

1. Product Overview

C10100 is Oxygen-Free Electronic Copper (OFE) - the highest-purity commercial copper grade available, containing at least 99.99% Cu (including silver) with oxygen controlled to 5 ppm or less and no residual deoxidant. It is produced by melting and casting under a protective, non-oxidising atmosphere (typically vacuum or high-purity inert-gas melted) so that no cuprous oxide (Cu_2O) particles form in the matrix and the total impurity content is held below 0.01%.

The result is an exceptionally pure, single-phase alpha copper that sets the benchmark for electrical and thermal conductivity: $\geq 101\%$ IACS, the highest of any commercial copper grade. Like C10200 (OFC), C10100 is immune to hydrogen embrittlement and can be brazed, welded, or operated at elevated temperature in hydrogen-bearing or reducing atmospheres without the steam-reaction cracking that limits tough-pitch C11000. The decisive difference from C10200 is purity: C10100 is held to tighter limits on every trace impurity, making it the grade of choice for electronic, vacuum, superconductor and high-reliability applications where even minute levels of oxygen, sulphur, or volatile elements matter.

C10100 is supplied across the full range of wrought product forms - busbar, rod, bar, wire, plate, sheet, strip, tube and custom shapes - in soft (annealed) and cold-worked tempers. It conforms to ASTM B152 (flat products), B187 (busbar, rod and shapes), B1 / B2 / B3 (wire) and B75 (seamless tube) as applicable, and is traceable by heat lot with EN 10204 mill test certificates including certified oxygen content.

1.1 Key Features

- Cu $\geq 99.99\%$ - the highest-purity commercial copper grade.
- Oxygen ≤ 5 ppm (0.0005%) - the strictest oxygen limit of any wrought copper.
- No deoxidant residue - conductivity retained at $\geq 101\%$ IACS, above the IACS baseline.
- Immune to hydrogen embrittlement - safe for brazing, welding and high-temperature hydrogen / reducing-atmosphere service.
- Superior brazeability and weldability - no Cu_2O steam reaction, no porosity, clean joints.
- Exceptional ductility - deep drawing, spinning, coining and cold heading without cracking.
- Low outgassing rate - suitable for ultra-high vacuum (UHV) and electronic-grade cleanliness.
- Certified oxygen and conductivity data on every heat-lot mill test certificate.

1.2 Typical Applications

Application	Description
Electronic connectors	High-conductivity terminals, contacts, lead frames, IC packaging substrates
Busbars & conductors	High-current busbars in switchgear, substations, and power distribution
Vacuum & electron devices	Vacuum-tube anodes, microwave components, particle-accelerator components
Superconductor stabiliser	Matrix / stabiliser copper for NbTi, Nb_3Sn and HTS (REBCO) magnets
Waveguides & RF	Precision waveguide, coaxial conductors, resonant cavities, gaskets
Photovoltaic & battery	Solar cell ribbon, lithium-battery current collectors, tab strip
Sputter targets	High-purity sputtering targets for PVD deposition of copper thin films
Anodes & electrodes	EDM electrodes, plating anodes, electrochemical cell components
Deep-drawn parts	Electronic enclosures, drawn cups, caps, shields and transistor packages

1.3 At-a-Glance Specification

Attribute	Value
UNS designation	C10100 (Oxygen-Free Electronic Copper, OFE)
Also known as	OFE, OF-HP, OFE-HP (Oxygen-Free Electronic, High Purity)
Alloy system	Pure copper, single-phase alpha (f.c.c.)
Cu content (incl. Ag)	≥ 99.99%
Oxygen content	≤ 5 ppm (0.0005%)
Total impurities	≤ 0.01% (100 ppm)
Deoxidant	None (vacuum / inert-gas melted)
Density	8.94 g/cm ³ (0.323 lb/in ³)
Conductivity	≥ 101% IACS (typ. 101 – 102%)
Melting point	1 083 °C (1 981 °F)
Thermal conductivity	≈ 391 W/(m·K)
Max service temp.	200 °C continuous (pressure); higher for non-pressure
Product forms	Busbar, rod, bar, wire, plate, sheet, strip, tube, shapes
Certificates	MTC EN 10204 3.1 / 3.2 (with certified O content), SGS, BV, TUV
MOQ	500 kg per specification

Composition and property limits conform to ASTM specifications for C10100. Oxygen content is the defining parameter and is certified on every heat-lot MTC. Verify all values against the MTC for each heat lot.

