IPC MIDWEST CONFERENCE & EXHIBITION

Semi-Automated Lead-Free BGA Rework

IPC Midwest Lead-Free Workshop

September 26 – 28, 2007

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Littleton, MA 01460

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Rework Process

- Remove Defective Component
- Site & Component Preparation
- Place and Reflow New Component
  - Common Thermal Profile for Removal and Replacement
  - Aggressive Removal Profile
  - Conservative Placement Profile

Rework Process

- Higher Temperatures
- Slower Wetting – Slower Bonding
- Board Finishes (Ag, OSP, etc.)
- Fluxes Higher Activity → Better Soldering
  - No-Clean Fluxes – short process window
  - Water Soluble- better than no clean on all metal finishes
  - OSP & no clean the worst combo
  - RMAs longer process window (TSF 6592 no clean RMA)
- Nitrogen – decrease oxidation (cost)

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Thermal Profiling

Reduced Thermal Window for Lead Free

Data For Decision Making

- Solder time & temperature above reflow?
- How hard are the heaters working?
- Board temperature vs site temperature?
- Delta between top heater air and component top temperature?
- Adjacent component temperatures?

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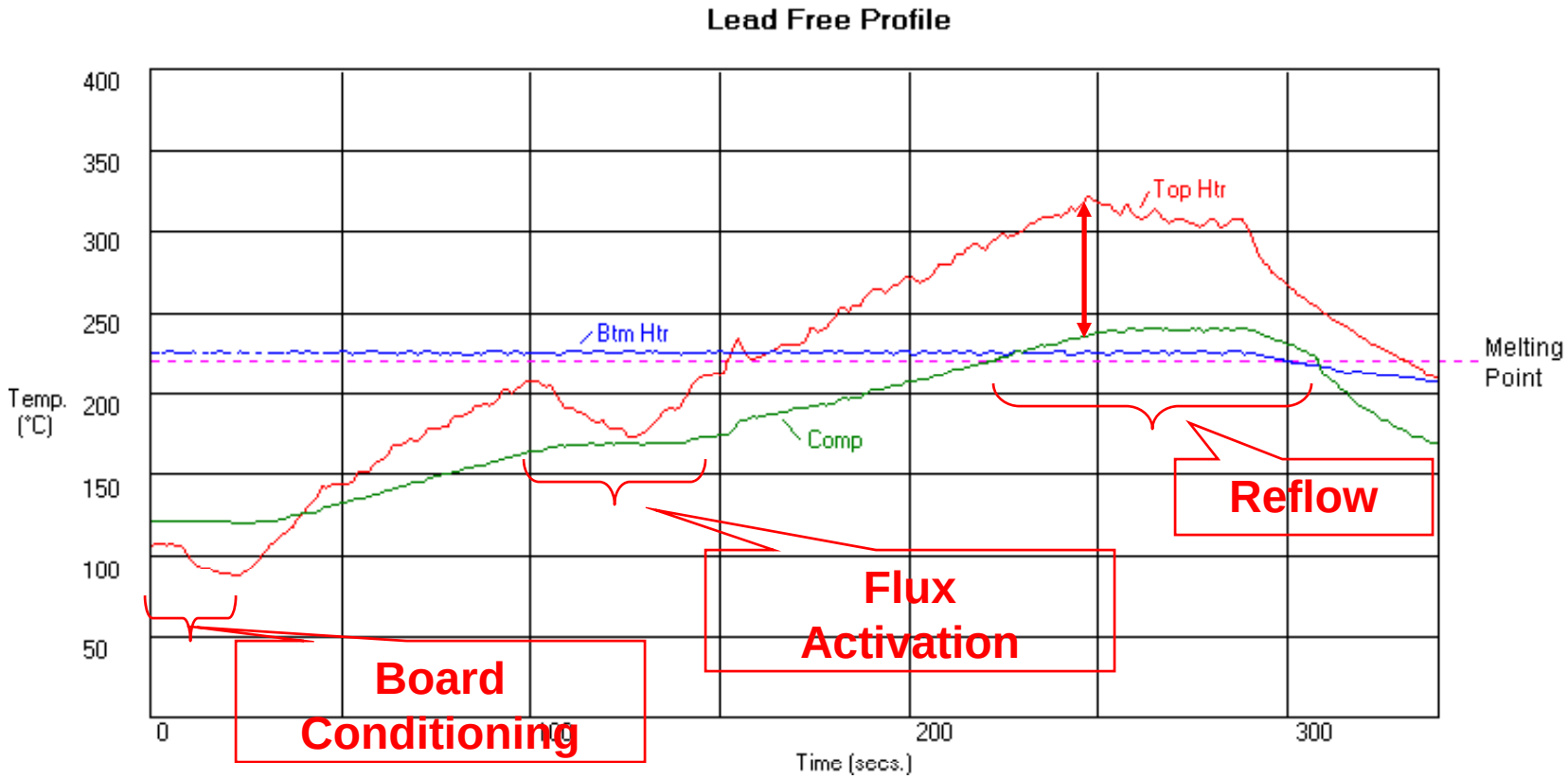
Thermal Profile

