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IPC-7526

Stencil and Misprinted Board Cleaning Handbook

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A standard developed by IPC

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Developed by the Stencil Cleaning Task Group (5-31g) of the Cleaning and Coating Committee (5-30) of IPC

Users of this publication are encouraged to participate in the development of future revisions.

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Acknowledgment

Any document involving a complex technology draws material from a vast number of sources. While the principal members of the Stencil Cleaning Task Group (5-31g) of the Cleaning and Coating Committee (5-30) are shown below, it is not possible to include all of those who assisted in the evolution of this standard. To each of them, the members of the IPC extend their gratitude.

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Stencil and Misprinted Board Cleaning Handbook

1 INTRODUCTION

1.1 Scope This Handbook addresses the removal of solder paste and uncured/unreacted SMT adhesives from stencils, misprinted printed circuit boards (PCBs) and application tools connected to the soldering paste application processes.

1.2 Purpose The purpose of this handbook is to provide a basic understanding of stencil/misprint cleaning processes. The handbook serves as a guide to users or prospective users of stencil/misprint cleaning technology.

1.3 Overview Cleaning of stencils and misprinted PCBs has taken an increasingly important role in surface mount technology. Fine and ultra-fine pitch lands, together with other advanced packages, place new demands on stencil cleaning. Paste volume is a critical issue for fine, ultra-fine, chip-scale, BGA and flip-chip components. Insufficient solder due to clogging of stencil apertures is a primary cause of defects. This results in poor paste printing and therefore; clean stencils are important in delivering the proper amount of paste. Process engineers estimate that approximately 70% of surface mount technology defects are due to solder paste printing problems.

Cleaning agents must be effective, safe for workers, and safe for the environment. Isopropyl alcohol (IPA), commonly used for cleaning, poses both environmental (VOC) and safety (i.e., fire hazard) concerns. Today, a much wider array of cleaning agents exists for stencil cleaning.

The residue encountered on stencils is generally nonreflowed solder paste. After hours of use, the solder paste may partially dry. This increases the difficulty of cleaning. In addition, there is also a need to remove uncured SMT adhesives used for bottom side mounting of surface mount devices. These issues afford the same cleaning problems for misprinted PCBs.

Section 2 provides a partial listing of documents and references that may need to be considered in the stencil cleaning process.

Appendix A provides definitions for terms used in this handbook.

1.4 Problem Statement Proper stencil cleaning should remove all solder particles and flux vehicle (organics) from stencil apertures without damaging the stencil, bonding

adhesives, and elastomer frame. Solder paste residue on a stencil can result in transferring paste from the bottom of the stencil onto the next board printed. The residue can also interfere with good “gasketing” of the stencil to the board being printed. Any of these conditions can cause misprints, solder paste where it should not be, or missing solder paste from where it should be, resulting in shorts, solderballs, or lack of sufficient solder paste when the PCA is reflowed.

1.5 Common Production Problems Printing or dispensing of solder paste is a crucial step in production of SMT PCAs. The stencils used must be clean and free of solder paste residue to avoid misprinting/misapplying solder paste deposits to PCAs. Additionally, the wetness and thixotropic property of the paste being applied, flatness of the PCA, the positioning of the stencil with respect to the PCA lands, the squeegee pressure, stencil aperture opening in relation to the PCA land dimensions, type of stencil technology, etc. can all result in solder paste being left on the stencil.

For the reasons stated above, the bottom of the stencil requires inspection, monitoring and wiping throughout the process. Printers provide various methods to wipe the stencil bottom. For printers that do not provide understencil wiping, manual methods must be employed.

Failure to implement a process that removes residue from stencil apertures contributes to board processing problems. Factors outside the cleaning process may also contribute to process issues. Figures 1-1 through 1-10 identify issues that contribute to stencil printing problems.

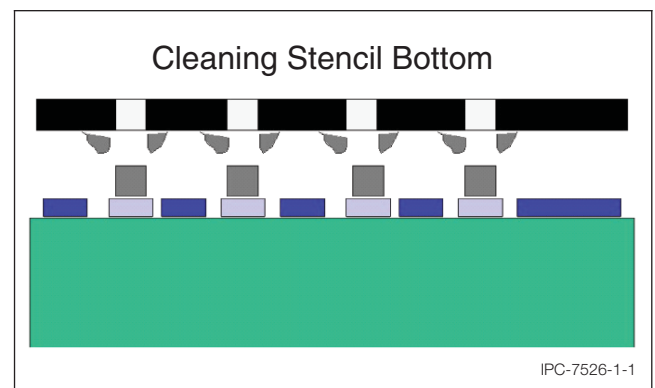


Figure 1-1 Cleaning Stencil Bottom

(Figure 1-1) Failure to underwipe or clean the bottom side of the stencil contributes to inconsistencies in solder paste deposition.

