

TECHNICAL REPORT

A CERTIFIED SOLUTION FOR PRINTED CIRCUIT BOARD LABELING

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SUMMARY OF RESULTS

ITW Thermal Films' B324 Durable Extreme Series Resin™ thermal transfer ribbon (B324 resin TTR), and FLEXcon's THERMLfilm® HT™ PI1W50G and PI2W50G are a certified combination for printed circuit board labels. B324 resin TTR outperformed all other resin thermal transfer ribbons recommended for printed circuit board labels on the above FLEXcon polyimide films.

INTRODUCTION

The purpose of this testing was to confirm previous results that showed B324 resin TTR and THERMLfilm® HT™ PI1W50G and PI2W50G polyimide films passed print quality and adhesion tests after five (5) in line wash cycles through the ELECTROVERT Aquastorm® 200 In Line Cleaner. Test conditions simulated those used in the manufacturing of printed circuit boards when exposed to the most aggressive manufacturing conditions outlined below.

PRINT SAMPLES AND TEST BOARDS

Test samples of ITW Thermal Films' B324 Durable Extreme Series Resin™ thermal transfer ribbon printed on FLEXcon's THERMLfilm® HT™ PI1W50G and PI2W50G polyimide films (1 and 2 mil) were generated in FLEXcon's print laboratory in Spencer, MA using a Zebra 110 XiIII thermal transfer printer. For comparison purposes, print samples were also generated with several competitive resin ribbons and films. The print samples were applied to the front side of blank fiberglass boards. A pre-exposed board is presented in Attachment 1.

TEST EQUIPMENT

- ITW Speedline ELECTROVERT OmniMax™ Reflow Oven – Operating parameters are presented in Attachment 2.
- ITW Speedline ELECTROVERT VectraElite™ Wave Solder – Operating parameters are presented in Attachment 3.
- ITW Speedline ELECTROVERT Aquastorm® 200 In Line Cleaner – Operating parameters are presented in Attachment 4.

TEST CHEMICALS

- Flux – Alpha Cookson Water Soluble 3355-11
- Cleaning Agent – ZESTRON VIGON® A 201, 20% (v/v)

EXPOSURE CONDITIONS

Test boards were exposed in duplicate to the following conditions:

- No reflow (for testing purposes here only)
- Reflow with lead profile
- Reflow with no lead profile
- Reflow with lead profile and wave solder
- Reflow with no lead profile and wave solder

After each exposure condition, the test boards were washed five (5) times using the ELECTROVERT Aquastorm® 200 In Line Cleaner.

RESULTS

Following the testing at Speedline Technologies, the printed circuit test boards were returned to FLEXcon for inspection and evaluation. The results showed the print quality of B324 resin TTR remained excellent and the THERMLfilm® HT™ PI1W50G and PI2W50G labels remained intact after exposure to:

- No lead reflow profile, wave solder and five (5) in line wash cycles through the Aquastorm® 200 – Attachment 5
- Lead reflow profile and five (5) in line wash cycles through the Aquastorm® 200 – Attachment 6
- No lead profile, no wave solder and five (5) in line wash cycles through the Aquastorm® 200 – Attachment 7
- “Pink Death” Flux – Alpha Cookson Water Soluble 3355-11
- Cleaning agent – ZESTRON VIGON® A 201

Disclaimer Notice: Due to the harsh environment of the in line wash cycle, all label materials should be tested prior to the actual manufacturing environment.