1.4 When to Choose C10100 over C10200 or C11000

C10100, C10200, and C11000 are all high-conductivity coppers, but they differ in purity and oxygen content. C11000 (ETP, tough-pitch) contains 0.02-0.05% oxygen as dispersed Cu₂O and is susceptible to hydrogen embrittlement above ~400 °C. C10200 (OFC) removes the oxygen (Cu ≥ 99.95%, O ≤ 10 ppm) and is embrittlement-immune. C10100 (OFE) goes further: Cu ≥ 99.99% with O ≤ 5 ppm and tighter limits on all volatile and metallic impurities, yielding the highest conductivity (≥ 101% IACS) and the lowest outgassing rate. Choose C10100 when peak conductivity, vacuum purity, or certified ultra-low oxygen is required - e.g. superconductor stabiliser, UHV components, sputter targets, or hydrogen-brazed joints in critical service. For general busbar, connector, or deep-drawn parts where 99.95% purity is sufficient, C10200 offers equivalent performance at lower cost. For non-hydrogen plumbing and general sheet use, C11000 is the most economical option.

2. Chemical Composition & Standards

C10100 is the purest commercial wrought copper. The defining metallurgical feature is the combination of ultra-low oxygen (≤ 5 ppm) and tight control of every other trace impurity, achieved by melting and casting under vacuum or high-purity inert gas. No phosphorus, lithium, boron, or other deoxidiser is added - oxygen is removed by the atmosphere itself, so no residual solute remains to scatter charge carriers. This is why C10100 can exceed 100% IACS, reaching ≥ 101%, the highest conductivity of any commercial copper grade and the value against which all others are benchmarked.

2.1 Chemical Composition (wt%)

Element	Symbol	Content (% mass)	Note
Copper (incl. Ag)	Cu	≥ 99.99	Matrix; IACS reference conductor
Oxygen	O	≤ 0.0005 (≤ 5 ppm)	Defining parameter; certified on MTC
Phosphorus	P	≤ 0.0003	Not added as deoxidant; trace only
Iron	Fe	□ 0.004	Trace impurity; controlled
Lead	Pb	□ 0.005	Trace impurity
Sulphur	S	□ 0.003	Volatile; affects outgassing
Bismuth	Bi	□ 0.001	Embrittling; strictly limited
Antimony	Sb	□ 0.002	Trace impurity
Tellurium	Te	□ 0.001	Trace impurity
Selenium	Se	□ 0.001	Trace impurity
Other (each)	various	□ 0.001	Ag, As, Cd, Mn, Ni, Sn, Zn controlled
Total impurities	—	≤ 0.01 (100 ppm)	Sum of all non-Cu, non-O elements

Composition limits conform to ASTM B152 / B187 / B1 specifications for the C10100 UNS designation and are tighter than C10200 in every element. Oxygen content (≤ 5 ppm) is the grade-defining parameter and must be certified on the MTC for each heat lot.

2.2 Applicable Standards by Product Form

Product form	Common standards
Busbar, rod & shapes	ASTM B187 (bus bar, rod and shapes); ASTM B188 (bus bar)
Plate / sheet / strip	ASTM B152; ASTM B272 (flat products)
Wire - hard drawn	ASTM B1
Wire - medium-hard drawn	ASTM B2
Wire - soft / annealed	ASTM B3
Seamless tube	ASTM B75 (general purpose); ASTM B68 (thin-wall)
Round rod / bar	ASTM B133; ASTM B187
Foil / thin strip	ASTM B152; customer specification
Sputter targets	ASTM B152 + customer purity spec; typical 99.99% / 99.999%

2.3 High-Purity Copper Comparison

Property	C10100 OFE	C10200 OFC	C11000 ETP
Cu (incl. Ag)	≥ 99.99%	≥ 99.95%	≥ 99.90%
Oxygen	≤ 5 ppm	≤ 10 ppm	0.02 – 0.05%
Total impurities	≤ 0.01%	≤ 0.05%	≤ 0.10%
Conductivity	≥ 101% IACS	≥ 100% IACS	≥ 100% IACS
Hydrogen embrittlement	Immune	Immune	Susceptible (>400 °C)
Brazability / weldability	Excellent	Excellent	Limited (steam reaction)
Outgassing rate	Lowest (UHV-grade)	Low	Higher (Cu ₂ O)
Cost relative	Highest	Medium-high	Lowest
Best for	Electronics, vacuum, superconductors, sputter targets	Busbar, connectors, vacuum parts	Plumbing, general busbar, sheet

C10100 commands a premium over C10200 and C11000 for its tighter impurity limits, certified ultra-low oxygen, and marginally higher conductivity. Choose it when the application demands peak conductivity, UHV cleanliness, or certified oxygen content; otherwise C10200 or C11000 deliver comparable performance at lower cost.

