

COPPER & COPPER ALLOYS  
MATERIALS TAILORED TO YOUR NEEDS

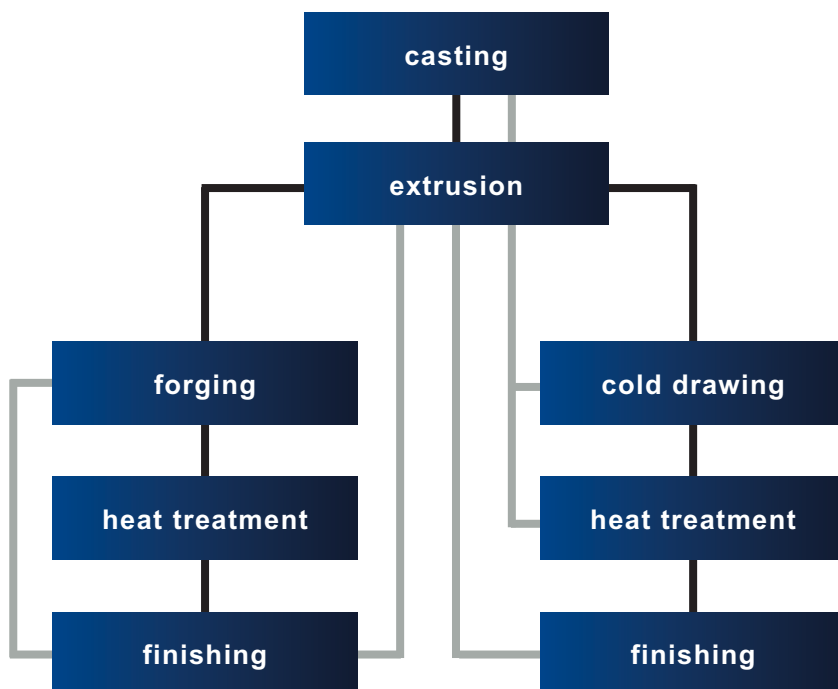




## NON-FERROUS METALS AT THE OTTO FUCHS DÜLKEN SITE

OTTO FUCHS Dülken specialises in the innovative processing of non-ferrous metals. We produce more than just products – we develop complete solutions to problems. We supply numerous industrial segments with our high-quality products, ranging from the automotive, mechanical and electrical engineering industries, to the building construction and sanitary installation work sectors. We can produce on a make to order or serial production basis, according to customer wishes.

From the product of the raw ingot through to the ready to install product, our in house processes cover the complete supply chain requirements. This enables us to achieve the optimal coordination of the individual steps of casting, extrusion, forging, machining and coating. Hence, we are not only a producer that performs to specification, but we also work as a development partner with our customers. The diversity of the materials we work with, the processes we use, and the expertise we have developed over many years enable us to produce innovative results time and time again. To meet your specific customer needs, we select the best available solution from our wide range of materials and processes.





# THE ALLOYING PROGRAMME OF THE OTTO FUCHS DÜLKEN SITE

The alloying programme of the OTTO FUCHS Dülken site encompasses a wide range of copper-based alloys. Materials are alloyed in different ways depending on the application-specific requirements. Typically copper alloys provide zinc and lead for brass, and in addition, special brass and bronze are alloyed with further elements such as manganese, aluminium, nickel or silicon. The specific chemical composition enables us to fulfill your demands.

## List of alloys according to chemical composition

OF	short name	DIN EN	density g/cm <sup>3</sup>	industries	example applications	special notes
<b>low-alloy coppers</b>						
2000	Cu-ETP	CW004A	8.9	electrical engineering	base wire products, profile metal	
2001	Cu-PHC	CW020A	8.9	electrical engineering	base wire products, profile metal	
2002	Cu-DHP	CW024A	8.9	electrical engineering	base wire products, profile metal	
2403	CuNi1Si	CW109C	8.8	automotive electrical engineering	terminals	can be age-hardened
2400	CuNi2Si	CW111C	8.8	automotive electrical engineering	terminals	can be age-hardened
<b>copper/zinc alloys with/without Pb</b>						
2195	CuZn5	CW500L	8.9	electrical engineering specials	installation parts	
2190	CuZn10	CW501L	8.8	electrical engineering specials	installation parts	
2185	CuZn15	CW502L	8.8	electrical engineering specials	installation parts	
2180	CuZn20	CW503L	8.7	electrical engineering	plug connectors	
2172	CuZn28	CW504L	8.6	electrical engineering specials	plug connectors parts for cold forming	
2170	CuZn30	CW505L	8.5	electrical engineering specials	plug connectors parts for cold forming	
2167	CuZn33	CW506L	8.5	electrical engineering specials	plug connectors	
2164	CuZn36	CW507L	8.4	specials	pipes, profile metal	
2362	CuZn36Pb3	CW603N	8.5	drinking water specials	product group C lathed parts	
2163	CuZn37	CW508L	8.4	specials	pipes, profile metal	
2363	CuZn37Pb0.5	CW604N	8.4	specials	lathed parts parts for cold forming	
2370	CuZn37Pb2	CW606N	8.5	specials	lathed parts parts for cold forming	
2161	CuZn38Pb1	CW607N	8.4	electrical engineering specials	plug connectors parts for cold forming	
2361	CuZn38Pb2	CW608N	8.4	electrical engineering specials	plug connectors parts for cold forming	
2360/ 2660	CuZn39Pb0.5	CW610N	8.4	electrical engineering specials	plug connectors parts for cold forming	2660 as polishing quality
2195	CuZn39Pb2	CW612N	8.4	drinking water	lathed parts, fittings	product group B+C
2158/ 2358	CuZn39Pb3	CW614N	8.4	electrical engineering specials	terminal elements components	2358: drinking water, product group C
2160	CuZn40	CW509L	8.4	drinking water specials	lathed parts, fittings pipes	product group B+C
2357/ 2657	CuZn40Pb2	CW617N	8.4	electrical engineering drinking water specials	lathed parts, fittings bearing retainer cage	2657 non-magnetic product group B+C
2157	CuZn42	CW510L	8.4	drinking water specials	lathed parts, fittings profile metal	product group B+C
2155	CuZn43Pb2	CW623N	8.4	specials construction	profile metal stair rails	

Suitability for drinking water in terms of hygiene: **Product group B:** Fittings, valves, pipe connectors, instruments and pumps

**Product group C:** Components in pumps, instruments and valves, where no more than 10% of the components' total surface area comes into contact with water.

**List of alloys according to chemical composition**

OF	short name	DIN EN	density g/cm <sup>3</sup>	industries	example applications	special notes
<b>copper/zinc alloys with arsenic</b>						
2276	CuZn20Al2As	CW702R	8.4	specials	pipes	
2275	CuZn32Pb2AsFeSi	CW709R	8.4	specials	pipes	
2274	CuZn33Pb1AlAs	CW725R	8.5	drinking water specials	turned parts pipes	also known as ACQUARIN® product group B+C
2764	CuZn36As	special alloy	8.4	specials	pipes	
2162	CuZn36Pb2As	CW602N	8.4	specials plant engineering	Pipes rods	
2565	CuZn37Pb0.5As	special alloy	8.4	specials	pipes	
2765	CuZn38As	CW511L	8.4	drinking water	turned parts, fittings	product group B+C
<b>copper/zinc/silicon alloys</b>						
2285/ 2286	CuZn21Si3P	CW724R	8.3	drinking water specials	turned parts, fittings	product group B+C
2269	CuZn31Si1 (Pb max 0.1%)	CW708R	8.4	automotive	bushings	
2268/ 2270	CuZn31Si1	CW708R	8.4	automotive machinery plant construction	bushings rods (2268)	





## List of alloys according to chemical composition

OF	short name	DIN EN	density g/cm <sup>3</sup>	industries	example applications	special notes
<b>special brass</b>						
2207	CuZn13Al1Ni1Si1	CW700R	8.5	machinery plant construction	brake lines gas pipes pipes sea water	non-magnetic non-sparking
2266	CuZn20Mn7Al5Si1	special alloy	7.7	automotive	synchroniser rings	high content of particles against wear
2264	CuZn23Al6Mn4Fe3Pb	CW704R	8.2	automotive	synchroniser rings for coating	high strength under static loads high impact resistance high fatigue strength
2805	CuZn28Al4Ni3Co1Si1Mn	special alloy	8.0	automotive machinery plant construction	synchroniser rings guide blocks sliding shoes other sliding elements	
2226	CuZn30Al2Mn2Ni2Fe2	special alloy	8.2	specials	bushings components	
2260	CuZn30Al3Mn3SiNiCr	special alloy	8.0	automotive	synchroniser rings	
2261	CuZn30Al3Mn3Si1NiCr	special alloy	8.0	automotive	synchroniser rings	can be age-hardened
2278	CuZn31Ni7Al4Si2Fe	special alloy	7.9	automotive	synchroniser rings	can be age-hardened
2202	CuZn35Ni3Mn2AlPb	CW710R	8.3	plant construction machinery	pipes profile metal rods	resistant to natural atmosphere
2218 ***	CuZn35Mn2Si	special alloy	8.3	machinery plant construction	bushings pipes rods	
2210	CuZn37Mn3Al2PbSi	CW713R	8.1	automotive machinery plant construction	synchroniser rings valve guides worm gears shift forks cone rings thrust bearings	
2211	CuZn37Mn3Al2PbSi	special alloy	8.1	automotive machinery plant construction	synchroniser rings cone rings sliding shoes worm gears	
2220 ***	CuZn37Mn3Al2PbSi	special alloy	8.1	machinery plant construction	distributor plates sliding shoes	resistant to natural atmosphere
2203	CuZn38Mn1Al	CW716R	8.3	machinery plant construction	bearings sliding elements	resistant to natural atmosphere
2216 ***	CuZn38Mn2NiSi	special alloy	8.3	machinery plant construction	sliding shoes cylinders distributor plates retaining segments	
2206 ***	CuZn39Mn1AlPbSi	CW718R	8.2	specials	profile metal cylinders	resistant to natural atmosphere
2204	CuZn40Mn2Fe1	CW723R	8.3	architecture marine engineering	profile metal, handrails components	resistant to natural atmosphere
2209	CuZn40Mn1Pb1AlFeSn	CW721R	8.3	architecture specials	handrails mining profile metal	resistant to natural atmosphere
2212 ***	CuZn40Al2Mn2Si	special alloy	8.1	machinery plant construction	thrust bearings distributor plates	
2156	CuZn43Pb1Al	CW622N	8.3	specials	profile metal	

