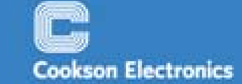
ALPHA® CVP-520 Solder Paste

product guide

A low melting point, lead-free, no clean solder paste designed for low temperature SMT reflow applications



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Welcome to the ALPHA® CVP-520 Product Guide

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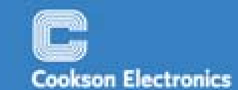

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CVP-520 solder paste

Introducing ALPHA® CVP-520, a low melting point, lead-free no clean solder paste from Cookson Electronics.

Low temperature (<170° C peak reflow temperature) lead free solder paste has 3 significant process advantages:

1. **Elimination of a Wave or Selective Soldering process step while preventing damage to temperature sensitive components and connectors**
2. **Significant reduction in reflow process cycle time**
3. **Reduced Energy Consumption**

Cookson's world class phase gate product development process began with a rigorous set of product specifications based on the voice of our customers. Exhaustive lab and field testing have resulted in a robust, high yield product that can solve one or more of the challenges associated with lead free, mixed technology (Surface Mount and Through Hole) soldering.

You can count on the complete support of Cookson's global team of technical experts, whenever and however you need us. It's the kind of support you would expect from a company that's remained dedicated to serving the needs of the Global circuit assembly market for over 50 years.

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Performance Summary

Process Benefit	CVP-520 Property	Performance Capability
Print Process Window	Fine Feature Print Definition	Excellent print definition and consistant volumetric performance to 0.3mm (12 mil) mask defined circles and 0.4mm (16 mil) pitch rectangular QFP pads using 125µ (5 mil) stencil. Minimum area ratio 0.60
	Tack Life	>8 hours
	Temperature Window	Capable of printing in temperatures from 20°C to ≥ 29°C (68°F to ≥ 86°F) at 30 to 65% relative humidity
	Print Consistency	Repeatable volume deposition and low volume variability (CpK > 2.0) on 0.5mm (20 mil) circles.
	Print Speed Range	Squeegee Speed: 40 mm/second to 100mm/second (1.5 inches/second to 4 inches/second)
Reflow Yield	Peak Reflow Temperature	Between 155° and 180°C, Depending on thermal mass of assembly
	Resistance to Voids	Exceeds requirements of IPC 7095 Class III using soak reflow profile. Class II with straight ramp profiles.
	Halogen Content	Zero Halogen , no halogen intentionally added
	Flux Residue Cosmetics	Clear, colorless residue.
Electrical Reliability	SIR	Meets/Exceeds - JIS, IPC and Bellcore Requirements
	Electromigration Resistance	Meets/Exceeds - JIS and Bellcore Requirements
	J-STD-004 Classification	ROL0
	Halide Content	Halide Free

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Value in Use Model

If you are using 1 or 2 surface mount reflow steps, plus a wave soldering step, could CVP-520 allow you to eliminate the wave soldering process?

If so, how much could you save with:

- **Lower Energy Consumption?**
- **Eliminate Cost of Wave Soldering?**
- **Reduced Working Capital?**

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CVP-520 value in use

Instructions: Fill in each yellow box with your best estimated value

Value Creation

Current Process Cost of Ownership Calculation

Reflow Side A		
Oven Energy Consumption	20	KW/Hr
Motors, PC Monitor etc.	5	KW/Hr
Total Energy Consumption/Hour	25	KW/Hr
Solder Paste	5	kg
Solder Paste Price	$65.00	per Kg
Operating Hours/Day	16	Hours
Working days/month	22	Days
Energy Cost/KWH	$0.15	per KWH
Cost of Energy/month	$1,320	
Cost of Paste/month	$7,150	
Total Cost / Month / Machine	$8,470	

Reflow Side B		
Oven Energy Consumption	20	KW/Hr
Motors, PC Monitor etc.	5	KW/Hr
Energy Consumption/Hour	25	KW/Hr
Solder Paste	5	kg
Solder Paste Price	$65.00	per Kg
Operating Hours/Day	16	Hours
Working days/month	22	Days
Energy Cost/KWH	$0.15	per KWH
Cost of Energy/month	$1,320	
Cost of Paste/month	$7,150	
Total Cost / Month / Machine	$8,470	

Wave Soldering	
Flux Preheat Energy Requirement	30
Solder Bath Energy Requirement	36
Motors, PC Monitor etc.	5
Total Energy Consumption/Hour	71
Flux Used/Day (liters)	14
Flux Price/liter	$4.00
Bar Solder Consumption(Kg/day)	7
Bar Solder Cost ($/Kg)	$37.47
Operating Hours/Day	16
Working days/month	22
Energy Cost/KWH	$0.15
Cost of Energy/month	$5,736
Cost of Flux/month	$1,232
Cost of Bar Solder/month	$5,770
Total Cost / Month / Machine	$12,738

Pallet Cost / Machine	
Number of Selective Soldering Pallets in	25
Cost/selective soldering pallet	$100
	$2,500

Working Capital Reduction	
SOLDER POT CAPACITY (Kg)	817
	$30,600

Variable Cost / Month / Line	$29,678
Pallet Cost / Line	$2,500
Metal Inventory Value	$30,600

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CVP-520 value in use

Instructions: Fill in each yellow box with your best estimated value

Value Creation

Comparison of Proposed Cost of Ownership

Reflow Side A			Reflow Side B		
Oven Energy Consumption	20	KW/Hr	Oven Energy Consumption	15	KW/Hr
Motors, PC Monitor etc.	5	KW/Hr	Motors, PC Monitor etc.	5	KW/Hr
Total Energy Consumption/Hour	25	KW/Hr	Total Energy Consumption/Hour	20	KW/Hr
Solder Paste Used/line/day	*5*	kg	Solder Paste Used/line/day	*5*	kg
Solder Paste Price	$65.00	per Kg	Solder Paste Price	$75.00	per Kg
Operating Hours/Day	16	Hours	Operating Hours/Day	16	Hours
Working days/month	22	Days	Working days/month	22	Days
Energy Cost/KWH	$0.15	per KWH	Energy Cost/KWH	$0.15	per KWH
Cost of Energy/month	$1,320		Cost of Energy/month	$1,056	
Cost of Paste/month	$7,150		Cost of Paste/month	$8,250	
Total Cost / Month / Machine	$8,470		Total Cost / Month / Machine	$9,306	

Total Variable Cost / Month / Line	$17,776

Proposed Process

Proposed Variable Cost / Month / Line	$17,776		
Pallet Cost / Machine	$0		
Metal Inventory Value	$0		

Existing Process

Current Variable Cost / Month / Line	$29,678
Pallet Cost / Machine	$2,500
Metal Inventory Value	$30,600

Cost Reduction / Line

Variable Savings / Month / Line	$11,902	40.1%
Pallet Cost / Machine	$2,500	
Reduced Working Capital	$30,600	

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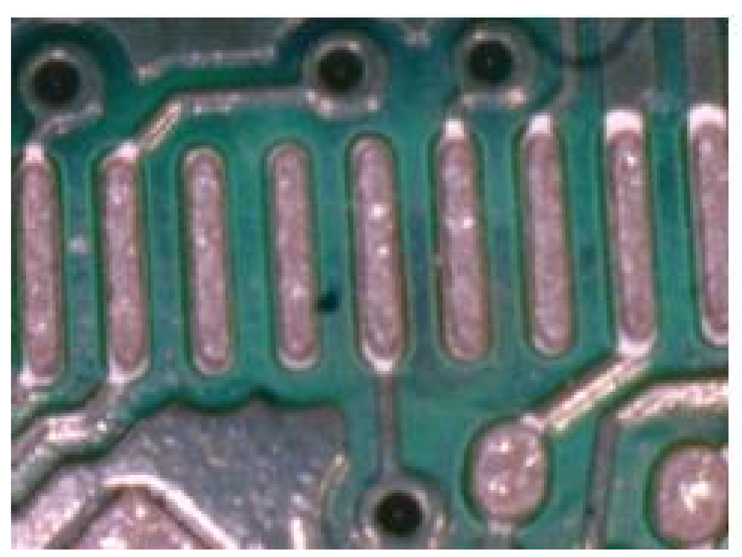
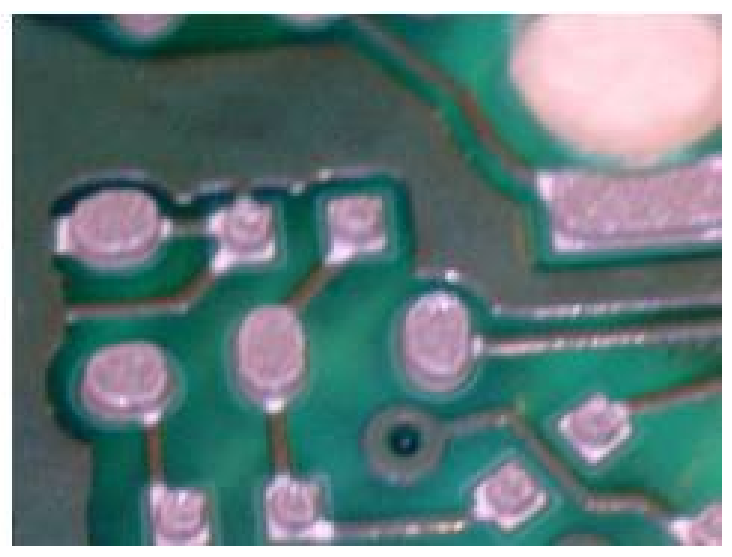
Fine Feature Print Definition





