

1. Product Overview

C71500 (70/30 cupronickel) is a copper-nickel-iron alloy containing approximately 30% nickel and 0.4-1.0% iron, with the balance copper. It is the highest-performance copper alloy for seawater service, offering superior resistance to general corrosion, erosion-corrosion, impingement and biofouling compared to 90/10 cupronickel (C70600) and aluminum brass (C68700). The higher nickel content produces a denser, more protective surface film and greater solid-solution strengthening, resulting in higher mechanical strength and the ability to tolerate seawater velocities up to 4.5 m/s.

Like C70600, C71500 develops a thin, adherent and self-renewing oxide film enriched in copper, nickel and iron oxides when exposed to seawater. This film provides the alloy's characteristic resistance to pitting, impingement attack and sulfide corrosion. C71500 also releases trace copper ions at the surface, which inhibit the attachment of marine organisms - a natural anti-fouling property that reduces the need for chlorination in seawater cooling systems.

C71500 is supplied as seamless and welded condenser tube, seamless and welded pipe, plate, bar and fittings. It is the preferred material for the most demanding seawater applications: high-velocity power-station condensers (including nuclear plants), large desalination units, offshore water-injection systems, and marine hardware subject to severe erosion conditions. It also exhibits excellent cryogenic toughness, making it suitable for LNG and low-temperature service.

1.1 Key Features

- Best-in-class seawater corrosion resistance among copper alloys - superior to C70600 and C68700.
- Tolerates seawater velocities up to 3.5-4.5 m/s (vs 3.0-3.5 m/s for C70600, 2.0-2.5 m/s for Al brass).
- Natural biofouling resistance: trace Cu release inhibits marine organism attachment.
- Resistant to sulfide attack and polluted-water corrosion - where aluminum brass fails.
- Higher strength than C70600 at the same temper, due to solid-solution strengthening from 30% Ni.
- Excellent cryogenic toughness - used in LNG (-162 °C) and low-temperature service.
- Single-phase alpha solid solution: good ductility, toughness and weldability.
- Full heat-lot traceability with EN 10204 3.1 / 3.2 mill test certificates.

1.2 Typical Applications

Application	Description
Power-station condensers	High-velocity surface condensers, including nuclear plants
Desalination	Multi-stage flash (MSF) and MED evaporator tubing in seawater
Refinery heat exchangers	Coolers and condensers in polluted / sulfide-bearing water
Seawater piping	High-velocity shipboard and offshore cooling / firewater systems
Offshore systems	Water injection, ballast and produced-water handling lines
Marine hardware	Valves, pump bodies, shafts, flanges in severe seawater service
Cryogenic / LNG	Piping and components for LNG and low-temperature applications

1.3 At-a-Glance Specification

Attribute	Value
UNS designation	C71500 (70/30 cupronickel)
EN designation	CW354H (CuNi30Fe1Mn); DIN 2.0837
Alloy system	Cu-Ni-Fe, single-phase alpha solid solution
Product forms	Tube, pipe, plate, bar, fittings, wire
Tempers	Annealed (O61, OS025), light-drawn (H55)
Density	8.94 g/cm ³ (0.323 lb/in ³)
Conductivity	≈ 5% IACS
Melting range	1 170 – 1 240 °C
Thermal conductivity	≈ 29 W/(m·K)
Max seawater velocity	≈ 3.5 – 4.5 m/s
Max service temp.	200 °C continuous (pressure / structural)
Certificates	MTC EN 10204 3.1 / 3.2, SGS, BV, TUV
MOQ	500 kg per specification

Composition and property limits conform to ASTM B111 / B466. Exact values should be verified against the material test certificate (MTC) for each order.

1.4 When to Choose C71500 over C70600

C71500 is specified when service conditions exceed the limits of 90/10 cupronickel. The main selection criteria are: seawater design velocity above 3.0 m/s (C71500 tolerates up to 4.5 m/s); severe impingement or erosion conditions at pump discharges and tube inlets; sulfide-bearing or polluted seawater with high corrosion potential; and applications requiring higher mechanical strength or cryogenic toughness. For less demanding service, C70600 offers equivalent corrosion resistance at lower cost.

