



TT433

The most durable thermal transfer product on the market

ABSTRACT: IDENTCO has developed a single, polyimide film and thermal transfer ribbon which can not only withstand multiple chemical wash cycles in PCB manufacture, but can perform without preliminary heat treatment. Extensive testing in the most rigorous production environments has demonstrated that TT433 is the only construction which can consistently maintain adhesion, scannability, and print quality.

BACKGROUND

Thermal transfer identification labels are essential for the manufacture of printed circuit boards (PCBs). Typically composed of various polyimide materials, the labels must withstand temperatures in excess of 200°C and multiple, harsh chemical wash cycles without losing adhesion or print quality.

The PCBs used in aerospace, military, and medical applications are also expected to contain absolutely no lead-free residues. Recent advances in cleaning chemistries have created products which meet residue requirements, but are too corrosive for existing thermal transfer products.

To make matters worse, a number of more sophisticated applications are demanding absolutely no residue at every stage of production. This means that before any heating or soldering can take place, the labeled FR4 board needs to be run through an extensive wash cycle. Before TT433, there was no product on the market that could survive exposure to multiple wash cycles without some preliminary heat treatment.

Missing or damaged labels means loss of traceability, verification, quality control, product, and time. Costs are also increased by having to rework the unmarked PCBs. In response to the failing thermal transfer labels, several EMS providers have been forced to add a second, removable layer of polyimide over the imprinted label to protect critical bar codes and ensure the tracking labels remain in place throughout the entire manufacturing process. At almost \$20 per roll, this additional layer not only adds expense to an already slim-margin product, but increases the time involved in set-up and production.

CHALLENGE

IDENTCO partnered with a pressure-sensitive material manufacturer, a cleaning chemical manufacturer, and a global EMS provider to create a solution. The new thermal transfer product had to survive exposure to

aggressive cleaners during the wash cycles with no heat treatment, as well as future in-line washes, wave soldering, and reflow oven cycles. A pass was defined as fulfilling three criteria: 1) no significant print fade, 2) accurate readings with a barcode scanner, and 3) no adhesion failures.

METHODOLOGY

Several combinations of adhesives, topcoats, polyimides, and ribbons were initially tested in a variety of chemicals. Based on early findings, a new construction (TT433) was engineered in conjunction with a more effective thermal transfer ribbon. The material was tested in four different soaks intended to replicate the manufacture of different SMT lines: a no-clean flux, an aqueous solution, a semi-aqueous solution, and toluene. The printed TT433 labels were soaked for 30 minutes with no pretreatment.

After several successful early trials, the new labels were entered in a 10-month, comparative experiment at three different sites of a global EMS provider. The TT433 labels were randomly placed on a standard FR4 board alongside the leading existing thermal transfer labels. Both sets of labels were imprinted with the label and ribbon type along with mock bar codes to evaluate print quality along with material durability and adhesion.

A comprehensive series of high wash and heat cycles were designed to represent the various operational steps in PCB production. The first objective was to establish if the TT433 labels could consistently survive a chemical wash before any heat was applied. This unique prewash was the source of most label failure prior to the new thermal transfer construction. In all tests, none of the leading labels received a passing score for adhesion. On average, three of five leading labels were completely removed from the board, and the remaining two displayed edge-peeling beyond an acceptable degree. All five TT433 labels remained adhered with minimal peeling.



Adhesive performance of TT433 and competing labels after testing.

durable high performance labels
for electronic, automotive, industrial, medical applications

