MOLEX MATERIAL SPECIFICATION – C70250 ALLOY METAL STRIPS

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 1) to comprehensively define the Molex requirements for the alloy's chemical composition, physical properties, mechanical properties, and 2) to reference other applicable documents related to quality requirements and dimensional tolerances.

This specification, when constructed, was derived from the requirements cited in the primary regional norms typically referenced for copper alloy strip manufacture in UNS C70250 alloy; ASTM B888M, European Copper Institute and various supplier citations.

3.0 REFERENCE DOCUMENTS

This primary specification focuses on the physics of C70250 alloy and related mechanical properties to ensure Molex product performance. 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 / 2.1 ASTM Standards
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 –** 2090580050– Molex Material Specification – C70250 Alloy Metal Strips)
5. Surface (2090580044) and Geometric (2090580043) Global Engineering Specifications

5.0 TECHNICAL REQUIREMENTS

5.1 Chemical Composition

UNS #	Cu	Fe	Ni	Si	Zn	Mg	Mn
C70250 [2]	Remainder	≤ 0.20	2.2 – 4.2	0.25 – 1.2	≤ 1.0	0.05 – 0.30	≤ 0.10

2. Copper + Sum of Named Elements = 99.5% min. (all vales in weight percent)
Limits for unnamed elements may be established between Molex and the supplier to satisfy certain environmental or customer requirements. Reference “Molex Chemical Substances Specification for Products and Packaging: Supplier Requirements” (2014040014).

5.2 Mechanical Properties (longitudinal direction)

Mechanical Properties Table C70250			
Designation	**Tensile Strength (1)**	**Yield Strength (1)**	**Elongation %**
	(MPa)	0.2% offset (MPa)	in 50 mm
TM00	620 - 760	≥ 450	≥ 10
TR02	607 - 726	≥ 550	≥ 6
Y550	620 - 740	≥ 550	≥ 14
TM02	655 - 780	≥ 585	≥ 7
TM03	690 - 800	≥ 655	≥ 5
TM04	750 - 840	≥ 720	≥ 1
TM06	800 - 900	≥ 760	≥ 1
TM08	840 - 920	≥ 810	≥ 1
TM10	900 - 1000	≥ 880	≥ 1
TM12	≥ 1000	≥ 950	N/A

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

5.3 Electrical Conductivity

5.3.1 The minimum requirement for tempersTM00 – TM06 shall be 23.2 MS/m (40% IACS) @ 20°C

5.3.2 The minimum requirement for tempersTM08 – TM12 shall be 20.3 MS/m (35% IACS) @ 20°C

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

5.4 Bending properties

Bending of metal strip samples shall be in accordance with ASTM B820, Bend Test for Formability of Copper Alloy Spring Material. The requirement is that the supplier's material when tested at finished thickness and temper shall achieve the inside bend radii as listed in the table below without observable cracking on the outside bend radius (reference 5.4.1.)

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

Bend Formability Table C70250*				
Temper Designation	**90˚ Good Way**	**180˚ Good Way**	**90˚ Bad Way**	**180˚ Bad Way**
TM00	0.5 r/t	0.5 r/t	0.5 r/t	0.5 r/t
TR02	1.0 r/t	3.0 r/t	3.0 r/t	5.0 r/t
Y550	0.5 r/t	1.0 r/t	0.5 r/t	1.0 r/t
TM02	0.5 r/t	1.5 r/t	0.5 r/t	1.3 r/t
TM03	1.1 r/t	2.0 r/t	0.8 r/t	1.8 r/t
TM04	1.7 r/t	2.7 r/t	1.5 r/t	2.5 r/t
TM06	2.5 r/t	4.0 r/t	5.0 r/t	6.0 r/t
TM08	3.5 r/t	3.5 r/t	Not Practical	Not Practical
TM10	4.0 r/t	4.5 r/t	Not Practical	Not Practical
TM12	4.5 r/t	5.0 r/t	Not Practical	Not Pratical

***Test specimen criteria:**		***Test specimen criteria: Green Box**
Thickness ≤ 0.5 mm		**Thickness ≤ 0.10 mm**
Width to thickness ratio ≥ 10:1		**Width to thickness ratio @ 12:1**

Note: bending ratios (r/t) > 6.0 are listed as "Not Practical" for most designs.

Note: r/t = inside bend radius to thickness ratio

5.4.1 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

5.5 Stress Relaxation Resistance (nominal expectation, in accordance with ASTM E 328)

C70250 Thermal Stress Relaxation - Percent Retained @ 1000 Hours			
Precipitation Hardened Condition			
Temp °C	50% $Rp_{0.2}$	80% $Rp_{0.2}$	100% $Rp_{0.2}$
75	98%	96%	91%
100	97%	95%	88%
125	95%	93%	85%
150	88%	86%	77%

Note: $Rp_{0.2}$ is equivalent to 0.2% offset Yield strength

Note: This table represents the “Thermal Stress Relaxation” in the precipitation hardened state, common in most Molex applications. What is not represented here is certain types of supplier processing such as, final cold rolling, stretch-bend-levelling, etc., that negatively influence the stress relaxation curve. Additional strong negative influences come from the types and intensities of part forming processes along with, the strain component applied at the separable interface. Therefore, this thermal relaxation is only one component of the total relaxation that could be experienced in use.

6.0 CERTIFICATION REQUIREMENTS

Certification at P.O. Level	Supplied Data at P.O. Level	Annual Capability Statement	Engineering Data by Request
Chemical Compostion (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)			

6.1 Requirements for "Annual Capability Assessment" of critical characteristics

6.1.1 Chemical composition requires a statistical assessment on an annual basis to verify capability. This assessment be on file and available to Molex when requested.

6.1.2 Mechanical properties requires a statistical assessment on an annual basis to verify capability. This assessment be on file and available to Molex when requested.

6.1.3 Dimensional tolerances, requires a statistical assessment on an annual basis to verify capability. This assessment be on file and available to Molex when requested.

6.1.4 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 75ºC and 125ºC. The supplier shall select an active Molex item to fulfill this requirement. It is acceptable to utilize Larson Miller Parameters to facilitate this annual verification audit.

6.2 Engineering Data

Acceptance of this material specification and the requirements include 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.

6.3 Recent Change Summary

Document ID# Change from **400005025-ES → 2090580050**.

Updated **Section 3: Reference Documents** to reflect new **2090580043** and **2090580044** titles and content.

Removed **ES-40000-5006: Mechanical Tool-Wear Test Standard** from **Section 3: Reference Documents** due to obsolescence.

Changed **Section 4: Definitions** (with no entries) to **Section 4: Order of Precedence**.

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

Therefore, the previous **Section 7: Certification Requirements** and associated 7.X.Y subsections have decreased by one to become **Section 6: Certification Requirements** and associated 6.X.Y subsections.