2. Chemical Composition & Standards

C71500 is a copper-nickel-iron alloy. The nickel (29-33%) provides the fundamental seawater corrosion resistance by enriching the protective oxide film; the higher nickel content compared to C70600 (9-11%) produces a denser, more protective film and greater solid-solution strengthening. The iron (0.4-1.0%) is incorporated into the surface film, improving resistance to impingement and erosion-corrosion - though the iron range is lower than in C70600 because the higher nickel already provides substantial film strength. Manganese (up to 1.0%) acts as a deoxidizer and improves hot workability. The microstructure is a single-phase alpha (f.c.c.) solid solution.

2.1 Chemical Composition (wt%)

Element	Symbol	Content (% mass)	Note
Copper (incl. Ag)	Cu	Remainder	Balance / matrix (≈ 65 – 67%)
Nickel (incl. Co)	Ni	29.0 – 33.0	Core corrosion-resistance element
Iron	Fe	0.40 – 1.0	Film strengthener; impingement resistance
Manganese	Mn	≤ 1.0	Deoxidizer; improves hot workability
Zinc	Zn	≤ 1.0	Trace / impurity
Lead	Pb	≤ 0.05	Trace
Sulfur	S	≤ 0.02	Trace
Carbon	C	≤ 0.05	Trace

Composition limits conform to ASTM B111 / B466. Verify against the MTC for each heat lot. Iron below 0.4% degrades impingement resistance; ensure Fe is within the specified range for seawater service.

2.2 Applicable Standards by Product Form

Product form	Common standards
Seamless condenser tube	ASTM B111/B111M; EN 12451 (CW354H); JIS H3300; GB/T 8890
Welded condenser tube	ASTM B543; EN 12452 (CW354H)
Seamless pipe / tube (general)	ASTM B466
Welded pipe	ASTM B467
Plate / sheet / strip	ASTM B122; EN 1652; GB/T 2040
Bar / rod	EN 12163; GB/T 4423 (as applicable)
Fittings	ASME B16.22 / B16.29; MSS SP-73 / SP-104

2.3 Seawater Alloy Comparison

Property	C71500 70/30 CuNi	C70600 90/10 CuNi	C68700 Al-brass
Ni content	29-33%	9-11%	0%
Seawater corrosion	Excellent+	Excellent	Very good (clean water)
Erosion / impingement	Excellent	Very good	Moderate
Sulfide / polluted water	Resistant	Resistant	Susceptible
Biofouling resistance	Yes (natural)	Yes (natural)	No
Max seawater velocity	3.5-4.5 m/s	3.0-3.5 m/s	2.0-2.5 m/s
Relative strength	High	Medium	Medium
Relative cost	Highest	Medium	Lowest
Best for	Severe / high-velocity service	Balanced seawater service	Clean-water HX tubes

3. Physical, Thermal & Electrical Properties

The values below are typical room-temperature properties for C71500 in the annealed condition. The 30% nickel content significantly reduces electrical and thermal conductivity compared to pure copper (C11000) and to 90/10 cupronickel (C70600), but the thermal conductivity remains adequate for heat-exchanger service. C71500 is essentially non-magnetic and retains excellent toughness at cryogenic temperatures. Values are representative; slight variations may occur between tube, plate and bar due to cold-work level and grain size.

Property	Symbol	Value	Unit
Density	ρ	8.94	g/cm ³
Melting point (solidus)	—	1 170	°C
Melting point (liquidus)	—	1 240	°C
Specific heat capacity	cp	0.380	J/(g·K)
Thermal conductivity	λ	29	W/(m·K)
Thermal expansion coeff.	α	16.2	$\times 10^{-6} / K$
Electrical conductivity	σ	5	% IACS
Electrical resistivity	ρ	0.35	$\mu\Omega \cdot m$
Modulus of elasticity	E	150	GPa
Shear modulus	G	57	GPa
Poisson's ratio	ν	0.33	—
Magnetic permeability	μ	≈ 1.0	essentially non-magnetic
Max continuous service temp.	—	200	°C

Sources: ASTM B111/B466 property data; CDA alloy data sheet for C71500; Nickel Institute CuNi 70/30 data. Values are typical annealed at 20 °C unless noted.

4. Mechanical Properties by Temper

Mechanical properties depend on temper, grain size and cold-work level. The table below summarizes typical values for C71500 condenser tube and pipe per ASTM B111 / B466. C71500 is considerably stronger than both C70600 (90/10 cupronickel) and C68700 (aluminum brass) at the same temper, due to the greater solid-solution strengthening effect of 30% nickel. Annealed tempers (O61 / OS025) are preferred for expanded tube-to-tubesheet joints and formed components where ductility is needed. For pressure-containing design, always verify against the MTC and the applicable code (e.g. ASME BPVC, TEMA).

