

SEMI G4-0302 (Reapproved 0811) SPECIFICATION FOR INTEGRATED CIRCUIT LEADFRAME MATERIALS USED IN THE PRODUCTION OF STAMPED LEADFRAMES

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NOTICE: This Standard or Safety Guideline has an Inactive Status because the conditions to maintain Current Status have not been met. Inactive Standards or Safety Guidelines are available from SEMI and continue to be valid for use.

1 Scope

1.1 This Specification covers the special requirements for a metal strip to be used to fabricate integrated circuit leadframes by stamping.

NOTICE: SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

2 Referenced Standards and Documents

2.1 Regional standards such as ANSI, ASTM, CEN, EN ISO, JIS, and MIL.

2.2 *ASME Standard*¹

ASME B46.1 — Surface Texture (Surface Roughness, Waviness and Lay)

2.3 *ASTM Standards*²

ASTM B193 — Test Method for Resistivity of Electrical Conductor Materials

ASTM B601 — Classification for Temper Designations for Copper and Copper Alloys—Wrought and Cast

ASTM E8 — Test Methods of Tension Testing of Metallic Materials

ASTM E228 — Test Method for Linear Thermal Expansion of Solid Materials with a Push-Rod Dilatometer

ASTM E290 — Test Methods of Bend Testing of Material for Ductility

ASTM E384 — Test Method for Knoop and Vickers Hardness of Materials

ASTM E527 — Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

2.4 *CES Standards*³

CES M0002-5 — Method of W-Bend Test for Metallic Materials

2.5 *CEN/EN Standards*⁴

EN 133/10 — Copper and Copper Alloys: Plate, Sheet, Strip, and Circles for General Purposes

EN 133/12 — Copper and Copper Alloys: Plate, Sheet, and Circles for Boilers, Pressure Vessels, and Hot Water Storage Units

¹ American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990, USA; Telephone: +1.973.882.1170, Fax: +1.973.882.1717, <https://www.asme.org>

² ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA; Telephone: +1.610.832.9585, Fax: +1.610.832.9555, <http://www.astm.org>

³ Certified Equipment Services; <http://www.certifiedequipmentservices.com>

⁴ European Committee for Standardization, Avenue Marnix 17, B-1000 Brussels; Telephone: +32.2.550.08.11, Fax: +32.2.550.08.19, <http://www.cen.eu>

EN 10002-1 — Tensile Testing of Metallic Materials – Part 1: Method of Test at Ambient Temperature

2.6 ISO Standards⁵

ISO 197-3 — Copper and Copper Alloys – Terms, and Definitions – Part 3: Wrought Products

ISO 1190-1 — Copper and Copper Alloys – Code of Designation – Part 1: Designation of Materials

ISO 4287-1 — Surface Roughness – Terminology – Part 1: Surface and Its Parameters

ISO 6507-1 — Metallic Materials – Vickers Hardness Test – Part 1: Test Method

ISO 6507-2 — Metallic Materials – Vickers Hardness Test – Part 2: Verification and Calibration of Testing Machines

ISO 7438 — Metallic Materials – Bend Test

2.7 JIS Standards⁶

JIS B 0601 — Definitions and Designation of Surface Roughness

JIS H 0505 — Measuring Methods for Electrical Resistivity and Conductivity of Non-Ferrous Materials

JIS H 3100 — Copper and Copper Alloy Sheets, Plates and Strips

JIS H 3110 — Phosphor Bronze and Nickel Silver Sheets, Plates and Strips

JIS Z 2201 — Test Pieces for Tensile Test for Metallic Materials

JIS Z 2241 — Method of Tensile Test for Metallic Materials

JIS Z 2244 — Vickers Hardness Test – Test Method

JIS Z 2251 — Knoop Hardness Test – Test Method

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

3 Ordering Information

3.1 Orders for material under this specification shall include the following information:

3.1.1 Quantity of each size.

3.1.2 Alloy name and number (see § 4).

3.1.3 Temper or mechanical properties (see § 4).

3.1.4 Dimensions: thickness and width (see § 5)

3.1.5 How furnished: coils and coil size (see § 10)

3.1.6 Special processing requirements

3.1.7 Certification or test report requirements (see § 11).

4 Designations

4.1 Material designations shall be based on appropriate area standards based on country or area of material origin.

4.1.1 *Europe* — ISO 1190-1

4.1.2 *Japan* — JIS H 3100, JIS H 3110

4.1.3 *United States* — ASTM E527

4.2 Temper designations shall be based on appropriate area standards based on country or area of material origin.

⁵ International Organization for Standardization, ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland; Telephone: +41.22.749.01.11, <http://www.iso.org>

