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1 SCOPE
This handbook addresses solvent cleaning of electrical/electronic assemblies, parts and application tools after soldering.

1.1 Purpose The content of this text is intended to provide a basic understanding of the subject and to serve as a guide to users or prospective users of solvent cleaning technology, allowing selection or improvement of solvent cleaning processes.

Notes:
1. Content of this revision is limited to those solvents that have a wide use in electronic assembly cleaning operations as of date of publication.
2. New solvents or formulations that are developed and then proven effective for this use will be included in a future revision.
3. Since normal propyl bromide (nPB) and its formulations are legal for sale and use for electronics cleaning, pending the issuance of a final rule by the U.S. Environmental Protection Agency (EPA) Significant New Alternatives Program (SNAP) office, all references to nPB or brominated cleaning agents in this document are in italics (see Annex C).
4. Transportation and storage related temperatures and weights are also provided in English units for safety related reasons. It is recognized that certain paragraphs are U.S. specific and other countries will need to substitute equivalent requirements/information.

1.2 Terms and Definitions All terms and definitions used throughout this handbook are in compliance with IPC-T-50. Other basic terms and definitions, essential for the discussion of the subject, are provided below or are defined in appropriate sections of this handbook.

Solvent Cleaning – A cleaning process that uses a solvent medium, instead of water, for washing and rinsing the electronic parts and assemblies. In solvent cleaning, drying is application and equipment dependent. In vapor defluxing, drying is accomplished by evaporating residual liquid solvent on the part being cleaned into the vapor zone generated by the boiling solvent. In all other applications, drying occurs by evaporation of residual solvent into the air, taking care to keep the vapor in air levels within recommended limits.

Wash or Washing – The primary cleaning operation that removes undesirable impurities (contaminants) from surfaces by chemical and physical effects, mainly dissolution of the contaminants.

Rinse or Rinsing – A cleaning operation (usually following the wash step) where fresh solvent replaces - via a dilution mode - any residual contamination, leaving surfaces wet with pure solvent.

Drying – The process of removing any residual liquid solvent on the surface of the washed and rinsed parts. In a vapor defluxing process, drying is accomplished in the vapor zone created by the boiling solvent in the wash zone of the cleaning machine. Drying can be augmented by passing superheated solvent vapor across the surface of the parts, to ensure complete removal of residual liquid solvent. This technique is especially effective with complex geometries that can entrap liquid solvent.

Defluxing (Flux Removal or Post Solder Cleaning) – The cleaning process designed to remove solder flux and by-products. Other objectives are removal of process residues and materials used as production aids, such as solvent soluble maskants. Impurities left by board or component fabrication processes or other operations may be removed during the process, thus the defluxing process widens the process window for assemblers.

1.2.1 Chemical Material Acronym Definitions
HCFC Hydrochlorofluorocarbon
HFC Hydrofluorocarbon
HFE Hydrofluoroether
nPB normal Propyl Bromide
CFC Chlorofluorocarbon
TCE Trichloroethylene
PCE Perchloroethylyene

2 APPLICABLE DOCUMENTS
This section contains references to industry standards, federal regulations, test methods and vehicles which are applicable to post solder solvent cleaning. Not all of these are cross-referenced in the text. They are listed below for the convenience of the readers.

2.1 Industry Standards
2.1.1 IPC Standards
IPC-B-24 Surface Insulation Resistance Test Board
IPC-B-25 Multipurpose Test Board

1. IPC, 2215 Sanders Road, Northbrook, IL 60062
2.3.25 Detection and Measurement of Ionizable Surface Contaminants
2.3.27 Cleanliness Test - Residual Rosin
2.3.27.1 Rosin Flux Residue Analysis - HPLC Method
2.3.28 Ionic Analysis of Circuit Boards, Ion Chromatography Method
2.3.30 Solvent pH Determination in Anhydrous Fluorocarbon Solvents
2.3.38 Surface Organic Contaminant Detection Test
2.3.39 Surface Organic Contaminant Identification Test (Infrared Analytical Method)
2.6.3.1 Moisture and Insulation Resistance - Polymeric Solder Masks and Conformal Coatings
2.6.3.3 Surface Insulation Resistance, Fluxes
2.6.9.1 Test to Determine Sensitivity of Electronic Assemblies to Ultrasonic Energy
2.6.9.2 Test to Determine Sensitivity of Electronic Components to Ultrasonic Energy
2.6.13 Assessment of Susceptibility to Metallic Dendritic Growth: Uncoated Printed Wiring
2.6.14 Resistance to Electrochemical Migration, Polymer Solder Mask

2.1.2 Joint Industry Standards

J-STD-001 Requirements for Soldered Electrical and Electronic Assemblies
J-STD-004 Requirements for Soldering Fluxes

J-STD-005 Requirements for Soldering Pastes
J-STD-006 Requirements for Electronic Grade Solder Alloys and Fluxed and Non-Fluxed Solid Solders for Electronic Soldering Applications

NOTE: For additional documents and references related to general cleaning issues (IPC, DOD, EIA, UL, ASTM and ANSI) the reader is referred to the IPC Cleaning Handbook; IPC-CH-65).

