

CARO-Plain Bearings **CARO-Special Turned Parts**

turned, milled, ready for assembly



CARO Plain Bearings and Special Turned Parts

turned, milled, ready for assembly

We produce

all solid plain bearings made to order - ready for assembly -

- to DIN ISO 4379 (supersedes DIN 1850 part 1)
- to DIN 1850
- to your drawing
- to your specification
- in all quantities
- in almost all dimensions
- from most bearing materials



The made to order production of all solid plain bearings permits us to be particularly responsive to your wishes regarding execution, tolerance and material selection.

We recommend, to design CAROBRONZE® Plain Bearing Bushes particularly thin-walled and narrow and in this way to save material, costs and space.

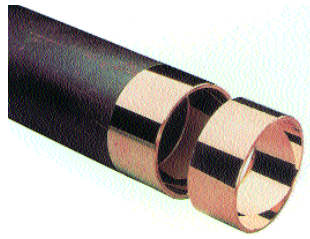
We offer you our advice

with regard to all questions about plain bearings such as bearing calculation, dimensioning, material selection, etc.



Our bearing materials:

- **CAROBRONZE®**



Plain bearings of

CAROBRONZE®

- for heavy-duty requirements
- excellent antifriction properties
- wear-resistant

➤ **Alloy composition of CAROBRONZE®**

Reference analysis Sn: ca. 8,5 %
P: ca. 0,3 %
Cu: Rest

The admissible impurities are lower by a power of 10 than the values specified for CuSn8 and CuSn8P in DIN 17662 or DIN ISO 4382 part 2 respectively.

The excellent antifriction properties of CAROBRONZE® are not only due to the high purity but also to the alloy composition (high phosphorus and tin content) and the production procedure. The combination of all these features result in the advantage of CAROBRONZE® over similar bearing materials which have the same material designation in DIN or DIN ISO.

CAROBRONZE® represents the highest quality CuSn8P Bronze.

➤ **Mechanical and physical properties of CAROBRONZE® (reference values)**

Mechanical properties				Tubes acc. to DIN EN 12449 CW459K					
				R460	R550	R620	H130	H165	H180
Tensile strength	R _m	N/mm ²	min.	460	550	620	-	-	-
Brinell hardness	HB	2.5/62.5		-	-	-	125 - 160	160 - 190	min. 175
Elongation	A ₅	%	min.	30	12	5	-	-	-
Proof stress	R _{p0.2}	N/mm ²	min.	280	480	540	-	-	-

Mechanical properties				Bars acc. to DIN EN 12163 CW459K					
				R390	R450	R550	R620	H125	H160
Tensile strength	R _m	N/mm ²	min.	390	450	550	620	-	-
Brinell hardness	HB	2.5/62.5		-	-	-	-	125 - 160	160 - 190
Elongation	A ₅	%	min.	35	18	10	4	-	-
Proof stress	R _{p0.2}	N/mm ²	min.	260	280	430	550	-	-

Physical properties		CAROBRONZE®	
Modulus of elasticity	kN/mm ²		115
Longitudinal expansion coefficient	10 ⁻⁶ /K		17
Thermal conductivity	W/mK		59
Density	kg/dm ³		8.8

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● A survey of further bearing materials (reference values)

Mechanical and physical properties*

➤ Wrought materials

Superseded standard designation	CuZn40Al2		CuZn31Si1		CuAl10Ni5Fe4		CuAl11Ni6Fe5		CuNi2Si	
Current standard designation	CuZn37Mn3Al2PbSi		CuZn31Si		CuAl10Ni5Fe4		CuAl11Fe6Ni6		CuNi2Si	
Material number	2.0550	CW713R	2.0490	CW708R	2.0966	CW307G	2.0978	CW308G	2.0855	CW111C
Tensile strength R_m N/mm ²	> 590	min.590	min. 490	min. 530	> 640	min. 680	> 730	min. 750	min. 640	min. 640
Elongation A_5 %	> 10	min. 10	min. 15	min. 12	> 15	min. 10	> 5	min. 10	min. 10	min. 10
Brinell hardness HB 2.5 / 62.5	160	ca. 160	ca. 150	ca. 150	180	min. 180	210	ca. 210	ca. 190	ca. 180
Proof stress $R_{p0.2}$ $R_{p0.2}$ N/mm ²	250	ca. 320	min. 290	ca. 330	> 270	min. 480	> 440	ca. 450	min. 590	ca. 620
Modulus of elasticity E kN/mm ²	93	93	108	108	125	125	125	125	140	140
Thermal expansion coefficient α 10 ⁻⁶ /K	20.4	20.4	19.2	19.2	17	17	17	17	17	17
Thermal conductivity λ W/(m·K) bei 15°C	63	63	71	71	50	50	40	40	160	160
Density ρ kg/dm ³	8.1	8.1	8.4	8.4	7.5	7.5	7.4	7.4	8.8	8.8
Electrical conductivity χ m/Ω·mm ²	7.8	7.8	8.9	8.9	6	6	5	5	19	19