Temper	Tensile (typ.)	Yield 0.5% EUL (typ.)	Elong. (min.)	Hardness (typ.)
Annealed (O61)	380 – 450 MPa	150 – 200 MPa	$\geq 30\%$	75 – 95 HV
Annealed grain (OS025)	380 – 450 MPa	150 – 200 MPa	$\geq 30\%$	75 – 95 HV
Light-drawn (H55)	≥ 450 MPa	≥ 340 MPa	$\geq 8\%$	100 – 130 HV

Yield is reported at 0.5% extension under load (EUL), the convention used in ASTM B111 for copper-alloy tube. Hardness in Vickers (HV). Values are indicative; verify against ASTM B111 / B466 specification limits and the MTC.

5. Product Forms & Size Range

C71500 is supplied in a wide range of product forms for the most demanding seawater applications. Custom lengths, end-finishing (plain, expanded, bevelled), U-bend forming and machined fittings are available on request. Nuclear-grade material with restricted cobalt content can be supplied against project specifications.

5.1 Standard Size Range by Product Form

Form	Typical size range	Notes
Seamless condenser tube	OD 6 – 51 mm; wall 0.5 – 3.0 mm	ASTM B111; straight or U-bend
Welded condenser tube	OD 16 – 51 mm; wall 0.7 – 2.5 mm	ASTM B543; straight lengths
Seamless pipe (general)	OD 6 – 219 mm; wall 1.0 – 8.0 mm	ASTM B466; schedule pipe available
Welded pipe	OD 50 – 610 mm; wall 1.5 – 12 mm	ASTM B467; large-diameter seawater lines
U-bend tube	OD 12 – 38 mm; min. bend $\geq 2.5 \times \text{OD}$	Stress-relieved after bending
Plate / sheet	Thick. 1 – 50 mm; width $\leq 1\,500$ mm	For tubesheets, baffles, hull cladding
Bar / rod	Dia. 5 – 120 mm; length 1 – 6 m	For valves, shafts, fittings

5.2 End Finishing & Special Processing

- Straight tube lengths: 3 – 18 m (commonly 6 m / 12 m).
- Plain, squared, deburred or bevelled ends as specified.
- U-bends supplied stress-relieved, with bend thinning controlled per TEMA / customer drawing.
- ID cleaned and passivated for heat-exchanger service; ends capped for shipment.
- Nuclear-grade material available with restricted cobalt content ($\leq 0.05\%$) upon request.

5.3 Packaging

- Straight tube / pipe: bundled in wooden cases with separator strips and end caps.
- U-bends: nested in cradles with foam protection at bend areas.
- Plate: palletized with interleave paper, edge protection and steel strapping.
- Each bundle tagged with heat number, size, temper and quantity.
- Export seaworthy packing with moisture barrier and desiccant.

6. Tolerances, Finish & Quality Control

C71500 tube and pipe are produced and inspected to ASTM B111 (or B466 / B467 for pipe). Because C71500 is used in pressurized seawater systems and critical applications where failure can be catastrophic, every lot is tested for dimensional accuracy, mechanical properties and, on request, for corrosion performance. Hydrostatic or pneumatic testing is performed on each tube.

6.1 Dimensional Tolerances (typical)

Parameter	Typical tolerance
Outside diameter	$\pm 0.05 - 0.13$ mm (ASTM B111/B466 class)
Wall thickness	$\pm 8 - 10\%$ of nominal wall
Length (straight)	+3 / -0 mm, or custom-cut to drawing
Straightness	≤ 1.5 mm in any 3 m length
Ovality (OD)	$\leq$ half the OD tolerance
U-bend thinning	max 17% of nominal wall at bend (per TEMA)

6.2 Surface Finish & Cleanliness

- Smooth, bright-annealed or mill-finish ID and OD; free from cracks, laminations and deep scratches.
- ID cleaned of residual drawing lubricant; ends capped to maintain cleanliness for HX service.
- Plate and bar supplied with mill, brushed or polished finish as specified.
- Surface meets customer cleanliness specification (e.g. TEMA, refinery spec).

