Formulation of a New Liquid Flux for High Temperature Soldering

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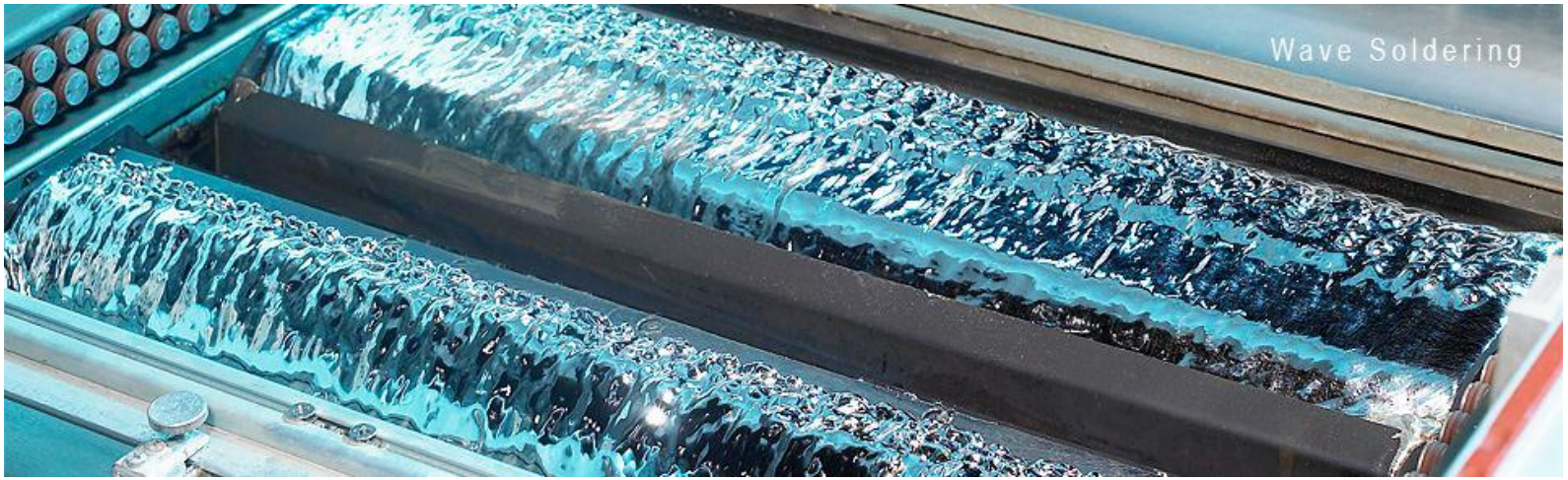
Outline/Agenda

- Introduction
- Experimental Methods
- Results of Experiments
- Conclusions
- Acknowledgements
- Q & A

Introduction

Wave soldering is alive and well!



Wave Soldering

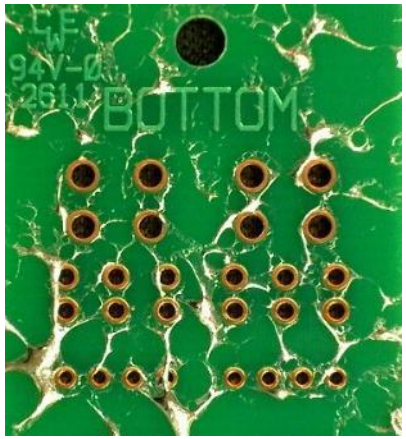
- Provides quick soldering of multiple holes
- Large thermal capacity lends itself to challenging assemblies
- Ideal for high volume production

Wave Soldering (after)

The Role of Flux

- **Aids in solder wetting**
- **Removes oxides**
- **Can provide thermal protection for the circuit board**

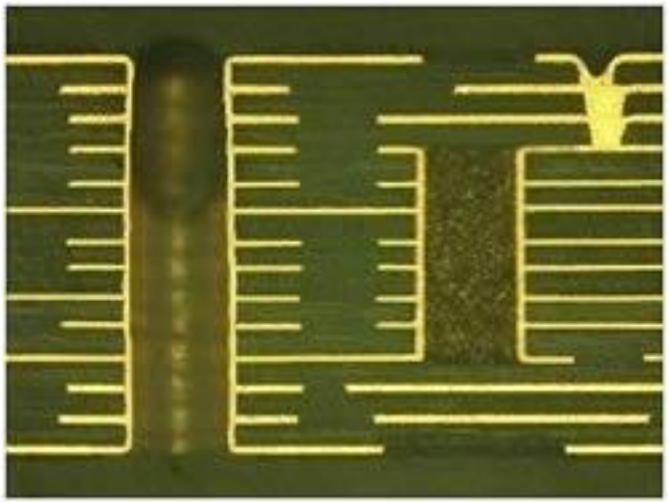
No Flux



Flux

Why Formulate a New Flux?

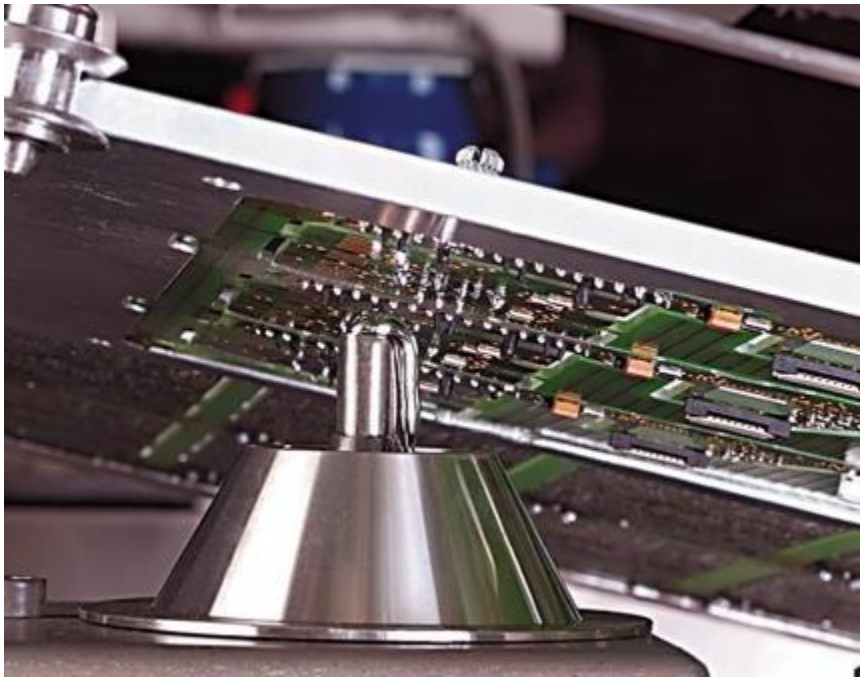
- Fluxes were formulated for tin-lead temps
- Need fluxes for high temps and long contact times
- Selective soldering uses much higher temps than wave