Delivers High Fine Feature Print Yields

Excellent print definition and consistent volumetric performance to 0.4mm (16mil) squares and 0.30mm (12 mil) diameter mask defined circles

*10 cm/sec (4in/sec), 0.26kg/cm (1.5 lbs/in) squeegee pressure, 0.125mm (5 mil) stencil

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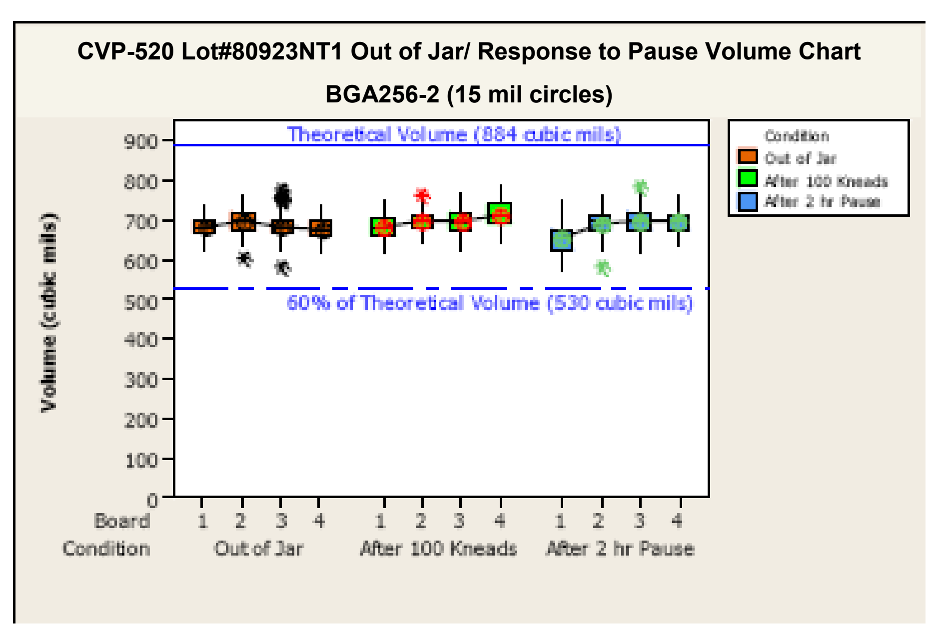
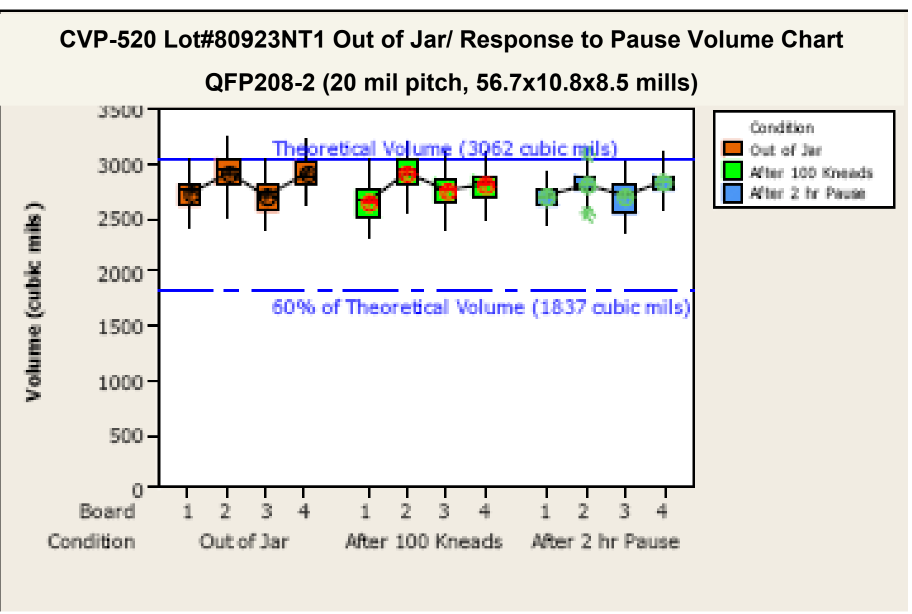
CVP-520 solder paste

Print Performance

Paste Volume, Repeatability- Room Temperature (25° C)





Repeatable volumes after 2 hour pause

- **Continuous monitoring of paste volume over time demonstrates ALPHA CVP-520's consistent printability**
- **High Volume Deposits**
- **High Level of Volume Repeatability**

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CVP-520 solder paste

Print Performance

Stencil Cleaning Frequency Test

Paste: Polar Bear-PNC0806N

Solder Paste - Wipe Frequency

Number of Bridges Board Set 1 QFP Pitch				
Prints	16 (100%)	16 (90%)	20 (100%)	20 (90%)
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	3	0	0	0
5	1	0	0	0
6	5	0	0	0
7	1	0	0	0
8	>10	0	0	0
9	>10	0	0	0
10	>10	0	0	0
11	>10	6	0	0
12	3	0	0	0
13	>10	>10	3	0
14	>10	5	0	0
15	>10	0	0	0
16	>10	>10	>10	0
17	>10	2	2	0
18	4	0	0	0
19	>10	9	5	0
20	>10	>10	>10	0

Over 10 Prints/Stencil Cleaning

- **Based on 1:1 (100%) Aperature Opening on 20 Mil QFP (63 mil x 12 mil deposit)**

·Lower Stencil Cleaning Frequency = Faster Print Cycle Time

No Defects due to Inadequate Stencil Cleaning

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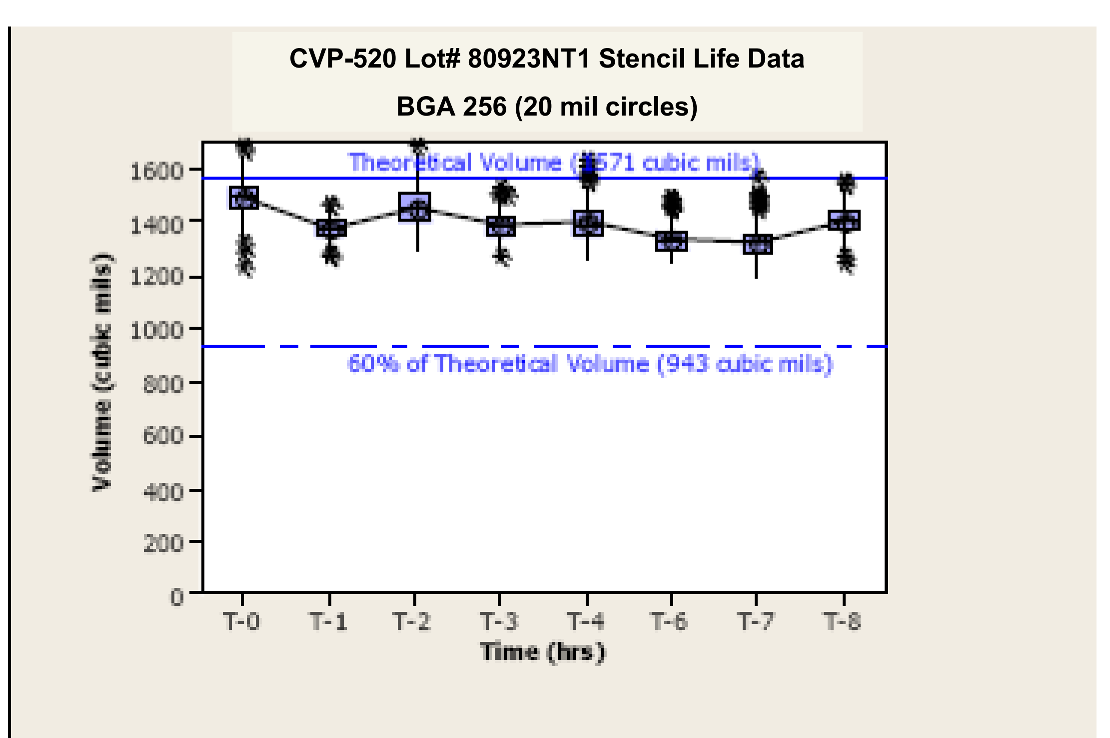
Print Performance

