COPPER C101

Technical Data Sheet & Comprehensive Guide

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1. INTRODUCTION

Copper C101 (also known as CW004A, Cu-ETP, or Electrolytic Tough Pitch Copper) is a commercially pure, high conductivity grade of copper that serves as a cornerstone material in electrical and thermal applications. It is refined through electrolytic deposition and then melted and oxidized to the 'tough pitch' condition with a controlled low oxygen content.

C101 is also commonly referred to as HDHC (Hard Drawn, High Conductivity) copper and represents one of the most widely used copper grades due to its exceptional combination of electrical and thermal conductivity, corrosion resistance, workability, and aesthetic appeal. It serves as the base material from which common brasses and bronzes are produced.

2. ALLOY DESIGNATIONS & STANDARDS

C101 copper corresponds to multiple international standards and designations:

Standard System	Designation
BS (British Standard)	C101
CEN (European)	CW004A
UNS (Unified Numbering)	C11000
ISO	Cu-ETP
DIN	2.0060
Other Names	HC Copper, ETP Copper, HDHC

3. CHEMICAL COMPOSITION

Element	Weight %	Notes
Copper (Cu)	99.90% min	Balance
Oxygen (O)	0.02 - 0.04%	Controlled low oxygen
Other Impurities	0.10% max	Total other elements

4. PHYSICAL PROPERTIES

Property	Value	Unit
Density	8.92	g/cm³
Melting Point	1083	°C (1981°F)
Modulus of Elasticity	117	GPa
Electrical Resistivity	0.0171 × 10■■	Ω·m
Electrical Conductivity	100 (min)	% IACS
Thermal Conductivity	391.1	W/m·K
Coefficient of Thermal Expansion	16.9 × 10■■	/K
Specific Heat Capacity	~0.385	J/g·K

5. MECHANICAL PROPERTIES

Mechanical properties vary based on temper, temperature, product form, and other factors. The following table shows typical ranges:

Property	Value Range	Condition
Tensile Strength	200 - 400 MPa	Varies with temper
Proof Stress (0.2%)	50 - 340 MPa	Varies with temper
Elongation (A50mm)	5 - 50%	Higher when annealed
Hardness (Vickers)	40 - 110 HV	Varies with temper
Hardness (Brinell)	65 - 90 HB	H065 temper

Yield Strength (Annealed)	70 - 100 MPa	Soft condition

R250 Temper (10-30mm bar):

Property	Minimum Value
Tensile Strength	250 MPa min
Proof Stress 0.2%	180 MPa min
Elongation A5	15% min

6. KEY FEATURES & CHARACTERISTICS

- **Very High Electrical Conductivity:** Nominal 100% IACS rating makes it ideal for electrical applications
- **Excellent Thermal Conductivity:** 391.1 W/m·K enables efficient heat transfer
- **High Ductility:** Excellent formability in annealed condition
- **High Impact Strength:** Suitable for demanding mechanical applications
- **Good to Excellent Corrosion Resistance:** Performs well in most environments
- **Excellent Joining Characteristics:** Superior solderability and good brazability
- **Aesthetic Appeal:** Develops attractive green patina over time
- **Versatility:** Base material for brass and bronze production

7. FABRICATION PROPERTIES

7.1 Cold Working

C101 can be readily cold worked. When in the annealed condition, it can be readily bent to shape and has excellent ductility. It work hardens relatively slowly and can be annealed in neutral or oxidising atmospheres.

7.2 Hot Working

C101 is very readily hot worked. It is excellent for hot working, cold working, and forging applications.

7.3 Heat Treatment

Solution treatment or annealing can be done by rapid cooling after heating to 370-650°C.

7.4 Machinability

C101 has a machinability rating of approximately 20% when free-machining brass (Alloy 360) is rated at 100%. Due to its high purity and softness, it is not ideal for machining. Tips for machining include: use sharp tools with positive rake angles, maintain good chip control, use plenty of lubrication, and opt for slow to moderate cutting speeds with light feeds.

7.5 Welding & Joining

Process	Rating
Soldering	Excellent
Brazing	Good
Butt Welding	Good

Gas Shielded Arc Welding	Fair
Other Welding Processes	Not Recommended

8. CORROSION RESISTANCE

C101 offers good to excellent corrosion resistance in most environments and atmospheres. Copper is naturally resistant to corrosion in marine and industrial environments. Over time, exposed C101 develops a characteristic green patina that provides additional corrosion protection and is often considered aesthetically desirable in architectural applications.

Environments to Avoid: C101 is corroded by oxidising acids, halogens, sulphides, and ammonia-based solutions. It should not be used in reducing atmospheres.

9. IMPORTANT CONSIDERATIONS

9.1 Hydrogen Embrittlement

Due to oxygen present in the form of Cu■O, this copper is susceptible to hydrogen embrittlement in reducing gases at elevated temperatures. The grade also carries the risk of embrittlement when heating, welding or brazing using an oxy-fuel gas flame. For applications requiring immunity to hydrogen embrittlement, oxygen-free copper grades (such as C10100) should be considered.

10. APPLICATIONS

10.1 Electrical & Electronic Applications

- Busbars and bus conductors
- Motor and transformer components
- Generator and instrument windings
- Enamelled wire
- All types of cables and overhead line conductors
- Electrical contacts and terminals
- Connectors and current-carrying applications
- Wave guides and hollow conductors

10.2 Thermal Applications

- Automotive and industrial radiators
- Heat exchangers and heatsinks
- Cooling systems

10.3 Architectural Applications

- Building fascias and cladding
- Roofing and flashing
- Gutters and downspouts
- Decorative metalwork

10.4 Industrial Applications

- General engineering components
- Chemical process equipment
- Vats, kettles, and pans
- Cold formed components
- Domestic appliances

11. AVAILABLE PRODUCT FORMS

- Round bar
- Flat bar
- Square bar
- Sheet and plate
- Strip
- Foil (shim)

- Wire
- Tube
- Rod

12. C101 vs C110 COMPARISON

Property	C101 (Cu-ETP)	C110 (UNS C11000)
Copper Content	99.90% min	99.90% min
Oxygen Content	0.02-0.04%	0.02-0.04%
Conductivity	~100% IACS	~101% IACS
Primary Use	General electrical	High-purity electrical
Cost	Lower	Higher

DISCLAIMER

This technical data sheet is provided for informational purposes only and should not be seen as a substitute for full material specifications. Mechanical property requirements vary widely with temper, product form, and dimensions. The information is based on current industry knowledge and is given in good faith. Users should verify specific properties with material suppliers for their particular applications. Always consult with qualified metallurgists and engineers for critical applications.

SOURCES

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