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## Guide to Nickel Aluminium Bronze for Engineers

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# Guide to Nickel Aluminium Bronze for Engineers

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**Copper Development  
Association**  
Copper Alliance

Copper Development Association is a non-trading organisation that promotes and supports the use of copper based on its superior technical performance and its contribution to a higher quality of life. Its services, which include the provision of technical advice and information, are available to those interested in the utilisation of copper and copper alloys in all their aspects. The Association also provides a link between research and the user industries and is part of an international network of trade associations, the Copper Alliance™.

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## Cover page images:

Adjustable bolted propeller – one of two 33 tonne propellers from the Queen Elizabeth class aircraft carrier capable of producing 40 MW of thrust (Courtesy Rolls Royce Marine)

Nickel aluminium bronze window frames, cladding and roof, Portcullis House, London

Seawater pipe sections (Courtesy Inoxyda SA, France)

# Contents

<b>1.0 Introduction.....</b>	<b>5</b>	6.9	Comparative Corrosion Resistance of Various Copper-based Alloys in Seawater Applications.....	38	
<b>2.0 Overview .....</b>	<b>6</b>	6.10	Erosion Corrosion.....	39	
2.1	Typical Mechanical and Physical Properties.....	7	6.11	Cavitation.....	39
2.2	Seawater Corrosion Behaviour.....	8	6.12	Stress Corrosion Cracking.....	40
2.3	Development Chronology.....	8	6.13	Corrosion Fatigue.....	41
<b>3.0 Applications.....</b>	<b>10</b>	6.14	Comparison in Seawater with Other Alloy Groups .....	43	
3.1	Aerospace.....	10	6.15	Corrosion Resistance of Nickel Aluminium Bronze in Chemical Environments.....	44
3.2	Architecture.....	11	6.15.1	Sulphuric Acid .....	44
3.3	Marine.....	11	6.15.2	Acetic Acid .....	44
3.3.1	Defence.....	11	6.15.3	Hydrochloric Acid.....	44
3.3.2	Commercial.....	13	6.15.4	Phosphoric Acid.....	44
3.4	Offshore Oil/Gas and Petrochemical.....	14	6.15.5	Hydrofluoric Acid.....	45
3.4.1	Bearing Applications within Oil Rig Equipment.....	15	6.15.6	Nitric Acid.....	45
3.4.2	Communications and Transponders.....	17	6.15.7	Alkalis.....	45
3.4.3	Actuator Valves.....	18	6.15.8	Salts .....	45
3.4.4	Oil Tankers.....	18	6.15.9	Other Corrosive Chemical Environments.....	45
3.5	Desalination and Water Condenser Systems.....	19	6.16	Weld Areas .....	46
<b>4.0 Alloying Elements and Microstructural Phases.....</b>	<b>21</b>	6.16.1	Galvanic Corrosion .....	46	
4.1	Influence of Alloying Elements.....	21	6.16.2	Selective Phase Attack .....	46
4.1.1	Aluminium.....	21	6.16.3	Stress Corrosion.....	46
4.1.2	Manganese.....	21	6.16.4	Porosity and Gas Inclusions.....	46
4.1.3	Nickel.....	21	<b>7.0 Heat Treatment.....</b>	<b>47</b>	
4.1.4	Iron.....	21	7.1	Stress Relieving.....	47
4.1.5	Impurities .....	21	7.2	Annealing.....	47
4.2	Types of Microstructural Phases.....	21	7.3	Quenching and Tempering .....	48
<b>5.0 Properties.....</b>	<b>26</b>	7.4	Heat Treatment of Cast CuAl10Fe5Ni5.....	49	
5.1	Mechanical Strength.....	26	7.5	Heat Treatments in International Standards.....	50
5.2	Low and High Temperature Properties.....	27	<b>8.0 Wear and Galling Performance .....</b>	<b>52</b>	
5.3	Impact Toughness.....	27	8.1	Fretting Wear .....	53
5.4	Fatigue Strength.....	28	8.2	Galling.....	54
5.5	Creep Strength .....	29	<b>9.0 Fabrication and Manufacture .....</b>	<b>56</b>	
5.6	Magnetic Permeability .....	30	9.1	Welding.....	56
<b>6.0 Corrosion Resistance .....</b>	<b>32</b>	9.1.1	Welding Processes.....	57	
6.1	Protective Surface Film.....	32	9.1.2	Joining Processes.....	57
6.1.1	Oxidation at Elevated Temperatures.....	32	9.1.3	Recommended Welding Processes.....	57
6.2	Pitting.....	32	9.1.3.1	TIG/GTAW Process.....	57
6.3	Crevice Corrosion.....	32	9.1.3.2	MIG/GMAW Process.....	58
6.4	Selective Phase Corrosion.....	33	9.1.3.3	Manual Metal Arc.....	59
6.5	Galvanic Corrosion .....	34	9.1.3.4	Electron Beam Welding .....	60
6.6	Biofouling.....	36	9.1.3.5	Friction Welding.....	60
6.7	Electrical Leakage (Stray Current) Corrosion .....	37	9.1.3.6	Laser Welding.....	60
6.8	Sulphide Pollution.....	37	9.1.4	Welding Practice and Joint Design.....	60
			9.1.4.1	Design of Joints.....	60
			9.1.4.2	Weld Preparation.....	61

