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ELECTRONICS INDUSTRIES

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Metal Foil for Printed Board Applications

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Base Materials Committee (3-10) of IPC

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

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Table of Contents

1 SCOPE	1	3.4.4 Area Weight	4
1.1 Purpose	1	3.4.4.1 Copper Foil.....	4
1.2 Foil Designation	1	3.4.4.2 Other Metallic Foil.....	4
1.2.1 Specification Sheet Description	1	3.4.5 Foil Profile.....	4
1.2.2 Foil Metal	1	3.5 Physical Requirements	4
1.2.3 Foil Type.....	1	3.5.1 Tensile Strength	4
1.2.4 Foil Grade	1	3.5.2 Fatigue Ductility.....	5
1.2.4.1 Foil Grades	1	3.5.3 Elongation.....	5
1.2.4.2 Other Metal Foil Grades	1	3.5.4 Peel Strength.....	5
1.2.5 Foil Weight and Thickness	1	3.5.5 Carrier Release Strength	5
1.2.5.1 Copper Foil Area Weight	1	3.5.6 Surface Finish.....	5
1.2.5.2 Thickness of Foils Other than Copper	1	3.6 Processing Requirements	5
1.2.6 Bond Enhancement Treatment	1	3.6.1 Etchability.....	5
1.2.7 Foil Profile.....	2	3.6.2 Chemical Cleaning	5
1.3 Quality/Performance Classification.....	2	3.6.3 Solderability.....	5
1.4 Presentation.....	2	3.6.4 Treatment Integrity	5
2 APPLICABLE DOCUMENTS	3	3.7 Workmanship	5
2.1 IPC	3	3.8 Requirements for Specific Metal Foil	5
2.3 ISO Standards	3	3.8.1 Copper Foil	5
3 REQUIREMENTS	3	3.8.1.1 Purity.....	5
3.1 Terms and Definitions	3	3.8.1.2 Resistivity	5
3.1.1 AABUS (As Agreed Upon Between User and Supplier)	3	3.8.2 Nickel Foil.....	5
3.1.2 Profile Factor	3	4 QUALITY ASSURANCE PROVISIONS	5
3.2 General Requirements Acceptability	3	4.1 Statistical Process Control (SPC)	5
3.2.1 Sheet Material.....	3	4.2 Responsibility for Inspection	6
3.2.2 Roll Material.....	4	4.2.1 Test Equipment and Inspection Facilities.....	6
3.3 Visual	4	4.2.2 Preparation of Samples	6
3.3.1 Pits and Dents.....	4	4.2.3 Standard Laboratory Conditions	6
3.3.2 Wrinkles.....	4	4.2.3.1 Permissible Temperature Variation in Environmental Chambers	6
3.3.3 Scratches	4	4.2.3.2 Reference Conditions	6
3.3.4 Holes and Tears	4	4.2.4 Tolerances	6
3.3.5 Cleanliness	4	4.3 Classification of Inspections	6
3.3.6 Pinholes and Porosity.....	4	4.4 Qualification Inspection	6
3.4 Dimensional.....	4	4.4.1 Frequency	6
3.4.1 Sheet Length and Width.....	4	4.4.2 Inspection of Product for Delivery	6
3.4.2 Roll Width	4	4.4.3 Extent of Qualification.....	6
3.4.3 Thickness	4	4.5 Quality Conformance Inspection	6
3.4.3.1 Copper Foil.....	4	4.5.1 Quality Conformance Inspection	6
3.4.3.1.1 Electrodeposited Foil.....	4	4.5.1.1 Inspection Frequencies	7
3.4.3.1.2 Wrought Foil.....	4	4.5.1.2 Lot.....	7
3.4.3.2 Other Metallic Foils	4	4.5.1.3 Lot Size.....	7
		4.5.1.4 Unit Size.....	7



