MATERIALS FROM MACHINED BEARINGS BY ELECTRICAL EROSION

Dr. Ing. IOAN BADIU¹, Prof. univ. dr. ing. MARCEL S. POPA²
¹Technical University of Cluj-Napoca, ROMANIA, e-mail: badiu.ioan07@yaho.com
²Technical University of Cluj-Napoca, ROMANIA, e-mail: popa.marcel@tcm.utcluj.ro

Abstract: Chromium alloy rings for bearings stockings and the rolling bearings were selected steels with high carbon about 1.00% and a chromium content of 1.5%, according to ISO 683-17. Although case hardening steels are rarely seen in manufacturing of bearings, they are used with good results in exploitation. These steels are usually recommended in the execution of large bearings and where bearing operation performed on shock and vibration. Bearings run in hardened steels are less susceptible to damage accidental, due to soft ductile core. Bearing cage materials are important elements of building bearing. The main function of the cage is to prevent direct contact between the rolling and guide their raceways. The ring bearings removable retaining cage serves rolling elements, such that they can not fall off when installing or removing them. Depending on the material used, as well as manufacturing technology, cages can be: cages pressed sheet steel, low carbon extra deep drawing according to EN 10130 + A1, cages of brass CuZn40PbT STAS 199/2.

Key words: bearings, electrical erosion, temperature, bearing materials.

1. INTRODUCTION.

The magnitude and direction of loads greatly influence the selection of bearings. Generally, for the same dimensions, the cylindrical roller bearing stands heavy loads than the deep groove balls bearing. The bearings with more rows of rolling elements, especially rollers have heavy load carrying capacity. According to the load acting direction, the following situation are distinguished:

a) Radial load: cylindrical roller bearings without ribs at one of the rings, with one row of rollers (type N or NU) or with two rows of rollers (type NN or NNU) and needle roller bearings are to be used.

b) Axial load: thrust balls or roller bearings according to the load magnitude, are to be used. The simple effect thrust roller bearings can be loaded only in a single direction and the double effect thrust roller bearings can be loaded in both directions.

c) Combined load: the simultaneous action of radial and axial load means that on the roller bearing acts a combined load. For light axial loads together with radial loads are used: deep groove ball bearings, single row. (combined load supported rises if the radial clearance is greater than normal), cylindrical roller bearings of the NUP and NJ+HJ types and spherical roller bearings. NJ type cylindrical roller bearings can only accommodate axial loads acting in a single direction and for axial displacement of the shaft in both directions it is recommended to mount roller bearings of the same type. If the axial load is heavy, a thrust bearing must be mounted together with a radial roller bearing. The angular contact balls bearing or four-point contact bearings (Q or QJ type) used when axial load predominates are mounted with
clearance fit for housing. In case of combined loads in which heavy axial load predominates, angular contact ball bearings single or double rows taper roller bearings or spherical roller thrust bearings. In which the black triangles indicate the loads direction for which the respective bearing was designed and the white triangles are indicating the possible loads. The size of the bearing is selected considering the condition of life requirements ensuring for imposed conditions of load, rating life and reliability of operation. Selection is done on the basis of a characteristic variable: basic load ratings.

2. PROCESSING BY ELECTRICAL FROM EROSION BEARINGS.

The AF-4300 is indicated for the production of large molds and is considered to be one of the best cars in its class in the world. AF-4300 offers racing 2.100mm X axis, Y axis 900mm Z axis 500mm SSI supports loads up to 10,000kg. Two independently controlled heads CNC, allowing erosion to two independent cavities and simultaneously. In addition, equipped with an open design 32/64 CNC, the machine is easy to integrate into the user management system. AF 4300 belongs to the class of modular EDM machines from Novick family. The piece de resistance of this machine is its versatility, since customers can choose different elements to set up a car for their needs. This EDM machine can be used with a tank split, thus functioning as two cars own CNC system.

2.1. Selection of bearing type considering the alignment between shaft and housing.

Angular misalignments occur generally when the shaft bends under the operating load or when bearings adjacent parts have form or position deviations. In such cases, self-aligning ball bearings, spherical roller bearings or spherical roller thrust bearings should be used. A certain bearing bent angle can compensate for errors of alignment and maximum angle values
are shown for each type in the introductory texts of the table sections. When misalignments should be compensated, radial and axial clearance are important. The larger the clearance, the greater the possibility of self-aligning. If the misalignment exceeds the permissible values shown in the introductory texts of the bearing tables, the bearing rating life decreases. The greater the ratio Fr/C0r, the shorter the rating life. If 0.1 <F0r/C0r< 3, the rating life decreases with about 25%.

2.2. Selection of bearing type considering the operating temperature.

Maximum operating temperature to which the bearings designed for normal applications can be used is of 120°C. Over this temperature in the material of the contact elements (rings and rolling elements) there are produced structural transformations with negative implications over the dimensional stability and physical and mechanical characteristics which determine the resistance to contact fatigue and, through implication, to the life of the bearing. Thus, at higher temperatures it is recommended to use special bearings having the component parts made of special steel brands or stabilized through thermal treatments. These bearings have special symbols. Remark: when the working conditions of bearing allow great temperature differences in operation for the two rings (interior and exterior) we recommend the use of bearings with radial clearance greater than normal (groups C3, C4, C5).

