MOLEX MATERIAL SPECIFICATION – C19010 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 alloy C19010 chemical composition, physical properties, mechanical properties, and reference other applicable documents related to quality requirements and standard default dimensional tolerances.

This specification is a merger of ASTM B888M, and supplier literature for UNS alloy C19010 to meet the needs of Molex connector applications.

3.0 REFERENCE DOCUMENTS

This primary specification focuses on the physics of C19010 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 and the associated reference documents listed under Section 2.1 *ASTM Standards*
ASTM B820 is specifically mentioned as critical to Molex formability requirements
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 –** 2090580057– Molex Material Specification – C19010 Alloy Metal Strips)
5. Surface (2090580044) and Geometric (2090580043) Global Engineering Specifications

5.0 TECHNICAL REQUIREMENTS

5.1 Chemical Composition

UNS #	Cu wt.%	Ni wt.%	P wt.%	Si wt.%
C19010	Remainder[2]	0.8 – 1.8	0.01 – 0.05	0.15 – 0.35

2. Copper + Sum of named elements (excluding Pb) = 99.5% min.
Limits for named and unnamed elements may be established between Molex and the supplier to satisfy certain environmental (REACH/RoHS) or other customer requirements. Reference “Molex Chemical Substances Specification for Products and Packaging: Supplier Requirements” (2014040014).

5.2 Mechanical Properties (longitudinal direction)

Mechanical Properties Table C19010			
Designation	**Tensile (1)**	**Yield (1)**	**Elongation %**
	(MPa)	0.2% offset (MPa)	In 50mm
TM04	490 - 560	≥410	≥10
TM06	520 - 590	≥440	≥8
TM08	580 - 650	≥540	≥7

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 shall be 29 MS/m (50% IACS) @ 20ºC
5.3.2 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.

TM04		90° GW	180° GW		90° BW	180° BW
	Thickness	10:1 w/t			10:1 w/t	
	0.51-1.0 mm	1.0 r/t	1.5 r/t		1.2 r/t	2.5 r/t
	0.3-0.5 mm	0.5 r/t	1.0 r/t		0.5 r/t	1.5 r/t
	0.15-0.29 mm	0.5 r/t	1.0 r/t		0.5 r/t	1.5 r/t
	≤0.149 mm	0.5 r/t	1.0 r/t		0.5 r/t	1.0 r/t
TM06		90° GW	180° GW		90° BW	180° BW
	Thickness	10:1 w/t			10:1 w/t	
	0.51-1.0 mm	1.0 r/t	2.0 r/t		1.5 r/t	3.0 r/t
	0.3-0.5 mm	0.5 r/t	1.5 r/t		0.5 r/t	2.0 r/t
	0.15-0.29 mm	0.5 r/t	1.5 r/t		0.5 r/t	2.0 r/t
	≤0.149 mm	0.5 r/t	1.0 r/t		0.5 r/t	1.5 r/t
TM08		90° GW	180° GW		90° BW	180° BW
	Thickness	10:1 w/t	10:1 w/t		10:1 w/t	10:1 w/t
	0.51-1.0 mm	1.5 r/t	2.5 r/t		2.0 r/t	4.0 r/t
	0.3-0.5 mm	1.0 r/t	2.0 r/t		1.0 r/t	3.0 r/t
	0.15-0.29 mm	1.0 r/t	2.0 r/t		1.0 r/t	3.0 r/t
	≤0.149 mm	0.8 r/t	1.5 r/t		0.8 r/t	2.5 r/t

Notes:
(1) W/t = width to thickness ratio (defining bending width). 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 minimum expectation (in accordance with ASTM E328)*

C19010 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	**93%**	**89%**	**71%**	**89%**	**83%**	**65%**
100	**88%**	**84%**	**66%**	**84%**	**78%**	**60%**
125	**85%**	**80%**	**60%**	**78%**	**72%**	**52%**
150	**77%**	**71%**	**54%**	**69%**	**63%**	**46%**

*Annual test data certification required

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 and 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 **400005032-ES** → **2090580057**.

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.