IPC-4204B

2018 - August

Flexible Metal-Clad Dielectrics for Use in Fabrication of Flexible Printed Boards

Supersedes IPC-4204A with Amendment 1
October 2013

An international standard developed by IPC

urrently in preview, click buy full versi

Association Connecting Electronics Industries

The Principles of Standardization

In May 1995 the IPC's Technical Activities Executive Committee (TAEC) adopted Principles of Standardization as a guiding principle of IPC's standardization efforts.

Standards Should:

- Show relationship to Design for Manufacturability (DFM) and Design for the Environment (DFE)
- Minimize time to market
- Contain simple (simplified) language
- Just include spec information
- Focus on end product performance
- Include a feedback system on use and problems for future improvement

Standards Should Not:

- Inhibit innovation
- Increase time-to-market
- Keep people out
- Increase cycle time
- Tell you how to make something
- Contain anything that cannot be defended with data

Notice

IPC Standards and Publications are designed to serve the public interest through eliminating misunderstandings between manufacturers and purchasers, facilitating interchangeability and improvement of products, and assisting the purchaser in selecting and obtaining with minimum delay the proper product for his particular need. Existence of such Standards and Publications shall not in any respect preclude any member or nonmember of IPC from manufacturing or selling products not conforming to such Standards and Publication, nor shall the existence of such Standards and Publications preclude their voluntary use by those other than IPC members, whether the standard is to be used either domestically or internationally.

Recommended Standards and Publications are adopted by IPC without regard to whether their adoption may involve patents on articles, materials, or processes. By such action, IPC does not assume any liability to any patent owner, nor do they assume any obligation whatever to parties adopting the Recommended Standard or Publication. Users are also wholly responsible for protecting themselves against all claims of liabilities for patent infringement.

IPC Position Statement on Specification Revision Change

It is the position of IPC's Technical Activities Executive Committee that the use and implementation of IPC publications is voluntary and is part of a relationship entered into by customer and supplier. When an IPC publication is updated and a new revision is published, it is the opinion of the TAEC that the use of the new revision as part of an existing relationship is not automatic unless required by the contract. The TAEC recommends the use of the latest revision. Adopted October 6, 1998

Why is there a charge for this document?

Your purchase of this document contributes to the ongoing development of new and updated industry standards and publications. Standards allow manufacturers, customers, and suppliers to understand one another better. Standards allow manufacturers greater efficiencies when they can set up their processes to meet industry standards, allowing them to offer their customers lower costs.

IPC spends hundreds of thousands of dollars annually to support IPC's volunteers in the standards and publications development process. There are many rounds of drafts sent out for review and the committees spend hundreds of hours in review and development. IPC's staff attends and participates in committee activities, typesets and circulates document drafts, and follows all necessary procedures to qualify for ANSI approval.

IPC's membership dues have been kept low to allow as many companies as possible to participate. Therefore, the standards and publications revenue is necessary to complement dues revenue. The price schedule offers a 50% discount to IPC members. If your company buys IPC standards and publications, why not take advantage of this and the many other benefits of IPC membership as well? For more information on membership in IPC, please visit www.ipc.org or call 847/597-2809.

Thank you for your continued support.

©Copyright 2018. IPC, Bannockburn, Illinois, USA. All rights reserved under both international and Pan-American copyright conventions. *Any copying, scanning or other reproduction of these materials without the prior written consent of the copyright holder is strictly prohibited and constitutes infringement under the Copyright Law of the United States.*

Currently in preview, click buy full version

IPC-4204B

Flexible Metal-Clad Dielectrics for Use in Fabrication of Flexible Printed Boards

Developed by the Flexible Circuits Base Materials Subcommittee (D-13) of the Flexible Circuits Committee (D-10) of IPC

Supersedes:
IPC-4204A with Amendment 1 - October 2013
IPC-4204A - October 2011
IPC-4204 - May 2002

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

Contact:

IPC
3000 Lakeside Drive, Suite 105N
Bannockburn, Illinois
60015-1249
Tel 847 615.7100
Fax 847 615.7105

Currently in preview, click buy full version

This Page Intentionally Left Blank

currently in preview, click buy full versi

Acknowledgment

Any document involving a complex technology draws material from a vast number of sources across many continents. While the principal members of the Flexible Circuits Base Materials Subcommittee (D-13) of the Flexible Circuits Committee (D-10) 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 IPC extend their gratitude.