Documents

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V

4.5.2	Sampling Plan.....	7	4.6.11	Chemical Cleaning	10
4.5.3	Sample Unit.....	7	4.6.12	Solderability.....	10
4.5.4	Group A Inspection	7	4.6.13	Treatment Integrity	10
4.5.4.1	Sampling Plans for Class 3 Material.....	8	4.6.14	Purity.....	10
4.5.4.2	Sampling Plans for Class 2 Material.....	8	4.6.15	Resistivity	10
4.5.4.3	Sampling Plan for Class 1 Material	8	4.7	Statistical Process Control (SPC)	10
4.5.4.4	Rejected Lots.....	8	5	PREPARATION FOR DELIVERY	10
4.5.5	Group B Inspection	8	5.1	Splices.....	10
4.5.5.1	Noncompliance Group B	8	5.2	Wrapping.....	10
4.5.6	Group C Inspection	8	5.3	Marking.....	10
4.5.6.1	Noncompliance Group C	8	6	NOTES	11
4.6	Test Methods	8	6.1	Ordering Data	11
4.6.1	Visual	8	APPENDIX A	Copper Foil Application	
4.6.1.1	Pinhole Evaluation of Foils with Carriers.....	8		Guidelines	12
4.6.1.2	Pinhole and Porosity Evaluation.....	8			
4.6.2	Dimensions	9		Tables	
4.6.3	Thickness	9	Table 1-1	Copper Foil Weights and Thickness	2
4.6.3.1	Thickness of Foil.....	9	Table 3-1	Maximum Foil Profile.....	5
4.6.3.2	Area Weight of Foils.....	9	Table 3-2	Maximum Resistivity of Deposited Foil (All Types)	5
4.6.3.2.1	Foil with Releasable Carrier	9	Table 3-3	Maximum Resistivity for Wrought Foil (All Weights)	5
4.6.3.2.2	Foil with Etchable Carrier	9	Table 4-1	Quality Conformance Inspection	7
4.6.3.3	Foil Profile.....	9	Table 4-2	IPC-4562 Sampling Plans	7
4.6.4	Tensile Strength.....	9	Table 4-3	Lot Inspection Plan.....	8
4.6.5	Fatigue Ductility.....	9	Table A1	Application Guide for Copper Foil.....	12
4.6.6	Elongation.....	9	Table A2	Application Guide—Hot Rupture Strength for Copper Foil	13
4.6.7	Peel Strength.....	9	Table A3	Application Guide—Rupture Bulge Height for Copper Foil	14
4.6.7.1	Peel Strength of Thin Foil with Carrier	9	Table A4	Engineering Data—Fatigue Ductility* (CIT)**.....	14
4.6.8	Release Between Carrier and Foil	9			
4.6.9	Surface Finish.....	9			
4.6.10	Etchability.....	10			

Metal Foil for Printed Board Applications

1 SCOPE

This specification covers metal foils supported by carrier films and unsupported foils suitable for subsequent use in printed boards. Unless otherwise agreed upon between user and supplier (AABUS), metal foils **shall** be considered acceptable, so long as the requirements in this specification are met.

1.1 Purpose This specification addresses the requirements for procurement of metal foils used only in printed wiring applications.

1.2 Foil Designation The foil designation **shall** be in the following forms:

IPC-4562/X	CU	E	3
Where X is the specification sheet number (See 1.2.1)	Foil Metal (See 1.2.2)	Foil Type (See 1.2.3)	Foil Grade (See 1.2.4)
2	S	XS	3
Foil Thickness (See 1.2.5)	Bond Enhancement Treatment (See 1.2.6)	Foil Profile (See 1.2.7)	Quality Classification (See 1.3)

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 a metal foil. The sheets are provided with a number for ordering purposes. For example, if a user wishes to order from specification sheet 1, the number "1" would be substituted for the "X" in the above designation example (e.g., IPC-4562/1).

The metal foils contained in this standard represent known materials. As new foils become available, they will be added to future revisions. Users and material developers are encouraged to supply information on new materials for review by the Metallic Foils Task Group (3-12a). Users who wish to invoke this specification for metal foils not listed **shall** list a 0 (zero) for the specification sheet number (e.g., IPC-4562/0).

This specification provides quality classes (see 1.2.3 through 1.2.7) for requirements to reflect functional performance (see Appendix A) and testing properties. The reference of a single class does not preclude invoking specific requirements defined in other classes.