\*\*\* Alloy can only be acquired through VDM

**List of alloys according to chemical composition**

OF	short name	DIN EN	density g/cm <sup>3</sup>	industries	example applications	special notes
<b>aluminium bronzes and other alloys</b>						
2231	CuAl10Fe3Mn2	CW306G	7.6	automotive machinery plant construction architecture specials	toothed gears worm gears bushings for bearings sliding elements bearing retainer cage	scale-resistant non-sparking sea water-resistant
2232/ 2233	CuAl10Ni5Fe4	CW307G	7.6	automotive machinery plant construction architecture specials	toothed gears worm gears bushings for bearings sliding elements bearing retainer cage	scale-resistant non-sparking sea water-resistant 2233: suitable for heat treatment
2250	CuZn39Sn1	CW719R	8.4	machinery plant construction marine engineering	pipes boat fittings	

The right composition of materials, the manufacturing and refining process, enable the creation of high-performance materials for demanding applications. OTTO FUCHS Dülken material is developed to exceed basic mechanical requirements and industrial standards. Our materials solutions are tailored to meet special-purpose processing requirements and, for use in tribological systems or corrosive substances. Our aim is to offer the optimum solution for applications ranging from the automotive, mechanical and electrical engineering industries to the building construction and sanitary installation work sectors. If you need a new solution, we can optimise our alloys to meet the needs of your products and processes.



# THE ALLOYING PROGRAMME OF THE OTTO FUCHS DÜLKEN SITE



automotive	machinery and plant engineering
<b>battery terminals</b>	<b>thrust bearings</b>
CuZn39Pb3 (OF 2158)	CuZn30Al3Mn3Si1NiCr (OF 2261)
CuNi2Si (OF 2400)	CuZn37Mn3Al2PbSi (OF 2210)
<b>bolts</b>	CuZn37Mn3Al2PbSi (OF 2211)
CuAl10Ni5Fe4 (OF 2232)	CuZn40Al2Mn2Si (OF 2212) ***
CuAl10Ni5Fe4 (OF 2233)	CuZn38Mn2NiSi (OF 2216) ***
CuNi1Si (OF 2403)	CuZn35Mn2Si (OF 2218) ***
CuNi2Si (OF 2400)	<b>impellers</b>
<b>bushings</b>	CuZn37Mn3Al2PbSi (OF 2210)
CuZn31Si1 (OF 2268)	CuZn37Mn3Al2PbSi (OF 2211)
CuZn31Si1 (OF 2269)	<b>sliding shoes</b>
CuZn31Si1 (OF 2270)	CuZn37Mn3Al2PbSi (OF 2210)
CuZn23Al6Mn4Fe3Pb (OF 2264)	CuZn37Mn3Al2PbSi (OF 2211)
CuZn37Mn3Al2PbSi (OF 2210)	CuZn37Mn3Al2PbSi (OF 2220) ***
CuZn37Mn3Al2PbSi (OF 2211)	CuZn38Mn2NiSi (OF 2216) ***
CuZn40Al2Mn2Si (OF 2212) ***	CuZn30Al3Mn3Si1NiCr (OF 2261)
CuZn35Mn2Si (OF 2218) ***	CuZn28Al4Ni3Co1Si1Mn (OF 2805)
CuAl10Fe3Mn2 (OF 2231)	<b>cone rings</b>
CuAl10Ni5Fe4 (OF 2232)	CuZn37Mn3Al2PbSi (OF 2211)
CuAl10Ni5Fe4 (OF 2233)	<b>worm gears</b>
<b>guide blocks</b>	CuZn37Mn3Al2PbSi (OF 2210)
CuZn37Mn3Al2PbSi (OF 2211)	CuZn37Mn3Al2PbSi (OF 2220) ***
CuZn38Mn2NiSi (OF 2216) ***	CuZn38Mn2NiSi (OF 2216) ***
CuZn28Al4Ni3Co1SiMn (OF 2805)	CuAl10Fe3Mn2 (OF 2231)
<b>shift forks</b>	CuAl10Ni5Fe4 (OF 2232)
CuZn37Mn3Al2PbSi (OF 2210)	CuAl10Ni5Fe4 (OF 2233)
CuZn37Mn3Al2PbSi (OF 2211)	<b>control/retainer/bearing/distributor plates</b>
CuZn37Mn3Al2PbSi (OF 2220) ***	CuZn40Al2Mn2Si (OF 2212) ***
<b>synchroniser rings</b>	CuZn37Mn3Al2PbSi (OF 2220) ***
CuZn37Mn3Al2PbSi (OF 2210)	CuZn38Mn2NiSi (OF 2216) ***
CuZn37Mn3Al2PbSi (OF 2211)	<b>various components</b>
CuZn30Al3Mn3SiNiCr (OF 2260)	CuZn38Mn1Al (OF 2203)
CuZn30Al3Mn3Si1NiCr (OF 2261)	CuZn39Mn1AlPbSi (OF 2206)
CuZn23Al6Mn4Fe3Pb (Trägerringe, OF 2264)	CuZn36Pb2As (OF 2162)
CuZn20Mn7Al5Si1 (OF 2266)	CuZn23Al6Mn4Fe3Pb (OF 2264)
CuZn31Ni7Al4Si2Fe (OF 2278)	CuZn31Ni7Al4Si2Fe (OF 2278)
CuZn28Al4Ni3Co1Si1Mn (OF 2805)	
<b>valve guides</b>	
CuZn37Mn3Al2PbSi (OF 2210)	

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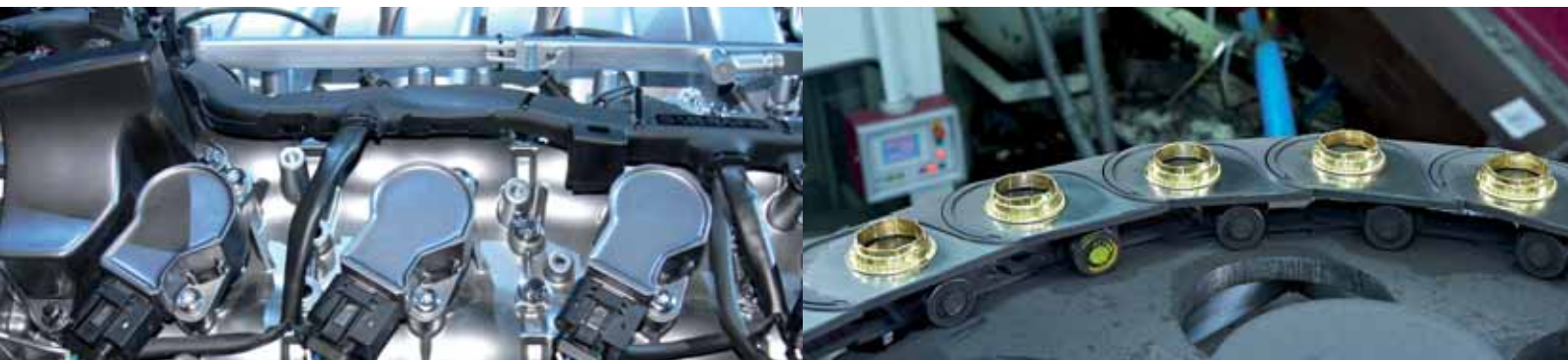




electrical engineering	construction and sanitation industries	specials
<b>pure copper</b>	<b>architecture</b>	<b>apparatus, equipment and maritime parts</b>
Cu-ETP (OF 2000)	CuZn40Mn2Fe1 (OF 2204)	CuZn28Sn1AS0.03 (OF 2171)
Cu-PHC (OF 2001)	CuAl10Fe3Mn2 (OF 2231)	CuZn39Sn1 (OF 2250)
Cu-DHP (OF 2002)	CuAl10Ni5Fe4 (OF 2232)	CuZn40Mn2Fe1 (OF 2204)
<b>catenary</b>	CuAl10Ni5Fe4 (OF 2233)	CuAl10Fe3Mn2 (2231)
CuNi1Si (OF 2403)	<b>drinking water, product group B and C</b>	CuAl10Ni5Fe4 (2232)
CuNi2Si (OF 2400)	CuZn40 (OF 2160)	CuAl10Ni5Fe4 (2233)
<b>terminal elements</b>	CuZn42 (OF 2157)	<b>mining</b>
CuZn39Pb3 (OF 2158)	CuZn33Pb1AlAs (OF 2274)	CuZn40Mn1Pb1AlFeSn (OF 2209)
CuZn40Pb2 (OF 2357)	CuZn39Pb2 (OF 2159)	CuAl10Fe3Mn2 (OF 2231)
CuZn42 (OF 2157)	CuZn40Pb2 (OF 2357)	CuAl10Ni5Fe4 (OF 2232)
CuZn43Pb1Al (OF 2156)	CuZn38As (OF 2765)	CuAl10Ni5Fe4 (OF 2233)
CuZn43Pb2 (OF 2155)	CuZn21Si3P (OF 2285)	<b>turned parts</b>
CuNi1Si (OF 2403)	CuZn21Si3P (OF 2286)	CuZn36Pb3 (OF 2362)
CuNi2Si (OF 2400)	<b>drinking water, product group C</b>	CuZn39Pb3 (OF 2158)
<b>plug connectors</b>	CuZn39Pb3 (OF 2358)	CuZn40Pb2 (OF 2357)
CuZn20 (OF 2180)	CuZn36Pb3 (OF 2362)	CuZn21Si3P (OF 2285)
CuZn28 (OF 2172)		CuZn21Si3P (OF 2286)
CuZn30As0.04 (OF 2170)		<b>for cold forming</b>
CuZn38Pb1 (OF 2161)		CuZn36 (OF 2164)
CuZn38Pb2 (OF 2361)		CuZn37 (OF 2163)
CuZn39Pb0.5 (OF 2360)		CuZn38Mn1Al (OF 2203)
		CuZn21Si3P (OF 2285)
		<b>for high resistance to corrosion</b>
		CuAl10Fe3Mn2 (OF 2231)
		CuAl10Ni5Fe4 (OF 2232)
		(OF 2233)
		<b>profile metal</b>
		CuZn42 (OF 2157)
		CuZn43Pb2 (OF 2155)
		CuZn43Pb1Al (OF 2156)
		<b>pipes for condensers/heat exchangers</b>
		CuZn20Al2As (OF 2276)
		CuZn39Sn1 (OF 2250)
		CuZn40 (OF 2160)
		<b>bearing retainer cage</b>
		CuZn40Pb2 (OF 2357)
		CuAl10Fe3Mn2 (OF 2231)
		CuAl10Ni5Fe4 (OF 2232)

Suitability for drinking water in terms of hygiene: **Product group B:** Fittings, valves, pipe connectors, instruments and pumps

**Product group C:** Components in pumps, instruments and valves, where no more than 10% of the components' total surface area comes into contact with water.