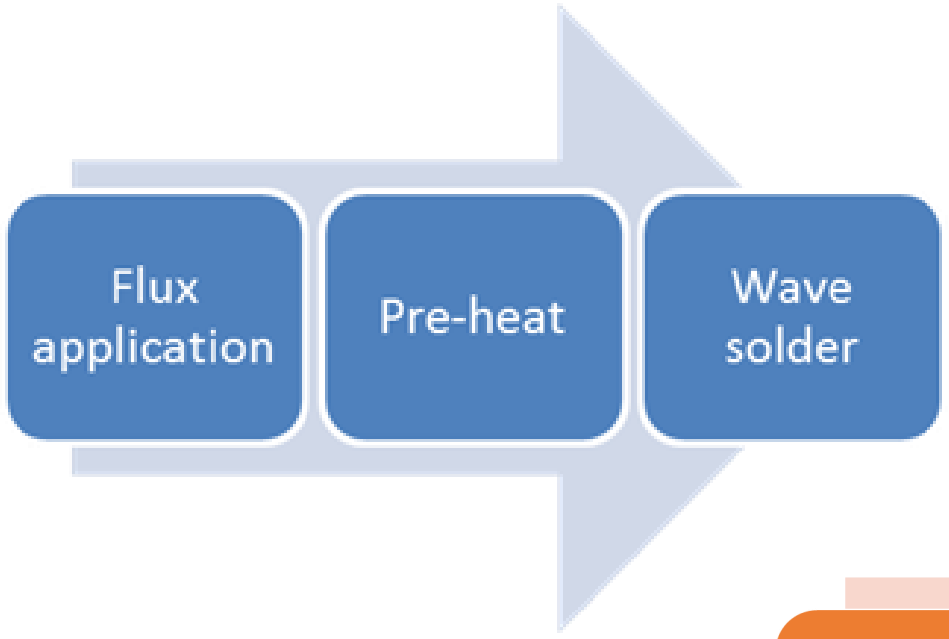
Attributes of Water Soluble Flux

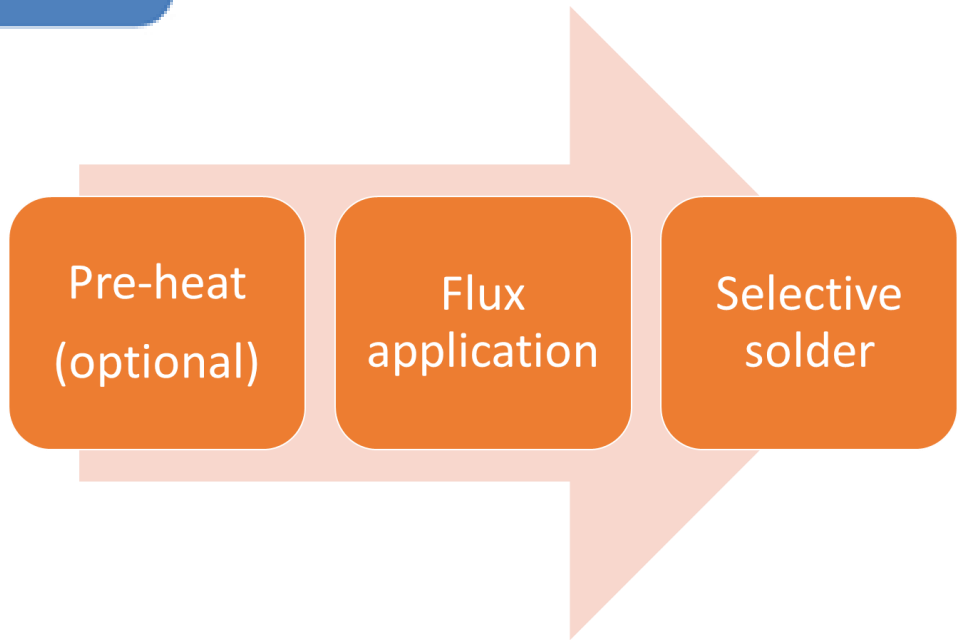
- Works with high temperatures:
  - Wave 290 °C
  - Selective 315 °C
- Optimal hole fill & minimal bridging
- Halide & halogen free
- Neutral pH
- Easy to wash and no residues
- Used in wave & selective and with all solder types

Wave vs. Selective Soldering



Wave vs. Selective Soldering





Fluxing Systems

Foaming:

- **Solvent evaporates**
- **Flux concentrates over time**
- **Applied liberally to the board**

Spray and Jet:

- **Minimal solvent loss**
- **Localized application**
- **Small nozzles can clog**

Flux System Requirements

Foaming:

- **Hold stable foam head, but not too much foam**
- **Able to be analyzed for solvent addition**
- **Non-corrosive to other contacted areas**

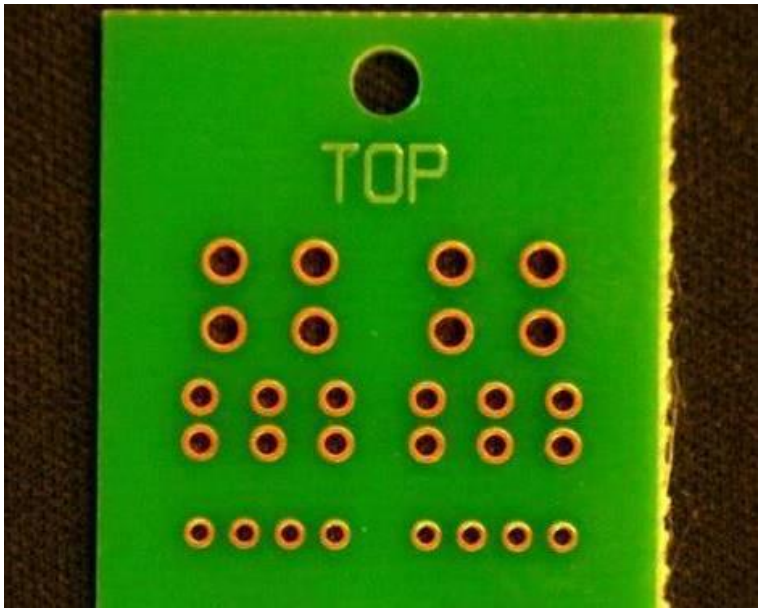
Spray and Jet:

- **Non-clogging**
- **Easy to turn into micro-droplets**
- **Non-corrosive in overspray areas**

Experimental Method

1. Create test fluxes
2. Test in the lab
3. Scale up for beta-site testing
4. Use feedback to refine the formulation
5. Verify performance in the lab and beta-sites
6. Finalize the new flux

Standard Test Board



0.062” (1.57 mm) thick

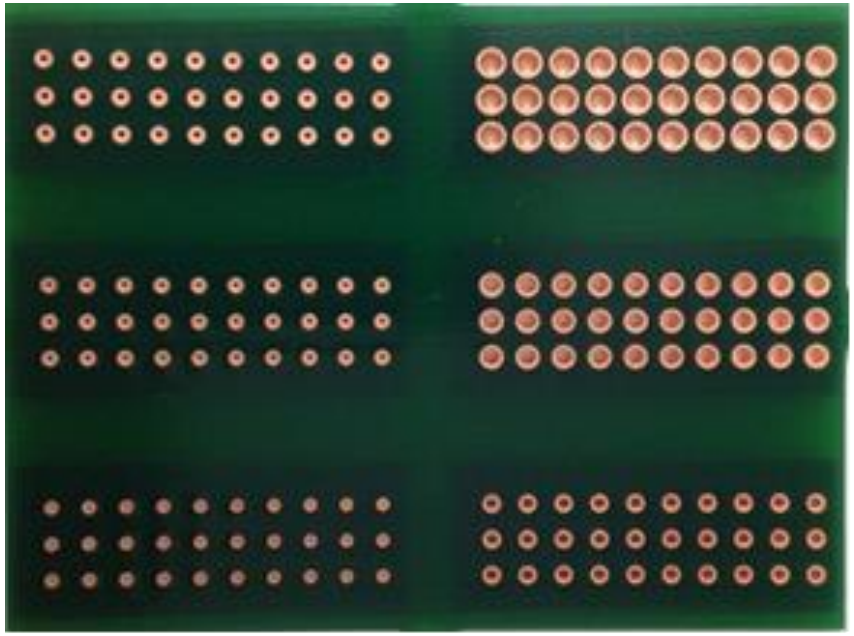
Double sided

0.5 ounce copper weights

Hole sizes - finished:

- 0.055” (1.40 mm)
- 0.039” (0.99 mm)
- 0.032” (0.81 mm)

Thermally Demanding Test Board



0.092” (2.34 mm) thick

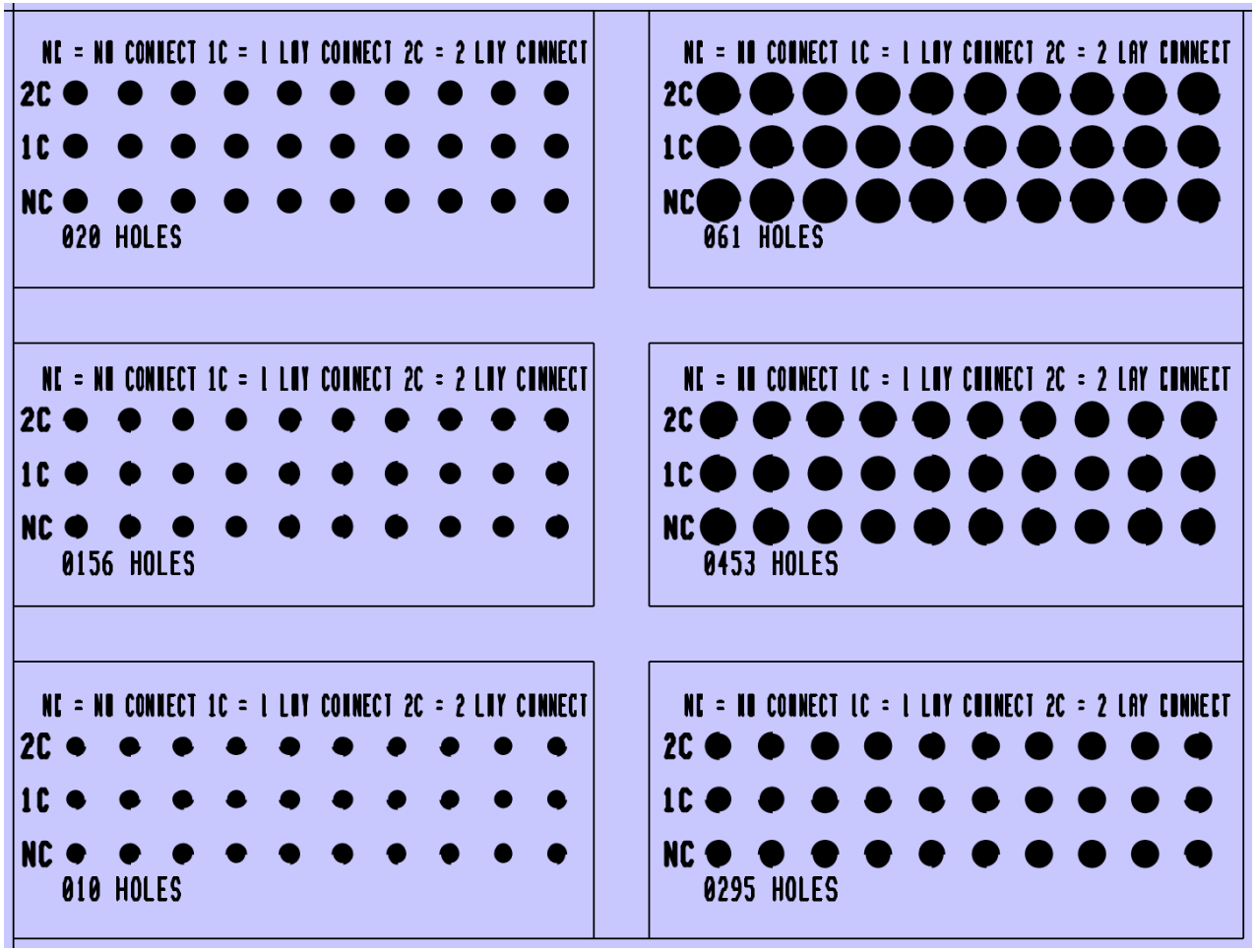
4 layer board

2.0 ounce copper weights

Hole sizes - finished:

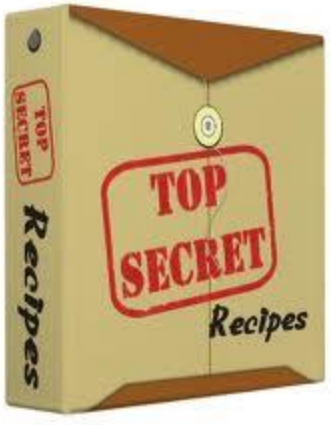
- 0.060” (1.52 mm)
- 0.043” (1.09 mm)
- 0.027” (0.68 mm)
- 0.016” (0.41 mm)
- 0.013” (0.33 mm)
- 0.007” (0.18 mm)

Thermally Demanding Test Board



Flux Ingredients

- Solvents – isopropanol and others
- Activators – organic acids
- pH adjustors – bases
- Wetting agents – surfactants
- Other additives



Flux Properties

Flux	Density (g/cc)	Halogens	Non-volatile content (% wt)
Current	0.87	yes	20
SP 20%	N/A	yes	20
W	0.92	yes	40
X	0.93	yes	40
Y	0.90	yes	37
Z	0.92	yes	38
A	0.91	no	26
B	0.91	no	27
C	0.90	no	27
D	0.88	no	28
E	0.85	no	24
F	0.85	no	26
G	0.85	no	26
I	0.86	no	25

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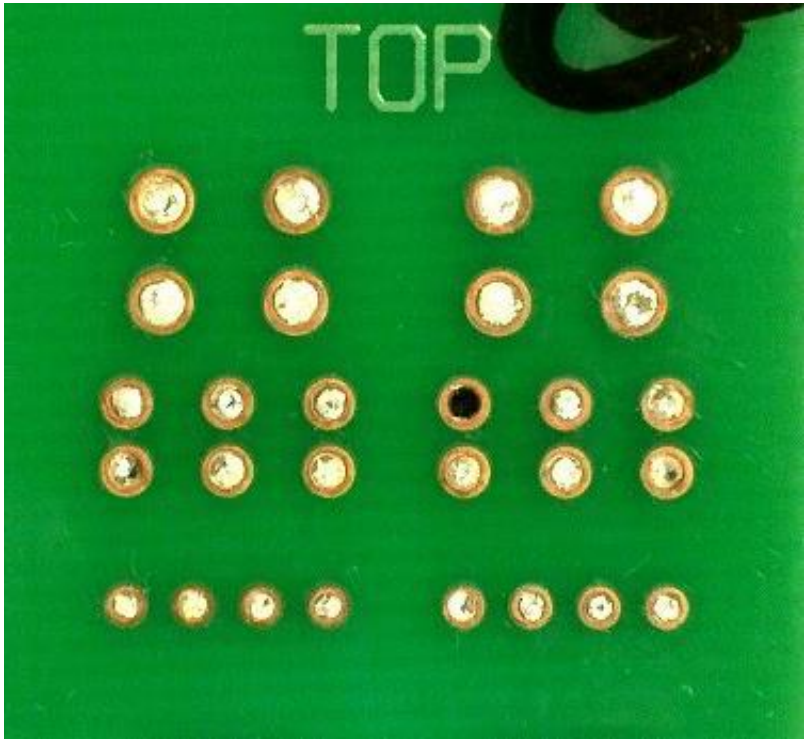
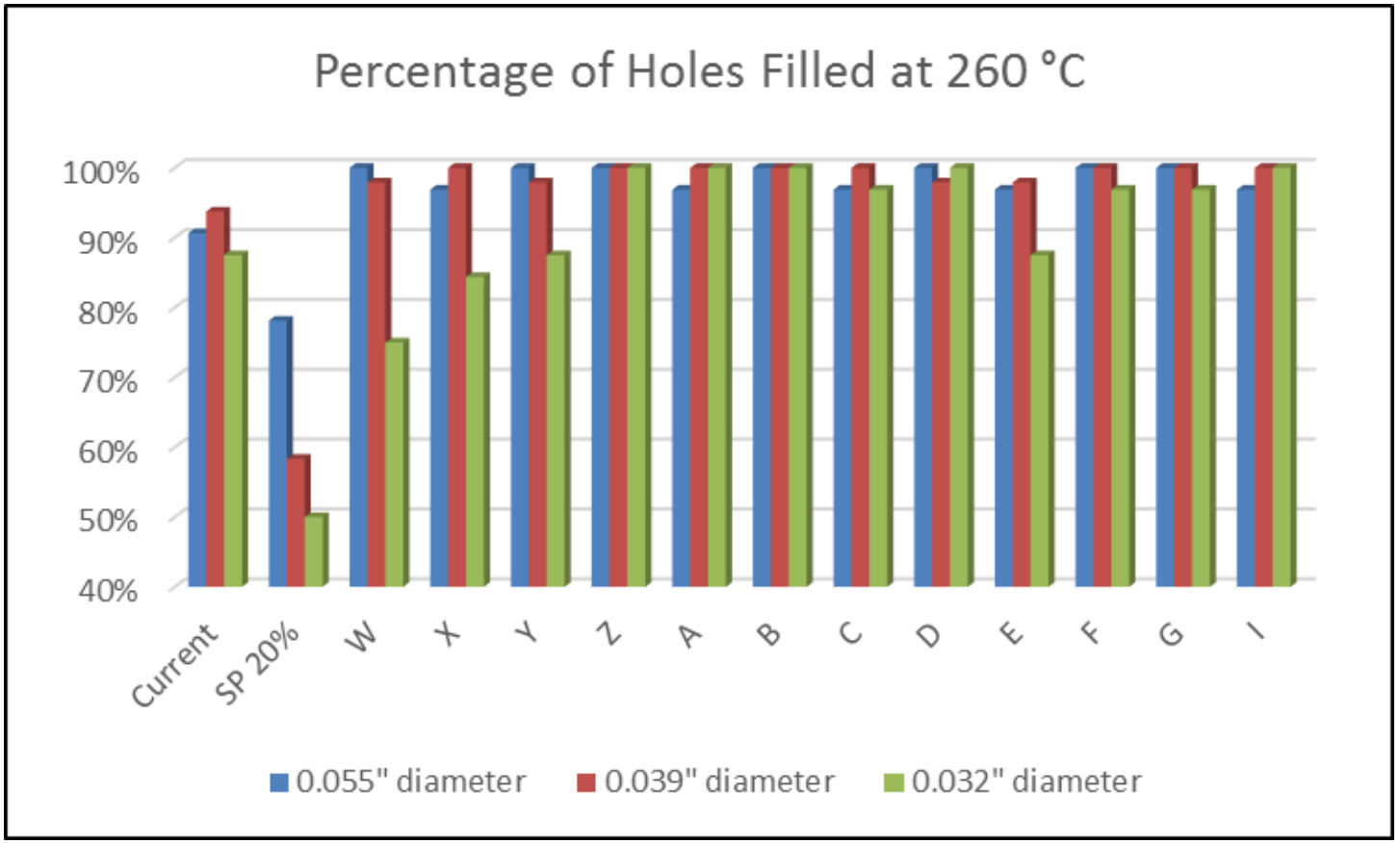