Removal or Replacement



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Process Repeatability

Control the Variables

- Board placement and mounting
- Top heater nozzle size and position
- Cold starts versus warm starts
- Production data collection and monitoring
- Control flux and paste application

Break Time Breezes / Summer Brownouts

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Intermetallic Compounds

chemical compounds between two or more
metals with crystal structures that differ
from those of the constituent metals.

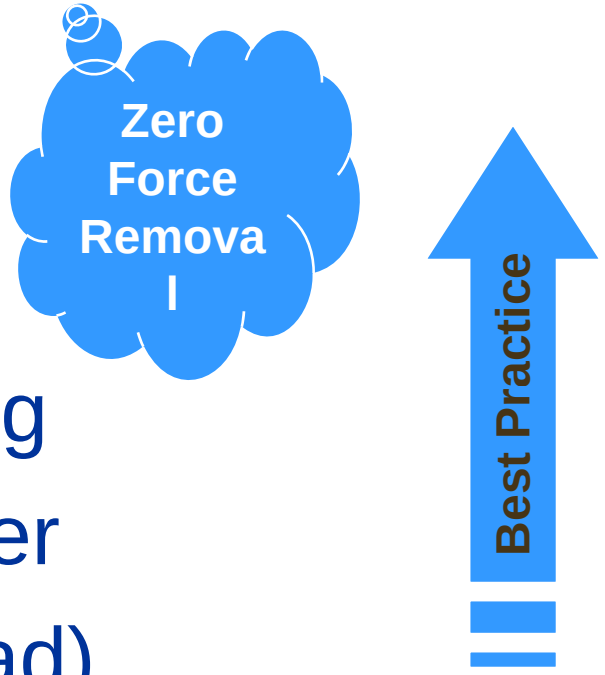
Cu_6Sn_5 and Ag_3Sn - non-metallic in character that solidify as faceted crystals

Contributing Factors

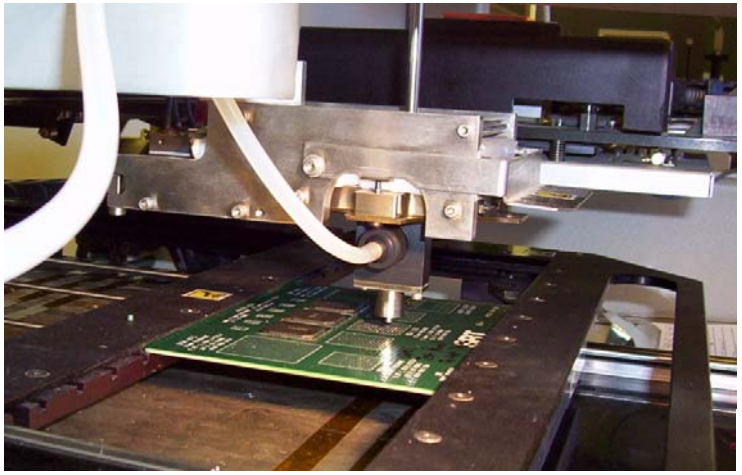
- More Tin Available
- Peak Temperatures
- Time at Temperature
- Excessive Thermal Cycling

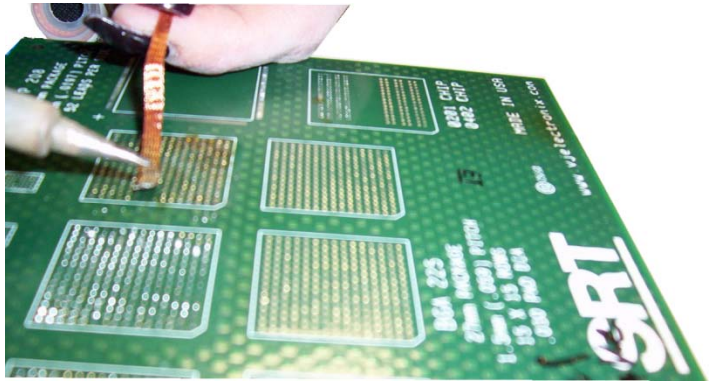
Site Dressing

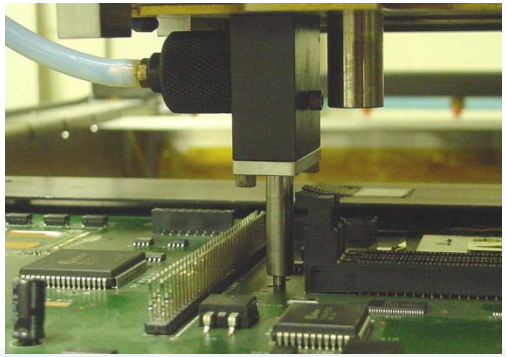
- Vacuum Scavenging
  - Non contact
  - Can clean too well?
- Copper Pad Scavenging
  - Leaves residual solder
- Solder Wick (Brillo Pad)
  - Pad damage (cratering, delam, pull)

