

MOLEX MATERIAL SPECIFICATION – C51000 ALLOY

1.0 SCOPE

This specification covers the comprehensive technical requirements, applicable reference documents, and quality requirements for metal strips. The values listed for acceptance criteria are in SI units.

2.0 PURPOSE

The purpose of this specification is to comprehensively define the Molex requirements for the alloy’s chemical composition, physical properties, mechanical properties, and reference other applicable documents related to quality requirements and dimensional tolerances.

This specification meets or exceeds the requirements cited in the primary regional norms typically referenced for copper alloy strip manufacture in UNS C51000 alloy; ASTM B888M/ASTM B103M, EN 1654 (CuSn5), and JIS H 3110 (C 5102 R).

3.0 REFERENCE DOCUMENTS

This primary specification focuses on the physics of C51000 alloy and related mechanical properties to ensure Molex product performance. Other Molex documents are necessary to verify material characteristics that support high quality and manufacturability of products.

These reference documents are crucial to the Molex process / product and therefore all requirements contained within them must be attested to and demonstrate their conformance, within the supplier’s process certification:

ASTM B888M / ASTM B103M and the associated reference documents listed under *2.1 ASTM Standards*

ASTM B820 is specifically mentioned as critical to Molex formability requirements

JIS H3110 and UFG supplier citations (< 4µm)

2090580043 Geometric Conditions and Tolerances for Metal Strips

2090580044 Metal Strip Surface conditions and Requirements

4.0 ORDER OF PRECEDENCE

This defines the priority order that should be followed when reviewing attributes and requirements of metal strip:

1. Molex Purchase Order
2. Packaging Specifications
3. Molex (Individual) Metal Strip Specification (i.e. Part Number Specification)
4. Molex Material Alloy Specification (**This document – 2090580048**– Molex Material Specification – C51000 Alloy Metal Strips)
5. Surface (2090580044) and Geometric (2090580043) Global Engineering Specifications

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REVISION DESCRIPTION	NEW RELEASE (TRANSITIONED FROM 400005023-ES)			MOLEX MATERIAL SPECIFICATION – C51000 ALLOY METAL STRIPS			
CHANGE NO.	849683						
REVISED BY	ELIJAH RESNICK	DATE	2026/04/15	DOC TYPE	DOC TYPE DESCRIPTION	DOC PART	SERIES
REV APPR BY	DANIEL MOLLA	DATE	2026/04/15	QMD	ENGINEERING STANDARD	000	209058
INITIAL RELEASE				CUSTOMER	DOCUMENT NUMBER	REVISION	SHEET
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5.0 DEFINITIONS

Ultrafine grain (UFG) – is defined as a “ready-to-finish” grain size of less than 0.004 mm (< 4µm).

6.0 TECHNICAL REQUIREMENTS

6.1 Chemical Composition

UNS #	Cu wt.%	Pb wt.%	Fe wt.%	P wt.%	Sn wt.%	Zn wt.%
C51000 ²	Remainder	≤ 0.05	≤ 0.10	0.03 – 0.35	4.2 – 5.8	≤ 0.30

2. Copper + Sum of Named Elements = 99.5% min.

Limits for unnamed elements may be established between Molex and the supplier to satisfy certain environmental or customer requirements.

6.2 Mechanical Properties (longitudinal direction)

Mechanical Properties Table C51000				
Designation	Tensile Strength (1)	Yield Strength (1)	Elongation %	RTF Grain size (2)
	(MPa)	0.2% offset (MPa)	in 50 mm	(mm)
061	315 - 385	≥ 130	≥ 48	N/A
H01	340 - 420	≥ 150	≥ 32	≤ 0.030
H02	400 - 505	≥ 325	≥ 10	≤ 0.025
H03	470 - 545	≥ 420	≥ 10	≤ 0.020
H04	525 - 625	≥ 510	≥ 9	≤ 0.010
H06	605 - 710	≥ 585	≥ 2	≤ 0.010
H08	655 - 760	≥ 635	≥ 1	≤ 0.010
H10	690 - 785	≥ 675	≥ 1	≤ 0.010
HR04	525 - 625	≥ 510	≥ 9	≤ 0.010
HR06	605 - 710	≥ 552	≥ 6	≤ 0.010
HR08	655 - 760	≥ 607	≥ 3	≤ 0.010
HR10	690 - 785	≥ 648	≥ 2	≤ 0.010

Notes:

(1) Tensile requirements are longitudinal values in uniaxial tension in accordance with ASTM E8M

(2) Ready to Finish (RTF) grain size is measured before final rolling for the H/HR tempers

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6.3 Electrical Conductivity (SnP bronze conductivity is strongly influenced by chemical composition)