Less than
100% filled

Ideal
100% filled

Standard Test Board



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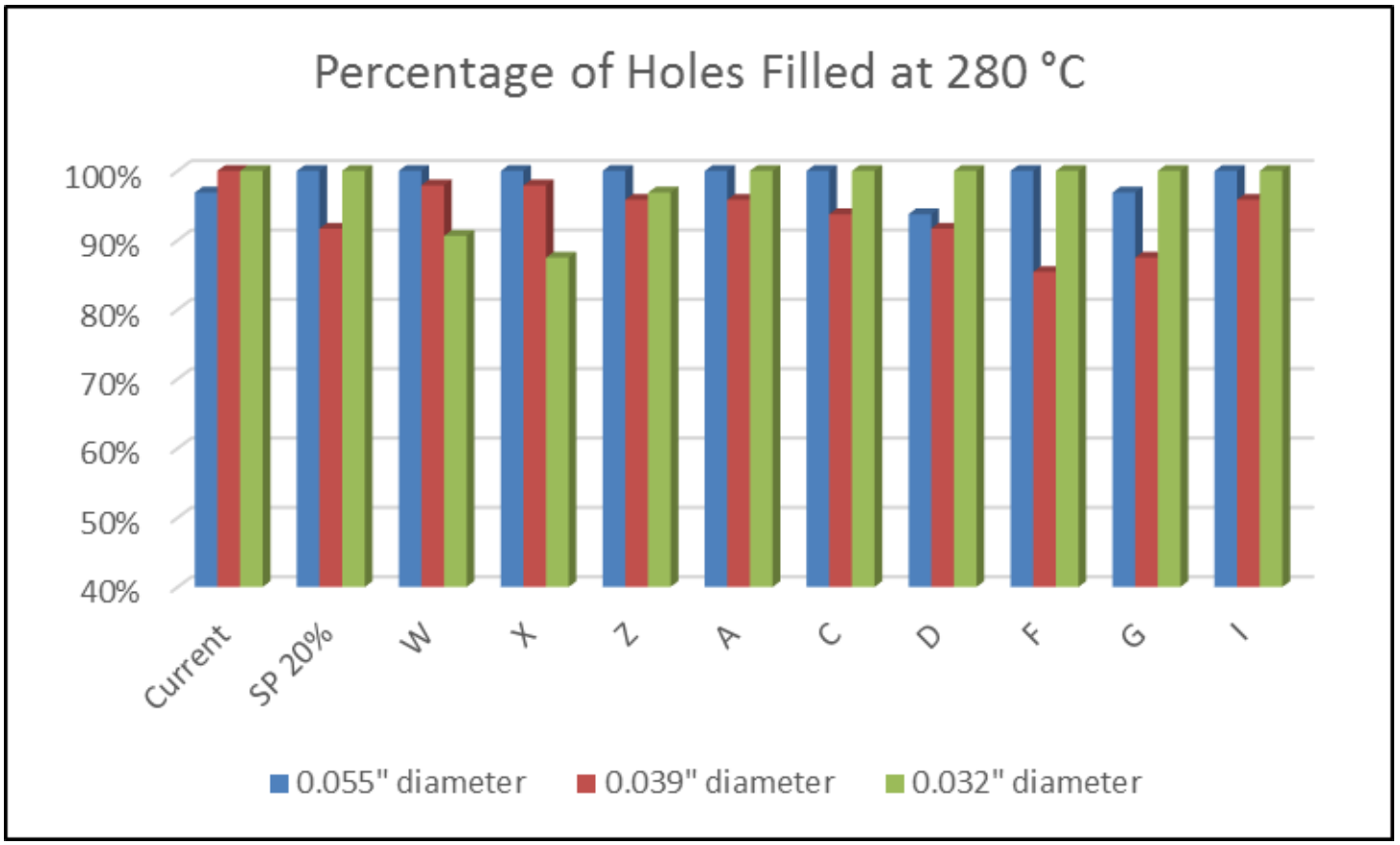

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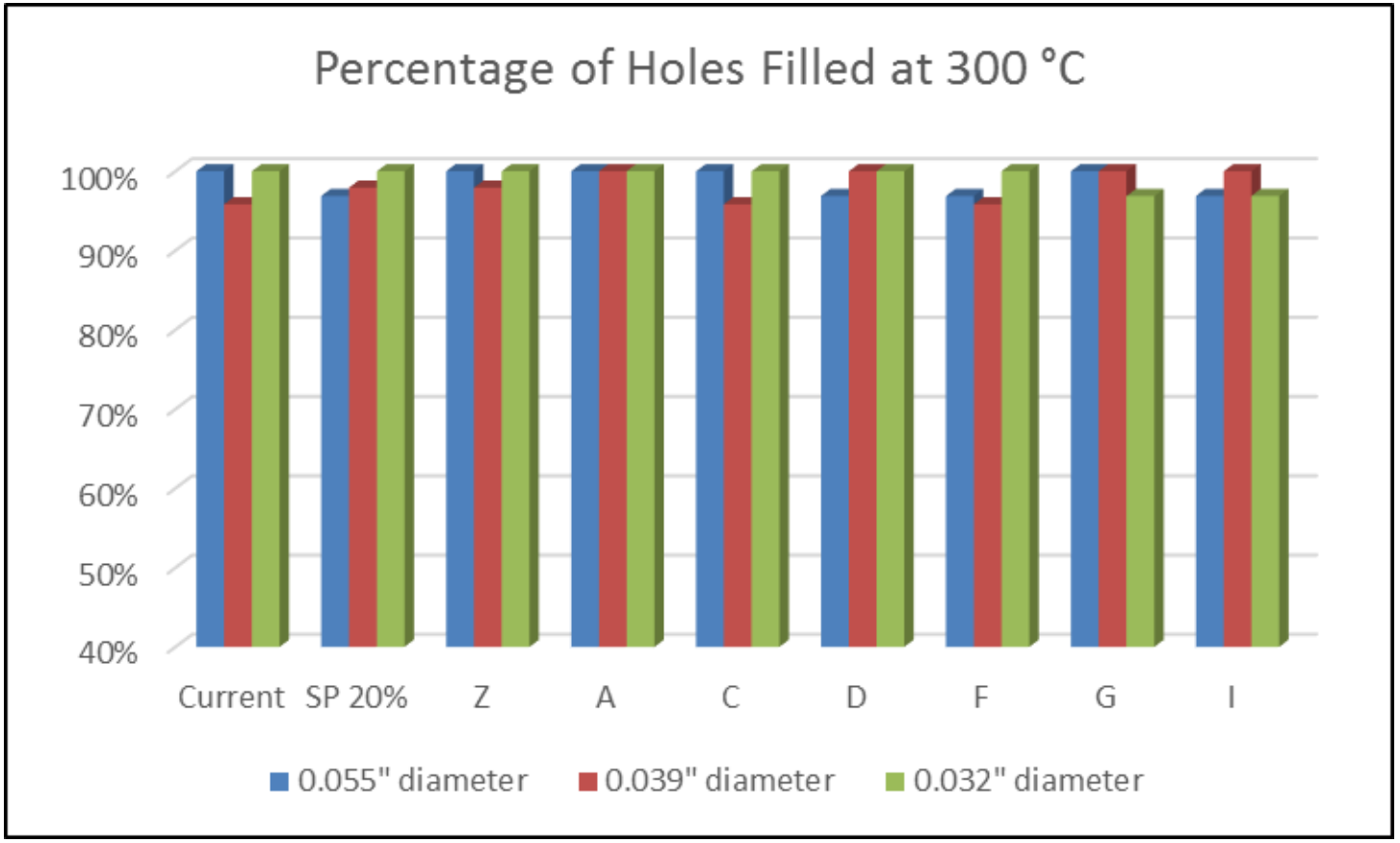

