1. Product Overview

C12200 (DHP - deoxidized high residual phosphorus copper) is a phosphorus-deoxidized copper alloy used across plumbing, HVAC, electrical, heat-transfer and architectural applications. Available as tubes, sheets, plates, bars, strips, busbars and wire, it is supplied in soft annealed, half-hard or hard tempers. The controlled residual phosphorus (0.015-0.040%) removes dissolved oxygen and makes the material immune to hydrogen embrittlement, while retaining excellent corrosion resistance, high thermal and electrical conductivity, and good solderability / brazability.

1.1 Key Features

- Phosphorus-deoxidized, oxygen-free microstructure - immune to hydrogen embrittlement.
- Excellent cold formability; bends, flares, deep-draws and presses without cracking.
- High electrical and thermal conductivity with stable performance over service life.
- Lead-free chemistry verified to NSF/ANSI 61 & 372 for potable water contact.
- Full heat-lot traceability with EN 10204 3.1 / 3.2 mill test certificates.
- Third-party inspection (SGS, BV, TUV) available on request.

1.2 Typical Applications

Application	Description
Plumbing	Potable hot & cold water distribution, recirculation loops
HVAC & Refrigeration	Refrigerant lines, chilled-water coils, heat-pump sets
Medical gas	Oxygen, medical air, vacuum (cleaned & capped)
Electrical	Busbars, connectors, terminals, switchgear components
Heat exchangers	Finned tubes, plate exchangers, solar collector panels
Architecture	Roofing, flashing, facades, railings, interior finishes
Industrial	Pneumatic lines, fuel oil, compressed air, low-pressure steam
Gas distribution	Natural gas / LPG lines per local codes

1.3 At-a-Glance Specification

Attribute	Value
UNS designation	C12200 (DHP)
Cu content	≥ 99.90% (incl. Ag)
P content	0.015 – 0.040%
Product forms	Tube, sheet, plate, bar, strip, busbar, wire
Tempers	O (annealed), 1/4H, 1/2H, 3/4H, H (hard)
Density	8.94 g/cm³ (0.323 lb/in³)
Conductivity	≥ 85% IACS (annealed)
Melting range	1 065 – 1 083 °C
Max service temp.	200 °C continuous
Surface finish	Bright, mill, brushed / polished
Certificates	MTC EN 10204 3.1 / 3.2, SGS, BV, TUV
Lead-free	NSF/ANSI 61 + 372 compliant
MOQ	500 kg per specification

Composition limits conform to ASTM B152/B187/B280/B837. Exact limits may vary slightly by product form and standard.

2. Chemical Composition & Standards

C12200 is a wrought, high-purity copper grade with deliberately controlled residual phosphorus. The phosphorus acts as a strong deoxidizer during melting, removing dissolved oxygen as P_2O_5 and preventing the formation of brittle Cu_2O networks. The result is a single-phase *α*-solid-solution copper that is essentially immune to hydrogen embrittlement at elevated temperatures - a critical property during brazing, soldering, or service in reducing atmospheres.

2.1 Chemical Composition (wt%)

Element	Symbol	Content (% mass)	Note
Copper (incl. Ag)	Cu	≥ 99.90	Balance / matrix
Phosphorus	P	0.015 – 0.040	Deoxidizer
Lead	Pb	≤ 0.01	NSF/ANSI 372 limit
Iron	Fe	≤ 0.05	Trace
Nickel (incl. Co)	Ni	≤ 0.05	Trace
Zinc	Zn	≤ 0.05	Trace
Antimony	Sb	≤ 0.005	Trace
Arsenic	As	≤ 0.005	Trace
Sulfur	S	≤ 0.015	Trace
Total other impurities	—	≤ 0.03	Combined residual

Composition limits conform to ASTM B152/B187/B280/B837. Exact limits may vary slightly by product form and standard.

