

**MOLEX MATERIAL SPECIFICATION – C19210 ALLOY METAL STRIPS**

**1.0 SCOPE**

This specification covers the 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 C19210 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, JIS H3100 and supplier literature for UNS alloy C19210 to meet the needs of Molex connector applications.

**3.0 REFERENCE DOCUMENTS**

This primary specification focuses on the physics of C19210 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 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 – 2090580056 – Molex Material Specification – C19210 Alloy Metal Strips)
5. Surface (2090580044) and Geometric (2090580043) Global Engineering Specifications

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**5.0 TECHNICAL REQUIREMENTS**

**5.1 Chemical Composition**

UNS #	Cu wt. %	Fe wt. %	P wt. %
C19210	Remainder <sup>2</sup>	0.05 – 0.15	0.025 – 0.04

2. Copper + Sum of Fe and P = 99.8% 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)**

<b>Mechanical Properties Table C19210</b>			
Designation	Tensile (1)	Yield (1)	Elongation %
	(MPa)	0.2% offset (MPa)	In 50mm
Annealed	190 - 290	≥ 110	≥ 30
H01	290 - 365	≥ 150	≥ 15
H02	325 - 410	≥ 280	≥ 5
H03	350 - 420	≥ 320	≥ 4
H04	385 - 455	≥ 350	≥ 3
HR04	385 - 455	≥ 275	≥ 6
H06	410 - 480	≥ 385	≥ 2
HR06	410 - 480	≥ 320	≥ 4
H08	440 - 510	≥ 415	≥ 1
HR08	440 - 510	≥ 350	≥ 2
H10	≥ 455	≥ 430	≥ 1
HR10	≥ 455	≥ 365	≥ 1

Notes:

- (1) Tensile requirements are longitudinal values in uniaxial tension in accordance with ASTM E8M
- (2) The rolled “H” tempers from H03 > H10 are listed with restricted grain sizes prior to finish rolling, this promotes bend formability.
- (3) For cold worked tempers that are “stress relieved”, an “R” should be added after the “H”; ex. HR08. The “H” temper properties listed also apply for the corresponding “HR” temper code as a default.

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**5.3 Electrical Conductivity**

- 5.3.1 For anneal to temper the minimum requirement shall be 53 MS/m (91% IACS) @ 20°C
- 5.3.2 For rolled tempers (“H”, “HR” temper codes) the minimum requirement shall be 44.7 MS/m (77% 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, will be capable to achieve 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.

<b>H04</b>		90° GW	180° GW	90° BW	180° BW		<b>HR04</b>		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	1.0 r/t	1.0 r/t	1.5 r/t			0.51-1.0 mm	0.8 r/t	1.0 r/t	1.0 r/t	1.5 r/t
	0.3-0.5 mm	0.5 r/t	1.0 r/t	1.0 r/t	1.5 r/t			0.3-0.5 mm	0.5 r/t	0.8 r/t	0.8 r/t	1.3 r/t
	0.15-0.29 mm	0.4 r/t	0.8 r/t	0.8 r/t	1.0 r/t			0.15-0.29 mm	0.4 r/t	0.7 r/t	0.7 r/t	0.9 r/t
	≤0.149 mm	0.3 r/t	0.5 r/t	0.5 r/t	0.8 r/t			≤0.149 mm	0.3 r/t	0.4 r/t	0.4 r/t	0.7 r/t
<b>H06</b>		90° GW	180° GW	90° BW	180° BW		<b>HR06</b>		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			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	2.0 r/t	1.8 r/t	2.5 r/t			0.51-1.0 mm	1.2 r/t	1.8 r/t	1.7 r/t	2.2 r/t
	0.3-0.5 mm	1.0 r/t	1.5 r/t	1.5 r/t	2.0 r/t			0.3-0.5 mm	0.8 r/t	1.2 r/t	1.2 r/t	1.7 r/t
	0.15-0.29 mm	0.8 r/t	1.0 r/t	1.0 r/t	1.8 r/t			0.15-0.29 mm	0.6 r/t	0.8 r/t	0.8 r/t	1.4 r/t
	≤0.149 mm	0.5 r/t	0.8 r/t	0.8 r/t	1.5 r/t			≤0.149 mm	0.4 r/t	0.6 r/t	0.6 r/t	1.2 r/t
<b>H08</b>		90° GW	180° GW	90° BW	180° BW		<b>HR08</b>		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			Thickness	10:1 w/t	10:1 w/t	10:1 w/t	10:1 w/t
	0.51-1.0 mm	2.0 r/t	3.0 r/t	3.0 r/t	3.2 r/t			0.51-1.0 mm	1.5 r/t	2.5 r/t	2.5 r/t	2.5 r/t
	0.3-0.5 mm	1.5 r/t	2.5 r/t	2.5 r/t	2.7 r/t			0.3-0.5 mm	1.0 r/t	2.0 r/t	2.0 r/t	2.0 r/t
	0.15-0.29 mm	1.3 r/t	2.3 r/t	2.3 r/t	2.5 r/t			0.15-0.29 mm	0.8 r/t	1.8 r/t	1.8 r/t	1.8 r/t
	≤0.149 mm	1.0 r/t	2.0 r/t	2.0 r/t	2.2 r/t			≤0.149 mm	0.6 r/t	1.6 r/t	1.6 r/t	1.6 r/t
<b>H10</b>		90° GW	180° GW	90° BW	180° BW		<b>HR10</b>		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			Thickness	10:1 w/t	10:1 w/t	10:1 w/t	10:1 w/t
	0.51-1.0 mm	-	-	-	-			0.51-1.0 mm	-	-	-	-
	0.3-0.5 mm	2.0 r/t	3.0 r/t	3.0 r/t	3.5 r/t			0.3-0.5 mm	1.5 r/t	2.0 r/t	2.0 r/t	2.5 r/t
	0.15-0.29 mm	1.8 r/t	2.8 r/t	2.8 r/t	3.3 r/t			0.15-0.29 mm	1.3 r/t	1.8 r/t	1.8 r/t	2.3 r/t
	≤0.149 mm	1.5 r/t	2.6 r/t	2.6 r/t	3.0 r/t			≤0.149 mm	1.0 r/t	1.6 r/t	1.6 r/t	2.0 r/t






**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.

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**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)**

<b>C19210 Alloy Stress Relaxation in Percent Retained @ 1000 Hours</b>						
Temp °C	50% R <sub>p0.2</sub>	80% R <sub>p0.2</sub>	100% R <sub>p0.2</sub>	50% R <sub>p0.2</sub> <sup>†</sup>	80% R <sub>p0.2</sub> <sup>†</sup>	100% R <sub>p0.2</sub> <sup>†</sup>
75	76%	72%	54%	72%	66%	48%
100	72%	68%	50%	68%	62%	44%
125	67%	62%	42%	60%	54%	34%
150	58%	52%	35%	50%	44%	27%

Confirmation testing: On well-established alloys such as C19210, it is allowable to use Larson Miller Parameters to fulfill the annual confidence testing requirement.

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**6.0 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)			

**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 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.

**6.2 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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**6.3 Recent Change Summary**

Document ID# Change from **400005031-ES** → **2090580056**.

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

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.

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