

CAROPLUS®

**Self-lubricating
Bearing Elements**



AUSTRIA BUNTMETALL



**ENZESFELD-CARO
METALLWERKE AG**

CAROPLUS®

SELF-LUBRICATING BEARING ELEMENTS

CAROPLUS® -Bearing Elements are maintenance-free, self-lubricating plain bearings, bearing plates, bearing and guiding pads as well as thrust washers, from approved high-quality copper base antifriction materials with embedded solid lubricant.



Applications of CAROPLUS Plain Bearings and Bearing Elements

Typical applications for CAROPLUS Plain Bearing Bushes, Plain Bearing Half Liners, Bearing Plates and Bearing Pads are:

- Mechanical and structural steel engineering
- Automotive industry (tool guides, e. g. to DIN 9834)
- Rolling mill bearings
- Locks and weirs for surface and underwater engineering
- Shipbuilding and offshore engineering
- Cranes and elevators, transporting and conveying equipment
- Building and earth moving machines
- Mining machines and quarrying industry
- Industrial furnace production
- Chemical industry
- Injection moulding machines
- Eccentric and packaging machines
- Manufacture of tools, jigs and fixtures
- Special machines construction



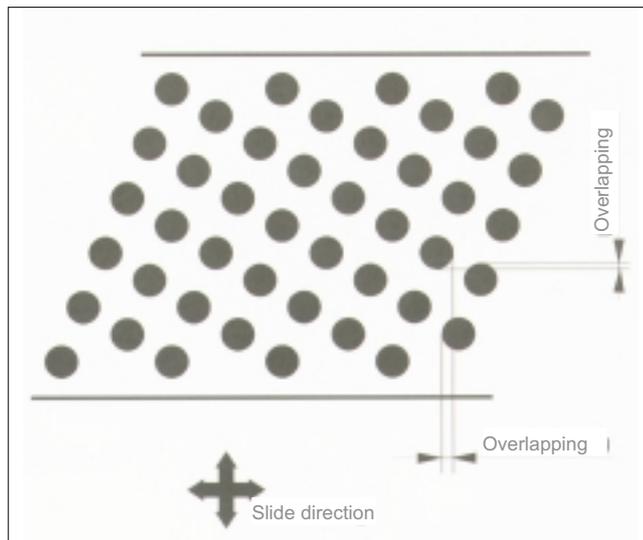
Advantages

- Plain bearings and bearing elements ready for installation
- Maintenance-free or low-maintenance operation with extended possible maintenance intervals
- No costs for lubricants and lubrication equipment (centralised lubrication systems)
- No impact on environment as there is no contamination by oil or grease and no disposal costs
- High static and dynamic load capacity
- Low sensitivity to impact, shock, dynamic and alternating load
- Low coefficients of friction (similar to grease lubrication)
- High wear resistance
- No stick-slip
- Good heat conductivity
- High temperature resistance
- High corrosion resistance
- Sea water resistance (CAROPLUS-AL)



Construction

Uniformly distributed holes are drilled into the bearing surfaces of the base material and are filled with a specially formulated solid lubricant compound.



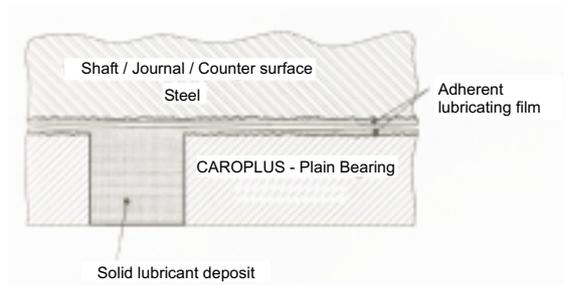
Arrangement of the lubricant holes in the bearing surface of the CAROPLUS-Bushes

The proportion of solid lubricant to the total bearing surface amounts to 25 to 30 % and the geometrical arrangement of the holes is determined in such a way that in direction of travel overlapping is always guaranteed.

