<th>72 Hours - R_s, Ω</th>
<th>Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>23°C/50% RH</td>
<td>1.60E+03</td>
<td>3.59E+03</td>
<td>3.54E+03</td>
<td>(n) = 7 sheets</td>
</tr>
<tr>
<td>52°C/05%RH</td>
<td>1.69E+03</td>
<td>3.64E+03</td>
<td>4.33E+03</td>
<td>(n) = 8 sheets</td>
</tr>
<tr>
<td>60°C</td>
<td>1.50E+03</td>
<td>3.0E+03</td>
<td>2.80E+03</td>
<td>(n) = 5 sheets</td>
</tr>
</tbody>
</table>

Test Method:

Surface resistance is measured at 23°C (73°F) 50% relative humidity per ESD – STM11.11-2001. Sample sheets were aged at various conditions for twelve and seventy-two hours to determine the stability of conductive properties at each interval. A “Prostat” PRS-801 Resistance System and PRF-914 High Resistance Concentric Ring Probe were used to measure surface resistance.

In summary, 3M™ Conductive 2689 Universal Cover Tape meets EIA Conductive properties (component side) with surface resistance values less than 10^5 Ohms/square.

The (backing) is considered non-conductive with average $R_s$ of 10^12 ohms per square.

Environmental Aging Results (Sealed with 2689 5.4mm Cover Tape to 8mm Carrier):

Environmental aging results (charts and raw data) depict typical 3M™ Universal Cover Tape adhesion to 3M™ Conductive 3000 and 3M™ Non-Conductive 2703 Polycarbonate and Competitor Polystyrene (PS) Carrier Tapes at 52°C/95% relative humidity conditions for 30 Days.

In addition to aging, we are also evaluating adhesive properties to ensure long term resistance to thermal degradation under extreme shipping and storage conditions were maintained.

*Note: Due to the unique design of Universal Cover Tape, 3M will reference the term “removal force” (references removal of the middle section instead of full width) to replace peel forces.*

52°C/95% RH Removal Forces for 3M™ Conductive 2689 Sealed to 3M™ Conductive 3000 Carrier

<table>
<thead>
<tr>
<th>Days Aged</th>
<th>Max. (grams)</th>
<th>Min. (grams)</th>
<th>Mean (grams)</th>
<th>Range (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 0</td>
<td>39.51</td>
<td>35.77</td>
<td>37.75</td>
<td>3.73</td>
</tr>
<tr>
<td>Day 1</td>
<td>38.58</td>
<td>34.89</td>
<td>36.78</td>
<td>3.68</td>
</tr>
<tr>
<td>Day 3</td>
<td>38.99</td>
<td>34.15</td>
<td>36.22</td>
<td>4.83</td>
</tr>
<tr>
<td>Day 7</td>
<td>39.80</td>
<td>35.30</td>
<td>37.70</td>
<td>4.47</td>
</tr>
<tr>
<td>Day 15</td>
<td>39.27</td>
<td>34.73</td>
<td>37.03</td>
<td>4.64</td>
</tr>
<tr>
<td>Day 20</td>
<td>40.10</td>
<td>35.90</td>
<td>38.02</td>
<td>4.21</td>
</tr>
<tr>
<td>Day 30</td>
<td>40.83</td>
<td>35.27</td>
<td>38.22</td>
<td>5.56</td>
</tr>
</tbody>
</table>
52°C/95% RH Removal Forces for 3M™ Conductive 2689 Sealed to 3M™ Non-Conductive 2703 Carrier

<table>
<thead>
<tr>
<th>Days Aged</th>
<th>Max. (grams)</th>
<th>Min. (grams)</th>
<th>Mean (grams)</th>
<th>Range (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 0</td>
<td>35.08</td>
<td>31.65</td>
<td>33.19</td>
<td>3.59</td>
</tr>
<tr>
<td>Day 1</td>
<td>34.74</td>
<td>31.79</td>
<td>33.10</td>
<td>2.94</td>
</tr>
<tr>
<td>Day 3</td>
<td>35.45</td>
<td>31.82</td>
<td>33.70</td>
<td>3.62</td>
</tr>
<tr>
<td>Day 7</td>
<td>35.24</td>
<td>31.53</td>
<td>33.35</td>
<td>3.68</td>
</tr>
<tr>
<td>Day 15</td>
<td>35.57</td>
<td>30.20</td>
<td>33.27</td>
<td>5.37</td>
</tr>
<tr>
<td>Day 20</td>
<td>36.49</td>
<td>31.29</td>
<td>33.66</td>
<td>5.20</td>
</tr>
<tr>
<td>Day 30</td>
<td>36.55</td>
<td>31.49</td>
<td>34.57</td>
<td>5.05</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Days Aged</th>
<th>Max. (grams)</th>
<th>Min. (grams)</th>
<th>Mean (grams)</th>
<th>Range (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 0</td>
<td>39.22</td>
<td>33.66</td>
<td>36.86</td>
<td>5.59</td>
</tr>
<tr>
<td>Day 1</td>
<td>37.80</td>
<td>32.44</td>
<td>35.05</td>
<td>5.36</td>
</tr>
<tr>
<td>Day 3</td>
<td>38.98</td>
<td>33.38</td>
<td>35.98</td>
<td>5.59</td>
</tr>
<tr>
<td>Day 7</td>
<td>37.89</td>
<td>33.13</td>
<td>35.90</td>
<td>4.76</td>
</tr>
<tr>
<td>Day 15</td>
<td>38.72</td>
<td>35.24</td>
<td>37.20</td>
<td>3.68</td>
</tr>
<tr>
<td>Day 20</td>
<td>38.93</td>
<td>35.34</td>
<td>36.29</td>
<td>3.59</td>
</tr>
<tr>
<td>Day 30</td>
<td>38.64</td>
<td>34.25</td>
<td>36.62</td>
<td>4.39</td>
</tr>
</tbody>
</table>