⁶ Japanese Standards Association, 4-1-24 Akasaka, Minato-ku, Tokyo 107-8440, Japan; Telephone: +81.3.3583.8005, Fax: +81.3.3586.2014, <http://www.jsa.or.jp>

4.2.1 *Europe* — EN 133/10, EN 133/12

4.2.2 *Japan* — JIS H 3100, JIS H 3110

4.2.3 *United States* — ASTM B601

5 Requirements

5.1 General Requirements

5.1.1 The materials covered by this Specification shall conform to the requirements detailed herein, unless otherwise agreed upon by supplier and purchaser.

5.2 Mechanical Properties

5.2.1 The preferred method of designating mechanical properties of material covered under this Specification is tensile strength. In addition to tensile strength, the 0.2% offset yield strength and percent elongation in 50 mm may be required if agreed between supplier and purchaser. The test shall conform to the appropriate area standards based on country or area of material origin.

5.2.1.1 *Europe* — EN 10002-1

5.2.1.2 *Japan* — JIS Z 2201, JIS Z 2241

5.2.1.3 *United States* — ASTM E8

5.2.2 Should supplier and purchaser agree, microhardness may be used in lieu of tensile strength as the test for mechanical property. The test shall conform to the appropriate area standard based on country or area of material origin.

5.2.2.1 *Europe* — ISO 6507-1, ISO 6507-2

5.2.2.2 *Japan* — JIS Z 2251, JIS Z 2244 (test load shall be chosen from Table 1).

5.2.2.3 *United States* — ASTM E384

Table 1

<i>Thickness of Metal Strip (mm)</i>	<i>Test Load of Vickers Hardness</i>
0.100 to 0.160	1.961 N (200 gf)
over 0.160 to 0.500	4.903 N (500 gf)
over 0.500	9.807 N (1 Kgf)

5.3 Thickness and Width Tolerance

5.3.1 Thickness tolerance for material covered under this Specification shall be chosen from Tables 2 and 3.

Table 2

<i>Thickness</i>	<i>Tolerance</i>
0.10 to 0.15 mm	±0.005 mm
over 0.15 to 2.0 mm	±3% of the ordered material thickness

Table 3

<i>Thickness</i>	<i>Tolerance</i>
0.10 mm up to 0.15 mm	±0.005 mm
0.15 mm up to 0.3 mm	±0.008 mm
0.3 mm up to 0.5 mm	±0.010 mm

<i>Thickness</i>	<i>Tolerance</i>
0.5 mm up to 0.8 mm	±0.013 mm
0.8 mm up to 1.0 mm	±0.015 mm
1.0 mm up to 1.5 mm	±0.020 mm
1.5 mm up to 2.0 mm	±0.025 mm

#1 Table 3 is used in Europe.

5.3.2 Width tolerance shall be as shown in Tables 4 and 5.

Table 4

<i>Width</i>	<i>Thickness</i>	<i>Tolerance</i>
under 15 to 55 mm	0.1 mm to under 0.3 mm	±0.05 mm
	0.3 mm to under 1.0 mm	±0.08 mm
	1.0 to 2.0 mm	±0.15 mm
over 55 to 100 mm	0.1 mm to under 0.3 mm	±0.08 mm
	0.3 mm to under 1.0 mm	±0.12 mm
	1.0 to 2.0 mm	±0.15 mm

Table 5

<i>Width</i>	<i>Thickness</i>	<i>Tolerance</i>
under 15 mm	over 0.1 to 0.3 mm	±0.05 mm
	over 0.3 to 1.0 mm	±0.08 mm
	over 1.0 to 2.0 mm	±0.15 mm
15 to 55 mm	over 0.1 to 0.3 mm	±0.05 mm
	over 0.3 to 1.0 mm	±0.08 mm
	over 1.0 to 2.0 mm	±0.15 mm
over 55 to 100 mm	over 0.1 to 0.3 mm	±0.08 mm
	over 0.3 to 1.0 mm	±0.12 mm
	over 1.0 to 2.0 mm	±0.15 mm

#1 Table 5 is used in Europe.

5.4 Surface Finish

5.4.1 The material shall be commercially free of surface imperfections such as pits, nicks, dents, gouges, scratches, laminations, or inclusions.

5.4.2 The surface roughness of both sides shall be measured perpendicular to the direction of rolling and indicated as the arithmetic average height (R_a) and the maximum peak-to-valley roughness height (R_{max}).