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
Hardness (HV)	ASTM E92	Each lot
Hydrostatic / pneumatic test	ASTM B111/B466 (per spec.)	Each tube / pipe
Eddy-current test	ASTM E243 (non-destructive)	Each tube (on request)
Dimensional / ovality	Calipers / micrometers	Each tube / pipe
Grain size	ASTM E112	Each lot (OS025 temper)
Flaring / flange test	ASTM B111 tube test	Per specification
Cobalt content (nuclear)	ICP-MS / customer spec.	On request (nuclear grade)

7. Corrosion Resistance & Service Conditions

C71500 is the most corrosion-resistant copper alloy available for seawater service. Its performance derives from a protective surface film - a complex oxide layer enriched in Cu, Ni and Fe that forms spontaneously in seawater and renews itself if damaged. The higher nickel content (30% vs 10% in C70600) produces a denser, more protective film and greater resistance to impingement and erosion-corrosion. This is why C71500 tolerates seawater velocities up to 4.5 m/s - the highest of any copper alloy - and is the preferred material for severe-service and high-velocity applications.

7.1 Corrosion Mechanisms & Performance

- General seawater corrosion: excellent; long-term corrosion rate typically < 0.025 mm/year in clean, flowing seawater.
- Pitting resistance: excellent; the protective film self-heals if locally damaged.
- Impingement / erosion-corrosion: excellent; tolerates seawater velocities up to 4.5 m/s (highest of any Cu alloy).
- Sulfide / polluted-water resistance: excellent; does not suffer rapid attack in sulfide-bearing seawater.
- Stress-corrosion cracking (SCC): resistant; not susceptible to ammonia SCC like brass.
- Galvanic compatibility: compatible with steel, other copper alloys and titanium; can be safely coupled in seawater systems with proper design.
- Cryogenic toughness: excellent; retains ductility and toughness at LNG temperatures (-162 °C) and below.
- Crevice corrosion: very low risk under normal flow conditions.

7.2 Biofouling Resistance

- C71500 releases trace copper ions at the surface in seawater, which are toxic to settling marine organisms (barnacles, mussels, algae).
- This natural anti-fouling effect reduces or eliminates the need for chlorination in seawater cooling systems.
- Biofouling resistance develops after an initial film-formation period of 4-12 weeks in service.
- Anti-fouling performance is maintained as long as the alloy surface is exposed to flowing seawater; stagnant conditions reduce effectiveness.
- Cu-Ni cladding (C71500) on ship hulls can reduce fuel consumption by maintaining a smooth, fouling-free surface.

7.3 Design Considerations & Service Limits

Recommended maximum seawater velocity for C71500 tubing is about 3.5-4.5 m/s - the highest of any copper alloy and substantially higher than C70600 (3.0-3.5 m/s) and aluminum brass (2.0-2.5 m/s). For piping systems, velocities up to 4.0 m/s are acceptable in straight runs; reduce at bends and pump discharges. The recommended continuous service temperature is 200 °C for pressure and structural applications. C71500 also performs excellently at cryogenic temperatures down to -200 °C and below. Key design practices:

7.4 Design Practices

- Avoid prolonged stagnant conditions (deposit attack); design for continuous or intermittent flow.
- For pipe entries and pump discharges, use design velocity limits: 4.0 m/s straight pipe, 3.0 m/s at inlets/bends.
- Initial film formation: allow 4-12 weeks of normal flow for the protective film to mature before full design velocity is applied.
- Weldability: C71500 can be TIG / MIG welded with matching Cu-Ni filler (ERCuNi); welds retain corrosion resistance if properly cleaned and pickled.
- Avoid direct contact with mercury, ammonia vapour or strong oxidizing acids in continuous service.
- For galvanic isolation from aluminium or stainless steel in seawater, use insulating flanges or sacrificial anodes.
- For less demanding service (velocity < 3.0 m/s, clean water), consider C70600 (90/10 cupronickel) for cost savings with equivalent corrosion resistance.

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 C71500 seamless and welded cupronickel tube, pipe, plate and bar for power-station condensers, desalination plants, seawater piping and marine hardware applications.

We provide project-specific mill test certificates (EN 10204 3.1 / 3.2), third-party inspection by SGS / BV / TÜV, and value-added services including U-bend forming, tube-to-tubesheet preparation, pipe cutting and bevelling, hull-cladding plate supply and technical consultation. Contact us for a quote or for help selecting the right temper and specification for your service environment.

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