



*The Institute for
Interconnecting
and Packaging
Electronic Circuits*

IPC-CF-152B

Composite Metallic Material Specification for Printed Wiring Boards

IPC-CF-152B

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A standard developed by the Institute for Interconnecting
and Packaging Electronic Circuits

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- Contain simple (simplified) language
- Just include spec information
- Focus on end product performance
- Include a feed back system on use and problems for future improvement

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- Increase cycle time
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- Contain anything that cannot be defended with data

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

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Acknowledgment

Any Standard involving a complex technology draws material from a vast number of sources. While the principal members of the IPC-CF-152 Task Group of the Base Materials Committee 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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Composite Metallic Material Specification for Printed Wiring Boards

1.0 SCOPE

This specification covers the requirements for copper/invar/copper (CIC), copper/molybdenum/copper (CMC), three-layer composite. The CIC material consists of copper bonded to each side of a layer of invar (nominal 36% nickel and 64% iron alloy). The copper clad molybdenum consists of copper bonded to each side of molybdenum.

1.1 Purpose This specification addresses the requirements for procurement of copper/invar/copper and copper/molybdenum/copper for use in electronic applications.

1.1.1 Applications Printed boards with ground and power planes and/or metal cores.

1.2 Designation The designation shall be in the following form:

IPC-CF-152/x	CIC	W	2
When x is the specification sheet number (see 1.2.1)	Composite Metal (see 1.2.2)	Composite Materials Foil Type (see 1.2.3)	Composite Material Thickness (see 1.2.4)

S
Bond
Enhancement
Treatment
(see 1.2.5)

1.2.1 Specification Sheet Description At the end of this document is a series of specification sheets. Each sheet outlines engineering and performance data for composite materials. The sheets are provided with a number for ordering purposes. For example, if a user wishes to order from specification sheet number 1, the number "1" would substitute the "x" in the above designation example (e.g., IPC-CF-152/1). The composite materials contained in this standard represent known products. As new materials become available they will be added to future revisions. Users and material developers are encouraged to supply information on new materials for review to the IPC-MF-150 Task Group (3-12a). Users who wish to invoke this specification for composite materials not listed shall list a zero (0) for the specification sheet number (e.g., IPC-CF-152/0).

1.2.2 Composite Metal The composite material shall be designated by a suitable two or three letter code.

CIC —Copper/Invar/Copper

CMC—Copper/Molybdenum/Copper

XX—Other

1.2.3 Composite Material Type Composite material types shall be distinguished by their process of manufacture and shall be designated:

E—Electrodeposited

W—Wrought (rolled)

O—Other

1.2.4 Composite Material Thickness Thickness of composite material shall be indicated in increments of 0.025 mm.

1.2.5 Bond Enhancement Treatment The bond enhancement treatment used on the metal surface shall be designated in the following manner:

N—No treatment, no stain proofing.

P—No treatment, with stain proofing both sides.

S—Single-sided bond enhancement treatment, with stain proofing both sides.

D—Double-sided bond enhancement treatment, with stain proofing both sides.

1.3 Presentation All dimensions and tolerances are expressed in millimeters and are not direct conversions in order to provide usable numbers. Users are cautioned to employ a single system and not to intermix millimeters and inches. Reference information is shown in parentheses ().

2.0 APPLICABLE DOCUMENTS

The following documents are referenced in this specification.

2.1 IPC¹

IPC-T-50 Terms and Definitions

IPC-PC-90 General Requirements for Implementation of Statistical Process Control

1. Publications are available from IPC, 2215 Sanders Road, Northbrook, IL 60062-6135.

IPC-TM-650 Test Method Manual²

- 2.1.1 Microsectioning
- 2.1.5 Surface Contamination
- 2.3.1.1 Chemical Cleaning of Metal Clad Laminate
- 2.3.6 Etching Ammonium Persulfate Method
- 2.3.7 Etching Ferric Chloride Method
- 2.3.7.1 Cupric Chloride Etching Method
- 2.4.1.5 Determination of Treatment Transfer
- 2.4.15 Surface Finish, Metal Foil
- 2.4.22 Bow and Twist

IPC-QL-653 Qualification of Facilities that Inspect/Test Printed Boards, Components, and Materials**2.2 American Society For Testing Materials³**

ASTM E8 Method for Tension Testing of Metallic Materials

ASTM E345 Method for Tension Testing of Metallic Foil

ASTM E384 Standard Test Method for Microhardness of Materials

2.3 National Conference of Standards Laboratories⁴

ANSI/NCSL Z540-1-1994 General Requirements for Calibration Laboratories and Measuring and Test Equipment

2.4 International Standards

ISO 10012-1 Quality Assurance Requirements for Measuring Equipment, Part 1 - Metrological Confirmation System for Measuring Equipment

3.0 REQUIREMENTS

Composite Foils shall be considered acceptable if they meet the requirements specified herein subject to agreements between user and vendor.

In the event of conflict, the following order of precedence shall apply:

1. Purchase order, as agreed upon between user and vendor (see Note 6.1).
2. Master drawing.
3. This specification.
4. Applicable documents (see 2.0).