Attachment 1

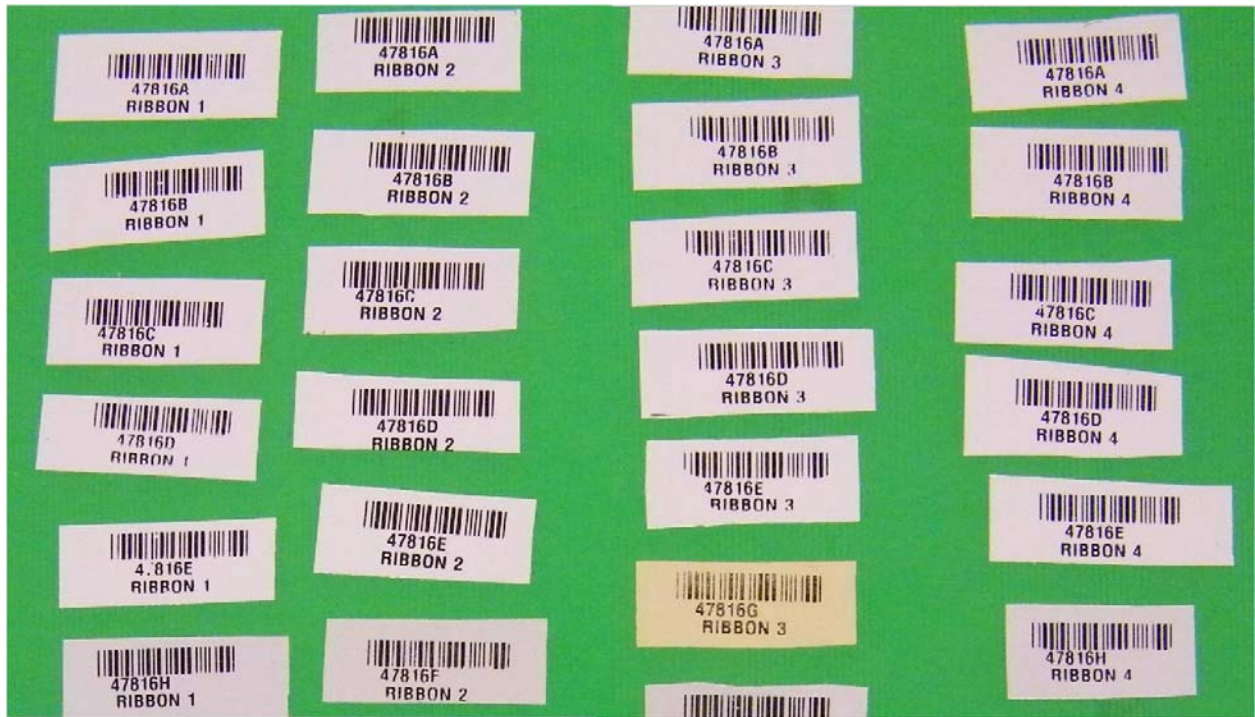
Pre-exposed Test Board

Ribbon 1
Competitor A

Ribbon 2
ITW Thermal Films
B324 Durable
Extreme Series Resin™

Ribbon 3
Competitor B

Ribbon 4
Competitor C



Attachment 2

Speedline Technologies ELECTROVERT OmniMax™ Reflow Oven

Operating parameters are presented as follows in Table 1 and 2 below:

TABLE 1 - ELECTROVERT OmniMax™ Reflow Oven – Equipment Settings – Lead Free Profile

Upper and Lower Zones 1 and 2	Temperature 302°F
Upper and Lower Zones 3	Temperature 338°F
Upper and Lower Zones 4	Temperature 374°F
Upper and Lower Zones 5	Temperature 437°F
Upper and Lower Zones 6 and 7	Temperature 491°F
Cooling Zone 1 and 2	Control = 1; Blower = 2640; Speed = 3
Conveyor # 1 Speed	30.0
Conveyor # 1 Width	10.0

TABLE 2 - ELECTROVERT OmniMax™ Reflow Oven – Equipment Settings – Lead Profile

Upper and Lower Zones 1	Temperature 230°F
Upper and Lower Zones 2	Temperature 266°F
Upper and Lower Zones 3	Temperature 302°F
Upper and Lower Zones 4	Temperature 338°F
Upper and Lower Zones 5	Temperature 374°F
Upper and Lower Zones 6	Temperature 410°F
Upper and Lower Zones 7	Temperature 446°F
Upper and Lower Zones 4	Temperature 338°F
Cooling Zone 1 and 2	Control = 1; Blower = 2640; Speed = 3
Conveyor # 1 Speed	24.0
Conveyor # 1 Width	8.06



Attachment 3

Speedline Technologies ELECTROVERT VectraElite™ Wave Solder

Operating parameters are presented as follows in Table 3 below:

TABLE 3 - ELECTROVERT Wave Solder – VectraElite™

Lower Preheater 1	300 ° F
Lower Preheater 2	280 ° F
Lower Preheater 3	500 ° F
Solder Temperature	511° F
Lead Clearance	0.5
Rotary Speed	300
Chip Wave	700
Lambda Wave	700
Conveyor Speed	5
Conveyor Width	8
External Fluxer Tank Pressure	28
External Fluxer Stroke Factor	64
External Fluxer Atomization	28
External Fluxer Maximum Stroke Factor	40
External Fluxer Valve Factor	50
External Fluxer Use Air Knife	0