Stencil Life



Maintains consistent print volume deposition over 8 hours

20 mil (0.50mm) Diameter Circles- Typical Feature Size for 0.65mm pitch BGA Package

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CVP-520 solder paste

Print Performance

Viscosity Stability

Storage days	0	1	2	6	10	15
3rpm	410	404	400	392	402	411
4rpm	330	324	327	328	331	344
5rpm	292	288	289	287	287	301
10rpm	**198**	**197**	**200**	**199**	**199**	**202**
20rpm	144	143	145	144	144	147
30rpm	122	121	124	121	121	122
10rpm	194	192	196	191	191	195

6 Month Shelf Life when stored at (0°C - 10°C)

2 Weeks Room Temperature Stability (25°C; 77°F)

Malcolm Viscometer, Viscosity in mPa-sec

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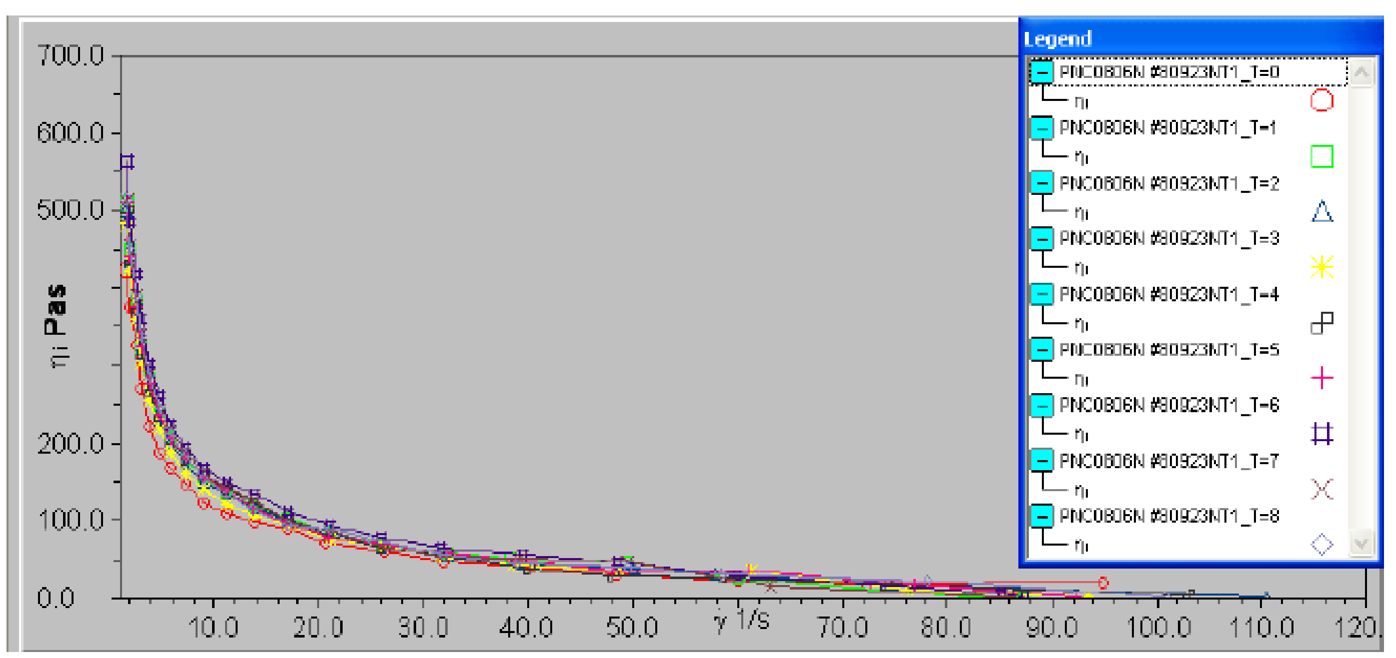
Print Performance

Stable Rheology



Consistent Shear Strain relationship after 8 hours of continuous printing

Excellent indicator of stable printing performance

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CVP-520 solder paste

Paste In Hole Performance

0.35” Overprint | 0.20” Overprint | .25” Overprint | .30” Overprint

Paste is drawn into plated through hole with up to .25in (6.4mm) Overprint

- **Enables reflow soldering of through hole components**
- **Complete hole fill possible with correct through hole/lead design**
- **More challenging volume requirements managed with use of additional solder volume from preforms**

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CVP-520 solder paste

Paste In Hole Performance

OSP Finished Plated Through Hole

CVP-520 Paste Deposit

Exactalloy ™ Preform Placed in Paste

Through Hole Component Inserted

Reflowed Solder Joint

Exactalloy™ Preforms Increases Solder Volume to enable complete hole fill + fillet. Often Required with rectangular pin in round through hole

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Application Note

Preforms do not need to be placed completely in the solder paste deposit. If at least 20% of the Exactalloy preform is in contact with paste, the preform will successfully add solder volume to the through hole joint.

OSP Finished Plated Through Hole

CVP-520 Paste Deposit

Exactalloy ™ Preform Placed in Paste

Through Hole Component Inserted

Reflowed Solder Joint

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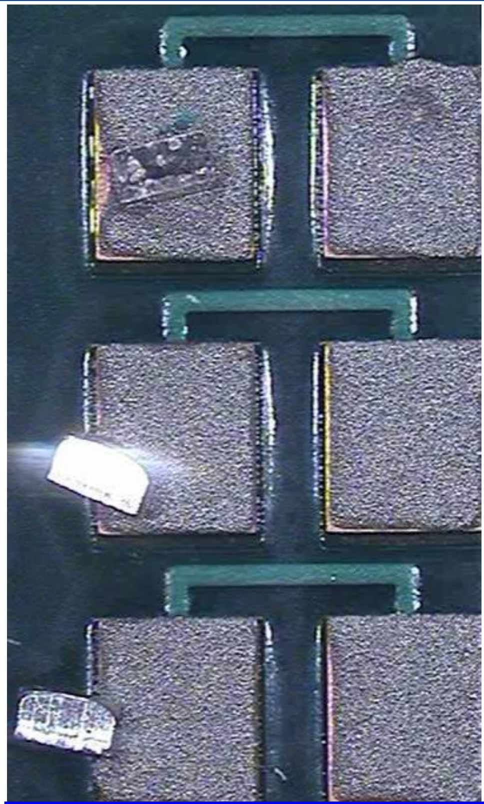
CVP-520 solder paste



Top: 100% of preform placed in solder paste deposit

Middle: 50% of preform placed into solder paste deposit

Bottom: 20% of preform placed in solder paste deposit

Preforms are drawn to center of solder paste deposit during ramp/soak portion of reflow process

Result: Additional solder volume successfully added, even if only 20% of the preform is placed in the solder paste deposit

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CVP-520 solder paste

Reflow Process Guidelines

General Reflow Profile Guidelines	
Parameter	**Guideline**
Atmosphere	Air or N2
SnBiAg (42/57.6/0.4) alloy	138°C (near eutectic)
Setting Zone	**Optimal Dwell Period**
40°C to 138°C	2:10 - 4:00 minutes
125°C to 138°C	0:30 - 1:30 minutes
100°C to 138°C	1:15 - 2:00 minutes
TAL (138°C)	0:30 - 1:30 minutes
Peak temperature	155 °C - 180°C
Joint cool down rate from 170°C	3°C - 8°C/sec