3.1 Terms and Definitions The definition of terms shall be in accordance with IPC-T-50 and the following paragraphs.

Annealing—A treatment process consisting of heating to and holding at a suitable temperature followed by cooling at a suitable rate, used primarily to soften metallic materials, but also to simultaneously produce desired changes in microstructure or other properties.

Foil—For the purpose of this document, material less than 0.254 mm will be designated foil.

Metal Core—For the purpose of this document, metal core will refer to material thickness ≥ 0.25 mm.

Stain Proofing—A process that minimizes the oxidation of a metal foil surface.

Volume Ratio—The proportional thickness of one component of the composite material to the total thickness of the composite.

3.2 General Requirements – Acceptability

3.2.1 Roll Material Each roll of untreated or treated composite metal shall be usable for the intended applications according to the requirements of 3.3 through 3.6.

3.2.2 Sheet Material Each sheet of untreated or treated composite metal shall be usable for the intended applications according to the requirements of 3.3 through 3.6.

3.3 Visual When tested in accordance with 4.5.1, the material shall meet the visual requirements specified in 3.3.1 through 3.3.5. The composite metal shall be free of visual defects that may affect serviceability.

3.3.1 Pits and Dents Pits and dents shall be located visually using 20/20 vision. The longest dimension of each defect located shall be measured under a minimum 4X magnifier with a referee inspection of 10X. The exterior 25.4 mm border on full size sheets or rolls does not apply. The exterior 6.4 mm border of cut panels does not apply. Pits penetrating into the invar or molybdenum layer are unacceptable. The point system for pits and dents shall be as follows:

Longest Dimension	Point Value
0.13 mm to 0.25 mm inclusive	1
0.28 mm to 0.51 mm inclusive	2
0.53 mm to 0.76 mm inclusive	4
over .76 mm	30

The total point count shall be less than 30 for any 300 mm x 300 mm area.

3.3.2 Wrinkles There shall be no wrinkles.

2. For convenience, applicable test methods from IPC-TM-650 are reprinted in the back of this standard. These methods represent the latest in effect at the time of standard publication. Methods may be updated independent of standard revision. Users should check IPC-TM-650 for the most up-to-date methods.

3. Application for test methods should be addressed to American Society for Testing Materials, 1916 Race Street, Philadelphia, PA 19103

4. Publications are available from: Standardization Documents Order Desk, Building 4D, 700 Robbins Ave., Philadelphia, PA 19111-5094

3.3.3 Scratches Scratches are not permitted where the depth is more than 20% of the nominal clad metal thickness (for example, 3.5 micron for the 17 micron copper layer). No more than three scratches per 300 mm x 300 mm are allowed. Any scratch with a depth less than 5% of the nominal clad metal thickness shall not be counted.

3.3.4 Holes, Tears, and Delaminations The material shall be substantially free of holes, tears, and delaminations. If present, holes, tears, and delaminations shall be suitably marked or flagged.

3.3.5 Cleanliness The composite metal shall be free from dirt, oil, corrosion, salts, smut, grease, finger prints, foreign matter, and other defects that may affect the life, serviceability, or appearance of the composite metal.

3.4 Dimensional When tested in accordance with 4.5.2, the material shall meet the dimensional requirements specified in 3.4.1 through 3.4.5.

3.4.1 Sheet Width and Length The width and length of sheets of composite metal shall be as specified in the procurement document (see 6.1). The length and width of the material shall be ± 3.2 mm of the value specified, or as agreed upon between user and vendor.

3.4.2 Roll Width The width of the composite metal shall be as specified in the procurement document (see 6.1). The width of the material shall be ± 3.2 mm of the value specified, or as agreed upon between user and vendor.

3.4.3 Thickness The overall thickness of composite metals should not include any treatment when present. The thickness is determined by 4.5.3 and shall be in accordance with the values specified in the applicable slash sheet.

3.4.4 Tolerance of Composite Layer Volume Ratio Individual layer volume ratios in the composite metals shall be as specified in the designated slash sheet.

3.4.5 Composite Metal Finish The finish of the treated metal shall be in accordance with the applicable specification sheet as determined by 4.5.4.

3.5 Physical Requirements

3.5.1 Mechanical Properties Testing for tensile, yield, and elongation shall be as specified in 3.5.1.1 through 3.5.1.3. Testing will be completed in the longitudinal (machine) direction.

3.5.1.1 Tensile Minimum tensile strength for the composite metal shall be in accordance with applicable specification sheet as determined by 4.5.5.

3.5.1.2 Yield Minimum yield for the composite metal shall be in accordance with the applicable sheet as determined by 4.5.6.

3.5.1.3 Elongation Minimum elongation values for composite metals shall be in accordance with the applicable specification sheet as determined by 4.5.7.

3.5.2 Overlay Volume Ratio Overlay volume ratio for composite metals shall be in accordance with the applicable slash sheet as determined by Appendix 1.

3.5.3 Bow and Twist When tested in accordance with 4.5.8, the maximum allowable bow and twist shall be as agreed upon between user and vendor.