Flexible Circuits Committee

Chair
Nick S. Koop
TTM Technologies

Vice Chair
William A. Ortloff
Raytheon Company

Flexible Circuits Base Materials Subcommittee

Chair
Clark F. Webster
All Flex LLC

Technical Liaison of the IPC Board of Directors

Robert Neves
Microtek (Changzhou) Laboratories

Flexible Circuits Base Materials Subcommittee

Takahisa Akatsuka, Nippon Mektron Ltd.

Alisha Amar, Lockheed Martin Space Systems Company

Masamitsu (Matt) Aoki, JETPA

Lance Auer, Raytheon Missile Systems

Richard Barnett, Hewlett-Packard Company

John Bauer, Rockwell Collins

Roger Bell, Space Systems/Loral

Mary Bellon

Dr.Tad Bergstresser, Bakaert Specialty Films LLC

Robert Black, Northrop Grumman Corporation

Frank Boehm

Scott Bowles, L-3 Fuzing and Ordnance Systems, Cincinnati

JianWei Cai, Shengyi Technology Co. Ltd.

Tracy Cai, Shengyi Technology Co. Ltd.

Rodd Cairns, Starkey Hearing Technologies

Byron Case, L-3 Communications

Shawn Chaput, Raytheon Missile Systems

Dr. Wennei Chen, Northrop Grumman Aerospace Systems

Jeffrey Ciesla, DLA Land and Maritime

Greg Clements, Kaneka North America LLC

Michael Collier, Teledyne Printed Circuit Technologies

David Corbett, DLA Land and Maritime

Andrea Cote, UL LLC

Michelle Courier, UL LLC

Dr. Sidney Cox

Michael Crutchfield, Dupont-RTP

Jay Desai, M-FLEX

Michael Dickson, UL LLC

Joseph DiPalermo, M-Flex/Pica Sales & Engineering

Mitsuharu Douwaki, Fujikura Ltd.

Don Dupriest, Lockheed Martin Missiles & Fire Control

Jim Edmonds, Shin-Etsu MicroSi

Theodore Edwards

Steven Ethridge, Dell Inc.

Alan Exley, Raytheon Company

Thomas Farrell

Jason Ferguson, NSWC Crane

Mark Finstad, Flexible Circuit Technologies, Inc.

Terry Fischer, Hitachi Chemical Co. America, Ltd.

Thomas Fisher, DuPont-RTP

Scott Foll, DuPont

Lionel Fullwood, WKK Distribution Ltd.

Mahendra Gandhi, Northrop Grumman Aerospace Systems

Feng (Andrew) Gao, Huawei Technologies Co., Ltd.

Thomas Gardeski, Gemini Sciences, LLC

Donna Gardner, DuPont

Michael Gleason, Draper

Ty Gragg, Unicircuit Inc.

Russell Griffith, Flexible Circuits Inc.

Rachel Grinvalds, Rockwell Collins

Christine Harrington, Amphenol Printed Circuits, Inc.

William Hazen, Raytheon Company

Todd Henninger, TTM Technologies

Hillary Herbert, DuPont

Donald Herr, Adhesives Research, Inc.

Scott Herrmann, DuPont

Stephen Jaarsma, Taconic Advanced Dielectric Division

William Jacobi, William Jacobi & Associates

Michael Jawitz, Orbital ATK

Tamotsu Kitagawa, ABC Corp.

Nick Koop, TTM Technologies

Toshiaki Kuroiwa, UBE

Karin LaBerge, KAL Consulting

Emi Lee, NTS - Anaheim

Grant Lee, Kaneka North America LLC

Currently in preview, click buy full version

Minsu Lee, Korea Printed Circuit Association

John Leschisin, Minco Products, Inc.