OTTO FUCHS Dülken's material portfolio include a large number of alloys for design engineering and tribological applications for the automotive industry. We pride ourselves on providing the right selection of alloys and processes for your specific application-related needs, we apply over 100 years of knowledge and experience to optimise the choice of material.

OTTO FUCHS offers alloys with special properties through selective processing and heat treatment. Such as hybrid parts with carbon coatings needed for maximising performance when friction is critical.

Bolts, bushings, guide blocks, shift forks, synchroniser rings, and valve guides – examples of automotive products supplied by OTTO FUCHS, guaranteed to meet our renowned quality levels.

**List of automotive alloys**

OF	short name	DIN EN	density g/cm <sup>3</sup>	Cu %	Al %	Mn %	Si %	Fe %	Pb %	Ni %	Cr %	Sn %	Zn %	example applications	special notes
2210	CuZn37Mn3Al2PbSi	CW713R	8.1	57 -59	1.3 -2.3	1.5 -3.0	0.3 -1.3	≤1	0.2 -0.8	≤1	-	≤0.4	Rest	synchroniser rings bushings valve guides sliding elements	resistant to natural atmosphere
2211	CuZn37Mn3Al2PbSi	special solution	8.1	58 -59	1.4 -1.7	1.8 -2.2	0.6 -0.9	0.35 -0.65	0.3 -0.6	≤0.2	-	0.1 -0.4	Rest	as with 2210 cone rings	resistant to natural atmosphere
2232	CuAl10Ni5Fe4	CW307G	7.6	Rest	8.5 -11	≤1	≤0.2	3 -5	≤0.05	4 -6	-	≤0.1	≤0.4	toothed gears worm gears bearing elements	scale-resistant non-sparking high fatigue strength
2233	CuAl10Ni5Fe4	CW307G	7.6	Rest	9.5 -11	≤0.05	≤0.2	4 -5	≤0.05	4 -5	-	≤0.1	≤0.4	toothed gears worm gears bearing elements sliding elements	scale-resistant non-sparking high fatigue strength for heat treatment suitable
2260	CuZn30Al3Mn3SiNiCr	special solution	8.0	60 -64	1.9 -3.5	2.5 -3.5	0.6 -1.2	≤0.15	≤0.15	0.25 -0.5	0.1- 0.25	≤0.15	Rest	synchroniser rings	
2261	CuZn30Al3Mn3Si1NiCr	special solution	8.0	60 -64	2.9 -3.3	2.9 -3.4	1 -1.3	≤0.15	≤0.1	0.25 -0.5	0.1- 0.25	≤0.15	Rest	synchroniser rings sliding shoes sliding elements	can be age-hardened
2264	CuZn23Al6Mn4Fe3Pb	CW704R	8.2	63 -65	5 -6	3.5 -5	≤0.2	2 -3.5	0.2 -0.8	≤0.5	-	≤0.2	Rest	synchronisers for coating	high impact resistance high fatigue strength
2266	CuZn20Mn7Al5Si1	special solution	7.7	63 -66	4.5 -6	7 -8.5	1 -2	0.5 -1.5	0.3 -0.8	≤0.5	-	≤0.5	Rest	synchroniser rings	high share of wearing materials

OF	short name	DIN EN	density g/cm <sup>3</sup>	Cu %	Al %	Mn %	Si %	Fe %	Pb %	Ni %	Cr %	Sn %	Zn %	example applications	special notes
2268	CuZn31Si1	CW708R	8.4	66 -70	-	-	0.7 -1.3	≤0.4	≤0.8	≤0.5	-	-	Rest	bushings guides/ducts sliding elements	high thermal stability
2269	CuZn31Si1	CW708R	8.4	66 -70	-	-	0.7 -1.3	≤0.4	≤0.1	≤0.5	-	-	Rest	bushings guides/ducts sliding elements	high thermal stability High purity
2270	CuZn31Si1	CW708R	8.4	66 -70	-	-	0.7 -1.3	≤0.4	0.1 -0.3	≤0.5	-	-	Rest	bushings guides/ducts sliding elements	high thermal stability
2278	CuZn31Ni7Al4Si2Fe	special solution	7.9	54 -57	3 -4.2	≤0.2	2 -2.5	0.5 -0.9	≤0.1	6 -7.2	-	≤0.15	Rest	synchroniser rings sliding elements wear-and-tear parts	can be age- hardened
2400	CuNi2Si	CW111C	8.9	Rest	-	≤0.1	0.4 -0.8	≤0.2	-	1.6 -2.5	-	-	-	bolts profile metal sliding elements	can be age- hardened
2403	CuNi1Si	CW109C	8.9	Rest	-	≤0.1	0.4 -0.7	≤0.2	-	1 -1.6	-	-	-	bolts profile metal sliding elements	can be age- hardened
2805	CuZn28Al4Ni3Co1Si1Mn	special solution	8.0	59 -62	3.5 -4.2	0.5 -1	1 -1.7	0.5 -1	0.2 -0.8	2.5 -3.5	-	≤0.3	Rest	synchroniser rings bushings for bearings guide blocks sliding shoes sliding elements	

**Processing properties of alloys for automotive use**

OF	short name	DIN EN	cold forming	hot forming	solution annealing	soft annealing	thermal stress relief
2210	CuZn37Mn3Al2PbSi	CW713R	poor	very good	-	500-650°C	350-450°C
2211	CuZn37Mn3Al2PbSi	special alloy	poor	very good	-	500-650°C	350-450°C
2232	CuAl10Ni5Fe4	CW307G	poor	good	800-950°C	350-600°C	150-300°C
2233	CuAl10Ni5Fe4	CW307G	poor	good	800-950°C	350-600°C	150-300°C
2260	CuZn30Al3Mn3SiNiCr	special alloy	unsuitable	good	-	500-600°C	250-450°C
2261	CuZn30Al3Mn3Si1NiCr	special alloy	unsuitable	good	-	500-600°C	250-450°C
2264	CuZn23Al6Mn4Fe3Pb	CW704R	poor	good	-	-	350-500°C
2266	CuZn20Mn7Al5Si1	special alloy	poor	good	-	-	350-500°C
2268	CuZn31Si1	CW708R	good	average	700-800°C	500-600°C	200-350°C
2269	CuZn31Si1	CW708R	good	average	700-800°C	500-600°C	200-350°C
2270	CuZn31Si1	CW708R	good	average	700-800°C	500-600°C	200-350°C
2278	CuZn31Ni7Al4Si2Fe	special alloy	poor	good	700-800°C	500-650°C	300-450°C
2400	CuNi2Si	CW111C	good (solution-annealed)	good	750-850°C	650-725°C	250-350°C
2403	CuNi1Si	CW109C	good (solution-annealed)	good	750-850°C	650-725°C	250-350°C
2805	CuZn28Al4Ni3Co1Si1Mn	special alloy	unsuitable	good	-	500-650°C	350-450°C

## BUSHINGS



Our alloys designed to be used in bushings for bearings combine high strength with good sliding properties and high thermal stability. We will find the material solution to meet your needs. This will be supported by our range of alloys, which includes silicon brasses, special brasses and aluminium brasses. Thanks to our in-house production capacity, we can supply you with ready-to-install bushings.



### Properties of materials used for bushings (values at room temperature)

OF	short name	DIN EN	condition	R <sub>p0.2</sub> MPa	RM MPa	A5 %	hardness HB 2.5/62.5	young's modulus GPa	α 10 <sup>-6</sup> /K	λ W/(m*K)	C <sub>p</sub> J/(kg*K)	machi- nability	
2210	CuZn37Mn3Al2PbSi	CW713R	R540	≥320	≥540	≥10	-	93*	20.4*	63*	377*	medium (40)*	
			R590	≥350	≥590	≥8	-						
2211	CuZn37Mn3Al2PbSi	special alloy	R540	≥320	≥540	≥10	-	93*	20.4*	63*	377*	medium (40)*	
			R590	≥350	≥590	≥8	-						
2232	CuAl10Ni5Fe4	CW307G	upon request						120*	17*	50*	450*	medium (-)
2233	CuAl10Ni5Fe4	CW307G	upon request						120*	17*	50*	450*	medium (-)
2260	CuZn30Al3Mn3SiNiCr	special alloy	R640	≥370	≥640	≥8	-	103*	20.2*	-	377*	medium (-)	
2261	CuZn30Al3Mn3Si1NiCr	special alloy	R640	≥370	≥640	≥8	-	103*	20.2*	-	377*	medium (-)	
			R700	≥450	≥700	≥8	-						
2264	CuZn23Al6Mn4Fe3Pb	CW704R	R780	≥540	≥780	≥8	-	105*	20.5*	27*	377*	medium (70)*	
2266	CuZn20Mn7Al5Si1	special alloy						103*	20.0*	30*	377*	medium (-)	
2268	CuZn31Si1	CW708R	R530	≥400	≥530	≥10	≥150	108*	19.2*	71*	377*	medium (40)*	
			R540	≥430	≥540	≥10	≥160						
2269	CuZn31Si1	CW708R	R530	≥400	≥530	≥10	≥150	108*	19.2*	71*	377*	medium (40)*	
			R540	≥430	≥540	≥10	≥160						
2270	CuZn31Si1	CW708R	R530	≥400	≥530	≥10	≥150	108*	19.2*	71*	377*	medium (40)*	
			R540	≥430	≥540	≥10	≥160						
2278	CuZn31Ni7Al4Si2Fe	special alloy	R650	≥500	≥650	≥5	-	110*	20.0*	70-80	360-380	medium (-)	
			R700	≥600	≥700	≥3	-						
			R830	≥720	≥830	≥3	-						
2805	CuZn28Al4Ni3Co1Si1Mn	special alloy						105*	20.0*	80*	377*	medium (40)*	

R<sub>p0.2</sub>, R<sub>m</sub>, A5 0.2%-elastic limit, tensile strength, elongation at break  
α Coefficient of thermal expansion  
λ, C<sub>p</sub> Thermal conductivity, heat capacity

medium (40)  
\*  
(-)

Average machinability (machinability index = 40%, with CuZn39Pb3 as per definition 100%)  
For information only  
Index unknown

# BOLTS

Bolts used in automotive engineering are subject to the most stringent requirements in terms of their dimensional accuracy and mechanical properties. We select the right materials and processes to provide alloys with the properties you need to enable you to further process the bolts using sophisticated procedures to achieve the desired strengths.