9.1.5	Pre-heating and Weld Run Temperature Control .....	62
9.1.6	Selection of Filler Materials for TIG/GTAW and MIG/GMAW Welding .....	63
9.1.7	Post Weld Heat Treatment .....	63
	9.1.7.1 Stress Relief .....	63
	9.1.7.2 Full Anneal .....	63
9.2	Machining .....	65
	9.2.1 Rough and Finishing Turning .....	67
	9.2.2 Milling .....	68
	9.2.3 Slot Milling .....	69
	9.2.4 Threading .....	70
9.3	Mechanical and Non-destructive Testing .....	71
	9.3.1 Mechanical Testing .....	71
	9.3.2 Non-destructive Testing .....	71
9.4	Manufacture - Casting Processes .....	72
	9.4.1 Modern Casting Techniques .....	72
	9.4.2 Continuous Casting Computer Simulation .....	73
	9.4.3 Continuous Casting .....	73
	9.4.4 Centrifugal Casting .....	75
9.5	Wrought Hot Working Processes .....	76
	9.5.1 Hot Working Ranges .....	76
	9.5.2 Cold Working .....	76
	9.5.3 Extrusion .....	76
	9.5.4 Rolling .....	76
	9.5.5 Forging .....	77
<b>10.0 Summary Guidelines for Engineers .....</b>		<b>79</b>
<b>11.0 References and Further Information ...</b>		<b>80</b>
11.1	General References .....	80
11.2	Publications from Copper Development Association (CDA) .....	81
11.3	Other Publications .....	81

<b>Appendix: Tables 1–22 .....</b>	<b>82</b>	
Standards, Designations, Chemical Compositions and Mechanical Properties		
<b>International Standards</b>		
Table App1	Nickel Aluminium Bronze – Wrought .....	83
Table App2	Nickel Aluminium Bronze – Cast .....	85
<b>UK: Nickel Aluminium Bronze – Wrought</b>		
Table App3	Chemical Compositions .....	86
Table App4	Mechanical Properties .....	86
<b>UK: Nickel Aluminium Bronze – Cast</b>		
Table App5	Chemical Compositions .....	87
Table App6	Mechanical Properties .....	87
<b>UK/European: Nickel Aluminium Bronze – Wrought</b>		
Table App7	Chemical Compositions .....	88
Table App8	Mechanical Properties .....	89
<b>UK/European: Nickel Aluminium Bronze – Cast</b>		
Table App9	Chemical Compositions .....	90
Table App10	Mechanical Properties .....	90
<b>France: Nickel Aluminium Bronze – Wrought</b>		
Table App11	Chemical Compositions .....	91
Table App12	Mechanical Properties .....	91
<b>France: Nickel Aluminium Bronze – Cast</b>		
Table App13	Chemical Compositions .....	92
Table App14	Mechanical Properties .....	92
<b>Germany: Nickel Aluminium Bronze – Wrought</b>		
Table App15	Chemical Compositions .....	93
Table App16	Mechanical Properties .....	94
<b>Germany: Nickel Aluminium Bronze – Cast</b>		
Table App17	Chemical Compositions .....	95
Table App18	Mechanical Properties .....	95
<b>USA: Nickel Aluminium Bronze – Wrought</b>		
Table App19	Chemical Compositions .....	96
Table App20	Mechanical Properties .....	96
<b>USA: Nickel Aluminium Bronze – Cast</b>		
Table App21	Chemical Compositions .....	97
Table App22	Mechanical Properties .....	98

# 1.0 Introduction

Alloys of copper and aluminium are known as aluminium bronze and, together with other alloying additions, produce a range of properties that are beneficial to a diverse range of industries. Of these, the nickel aluminium bronze group of alloys is the most widely used. They have been adapted with time to optimise performance and can provide a combination of properties that can offer an economic alternative to other types of alloy systems.

Nickel aluminium bronzes are available in both cast and wrought product forms and have a unique combination of properties:

- Excellent wear and galling resistance
- High strength
- Density (10% lighter than steel)
- Non-sparking
- Low magnetic permeability (of  $<1.03 \mu$  in selected grades)
- High corrosion resistance
- Good stress corrosion properties
- Good cryogenic properties
- High resistance to cavitation
- Damping capacity twice that of steel
- High resistance to biofouling
- A protective oxide surface film which has the ability to self-repair.

End uses range from landing gear bushing and bearings for all of the world's commercial aircraft to seawater pumps and valves, propellers for naval and commercial shipping, non-sparking tools in the oil and gas industry and pleasing facades in architecture.

The nickel aluminium bronze alloys are fairly complex materials and, during manufacture, require good control of the metal structure by attention to composition and heat treatment. As such it is the purpose of this publication to provide an engineering overview of the properties of the alloys, their specifications and their applications for operators, designers, manufacturers and fabricators. Their corrosion behaviour is explained and guidance is given to obtain optimum service performance. Methods of manufacture, welding and fabrication are also described and a list of references and useful publications is provided. The Appendix covers full details of designations, specifications and related composition and mechanical property requirements.