MOLEX MATERIAL SPECIFICATION – C19400 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 C19400 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 B465, JIS H3100 combined with supplier literature from all regions for UNS alloy C19400 to meet the needs of Molex connector applications.

3.0 REFERENCE DOCUMENTS

This primary specification focuses on the physics of C19400 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 B465 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** – 2090580054 – Molex Material Specification – C19400 Alloy Metal Strips)
5. Surface (2090580044) and Geometric (2090580043) Global Engineering Specifications

5.0 TECHNICAL REQUIREMENTS

5.1 Chemical Composition

UNS #	Cu wt.%	Fe wt.%	P wt.%	Zn wt.%
C19400	97.0 min	2.1 – 2.6	0.015 – 0.15	0.05 – 0.2

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 C19400			
Designation	**Tensile (1)**	**Yield Strength (1)**	**Elongation %**
	(MPa)	0.2% offset (MPa)	In 50mm
O60	275 - 345	≥ 110	≥ 30
O50	310 - 380	≥ 150	≥ 25
O82	345 - 415	≥ 220	≥ 15
H02	365 - 435	≥ 250	≥ 5
H04	415 - 485	≥ 365	≥ 2
HR04	415 - 485	≥ 310	≥ 6
H06	460 - 505	≥ 425	≥ 2
HR06	460 - 505	≥ 380	≥ 4
H08	480 - 525	≥ 460	≥ 1
HR08	480 - 525	≥ 400	≥ 2
H10	505 - 560	≥ 485	≥ 1
HR10	505 - 560	≥ 430	≥ 1
H12	≥ 550	≥ 530	-
HR12	≥ 550	≥ 470	≥ 1

Notes:

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

(2) 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.

5.3 Electrical Conductivity

5.3.1 The minimum requirement shall be 34.8 MS/m (60% 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, 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 180º 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.

C19400 H02/HR02						
		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
	≤ 0.8 mm	0.5 r/t	0.5 r/t	≤ 0.8 mm	0.5 r/t	1.0 r/t

C19400 H04/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
	≤ 0.8 mm	0.5 r/t	1.0 r/t	≤ 0.8 mm	1.0 r/t	1.5 r/t

C19400 H06/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
	≤ 0.8 mm	1.0 r/t	1.5 r/t	≤ 0.8 mm	1.5 r/t	2.0 r/t

C19400 H08/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
	≤ 0.8 mm	1.0 r/t	2.0 r/t	≤ 0.8 mm	2.0 r/t	2.0 r/t

C19400 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
	≤ 0.8 mm	1.5 r/t	2.0 r/t	≤ 0.8 mm	2.0 r/t	2.5 r/t

C19400 HR12						
		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
	≤ 0.8 mm	2.0 r/t	2.5 r/t	≤ 0.8 mm	2.5 r/t	3.0 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 H02 will possess bend formability that is as good (or better) than the values listed for the H02 temper.

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 E 328)

C19400 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	84%	80%	62%	80%	74%	56%
100	74%	70%	52%	70%	64%	46%
125	60%	55%	35%	53%	47%	27%
150	37%	31%	11%	30%	24%	4%

Confirmation testing: On well-established alloys such as C19400, it is allowable to use Larson Miller Parameters to fulfill the annual confidence testing requirement

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 **400005029-ES** → **2090580054**.

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.