2.2 Applicable Standards by Product Form

Product form	Common standards
Tube	ASTM B88, B280, B837; EN 1057; JIS H3300; GB/T 18033
Sheet / Plate / Strip	ASTM B152; EN 1172 / 1652; JIS H3100; GB/T 2040 / 2059
Bar / Rod / Section	ASTM B124, B187; EN 12163 / 12165 / 12167; JIS H3250; GB/T 4423
Wire	ASTM B1 / B2 / B3; GB/T 21652
Busbars	IEC 60393-3 / ASTM B187; GB/T 5585.1

2.3 DHP vs ETP Comparison

Property	C12200 DHP	C11000 ETP
Oxygen content	< 10 ppm (deoxidized)	≤ 0.04%
Hydrogen embrittlement	Immune	Risk in H_2 atmosphere
Typical conductivity	≥ 85% IACS	≥ 100% IACS
Brazing / gas welding	Excellent	Requires deoxidized filler
Potable water	Lead-free certified	Lead-free certified
Best for	Tube, deep-drawn parts	Electrical busbar, wire

3. Physical, Thermal & Electrical Properties

The values below are typical room-temperature properties for C12200 in the annealed condition. They are representative of all wrought product forms; slight differences may occur between tube, sheet, bar and wire due to cold-work level and texture.

Property	Symbol	Value	Unit
Density	ρ	8.94	g/cm³
Melting point (liquidus)	—	1 083	°C
Melting point (solidus)	—	1 065	°C
Specific heat capacity	cp	0.385	J/(g·K)
Thermal conductivity	λ	339	W/(m·K)
Thermal expansion coeff.	α	17.0	× 10□⁶ / K
Electrical conductivity	σ	≥ 85	% IACS
Electrical resistivity	ρ	0.0203	μΩ·m
Modulus of elasticity	E	115	GPa
Shear modulus	G	44	GPa
Poisson's ratio	ν	0.34	—
Magnetic permeability	μ	≈ 1.0	non-magnetic
Max continuous service temp.	—	200	°C

Sources: ASTM B152/B187 property tables; CDA Alloy Data Sheet C12200; typical annealed values at 20 °C unless noted.

4. Mechanical Properties by Temper

Mechanical properties vary with temper and product form. The table below summarizes typical minimum values for wrought C12200 sheet, plate, tube and bar according to common ASTM and EN specifications. Exact limits should be verified against the relevant material certificate for each order.

Temper	Tensile (min)	Yield (min)	Elongation (min)	Hardness (typ.)
O (annealed)	≥ 205 MPa	≥ 62 MPa	≥ 40%	45-65 HRF
1/4 Hard (H01)	235-290 MPa	≥ 180 MPa	≥ 25%	70-85 HRF
1/2 Hard (H02)	250-310 MPa	≥ 195 MPa	≥ 15%	80-95 HRF
3/4 Hard (H03)	270-330 MPa	≥ 210 MPa	≥ 10%	90-100 HRF
Hard (H04)	290-350 MPa	≥ 230 MPa	≥ 5%	95-105 HRF

Note: Tube tempers in ASTM B88 use different designations (O60, H58, etc.) but fall within similar strength ranges. Hardness values are indicative only.

5. Product Forms & Size Range

Gnee Metal supplies C12200 in the common wrought forms listed below. Custom dimensions, cut lengths, edge conditioning and surface finishes are available on request.

5.1 Product Forms

Product form	Typical size range	Common surface / edges
Tube / Pipe	OD 3 – 219 mm; wall 0.5 – 10 mm	Bright annealed, drawn, plain/bevel/threaded ends
Sheet / Plate	Thick. 0.2 – 50 mm; width ≤ 1 500 mm	Mill, bright, brushed, polished, PVC one/both sides
Strip / Coil	Thick. 0.05 – 3.0 mm; width ≤ 600 mm	Bright, mill, slit edges, oscillate wound
Round bar / rod	Dia. 3 – 120 mm; length 1 – 6 m	Peeled, polished, ground
Flat bar / busbar	Thick. 3 – 25 mm; width 20 – 200 mm	Mill, punched, radius/chamfer edges
Wire	Dia. 0.1 – 8.0 mm; coil / spool	Bright, annealed, hard-drawn

5.2 Packaging

- Tubes: plastic caps + PE wrap + wooden crate / woven bag; seaworthy export packing.
- Sheets / strips: interleaved paper + wooden pallet + steel strapping + corner guards.
- Bars / rods: bundled with steel straps, oiled if required, packed in crates or pallets.
- Coils: eye-to-sky on wooden pallets with moisture-proof wrapping.