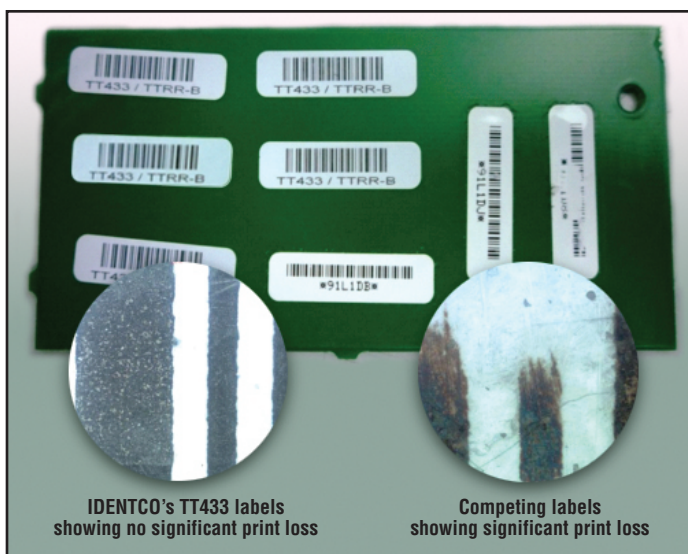


Adhesive Wash Test					
	Cycle 1	2	3	4	5
Item	Stick on PCB	Peel and stick	Peel and stick	Peel and stick	Peel and stick
Eval Method	SMT Reflow	SMT Reflow	SMT Reflow	SMT Reflow	SMT Reflow
Eval Qty =	5pcs IDENTCO TT433	5pcs Competitor Label	5pcs Competitor Label	5pcs Competitor Label	5pcs Competitor Label
Results	TT433: 0/5 Competitor: 0/5	TT433: 0/5 Competitor: 0/5	TT433: 0/5 Competitor: 0/5	TT433: 0/5 Competitor: 0/5	TT433: 0/5 Competitor: 3/5 Missing after wash

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The boards were then subjected to a multiple-pass, SMT reflow oven with a maximum temperature of 238°C and a dwell time of 117 seconds. Average time to peak was 4:38 minutes, and no paste or flux was used. An inline, batch chemical wash followed. Every wash cycle was critical to the testing due to the highly corrosive nature of the newer chemicals.

The 2-cycle wave soldering was run at a maximum top temperature of 125°C and a maximum bottom temperature of 145°C. The solder pot temperature was 265°C. A final 2-cycle wash preceded a conformal coating, which was brush coated. In three out of the four trials, the printing on the leading product was smeared or washed off entirely. Only the printing on the TT433 product consistently withstood the extensive washing and heating cycles.



Print durability evaluation of TT433 and competing labels.

Evaluation Matrix				
	Eval A	Eval B	Eval C	Eval D
Qty = 5pcs IDENTCO TT433 3pcs Competitor Label	Qty = 5pcs IDENTCO TT433 3pcs Competitor Label	Qty = 5pcs IDENTCO TT433 3pcs Competitor Label	Qty = 5pcs IDENTCO TT433 3pcs Competitor Label	Qty = 5pcs IDENTCO TT433 3pcs Competitor Label
Soak in Flux NR330 (30 min)	Soak in Kyzen (Brix 10-13%) (30 min)	Soak in Toluene (30 min)	Soak in Ionox (30 min)	
SMT Reflow (5 cycle)	SMT Reflow (5 cycle)	SMT Reflow (5 cycle)	SMT Reflow (5 cycle)	SMT Reflow (5 cycle)
AquaStorm Kyzen Washing (5 cycle)	AquaStorm Kyzen Washing (5 cycle)	AquaStorm Kyzen Washing (5 cycle)	AquaStorm Kyzen Washing (5 cycle)	AquaStorm Kyzen Washing (5 cycle)
Wave soldering (2 cycle)	Wave soldering (2 cycle)	Wave soldering (2 cycle)	Wave soldering (2 cycle)	Wave soldering (2 cycle)
AquaStorm Kyzen Washing (2 cycle)	AquaStorm Kyzen Washing (2 cycle)	AquaStorm Kyzen Washing (2 cycle)	AquaStorm Kyzen Washing (2 cycle)	AquaStorm Kyzen Washing (2 cycle)
Results	TT433: 0 Competitor: 0	TT433: 0 Competitor: 0	TT433: 0 Competitor: 1 smear Smeared after wash	TT433: 0 Competitor: 1 smear Smeared after wash

Print durability evaluation of TT433 and competing labels.

RESULTS

In total, the TT433 material with the TTRR-CR resin ribbon was evaluated through 11 separate cycles of testing, and received a passing score in every case. Since the trials, the new product has been continually run alongside the leading material in real-world manufacturing lines at the same ESM provider for six months. The new TT433 labels have not only outperformed the leading existing labels, but they have equally matched the performance of current thermal transfer labels combined with a polyimide mask. In addition, the TT433 labels have been trialled with at least five other contract manufacturers with similar results.

The cost savings achieved by utilizing only one material rather than the additional polyimide masks exceeded \$1000 per production run. Time savings were realized through a more streamlined manufacturing process, no need to replace lost labels, and no need to rework unmarked boards. Most production runs experienced more than 2000 hours in savings.

CONCLUSION

The TT433 construction has been demonstrated to be the only product on the market which can withstand the harsher cleaning chemistry during inline wash processing associated with the no-lead soldering process. In addition, it performs without pre-heating and without any additional polyimide layers. Although unique to particular contract manufacturing process designs, the TT433 combination of polyimide material and the TTRR-CR thermal transfer ribbon can sustain an inline chemical wash prior to reflow with no degradation of print or adhesive performance.