Dr. Yanmei Li, Schlumberger Well Services

Daniel Lunger, DuPont

Duane Mahnke, DBMahnke Consulting

John Marke, UL LLC

Eric Matuska, ALL Flex LLC

Mark McAlees, DuPont

Dr. Thomas McCarthy, Taconic Advanced Dielectric Division

Daniel McCormick, NSWC Crane

Robert P. McGarry, RPM Solutions

Paul Meloni, Kaneka North America LLC

Peter B. Menuez

Roger J. Miedico, Raytheon Company

Keita Miyasato, Taiyo Industrial Co., Ltd.

Steve A. Musante, Raytheon Missile Systems

Dr. Yoji Nakajima, Asahi Glass Co., Ltd.

Robert Neves, Microtek (Changzhou) Laboratories

Dr. Thi Nguyen, Lockheed Martin Missile & Fire Control

Dominique Numakura, DKN Research

Chiaki Okawa, Taiyo Industrial Co., Ltd.

Glenn Oliver, Raytheon Missile Systems

William Ortloff, Raytheon Company

Dr. J. Lee Parker, JLP

Joel Peiffer, 3M Company

Tony Plemel, Minco Products, Inc.

John Potenza, Lockheed Martin Mission Systems & Training

Damon Rachell, NTS - Anaheim

Donna Richardson, L-3 Communications

Thomas Romont, IFTEC

Jim Ryan, Insulectro

Dr. Jerome Sallo, Sallo Consulting Services

Edward Sandor, Taconic Advanced Dielectric Division

Takeshi Sasaki, Nippon Steel Chemical Company

Sie Sauers, GE Healthcare

Rolland Savage, Savage Consulting

Charles Schamberg, Raytheon Missile Systems

Joseph Schmidt, Raytheon Missile Systems

Julie Scopel, UL LLC

Mark Seelhammer, Rogers Corporation

Tony Senese, Panasonic Industrial Devices Sales Company of America

Jesse Session, Taiyo America Inc.

Gilbert Shelby, Raytheon Systems Company

Robert Sheldon, Pioneer Circuits Inc.

Terry Shepler, Electro-Materials, Inc.

Lowell Sherman, DLA Land and Maritime

Caroline Simonian-Owens, UL LLC

Doug Sober, Essex Technologies Group Inc.

Vern Solberg, Solberg Technical Consulting

Valerie A. St. Cyr, Teradyne Inc.

Herb Stark, Flexible Circuits Inc.

Rebecca Steinbauer, ALL Flex LLC

Brian Stevens, Rockwell Collins

James Stockhausen, ELANTAS PDG, Inc.

Darin Stotz, Northfield Automation Systems Inc.

Brent Sweitzer, Multek Flexible Circuits, Inc.

Kunio Takahara, JPCA-Japan Electronics Packaging and Circuits Assoc.

Mamoru (Mark) Takahashi, Asahi Glass

Dung (Young) Viet, Lockheed Martin Space Systems Company

Randy Tolbert, NSWC Crane

Crystal Vanderpan, UL LLC

Steve Vetter, NSWC Crane

Jennet Volden, Rockwell Collins

Nicholas Watts, Intel Corporation

David Weatherford, Teledyne Printed Circuit Technologies

Vern Welk, Molex Copper Flex Products

Richard Wessel, DuPont - RTP

Kurt Whitcomb, Amphenol Printed Circuits, Inc.

Jay Wu, Taiflex Scientific Co., Ltd.

Miou Yamaoka, Meiko Electronics Co. Ltd.

Ryoichi Yoshimura, Nippon Mektron Ltd.

Haida Yvjiro, Nippon Mektron Ltd.

Currently in preview, click buy full version

Table of Contents

1 SCOPE 1
1.1 Classification System 1
1.1.1 Nonspecific Designation 1
1.1.2 Specific Designation 1
1.1.2.1 Base Material Type 2
1.1.2.2 Reinforcement Method 2
1.1.2.3 Reinforcement Type 2
1.1.2.4 Base Material Thickness 3
1.1.2.5 Adhesive Type 3
1.1.2.6 Adhesive Thickness 3
1.1.2.7 Metal Cladding 3
1.1.2.7.1 Metal Foil 4
1.1.2.7.2 Metal Foil Type 4
1.1.2.7.3 Foil Designation 4
1.1.2.7.4 Nominal Metal Cladding Thickness 4
1.1.2.7.5 Bond Enhancement Treatment 5
1.2 Qualification 5
1.3 Quality Conformance 5
1.4 Material Characteristics 5
1.5 New Materials 5