3. Physical, Thermal & Electrical Properties

C10100 exhibits the benchmark physical and electrical properties of the purest commercial copper. Because it contains neither oxygen particles nor residual deoxidant, and because total impurities are held below 0.01%, its electrical conductivity can reach 101-102% IACS - above the International Annealed Copper Standard reference of 100% (58 MS/m at 20 °C). Thermal conductivity is similarly outstanding, and the alloy is essentially non-magnetic. Values below are typical for annealed material at room temperature; cold work slightly increases strength and resistivity and slightly lowers conductivity.

Property	Symbol	Value	Unit
Density	ρ	8.94	g/cm ³
Melting point	T_m	1 083	°C
Boiling point	—	2 567	°C
Specific heat capacity	c_p	0.385	J/(g·K)
Thermal conductivity	λ	391	W/(m·K)
Thermal expansion coeff.	α	17.0	$\times 10^{-6} / K$ (20 – 100 °C)
Electrical conductivity	σ	≥ 101 (typ. 101 – 102)	% IACS
Electrical resistivity	ρ	0.0171	$\mu\Omega \cdot m$ (at 20 °C)
Temp. coeff. of resistance	α_r	0.00393	/°C (0 – 100 °C)
Modulus of elasticity	E	117	GPa
Shear modulus	G	44	GPa
Poisson's ratio	ν	0.34	—
Magnetic permeability	μ	≈ 1.0	essentially non-magnetic
Max continuous service temp.	—	200	°C (pressure)

Sources: ASTM B152 / B187 property data; CDA alloy data sheet for C10100 (OFE). Values are typical for annealed material at 20 °C unless noted. C10100 may reach 101-102% IACS due to its ultra-high purity; C10200 and C11000 typically test at 100-101%.

4. Mechanical Properties by Temper

C10100 mechanical properties depend almost entirely on the degree of cold work and grain size, since the composition is fixed at ultra-high purity with no strengthening precipitates. The annealed (soft) temper gives maximum ductility - the defining property for deep drawing, spinning and forming - while cold-worked tempers deliver higher strength and stiffness for structural and busbar use. Because oxygen-free electronic copper is the purest and cleanest of all commercial coppers, its forming limits, fatigue performance, and joint soundness in drawn and brazed parts are marginally superior even to C10200. Typical values at room temperature are shown below.

Temper	Tensile (typ.)	Yield 0.2% (typ.)	Elong. (min.)	Hardness (typ.)
Annealed (O61 / OS025)	220 – 260 MPa	30 – 70 MPa	$\geq 45\%$	35 – 45 HRF
Cold-worked 1/4 hard (H01)	250 – 300 MPa	190 – 240 MPa	$\geq 25\%$	45 – 55 HRB
Cold-worked 1/2 hard (H02)	290 – 360 MPa	240 – 300 MPa	$\geq 12\%$	55 – 65 HRB
Cold-worked 3/4 hard (H03)	330 – 390 MPa	280 – 340 MPa	$\geq 8\%$	65 – 72 HRB
Cold-worked full hard (H04)	≥ 345 MPa	≥ 310 MPa	$\geq 6\%$	72 – 78 HRB
Spring (H06 / H08)	≥ 380 MPa	≥ 350 MPa	$\geq 3\%$	≥ 78 HRB

Hardness shown in Rockwell F (soft) and Rockwell B (hard) scales. Values are indicative; verify against ASTM specification limits and the MTC for each lot. Annealed grain size per ASTM B187 / B152 (typically 0.010 – 0.040 mm for OS025).

5. Product Forms & Size Range

C10100 is supplied across the full range of wrought product forms to serve electronic, electrical, vacuum and high-purity applications. Busbar and rod are the highest-volume forms, followed by plate, sheet, strip, foil, wire and seamless tube. Sputter targets and custom drawn profiles are available to customer specification.

Because oxygen-free electronic copper is most often specified for its ultra-high purity and certified low oxygen, surface cleanliness, the absence of oxide inclusions, and batch-to-batch traceability are controlled throughout production. Mill-annealed, cold-rolled, and precision-finished surfaces are offered per the applicable ASTM specification and customer requirements.