Specifically with the alloy OF 2233, the mechanical properties can be varied across a wide range by fine-tuning in the process chain with the use of extrusion, solution annealing, cold drawing and tempering. In its tempered state, the alloy OF 2233 is characterised by a combination of equally high elasticity, strength and ductility.



Properties of materials used for bolts (values at room temperature)

OF	short name	DIN EN	condition	R <sub>p0.2</sub> MPa	R <sub>m</sub> MPa	A <sub>5</sub> %	hardness HB 2.5/62.5	young's modulus GPa	α 10 <sup>-6</sup> /K	λ W/(m*K)	C <sub>p</sub> J/(kg*K)	machi- nability	
2232	CuAl10Ni5Fe4	CW307G	R680	≥320	≥680	≥10	-	120*	17*	50*	450*	medium (-)	
2233	CuAl10Ni5Fe4	CW307G	R680	≥320	≥680	≥10	-	120*	17*	50*	450*	medium (-)	
			R740	≥400	≥740	≥10	-	-	-	-	-	-	-
			R800	≥600	≥800	≥8	-	-	-	-	-	-	-
2400	CuNi2Si	CW111C	R600	≥520	≥450	≥10	-	130*	17.0*	160**	377*	moderate (30)*	
			R640	≥590	≥500	≥10	-	-	-	-	-	-	-
2403	CuNi1Si	CW109C	R540	≥470	≥540	≥10	-	140-155*	16.8*	160**	377*	moderate (30)*	
			R590	≥540	≥590	≥12	-	-	-	-	-	-	-

R<sub>p0.2</sub>, R<sub>m</sub>, A<sub>5</sub> 0.2% elastic limit, tensile strength, elongation at break  
 α Coefficient of thermal expansion  
 λ, C<sub>p</sub> Thermal conductivity, heat capacity

medium (40)  
 \*  
 \*\*  
 (-)

Average machinability (machinability index = 40%, with CuZn39Pb3 as per definition 100%)  
 For information only  
 Significantly dependent on production state  
 Index unknown



## OF 2403 (CuNi1Si) UND OF 2400 (CuNi2Si)

OF 2403 and OF 2400 are alloys that can be age-hardened and stand out with their combination of high strength, high durability and high electricity and thermal conductivity.

To achieve your required properties for bolts we select the right materials and processes. This enables you to machine the bolts using sophisticated procedures.

The process chain can be fine-tuned with the use of extrusion, solution annealing, cold drawing and tempering, enabling us to control the precipitation state in the alloys OF 2403 and OF 2400.

As precise and reliable friction couplings, synchroniser rings are a prerequisite for high-performance driving, smooth transmission and easy gear-change. For manual gear-change transmissions (as well as automatic transmissions) and modern dual-clutch transmissions, synchroniser rings use friction to ensure that the rotation speed of the gear wheels is synchronised before a gear change can be performed. For around 60 years, OTTO FUCHS has been producing synchroniser rings forged from special brass materials. We select the solution for your application from our wide range of materials and processes.



## Properties of materials used for synchroniser rings (values at room temperature)

OF	short name	DIN EN	condition OF-internal	hardness HB 2.5/62.5	young's modulus GPa	$\alpha$ 10 <sup>-6</sup> /K	$\lambda$ W/(m*K)	Cp J/(kg*K)	machina- bility
2210	CuZn37Mn3Al2PbSi	CW713R	H140	140-175	93*	20.4*	63*	377*	medium (40)*
2211	CuZn37Mn3Al2PbSi	special alloy	H150	150-190	93*	20.4*	63*	377*	medium (40)*
2260	CuZn30Al3Mn3SiNiCr	special alloy	H170	≥170	103*	20.2*	-	377*	medium (-)
2261	CuZn30Al3Mn3Si1NiCr	special alloy	H180	≥180	103*	20.2*	-	377*	medium (-)
			H195S	195-225					
2264	CuZn23Al6Mn4Fe3Pb	CW704R	H190	190-240	105*	20.5*	27*	377*	medium (70)*
2266	CuZn20Mn7Al5Si1	special alloy	H210	210-260	103*	20.0*	30*	377*	medium (-)
2278	CuZn31Ni7Al4Si2Fe	special alloy	H220	≥220	110*	20.5*	70-80*	360-380*	medium (40)*
			H240S	240-300					
2805	CuZn28Al4Ni3Co1Si1Mn	special alloy	H190	190-240	105*	20.0*	80*	377*	medium (40)*

R<sub>p0.2</sub>, R<sub>m</sub>, A<sub>5</sub> 0.2%-elastic limit, tensile strength, elongation at break

$\alpha$  Coefficient of thermal expansion

$\lambda$ , Cp Thermal conductivity, heat capacity

medium (40)

\*

(-)

Average machinability (machinability index = 40%, with CuZn39Pb3 as per definition 100%)

For information only

Index unknown

### OTTO FUCHS threaded rings

In conventional synchroniser rings, a thread is cut into the brass friction cone. The grooves of the thread serve as 'drains' to form a film of hydrodynamic lubricant where the friction surfaces meet during synchronisation.

### OTTO FUCHS surface-profiled rings

The new OTTO FUCHS surface-profiled rings have the lathed thread profile replaced by a directly forged brass profile in the brass friction cone. The benefits of the OTTO FUCHS surface-profiled ring include a higher service life and significantly reduced costs while maintaining the same functionality.

### OTTO FUCHS sprayed-carbon rings

In modern dual-clutch transmissions as well as high-end manual transmissions, it is advisable to use coated synchroniser rings. For all such applications, OTTO FUCHS has developed an innovative solution where a carbon-fibre-based mass is sprayed onto the cone, creating a hybrid ring.



The excellent sliding properties and high resistance to wear of OTTO FUCHS alloys are good reasons for using them in machinery and plant engineering. We select the right alloy and process for your specific application-related needs. With the OTTO FUCHS range of alloys, we have the ability to ensure that your material specifically matches your lubricants.

### List of machine and plant alloys

OF	short name	DIN EN	density g/cm <sup>3</sup>	Cu %	Al %	Mn %	Si %	Fe %	Pb %	Ni %	Cr %	Sn %	Zn %	example applications	special notes
2203	CuZn38Mn1Al	CW716R	8.3	59 -61	0.3 -1.3	0.6 -1.8	≤0.5	≤1	≤0.8	≤0.6	-	≤0.3	Rest	slide rails guide rails floor / base plates bushings	low permeability
2206 ***	CuZn39Mn1AlPbSi	CW718R	8.2	57 -59	0.3 -1.3	0.8 -1.8	0.2 -0.8	≤0.5	0.2 -0.8	≤0.5	-	≤0.5	Rest	slide rails guide rails floor / base plates bushings	low permeability
2210	CuZn37Mn3Al2PbSi	CW713R	8.1	57 -59	1.3 -2.3	1.5 -3.0	0.3 -1.3	≤1	0.2 -0.8	≤1	-	≤0.4	Rest	thrust bearings impellers sliding shoes worm gears	resistant to natural atmosphere
2211	CuZn37Mn3Al2PbSi	special solution	8.1	58 -59	1.4 -1.7	1.8 -2.2	0.6 -0.9	0.35 -0.65	0.3 -0.6	≤0.2	-	0.1 -0.4	Rest	as with 2210 cone rings	resistant to natural atmosphere
2212 ***	CuZn40Al2Mn2Si	special solution	8.1	57 -59	1.4 -1.7	2.3 -2.6	0.7 -1.0	≤0.3	≤0.3	≤0.3	-	≤0.4	Rest	as with 2210 distributor plates	resistant to natural atmosphere
2216 ***	CuZn38Mn2NiSi	special solution	8.3	57*	-	2.2*	1*	-	0.7*	2*	-	-	Rest	forged parts thrust bearings control plates sliding shoes worm gears distributor plates	high fatigue resistance high cavitation resistance
2218 ***	CuZn35Mn2Si	special solution	8.3	62*	-	2.2*	0.8*	-	0.7*	-	-	-	Rest	thrust bearings	
2220 ***	CuZn37Mn3Al2PbSi	special solution	8.1	57 -59	1.3 -1.8	1.6 -2.7	0.3 -1.1	0.3 -0.8	0.3 -0.9	≤0.6	-	≤0.4	Rest	thrust bearings sliding shoes	resistant to natural atmosphere

