

Removing Particulates and soils from Electronics and Aerospace Components

David A. Ferguson

Microcare: Cleaning, Coating and Carrier Fluids



Contamination Removal

TM 3 types of contaminant

¾ Particulates (LOx, LASER, Optics)

¾ organics

¾ Inorganics (No Clean / lead Free)

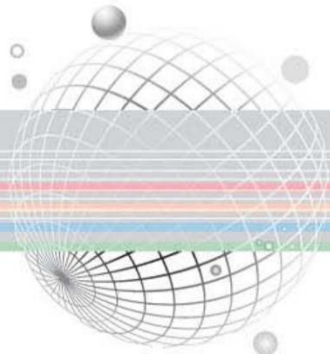
TM What level of cleanliness do you need?

¾ Visual Specification

¾ 2+ micron or particle count spec?

¾ Cleanliness to 1 micron or submicron spec?

TM Bear in mind your production environment when determining your cleanliness spec.



MicroCare[®]



Particulates – Not Easy to Clean

TM Clean Rooms Are Rated From “Class 10,000” To “Class 1”

TM Class 1 Clean Rooms Are*—

- ~1,000 Times Cleaner Than A Hospital Operating Room
- Allow Only One Particulate Per Cubic Foot Air

TM 130 Trillion 0.5μ Particles Fit Inside A Ping Pong Ball

TM Humans Shed About:

- 100,000 Particles When You Blink
- 5 Million Particles When You Walk
- 10s Millions Of Particulate When You Move Vigorously

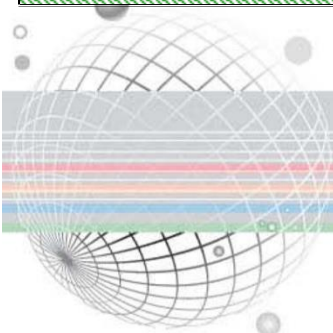
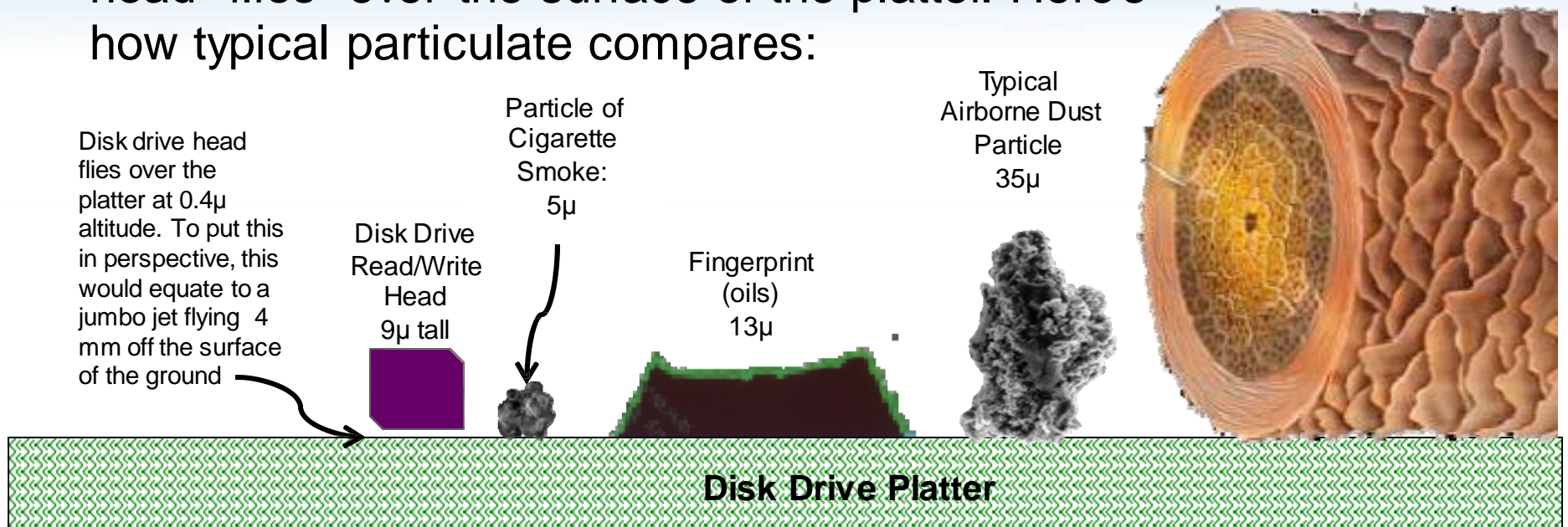


* Source: Rockwell's Dryden Engineering Co.