5.1 Standard Size Range by Product Form

Form	Typical size range	Notes
Busbar	Thick. 3 – 25 mm; width 12 – 300 mm	ASTM B187 / B188; straight lengths 1 – 6 m
Round rod / bar	Dia. 3 – 100 mm; length 1 – 6 m	ASTM B187 / B133; cold-drawn or cold-headed
Square / hex bar	5 – 60 mm across flats	For electrical and forged components
Plate	Thick. 3 – 50 mm; width ≤ 1 200 mm	ASTM B152; for anodes, bus plates, sputter targets
Sheet / strip	Thick. 0.1 – 3 mm; width ≤ 600 mm	ASTM B152; deep-drawing and electronic stock
Foil	Thick. 0.02 – 0.1 mm	Battery, PV ribbon, electronic, sputter-target stock
Wire	Dia. 0.05 – 8 mm	ASTM B1 / B2 / B3; spring, lead, bond wire
Seamless tube	OD 3 – 50 mm; wall 0.5 – 3 mm	ASTM B75; for conductors, vacuum lines
Sputter targets	Per customer spec; typ. 99.99% / 99.999% purity	Bond to backing plate; certified O content

5.2 Surface Finish & Special Processing

- Busbar: mill, brushed or polished finish; edges rounded (radius per spec).
- Plate / sheet: mill-annealed, cold-rolled, precision-flat or mirror finish.
- Strip / foil: precision-rolled to tight thickness tolerance for electronic use.
- Wire: hard, medium-hard or annealed; bare, tinned or silver-plated on request.
- Surfaces free from oxide inclusions, laminations and cracks per ASTM acceptance criteria.
- Vacuum / UHV-grade cleanliness available (low outgassing, baked if required).
- Sputter targets: hot-pressed or cast; bonded to Cu / Mo backing plate; certified purity.
- Custom cutting, flat-stock squaring and drawn profiles to customer drawing.

5.3 Packaging

- Busbar / bar: bundled in wooden cases with separator strips and end protection.
- Plate / sheet: palletized with interleave paper and edge protectors.
- Strip / foil: coil on cores, moisture-barrier wrapped, desiccant included.
- Wire: coils or spools, individually bagged, desiccant included.
- Sputter targets: vacuum-sealed in clean-room-grade packaging with batch certificate.
- Each bundle tagged with heat number, size, temper, oxygen content and quantity.
- Export seaworthy packing with moisture barrier and desiccant.

6. Tolerances, Finish & Quality Control

C10100 products are produced and inspected to the applicable ASTM specification (B152, B187, B1 / B2 / B3, B75, B188). Because the alloy is most often used in electronic, vacuum and high-reliability service, dimensional accuracy, surface integrity, verified conductivity, and certified oxygen content are controlled on every lot. Hydrostatic or pneumatic testing applies to tube; electrical conductivity testing applies to busbar, rod and flat stock. Oxygen/hydrogen analysis is performed on every heat to confirm the defining property of the grade, and hydrogen-embrittlement testing may be performed on request.

6.1 Dimensional Tolerances (typical)

Parameter	Typical tolerance
Busbar thickness	± 0.08 – 0.25 mm (per ASTM B187 / B188 class)
Busbar width	± 0.15 – 0.50 mm
Rod diameter (cold-drawn)	h8 – h9 (e.g. ± 0.02 – 0.07 mm)
Plate thickness	± 0.10 – 0.40 mm (per thickness range)
Sheet / strip thickness	± 0.005 – 0.05 mm (precision strip tighter)
Wire diameter	± 0.005 – 0.04 mm (per AWG / metric class)
Tube OD / wall	Per ASTM B75 class; OD ± 0.05 – 0.13 mm
Straightness (bar)	≤ 1.5 mm in any 1 m length

6.2 Surface Finish & Cleanliness

- Smooth, oxide-inclusion-free surface per ASTM acceptance standard; no laminations or cracks.
- Surfaces cleaned of residual rolling lubricant for electrical / electronic service.
- Vacuum / UHV-grade cleanliness available on request (low outgassing, baked if required).
- Busbar edges rounded (radius) and burr-free for safe handling and assembly.
- Strip and foil supplied with controlled surface roughness for plating / bonding.
- Sputter targets supplied with certified surface finish and flatness for uniform erosion.

6.3 Quality Control Test List

Test	Standard / method	Frequency
Chemical analysis (full)	ASTM E478 / ICP-MS (Cu, O, P, all impurities)	Each heat
Oxygen / hydrogen analysis	ASTM E2576 / E1409 (inert gas fusion)	Each heat (mandatory for OFE)
Electrical conductivity	ASTM B193 / E1004 (eddy-current)	Each lot (busbar / rod / strip)
Tensile / elongation	ASTM E8 / E8M	Each lot
Hardness (HRF / HRB)	ASTM E18	Each lot
Dimensional inspection	Calipers / micrometers / laser	Each piece / sample
Hydrostatic / pneumatic test	ASTM B75 (tube)	Each tube
Grain size (annealed)	ASTM E112	Each lot (O61 / OS025)
Hydrogen-embrittlement test	ASTM B577 / B776	On request
Outgassing rate (UHV)	ASTM E595 / customer method	On request (vacuum-grade)
Bend / formability test	ASTM E290 / customer method	Per specification

Oxygen analysis is mandatory for every heat lot of C10100 - it confirms the grade-defining property (≤ 5 ppm). Electrical conductivity testing is mandatory for busbar and conductor stock. For UHV applications, outgassing rate can be measured on request. Verify all values against the MTC.