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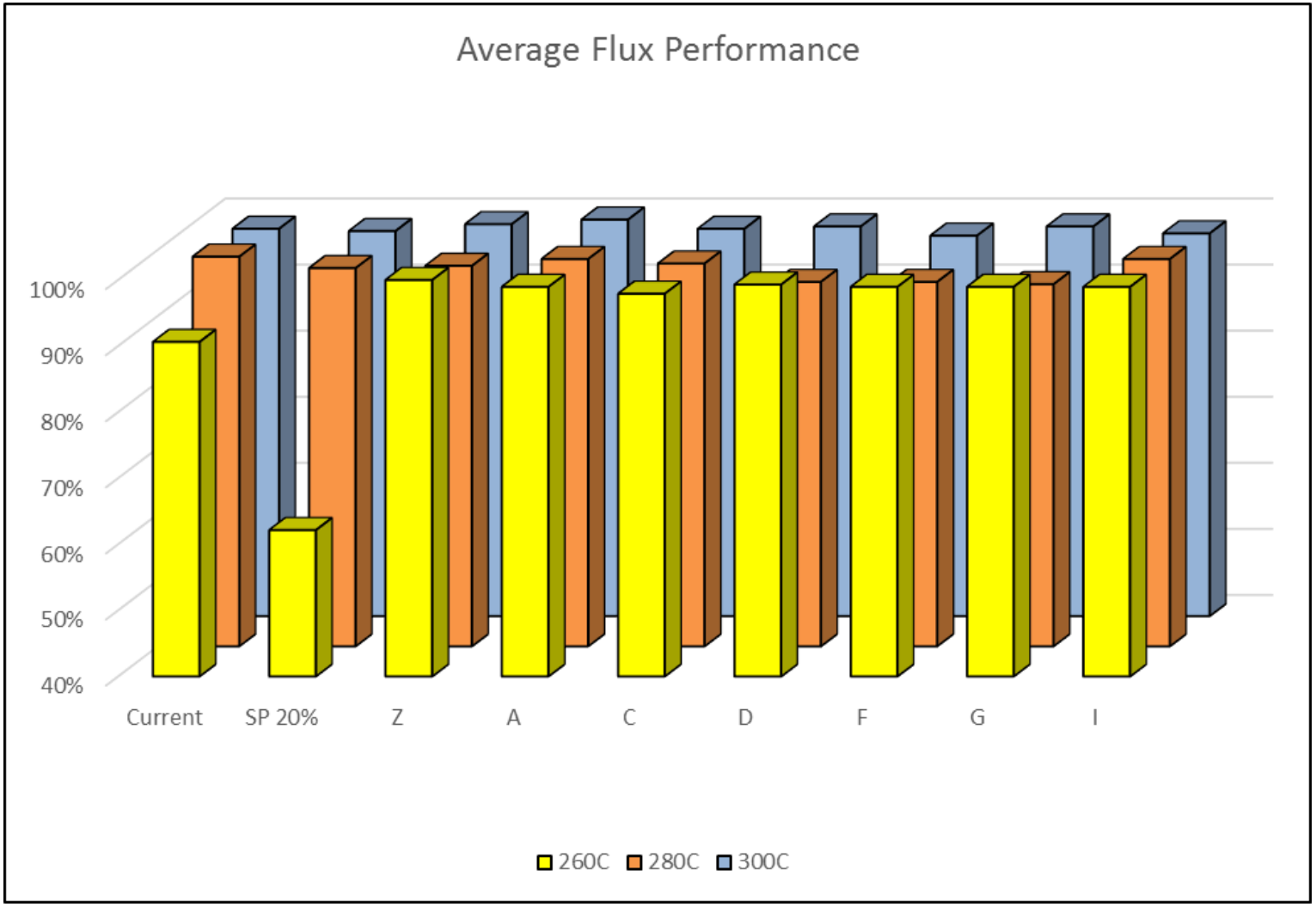
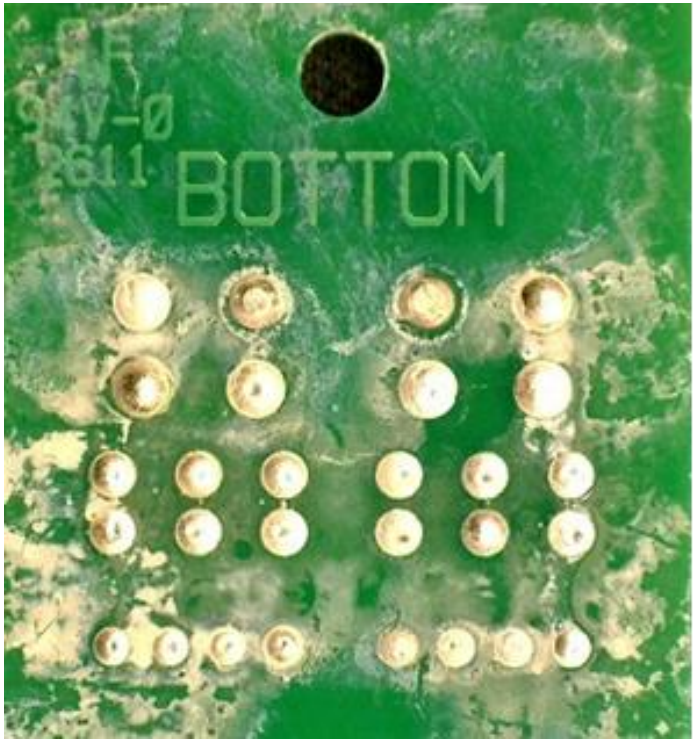
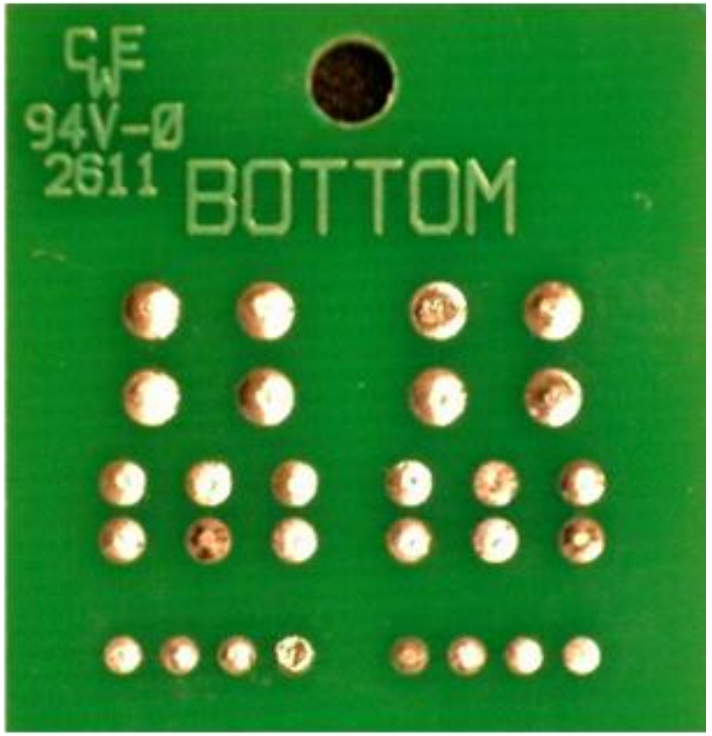


Water Washability



Flux A

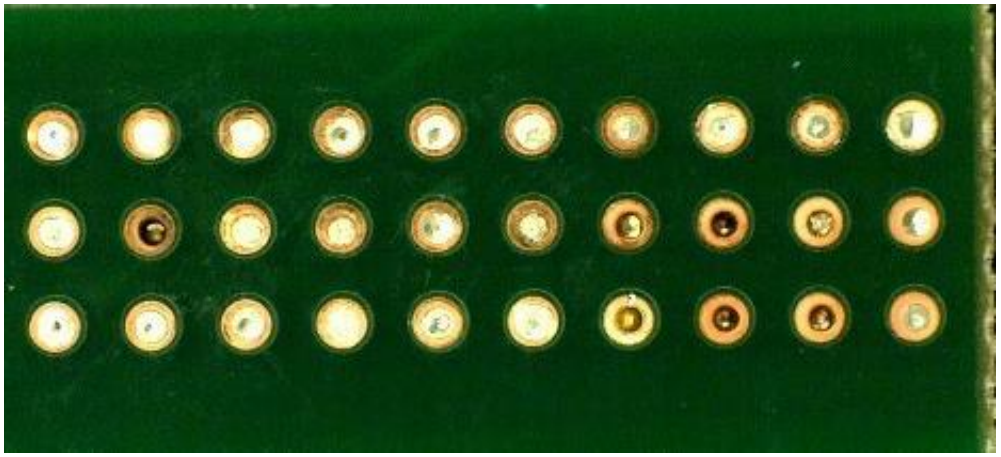


Flux E

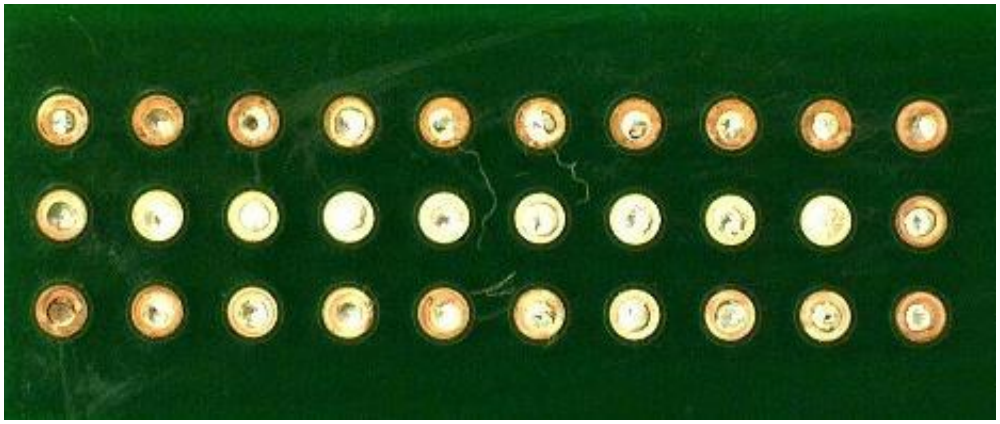
Water Washability

Flux	Water Wash Results
Current	Washed clean. No residues
SP 20%	Washed clean. No residues
W	White haze over surface
X	White haze over surface
Y	White haze over surface
Z	Faint residue on surface, but improved over W, X, and Y
A	Gratuituous white waxy residue, especially around solder joints
B	Waxy residue
C	Waxy residue
D	Waxy residue
E	Washed clean. No residues
F	Washed clean. No residues
G	Washed clean. No residues
I	Washed clean. No residues