Note: The technical information and data presented here should be considered representative or typical only, and should not be used for specification purposes.

In summary, 3M™ Conductive 2689 Universal Cover Tape sealed to various carrier tape materials are relatively consistent in terms of average minimum, maximum and mean values. We have also demonstrated tight ranges (below 10 grams) for each carrier and cover tape system. Overall results were well within the typical 20 gram minimum to 80 gram maximum limits specified by customers.

Products were sealed using and Ismeca 3M® 139349; with 0.10 seconds dwell time; 1 Bar; double strikes equipment settings applied.

**Historical Data:**

Historical one hundred thirty-two day aging results for 5.4mm 3M™ Non-Conductive 2680 Universal Cover Tape (with identical adhesive formulation presented in previous 3M™ Conductive 2689 Universal Cover Tape) sealed to 3M™ Conductive 3000 Carrier at both room temperature (23°C/50%RH) and accelerated (52°C/95% RH) environments are as follows:
23°C/50% and 52°C/95% RH Removal Forces for 3M™ Non Conductive 2680 Universal Cover Tape

Removal Force Comparison between 3M UCT and Heat Activated Cover Tape

**Typical UCT Peel**
Smooth Flat Peel
Tight range (below 10 grams)

**EIA Peel Force Specification**
8mm carrier: 10 gram Min, 100 gram Max.
12mm & above: 10 gram Min, 130 gram Max.

**Typical HAA Peel**
Uneven Peel
Wide Range (20 – 40 grams)

**REWORK:**

Many customers have their own method of reworking standard PSA or HAA cover tapes. **3M Does Not Recommend Rework of UCT taped carrier, however it is known that some customers are performing rework on finish product.** This procedure is being provided to communicate rework concepts for UCT.

Due to the unique design of 3M™ Universal Cover Tapes certain steps should be taken to reduce damage to peel enabling features.

In summary, photos are being provided to demonstrate reworkable applications practiced by customers in the industry as follows:
**STEP 1**
Using a sharp object (tweezers, pin, or scribe) break seal by sliding tool under the non-tacky edge of cover tape

**STEP 2**
Slide sharp object into adhesive zone in opposite direction of peel (lifting the adhesive zone on both ends)

**STEP 3**
Gently slide tool to opposite end of (Adhesive zone) without puncturing or breaking the peel-enabling feature

**STEP 4**
Gently lift disturbed region, remove component and orientate component in pocket correctly

**STEP 5**
Re-position over disturbed region, reseal with flat solid object or press fit with finger and reseal in equipment for proper “wet-out”.

Step 6
Perform “twist test” to ensure cover tape will not delaminate from carrier. Reworked package is complete.

Reworked regions of sealed product “will not” have the same appearance as initials. Additional testing should be performed by the user to ensure proper adhesion to carrier, removal force, and any other product quality related concerns at user’s discretion. Graph 1 below shows a slight increase in removal force and range for reworked region.

**Graph 1**

**Splicing:**

**Splicing Procedure**

Splicing applications are commonly used by printed circuit board assemblers (PCBA) to increase productivity by reducing numerous changeovers. Due to the unique product construction of UCT, tests were preformed to satisfy splicing applications in feeders as follows:

1. Apply IPA to a clean cotton cloth.
2. Wipe IPA on backing of UCT on leader and trailer region three times.
3. Insert metal brace into splicing tool.
4. Insert carrier tape leader and trailer on top of the metal brace.
5. Crimp the metal brace to connect carrier leader and trailer sections forming one continuous strip
6. Let section dry at room temperature
7. Apply splicing tape.
8. Press down the splicing tape and remove the splicing tape liner

Note: The leader (front end of taped carrier) and trailer (back end of taped carrier) should contain 30 empty pockets (with no components in carrier pockets) at each end.
**Splicing Flowchart**

**Step 1**
Clean the surface of UCT cover tape on Carrier Tape Trailer and Leader with *IPA (Isopropyl alcohol)*. Recommend wiping with IPA three times and let surface dry for ~30 sec.