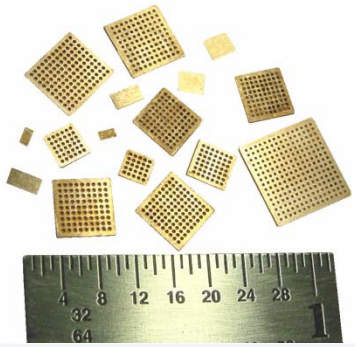


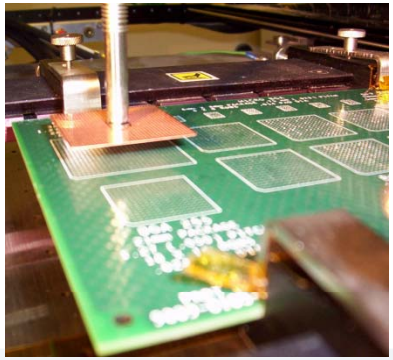
Site Dressing







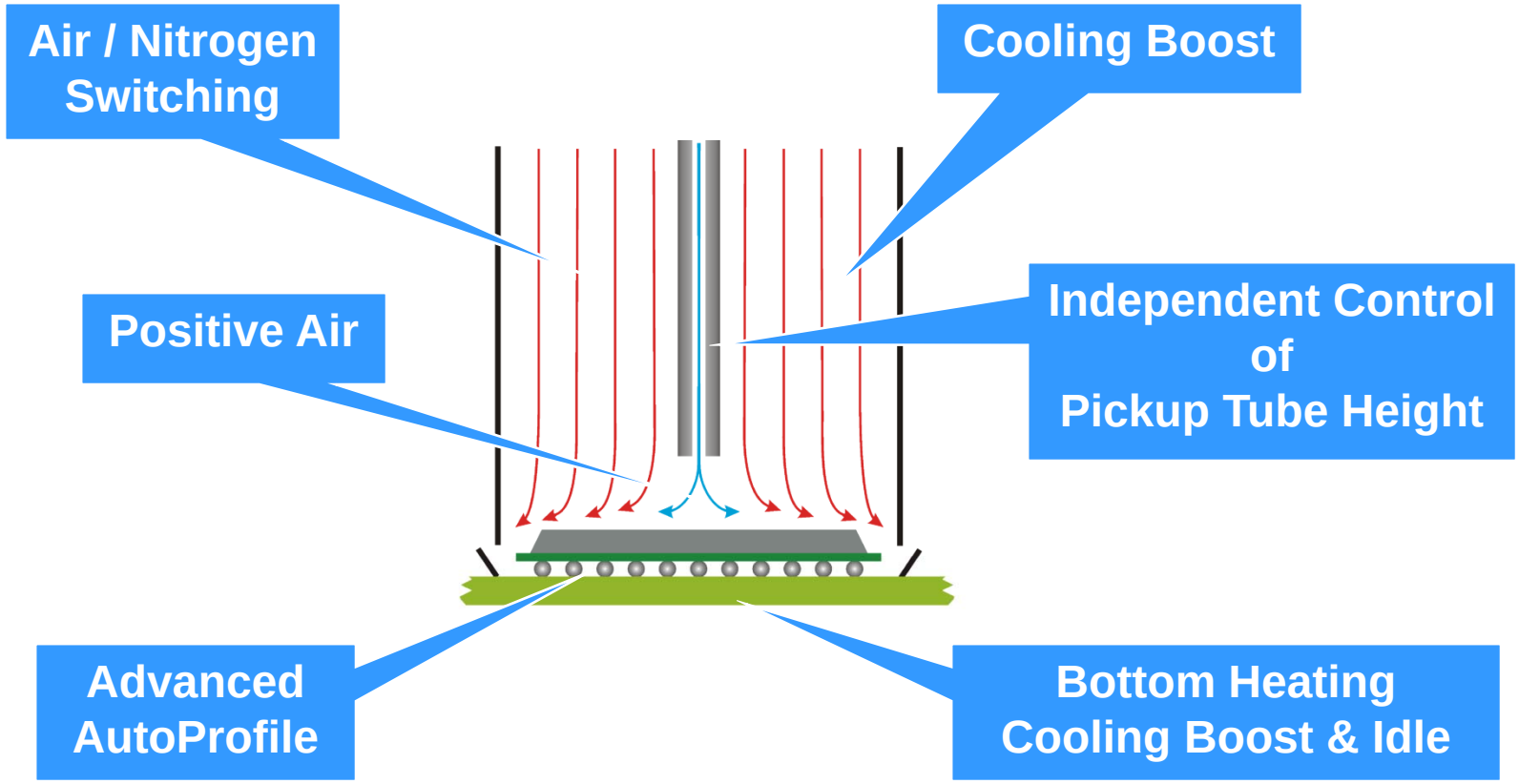




Semi-Automated Rework Lead-Free Features

- Air/Nitrogen switching for top heating
- Positive Air cooling for top component
- Top heater cooling boost
- Independent PUT and top heater control
- Bottom heater cooling boost
- Bottom Heater Idle
- Advanced Auto-Profiling

Semi-Automated Rework Lead-Free Features



Process Options Tool Kit

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Advanced Auto-Profiling

Rules Based