2.2 U.S. Federal Regulations

2.2.1 Federal Laws

CAA Clean Air Act
CWA Clean Water Act
RCRA Resource Conservation and Recovery Act
CERCLA Comprehensive Environmental Response, Compensation and Liability Act
SARA Superfund Amendment and Reauthorization Act

2.2.2 Federal Standards

O-A-51 Acetone, Technical
O-E-760 Special Industrial Solvents
O-M-232 Methanol (Methyl Alcohol)
O-T-236 Tetrachloroethylene (Perchloroethylene); Technical
O-T-620 1,1,1-Trichloroethane, Technical, Inhibited (Methyl Chloroform)
O-T-634 Trichloroethylene, Technical, Inhibited
TT-B-848 Butyl Alcohol, Secondary, For Use in Organic Coatings
TT-I-735 Isopropyl Alcohol
TT-M-261 Methyl Ethyl Ketone
TT-N-95 Naphtha, Aliphatic
TT-N-97 Naphtha, Aromatic
TT-T-548 Toluene Ethyl Alcohol, (Ethanol) Denatured Alcohol, Proprietary Solvents

2.2.3 Department of Defense

MIL-C-81302 Cleaning Compound, Solvent, Trichlorotrifluoroethane

2. General Services Administration, Federal Supply Service, Bureau Specifications Section (3FBP-W), Suite 8100 470 L’Enfant Plaza SW, Washington, DC 20407
3. Standardization Documents Order Desk, 700 Robbins Avenue, Bldg. 4D, Philadelphia, PA 19111-5094
MIL-C-85447 Cleaning Compounds, Electrical & Electronic Components
MIL-N-15178 Naphtha, Solvent
MIL-T-81533 Trichloroethane 1,1,1 (Methyl Chloroform) Inhibited, Vapor Degreasing

2.2.4 Occupational Safety and Health Administration
OSHA 29 CFR 1910.1000 Air Contaminants
OSHA 29 CFR 1910.134 Respiratory Protection
OSHA 29 CFR 1910.106 Flammable and Combustible Liquids

2.2.5 Environmental Protection Agency
EPA 40 CFR 63 National Emission Standards for Hazardous Air Pollutants for Source Categories
EPA 40 CFR 82 Protection of Stratospheric Ozone
EPA 40 CFR 117.3 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

2.2.6 Department of Transportation
DOT 33 CFR 153.203 Procedure for the Notice of Discharge

2.2.7 American Conference of Governmental Industrial Hygienists (ACGIH) and National Institute of Occupational Safety and Health (NIOSH)
Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents, and Biological Exposure Indices Published by ACGIH Worldwide.

Permissible Exposure Limit (PEL) (eight hour exposures)
Short Term Exposure Limit (STEL) (typically 15 minutes)

2.3 Other

2.3.1 American Standards for Testing Materials

2.3.1.1 Test Methods
ASTM Method D-56 Flash Point, TAG Closed Cup
ASTM Method D-92 Flash Point, Cleveland Open Cup
ASTM Method D-93 Flash Point, Pensky-Martens Closed Cup
ASTM Method D-1133 Kauri-Butanol Value for Hydrocarbon solvents
ASTM Method D-1320 Tensile Strength of Paraffin Wax (withdrawn without replacement)
ASTM Method D-2106 Amine Acid Acceptance of Halogenated Organic Solvents
ASTM Method D-2109 Non-Volatile Matter in Halogenated Organic Solvents and Their Admixtures
ASTM Method D-2111 Specific Gravity of Halogenated Organic Solvents and Their Admixtures
ASTM Method D-2942 Total Acid Acceptance Of Halogenated Organic Solvents
ASTM Method D-2989 Acidity/Alkalinity of Halogenated Organic Solvents and Their Admixtures
ASTM Method D-3401 Water in Halogenated Organic Solvents and Their Admixtures
ASTM Method D-3443 Chloride in Trichlorotrifluoroethane

2.3.1.2 Standard Specification of Materials
ASTM D 329 Acetone
ASTM D 362 Toluene (Discontented without replacement)
ASTM D 740 Methyl Ethyl Ketone
ASTM D 1153 Methyl Isobutyl Ketone

4. OSHA, Public Affairs Office - Room: 3647, 200 Constitution Avenue, Washington, DC 20210
5. EPA, 401 Main Street SW, Washington, DC 20460-0003, Telephone: 800-424-8802
6. DOT, 400 Seventh Street SW, Washington, DC 20590
7. ACGIH, 1330 Kemper Meadow Drive, Suite 600, Cincinnati, OH 45240
8. NIOSH, 200 Independence Avenue SW, Room 715H, Washington, DC 20201
9. ASTM, 100 Barr Habor Drive, West Conshohocken, PA 19428-2959