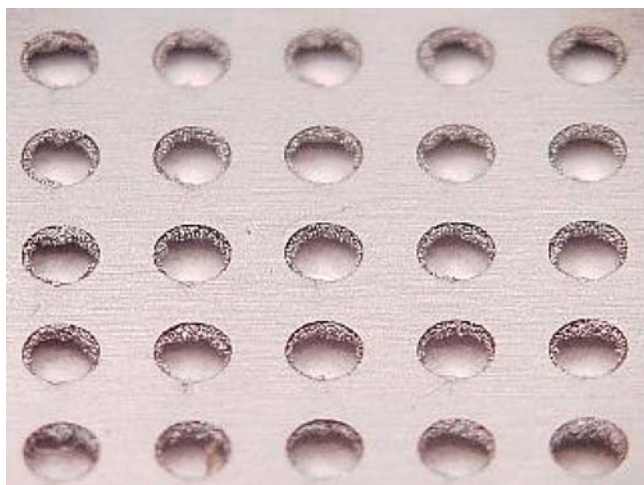


Figure 1-2 Solder Paste Buildup on Walls of Stencil Apertures



Figure 1-3 Solder Paste Buildup on Walls of Stencil Apertures

(Figures 1-2, 3) Solder balls attach to the walls of the stencil aperture over time. Failure to clean this buildup from the stencil affects the amount of deposited solder paste and could potentially cause open solder joints, bridging, and solder ball formation on the subsequent PCA.



Figure 1-4 Open or Insufficient Solder Joints

(Figure 1-4) When solder paste and/or the flux vehicle is not completely removed from stencil apertures in the cleaning operation the dried residue partially or completely blocks the correct volume of solder paste, resulting in insufficient or open solder connections.



Figure 1-5 Solder Balls Following Solder Reflow

(Figure 1-5) Water or solvent remaining on circuit boards or stencils following cleaning may be mixed with the solder paste resulting in satellite solder ball formation in the solder reflow process. Improper cleaning of solder paste from miprinted boards can leave large quantities of solder balls from the solder paste on and around the lands and in the vias.



Figure 1-6 Bridging or Poorly Defined Solder Paste Printing

(Figure 1-6) Damage to the stencil patterns during removal of excessive solder paste or in a cleaning process will result in poorly defined joints or bridged parts. Improper rinsing of stencils can leave surface contaminants or residual cleaning fluid on the surface of the stencil. These contaminants promote flux bridging under the stencil during the printing process. The release of the board from the stencil creates a vacuum as the stencil separates from the board, sucking the solder paste beneath the stencil, leaving poorly defined prints or bridges.

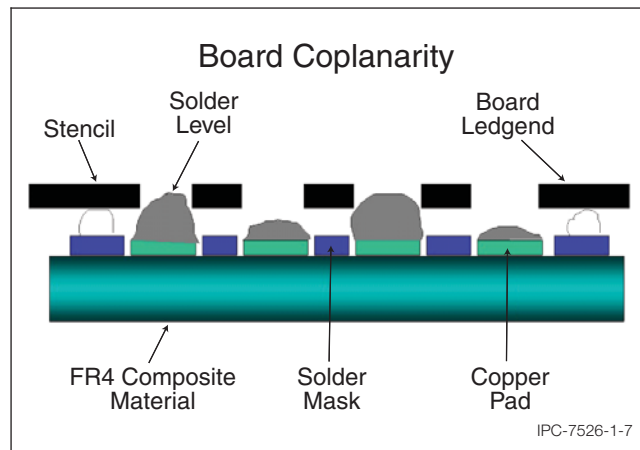


Figure 1-7 Failure to Place the Stencil on a Level Plane

(Figure 1-7) The stencil must sit on a level plane that is flat with well-identified points and lines. The stencil should contact the board at the solder mask height. Variations in hot air solder leveling (HSAL) or excessive legend ink thickness can lead to poor gasketing, which will allow solder paste to flow beyond the aperture opening on the bottom of the stencil resulting in poor print definition.

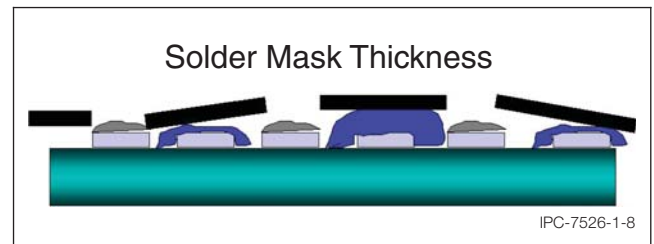


Figure 1-8 Variations in Solder Mask Thickness

(Figure 1-8) Variations in solder mask thickness contribute to inconsistencies in solder paste deposition. This condition is similar to the board coplanarity problem and will lead to poor definition and increase the need for stencil wiping.