2.3. Selection of bearing internal clearance.

In most cases, while operating, bearings should have a small radial clearance that can be defined as "the possible value of displacement in radial direction of one bearing ring in relation to the other without parts deformations". While operating, bearing internal clearance is different from the one at delivery, since the latter is reduced when mounting bearings with a certain tight fit. Under operating conditions, internal clearance change is also caused by different temperatures between the outer and inner ring. Bearings are generally delivered with a normal radial or axial clearance according to the values shown for each rolling bearing group.

The decrease in radial clearance due to the tight fit and operating temperature is considered to be between 60-80% of the tightening value, depending on bearing series and size. After the clearance in bearings has been decreased, a large enough operational clearance should remain, so that the lubricant film shouldn't be destroyed. Deep groove ball bearings should have an operational clearance close to zero. There may be often a light-preload, due to the point-contact between the rolling elements and raceways. Small-sized cylindrical roller and needle roller bearings should have an operational clearance of 5-10 μm and larger-sized bearings a clearance of 10-30 μm. Bearing producers can also manufacture - at request - bearings with radial and axial clearances smaller (C1 and C2) or larger (C3, C4 and C5) than normal, so that the most favorable operating conditions for bearings should be assured. Cylindrical and needle roller bearings can be manufactured with interchangeable rings (no special designation) and with non interchangeable rings (suffix NA). Bearings with non interchangeable parts have a smaller radial clearance than bearings with interchangeable parts. Changing rings from one bearing to another is not allowed. In case of bearings with
interchangeable parts, the rings may be changed and the values of radial clearance will be not altered.

Bearing types and technical characteristics

Bearing type is selected depending on the technical characteristics required by a certain application. A suggestive graphic symbol has been determined for each main technical characteristics. Thus, a proper bearing for each purpose can be easily chosen. According to the specifications in this catalogue, the proper type and size of bearing can be selected, together with all manufacturing and operating technical conditions.

3. MATERIALS FOR ROLLING BEARINGS.

Due to various operating conditions and intricate aspects of deterioration phenomena, direct connections between mechanical characteristics and materials used for bearing manufacturing have been ascertained. Experimental studies proved that the following characteristics have to be considered, when appreciating the quality of bearing steels: rating life and contact fatigue loading, hardness at environment temperature and high temperatures, coefficient of expansion, tenacity, corrosion resistance and metallurgical conversion characteristics. In case of normal applications and operating conditions, only the first two characteristics are of importance, the other being of importance only in case of bearings used for special applications. Material behavior when being loaded at fatigue contact is difficult to be estimated due to the complex of the factors involved while hardness can be estimated by classic methods. These led to the selection of some steels, which are able to satisfy the main demands of normal and special operating conditions. The steels that meet the requirements for rings and rolling elements manufacturing are the following:

3.1. Chrome-alloy bearing steels.

Steels with high carbon content 1% and with chrome 1.5% according ISO 683-17 have been chosen for bearing rings and rolling elements.

3.2. Case-hardening steels.

Although case-hardening steels are not usually selected for bearing manufacturing, for certain applications they can be successfully used. These steels are generally recommended for large-sized bearings and where bearings are operated under shock, loads and vibrations. Bearings manufactured of case-hardening steels are less liable to casual failure due to the ductile and soft core of these steels. The case-hardening bearing steels used and the chemical content are according ISO 683-17.

3.3. Bearing cages

Bearing cages are of great importance for bearing design. The main purpose of the cage is to prevent immediate contact between two neighboring rolling elements and to guide them on raceways. Where bearings are of separable design, the cage also serves to retain the rolling elements when one bearing ring is removed during mounting and
dismounting. Considering the cage manufacturing technologies, they can be classified as follows: pressed cages of steel sheet, low carbon content, for extra-deep drawing. Polyamide cages are used for some small and medium-sized bearings due to the following properties: low density, high elasticity, low wear at sliding movement, low inertia moment.

**Fig.2. Medium carbon steel insulated system transformed Fe, C 0.4, 1.3 Ni, 0.65 Cr, 0.65 Mo**

**Fig.3. Medium carbon steel insulated system transformed Fe, C 0.4, 1.3 Ni, 0.65 Cr, 0.65 Mo**

**Fig.4. Medium carbon steel insulated system transformed Fe, C 0.4, 1.3 Ni, 0.65 Cr, 0.65 Mo**
**Fig. 5.** Medium carbon steel insulated system transformed Fe, C 0.4, 1.3 Ni, 0.65 Cr, 0.65 Mo.

**Fig. 6.** Medium carbon steel insulated system transformed Fe, C 0.4, 1.3 Ni, 0.65 Cr, 0.65 M

**Fig. 7.** Nickel Stainless martensitic Fe, 2.95 C, 0.60 Si, 0.60 Mn, 4.00 Ni, 1.90 Cr.
4. CONCLUSION.

Bearing steels are steels that must meet specific requirements or demands of machine bearings analog tensile strength, wear and fatigue very high and good dimensional stability. Steel bearings a hipereutectoid (C > 1%) Low Alloy Cr, Cr-Si avoiding alloying with elements that would increase the percentage of residual austenite. Use the martensite after quenching and low return. Bearings can be radial or axial to radial, axial those and other types of bearings are designed for combined loads (radial and axial). In general, ball bearings are suitable for small and medium load tasks and roller bearings are suitable for heavy duty load tasks. Bearings can be radial or axial to radial, axial those and other types of bearings are designed for combined loads (radial and axial). In general, ball bearings are suitable for small and medium load tasks and roller bearings are suitable for heavy duty load.

5. REFERENCES.