- Use Multiple TCs for Temperature Control
  - Set Max Allowable Temperature Delta for Top Heater Air and Component Top
  - Assign Min/Max Ramp Rates
  - Establish Board Conditioning Temperature
  - Set Min/Max Times for Flux Activation
  - Assign Solder Peak Temperature and Time Above Melting Point (Single or Multiple TC Average)
- Let Software Auto Adjust Profiles to Meet Rule Constraints
- Let Software Record Power Settings for Future Reapplication

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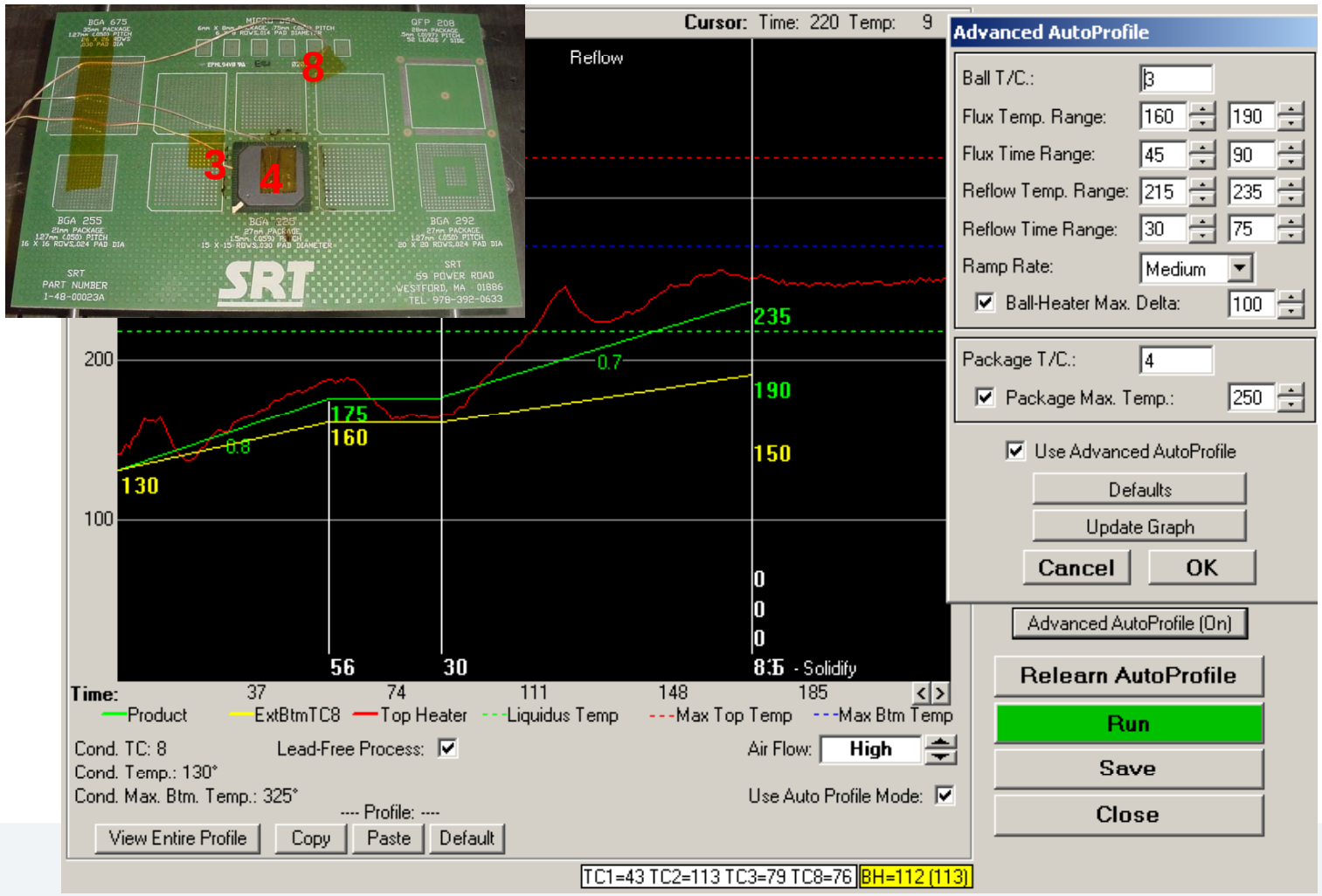
Advanced Auto-Profiling