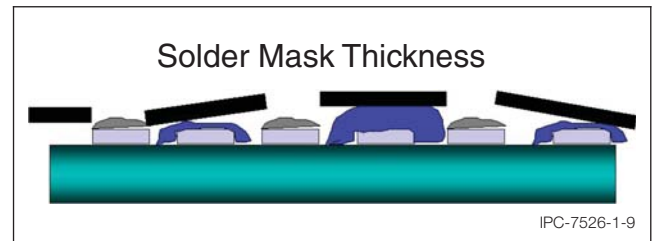


Figure 1-9 Inconsistent Component Land Width

(Figure 1-9) Component land width must be consistent. Variations contribute to inconsistencies in solder paste deposition. If the land is smaller than the aperture, paste will flow beyond the land and if soldermask is not present, the possibility of bridging between the lands will increase.

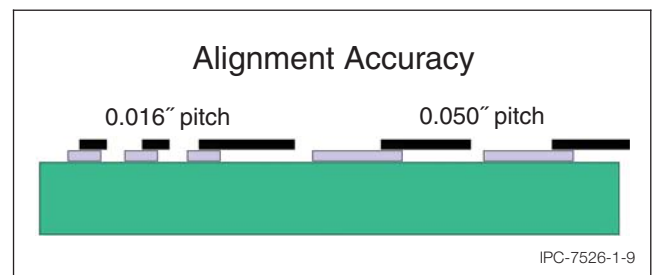


Figure 1-10 Misaligned Stencil

(Figure 1-10) Poor alignment contributes to inconsistencies in solder paste deposition and increases contamination of the stencil bottom. This leads to poor definition on subsequent prints and increased frequency of the stencil bottom cleaning to maintain acceptable print quality.

2 BIBLIOGRAPHY OF DOCUMENTS, SPECIFICATIONS AND REFERENCES

The following documents are provided as possible sources of additional information.

2.1 IPC¹

IPC-SC-60 Post Solder Solvent Cleaning Handbook

IPC-SA-61 Post Solder Semiaqueous Cleaning Handbook

IPC-AC-62 Post Solder Aqueous Cleaning Handbook

IPC-CH-65 Guidelines for Cleaning of Printed Boards and Assemblies

IPC-CA-82 General Requirements for Thermally Conductive Adhesives

IPC-A-610 Acceptability of Electronic Assemblies

IPC-3406 Guidelines for Electrically Conductive Surface Mount Adhesives

IPC-3408 General Requirements for Anisotropically Conductive Adhesive Films

IPC-7525 Stencil Design Guidelines

2.2 Joint Industry Standards²

J-STD-001 Requirements for Soldered Electrical and Electronic Assemblies

J-STD-005 Requirements for Soldering Pastes

2.3 American Standards for Testing Materials³

2.4 Federal Laws and Standards⁴

CAA Clean Air Act

CWA Clean Water Act

CERCLA Comprehensive Environmental Response, Compensation and Liability Act

RCRA Resource Conservation and Recovery Act

SARA Superfund Amendment and Reauthorization Act

2.5 Department of Defense⁵

MIL-C-85447 Cleaning Compounds, Electrical & Electronic Components

2.6 Occupational Safety and Health Administration⁶

OSHA 29 CFR 1910.106 Flammable and Combustible Liquids

OSHA 29 CFR 1910.134 Respiratory Protection

OSHA 29 CFR 1910.1000 Air Contaminants

2.7 Environmental Protection Agency (EPA)⁷

EPA 40 CFR 63 National Emission Standards for Hazardous Air Pollutants for Source Categories

EPA 40 CFR 82 Protection of Stratospheric Ozone

EPA-453/R-94-081 Guidance Document for the Halogenated Solvent Cleaner NESHAP

EPA 40 CFR 117. Determination of Reportable Quantities for Hazardous Substances

EPA 40 CFR 131.36 Toxic Criteria for those States not Complying with Clean Water Act Section 303(c)(2)(B)

EPA 40 CFR 261 Identification and Listing of Hazardous Waste

EPA 40 CFR 302.4 Designation of Hazardous Substances

EPA 40 CFR 355.30 (b) Emergency Release Notification

EPA 40 CFR 370 Hazardous Chemical Reporting: Community Right To Know

EPA 40 CFR 372 Toxic Chemical Release Reporting: Community Right-to-Know

2.8 Department of Transportation⁸

DOT 33 CFR 153.203 Procedure for the Notice of Discharge

2.9 National Fire Protection Association (NFPA)⁹

NFPA 35 Definitions of Flammable & Combustible Substances

2.9.1 Air Quality Management Standards (AQMD)

3 STENCIL CLEANING PROCESS

3.1 Objectives for the Cleaning Process Stencil cleanliness is an essential issue for delivering the proper amount

1. www.ipc.org

2. www.ipc.org

3. www.astm.org

4. ecfr.gpoaccess.gov

5. www.answers.com/topic/united-states-department-of-defense

6. www.osha.gov/

7. www.osha.gov/

8. www.dot.gov/

9. www.nfpa.org/