Thermally Demanding Test Board

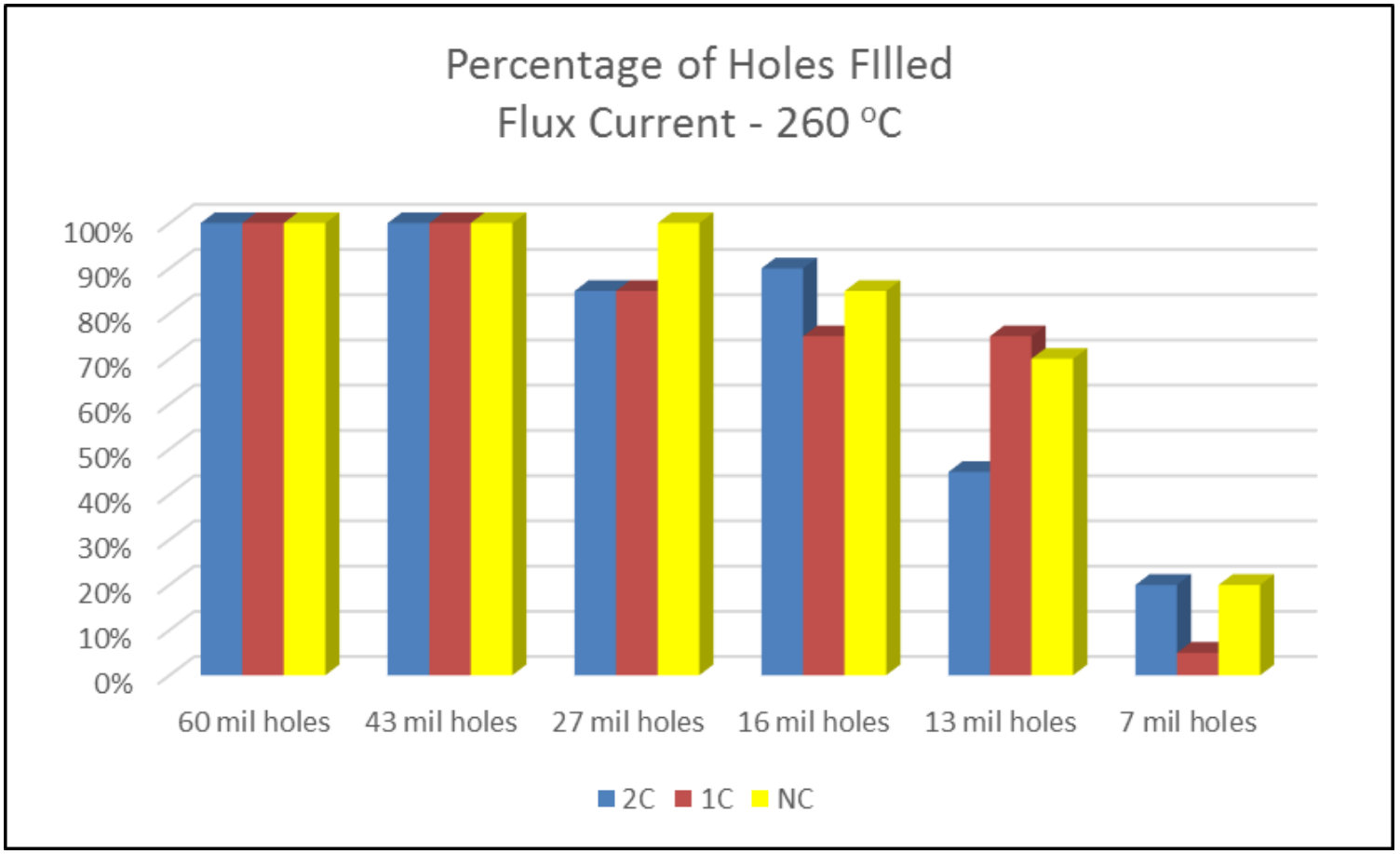


Less than
100% filled



Ideal
100% filled

Thermally Demanding Test Board



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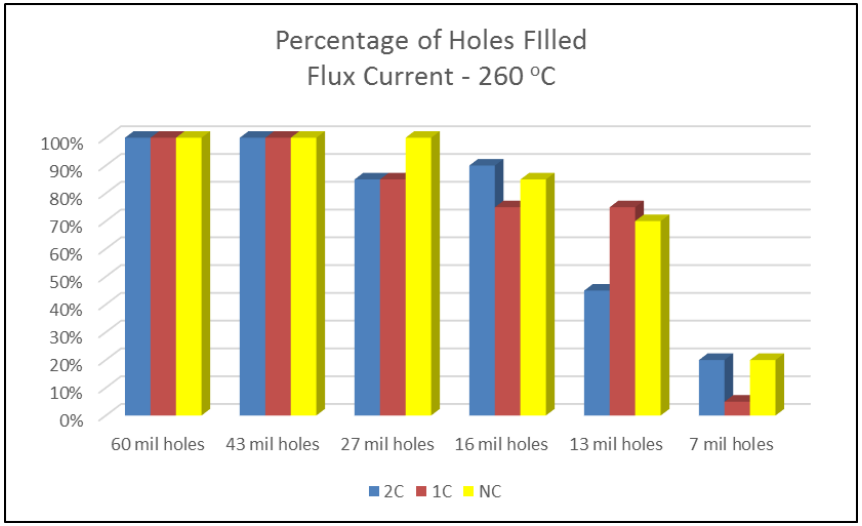

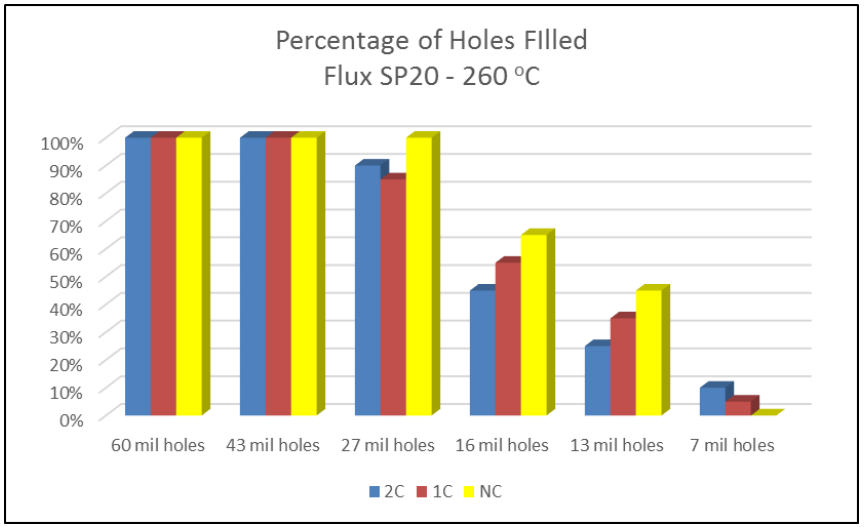

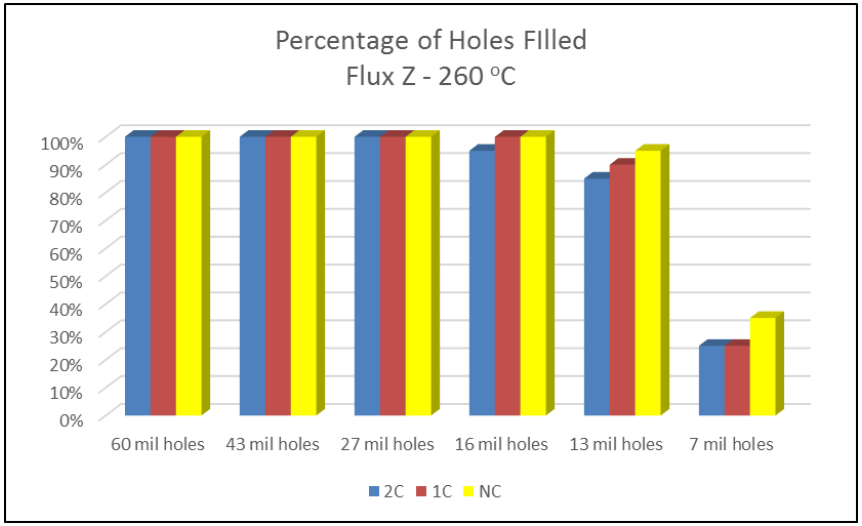

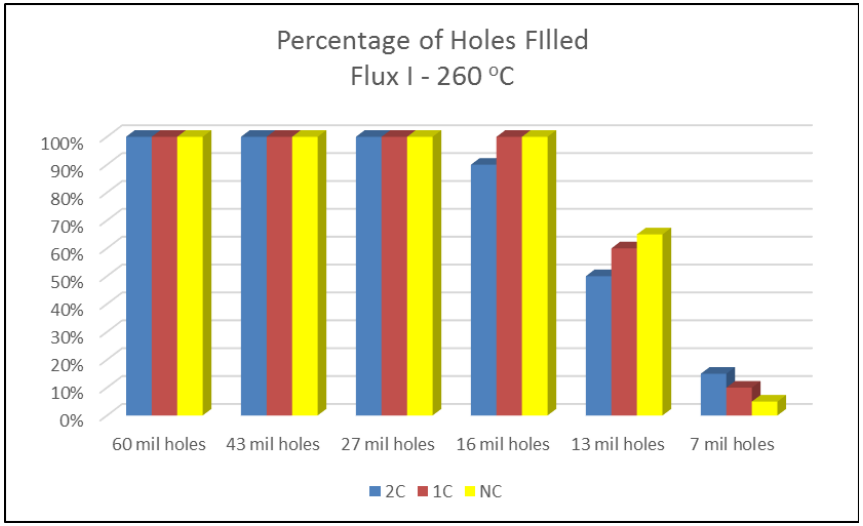

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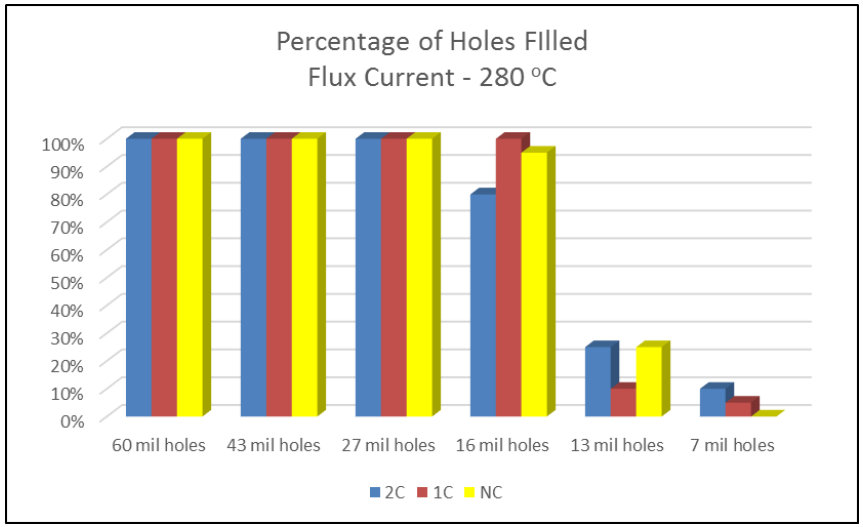