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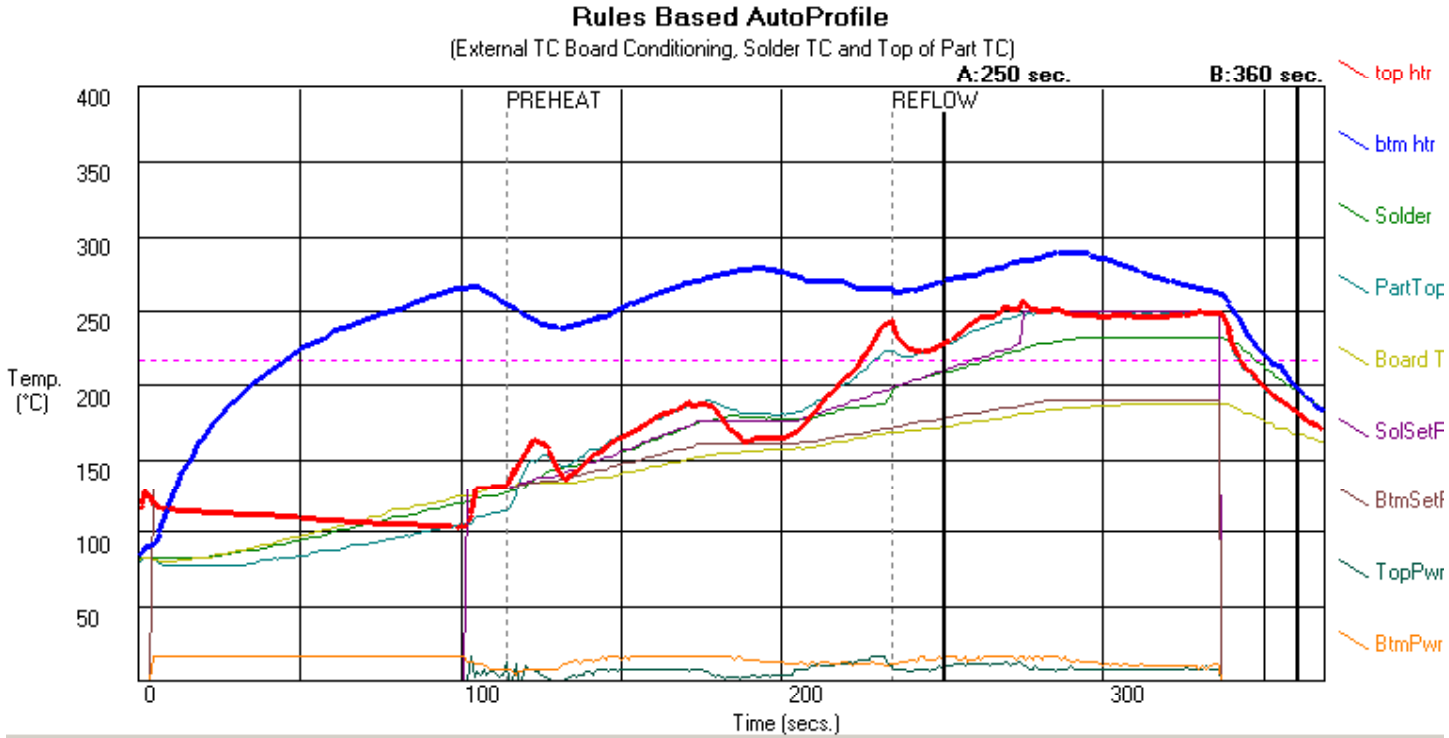
Advanced Auto-Profiling



File:	SMTA4.LOG
Date:	4/25/2007
Time:	7:59:09 AM
Board:	SRT Demo Board
Site:	BGA225
Seq.:	_Reflow Site
Serial:	

	A	B	Slope	Min	Max	Liq
top htr	229	182	-0.4	182	256	93
btm htr	270	200	-0.6	200	290	102
Solder	209	197	-0.1	197	233	83
PartTop	228	182	-0.4	182	251	93
Site 3						
comptop						
adjacent						
Board TC	173	168	0.0	168	188	0