2 APPLICABLE DOCUMENTS 5
2.1 IPC 5
2.2 American Society For Testing and Materials (ASTM) 6
2.3 Underwriters Laboratories Standards 6
2.4 ISO 6

3 REQUIREMENTS 6
3.1 Terms and Definitions 6
3.1.1 Qualification Testing 6
3.1.2 Quality Conformance Testing 6
3.1.3 User Inspection Lot 6
3.1.4 Supplier Inspection Lot 6
3.1.5 Structurally Similar Construction 6
3.2 Specification Sheets 7
3.3 Conflict 7
3.4 Materials 7
3.4.1 Base Material 7
3.4.2 Adhesive 7
3.4.3 Metal-Cladding 7
3.4.4 Sheet Material 7
3.4.5 Roll Material 7
3.5 Visual Requirements 7
3.5.1 Marking 7
3.5.2 Wrinkles, Creases, Streaks and Scratches 7
3.5.3 Inclusions .... [illegible]
3.5.4 Voids 8
3.5.5 Holes, Tears and Delaminations .... [illegible]
3.5.6 Pits and Dents 8
3.5.7 Discoloration 8
3.6 Dimensional Requirements 8
3.6.1 Sheet Width and Length 8
3.6.2 Roll Width 8
3.6.3 Roll Length 8
3.6.4 Dielectric Thickness 8
3.6.5 Adhesive Thickness 9
3.6.6 Metal Foil Thickness 9
3.7 Physical Requirements 9
3.7.1 Dimensional Stability 9
3.7.2 Peel Strength 9
3.7.2.1 Peel Strength As Received 9
3.7.2.2 Peel Strength After Solder Float 9
3.7.2.3 Peel Strength After Temperature Cycling 9
3.7.3 Initiation Tear Strength 9
3.7.4 Propagation Tear Strength 9
3.7.5 Flexural Endurance 9
3.7.6 Low Temperature Flexibility 9
3.8 Chemical Requirements 9
3.8.1 Chemical Resistance 9
3.8.2 Solder Float 9
3.8.3 Solderability 9
3.9 Electrical Requirements 10
3.9.1 Permittivity (Dielectric Constant) 10
3.9.2 Loss Tangent (Dissipation Factor) 10
3.9.3 Volume Resistivity (Damp Heat) 10
3.9.4 Surface Resistance (Damp Heat) 10
3.9.5 Dielectric Strength 10
3.10 Environmental Requirements 10
3.10.1 Fungus Resistance 10
3.10.2 Moisture Absorption 10
3.10.3 Flammability 10
3.10.4 Service Temperature 11
3.10.5 Moisture and Insulation Resistance 11
3.11 Workmanship 11

Currently in preview, click buy full versi

4 QUALITY ASSURANCE PROVISIONS 11
4.1 Responsibility for Inspection 11
4.2 Test Equipment and Inspection Facilities 11
4.3 Preparation of Samples 11
4.4 Standard Laboratory Conditions 11
4.5 Tolerances 11
4.6 Classification of Inspections 11
4.7 Materials Inspection 11
4.8 Qualification Inspection 11
4.8.1 Characterization Testing 12
4.8.2 Frequency 12
4.9 Quality Conformance Inspection 12
4.9.1 Inspection of Product for Delivery 13
4.9.2 Sample Unit 13
4.9.2.1 Sampling Plan 13
4.9.3 Group A Inspection 13
4.9.3.1 Failures 13
4.9.3.2 Rejected Lots 13
4.9.4 Group B Inspection 13
4.9.4.1 Sampling Plan 13
4.9.4.2 Failures 13
4.9.4.3 Noncompliance of Material 13
4.9.5 Group C Inspection 13
4.9.5.1 Sampling Plan 14
4.9.5.2 Failures 14
4.9.5.3 Noncompliance of Material 14
4.10 Statistical Process Control (SPC) 14
4.10.1 Reduction of Quality Conformance Testing 14
4.11 Change Notification and Authorization 14
4.12 Certificate of Conformance 15