7. Fabrication, Welding & Service Considerations

C10100 is the most workable and joinable of all commercial coppers. Its ultra-high purity, zero-oxygen, deoxidant-free chemistry means it can be brazed and welded under hydrogen-bearing or reducing atmospheres without the steam-reaction cracking that limits tough-pitch C11000. Its exceptional purity also gives the highest ductility, cleanest joining behaviour, and lowest outgassing rate of any copper grade. The guidance below covers the fabrication and service practices that exploit these advantages.

7.1 Forming & Joining

- Cold formability: excellent - deep drawing, spinning, coining, cold heading and bending without cracking.
- Annealed temper (O61) gives maximum ductility for severe draws; cold-worked tempers give stiffness for formed busbar.
- Brazing: excellent with silver (BAG) and copper-phosphorus (BCuP) brazing alloys; no hydrogen embrittlement.
- Welding: GTAW / TIG and GMAW / MIG weld cleanly; superior to C11000 (no Cu_2O steam reaction) and marginally cleaner than C10200.
- Soldering: excellent; surfaces accept tin-lead and lead-free solders readily after proper fluxing.
- Machining: poor to fair (pure copper is gummy); use free-machining C14500 (tellurium copper) if high-speed turning is the primary operation.
- Hydrogen / reducing atmosphere: safe for service above 400 °C - the defining advantage over C11000.
- Vacuum bonding / UHV assembly: low outgassing rate allows direct use in UHV systems without lengthy bake-out.

7.2 Service Limits & Design Notes

C10100 can operate continuously up to about 200 °C for pressure-containing and structural code applications; for non-pressure electrical and vacuum service, higher temperatures are acceptable, and the grade is valued precisely for its stability at elevated temperature in reducing / hydrogen atmospheres. Softening of cold-worked tempers begins near 200 °C, so spring temper parts should not see sustained service above this level without re-annealing consideration. Galvanically, C10100 is compatible with other copper alloys and with steel; it should be insulated from aluminium and from passive stainless steel in conductive media to avoid galvanic attack. For UHV service, request baked stock and verify outgassing rate against the application limit.

7.3 Design Practices

- Specify C10100 (not C10200 or C11000) when certified ultra-low oxygen (≤ 5 ppm) or $\geq 101\%$ IACS conductivity is required.
- For superconductor stabiliser, request grain-refined, high-conductivity ($\geq 101\%$ IACS) stock with verified RRR (residual resistivity ratio).
- For sputter targets, specify purity tier (99.99% or 99.999%) and certify oxygen content on the MTC.
- Use annealed temper (O61 / OS025) for deep-drawn parts; use cold-worked tempers (H02 – H04) for formed busbar and springs.
- When machining is the dominant operation, switch to free-machining C14500 (tellurium) or C14700 (sulphur) to keep productivity.
- For plumbing tubes that will be brazed, C12200 (DHP) is usually sufficient and cheaper - choose C10100 only when peak conductivity, vacuum purity, or certified oxygen is required.
- Control surface cleanliness for vacuum / electronic parts; request baked / UHV-grade stock where outgassing matters.
- Verify oxygen content (≤ 5 ppm) on the MTC for any part destined for high-temperature hydrogen service or UHV application.

8. About Gnee Metal

Gnee Metal is a supplier of copper and copper-alloy products for export markets. Our ISO 9001 / 14001 / 45001 certified plants serve customers in North America, Europe, the Middle East and Southeast Asia with C10100 oxygen-free electronic copper busbar, rod, bar, plate, sheet, strip, wire, seamless tube and sputter targets for electronic, vacuum, superconductor and high-reliability applications.

We provide project-specific mill test certificates (EN 10204 3.1 / 3.2) with certified oxygen content and conductivity data, third-party inspection by SGS / BV / TUV, and value-added services including custom cutting, flat-stock squaring, drawn profiles, UHV-grade cleanliness preparation, and technical consultation to help you select the correct grade and temper for your

application. Contact us for a quote or for assistance.

Item	Detail
Website	chinacopperalloys.com
Email	sales@gneemetal.com
Certificates	ISO 9001 / ISO 14001 / ISO 45001
Third-party	SGS, Bureau Veritas, TÜV