The Particulate Problem

One of the most challenging cleaning environments is inside a modern disk drive, where the read-write head “flies” over the surface of the platter. Here’s how typical particulate compares:

Typical Human Hair
75 μ -90 μ



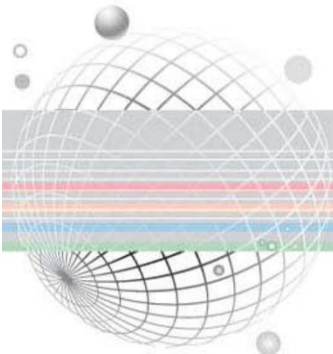
Particulate Size Governs the Difficulty of Removal

500 μ Particulate \Rightarrow 2 Gs to Remove

50 μ Particulate \Rightarrow 200 Gs

5 μ Particulate \Rightarrow 20,000 Gs

.5 μ Particulate \Rightarrow 2,000,000 Gs



MicroCare[®]



Methods of Particulate Removal

Large Particulate
($>1,000\mu$)



Mechanical Action
(Gravitational & Inertial Forces)

Medium Particulate

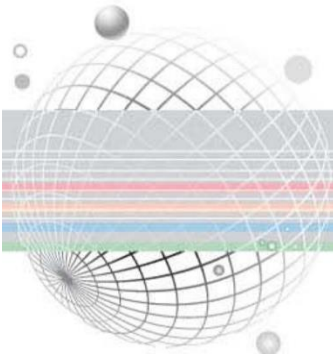


Chemical Action
(Gravitational & Intermolecular Forces)

Small Particulate
($< 0.1\mu$)



Chemical Action
(Molecular Forces Alone)

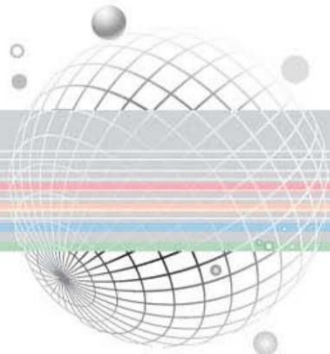


MicroCare[®]



Chemical choices

- TM Aqueous
 - TM Hydrocarbons
 - TM Oxygenated
 - TM Halocarbons (Fluorinated)
- $\frac{3}{4}$ Low Surface Tension
 - $\frac{3}{4}$ Low Viscosity
 - $\frac{3}{4}$ High Molecular density
 - $\frac{3}{4}$ Non-flammable
 - $\frac{3}{4}$ Good toxicity

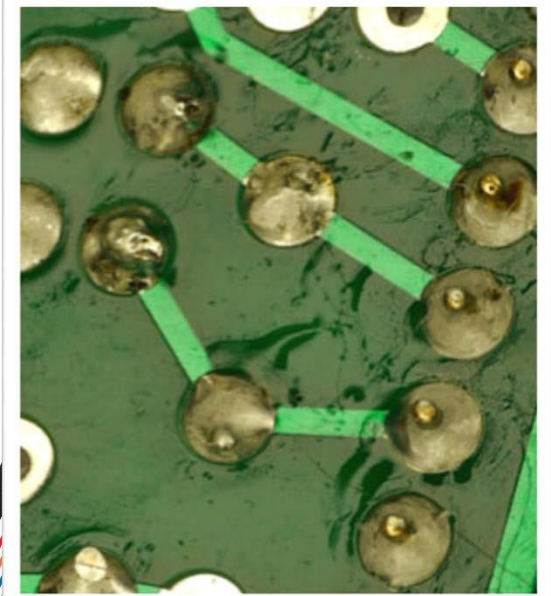
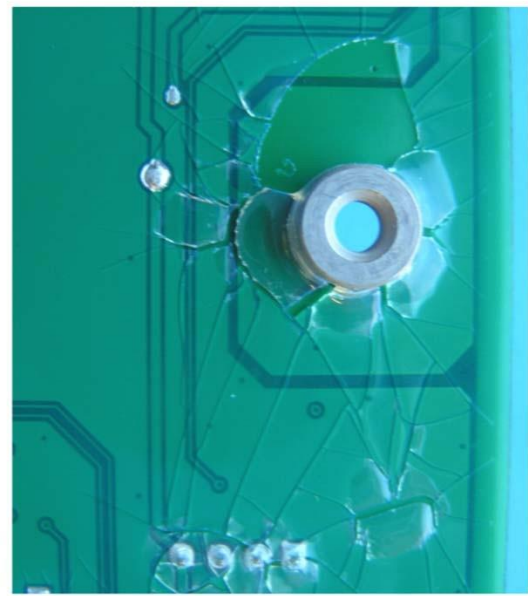


MicroCare[®]



Removing Lead-Free and No-Clean Fluxes from Modern PCBs

- TM The importance of cleaning:
- ¾ Remove harmful residues
 - ¾ Application of conformal coating
 - ¾ Visual appearance