➤ Cast materials

Superseded standard designation	GC-CuAl10Ni		CuSn7ZnPb		CuSn12		CuPb15Sn	
Current standard designation	CuAl10FeNi5-C		CuSn7Zn4Pb7-C		CuSn12-C		CuSn7Pb15-C	
Material number	2.0975.04	CC333G	2.1090	CC493K	2.1052	CC483K	2.1182	CC496K
Tensile strength R_m N/mm ²	> 700	min.650	> 260	min. 260	> 280	min. 300	> 220	min. 200
Elongation A_5 %	> 13	min. 13	> 12	min. 12	> 7	min. 6	8	min. 8
Brinell hardness HB 2.5 / 62.5	160	ca. 150	70	min. 70	90	min. 90	65	min. 65
Proof stress $R_{p0.2}$ $R_{p0.2}$ N/mm ²	> 300	ca. 280	120	min. 120	> 150	min. 150	100	min. 90
Modulus of elasticity E kN/mm ²	120	120	107	107	100	100	77	77
Thermal expansion coefficient α 10 ⁻⁶ /K	17	17	18.5	18.5	18.5	18.5	18.8	18.8
Thermal conductivity λ W/(m·K) bei 15°C	60	60	64	64	54	54	63	63
Density ρ kg/dm ³	7.6	7.6	8.8	8.8	8.4	8.4	9.1	9.1
Electrical conductivity χ m/Ω·mm ²	4 - 6	4 - 6	7.5	7.5	6.2	6.2	7	7

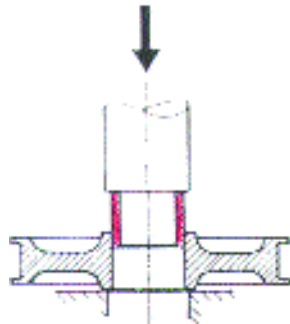
* Reference values

We recommend

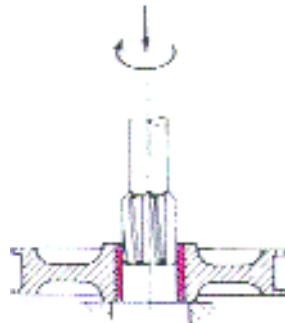
- **CAROBRONZE®-P Bushes**
the cost-efficient alternative

The outside diameter of the bushes is drawn to a precision press-fit. There is no machining of the outside diameter.

The bush is ready for press fitting into an H7 seating bore.



PRESS FITTING



REAMING



➤ **Applications of CAROBRONZE®-P Bushes:**

- Plain bearing bushes in rollers and running wheels
- Plain bearing bushes in belt tensioning pulleys and gearwheels
- Connecting rod bushings, rocker arm bushings, spring bushings

and many more applications (in which the bushes - individually arranged - need not be in precision alignment with other bushes, so that the small wall thickness deviation (max. $\pm 5\%$) caused by cold drawing is without significance).

➤ **Dimensions of P-Bushes available from stock (with reaming allowance)**

Finished bore \varnothing in mm	Bush or tube \varnothing in mm	Finished bore \varnothing in mm	Bush or tube \varnothing in mm	Finished bore \varnothing in mm	Bush or tube \varnothing in mm
10	9.8/16 P	15	14.8/18 P	25	24.8/30 P
12	11.8/16 P 11.8/18 P	16	15.8/20 P	30	29.8/35 P 29.8/36 P 29.8/40 P
14	13.8/18 P	20	19.8/24 P 19.8/25 P 19.8/26 P		

The bushes can be supplied ready for press fitting in the desired length.