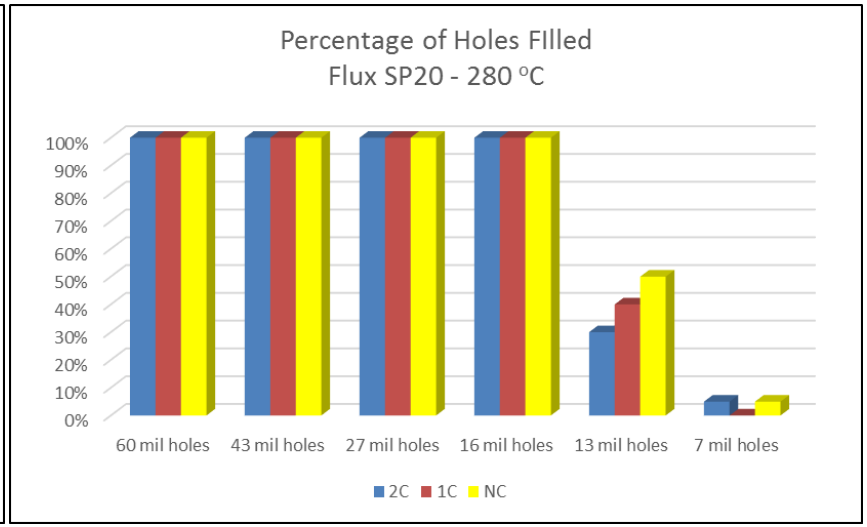

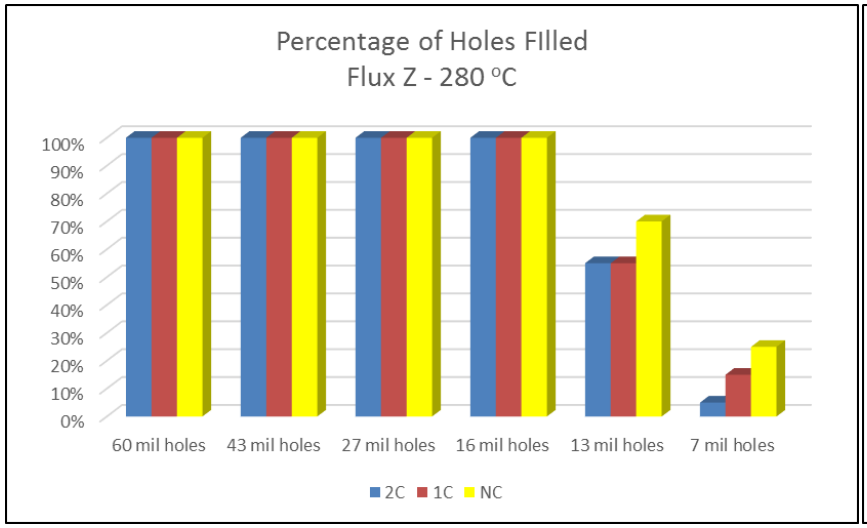

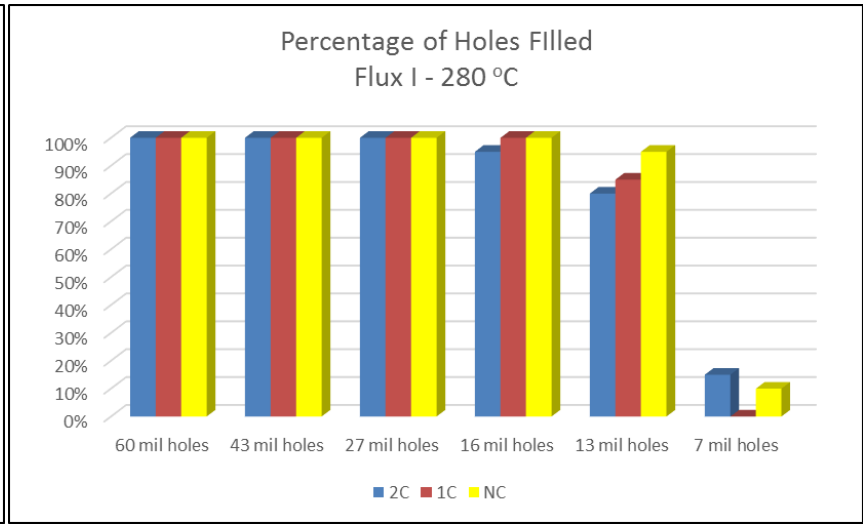

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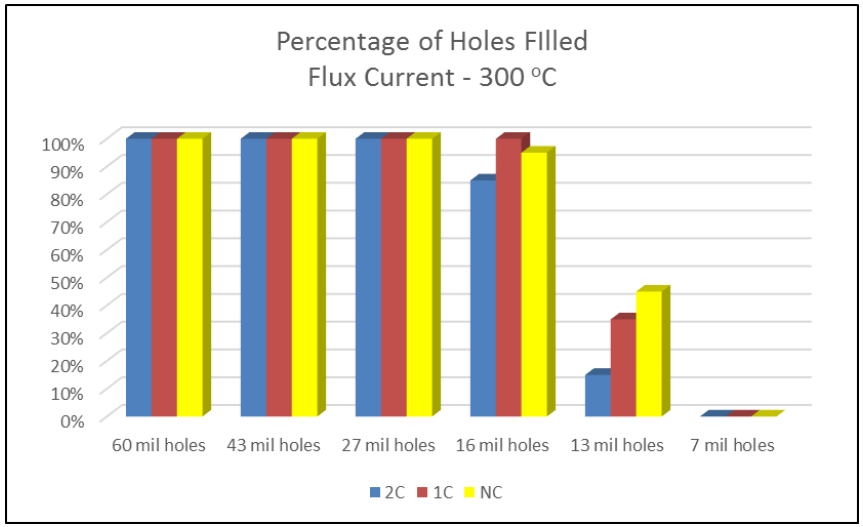