	A	B	Slope	Min	Max	Liq
SolSetPt	210	0	-1.9	0	250	77
BtmSetPt	178	0	-1.6	0	190	0
TopPwr	8	0	-0.1	0	13	0
BtmPwr	14	0	-0.1	0	16	0
AUX13						
AUX14						
AUX15						
AUX16						

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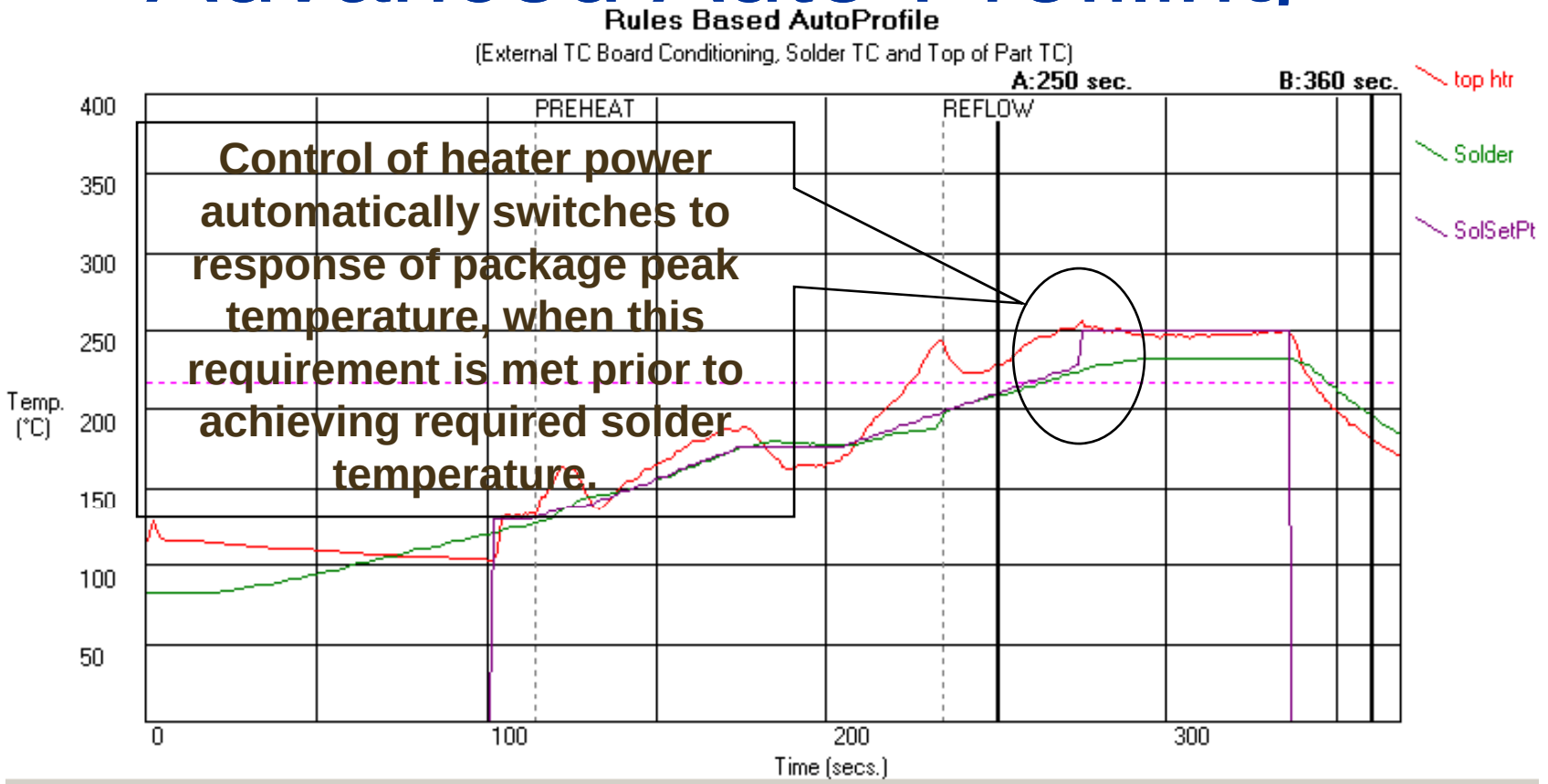
Advanced Auto-Profiling



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BtmSetPt	☐						
TopPwr	☐						
BtmPwr	☐						