\* Guideline value

\*\*\* Alloy can only be acquired through VDM



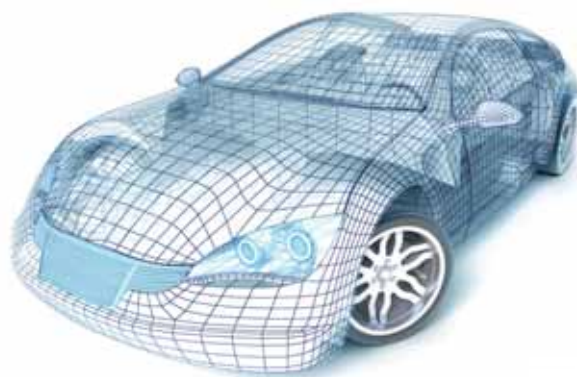


OF	short name	DIN EN	density g/cm <sup>3</sup>	Cu %	Al %	Mn %	Si %	Fe %	Pb %	Ni %	Cr %	Sn %	Zn %	example applications	special notes
2231	CuAl10Fe3Mn2	CW306G	7.6	Rest	9 -11	1.5 -3.5	≤0.2	2 -4	≤0.05	≤1	-	≤0.1	≤0.5	worm gears bushings for bearings sliding elements	scale-resistant non-sparking corrosion-resistant cavitation-resistant sea water-resistant
2232	CuAl10Ni5Fe4	CW307G	7.6	Rest	8.5 -11	≤1	≤0.2	3 -5	≤0.05	4 -6	-	≤0.1	≤0.4	worm gears sliding elements	scale-resistant non-sparking corrosion-resistant cavitation-resistant high fatigue strength
2233	CuAl10Ni5Fe4	CW307G	7.6	Rest	9.5 -11	≤0.05	≤0.2	4 -5	≤0.05	4 -5	-	≤0.1	≤0.4	worm gears bearing elements sliding elements	scale-resistant non-sparking corrosion-resistant cavitation-resistant high fatigue strength suitable for heat treatment
2260	CuZn30Al3Mn3SiNiCr	special solution	8.0	60 -64	1.9 -3.5	2.5 -3.5	0.6 -1.2	≤0.15	≤0.15	0.25 -0.5	0.1- 0.25	≤0.15	Rest	sliding elements	
2261	CuZn30Al3Mn3Si1NiCr	special solution	8.0	60 -64	2.9 -3.3	2.9 -3.4	1 -1.3	≤0.15	≤0.1	0.25 -0.5	0.1- 0.25	≤0.15	Rest	thrust bearings sliding shoes sliding elements	can be age-hardened
2264	CuZn23Al6Mn4Fe3Pb	CW704R	8.2	63 -65	5 -6	3.5 -5	≤0.2	2 -3.5	0.2 -0.8	≤0.5	-	≤0.2	Rest	toothed gears	high impact resistance high fatigue strength
2268	CuZn31Si1	CW708R	8.4	66 -70	-	-	0.7 -1.3	≤0.4	≤0.8	≤0.5	-	-	Rest	bushings guides/ducts sliding elements	high thermal stability
2269	CuZn31Si1	CW708R	8.4	66 -70	-	-	0.7 -1.3	≤0.4	≤0.1	≤0.5	-	-	Rest	bushings guides/ducts sliding elements	high thermal stability high purity
2270	CuZn31Si1	CW708R	8.4	66 -70	-	-	0.7 -1.3	≤0.4	0.1 -0.3	≤0.5	-	-	Rest	bushings guides/ducts sliding elements	high thermal stability
2278	CuZn31Ni7Al4Si2Fe	special solution	7.9	54 -57	3 -4.2	≤0.2	2 -2.5	0.5 -0.9	≤0.1	6 -7.2	-	≤0.15	Rest	sliding elements wear-and-tear parts	can be age-hardened
2805	CuZn28Al4Ni3Co1Si1Mn	special solution	8.0	59 -62	3.5 -4.2	0.5 -1	1 -1.7	0.5 -1	0.2 -0.8	2.5 -3.5	-	≤0.3	Rest	guide blocks sliding shoes sliding elements	

### Processing properties of alloys for machinery and plant

OF	short name	DIN EN	cold forming	hot forming	solution annealing	soft annealing	thermal stress relief
2203	CuZn38Mn1Al	CW716R	average	good	-	500-650°C	300-430°C
2206	CuZn36Pb2As	CW718R	average	good	-	upon request	upon request
2210	CuZn37Mn3Al2PbSi	CW713R	poor	very good	-	500-650°C	350-450°C
2211	CuZn37Mn3Al2PbSi	special alloy	poor	very good	-	500-650°C	350-450°C
2212***	CuZn40Al2Mn2Si	special alloy	poor	very good	-	500-650°C	350-450°C
2216***	CuZn38Mn2NiSi	special alloy	moderate	very good	-	500-650°C	350-450°C
2218***	CuZn35Mn2Si	special alloy	average	very good	-	500-650°C	350-450°C
2220***	CuZn37Mn3Al2PbSi	special alloy	poor	very good	-	500-650°C	350-450°C
2231	CuAl10Fe3Mn2	CW306G	poor	good	700-900°C	350-900°C	150-250°C
2232	CuAl10Ni5Fe4	CW307G	poor	good	800-950°C	350-600°C	150-300°C
2233	CuAl10Ni5Fe4	CW307G	poor	good	800-950°C	350-600°C	150-300°C
2260	CuZn30Al3Mn3SiNiCr	special alloy	unsuitable	good	-	500-600°C	250-450°C
2261	CuZn30Al3Mn3Si1NiCr	special alloy	unsuitable	good	-	500-600°C	250-450°C
2264	CuZn23Al6Mn4Fe3Pb	CW704R	poor	good	-	-	350-500°C
2268	CuZn31Si1	CW708R	average	average	700-800°C	500-600°C	200-350°C
2269	CuZn31Si1	CW708R	average	average	700-800°C	500-600°C	200-350°C
2270	CuZn31Si1	CW708R	average	average	700-800°C	500-600°C	200-350°C
2278	CuZn31Ni7Al4Si2Fe	special alloy	poor	good	700-800°C	500-650°C	300-450°C
2805	CuZn28Al4Ni3Co1Si1Mn	special alloy	unsuitable	good	-	500-650°C	350-450°C

\*\*\* Alloy can only be acquired through VDM



## THRUST BEARINGS

Materials for thrust bearings distinguish themselves by their excellent resistance to wear. Very high standards apply in particular when it comes to cavitation resistance, capacity to embed foreign particles and adaptability. Adhesion resistance and corrosion resistance are other key properties for thrust bearing materials.



### Properties of materials used for thrust bearings (values at room temperature)

OF	short name	DIN EN	condition	R <sub>p0.2</sub> MPa	RM MPa	A5 %	hardness HB 2.5/62.5	young's modulus GPa	α 10 <sup>-6</sup> /K	λ W/(m*K)	C <sub>p</sub> J/(kg*K)	machi- nability
2210	CuZn37Mn3Al2PbSi	CW713R	H125	(≥180)	(≥470)	(≥16)	≥125	93*	20.4*	63*	377*	medium (40)*
			H140	(≥320)	(≥510)	(≥12)	≥140					
2211	CuZn37Mn3Al2PbSi	special alloy	H125	(≥180)	(≥470)	(≥16)	≥125	93*	20.4*	63*	377*	medium (40)*
			H140	(≥320)	(≥510)	(≥12)	≥140					
2212***	CuZn40Al2Mn2Si	special alloy	H125	(≥180)	(≥470)	(≥16)	≥125	93*	20.4*	63*	377*	medium (40)*
			H140	(≥320)	(≥510)	(≥12)	≥140					
2216***	CuZn38Mn2NiSi	special alloy	H140	270*	480*	11*	≥140	117*	19.5*	74*	377*	medium (-)
			H150	300*	510*	13*	≥150					
2218***	CuZn35Mn2Si	special alloy	H140	300*	490*	10*	≥140	115*	19.5*	76*	377*	medium (-)
			H150	380*	510*	8*	≥150					
2261	CuZn30Al3Mn3Si1NiCr	special alloy	H180	-	-	-	≥180	103*	20.2*	-	377*	medium (-)
			H195S				195-225					

\* Guideline value

\*\*\* Alloy can only be acquired through VDM

## SLIDING SHOES

Materials for sliding shoes are designed to withstand high operating pressures. The materials for sliding shoes provided by OTTO FUCHS combine high strength with high fatigue strength, high durability and effective resistance to frictional wear and oil corrosion.



### Properties of materials used for sliding shoes (values at room temperature)

OF	short name	DIN EN	condition	R <sub>p0.2</sub> MPa	RM MPa	A5 %	hardness HB 2.5/62.5	young's modulus GPa	α 10 <sup>-6</sup> /K	λ W/(m*K)	C <sub>p</sub> J/(kg*K)	machi- nability
2210	CuZn37Mn3Al2PbSi	CW713R	H125	(≥180)	(≥470)	(≥16)	≥125	93*	20.4*	63*	377*	medium (40)*
			H140	(≥320)	(≥510)	(≥12)	≥140					
2211	CuZn37Mn3Al2PbSi	special solution	H125	(≥180)	(≥470)	(≥16)	≥125	93*	20.4*	63*	377*	medium (40)*
			H140	(≥320)	(≥510)	(≥12)	≥140					
2216***	CuZn38Mn2NiSi	special solution	H140	270*	480*	11*	≥140	117*	19.5*	74*	377*	medium (-)
			H150	300*	510*	13*	≥150					
2218***	CuZn35Mn2Si	special solution	H140	300*	490*	10*	≥140	115*	19.5*	76*	377*	medium (-)
			H150	380*	510*	8*	≥150					
2220***	CuZn37Mn3Al2PbSi	special solution	H140	230*	510*	12*	140-170	110*	20*	74*	380*	medium (-)
2261	CuZn30Al3Mn3Si1NiCr	special solution	upon request					103*	20.2*	-	377*	medium (-)
2805	CuZn28Al4Ni3Co1Si1Mn	special solution	upon request					105*	20.0*	80*	377*	medium (40)*

\* Guideline value

\*\*\* Alloy can only be acquired through VDM



## WORM GEARS

OTTO FUCHS offers various alloys made of special brass or aluminium bronze for worm gears. Special brasses and aluminium bronzes are the materials of choice when it comes to the transmission of high torque generated by the worm gear. With our range of alloys and processes, we are able to provide the ideal solution to suit the lubricant used in your transmissions.