Introduction

™ Manual cleaning methods



© MicroCare Corporation 2017

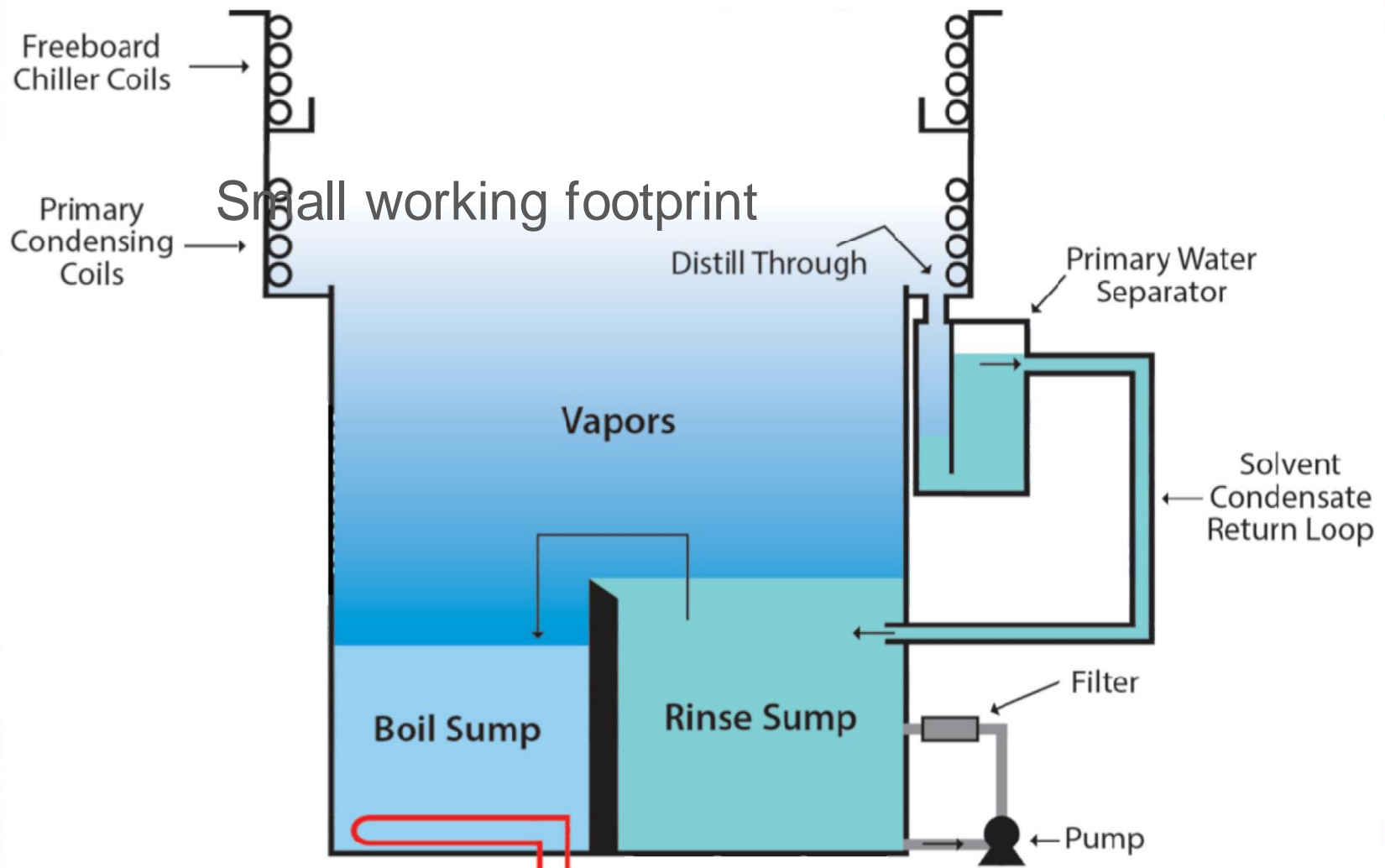
Introduction

™ Bulk cleaning methods



© MicroCare Corporation 2017

Solvent Cleaning / Vapor Degreaser



Cleanliness Specification for Flux Removal

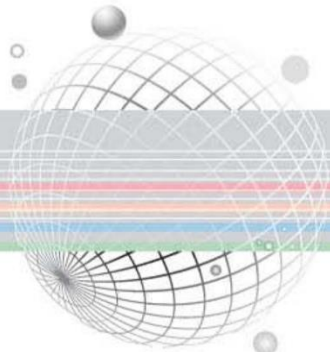
TM Should be written with equipment and chemistry in mind.

$\frac{3}{4}$ Aqueous Cleaning - for mass production of circuit boards.

$\%_{00}$ Many chemistries / equipment suppliers available.

