12th International Research/Expert Conference
”Trends in the Development of Machinery and Associated Technology”
TMT 2008, Istanbul, Turkey, 26-30 August, 2008

STUDIES CONCERNING NEW BALL-BEARINGS HAVING 35 mm THE INNER DIAMETER OF THE INTERNAL RING (part II)

Dan Săvescu
Transilvania University of Braşov
B-dul Eroilor, nr. 29, Braşov
România

ABSTRACT
The paper presents some aspects regarding the deflections of new construction of ball-bearings with 35mm the dimension of the inner diameter, providing from the standard construction of the 6305 ball-bearing. Different constructions were obtained using an algorithm, having another internal geometry, other dimensions of the rings and other number of balls, in the way to obtain higher static or dynamic performances/ capacities. The ball-bearings are mounted on shafts and the experimental part uses an especial device.
Keywords: 6305 ball-bearing, internal construction, deformations

1. INTRODUCTION
There are papers [1, 2, and 3] in which there are presented the possibilities to modify the internal geometry of ball-bearings in the way to obtain high performances, for example - loading capacities, or to increase the inner diameter, for three established dimensions (external diameter D, internal diameter d and the width B).

2. THE LABORATORY INSTALLATION CONSTRUCTION
The laboratory testing installations designed for the determination of the ball-bearings' rigidity, in the situations of the bearings mounted on shafts, must realise the following:
- the possibilities for variable charging with radial, axial or combined loading forces;
- the possibilities of mounting the bearing on the shaft in different controlled press fitting conditions;
- the possibilities to mount the bearings in the housing by close running fit;
- the shaft and the housing must be carefully machining processed, with smooth surfaces (small grades), no allowances to cylinder or polygon;
- the loading of the inner ring must be symmetrical and uniform;
- the housing must be extremely rigid, like all the installation.

The installation from figure 1 was designed for the experimental researches presented in this paper. The tested ball-bearing (1) is mounted on the shaft (2) and in the great rigidity housing (3).
For loading, a wire - to which a G weight is corded - is placed to different arms. The weight G goes into an equilibrium position displacing itself by means of a roll mounted on the wire.
The constructive solution of the mentioned installation is presented in figure 2, in which the tested bearing (2) mounted on the shaft (1) is charged with the weights (13) by the wire (10). The bearing position is assured by the device and the lids (3). The left / right deformations are read using the measurement apparatus (5 – dial indicators) fixed in the carriers (6).

3. EXPERIMENTAL RESEARCHES
Starting from the theoretical calculus of rigidity [1, 2] the deformations values on radial direction δ_r can be determined, for radial loadings F_r.

Taking into consideration the hypothesis of the loading zone parameter ε = 0.5 [1, 3], table 1 presents the obtained values of the forces F_0 and F_1 = F cosγ as well as the deformations δ_{r0} and δ_{r1}, for radial loadings between 250 and 10000 N limits applied to a 6305 URB ball-bearing. With these results, the diagram form the figure 1 was drawn and can be observed the nonlinear characteristic.