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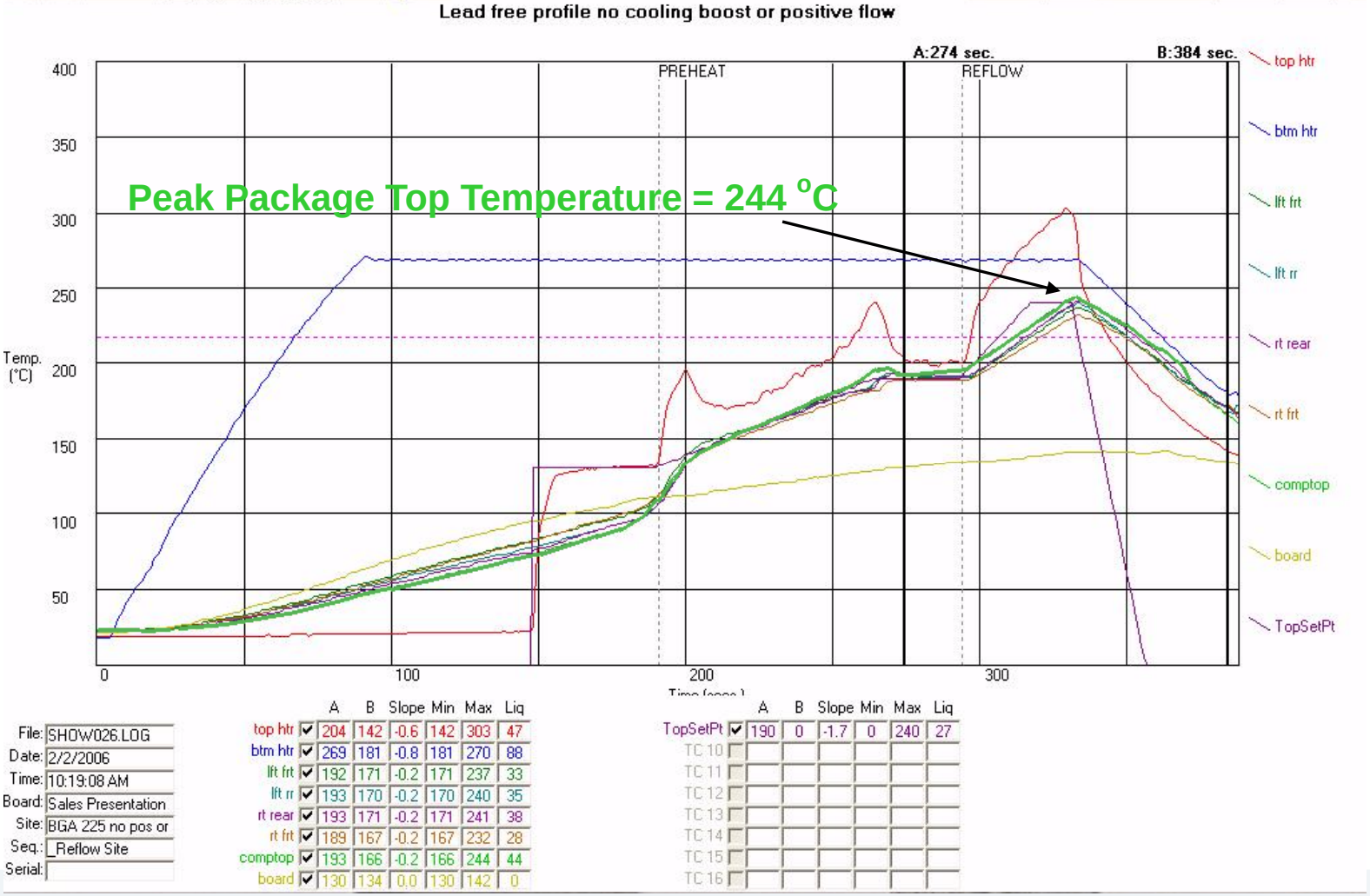
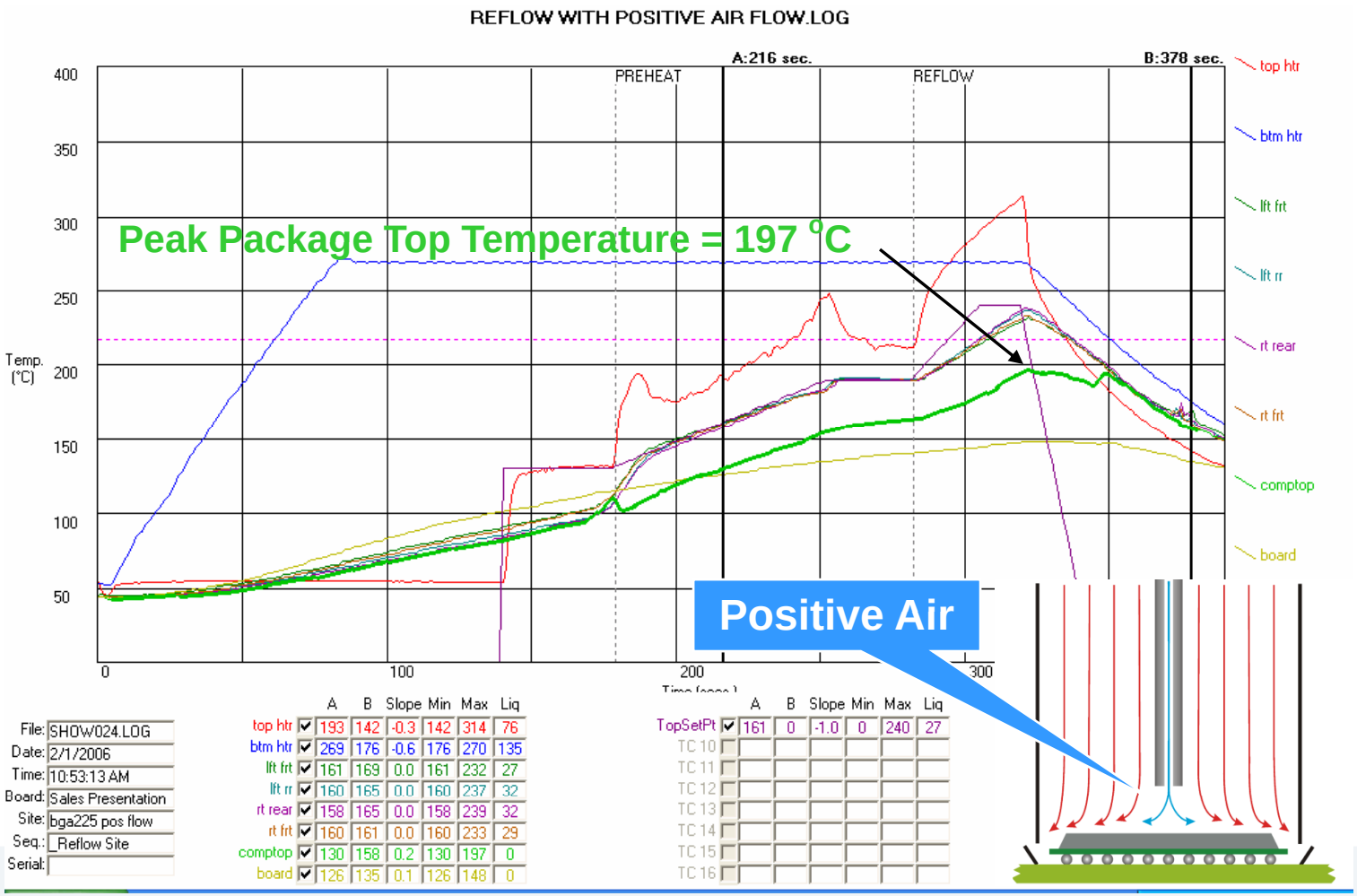
Lead-Free Profile