$\%_{00}$ Aqueous chemistry has a lower success threshold at
1 micron stand-offs

$\frac{3}{4}$ Solvent Cleaning can achieve cleanliness down to the Angstrom level

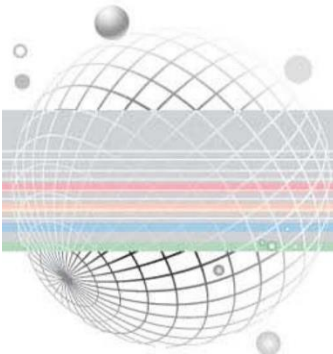


MicroCare[®]



Study on new solvent cleaners

- TM Evaluate 3 different no-clean flux formulations
- TM Evaluate 7 different no-clean, lead-free or high-temperature solder paste formulations
- TM Compare cleaning capability of new vapor degreasing formulations with classic vapor degreasing solvents
- TM Confirm cleaning will improve and not compromise product performance



MicroCare[®]

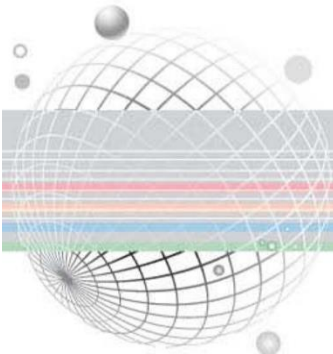
© MicroCare Corporation 2017

Evaluated Fluxes and Solder Pastes

Paste/Flux	Type	No-Clean	Lead-Free
AIM 217	Flux	✓	NA
AIM NC Paste Flux	Flux	✓	NA
AIM Flux Pen	Flux	✓	NA
AIM M8	Solder Paste	✓	✓
AIM RMA258-15R	Rosin-based Solder Paste	X	X
Loctite GC3W	Water-Soluble Solder Paste	✓	✓
Alpha OM350	Solder Paste	✓	✓
Indium 8.9HF1	Solder Paste	✓	✓
Loctite GC10	Solder Paste	✓	✓
Indium SMQ92-J	Solder Paste	✓	X

Visual Cleaning Evaluation

- TM Confirm similar cleaning process to typical vapor degreasing solvents
- TM Confirm improved removal of “white residues”
- TM Confirm improved removal of no-clean and high-temperature fluxes



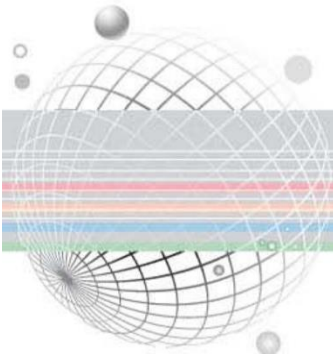
MicroCare[®]



© MicroCare Corporation 2017

Visual Cleaning Evaluation

- TM Clean standard test boards containing flux and solder pastes with Solvent A, Solvent B and a “Classic Solvent”
- TM Conduct visual analysis of the cleaning results at 35x magnification
- TM Photograph results for a visual comparison of cleaning capability



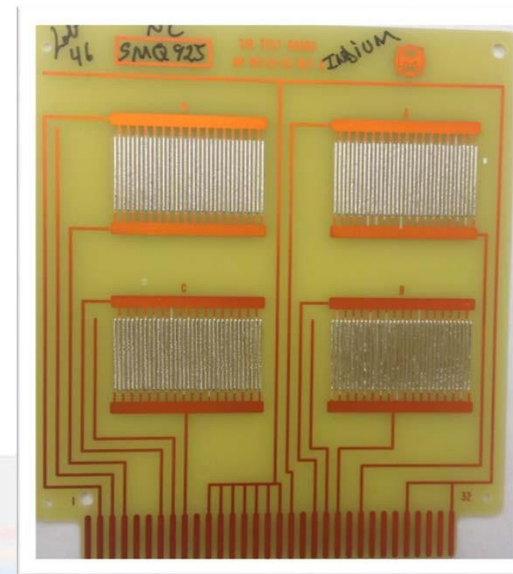
MicroCare[®]



© MicroCare Corporation 2017

Visual Cleaning Evaluation

- TM B-36 coupons reflowed with each paste
- TM 6 coupons for each paste
- TM 2 coupons cleaned in each solvent



Visual Cleaning Evaluation

TM Cleaning Cycle:

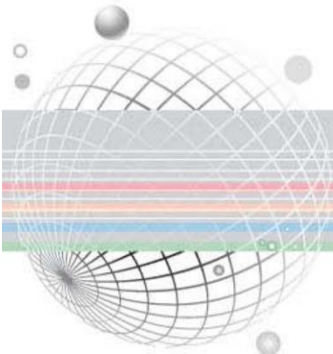
$\frac{3}{4}$ 30 seconds vapor

$\frac{3}{4}$ 5 minute boiling immersion

$\frac{3}{4}$ 5 minute rinse immersion

$\frac{3}{4}$ 30 seconds vapor

TM Total cleaning time of 11 minutes



MicroCare[®]