Solid Lubricant and Function

A very low-friction graphite base compound is used as a solid lubricant. This does not contain any lead or other heavy metals and, therefore, can be used without hesitation in the food industry.

The solid lubricant, embedded in the holes, starts with the first sliding movements of the running-in operation to build up an adherent uniform lubricating film. The solid lubricant fills the roughness valleys of the two surfaces sliding one on top of the other. At the same time a smoothing of the roughness points takes place and a continuous compression-proof solid lubricant film is formed. By this means, the bearing surfaces are separated from each other and metallic contact is prevented.



Formation of an adherent solid lubricant film between the bearing surfaces

Besides its high load-carrying capacity the solid lubricant also acts as an efficient carrier for embedded metallic rubbings, foreign particles and dirt in the lubricant reservoirs (holes). These embedded particles displace a similar volume of lubricant, which is then, in addition, available for the lubrication of the bearing surfaces. Together with the very good antifrictional properties of the solid lubricant film this embedding and displacing process is decisive for the operationally reliable and maintenance-free running of the CAROPLUS Plain Bearings and Bearing Elements.

Initial lubrication / Regreasing

CAROPLUS Plain Bearings and Bearing Elements are self-lubricating due to the incorporated solid lubricant. However, in order to facilitate the running-in process, before mounting we recommend to provide the bearing surfaces with a thin running-in lubrication film using the starting grease supplied together with the bearing elements. If for any reason such lubrication with grease cannot be carried out for the initial lubrication, we can supply an optimised spray to provide the bearing surfaces with an initial lubrication film.

Dependent on the application and the required life a periodic regreasing is recommended. In this way the life expectancy can be considerably increased. We can recommend a suitable special lubricant for this purpose adapted to the specific application on request.

Mating material / Shaft material

Because of the use of very wear-resistant base materials for the CAROPLUS Plain Bearings the hardness of the counter material must 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 a certain corrosion protection. The plating thickness should amount to approximately 30 to 50 μm and the hardness should reach min. 56 HRC.

When choosing stainless steel grades attention must be paid to achieve sufficient hardness. It is preferable to choose nickel-free chromium steel grades. Particularly for the highly loaded CAROPLUS 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 $< 3 \mu\text{m}$ are required and, in general, the lower the Rz value, the lower the arising coefficient of friction.

CAROPLUS - Parameters

Type	CAROPLUS SN-hh	CAROPLUS SN-h	CAROPLUS SN-xh	CAROPLUS AL
Base material	CAROBRONZE CuSn8P half hard	CAROBRONZE CuSn8P hard	CAROBRONZE CuSn8P extra hard	CuAl10Ni5Fe4
Tensile strength R_m (N/mm ²)	> 450	> 540	> 590	> 600
Proof stress $R_{p0,2}$ (N/mm ²)	> 250	> 460	> 540	> 300
Elongation A_5 %	> 28	> 10	> 10	> 10
Brinell hardness HB _{2,5 / 62,5}	145	170	190	150
Temperature limit (°C)	180 °	180 °	180 °	300 °
Max. admissible specific surface pressure (N/mm ²) for $v = 0$	80	120	150	80
Max. admissible funning speed (m/s) for load = 0	1	0,8	0,5	0,4
Max. pv-value* (N/mm ² x m/s)	0,8	1,4	3,0	1,0
Max. outside diameter for bushes (mm)	160	160	160	160
Remarks	CAROPLUS type for mean surface	CAROPLUS type for mean to high surface pressure	CAROPLUS type for very high surface pressure	