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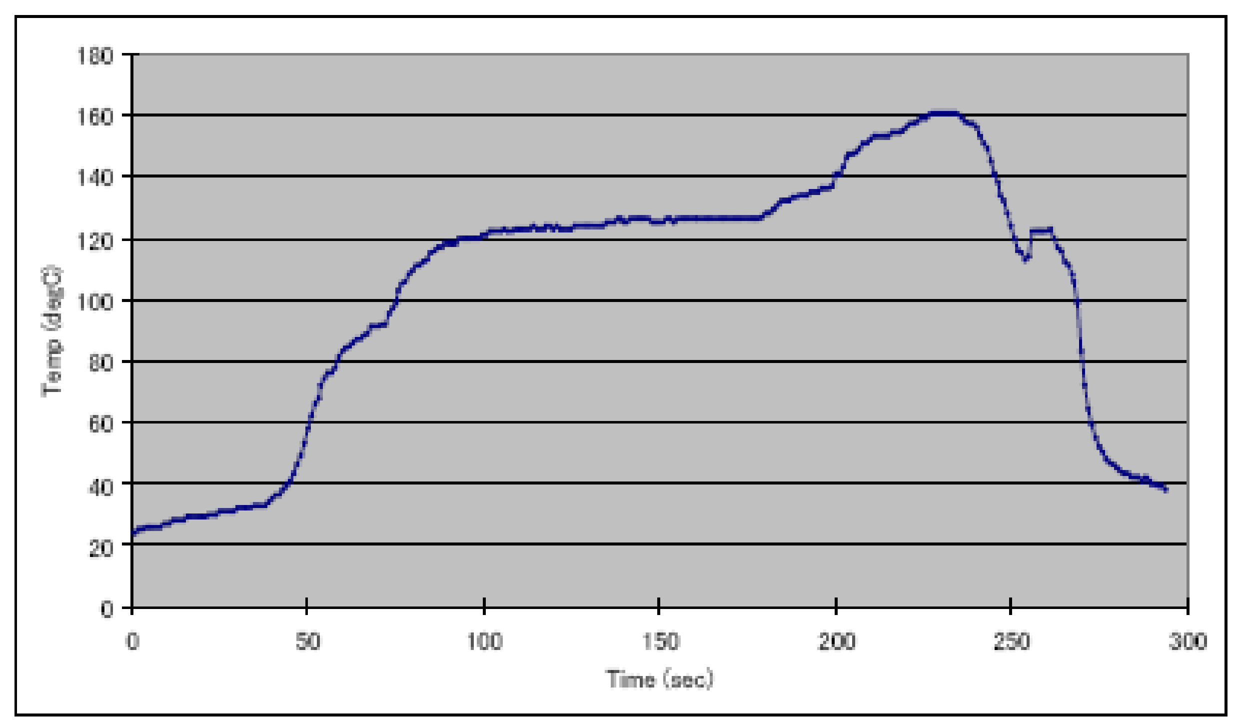
CVP-520 solder paste

Example Reflow Profile 1:

CVP-520 42 Sn/57.6 Bi/0.4 Ag



2°C/Sec Ramp, 120°-130° 160 Sec Soak, 160° Peak, 45 seconds TAL (138°C)

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CVP-520 solder paste

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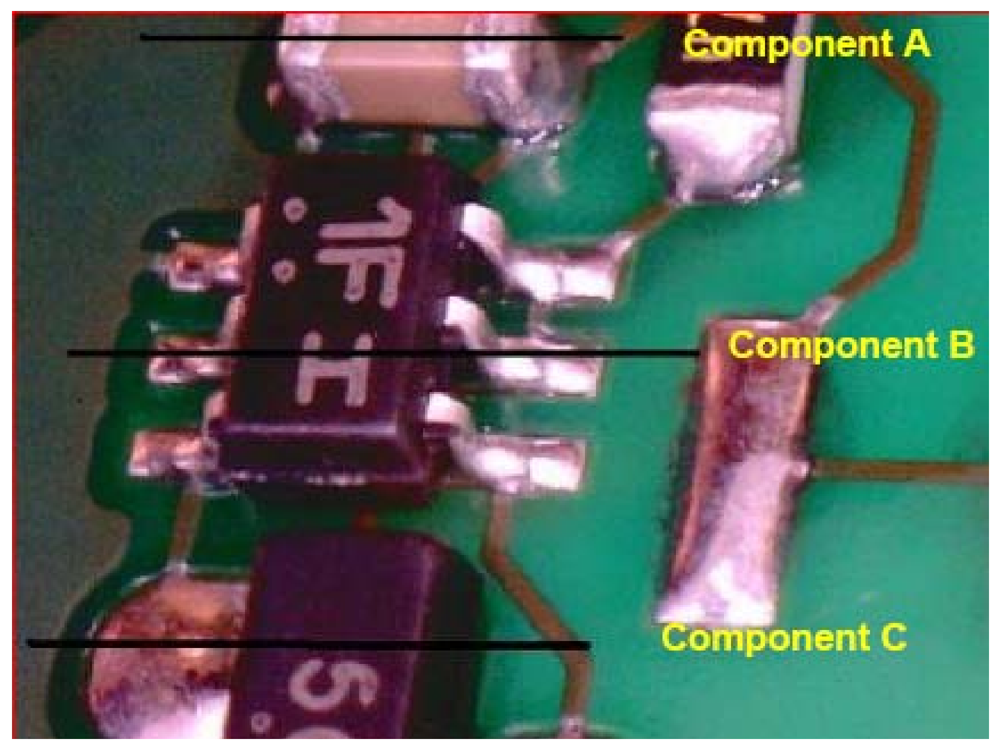

2°C/Sec Ramp, 120°-130° 160 Sec Soak, 160° Peak, 45 seconds TAL (138°C) Cross Section Analysis

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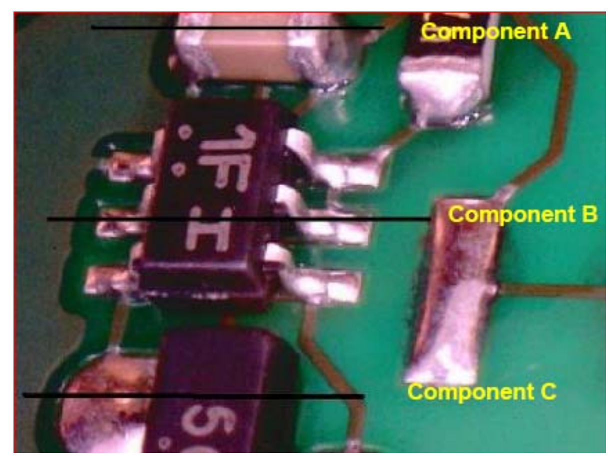
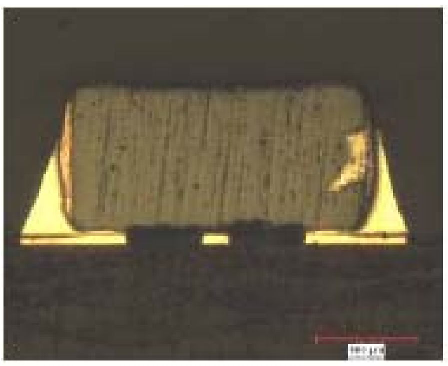
CVP-520 solder paste

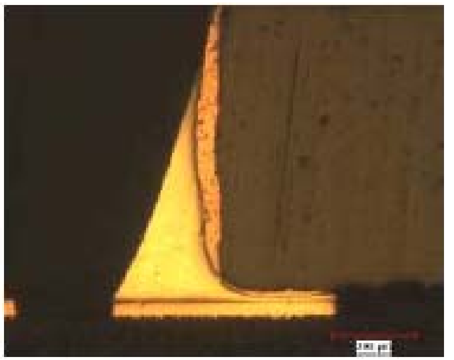
Reflow Performance

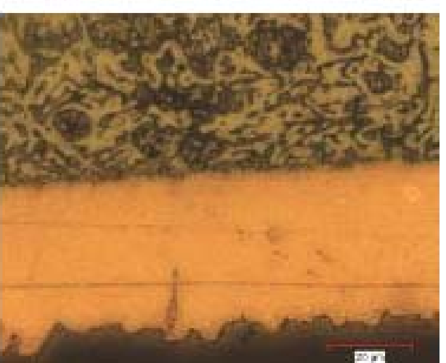
Example Reflow Profile 1:

CVP-520 42 Sn/57.6 Bi/0.4 Ag









Component A Cross Section Analysis

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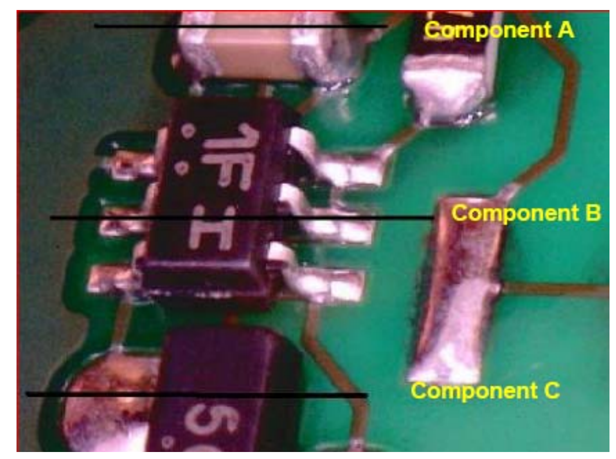
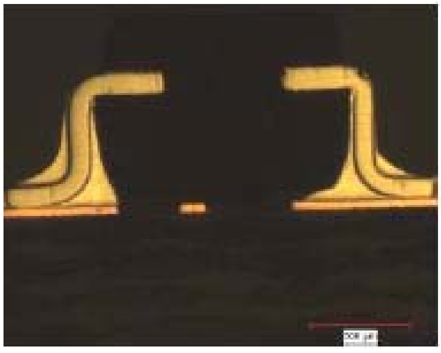
CVP-520 solder paste

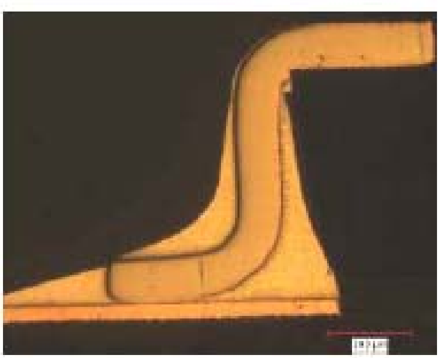
Reflow Performance

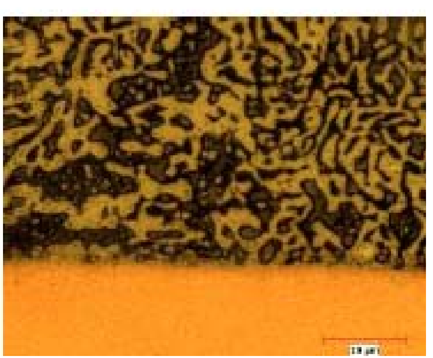
Example Reflow Profile 1:

CVP-520 42 Sn/57.6 Bi/0.4 Ag









Component B Cross Section Analysis

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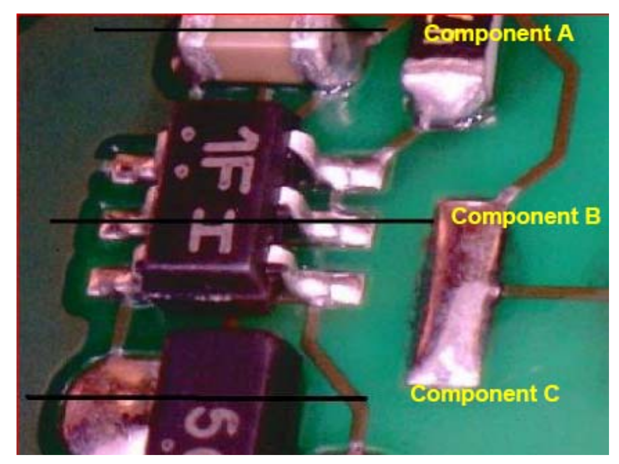
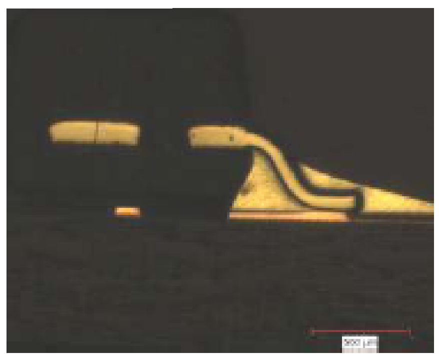
CVP-520 solder paste

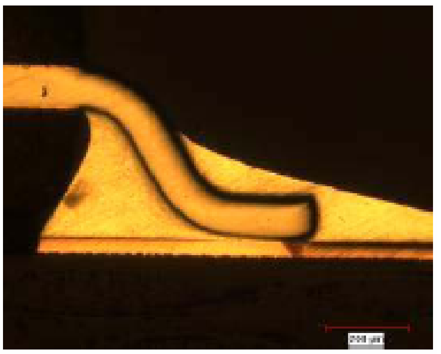
Reflow Performance

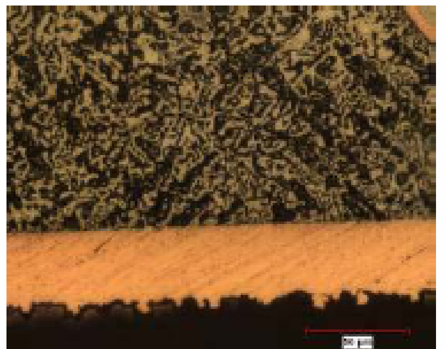
Example Reflow Profile 1:

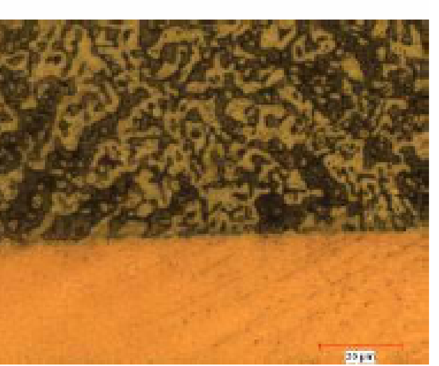
CVP-520 42 Sn/57.6 Bi/0.4 Ag











Component C Cross Section Analysis

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CVP-520 solder paste

Example Reflow Profile 2:

CVP-520 42 Sn/57.6 Bi/0.4 Ag

0.8°C/Sec Ramp, 167° Peak, 50 seconds TAL (138°C)

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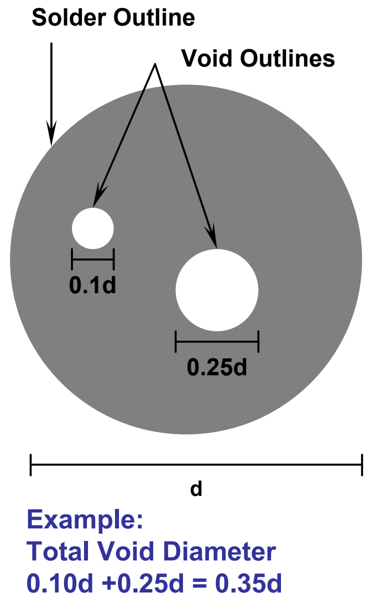
Reflow Yield: Application Note

Definition of Voiding Performance

Location of Void	Class I	Class II	Class III
Void in Solder (Solder Sphere)	60% of diameter = 36% of Area	42% of diameter = 20.25% of Area	30% of diameter = 9% of Area
Void at interface of Solder (Sphere) and Substrate	50% of diameter = 25% of Area	25% of diameter = 12.25% of Area	20% of diameter = 4% of Area



Example:
Total Void Diameter
0.10d +0.25d = 0.35d

IPC Criteria for Voids in BGAs, IPC 7095 7.4.1.6

The IPC criteria provide three classes of acceptance for both the solder sphere and the sphere-pad interface.

Where multiple voids exist, the dimensions will be added to calculate total voiding in the joint.