© MicroCare Corporation 2017

Visual Results- Alpha OM340

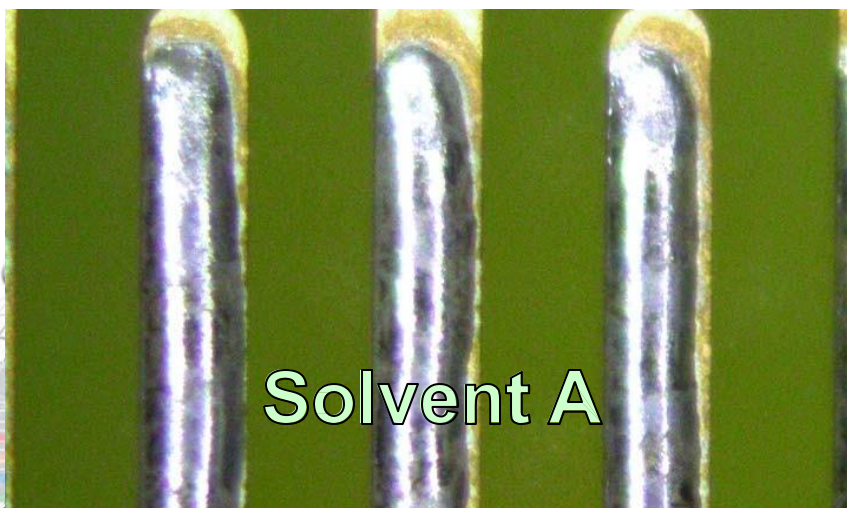
Before Cleaning



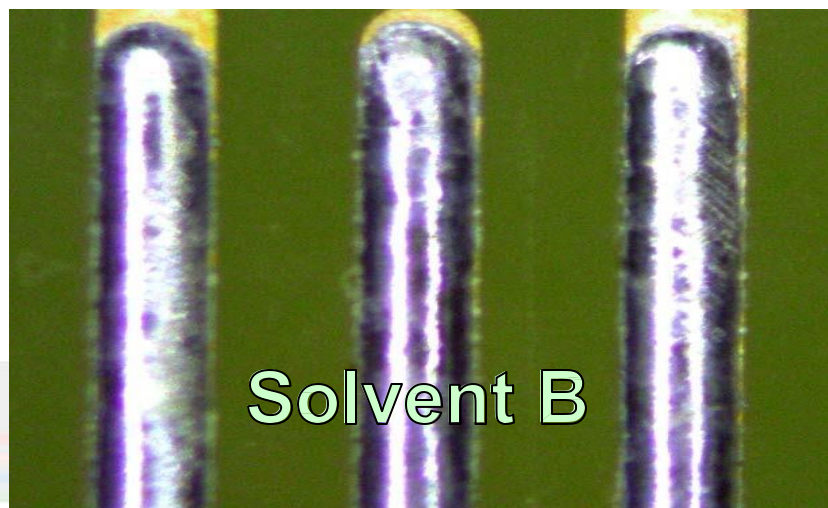
Classic Solvent



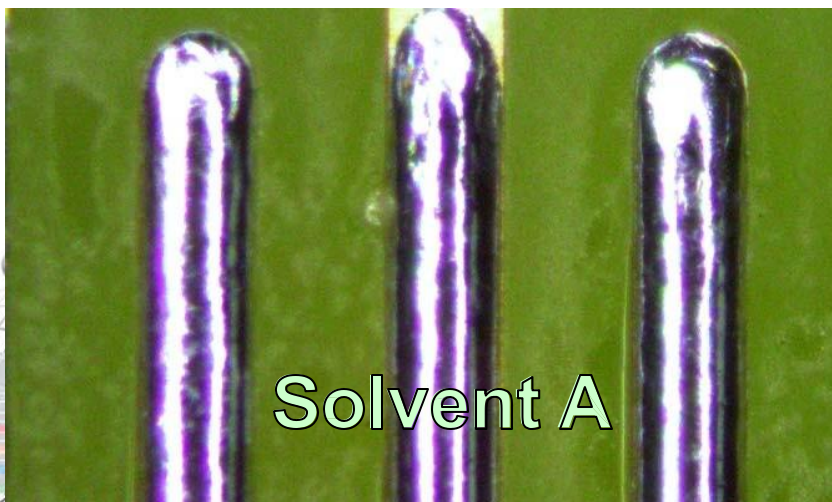
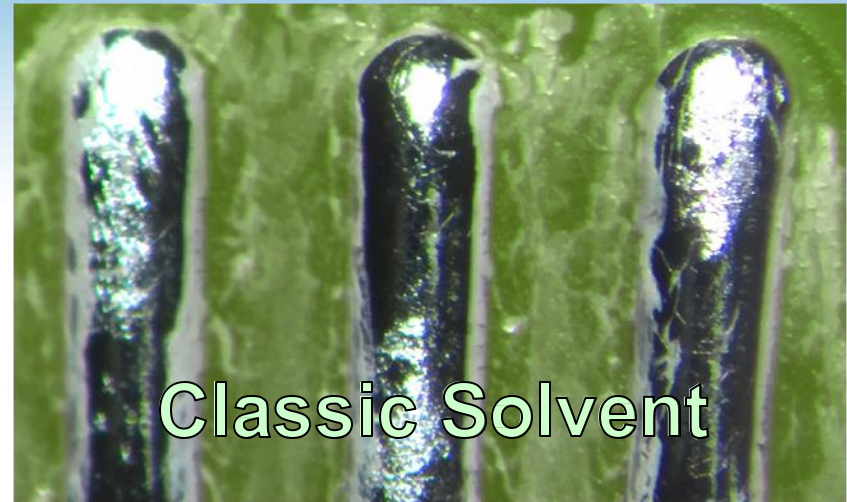
Solvent A