6. Tolerances, Finish & Quality Control

Dimensional verification is performed on each production lot in accordance with the governing ASTM / EN / JIS standard. Test certificates report measured values and confirm compliance with the ordered specification.

6.1 Dimensional Tolerances

Parameter	Typical tolerance class
Tube OD	± 0.05 – 0.30 mm depending on ASTM B88 / EN 1057 size
Tube wall thickness	± 10% nominal (ASTM B88)
Sheet / plate thickness	± 0.03 – 0.30 mm per ASTM B152 / EN 1172
Strip width	± 0.10 – 0.50 mm per slit-edge requirements
Bar diameter / width	± 0.05 – 0.30 mm per ASTM B187 / EN 12163
Length	± 5 – 25 mm or custom-cut to drawing
Straightness	≤ 1 mm per metre, or as agreed

6.2 Surface Finish & Cleanliness

- Smooth, bright metallic surface free from cracks, slivers, burrs, dents and deep scratches.
- Optional finishes: bright-annealed (BA), mill, brushed, polished or passivated.
- Tubes for medical gas / oxygen service are internally cleaned, degreased and capped.
- Surface cleanliness meets ISO 16232 for critical oil & grease residue limits.

6.3 Quality Control Test List

Test	Standard / method	Frequency
Chemical analysis	ASTM E478 / ICP-OES	Each heat
Tensile / elongation	ASTM E8 / E8M	Each lot
Rockwell hardness	ASTM E18	Each coil / batch
Hydrostatic pressure	ASTM B88 Sec. 11 / EN 1057	100% (tube)
Eddy-current (cracks)	ASTM E243	100% (tube)
Pneumatic test	0.4 MPa, 5 s	100% on DWV tube
Dimension & ovality	Calipers / micrometers / CMM	Each lot
Surface cleanliness	ISO 16232	Each lot

7. Corrosion Resistance & Service Conditions

C12200 offers excellent corrosion resistance in natural waters, marine atmospheres, neutral saline solutions and many industrial chemicals. The phosphorus-rich surface film stabilizes the material and reduces susceptibility to dezincification and stress-corrosion cracking in common service environments.

7.1 Suitable Environments

- Potable water (hot and cold), including hard and moderately soft waters.
- Seawater and brackish water in low-velocity, non-erosive conditions.
- Atmospheric exposure: rural, urban, industrial and marine climates.
- Refrigerants and HVAC working fluids (R410A, R32, R134a compatible).
- Neutral and mildly alkaline salt solutions; dilute organic acids.

7.2 Design Considerations

- Avoid continuous contact with ammonia, amines or strong oxidizing acids, which can cause stress-corrosion cracking.
- Velocity in potable water should normally be limited to < 3 m/s to prevent erosion-corrosion.
- Use compatible solders and brazing alloys; avoid direct galvanic coupling with aluminium, steel or stainless steel without isolation.
- For brazing in reducing atmospheres, DHP copper is preferred over ETP copper because it resists hydrogen embrittlement.

7.3 Maximum Service Temperature

200 °C continuous is generally accepted for C12200 in pressure applications. Short-term excursions above this temperature are possible, but mechanical strength and creep resistance should be verified against the applicable pressure-vessel or piping code.

8. About Gnee Metal

Gnee Metal is a trusted 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 C12200 tubes, sheets, bars, strips and custom-machined components.

We provide project-specific mill test certificates (EN 10204 3.1 / 3.2), third-party inspection by SGS / BV / TUV, and value-added services including precision cutting, surface finishing, edge conditioning and technical consultation. Contact us for a quote or for help selecting the right temper and specification for your application.

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