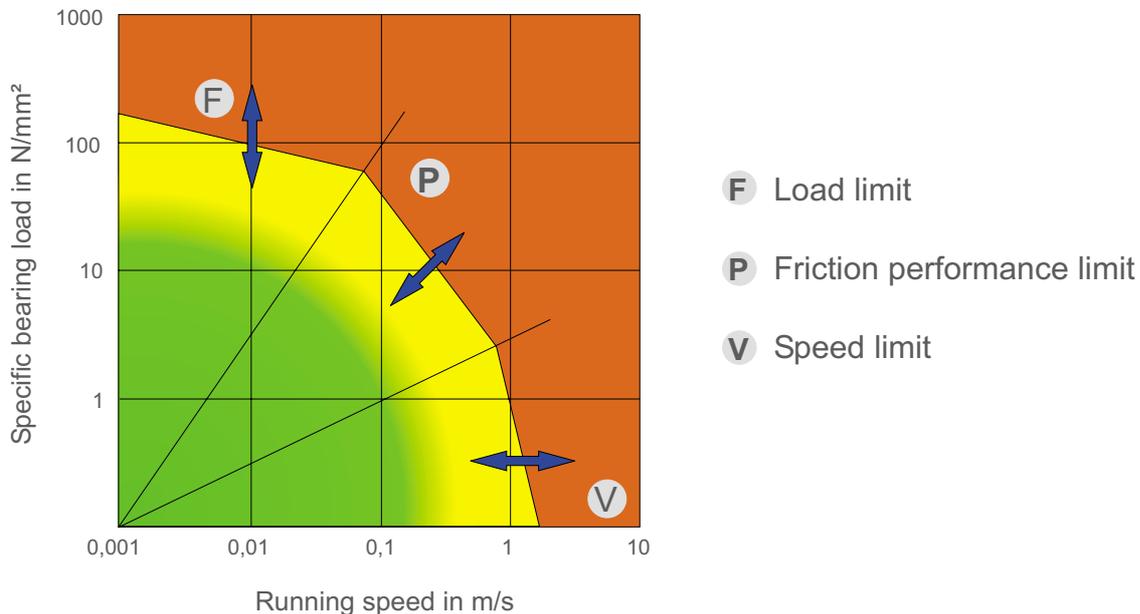
* The formerly frequently used pv value is primarily a parameter for the heat dissipation conditions. For sufficient heat dissipation the values indicated show the upper limit values for a safe operation of the bearings.

In the case of specific requirements (such as larger diameters) we can also supply CAROPLUS Bearings and Bearing Elements from other base materials.

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CAROPLUS - application conditions



The applications shown in the green area of the diagram are uncritical. The further the operating conditions reach into the yellow area the more attention should be paid to all influential parameters which should be considered when choosing CAROPLUS Bearings.

Particularly in such cases it is important that you submit to us the enclosed Questionnaire duly completed so that we can offer you a specific solution.

Dimensions and tolerances

While oil and grease-lubricated plain bearing bushes from CAROBRONZE are usually very thin-walled, CAROPLUS Plain Bearing Bushes require a minimum thickness, which can be determined as follows:

$$s = 0.05 D_i + (2 \text{ to } 5 \text{ mm})$$

s Minimum wall thickness (in mm)
 D_i Bearing inside diameter (in mm)

The bearing length usually amounts to $B = 0,6 \text{ bis } 1,5 \cdot D_i$

In the case of bearing pads and bearing plates the thickness should not fall below a minimum of $s = 10 \text{ mm}$.

Guide bushes having considerably bigger bearing lengths ($B \gg 1.5 D_i$) are manufactured with a clearance zone in the bush bore. This increases the guiding precision and prevents jamming in case of guide deflexion.

The clearance zone between the two bearing surfaces is often also used as an additional reservoir for the lubricant of the starting lubrication or for regreasing purposes.

For building-up the lubricating film CAROPLUS Plain Bearings lubricated with a solid lubricant in principle require a bigger clearance than oil or grease-lubricated hydrodynamic plain bearings.

	Standard tolerances:	
Bush inside diameter	E6 H8	before mounting after mounting
Bush outside diameter	s6	before mounting
Housing bore	H7	
Shaft diameter	d7 c8	normal load high load, high temperature

On request, we can also supply bushes with other tolerances.



Coefficients of friction

The coefficients of friction of CAROPLUS Plain Bearings and Bearing Elements depend on a number of parameters. These are for example the surface qualities of the friction pairing, the surface pressure, the temperature or the existence of an additional lubricant (e. g. grease or even water).