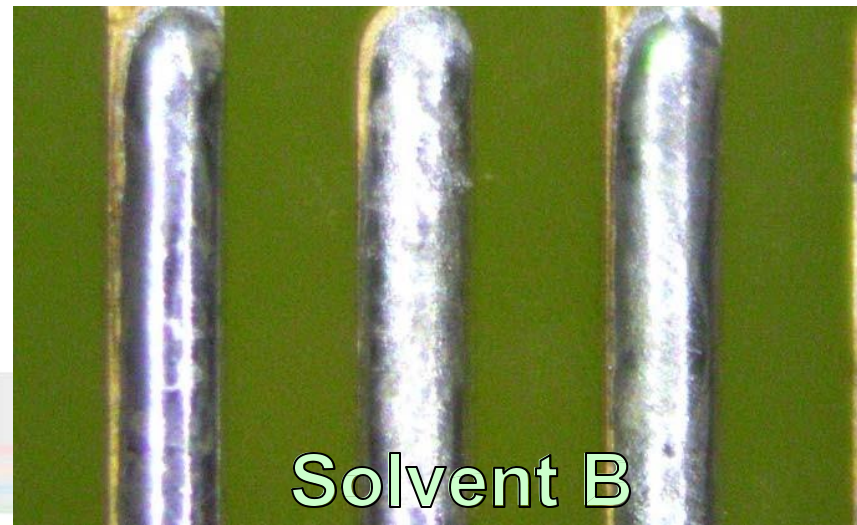
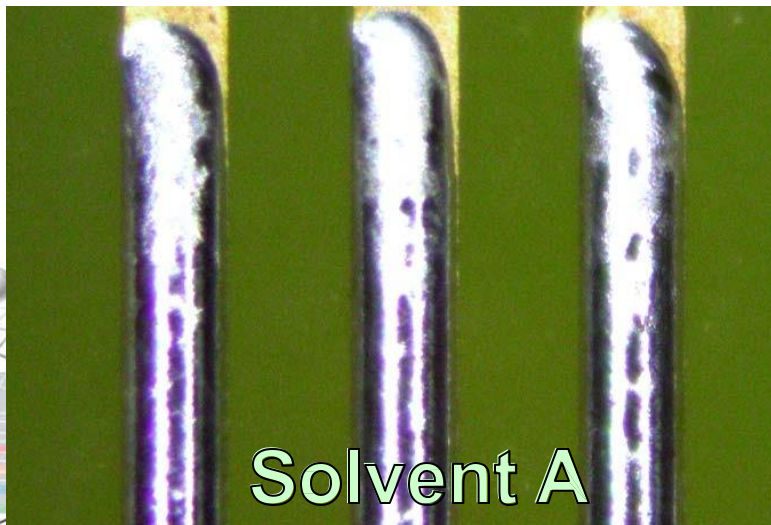
Solvent B