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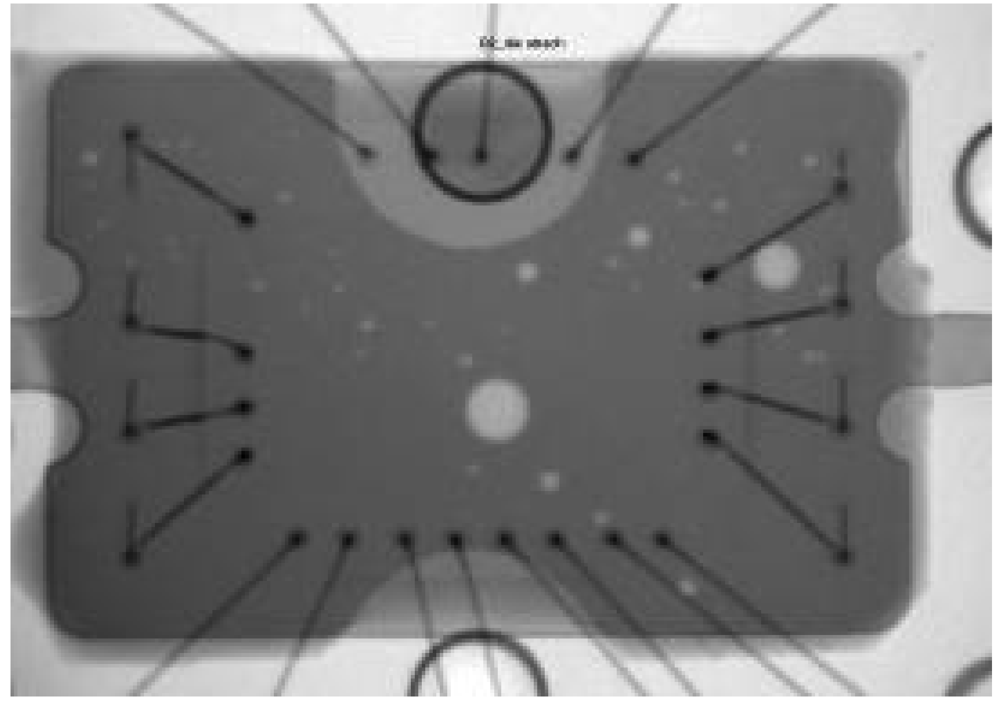
Voiding Performance



Excellent, low voiding performance

- **Meets IPC 7095 Class III Requirements with Soak Reflow Profile**

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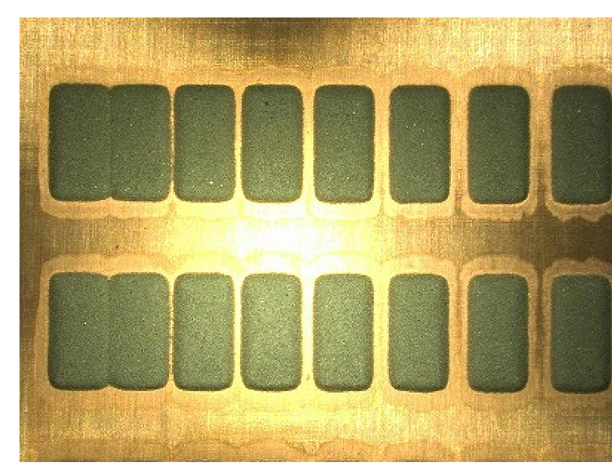
CVP-520 solder paste

Reflow Performance

Cold & Hot slump performance



No bridging >0.3mm after 3 minute soak at 100°C using JIS-Z-3284 Appendix 8 test pattern

Meets Hot & Cold Slump Requirements per IPC J-STD-005

	Cold Slump 25˚C / 50% / 75% RH		Hot Slump Oven 100˚C 10 minutes	
Pad Size	**0.63 x 2.03mm**	**0.33 x 2.03mm**	**0.63 x 2.03mm**	**0.33 x 2.03mm**
IPC max gap	0.48	0.2	0.56	0.25
bridge allowed	**Pass**	**Pass**	**Pass**	**Pass**

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Resistance to Solder Balls

Alloy	Sn/Bi/0.4Ag
Metal loading	90wt%
Solder ball test 150um , 6.5mm stencil Hot plate 160ºC **Initial**	
Solder ball test 150um , 6.5mm stencil Hot plate 160ºC **24hr storage at RT**	

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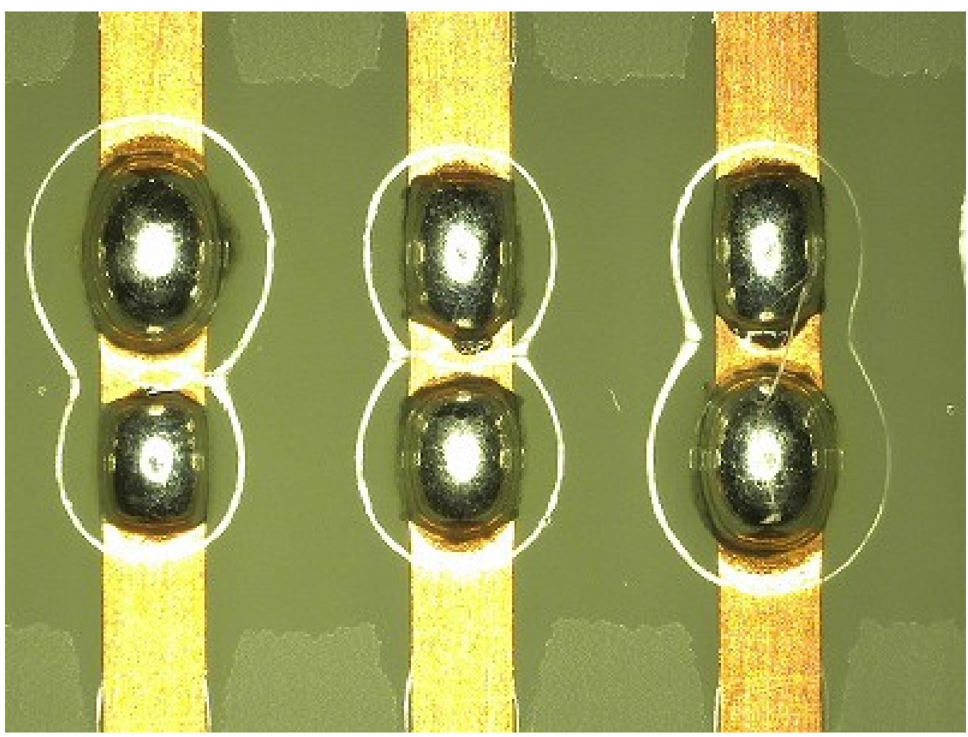
Flux Residue Cosmetics

Post-Reflow Cosmetics



Performance Indicator

- Products that do not deliver clear residues can lead to inconsistent flux cosmetics, increasing the difficulty of visual inspection.

- **Clear, colorless flux residue**
- **No evidence of bubbles in flux**
- **No flux burning on copper substrate**

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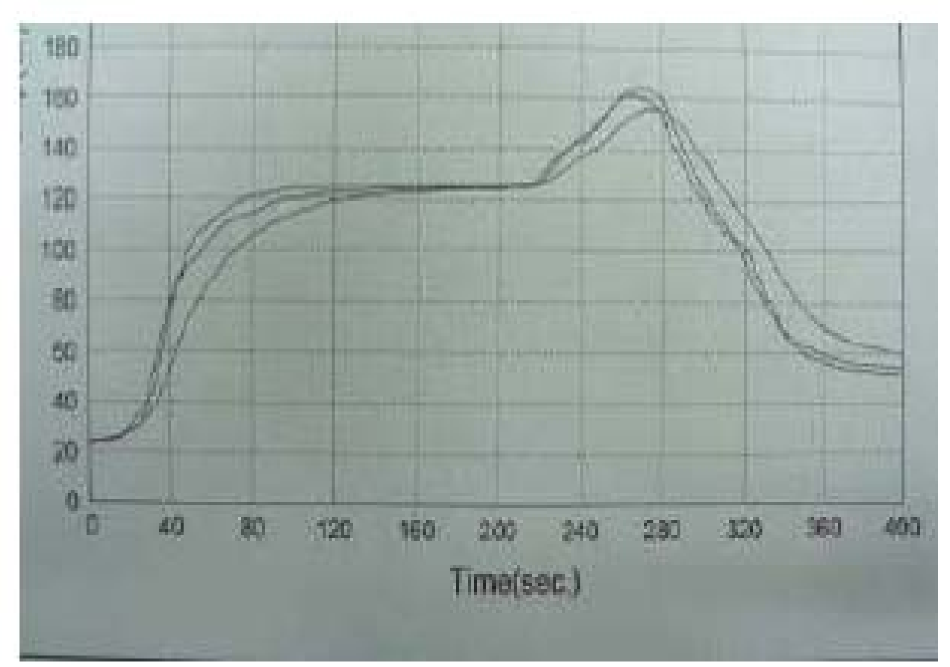
Shear Force After Thermal Cycling