6.3.1 For annealed temper (“O” temper codes) the minimum requirement shall be 8.7 MS/m (15% IACS) @ 20°C

6.3.2 For rolled tempers (“H”, “HR” temper codes) the minimum requirement shall be 7.5 MS/m (13% IACS) @ 20°C

6.3.3 The test standard shall be ASTM E 1004 (eddy current) or ASTM B 193 (resistivity)

6.4 Bending properties

Bending of metal strip samples shall be in accordance with ASTM B 820; Bend Test for Formability of Copper Alloy Spring Material. The requirement is that the supplier’s material, when tested at finished thickness and temper, will be capable of achieving the inside bend radii as listed in the tables below without observable cracking on the outside bend radius (reference 5.4.1.) At a minimum, samples shall be tested in both directions, at 180° of bending, at the most representative thickness category for the metal strip purchase order.

If special forming requirements are necessary, those will be listed separately on the part number document.

H04		90° GW	180° GW	90° BW	180° BW	HR04		90° GW	180° GW	90° BW	180° BW
Thickness		10:1 w/t		10:1 w/t		Thickness		10:1 w/t		10:1 w/t	
0.51-1.0 mm		0.8 r/t	1.5 r/t	0.8 r/t	2.5 r/t	0.51-1.0 mm		0.5 r/t	0.5 r/t	0.5 r/t	1.2 r/t
0.3-0.5 mm		0.5 r/t	1.0 r/t	0.5 r/t	2.0 r/t	0.3-0.5 mm		0.5 r/t	0.5 r/t	0.5 r/t	1.0 r/t
0.15-0.29 mm		0.4 r/t	0.8 r/t	0.5 r/t	1.5 r/t	0.15-0.29 mm		0.4 r/t	0.5 r/t	0.5 r/t	0.8 r/t
≤0.149 mm		0.3 r/t	0.5 r/t	0.5 r/t	1.0 r/t	≤0.149 mm		0.3 r/t	0.5 r/t	0.5 r/t	0.7 r/t
H06		90° GW	180° GW	90° BW	180° BW	HR06		90° GW	180° GW	90° BW	180° BW
Thickness		10:1 w/t		10:1 w/t		Thickness		10:1 w/t		10:1 w/t	
0.51-1.0 mm		0.8 r/t	2.5 r/t	2.5 r/t	3.5 r/t	0.51-1.0 mm		0.5 r/t	1.5 r/t	1.5 r/t	2.0 r/t
0.3-0.5 mm		0.5 r/t	2.0 r/t	2.0 r/t	3.0 r/t	0.3-0.5 mm		0.5 r/t	1.0 r/t	1.0 r/t	1.5 r/t
0.15-0.29 mm		0.4 r/t	1.8 r/t	1.5 r/t	2.5 r/t	0.15-0.29 mm		0.4 r/t	0.8 r/t	0.8 r/t	1.2 r/t
≤0.149 mm		0.3 r/t	1.0 r/t	1.0 r/t	2.0 r/t	≤0.149 mm		0.3 r/t	0.5 r/t	0.5 r/t	1.0 r/t
H08		90° GW	180° GW	90° BW	180° BW	HR08		90° GW	180° GW	90° BW	180° BW
Thickness		10:1 w/t		10:1 w/t		Thickness		10:1 w/t		10:1 w/t	
0.51-1.0 mm		1.0 r/t	2.7 r/t	3.5 r/t	4.0 r/t	0.51-1.0 mm		0.8 r/t	2.0 r/t	2.0 r/t	3.0 r/t
0.3-0.5 mm		0.5 r/t	2.2 r/t	2.5 r/t	3.5 r/t	0.3-0.5 mm		0.5 r/t	1.0 r/t	1.0 r/t	2.0 r/t
0.15-0.29 mm		0.4 r/t	2.0 r/t	2.0 r/t	3.0 r/t	0.15-0.29 mm		0.4 r/t	1.0 r/t	1.0 r/t	1.5 r/t
≤0.149 mm		0.3 r/t	1.1 r/t	1.5 r/t	2.5 r/t	≤0.149 mm		0.3 r/t	0.8 r/t	0.8 r/t	1.3 r/t
H10		90° GW	180° GW	90° BW	180° BW	HR10		90° GW	180° GW	90° BW	180° BW
Thickness		10:1 w/t		10:1 w/t		Thickness		10:1 w/t		10:1 w/t	
0.51-1.0 mm		1.5 r/t	3.7 r/t	5.0 r/t	7.0 r/t	0.51-1.0 mm		1.5 r/t	3.2 r/t	3.2 r/t	5.0 r/t
0.3-0.5 mm		0.8 r/t	3.2 r/t	4.0 r/t	6.0 r/t	0.3-0.5 mm		0.8 r/t	2.5 r/t	2.5 r/t	4.0 r/t
0.15-0.29 mm		0.5 r/t	2.5 r/t	2.5 r/t	5.0 r/t	0.15-0.29 mm		0.5 r/t	1.8 r/t	1.8 r/t	3.0 r/t
≤0.149 mm		0.3 r/t	1.5 r/t	2.0 r/t	4.0 r/t	≤0.149 mm		0.3 r/t	1.2 r/t	1.2 r/t	2.0 r/t