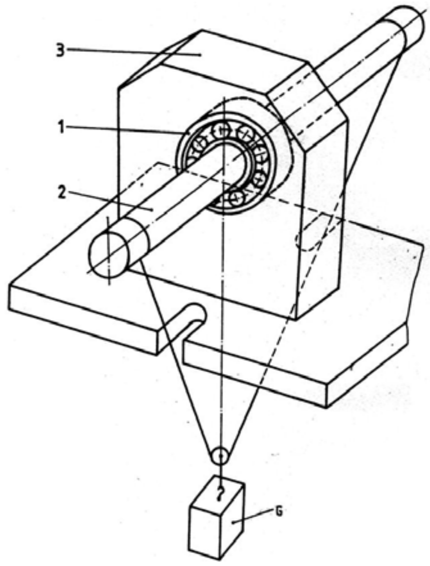

Figure 1. The scheme of the testing machine

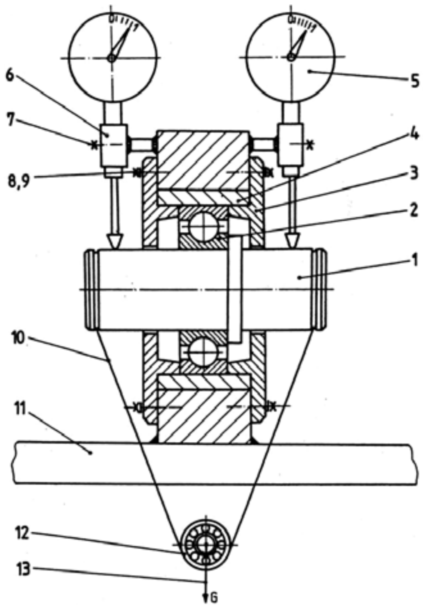

Figure 2. The testing machine

Table 1. The force and the deformations for 6305 URB ball-bearing

	250	500	750	1000	3000	5000	10000
F_o	136.5	273.12	409.68	546.25	1638.7	2731.2	5462.5
F cosγ	96.52	193.12	289.68	386.25	1158.7	1931.2	3862.5
$\delta_{r\,0} \times 10^{-4}$	46.51	73.51	96.07	116.16	239.87	336.04	530.98
$\delta_{r\,1} \times 10^{-4}$	37.003	58.48	76.43	92.41	190.82	267.33	422.40

With the installation presented above, for three apparently identical 6305 URB ball-bearings, experimental measurements were realized. The rounded average values of the deformations among the balls and of the deformations straight the balls are presented in table 2 and they lead to the graphic from figure 4.

Table 2. The force and the average deformations for 6305 URB ball-bearing

	250	500	750	1000	1500
Deformation among the balls × 10^{-4}	36	80	119	131	183
Deformation straight the balls × 10^{-4}	26.5	74	100	123.5	158.5

Table 3. The force and the deformations for 6305 M2 ball-bearing

	250	500	750	1000	3000	5000	10000
F_o	136.5	273.12	409.68	546.25	1638.7	2731.2	5462.5
F cosγ	96.52	193.12	289.68	386.25	1158.7	1831.2	3862.5
$\delta_{r\,0} \times 10^{-4}$	46.35	73.27	95.75	115.77	239.07	334.92	529.2
$\delta_{r\,1} \times 10^{-4}$	36.88	58.29	76.17	92.1	190.18	266.44	420.99

Similar experimental researches were made with variants of the 6305 URB ball-bearings to which were modified the rolling ways' diameters, the balls' diameters D_w and number z. An example in this way is the 6305 M2 ball-bearing variant with D_w = 11.112, z = 8. In table 9 are presented the values of the forces F_0 and F_1=Fcosγ and also the deformations δ_{r0} and δ_{r1} that were obtained straight at the balls. The results from the table 3 were used to draw the graphics from the figure 5. The graphic from