Test Conditions



Thermal cycle

-45 (30min) ⇔ +125 (30min)

Espce TSA-70S

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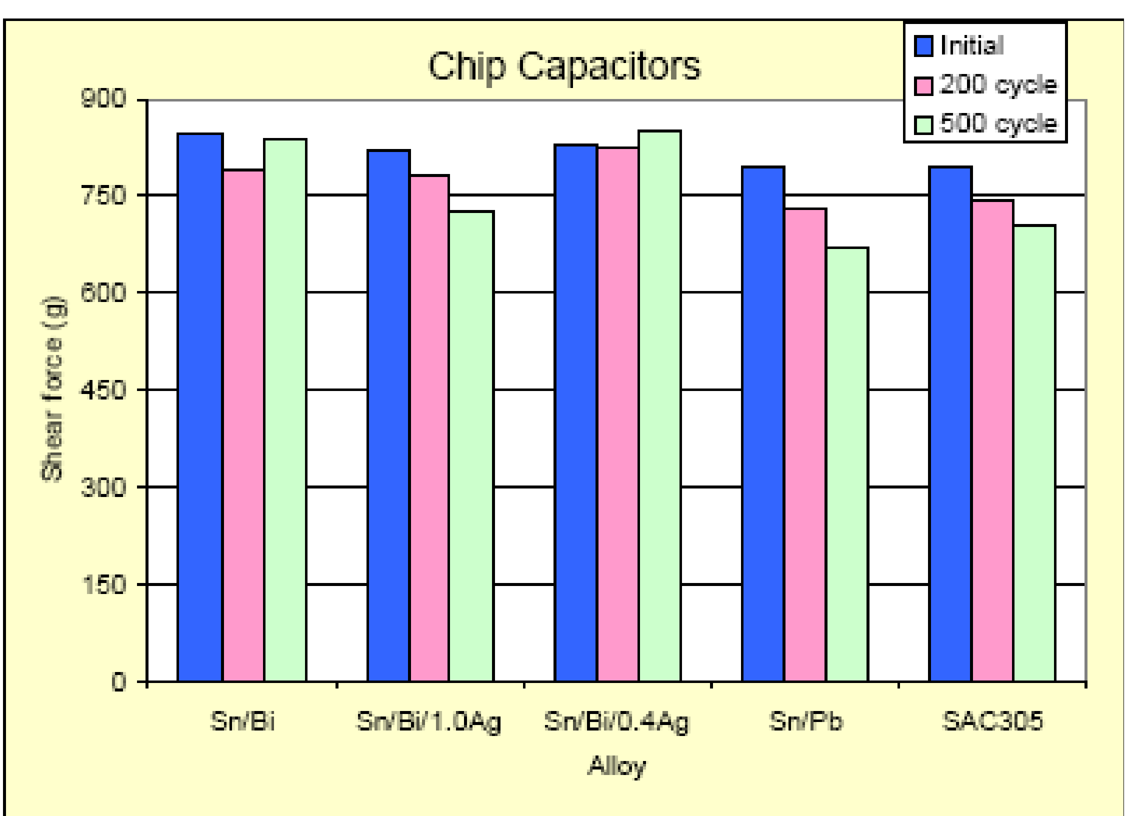
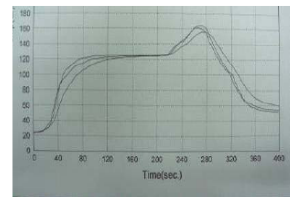
CVP-520 solder paste

Reliability





- Thermal cycle
  -45 (30min) ⇔ +125 (30min)
  Espce TSA-70S

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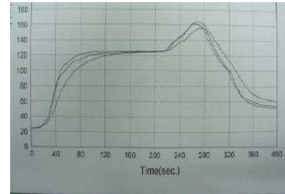
CVP-520 solder paste

Reliability

Shear Force After Thermal Cycling



Thermal cycle
-45 (30min) ⇔ +125 (30min)
Espce TSA-70S

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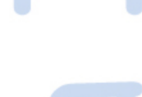
Application Note:

When using a Bismuth/Tin/Silver alloy solder paste, ***all*** components and soldered surfaces should be lead free. Pb bearing alloy components will form a very low melting point Tin/Bismuth/Lead Ternary alloy that may reduce assembly's resistance to failure at operating temperatures over 100ºC.



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CVP-520 solder paste

Summary Table

Chemical		
Cu Corrosion	IPC J-STD 004	Pass
	JIS Z 3197 - 1999 8.4.1	Pass
Cu Mirror	IPC J-STD 004	Pass
Ag Chromate	IPC J-STD 004	Pass
Zero Halogen	EN14582, by oxygen bomb combustion, Non detectable (ND) at < 50 ppm	Pass

Paste is ROL0 per IPC

Electrical			
SIR (IPC)	7 day 85˚C/85% RH (Ω)	3.6E+11	> 10^8 = Pass
SIR (Bellcore)	96 hours @ 35˚C/85% RH (Ω)	1.1E+12	> 10^{11} = Pass
Electromigration (Bellcore)	500 hours, 65° C, 85% RH	Initial 8.4E+11 Final 1.4E+12	Pass Final > Initial/10
Electromigration (JIS)	1000 hours, 85°C, 85% RH 48V (Ω)	1.0E+10	Pass > 1.0 X 10^8 ohm

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Electrical Reliability Data

Passes IPC SIR Test

	SIR	TEST	PER	J-STD-004			
	*********************						
Test	#:0824-2i	Date:	9/9/2008	T/H/B	85C/85%RH/-48V		
Tested	by:	K. Tellefsen		P/F	limit:		
Reported	by:	K. Tellefsen		1.00E+08	ohms		
		Tellefsen					
Material Tested	Initial	SIR(ohms)	SIR	SIR	Final	COMMENTS	
	ambient	(1 Day)	(4 Days)	(7 Days)			
	-------	-------	-------	-------	-------		
CVP-520	SnBiAg						
Reflowed	100C Soak	soak	175C				
	9.00E+10	7.40E+09	2.90E+09	2.70E+09	3.60E+11	Passed Electrical and Visual	
	9.80E+09	2.30E+09	1.10E+09	2.20E+08	2.80E+10		
Uncleaned	1.10E+10	2.00E+09	4.90E+08	5.70E+08	6.00E+10		
	8.40E+10	5.50E+09	2.50E+09	2.40E+09	3.40E+11		
	6.00E+09	7.50E+08	1.90E+08	1.50E+08	9.00E+10		
	7.40E+10	6.30E+09	3.40E+09	3.00E+09	3.30E+11		
	1.20E+11	7.10E+09	3.00E+09	2.80E+09	2.20E+11		
	1.10E+10	9.30E+08	5.60E+08	1.40E+08	1.30E+10		
	>1.0E12	3.20E+09	2.10E+09	2.40E+09	>1.0E12		
	>1.0E12	3.50E+09	1.90E+09	2.70E+09	>1.0E12		
	5.70E+11	1.30E+10	6.80E+09	4.50E+09	5.80E+11		
	>1.0E12	2.00E+10	7.60E+09	5.90E+09	3.20E+11		
	-------	-------	-------	-------	-------		
Arithmetic Mean	3.30E+11	6.00E+09	2.70E+09	2.30E+09	3.60E+11		
Control Boards	>1.0E12	6.40E+10	2.30E+10	2.60E+10	>1.0E12		
	>1.0E12	9.40E+10	3.20E+10	3.50E+10	>1.0E12		
	>1.0E12	1.50E+11	6.40E+10	7.10E+10	>1.0E12		
	>1.0E12	4.20E+10	2.30E+10	2.80E+10	>1.0E12		
	>1.0E12	2.60E+10	1.10E+10	1.90E+10	>1.0E12		
	>1.0E12	2.70E+10	1.10E+10	1.90E+10	>1.0E12		
	6.10E+11	4.60E+10	2.20E+10	2.30E+10	4.40E+11		
	7.50E+11	5.00E+10	2.30E+10	2.40E+10	>1.0E12		
	3.00E+10	8.10E+10	3.80E+10	4.20E+10	>1.0E12		
	>1.0E12	7.10E+10	3.10E+10	3.30E+10	>1.0E12		
	>1.0E12	2.20E+10	1.70E+10	2.30E+10	>1.0E12		
	>1.0E12	6.40E+10	3.30E+10	3.50E+10	>1.0E12		
	-------	-------	-------	-------	-------		
Arithmetic Mean	8.70E+11	6.10E+10	2.70E+10	3.20E+10	9.50E+11		