Generally it is true that the coefficient of friction falls with the increased surface pressure after the running-in phase and rises with increasing temperature, higher speed and higher Rz roughness values.

For CAROPLUS Plain Bearings coefficients of friction of 0.05 to 0.15 are to be expected. For a calculation it is recommended not to use coefficients of friction below 0.1.

Corrosion resistance

On account of the good corrosion resistance of all base materials of the CAROPLUS Plain Bearings it is possible to use these bearings in various corrosive media and in the areas of fresh water, also at higher temperatures (CAROPLUS-AL also in sea water).

On your special request we can submit detailed advice and recommendations for the most favourable base material for your individual application.

Design / Determination / Calculation

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

Please return a copy of the completed questionnaire overleaf including a drawing, if possible. Or ask for an expert to visit you for a personal discussion.

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

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Mounting instructions

Due to the large difference between the metallic base material and the solid lubricant the bushes must **NOT** be subcooled for mounting using liquid nitrogen. It is recommended to provide the CAROPLUS bearing elements before mounting with a starting lubrication film (see section "Initial lubrication / Regreasing").

In the case of very high specific bearing loads we recommend the use of an additional antitorsion device.

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



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/Rzµm

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=.....rpm.

rotating shaft rotation bearing

continuous intermittent

stroke movement pivoting angel +/-°

Strokemm frequency.....1/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

CAROPLUS-bearing in contact with

lubricant

pumping medium

others

Further details / Requirements:

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Enzesfeld-Caro Metallwerke AG

Since 1905 Enzesfeld-Caro Metallwerke AG (ECM) have produced high-quality semi-finished and finished products in copper alloys. The enterprise which in 1989 - in the scope of a management buyout - has been entirely denationalised, is the leading non-ferrous metal manufacturer in Austria. Under the direction of Managing Director Ing. Gerhard Eschner and Mag. Berndt Exenberger in 1999 the company had a turnover of more than 300 million Austrian shillings.

More than 50 % of the products manufactured by the 208 employees are exported. Well-known companies such as SKF Austria, Heidelberger Druckmaschinen and Ferrari count among our customers.

The wide production range covers pre-material, semi-products and precision components ready for assembly. In the manufacturing divisions foundry, drawing shop, cage and bush production as well as railway engineering, approx. 25,000 tons of high-quality copper and copper alloy products are produced a year.



Horizontal continuous casting



Casting from melting crucible



CNC bush production



Drawing shop

In the foundry billets, bars and tubes are produced on modern horizontal and vertical continuous casting installations in more than 100 different copper alloys. These products are used for further fabrication in our own works or in the works of our subsidiary **Buntmetall Amstetten**, however, are also directly supplied to customers.



CAROBRONZE® bars, tubes and profiles

In the drawing shop wrought copper alloys in form of bars, tubes and profiles are produced. Special trademarks are the high-performance plain bearing material **CAROBRONZE®** and the high-strength, age-hardenable copper alloy **CARODUR®**. Both are internationally recognised and approved materials.



CAROBRONZE®-plain bearing bushes and bearing elements

The roller bearing cage and bush production is equipped with state-of-the-art CNC and automatic machines and specialised in the production of precision parts. Main products of the finished product line are **CARO Plain Bearing Bushes** and **Bearing Elements**, maintenance-free **CAROPLUS® Plain Bearings** with solid lubricant, **Brass Roller Bearing Cages** (turned and precision milled) and **AUSTROROLL®**, a maintenance-free roller device for railway points.



CAROPLUS®-plain bearings with solid lubricant

Decades of experience and well-founded expertise in production and application technique have contributed to the fact that the **Quality Products** of Enzesfeld-Caro Metallwerke - "from **Semi-Products to Finished Products - all from a Single Source**" - are now well-known throughout the world. The Quality Management System certified according to EN ISO 9001 and the Environmental Management System certified according to ISO 14001 as well as the committed staff, will ensure that this passion for high quality will result in achieving even higher goals in the future.



Solid cages



AUSTROROLL® - roller device for maintenance-free railway points

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