### Properties of materials used for worm gears (values at room temperature)

OF	short name	DIN EN	condition	R <sub>p0.2</sub> MPa	RM MPa	A5 %	hardness HB 2.5/62.5	young's modulus GPa	α 10 <sup>-6</sup> /K	λ W/(m*K)	Cp J/(kg*K)	machi- nability
2210	CuZn37Mn3Al2PbSi	CW713R	H125 H140	(≥180) (≥320)	(≥470) (≥510)	(≥16) (≥12)	≥125 ≥140	93*	20.4*	63*	377*	medium (40)*
2220***	CuZn37Mn3Al2PbSi	special solution	H140	230*	510*	12*	140-170	110*	20*	74*	380*	medium (-)
2231	CuAl10Fe3Mn2	CW306G	H120	(≥200)	(≥650)	(≥12)	≥120	120*	17*	57*	430*	medium (-)
2232	CuAl10Ni5Fe4	CW307G	H125	(≥350)	(≥750)	(≥12)	≥125	120*	17*	50*	450*	medium (-)
2233	CuAl10Ni5Fe4	CW307G	H140	(≥400)	(≥750)	8*	≥140	120*	17*	50*	450*	medium (-)

R<sub>p0.2</sub>, R<sub>m</sub>, A5 0.2%-elastic limit, tensile strength, elongation at break  
 α Coefficient of thermal expansion  
 λ, Cp Thermal conductivity, heat capacity  
 medium (40)  
 \* For information only  
 \*\*\* Alloy can only be acquired through VDM  
 (-) Index unknown

## DISTRIBUTOR PLATES

In the OTTO FUCHS alloy range, there are several special brasses that are optimised specifically for use in distributor plates. In our range of alloys you will find the ideal solution for your application, perfect for the oil you are using and the output of the axial piston pump.



### Properties of materials used for distributor plates (values at room temperature)

OF	short name	DIN EN	condition	R <sub>p0.2</sub> MPa	RM MPa	A5 %	hardness HB 2.5/62.5	young's modulus GPa	α 10 <sup>-6</sup> /K	λ W/(m*K)	Cp J/(kg*K)	machi- nability
2210	CuZn37Mn3Al2PbSi	CW713R	H125 H140	(≥180) (≥320)	(≥470) (≥510)	(≥16) (≥12)	≥125 ≥140	93*	20.4*	63*	377*	medium (40)*
2211	CuZn37Mn3Al2PbSi	special solution	H125 H140	(≥180) (≥320)	(≥470) (≥510)	(≥16) (≥12)	≥125 ≥140	93*	20.4*	63*	377*	medium (40)*
2212 ***	CuZn40Al2Mn2Si	special solution	H125 H140	(≥180) (≥320)	(≥470) (≥510)	(≥16) (≥12)	≥125 ≥140	93*	20.4*	63*	377*	medium (40)*
2216 ***	CuZn38Mn2NiSi	special solution	H140 H150	270* 300*	480* 510*	11* 13*	≥140 ≥150	117*	19.5*	74*	377*	medium (-)
2218 ***	CuZn35Mn2Si	special solution	H140 H150	300* 380*	490* 510*	10* 8*	≥140 ≥150	115*	19.5*	76*	377*	medium (-)
2261	CuZn30Al3Mn3Si1NiCr	special solution	H180 H195S	- -	- -	- -	≥180 195-225	103*	20.2*	-	377*	medium (-)

R<sub>p0.2</sub>, R<sub>m</sub>, A5 0.2%-elastic limit, tensile strength, elongation at break  
 α Coefficient of thermal expansion  
 λ, Cp Thermal conductivity, heat capacity  
 medium (40)  
 \* For information only  
 \*\*\* Alloy can only be acquired through VDM  
 (-) Index unknown

## ELECTRICAL ENGINEERING

The combination of strength, toughness, good electrical and thermal conductivity are the outstanding characteristics of the OTTO FUCHS alloys produced for applications in the field of electrical engineering.

The OTTO FUCHS alloys for electrical engineering applications are optimised to enable further processing by the customer to their specifications.

These outstanding properties are achieved by the combination of alloying, and by determining the specific process to be used for the production and processing of the alloy.

### List of electrical engineering alloys

OF	short name	DIN EN	density g/cm <sup>3</sup>	Cu %	Al %	Mn %	Si %	Fe %	Pb %	Ni %	Cr %	Sn %	Zn %	example applications	special notes
2000	Cu-ETP	CW004A	8.9	≥99.90	-	-	-	-	-	-	-	-	-	semi-finished products closed-die forged products	electrolytically refined contains oxygen ≤0.040 % O
2001	Cu-PHC	CW020A	8.9	≥99.95	-	-	-	-	-	-	-	-	-	semi-finished products	deoxidised highly conductive 0.001-0.006 % P
2002	Cu-DHP	CW024A	8.9	≥99.90	-	-	-	-	-	-	-	-	-	semi-finished products	deoxidised 0.015-0.04 % P
2158	CuZn39Pb3	CW614N	8.4	57 -59	≤0.05	-	-	≤0.3	2.5 -3.5	≤0.2	-	≤0.3	Rest	terminal elements semi-finished products forged products	
2161	CuZn38Pb1	CW607N	8.4	60 -61	≤0.05	-	-	≤0.2	0.8 -1.6	≤0.3	-	≤0.2	Rest	plug connectors stamped parts punched parts	well-suited to cold forming
2170	CuZn30As0.04	CW707R	8.5	69 -71	≤0.02	-	-	≤0.05	≤0.05	≤0.3	-	≤0.1	Rest	deep-drawn parts springs sleeves	well-suited to cold forming very well-suited to soldering
2172	CuZn28	special solution	8.6	71 -73	≤0.02	-	-	≤0.05	≤0.05	≤0.2	-	≤0.1	Rest	deep-drawn parts springs	well-suited to cold forming very well-suited to soldering
2180	CuZn20	CW503L	8.7	79 -81	≤0.02	-	-	≤0.05	≤0.05	≤0.2	-	≤0.1	Rest	installation parts	
2357	CuZn40Pb2	CW617N	8.4	57 -59	≤0.05	-	-	-	1.6 -2.5	≤0.3	-	≤0.3	Rest	plug connectors terminals	
2360	CuZn39Pb0.5	CW610N	8.4	59 -60.5	≤0.05	-	-	≤0.2	0.2 -0.8	≤0.3	-	≤0.2	Rest	pins plug connectors	
2360	CuZn39Pb0.5	CW610N	8.4	59 -60.5	≤0.05	-	-	≤0.2	0.2 -0.8	≤0.3	-	≤0.2	Rest	pins plug connectors	
2361	CuZn38Pb2	CW608N	8.4	60 -61	≤0.05	-	-	≤0.2	1.6 -2.5	≤0.3	-	≤0.2	Rest	plug connectors	
2400	CuNi2Si	CW111C	8.9	Rest	-	≤0.1	0.4 -0.8	≤0.2	-	1.6 -2.5	-	-	-	profile metal sliding elements clamping elements	can be age-hardened
2403	CuNi1Si	CW109C	8.9	Rest	-	≤0.1	0.4 -0.7	≤0.2	-	1 -1.6	-	-	-	profile metal sliding elements clamping elements	can be age-hardened

## Processing properties of alloys for electrical engineering

OF	short name	DIN EN	cold forming	hot forming	solution annealing	soft annealing	thermal stress relief	solderability
2000	Cu-ETP	CW004A	very good	good	-	250-500°C	100-150°C	good
2001	Cu-PHC	CW020A	very good	good	-	250-500°C	100-150°C	good
2002	Cu-DHP	CW024A	very good	good	-	250-500°C	150-200°C	very good
2158	CuZn39Pb3	CW614N	moderate	very good	-	450-600°C	200-380°C	very good (soft soldering)
2161	CuZn38Pb1	CW607N	average	very good	-	450-650°C	200-300°C	very good (soft soldering)
2170	CuZn30	CW707R	very good	good	-	450-680°C	200-300°C	very good
2172	CuZn28	Sonderl.	very good	good	-	450-680°C	200-300°C	very good
2180	CuZn20	CW503L	good	average	-	450-600°C	200-300°C	very good
2357	CuZn40Pb2	CW617N	unsuitable	good	-	500-600°C	250-450°C	-
2360	CuZn39Pb0.5	CW610N	average	very good	-	450-600°C	200-380°C	very good (soft soldering)
2361	CuZn38Pb2	CW608N	average	very good	-	450-600°C	200-380°C	very good (soft soldering)
2400	CuNi2Si	CW111C	good (solution-annealed)	good	750-850°C	650-725°C	250-350°C	average to good
2403	CuNi1Si	CW109C	good (solution-annealed)	good	750-850°C	650-725°C	250-350°C	average to good



## ALLOYS FOR PLUG CONNECTORS

Alloys for plug connectors combine good suitability for cold forming with very high solderability.

## BARS AND PROFILES MADE OF OF 2403 (CuNi1Si) AND OF 2400 (CuNi2Si)

Base materials for terminals are often used for catenary cables, power feeders and ground terminals in railroad engineering. This is just one example of the specific applications in which the alloys OF 2403 and OF 2400 can be used.

In railroad engineering and other applications, the alloys OF 2403 and OF 2400 bring their outstanding combinations of properties to bear for your benefit: High strength and durability while maintaining the same good electrical and thermal conductivity values.

The high resistance to wear, creep and fatigue of the alloys OF 2403 and OF 2400 provide further benefits in the applications of these outstanding alloys.

## BUILDING AND SANITARY

The decorative properties of copper alloys, a good general resistance to corrosion and excellent anti-bacterial properties explain the broad use of these alloys in building construction and sanitary installation work.

The use of both traditional and modern materials for use in the field of drinking water supply contributes to making efficient use of resources and protecting the consumer. The quality of our drinking water is protected through the use of our lead-free materials, for example the alloy Cuphin. Cuphin ideally satisfies the increasingly strict requirements for materials that come into contact with our drinking water. Cuphin contributes decisively to ensuring the quality of our most precious element of life.