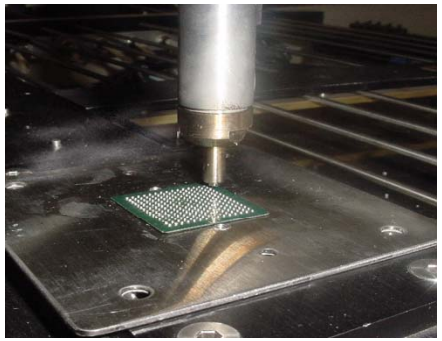
Lead-Free Profile with Positive Air Cooling



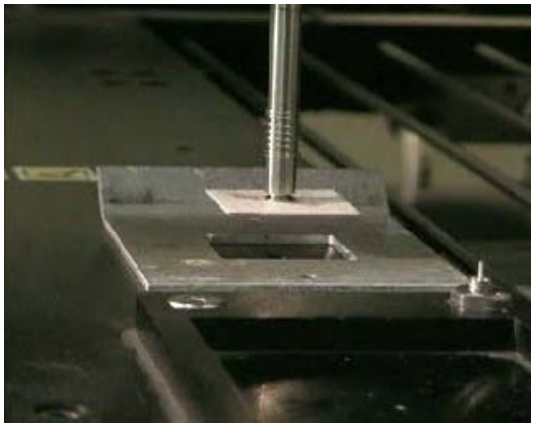
Reballing Parts

Tin-Lead to Lead-Free

Lead-Free to Tin-Lead



Vacuum Scavenge



Place & Reflow Preform

Remove Preform Paper

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Summary

- Lead-free applications can be easily handled by semi-automated rework systems
- Special attention is needed for temperature control and chemistry issues
- It has become more important to match product requirements with process control options.

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