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Reliability

Electrical Reliability Data

Passes Bellcore SIR Test

Test #: 0824-2b Date9/9/2008 T/H/B:35/85/-48

Tested by: K. Tellefsen Reported by:K. TellP/F limit:1E11 Ohms

MATERIAL TESTED/ CONDITION	SIR (1 day)	SIR (4 days)	COMMENTS
CVP-520 SnBiAg	1.1E+12	1.1E+12	Visually OK
Reflowed	1.1E+12	1.1E+12	
Uncleaned	1.3E+12	2.0E+12	
	1.4E+13	9.9E+11	
	7.1E+12	2.5E+12	
	2.5E+12	9.9E+11	
	8.3E+12	1.1E+12	
	1.7E+12	5.0E+12	
	5.0E+12	1.4E+12	
	8.3E+12	5.0E+12	
	8.3E+12	5.1E+10	
	2.5E+11	3.6E+11	
Geometric mean:	**3.0E+12**	**1.1E+12**	
Control boards	**5.0E+13**	**5.0E+12**	
	7.6E+12	1.1E+13	
	7.6E+12	1.1E+13	
	1.1E+13	1.4E+13	
	2.6E+12	3.8E+12	
	7.1E+12	9.9E+13	
	9.9E+12	2.0E+13	
	8.3E+12	2.0E+13	
	1.1E+12	9.9E+13	
	7.1E+12	5.0E+13	
	7.1E+12	9.9E+13	
	9.0E+12	3.3E+13	
Geometric mean:	**7.3E+12**	**2.3E+13**	

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Electrical Reliability Data

Passes Bellcore EM Test

Test #: 0824-2b Date9/9/2008 T/H/B:35/85/-48

Tested by: K. Tellefsen Reported by:K.

TellP/F limit:1E11 Ohms

MATERIAL TESTED/ CONDITION	SIR (1 day)	SIR (4 days)	COMMENTS
CVP-520 SnBiAg	1.1E+12	1.1E+12	Visually OK
Reflowed	1.1E+12	1.1E+12	
Uncleaned	1.3E+12	2.0E+12	
	1.4E+13	9.9E+11	
	7.1E+12	2.5E+12	
	2.5E+12	9.9E+11	
	8.3E+12	1.1E+12	
	1.7E+12	5.0E+12	
	5.0E+12	1.4E+12	
	8.3E+12	5.0E+12	
	8.3E+12	5.1E+10	
	2.5E+11	3.6E+11	
Geometric mean:	**3.0E+12**	**1.1E+12**	
Control boards	**5.0E+13**	**5.0E+12**	
	7.6E+12	1.1E+13	
	7.6E+12	1.1E+13	
	1.1E+13	1.4E+13	
	2.6E+12	3.8E+12	
	7.1E+12	9.9E+13	
	9.9E+12	2.0E+13	
	8.3E+12	2.0E+13	
	1.1E+12	9.9E+13	
	7.1E+12	5.0E+13	
	7.1E+12	9.9E+13	
	9.0E+12	3.3E+13	
Geometric mean:	**7.3E+12**	**2.3E+13**	

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Reliability

Electrical Reliability Data

Passes JIS ECM Test

1.0E+12
1.0E+11
1.0E+10
1.0E+09
1.0E+08
1.0E+07
1.0E+06

SIR (ohm)

0 200 400 600 800 1000

Time

Equipment : Espec Ion migration tester

Bias Voltage : 48VDC

Conditions : 85ºC/85%RH

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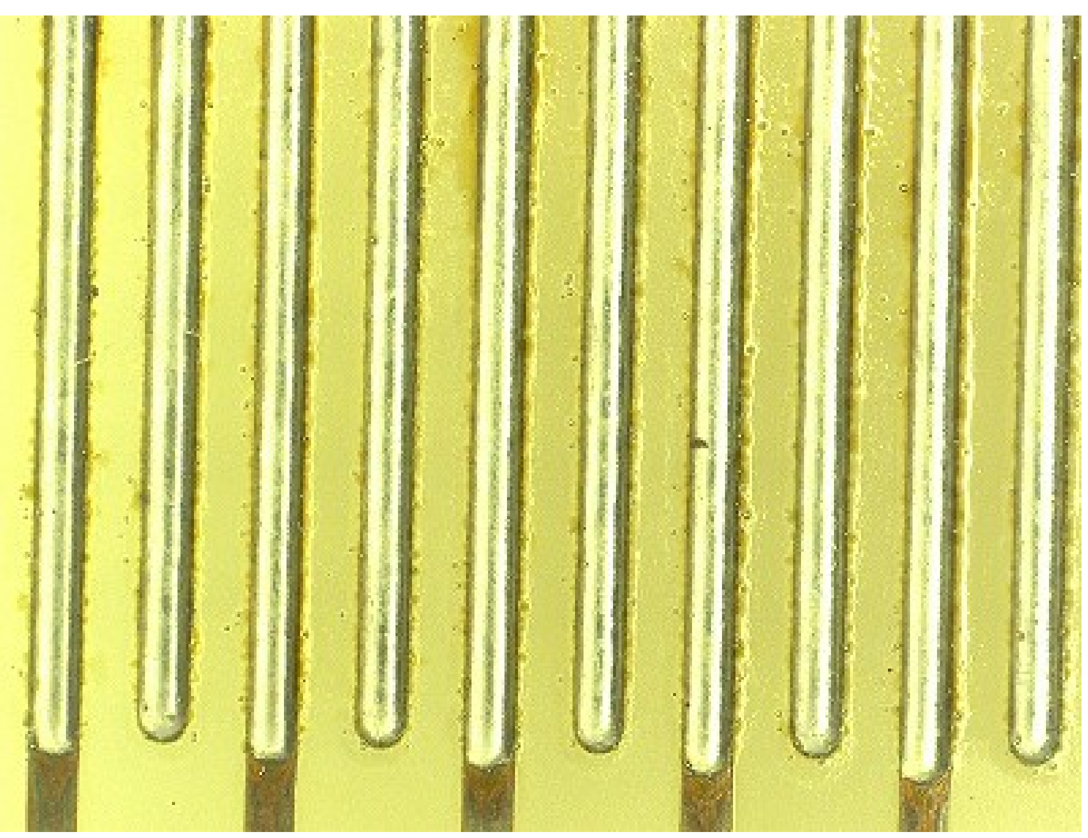
Electrical Reliability Data

Reliability

Passes JIS ECM Test



No Dendritic Growth after 1,000 hours at 85°C/85% RH,

Equipment : Espec Ion migration tester

Bias Voltage : 48VDC

Conditions : 85ºC/85%RH

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Enabling Technology for Low Peak Temperature Reflow Applications

Potential to Eliminate Wave Soldering in Multiple Reflow Assemblies

Proven Mechanical and Electrical Reliability

Reduced Energy Consumption vs. Typical SAC Alloys

Cookson Electronics Global Manufacturing and World Class Technical Support

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CVP-520 solder paste

Summary

Leading Products:

No Clean, SnPb

- •ALPHA OM-5100
- •ALPHA OM-5300

No Clean, Lead-free

- • ALPHA OM-338 T
- •ALPHA OM-338 PT
- • ALPHA OM-340
- •ALPHA OM-350
- •ALPHA CVP-520
- •ALPHA CVP-360

Water Soluble, SnPb

- • ALPHA WS-809

Water Soluble, Lead-free

- • ALPHA WS-819
- • ALPHA WS-820

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