### List of alloys for the construction and sanitation industries

OF	short name	DIN EN	density g/cm <sup>3</sup>	Cu %	Al %	Mn %	Si %	Fe %	Pb %	Ni %	Cr %	Sn %	Zn %	example applications	special notes
2157	CuZn42	CW510L	8.4	57 -59	≤0.05	≤0.05	-	≤0.3	≤0.2	≤0.3	-	≤0.3	Rest	profile metal	drinking water, group B + C
2159	CuZn39Pb2	CW612N	8.4	59 -60	≤0.05	≤0.05	-	≤0.3	1.6 -2.5	≤0.3	-	≤0.3	Rest	plates	drinking water, group B + C
2160	CuZn40	CW509L	8.4	59 -61.5	≤0.05	≤0.05	-	≤0.2	≤0.2	≤0.3	-	≤0.2	Rest	fittings	drinking water, group B + C
2162	CuZn36Pb2As	CW602N	8.4	61 -63	≤0.05	≤0.05	-	≤0.1	1.7 -2.2	≤0.2	-	≤0.1	Rest	heating systems	low-dezincification
2204	CuZn40Mn2Fe1	CW723R	8.3	56.5 -58.5	≤0.1	≤0.1	≤0.1	0.5 -1.5	≤0.5	≤0.6	-	≤0.3	Rest	architecture construction profiles handrails	well-suited to soldering brown colouring
2231	CuAl10Fe3Mn2	CW306G	7.6	Rest	9 -11	9 -11	≤0.2	2 -4	≤0.05	≤1	-	≤0.1	≤0.5	handrails rails	scale-resistant non-sparking corrosion-resistant cavitation-resistant
2232	CuAl10Ni5Fe4	CW307G	7.6	Rest	8.5 -11	8.5 -11	≤0.2	3 -5	≤0.05	4 -6	-	≤0.1	≤0.4	handrails rails	scale-resistant non-sparking corrosion-resistant cavitation-resistant high fatigue strength
2233	CuAl10Ni5Fe4	CW307G	7.6	Rest	9.5 -11	9.5 -11	≤0.2	4 -5	≤0.05	4 -5	-	≤0.1	≤0.4	handrails rails	scale-resistant non-sparking corrosion-resistant cavitation-resistant high fatigue strength Suitable for heat treatment
2274	CuZn33Pb1AlAs	CW725R	8.5	64 -67	0.1 -0.4	0.8 -1.0	0.1 -0.3	≤0.3	0.5 -0.8	≤0.2	-	≤0.3	Rest	fittings pipe connectors lathed parts	drinking water, group B + C
2285	CuZn21Si3P	CW724R	8.3	75 -77	≤0.05	≤0.05	2.7 -3	≤0.3	≤0.1	≤0.2	-	≤0.3	Rest	fittings pipe connectors	drinking water, group B + C
2286	CuZn21Si3P	CW724R	8.3	75 -77	≤0.05	≤0.05	2.7 -3.5	≤0.3	≤0.1	≤0.2	-	≤0.3	Rest	fittings pipe connectors lathed parts	drinking water, group B + C
2357	CuZn40Pb2	CW617N											Rest	lathed parts profile metal forged products	drinking water, group B + C
2358	CuZn39Pb3	CW614N	8.4	57 -59	≤0.05	≤0.05	-	≤0.3	2.5 -3.5	≤0.2	-	≤0.3	Rest	lathed parts profile metal forged products	drinking water, group B + C
2362	CuZn36Pb3	CW603N	8.4		≤0.05	≤0.05	2.7 -3.5	≤0.3	≤0.1	≤0.2	-	≤0.3	Rest	lathed parts pipes	drinking water, group B + C
2765	CuZn38As	CW511L	8.4	61.5 -63.5	≤0.05	≤0.05	-	≤0.3	≤0.5	≤0.3	-	≤0.3	Rest	drinking water	drinking water, group B + C

Suitability for drinking water in terms of hygiene: Product group B: Fittings, valves, pipe connectors, instruments and pumps

Product group C: Components in pumps, instruments and valves, where no more than 10% of the components' total surface area comes into contact with water.

Thanks to their superb suitability for cold forming, the copper alloys of OTTO FUCHS Dülken can be used to great advantage in building construction and sanitary installation work, for example for the construction of cold-formed joints. The very good suitability for soldering also facilitates the execution of tightly sealed material bondings in building construction and sanitary installation work.

Special alloys such as CuZn39Pb3 (OF2358) are available for coating, e.g. for chroming.

### Processing properties of alloys for the construction and sanitation industries

OF	short name	DIN EN	cold forming	hot forming	solution annealing	soft annealing	thermal stress relief	solderability
2157	CuZn42	CW510L	poor	very good	-	450-550°C	200-300°C	very good (soft soldering)
2159	CuZn39Pb2	CW612N	poor	very good	-	450-600°C	200-380°C	very good (soft soldering)
2160	CuZn40	CW509L	average	very good	-	450-650°C	200-300°C	good to very good
2162	CuZn36Pb2As	CW602N	good	good	-	450-600°C	200-380°C	-
2204	CuZn40Mn2Fe1	CW723R	very good	good	-	250-500°C	100-150°C	good
2231	CuAl10Fe3Mn2	CW306G	very good	good	720-900°C	350-550°C	150-250°C	medium (brazing)
2232	CuAl10Ni5Fe4	CW307G	very good	good	850-950°C	350-600°C	150-300°C	medium (brazing)
2233	CuAl10Ni5Fe4	CW307G	very good	good	850-950°C	350-600°C	150-300°C	medium (brazing)
2285	CuZn21Si3P	CW724R	good	very good	-	530-700°C	250-300°C	very good
2286	CuZn21Si3P	CW724R	good	very good	-	530-700°C	250-300°C	very good
2274	CuZn33Pb1AlAs	CW725R	average	good	-	450-600°C	200-300°C	medium (brazing)
2357	CuZn40Pb2	CW617N	low	very good	-	450-600°C	200-380°C	very good (soft soldering)
2358	CuZn39Pb3	CW614N	low	very good	-	450-600°C	200-380°C	very good (soft soldering)
2362	CuZn36Pb3	CW603N	good	good	-	450-600°C	200-380°C	very good (soft soldering)
2765	CuZn38As	CW511L	good	average	-	450-550°C	200-250°C	very good



## ALUMINIUM BRONZE AND 'ARCHITECTURAL BRONZE' (OF 2204)

Aluminium bronze and 'architectural bronze' are outstanding by virtue of their high strength, ease of working and insensitivity to the natural atmosphere.

A particular aspect of copper alloys suitable for use as external decorative elements is their available range of colours, from gold-yellow, yellow-brown to red-brown. In a natural atmosphere, bronze develops a natural patina that ranges from a soft brown to tones encompassing deep brown to anthracite grey. Surface treatment methods, such as blasting, can be used specifically to heighten or reduce the colour effect of the natural patina.

Combined with our extrusion processes, OTTO FUCHS is able to create complex profiles to meet almost any form or function. Due to their weldability, such profiles can also be joined to framework structures, large-sized walls or other complex construction elements.

### Mechanical and physical properties of materials used for building construction (values at room temperature)

OF	short name	DIN EN	condition	R <sub>p0.2</sub> MPa	RM MPa	A5 %	hardness HB 2.5/62.5	young's modulus GPa	α 10 <sup>-6</sup> /K	λ W/(m*K)	C <sub>p</sub> J/(kg*K)	machi- nability
2204	CuZn37Mn3Al2PbSi	CW723R	R440	≥170	≥440	≥15	-	100*	18.5*	67*	377*	medium (50)*
			R490	≥270	≥490	≥10	-					
2231	CuZn37Mn3Al2PbSi	CW306G	R590	≥330	≥590	≥12	-	120*	17*	57*		medium (-)
			R690	≥510	≥690	≥6	-					
2232	CuZn40Al2Mn2Si	CW307G	R680	≥320	≥680	≥10	-	120*	17*	50*	450*	medium (-)
2233	CuZn30Al3Mn3SiNiCr	CW307G	R680	≥320	≥680	≥10	-	120*	17*	50*	450*	medium (-)
			R740	≥400	≥740	≥10	-					
			R800	≥600	≥800	≥8	-					

R<sub>p0.2</sub>, R<sub>m</sub>, A5 0.2%-elastic limit, tensile strength, elongation at break  
 α Coefficient of thermal expansion  
 λ, C<sub>p</sub> Thermal conductivity, heat capacity

medium (40)  
 \*  
 (-)

Average machinability (machinability index = 40%, with CuZn39Pb3 as per definition 100%)  
 For information only  
 Index unknown

## MATERIALS IN PRODUCT GROUPS B AND C FOR DRINKING WATER

Brass has become well-established as the standard material for fittings and connectors in drinking water installations and is subject to the standard DIN 50930, part 6. This applies, for example, to fittings and pipe connectors made of the alloys CuZn39Pb3 (OF 2358), CuZn40Pb2 (OF 2357).

The lead in the alloy OF 2358 makes it superbly suited to machining, which is why significant quantities of it are used in lathed parts. Key applications of OF 2357 include hot-pressed, and lathed parts. OF 2357 specifically meets the requirements of DIN 50930, part 6.

In the German Federal Environment Agency list, materials within (DIN 50930, part 6) are categorised by their hygienic suitability for drinking water into three application fields (Product Groups): A to C.

The OTTO FUCHS alloys for drinking water are included in group B (materials for fittings) or C (materials for components in fittings and pumps).