CAROBRONZE®-P Bushes can also be supplied with a **machining allowance** on the inside diameter. By boring the bushes to the finished diameter a bearing bore that is concentric to the O/D is achieved. Please, consult us for minimum quantities.

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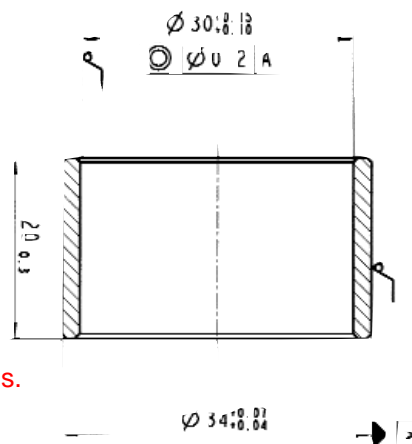
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For various applications we supply:

- **CARO - Bearing Bushes, precision-drawn**

- cut from a precision-drawn CAROBRONZE® Tube, ready for assembly with-out rework -

! By our special cold forming procedure we can achieve diameter tolerance up to the quality IT 8 - dependent on diameter and wall thick-ness.



Benefit from the advantages of these cost-efficient bearings.

Application instructions

- **Mating material / Shaft material**

Because of the use of very wear-resistant base materials for the CARO Plain Bearings the hardness of the shaft material must also be specified in such a way that a hardness ratio of the base material to the mating material of 1 : 3 is guaranteed.

Hard chrome plated and also hard nickel plated surfaces are well suited to use as mating surfaces and besides the desired hardness also provide additional corrosion protection. The plating thickness should amount to approximately 30 to 50 µm and the hardness should reach min. 56 HRC.

Particularly for the highly loaded CARO Plain Bearings the surface quality of the shafts is critical when considering the coefficient of friction and the magnitude of the wear to be expected. Therefore, in most cases Rz roughness values of < 3 µm are required and, in general, the lower the Rz value, the lower the resulting coefficient of friction.

- **Coefficients of friction**

The coefficients of friction of plain bearings depend on a number of parameters. These are for example the surface qualities of the friction pairing, the temperature, the surface pressure and above all type and quantity of the existing lubricant. Generally it is true that the arising coefficient of friction, just as the admissible surface pressure, is not a material parameter but a system parameter which falls with increasing surface pressure after the running-in phase and rises with increasing temperature, higher speed and higher Rz roughness values.

For grease-lubricated plain bearings it is recommended not to use for a calculation coefficients of friction below 0.1. In the case of hydrodynamic running, oil-lubricated plain bearings coefficients of friction below 0.01 are to be expected.

- **Design / Determination / Calculation**

As a special service we offer you our help and support for the selection, design and determination of the CARO Plain Bearings and Bearing Elements.

Please return a copy of the completed questionnaire overleaf including a drawing, if possible.

The more details and information you are able to provide the greater the attention we can give to your special plain bearing problem.

QUESTIONNAIRE

for the design and calculation of CARO Plain Bearings

Requesting company:

Responsible/dept.:

Phone/Fax:

Application:

Type of machine/device:

drawing/draft enclosed:

Bearing/type/design:

drawing/draft enclosed:

Dimensions: (with tolerances)

Bearing:inside-Ømm Tol.

outside-Ømm Tol.

widthmm Tol.

Shaft:

shaft-Ømm Tol.

material

surface roughness Ra/Rt/Rz.....µm

temper
(hardened, nitrated, chromium plated a.s.o.)

hardness

Housing: design

material

dimensions

Working conditions:

Bearing load radialN

axialN

static, rotating, changing, swelling, pulsating

Operating speed:

n=.....1/min

rotating shaft rotation bearing

continuous intermittend

stroke movement pivoting angel +/- °

Stroke.....mm frequence1/s

Direction of rotation:

constant changing oscillating

operating times/min/h

rest periods/min/h

Temperature:

bearing temperature°C

housing temperature°C

ambient temperature°C

Special ambient influences:

e.g. dust, humidity, corrosive atmosphere

CARO-bearing in contact with

lubricant

pumping medium.....

others

Further details / Requirements:

.....

.....

.....



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Diecasting Components for Light Metal Diecasting Machines

From the cobalt- and beryllium-free high-performance material

CARODUR-DC / CuNi2Si + Cr

specially developed for aluminium diecasting, we produce bushes and pistons made to order to your drawings.