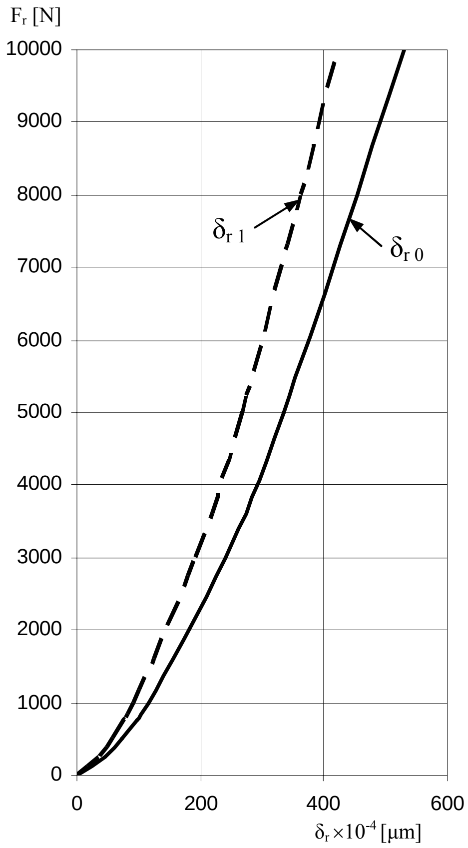

Figure 3. Deformations for the6305 URB ball-bearing

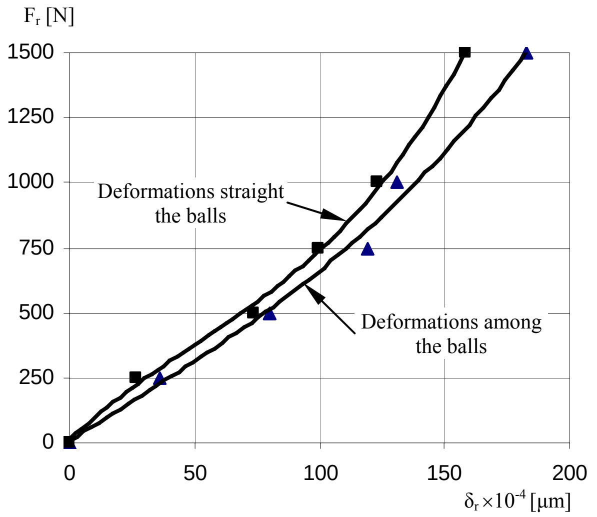

Figure 4. Average deformations for the 6305 6305 URB ball-bearing

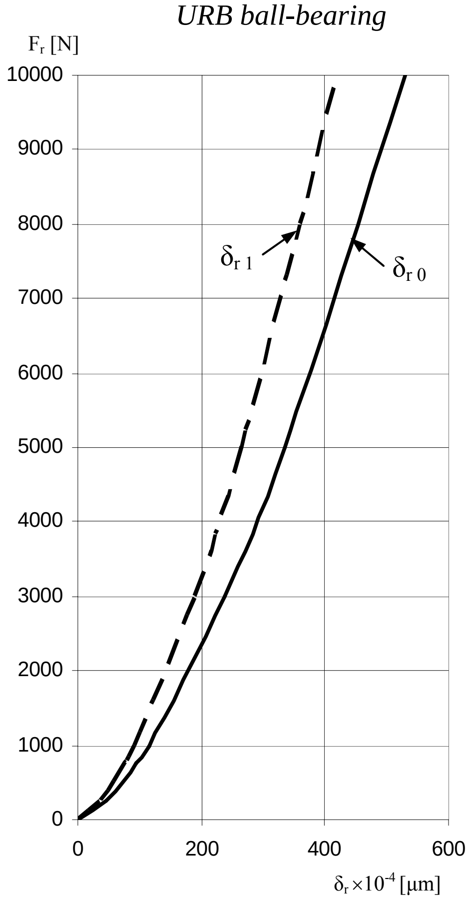

Figure 5. Deformations for the 6305 M2 ball-bearing

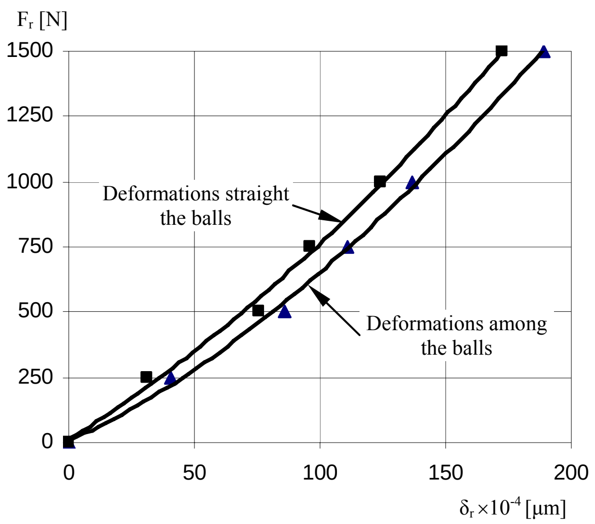

Figure 6. Average deformations for the 6305 M2 ball-bearing

the figure 6 was drawn for the 6305 M2 bearing using a similar method like for 6305 URB bearing and seeing results from the table 4.

4. CONCLUSIONS

- There is not a big difference among the values obtained at the tested ball-bearings, both straight at the balls and among the balls;
- Deformations among the balls (δr=132×10-4 mm for Fr=1000 N) are bigger than those measured straight at the balls (δr=123×10-4 mm for Fr=1000 N);
- The experimental values are higher then the theoretical ones (δr theor=118.6×10-4 mm, δr exp=123×10-4 mm for Fr=1000 N), due to the simplified hypothesis admitted (ε=0.5, lack of the functional clearance);
- In the case of the 6305 M2, deformations are smaller at the same loading (δr theor=116.3×10-4 mm, δr exp=119.63×10-4 mm for Fr=1000 N).

5. REFERENCES

[1] Săvescu, D.: Theoretical researches concerning ball bearings having 35 mm the inner diameter (Part I and II). The 3rd International Conference RaDMI 2003, p. 1973-1980, Herceg Novi, Serbia and Montenegro.

[2] Săvescu, D. Some aspects regarding the internal construction of ball-bearings and their rigidity. The IXth International Conference on Theory of Machines and Mechanisms, 2004, Liberec, Czeck Republic, p. 689-694.

[3] Săvescu. D. About new constructive variants of ball-bearings used in mechanical constructions. The IXth International Conference on Theory of Machines and Mechanisms, 2004, Liberec, Czeck Republic, p. 695-698.

[4] Săvescu, D. Loading capacities analysis for ball-bearings having 35 mm the inner diameter dimensions (Part I and II). ROTRIB'03, Galați, România, p. 384-389.