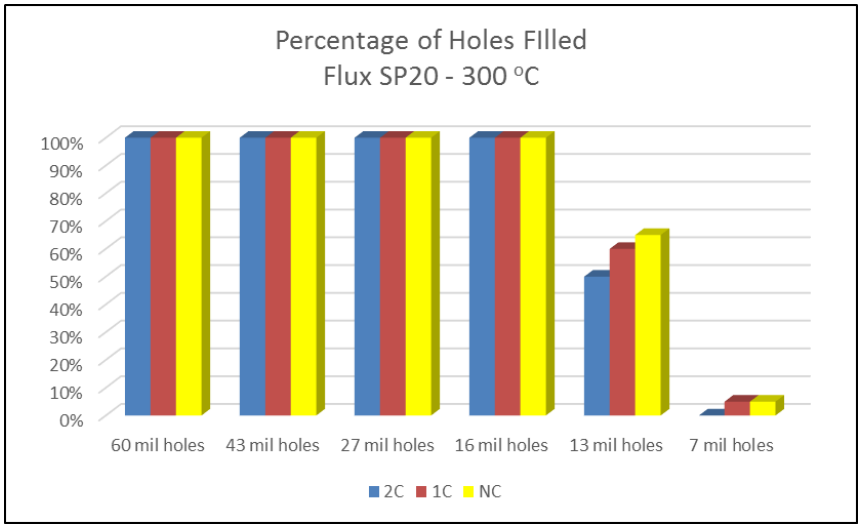

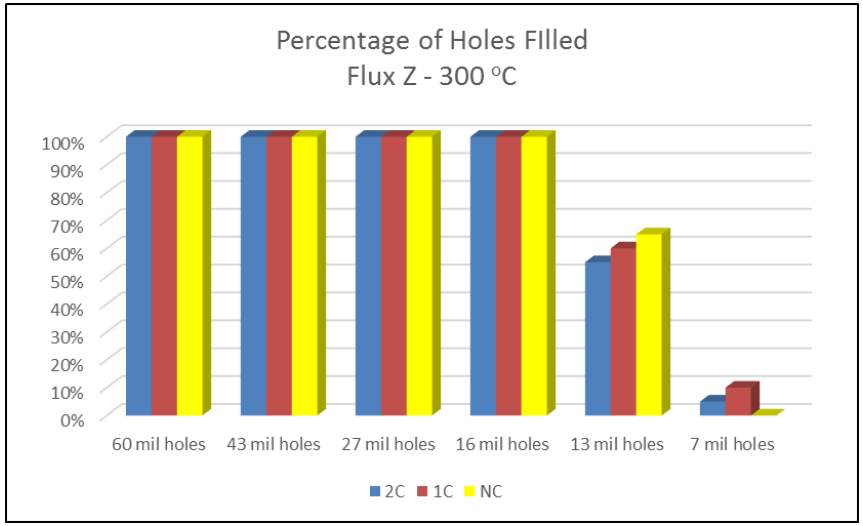

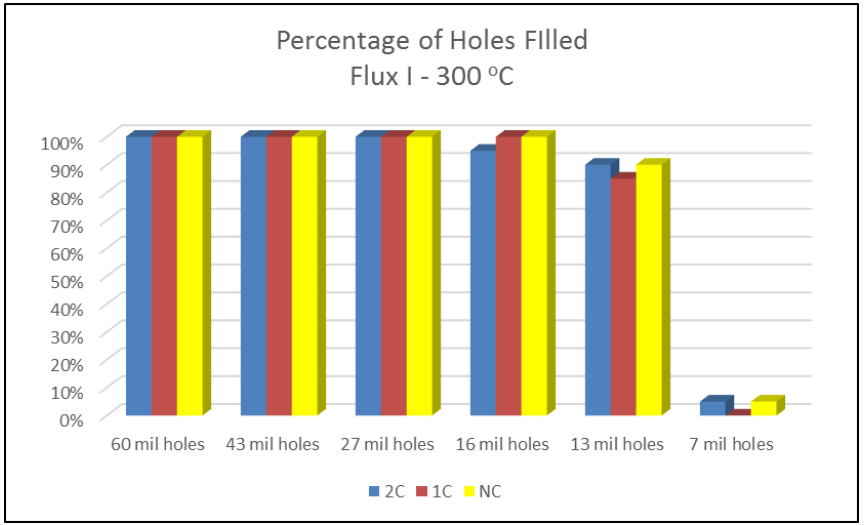

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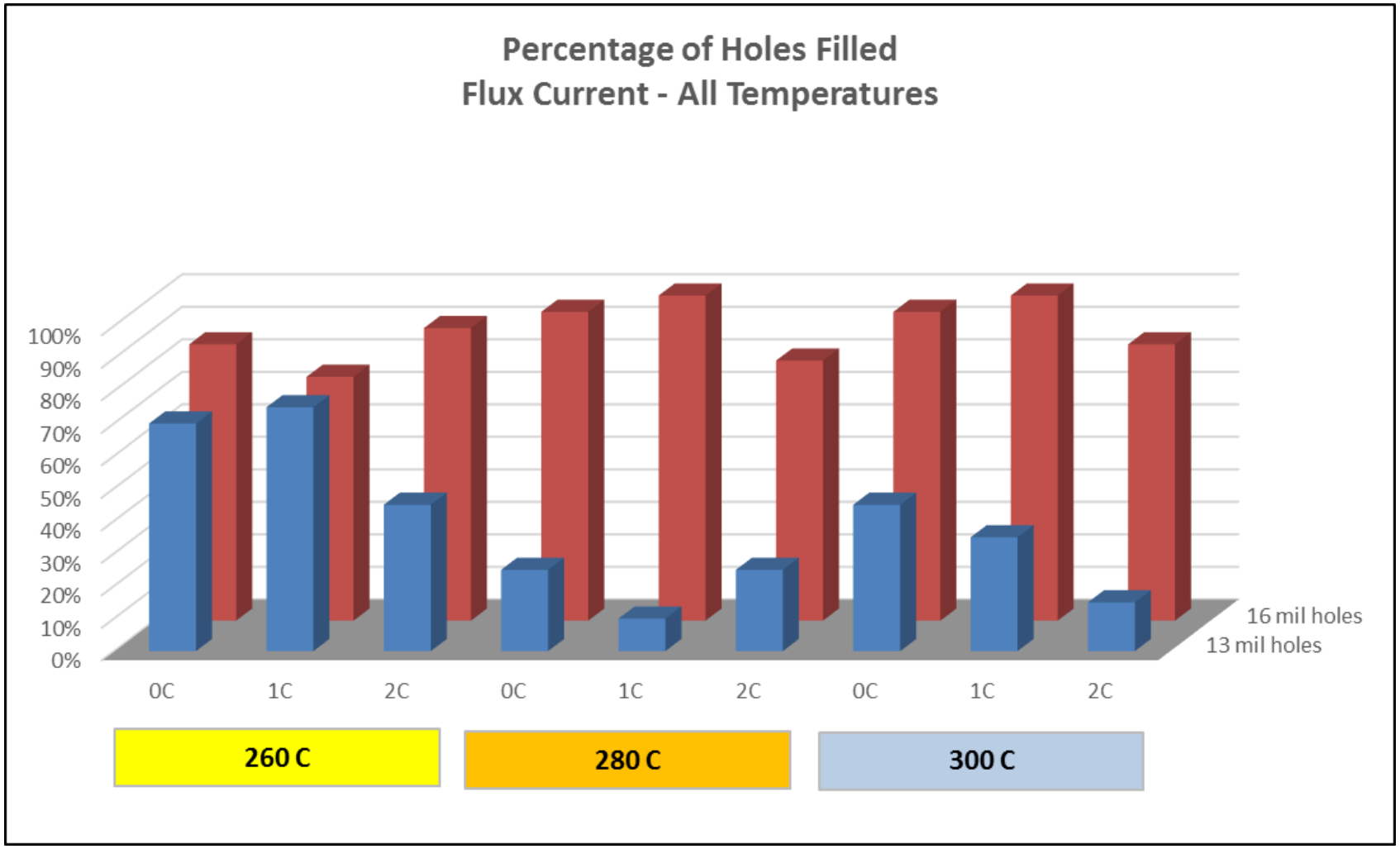
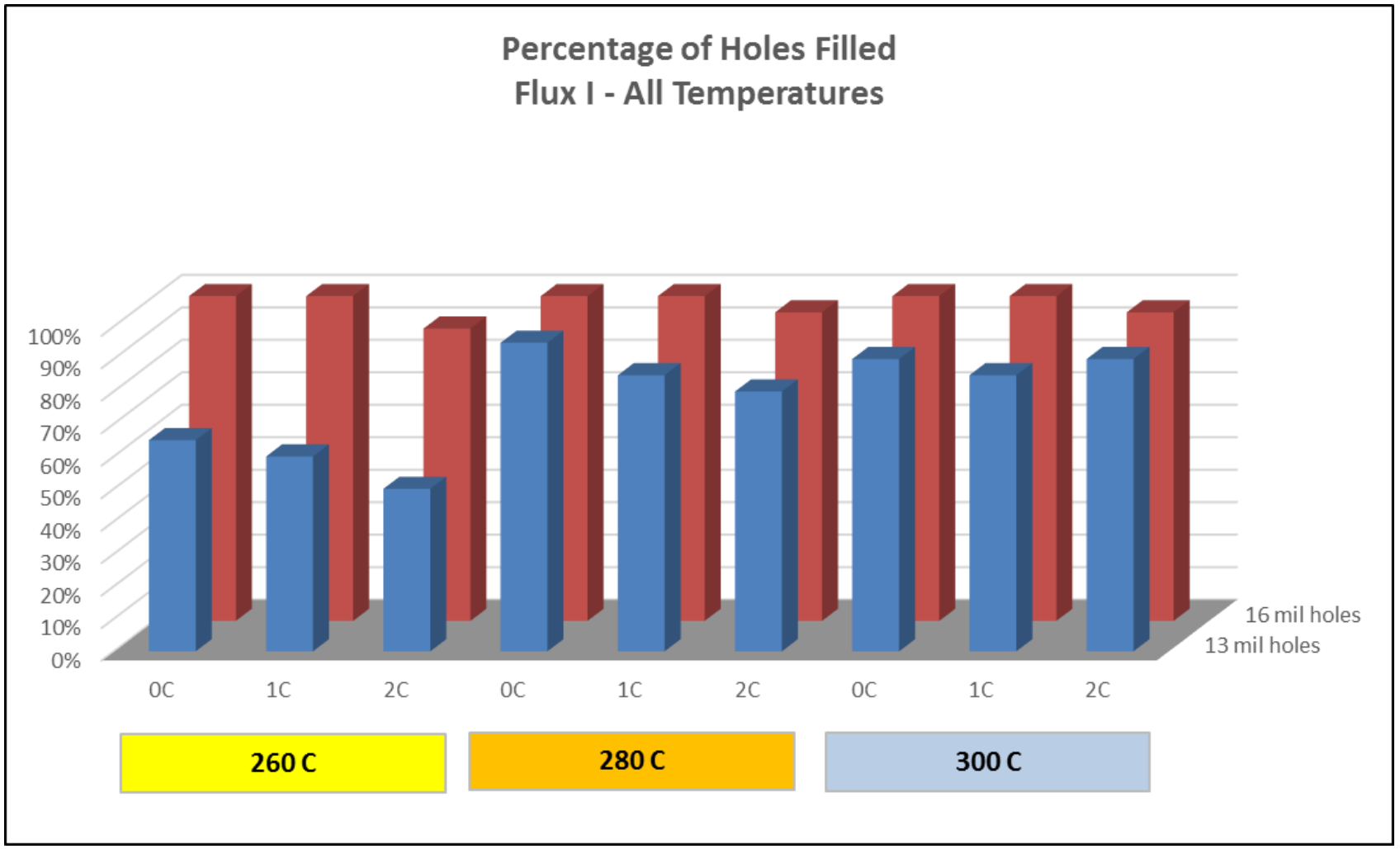


Flux Current

Thermally Demanding Test Board



Flux I

Beta Site Testing

Wave soldering

- **SAC305, SN100C and 63Sn / 37Pb alloys**
- **Excellent soldering results**
- **Good Washability**

Selective soldering

- **SAC305, SN100C and 63Sn / 37Pb alloys**
- **Excellent soldering results**
- **Working well with drop jet systems**

Conclusions

This process created a new flux:

- **Works with high temps & long contact times**
- **Also works with low temps / leaded solder**
- **Halogen and halide free**
- **Easy to wash / leaves no residues**
- **Beta site testing shows good results with wave, selective and multiple alloys**

Acknowledgements

We thank Jay Vyas at SigmaTron International for his continued support and beta site testing.

Much appreciation to Sven Bock of FCT Companies for his help with design and production of our test boards.

Thank You!

Any Questions?

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