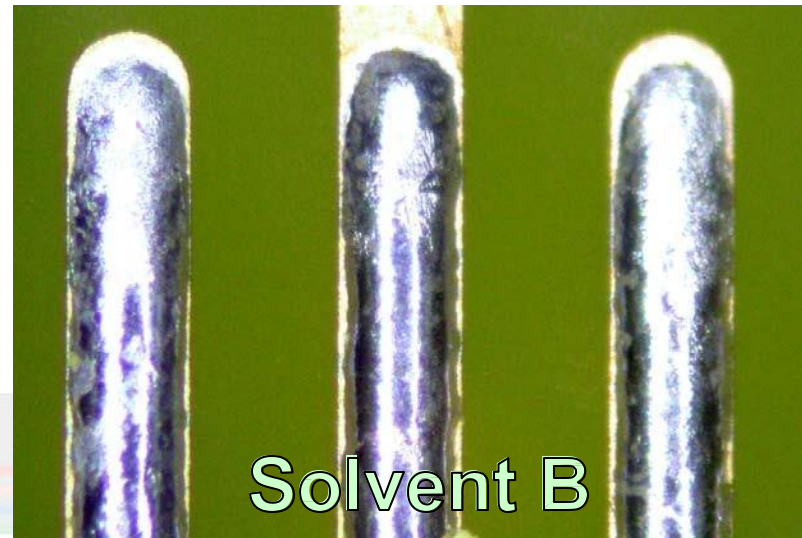
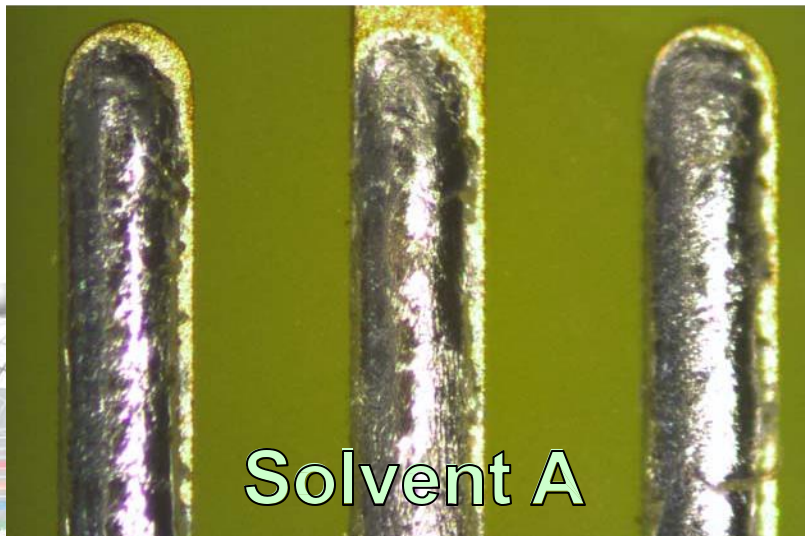
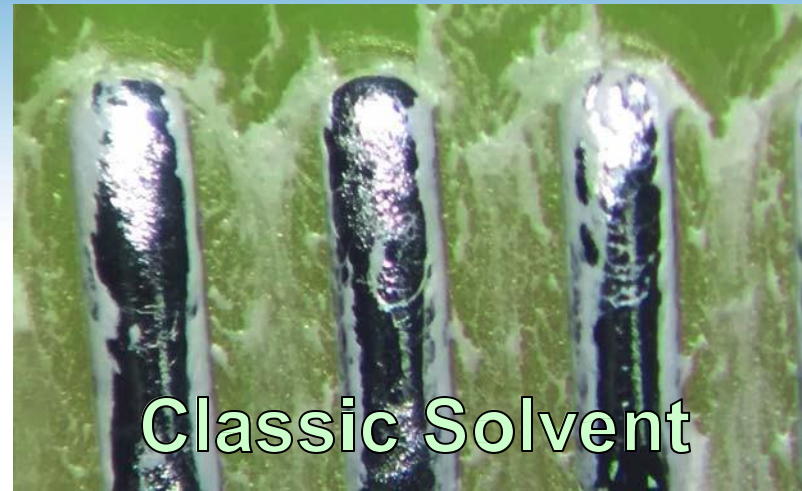
Visual Results- Indium 8.9



Visual Results- Loctite GC10

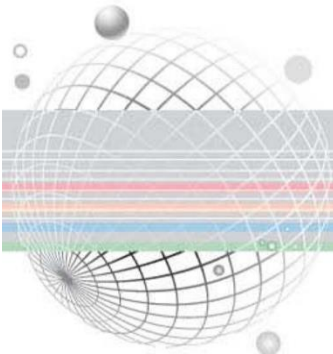


Visual Results- Loctite GC3



SIR Evaluation

- TM Confirm the cleaning capability of the two solvent formulations via SIR testing
- TM Confirm removal of dendrite-forming ingredients
- TM Confirm that no detrimental ingredients are left behind by cleaner
- TM Confirm that partial cleaning of flux residue does not result in circuit failure



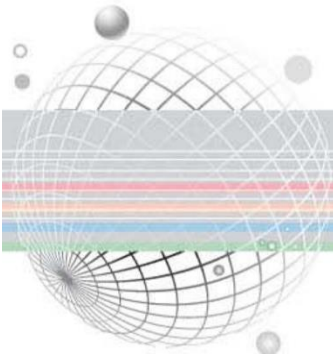
MicroCare[®]



© MicroCare Corporation 2017

SIR Evaluation

- TM Repeat cleaning procedure used for the visual cleaning study
- TM Clean test boards in Solvent A and Solvent B
- TM Submit cleaned boards to an outside testing facility for SIR analysis



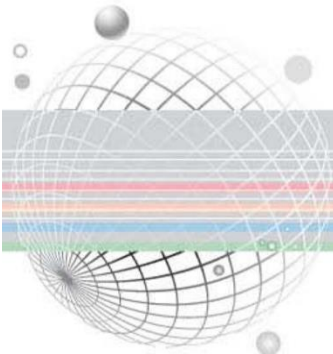
MicroCare[®]