### Mechanical and physical properties of materials used for sanitary installations (values at room temperature)

OF	short name	DIN EN	condition OF-internal	hardness HB 2.5/62.5	young's modulus GPa	$\alpha$ 10 <sup>-6</sup> /K	$\lambda$ W/(m*K)	Cp J/(kg*K)	machinability
2157	CuZn42	CW510L	H090	90-125	102*	20.9*	109*	377*	medium (65)*
2159	CuZn39Pb2	CW612N	H070 H100 H120	70-100 100-145 ≥120	102*	21.1*	109*	377*	medium (40)*
2160	CuZn40	CW509L	H070 H100 H120	70-100 100-145 ≥120	102*	20.3*	117*	377*	medium (60)*
2285	CuZn21Si3P	CW724R	H110	110-170	85*	19.7*	33*	377*	good (80)*
2286	CuZn21Si3P	CW724R	H110 H130 H150	110-170 130-190 150-210	85*	19.7*	33*	377*	good (80)*
2279	CuZn33Pb1.5As	CW626N							
2357	CuZn40Pb2	CW617N	H090 H115	90-125 110-145	96*	21.1*	113*	377*	very good (90)*
2358	CuZn39Pb3	CW614N	H090 H115	90-125 110-145	96*	21.4*	113*	377*	very good (100)*
2362	CuZn36Pb3	CW603N	H070 H080 H105	70-120 75-105 100-135 (bzw. 140)	102*	20.6*	100*	377*	very good (90)*
2765	CuZn38As	CW511L	H070 H090 H105	70-110 90-135 ≥105	113*	21.7*	114*	377*	medium (-)

Rp0,2, Rm, A5 0.2%-elastic limit, tensile strength, elongation at break  
 $\alpha$  Coefficient of thermal expansion  
 $\lambda$ , Cp Thermal conductivity, heat capacity

medium (40)  
 \*  
 (-)

Average machinability (machinability index = 40%, with CuZn39Pb3 as per definition 100%)  
 For information only  
 Index unknown

You have needs, we have ideas! This is why, depending on a customer's specific needs, we seek out, develop and produce entirely customised components and materials. Whether it's profile metal for cable cars, tubing for church seating, parts for a concert piano, bronze-coloured choir stalls, base materials for art projects and so on. Our capabilities are as diverse as the fields of application. Just ask – we love a challenge.

To quote a couple of examples, we have the special-purpose alloys OF 2209 and OF 2285. OF 2209 (CuZn40Mn1Pb1AlFeSn) for example, is used for supports in mining operations. OF 2285 is a variant of the alloy CuZn21Si3P used for processing and has a high cold-forming capacity. More details on our OTTO FUCHS alloys for roller bearing cages and bearing bushings are provided in the next section.

## PRE-MATERIAL FOR ROLLER BEARING CAGES AND BUSHINGS FOR BEARINGS

OTTO FUCHS offers an assortment of materials for a wide range of strength values for use in roller bearing cages and bearing bushings in the form of brasses and aluminium bronzes.

OF 2357 is distinguished by its excellent machinability. The sophisticated properties of the aluminium bronzes are a high fatigue strength and excellent resistance to corrosion and cavitation.



**Mechanical and physical properties of alloys used for roller bearing cages or bearing bushings (values at room temperature)**

OF	short name	DIN EN	condition	R <sub>p0.2</sub> MPa	RM MPa	A5 %	hardness HB 2.5/62.5	young's modulus GPa	α 10 <sup>-6</sup> /K	λ W/(m*K)	C <sub>p</sub> J/(kg*K)	machi- nability
2231	CuZn37Mn3Al2PbSi	CW306G	R590	≥330	≥590	≥12	-	120*	17*	57*		medium (-)
			R690	≥510	≥690	≥6	-					
2232	CuZn40Al2Mn2Si	CW307G	R680	≥320	≥680	≥10	-	120*	17*	50*	450*	medium (-)
2233	CuZn30Al3Mn3SiNiCr	CW307G	R680	≥320	≥680	≥10	-	120*	17*	50*	450*	medium (-)
			R740	≥400	≥740	≥10	-					
			R800	≥600	≥800	≥8	-					
2268	CuZn31Si1	CW708R	R530	≥400	≥530	≥10	≥150	108*	19.2*	71*	377*	medium (40)*
			R540	≥430	≥540	≥10	≥160					
2269	CuZn31Si1	CW708R	R530	≥400	≥530	≥10	≥150	108*	19.2*	71*	377*	medium (40)*
			R540	≥430	≥540	≥10	≥160					
2270	CuZn31Si1	CW708R	R530	≥400	≥530	≥10	≥150	108*	19.2*	71*	377*	medium (40)*
			R540	≥430	≥540	≥10	≥160					
2357	CuZn40Pb2	CW617N	R360	≥250	≥360	≥25	-	100*	18.5*	67*	377*	very good (90)*
			R430	≥250	≥430	≥12	-					
			R500	≥370	≥500	≥8	-					

R<sub>p0.2</sub>, R<sub>m</sub>, A5 0.2%-elastic limit, tensile strength, elongation at break  
 α Coefficient of thermal expansion  
 λ, C<sub>p</sub> Thermal conductivity, heat capacity

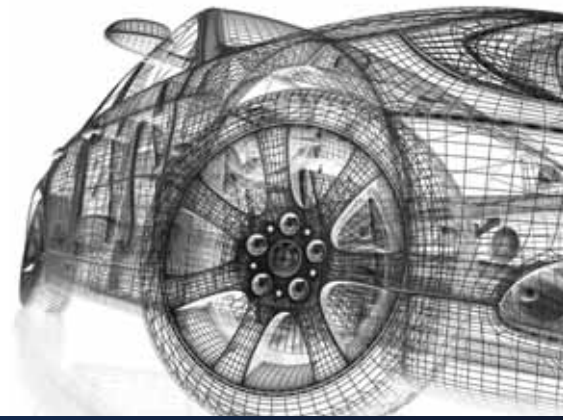
medium (40)  
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Average machinability (machinability index = 40%, with CuZn39Pb3 as per definition 100%)  
 For information only  
 Index unknown

## LARGE BUSHINGS AND BEARING RINGS

We can supply large bushings and rings with an external diameter of up to 1000 mm. Thanks to our diversity of materials and processes, we will find the tailored solution that meets your specific needs.

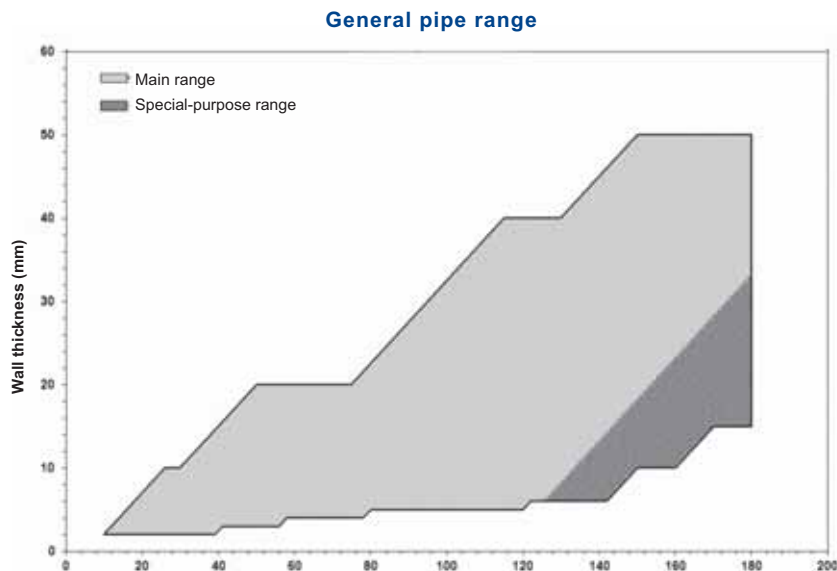




## DIMENSIONS FOR NON-FERROUS METAL FROM OTTO FUCHS DÜLKEN

We can supply metal profiles and rectangular rods in extruded form up to 180 mm and in drawn form up to 130 mm. Profiles can be solid, hollow or moulded. Rods can be round, flat or multi-edged.

Our general dimensions for hollow bars and round tubes/pipes are illustrated in the following diagram.



Whether open-die or closed-die, the possible dimensions of our forged parts are practically unlimited.

Single-spindle and multi-spindle lathes and milling centres are available for the finishing of our base materials and forged products. From the casting to the finishing phase, we coordinate the various steps of processing throughout the entire production chain under one single roof. This enables special contours to be produced by means of our start-to-finish production processing.

## DEVELOPING THE IDEAL SOLUTION TO MEET YOUR NEEDS

We do not rest on our laurels – we combine traditional methods and materials with state-of-the-art production techniques to enhance both continuously. Through the ongoing development of our techniques and materials, we have been developing a close partnership with our customers over decades.

Our commitment begins in a very early phase of product development. This enables us to optimise our alloys for the products and processes in question. During the entire product cycle, we utilise a wide range of methods to develop the properties of a material or a component. This includes special tests on the microstructure and surface structure of the materials, precise dimensioning of the components, determination of mechanical or physical properties, tribological examinations and experimental simulation procedures in 2D and 3D to help the day-by-day optimisation of the product.

The combination of new materials and procedures helps eliminate certain work steps. We use machinery concepts developed in-house to refine materials and techniques and are never satisfied with the status quo, because we know that things can always be a little more precise, a little more reliable and a little safer. The result is shorter development times, more reliable process optimisation and increased cost efficiency.



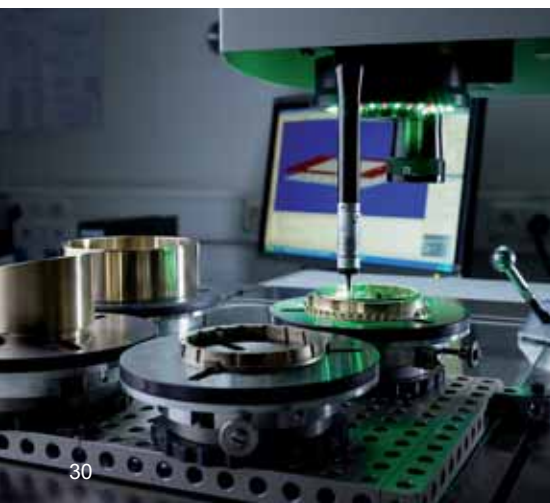


## QUALITY FOR YOUR SUCCESS

OTTO FUCHS maintains a standard of quality that is practically legendary and has been a leading pioneer in our industry for many years. The awards and recognition we receive and the satisfaction of our customers encourage our employees to keep coming up with new ideas and to give of their very best – various certificates testify to the renowned OTTO FUCHS quality.



All certificates listed here are available to you as files and can be downloaded from the internet.





[www.otto-fuchs-duelken.com](http://www.otto-fuchs-duelken.com)

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