Attachment 4

Speedline Technologies ELECTROVERT Aquastorm® 200 In Line Cleaner

Operating parameters are presented as follows in Table 4 below:

TABLE 4 - ELECTROVERT Aquastorm® 200 Equipment Settings

Conveyor Speed	2.0
Board Hole Length	0.5
PCB Multiplier	1
Board Number	2935
Wash Temperature	150° F
Wash Tank AutoFill	0
Wash Spray Auto ShutOff	1
Wash Upper Pressure	70
Wash Lower Pressure	60
Wash Upper Hurricane Pressure	65
Wash Lower Hurricane Pressure	50
Pre-Wash Upper Pressure	60
Pre-Wash Lower Pressure	50
Pre-Wash Flow	4.0
Chemical Isolation Upper Pressure	30
Chemical Isolation Lower Pressure	30
Rinse Temperature	145° F
Rinse Upper Pressure	80
Rinse Lower Pressure	60
Rinse Hurricane Upper Pressure	70
Rinse Hurricane Lower Pressure	40
Final Rinse Upper Pressure	55
Final Rinse Lower Pressure	55
Dryer Torrid 2 Temperature	220° F
Dryer 3 Temperature	220° F

Disclaimer Notice: Due to the harsh environment of the in line wash cycle, all label materials should be tested prior to the actual manufacturing environment.



Attachment 5

Post-exposure Test Board – No Lead Reflow Profile, Wave Solder, and Five (5) In Line Wash Cycles

Ribbon 1
Competitor A

Ribbon 2
ITW Thermal Films
B324 Durable
Extreme Series Resin™

Ribbon 3
Competitor B

Ribbon 4
Competitor C



Attachment 6

Post-exposure Test Board – Lead Reflow Profile and Five (5) In Line Wash Cycles

Ribbon 1
Competitor A

Ribbon 2
ITW Thermal Films
B324 Durable
Extreme Series Resin™

Ribbon 3
Competitor B

Ribbon 4
Competitor C



Attachment 7

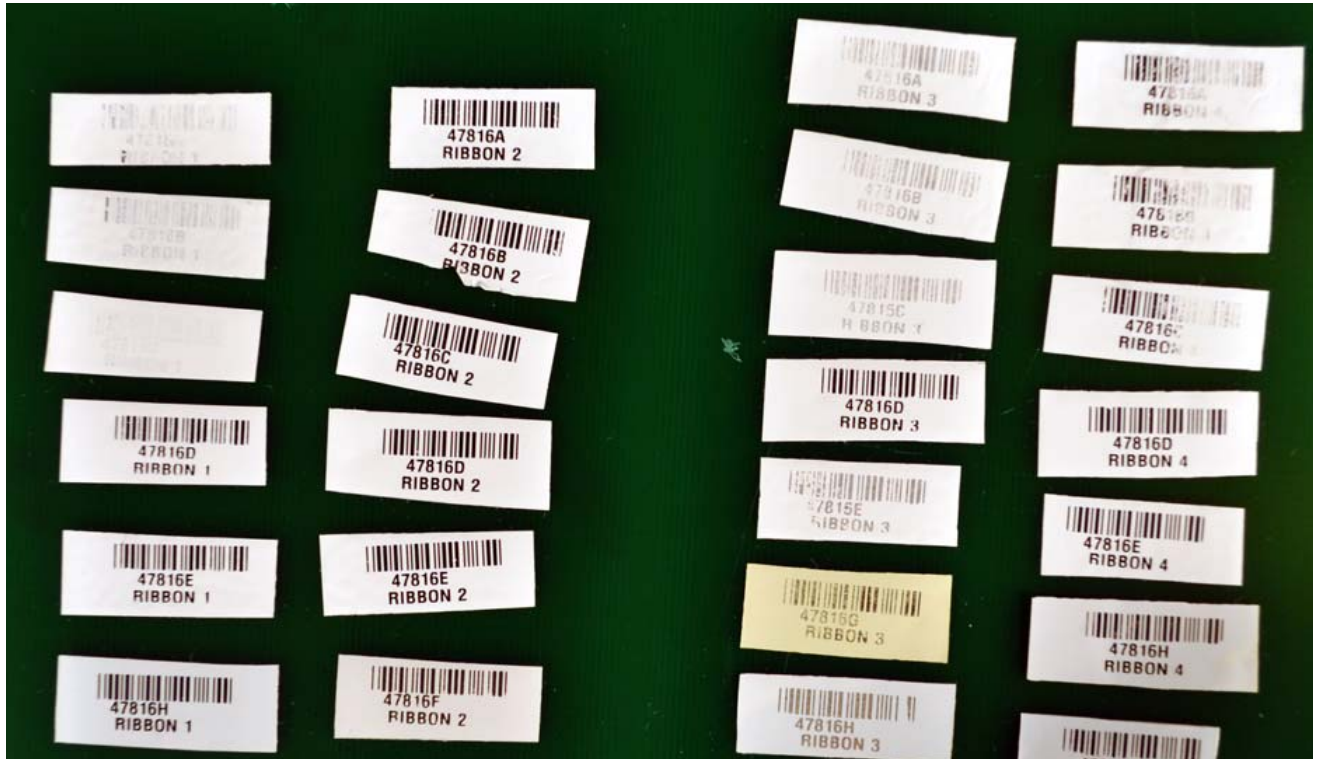
Post-exposure Test Board - No Lead Reflow Profile and Five (5) In Line Wash Cycles