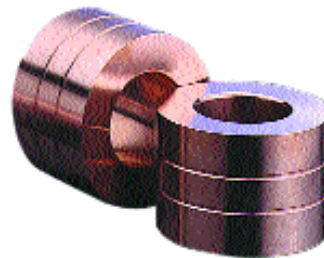
● Application

- Pistons and sleeves in cold chamber machines for aluminium diecasting
- Pistons for one-piece or split loading chambers

● Advantages

- Very good antifriction properties
- High wear resistance
- Constantly high thermal conductivity over the total temperature range
- Long life and high shot numbers with adequate cooling

All pistons and sleeves ready to be installed are produced to order according to customers' drawings (also special designs) in all quantities. Our precision production also permits the manufacture of special pistons with piston lengths of $L > 1.5 \times D$ (D = piston diameter).



Valve Guides

manufactured according to your requirements

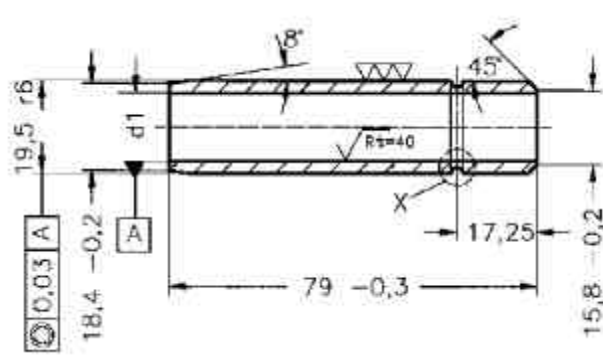
from **CAROBRONZE®**, **CARODUR**, **CAROTHERM B**, as well as materials to your specifications

● Application

- Passenger car and motorcycle engines
- Large diesel engines
- Racing engines

● Advantages

- Best antifriction properties
- High wear resistance
- High thermal conductivity
- Components ready for installation



We would be glad to submit you our offer for your drawing parts, which is without engagement for you.

Special Parts, Sub-assemblies

manufactured according to your drawings and specification

● Materials

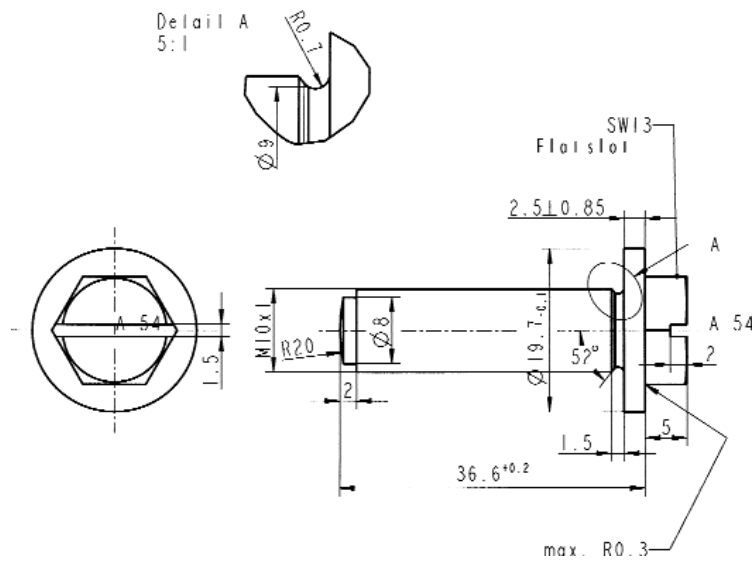
- Copper and copper alloys
- Aluminium and aluminium alloys
- Steel

● Executions

- Turned parts, such as axles, screws, nuts, bolts
- Sub-assemblies

● Example

- Corrosion-resistant special screw from CARODUR-CuNi2Si



Quality

ENZESFELD-CARO METALLWERKE AG is a leading manufacturer of semi-products and final products in copper alloys and works to a Quality Management System to ÖNORM EN ISO 9001 which was certified for the first time in 1993 by ÖQS (Austrian Association for Certification of Quality and Management Systems).

With the CARO Plain Bearings and Bearing Elements ECM offers you - from the material to the CARO Plain Bearing ready for installation - products which are all produced in one plant with constantly outstanding quality.