3.5.4 Temper Copper/Invar/Copper shall be furnished in the annealed condition, while copper/molybdenum/copper shall be furnished with fully annealed copper and stress relieved molybdenum.

3.5.4.1 Invar Hardness Invar hardness shall be tested in accordance with 4.5.9. Values shall be in accordance with the applicable slash sheet.

3.5.5 Bond Integrity

3.5.5.1 Copper to Invar or Molybdenum Bond Under microscopic examination, the material shall not delaminate after bending 180° around a mandrel with a diameter equal to twice the material thickness.

3.5.5.2 Copper to Molybdenum Bond Under microscopic examination, the material shall not delaminate after bending 180° around a mandrel with a diameter equal to twice the material thickness.

3.5.6 Coefficient Of Thermal Expansion (X, Y) The average coefficient of thermal expansion values are measured per Appendix 1, paragraph 2, and shall be in accordance with the applicable slash sheet. The average expansion, as measured in the rolling direction, will be reported for a temperature range of -55°C to 125°C.

3.6 Processing Requirements—Treated Composite Foils

3.6.1 Etchability The composite metal surface treatment, including the composite metal treatment, shall be capable of being removed by normal etching processes when evaluated in accordance with 4.5.10. The treatment shall be functionally uniform within a roll.

3.6.2 Chemical Cleaning When evaluated in accordance with 4.5.11, the foil shall exhibit a uniform appearance.

3.6.3 Treatment Integrity Treatment integrity shall be tested in accordance with 4.5.12. Actual requirements shall be as specified in the procurement document and as agreed upon between user and vendor.

4.0 Quality Assurance Provisions

4.1 Quality System A quality system shall be documented to support the conformance testing frequency selected by the composite metallic material manufacturer.

4.2 Responsibility for Inspection Unless otherwise specified in the purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the purchase order, the supplier may use his own or any other facility suitable for the performance of the inspection requirements herein.

4.2.1 Test Equipment and Inspection Facilities Testing and measuring equipment and inspection facilities of sufficient accuracy, quality, and quantity to permit performance of the required inspection shall be established and maintained by the supplier. The establishment and maintenance of a calibration system to control the accuracy of the measuring and testing equipment shall be in accordance with ANSI/NCSL Z540-1-1994 or ISO 10012-1.

4.2.2 Standard Laboratory Conditions Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in IPC-QL-653.

4.3 Qualification Inspection Qualification testing shall be performed on the test specimens, which are produced with equipment and procedures normally used in production. Qualification testing samples may be combined for those materials where volume ratio will not affect results. Where the test is ratio dependent, combination is not permitted.

4.3.1 Frequency Each material (as outlined in the specification sheets) shall undergo qualification once. Upon demand, the vendor shall provide certified data that the supplied material is qualified to this standard. Qualification retesting is not required, unless agreed upon between user and vendor.

4.4 Quality Conformance Inspection

4.4.1 Quality Conformance Inspection Quality Conformance Inspection shall be as documented in the composite metallic material supplier's Manufacturing Quality System. If a documented quality system does not exist, conformance testing shall be conducted in accordance with

Table 1. Additional testing required by the user must be included in the purchase order.

4.4.1.1 Frequency The frequency of conformance testing shall be as specified in the Manufacturers Quality System or as specified in Table 1 or by the purchase order. Where "lot" is defined in 4.4.1.2, additional samples may be taken to satisfy the terms of the purchase order. It is recommended that a user of the composite metal foil inspect at least one sample per 300 m of sheet or rolled material.

4.4.1.2 Lot A lot is a manufacturer's master roll not exceeding 4500 kg and having undergone essentially identical processing on the same processing line.

4.4.1.2.1 Lot Size The lot size is the number of units of product in a lot.

4.4.1.2.2 Unit Size The unit size is used to determine the number of samples to be taken from a master roll for quality conformance inspection. A unit of composite metal is 45 kg. Proper sampling shall be determined between supplier and user.

4.4.1.3 Acceptance Criteria The acceptance number for all tests conducted on a lot basis will be zero (0). For tests conducted on a month or over basis, the acceptance number shall be defined by user and supplier.

4.4.1.4 Rejected Lots If an inspection lot is rejected, the supplier may rework it to correct the defects or screen out the defective units and resubmit for reinspection. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots and clearly identified as reinspected lots while the material is within the manufacturer's facility. If the defect cannot be screened out, the supplier shall sample additional lots and make processing corrections as necessary. If the additional lots inspected show the same defect, it shall be the supplier's responsibility to contact the users regarding the problem.

4.4.2 Sampling Plan Sampling plans for quality conformance inspection are in accordance with Table 1.

4.4.3 Sample Unit The definition of a sample unit is 1 m for roll goods.

4.4.4 Group A Inspection Group A inspection shall consist of tests specified in Table 1.

4.4.4.1 Sampling Plan A sampling plan sufficient to ensure an acceptable quality level (AQL) of 4.0% shall be used (see Table 1). Sampling plans shall be substantiated by the vendor and available for inspection by the user upon request.



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