Aluminium Bronze

CA104 / DTD197A ● DEF STAN 02-833
C63000 / AMS4640 ● DEF STAN 02-834

COLUMBIA METALS
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Aluminium bronzes are the most widely used of all the high performance copper alloys mainly due to their superb blend of strength and corrosion resistance. These properties ensure the alloys are widely utilised in marine and offshore applications in seawater and under adverse atmospheric conditions. This essential group of engineering alloys also services the aerospace, automotive and petrochemical industries together with general engineering requirements.

Aluminium bronzes are primarily copper-based alloys with an aluminium content of between 6 and 14%. Other alloying additions such as nickel, iron, manganese and silicon can be made to enhance the properties of individual grades. There are three main types of aluminium bronze: the single-phase alpha alloys containing less than 8% aluminium; the two-phase or duplex grades containing between 8 and 11% aluminium (these are usually alloyed with iron and nickel); and the copper aluminium and silicon alloys known as aluminium silicon bronzes. The most popular engineering alloys fall into the duplex category and are usually alloyed with iron and nickel to achieve higher strength and corrosion resistance, whilst the higher aluminium content creates a hard beta phase in the microstructure that improves overall strength and hardness. Aluminium silicon bronzes are mainly utilised in marine applications.

The most popular grades of aluminium bronze, all stocked by Columbia Metals in a wide range of sizes in round bar, hexagon and sheet, are described below.

CA104 / CW307G / BS2 B23 / DTD197A

These alloys are classed as 10/5/5 nickel aluminium bronzes as the nominal composition is 10% aluminium, 5% nickel and 5% iron, with the remainder made up of copper. They are the most commonly used grades within the United Kingdom. DTD197A / BS2B23 are used for aerospace engineering, while the European and British grades CW307G and CA104 are utilised in marine, chemical and general engineering. Mainly used for their high strength and excellent corrosion resistance, they also offer excellent wear and abrasion resistance, an ability to withstand shock loading, non-sparking properties and excellent mechanical properties at cryogenic temperatures.

- HIGH STRENGTH AND TOUGHNESS
- EXCELLENT CRYOGENIC PROPERTIES
- VERY GOOD CORROSION RESISTANCE
- EXCELLENT WEAR RESISTANCE
- NON-SPARKING
- GOOD SOFTENING RESISTANCE

DEF STAN 02-833 / NES 833 / DGS 1043

DEF STAN 02-833 is a nickel aluminium bronze similar in composition to CA104, but is manufactured to the more exacting requirements of the MoD (Navy). The MoD stipulate a nickel content that exceeds the iron content to improve the general corrosion performance. Additionally, a heat treatment may be required for smaller diameter rods to control the microstructure and phases present. Other requirements include a minimum impact value on sizes above 15mm diameter and a full ultrasonic inspection to conform to Grade 1 material. This grade has primarily been developed for offshore and marine applications and offers a high strength, an excellent corrosion resistance in seawater and other aggressive media and a high wear and abrasion resistance.

C63000 / AMS4640

C63000 is the most popular American grade of nickel aluminium bronze. Developed as an equivalent to the grades above, it has been adapted to become an important aerospace material under the specification AMS4640. The alloy features a high strength and toughness combined with a very good corrosion resistance and an excellent resistance to wear, shock and abrasion.

DEF STAN 02-834 / NES 834 / DGS 1044 / DEF STAN 02-879

This aluminium silicon bronze has similar attributes to the other aluminium bronzes, with a 2% silicon addition to enhance the material strength, corrosion resistance and impact strength whilst also improving the alloy machinability. As an MoD (Navy) specification, this material is subject to special requirements including impact properties and a controlled low magnetic permeability level of <1.05.

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Technical Data

Nominal Composition (%)

	Cu	Al	Ni	Fe	Mn	Si
CA104	Rem	8.5 - 11.0	4.0 - 5.5	4.0 - 5.5	0.5 max	-
DEF STAN 02-833	Rem	8.5 - 10.0	4.5 - 5.5	4.0 - 5.0	0.5 max	-
C63000 / AMS4640	Rem	9.0 - 11.0	4.0 - 5.5	2.0 - 4.0	1.5 max	0.25 max
DEF STAN 02-834	Rem	6.0 - 6.4	-	0.5 - 0.7	0.5 max	2.0 - 2.4

Mechanical Properties (specification minima - 1" diameter)

	CA104	DEF STAN 02-833	C63000	DEF STAN 02-834
Ultimate Tensile Strength (N/mm^2)	700	635	760	525
0.2% Proof Strength (N/mm^2)	370	295	415	275
Elongation (%)	12	17	10	20
Impact Strength (J)	-	27	-	33

Typical Physical Properties

	CA104	DEF STAN 02-833	C63000	DEF STAN 02-834
Density (g/cm^3)	7.5	7.5	7.6	7.8
Melting Range (°C)	1060 - 1075	1060 - 1075	1050 - 1070	980 - 1010
Thermal conductivity (20°C; W/m°K)	59 - 67	59 - 67	38 - 46	45
Coeff. Thermal Exp. (0-300°C; m/m°K x 10^{-6})	18	18	17	18
Electrical Conductivity (% IACS)	12 - 14	12 - 14	7 - 9	7 - 8
Magnetic Permeability	1.5	1.5	1.0002	<1.0001

Stock Sizes

Round Bar								
1/4"	1/2"	*25mm*	1.1/2"	2.1/8"	*70mm*	3.3/4"	5.1/4"	7"
5/16"	5/8"	1"	1.9/16"	2.1/4"	3"	4"	5.1/2"	7.1/2"
3/8"	11/16"	1.1/8"	1.5/8"	2.3/8"	3.1/8"	4.1/4"	5.3/4"	8"
10mm	3/4"	1.1/4"	1.3/4"	2.1/2"	3.1/4"	4.1/2"	*150mm*	9"
7/16"	*22mm*	1.5/16"	1.7/8"	2.5/8"	3.3/8"	4.3/4"	6"	*252mm*
12mm	7/8"	1.3/8"	2"	2.3/4"	3.1/2"	5"	6.1/2"	10"

Hexagon	Flat / Square Bar	Sheet
3/8" - 2.1/2" A/F in a comprehensive range	Flat: wide range of sizes Square: 1/4" - 4"	4' x 2' sheets in thickness from 1/4" to 1.1/2"

REV4/10/23

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