**Step 2**
Join carrier tape leader and carrier tape trailer with metal brace.

**Step 3**
Apply Splicing Tape. Press splicing tape into position; rub down the splicing tape emphatically to adhere to UCT.

**Feeder Evaluations**

Feeder type: Universal Instrument Golden feeder (8mm)
Hanging Weight Test method

IEC 60286-3:1997 was used to ensure spliced cover tape would withstand a break force (in the direction of unreeling) of 1.0 kgf for 30 seconds. Paragraph 4.6 states; “the break force of the tape in the direction of unreeling shall be at least 10 N. Splices shall be at least as strong as the original tape and shall not hamper the transport and the cutting of the tape”. Paragraph 4.7 Peel force of the cover tape states; “the angle between cover tape during peel-off and the direction of unreeling shall be 165 degrees to 180 degrees. The cover tape shall adhere uniformly to the carrier tape along both sides in direction of unreeling”. The peel force shall be 0.1 N to 1.0 N for an 8 mm tape width”.

Results: With a 1 kg weight suspended by splicing tape adhered to UCT approximately 300 millimeters in length, our splice with UCT met IEC requirements of 1.0 kgf with a hang time of 30 seconds.

CASE STUDIES:

Brief synopses of UCT evaluations will are captured to demonstrate current success stories.

Case Study 1 – Passive Component Manufacturer

3M Carrier: 2705 8mm, 3M 058271 (Ao 1.3, Bo 2.3, Ko 1.23mm)  
3M Cover Tape: 2689 5.4mm PSA (Tantalum cap. only)

Taping machine: Tokyo Weld model 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 (even with seal gaps or incomplete wetting of seal line)  
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 Carrier: 3000 BD 8 x 4 mm  
3M Cover Tape: 2689 5.4mm UCT

Taping machine: STI model with metal shoe (Made in Singapore)  
Peel force machine: GPD Global model
Peel force specification: Max: 80 grams, Min: 20 grams

<table>
<thead>
<tr>
<th>Sample</th>
<th>Max (grams)</th>
<th>Min (grams)</th>
<th>Mean (grams)</th>
<th>Range (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>35</td>
<td>29</td>
<td>32</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>35</td>
<td>26</td>
<td>31</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>35</td>
<td>27</td>
<td>32</td>
<td>8</td>
</tr>
</tbody>
</table>

*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, switch off heat, switch off, cover tape unwind motor)

*Case Study 3 - Bump Die Manufacturer*

3M Carrier: 3000 BD 8mm x 4mm pitch
3M Cover Tape: 2689 UCT 5.4mm

Taping Machine: Muhlbauer model with rubber shoe (Made in Germany)
Peel Force Tester: GPD model

Peel force specification: Max: 60 grams, Min: 15 grams

<table>
<thead>
<tr>
<th>Sample</th>
<th>Max (grams)</th>
<th>Min (grams)</th>
<th>Mean (grams)</th>
<th>Range (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40</td>
<td>31</td>
<td>36</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>37</td>
<td>29</td>
<td>33</td>
<td>8</td>
</tr>
<tr>
<td>3 (with rework)</td>
<td>40</td>
<td>29</td>
<td>34</td>
<td>11*</td>
</tr>
</tbody>
</table>

*Indicates increased range value was attributed to rework region. Range value was considered acceptable.*

*Initial feedback direct from Production line study (14 Nov 06)*

Pass peel force test (even with seal gaps or incomplete wetting of seal line)
Pass inspection (good transparency)
No machine adjustment required (direct drop in, switch out heat)

*Case Study 4 – Pick and Place Manufacturer*

<table>
<thead>
<tr>
<th>Test Conditions</th>
<th>2689 UCT Cover Tape</th>
<th>2668 PSA Standard Product</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>With Splicing Tape</td>
<td>Rework with heat</td>
</tr>
<tr>
<td>Pick and Place</td>
<td>(10 Position)</td>
<td>(10 Position)</td>
</tr>
<tr>
<td>Quantity</td>
<td>2880</td>
<td>480</td>
</tr>
<tr>
<td>Mis-pick defects</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Stand up defects</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*Indicated failure was attributed to tomb stoning*

Total units picked from pockets for 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 jamming in gears or collection bins  
d) No machine stoppage due to reworked areas  
e) No splice failures due to breakage

Yield loss as a result of de-taping UCT in Panasonic CM-402 Pick and Placement Feeders 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. UCT provides the best performance regardless of width, carrier material, and equipment which ultimately improves productivity and throughput.

Printed circuit board assemblers (end user) 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, UCT eliminates 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).
REFERENCES:

[1] Approved American National Standard / Electronic Industries Alliance (ANSI/EIA) 481 Revision C; 8 mm Through 200 mm Embossed Carrier Taping and 8 mm & 12mm Punched Carrier Taping of Surface Mount Components for Automatic Handling; October 23, 2003


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