1.2.2 Foil Metal The metal foil **shall** be designated by a suitable two- or three-letter code:

CU - Copper

NI - Nickel

XX - Other

1.2.3 Foil Type Metal foil types **shall** be distinguished by their process of manufacture and **shall** be designated as:

E - Electrodeposited

W - Wrought (rolled)

O - Other

1.2.4 Foil Grade

1.2.4.1 Foil Grades Foil grades **shall** be distinguished according to the following foil grade designations:

1. Standard electrodeposited (STD-Type E)
2. High ductility electrodeposited (HD-Type E)
3. High temperature elongation electrodeposited (HTE-Type E)
5. As rolled-wrought (AR-Type W)
7. Annealed-wrought (ANN-Type W)
8. As rolled-wrought low temperature annealable (LTA-Type W)
9. Nickel, standard electrodeposited
10. Electrodeposited low temperature annealable (LTA-Type E)
11. Electrodeposited annealable (A-Type E)

1.2.4.2 Other Metal Foil Grades Other metal foil grades will be designated as the need arises.

1.2.5 Foil Weight and Thickness

1.2.5.1 Copper Foil Area Weight The area weight and nominal thickness for copper **shall** be as identified in Table 1-1.

1.2.5.2 Thickness of Foils Other than Copper Thickness of all other metals **shall** be indicated by dimensions to the nearest 0.025 mm [0.0009843 in].

1.2.6 Bond Enhancement Treatment The bond enhancement treatment used on the metal foil **shall** be designated as one of the following:

N - No treatment; no stain proofing

P - No treatment; stain proofing both sides

S - Single-sided bond enhancement treatment (matte side); stain proofing on both sides

Table 1-1 Copper Foil Weights and Thickness

Foil Designation	Common Industry Terminology	Metric		English		
		Area Weight (g/m ²)	Nominal Thickness (μm)	Area Weight (oz./ft. ²)	Area Weight (g/254 in ²)	Nominal Thickness (10 ⁻³ in)
E	5 μm	45.1	5.1	0.148	7.4	0.20
Q	9 μm	75.9	8.5	0.249	12.5	0.34
T	12 μm	106.8	12.0	0.350	17.5	0.47
H	1/2 oz	152.5	17.1	0.500	25.0	0.68
M	3/4 oz	228.8	25.7	0.750	37.5	1.01
1	1 oz	305.0	34.3	1	50.0	1.35
2	2 oz	610.0	68.6	2	100.0	2.70
3	3 oz	915.0	102.9	3	150.0	4.05
4	4 oz	1220.0	137.2	4	200.0	5.40
5	5 oz	1525.0	171.5	5	250.0	6.75
6	6 oz	1830.0	205.7	6	300.0	8.10
7	7 oz	2135.0	240.0	7	350.0	9.45
10	10 oz	3050.0	342.9	10	500.0	13.50
14	14 oz	4270.0	480.1	14	700.0	18.90

For nominal weights not listed in this table the nominal thickness is calculated as follows:

Thickness (10⁻³ in) = 1.35 x Area Wt. (oz/ft²)

Where 1.35 is a factor determined from the density of copper foil assumed to be 8.93 g/cm³ [5.16 oz/in³]. This factor is within 1% for all densities from 8.81 g/cm³ to 8.99 g/cm³.

For any alloy or other metals outside this density range the appropriate factor must be used to calculate the foil thickness.

For double-sided bond treated foils, the nominal area weight **shall** be increased by 4.58 g/m² [0.75 g/254 in² or 0.0150 oz/ft²] to the values in Table 1-1 to determine the upper tolerance limits.

Caution: Values in the table are not representative of mechanical thickness of the foil. An allowance for the roughness of the treated side must be added to all values.

D - Double-sided bond enhancement treatment; stain proofing on both sides

R - Reverse-treated bond enhancement (cathode side); stain proofing on both sides

1.2.7 Foil Profile All foils **shall** have a two-letter descriptor to designate the profile of both the cathode and anode/matte sides. Order **shall** be the cathode side followed by matte side. Profile ranges not accommodated below will be AABUS.

Designation	Description
X	No treatment or roughness (see 3.5.6)
S	Standard profile foil
L	Low profile foil
V	Very low profile foil

1.3 Quality/Performance Classification Three general classes have been established to reflect progressive increases in inspection and testing frequency. It should also be recognized that there is typically an overlap between classes. In many cases the difference between classes is one of attribute assurance level not attribute difference. The user has the responsibility to determine the class into which his product belongs. Testing and inspection requirements in this specification have been separated so the metallic foils

may be tested to any one of the three quality/performance classes.