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Notes:

- (1) W/t = width to thickness ratio (defining bending width). r/t = inside bend radius to thickness ratio
- (2) It is the expectation that tempers lower than H04 will possess bend formability that is as good (or better) than the values listed for the H04 temper.

6.4.1 Acceptance Criteria for Bending

Bending Observations	Acceptance Criteria	Rank
	"Accepted", smooth, no orange peel, no cracks	1
	"Accepted", small orange peel, no cracks	2
	"Accepted", heavy orange peel, no cracks	3
	"Rejected", heavy orange peel, shallow cracks	4
	"Rejected", heavy orange peel, deep cracks	5

6.5 Stress Relaxation Resistance (in accordance with ASTM E 328) *

C51000 Alloy Stress Relaxation in Percent Retained @ 1000 Hours						
Temp °C	50% R _{p0.2}	80% R _{p0.2}	100% R _{p0.2}	50% R _{p0.2} [†]	80% R _{p0.2} [†]	100% R _{p0.2} [†]
75	99%	98%	76%	98%	97%	75%
100	95%	94%	72%	92%	93%	71%
125	83%	82%	60%	78%	79%	57%
150	66%	65%	43%	63%	62%	40%

*Annual test data certification required

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7.0 CERTIFICATION REQUIREMENTS

Certification at P.O. Level	Supplied Data at P.O. Level	Annual Capability Statement	Engineering Data by Request
Chemical Composition (data)		Chemical Capability	
Tensile (data)		Tensile Capability	Transverse properties
Yield (data)		Yield Capability	Spring Bending Limit
Elongation (data)			
Grain size (data)			
			Elastic Modulus (data)
Thickness (data)		Thickness Capability	
Width (data)		Width Capability	
Camber (pass/fail)			
Surface Roughness (data)			
		Stress Relaxation Verification	
Burr (pass/fail)			
Bend Formability (pass/fail)			ASTM B820 Appendix narrow beam reporting table, or other
Electrical Conductivity (data)			
			Other Physical Properties
Reference Documents (pass/fail)			

7.1 Requirements for “Annual Capability Assessment” of critical characteristics

- 7.1.1** Chemical composition requires a statistical assessment on an annual basis to verify capability. This assessment be on file and available to Molex when requested.
- 7.1.2** Mechanical properties requires a statistical assessment on an annual basis to verify capability. This assessment be on file and available to Molex when requested.
- 7.1.3** Dimensional tolerances, requires a statistical assessment on an annual basis to verify capability. This assessment be on file and available to Molex when requested.
- 7.1.4** Stress relaxation resistance is to be verified for a temper and a process in the H04 to H08 designation range at 80% of yield strength for 1000 hours at 75°C and 125°C. The supplier shall select and active Molex item to fulfill this requirement. It is acceptable to utilize Larson Miller Parameters to facilitate this annual verification audit.

7.2 Engineering Data

Acceptance of this material specification and the requirements includes the supplier’s commitment to provide other engineering data when requested. These types of data may include transverse properties, spring bending limits or other physical properties of this material.

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7.3 Recent Change Summary

Document ID# Change from **400005023-ES** → **2090580048**.

Updated **Section 3:**

- **Reference Documents** to reflect new **2090580043** and **2090580044** titles and content.
- Included JIS H3110 for UFG supplier citations.
- Removed **ES-40000-5006: Mechanical Tool-Wear Test** due to obsolescence.

Added **Section 4: Order of Precedence.**

Included definition of *Ultrafine Grain* into **Section 5: Definitions.**

Removal of what was previous **Section 6: Dimensional Requirements**

- All current Geometric and Dimensional Requirements are contained in **2090580043: GEOMETRIC CONDITIONS AND TOLERANCES FOR METAL STRIPS**. Including:
 - Strip Thickness
 - Strip Width
 - Burr
 - Camber
- All current Surface Condition Requirements are contained in **2090580044: METAL STRIP SURFACE CONDITIONS AND REQUIREMENTS**. Including:
 - Surface Roughness

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