Ribbon 1
Competitor A

Ribbon 2
ITW Thermal Films
B324 Durable
Extreme Series Resin™

Ribbon 3
Competitor B

Ribbon 4
Competitor C



ADDITIONAL NOTES:

1. ITW Thermal Films, FLEXcon, Speedline Technologies and ZESTRON are members of IPC – Association Connecting Electronics Industry®.
2. ITW Thermal Films, Speedline Technologies and ZESTRON are members of Surface Mount Technology Association (SMTA).
3. Speedline Technologies is part of the Power Systems & Electronics Group within Illinois Tool Works Inc. (NYSE: ITW).
4. Scan QR code with your smart phone to watch a video on printed circuit board technical testing procedures.



COMPANY OVERVIEWS



ITW Thermal Films is a worldwide manufacturer, converter and distributor of PrintheadSaver® thermal transfer ribbon products for flat head and near edge technology printers. A leader in the Automatic Identification and Data Collection Industry (AIDC), ITW Thermal Films has been delivering quality bar code ribbon products, value-added services, technologies and solutions to customers for more than 25 years. ITW Thermal Films is a division of Illinois Tool Works Inc. (NYSE: ITW), a multi-national Fortune 200 Company and part of the worldwide ITW Foils and Thermal Films Group whose business units provide productivity-enhancing solutions to a diverse set of customers around the world.

For more information on ITW Thermal Films' B324 Durable Extreme Series Resin™ thermal transfer ribbon, call +1-877-887-3456, or visit www.itwextremesolutions.com. For more information on ITW Thermal Films, visit www.itwthermalfilms.com.



FLEXcon is an ISO 9001:2008 worldwide manufacturer of pressure-sensitive films and adhesives for applications including indoor and outdoor advertising, bonding/mounting, and product identification, safety, hazard, bar-coded, and primary labels. The company's Value-Better-Supreme (VBS) product offering is the most extensive standard product offering in the pressure-sensitive film industry. FLEXcon is also a leader in developing custom solutions to meet unique converting or application needs. FLEXcon's mission is to provide its customers the highest quality products with exceptional service. The company is headquartered in Spencer, Massachusetts, and has operations throughout North America and Europe, with distribution worldwide.

For more information on FLEXcon's THERMLfilm® HT™ 1 and 2 mil white polyimide films, call +1-508-885-8300, or visit www.FLEXcon.com/HT. For more information on FLEXcon, visit www.FLEXcon.com.



Speedline Technologies is the global leader in process knowledge, services and manufacturer of capital equipment used in printed circuit board assembly and semiconductor industries. Based in Franklin, Massachusetts, USA, the company markets five best-in-class brands: Accel microelectronics cleaning equipment; Camalot dispensing systems; Electrovert wave soldering, reflow soldering and cleaning equipment; MPM stencil and screen printing systems; and Protect global services, support and training solutions.

For more information about Speedline Technologies call +1-573-317-3041, or visit www.speedlinetech.com,



Headquartered in Manassas, Virginia, and operating in more than 35 countries, ZESTRON is the globally leading provider of high precision cleaning products, services and training solutions for the electronics manufacturing industry. With five worldwide technical centers and the largest team of chemical engineers in the industry, ZESTRON's commitment to ensuring that its customers surpass even the most stringent cleaning requirements is without equal.

For additional information on ZESTRON's cleaning agents, please call +1-703-393-9880, or visit <http://www.zestron.com>.