5.4.2.1 Measurement and designations of surface roughness shall conform to appropriate area standards based on country or area of material origin.

5.4.2.1.1 *Europe* — ISO 4287-1

5.4.2.1.2 *Japan* — JIS B0601

5.4.2.1.3 *United States* — ASME B46.1

5.4.2.2 Conditions for the measurement are shown in Table 6.

Table 6

<i>Radius of Diamond Stylus: Less than 5 mm</i>	<i>(Record Actual Size)</i>
Cut Off:	0.8 mm
Stroke:	4 mm

5.4.2.3 Maximum acceptable values for surface roughness are shown in Table 7.

Table 7

<i>Thickness</i>	<i>R_a</i>	<i>R_{max}</i>
0.1 mm to under 0.3 mm	0.15 μm	1.0 μm (1.5 μm)
0.3 mm to 2 mm	0.20 μm	1.5 μm (2.0 μm)

#1 Values in parentheses are used in Europe.

5.5 Camber (Edgewise Curvature)

5.5.1 Camber is measured by placing a length of strip on a flat surface against the edge of a straight edge, as shown in Figure 1. The straight edge shall be of sufficient length to equal or exceed the length traditionally used in the area or country of origin of the material. The largest amount of separation of the strip sample from the straight edge shall be measured. Extreme care must be exercised with this test to ensure that the sample illustrates a uniform camber (no reverse curvature should be present in the sample), and also that it is not bent or kinked, as this could result in a grossly inaccurate measurement. The maximum camber per length allowable are shown in Table 8.

Table 8

<i>Width</i>	<i>Thickness</i>	<i>Max Camber allowed in 1 meter</i>
Under 15 mm	0.1 mm to under 0.3 mm	1.8 mm (2.0 mm)
	0.3 mm to under 1.0 mm	2.2 mm (2.5 mm)
	1.0 mm to 2.0 mm	4.0 mm
15 mm to 55 mm	0.1 mm to under 0.3 mm	1.3 mm
	0.3 mm to under 1.0 mm	2.0 mm
	1.0 mm to 2.0 mm	3.0 mm
Over 55 mm to 100 mm	0.1 mm to under 0.3 mm	1.0 mm
	0.3 mm to under 1.0 mm	1.5 mm
	1.0 mm to 2.0 mm	2.5 mm

5.6 Flatness

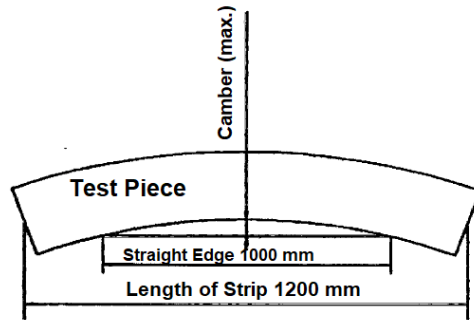


Figure 1
Camber

5.6.1 Coil Set (Longitudinal Curl)

5.6.1.1 Coil set shall be measured by attaching a length of strip, appropriate to the country or area of material origin, to a flat vertical surface as shown in Figure 2. The attachment shall be with a rigid block, wider than the strip. The block shall be so rigid as to ensure complete contact of the strip with the vertical surface. The distance between the flat surface and the free-hanging end of the strip (that is positioned for maximum distance from the flat vertical surface) shall be measured. The coil set shall be uniformly in the direction of coiling. Lengths shall be appropriate to the country or area of material origin. Maximum coil set for appropriate lengths are shown in Tables 9 and 10.

Table 9

<i>Inside Diameter of Coil</i>	<i>Thickness</i>	<i>Width</i>	<i>Max Coil Set in 1 m</i>
400 mm	under 0.3 mm	under 100 mm	100 mm

Table 10

<i>Thickness</i>	<i>Width</i>	<i>Max Coil Set in 0.3 m</i>
Under 0.3 mm	up to 15 mm	60 mm
	over 15 to 24 mm	50 mm
	over 24 to 55 mm	45 mm
	over 55 to 100 mm	40 mm
0.3 mm to 0.5 mm	up to 15 mm	70 mm
	over 15 to 24 mm	60 mm
	over 24 to 55 mm	55 mm
	over 55 to 100 mm	50 mm

#1 Table 10 is used in Europe.

5.6.2 Crossbow (Dish)

5.6.2.1 Crossbow shall be measured across the width of the strip, as shown in Figure 3. Burrs shall be removed or burr height excluded from this measurement. Crossbow shall be measured with a tool maker's microscope or equivalent. Crossbow maxima are listed in Tables 11 and 12.