© MicroCare Corporation 2017

SIR Evaluation Procedure

1. All boards visually examined before cleaning
 - 10-40x magnification
2. All boards cleaned according to cleaning cycle
 - Total cleaning time of 21 minutes
3. Boards immediately analyzed visually
 - 10-40x magnification
4. Packaged and shipped to SIR lab



SIR Evaluation Procedure

TM SIR method followed IPC-TM-650 Method 2.6.3.3, requirements per IPC J-STD-004A, paragraph 3.2.4.5

EQUIPMENT LIST

ID	Manufacturer	Equipment Name	Serial / Model Number	Calibration Date	Calibration Due Date
CH-29	Thermotron	Environmental Test Chamber	45250/SM-16-8200	20-Apr-2016	30-Apr-2017
E-54	Concoat	Auto-Sir	12861/256 Channel Rack-mount	9-Feb-2016	9-Feb-2017
E-76	Concoat	Auto-Sir	18811/256 Rack	8-Feb-2016	8-Feb-2017
MS-23	Olympus	Microscope and Camera	SZX16	30-Nov-2015	31-May-2017
S-26	JBC	Soldering Station - Auto Feed	159368/AL-1A	18-Apr-2016	30-Apr-2017

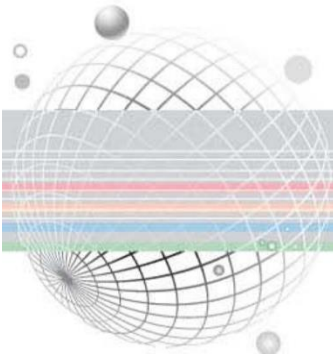


MicroCare[®]

© MicroCare Corporation 2017

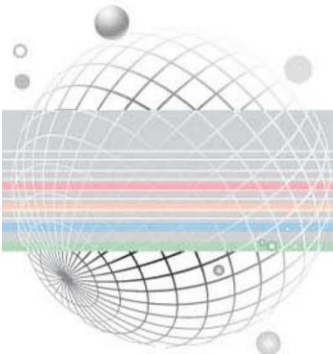
SIR Testing Results

- TM All 10 fluxes passed SIR testing after cleaning in both Solvent A and Solvent B
- TM 4 out of 10 fluxes failed SIR testing if no cleaning was performed



Conclusions of Visual Study

- TM Simple cleaning cycle- 11 minutes total time
- TM Immersion in boiling liquid is necessary
- TM Improved removal of white residues
- TM Consistently cleaner results than “Classic Solvent”
- TM Ability to remove no-clean, high-temperature, lead-free and water-soluble residues



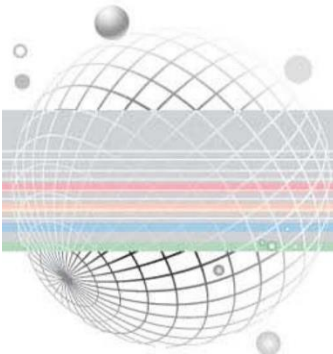
MicroCare[®]



© MicroCare Corporation 2017

Conclusions of SIR Study

- TM Resistance readings were consistent across all trace pads on all boards
- TM Incomplete cleaning did not result in formation of detrimental compounds
- TM Cleaning formula did not leave behind any detrimental compounds
- TM Cleaning prevented failures for pastes that may have otherwise failed



MicroCare[®]



© MicroCare Corporation 2017

Presentation Summary

TM Halocarbons and their mixtures can be used for Critical cleaning to remove

$\frac{3}{4}$ Particulates

$\%_{00}$ LOx/ GOx

$\%_{00}$ LASERS / Optics

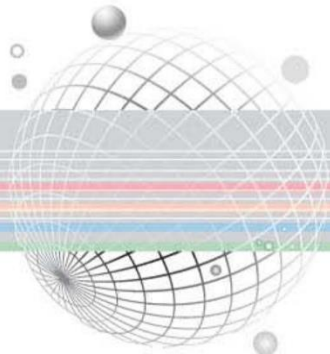
$\%_{00}$ Disc Drives

$\frac{3}{4}$ Stubborn salts and White Residues

$\frac{3}{4}$ Residues that can aid in the formation of Dendrites

$\%_{00}$ Electronics and Electronic assemblies

TM Contact MicroCare regarding more information on these types of fluids.



MicroCare[®]

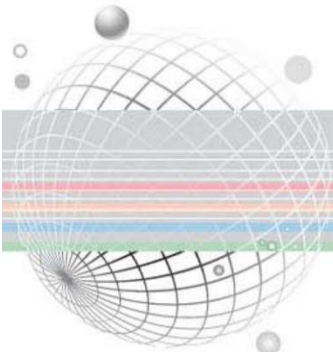


Contact Information

TM David A. Ferguson
Sr. Market and Technical Manager

TM MicroCare Corporation
595 John Downey Drive
New Britain, CT 06051

davidferguson@MicroCare.com
(860) 515-3084



© MicroCare Corporation 2017