5 PREPARATION FOR DELIVERY 15
5.1 Packaging 15

6 NOTES 15
6.1 Ordering Data 15
6.2 Specific Chemical Exposure 15

Tables

Table 1-1 Base Dielectric Type Designation 2
Table 1-2 Reinforcement Method Designation 2
Table 1-3 Reinforcement Type Designation 2
Table 1-4 Base Dielectric Thickness Designation or Adhesive Thickness Designation 3
Table 1-5 Adhesive Type Designation 3
Table 1-6 Specification Designation from IPC-4562 4
Table 1-7 Copper Thickness Designator 4
Table 3-1 Point Values Assigned to Pits and Dents Based on Their Longest Dimension 8
Table 3-2 Allowable Deviation from Nominal Thickness of Base Dielectric 8
Table 3-3 Allowable Deviation from Nominal Thickness of Adhesive 9
Table 4-1 Test Method Frequency 12
Table 4-2 Sampling Plan for Group A and Group B Inspection for Sheet Goods 13
Table 4-3 Sampling Plan for Group A and Group B Inspection for Roll Goods 13

Currently in preview, click buy full versi

Flexible Metal-Clad Dielectrics for Use in Fabrication of Flexible Printed Boards

1 SCOPE

This standard establishes the classification system, the qualification and quality conformance requirements for flexible metal-clad dielectric materials to be used for the fabrication of flexible printed boards.

1.1 Classification System The system described in 1.1.1 through 1.1.2.7 identifies flexible metal-clad dielectrics.

1.1.1 Nonspecific Designation A nonspecific designation is intended for use by ***designers*** on master drawings to designate their material choice. At the end of this standard is a series of material specification sheets identified by specification sheet numbers. Each sheet outlines engineering and performance data for a flexible metal-clad dielectrics, indicating base material type, adhesive type and method of reinforcement.

Example of nonspecific designation:
IPC-4204/1, *where "1" refers to the specification sheet detailing copper-clad polyimide dielectric with acrylic adhesive.* If further material specification details (such as dielectric, adhesive or copper thicknesses) are required, they should be highlighted in cross sectional views or notes on the master drawing.

1.1.2 Specific Designation The specific designation should be in the form shown in the following example, and is intended for use on material purchase orders by ***fabricators*** (see 6.1). The specific designation should not be used by designers on master drawings to indicate their material selection, as the designation is lengthy and requires fabricator level knowledge in making the detailed selections.

NOTE: The alpha character "Z" replaces and is entirely equivalent to the alpha character "O" (ref: Table 1-5) in the original release (prior revision) of this IPC standard. This interchange of characters within the designation will help alleviate confusion from using both the alpha character "O" and the digit "0" from the original release of this IPC standard. Legacy designs that utilize a designation and material description from the original release of this IPC standard [alpha character "O" (from Table 1-5)] may continue to be used. Supplier material certifications will reflect the current IPC standard's revision, and accordingly, the alpha character "Z" in the designation.

Example of specific designation:
IPC-4204/1 – E1E2M2/2 CU-W7-1P/1P

Where:
IPC-4204/1 – *Nonspecific Designation (see 1.1.1) specifying copper-clad dielectric with acrylic adhesive*
E *– Base Dielectric Type Designation (see 1.1.2.1) specifying polyimide*
1 *– Reinforcement Method Designation (see 1.1.2.2) specifying non-reinforced*
E *– Reinforcement Type Designation (see 1.1.2.3) specifying non-reinforced film*
2 *– Base Dielectric Thickness Designation (see 1.1.2.4) specifying 50microns [0.002 in]*
M *– Adhesive Type Designation (see 1.1.2.5) specifying acrylic adhesive*
2/2 – *Adhesive Thickness Designation (see 1.1.2.6) specifying 50 micron both sides (Not used for adhesiveless product)*
CU-W7-1P/1P – *Metal Cladding Designation (see 1.1.2.7) specifying wrought rolled annealed copper, 35 microns both sides with no treatment*

Currently in preview, click buy full version