The three classes are:

Class 1 Material in this class is suitable for applications where mechanical properties and cosmetic defects are not important, and the only requirement is functionality of the complete circuit. This material has no prescribed inspection and testing requirements.

Class 2 Material in this class is suitable for use where circuit design, process yield, and specification conformance requirements allow localized areas of nonconformance. This material has moderate levels of assurance, demonstrated via the use of testing and/or statistical process control (SPC)/statistical quality control (SQC) techniques.

Class 3 Material in this class is suitable for applications where high levels of assurance are required. These levels of assurance **shall** be demonstrated via the use of testing and/or SPC/SQC techniques.

1.4 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 mix metric and English equivalents. Reference information is shown in brackets [].

2 APPLICABLE DOCUMENTS

The following documents, issue currently in effect, form a part of this specification to the extent specified herein.

2.1 IPC¹

IPC-T-50 Terms and Definitions for Interconnecting and Packaging Electronic Circuits

IPC-9191 General Guidelines for Implementation of Statistical Process Control (SPC)

IPC-D-330 Design Guide Manual

IPC-TR-484 Results of Copper Foil Ductility Round Robin

IPC-TR-485 Results of Copper Foil Rupture Strength Test Round Robin Study

IPC-TM-650 Test Methods Manual²

- 2.1.2 Pinhole Evaluation, Dye Penetration Method
- 2.1.5 Surface Examination, Unclad and Metal Clad Material
- 2.2.12 Thickness of Copper By Weight
 - 2.2.12.1 Overall Thickness and Profile Factor of Copper Foils Treated and Untreated
 - 2.2.12.2 Weight and Thickness of Copper Foils with Releasable Carriers
 - 2.2.12.3 Weight and Thickness Determination of Copper Foils with Etchable Carriers
- 2.2.17 Surface Roughness and Profile of Metallic Foils (Contacting Stylus Technique)
 - 2.3.1.1 Chemical Cleaning of Metal Clad Laminates
- 2.3.6 Etching, Ammonium Persulfate Method
- 2.3.7 Etching, Ferric Chloride Method
 - 2.3.7.1 Cupric Chloride Etching Method
- 2.3.15 Purity, Copper Foil or Plating
- 2.4.1.5 Determination of Treatment Transfer
 - 2.4.2.1 Flexural Fatigue and Ductility, Foil
- 2.4.8 Peel Strength of Metallic Clad Laminates
 - 2.4.8.4 Carrier Release, Thin Copper
- 2.4.12 Solderability, Edge Dip Method
- 2.4.18 Tensile Strength and Elongation, Copper Foil
- 2.5.14 Resistivity of Copper Foil

2.2 NCSL National Conference of Standards Laboratories³

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

2.3 ISO Standards⁴

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

ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories

3 REQUIREMENTS

Metal foils **shall** be considered acceptable if the requirements specified herein are met, unless otherwise AABUS. The specification (slash) sheets specify the specific requirements for a metal foil.

Note: Unless otherwise specified, Class 3 material **shall** be used for military electronic equipment. If no quality classification is specified, Class 1 is assumed.

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

1. Purchase order AABUS
2. Compliance to IPC-4562
3. Applicable documents (see Section 2)

3.1 Terms and Definitions The definition of terms **shall** be in accordance with IPC-T-50, 3.1.1 and 3.1.2.

3.1.1 AABUS (As Agreed Upon Between User and Supplier) Indicates additional or alternate requirements to be decided between the user and the supplier in the procurement documentation. Examples include contractual requirements, modifications to purchase documentation and information on the drawing. Agreements can be used to define test methods, conditions, frequencies, categories or acceptance criteria within a test, if not already established.

3.1.2 Profile Factor The amount by which the overall average thickness of a metal foil sample exceeds the thickness calculated from the established density of the metal foil and the actual area weight of the sample.

3.2 General Requirements Acceptability

3.2.1 Sheet Material Each sheet of metal foil **shall** be usable for the intended applications according to the requirements of 3.3 through 3.8.

1. IPC, 2215 Sanders Rd., Northbrook, IL 60062-6135, (847) 509-9700, www.ipc.org.

2. Current and revised IPC Test Methods are available on the IPC Web site (www.ipc.org/html/testmethods.htm)

3. www.ncsl-hq.org

4. www.ansi.org 642-4900, www.ansi.org.