# DEVICE AND METHOD FOR DETERMINING THE BEARING CAPACITY OF THE ASSEMBLY WITH BRACELET AND COVER

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**Abstract:** *The study shows the algorithm for determination the bearing capacity of the assembly with bracelet and cover, specifying the factors which can lead to high values of the torsion able moment of the assembly.*

*To confirm the credibility of theoretical results, it is used the stand trial of assembly with bracelet and cover, and the obtained results. The study has application in construction of machineries. The machineries have sub-assemblies which use assemblies with bracelet and cover.*

**Keywords:** *assembly, cover, bracelet, safety coefficient*

## 1. General facts

The cover and bracelet assemblies are used in the conditions of a reduced load, when frequent mountings and unmounting's are required, when the adjustment of the flow constriction is required, or even when there can not be established the section of the axle.

The composing parts of the assembly are the two elements: the bracelet and the cover, that are mounted on the axle with the aid of threaded members.

If the torque $M_t$ is actioning on the axle, in order to be transmitted to the bracelet and the cover, the screws have to be tightened using the force $F_s$ [Chisiu, 1981], [Gafiţanu, 1981].

## 2. The calculation of the cap and bracket assembly

According to the Figure 1, the functional condition for transmitting the torque using friction is [Grigore, 2000], [Jula, 1986]:

$$M_f = \mu_c \times N \times d > M_t = c_s \times M_t . \quad (1)$$

where $c_s$ is the safety coefficient, $d$ is the diameter of the axle, $N$ is the reaction at the contact of the axle with the bracket, $M_t$ is the torque transmitted and $\mu_c$ is the friction coefficient.

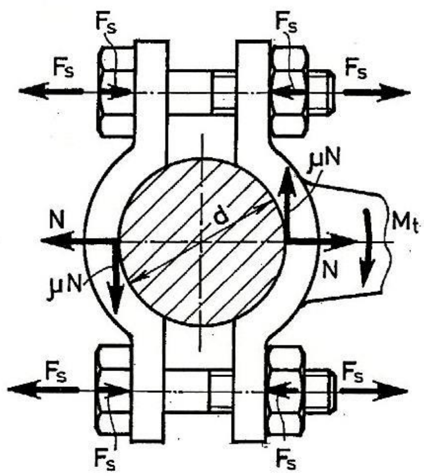


**Figure 1:** *The calculation scheme for the bracelet and cover assembly.*

From the first equation (1) we can obtain:

$$N = \frac{c_s \times M_t}{\mu_c \times d} . \quad (1')$$

and from the balance condition of the bracelet we can obtain:

$$N - 2 \times z \times F_s = 0 . \quad (2)$$

where z is the number of screws arranged on a single side of the bracelet.

From the second equation (2) we can obtain the force $F_s$ developed inside the threaded assembly that stretches the screw and compresses the flange parts (the bracelet and the cover):

$$F_s = \frac{N}{2 \times z} = \frac{c_s \times M_t}{2 \times \mu \times d \times z}. \quad (3)$$

where we used the first equation (1') and $c_s$ has values in this range (1.2…1.8).

The verification of the contact pressure is made using:

$$p_{ef} = \frac{N}{l \times d} = \frac{2 \times z \times F_s}{l \times d} \leq p_a. \quad (4)$$

where $l$ is the width of contact between the bracelet, the cover and the axle.

## 3. The experimental determination of the load of the bracelet and cover assembly

### 3.1 The composing parts of the facility

The composing parts of the facility are: the bracelet and cover assembly (Figure 2), the torsion test stall of the assembly and the measuring tools (dynamometric watch, dynamometric wrench, beam compasses etc.).

The bracelet and cover assembly is composed of the axle 1 that has a head ended with a cylindrical surface and the other one ended with a portion that has its exterior in a hexagonal shape needed for the mounting on the torsion test device, the bracelet 2 and the cover 3 are realized in welded construction and the threaded members assembly (the screw 4 and the bolt nut 5).

For the torsion test the bracelet and cover assembly is mounted on the test stall.

### 3.2 The constructive characteristics of the assembly

The assembly scheme is presented in Figure 2.

The main geometrical elements of the bracelet and cover assembly are:

- geometrical elements of the screw and the bolt nut: $d$=16 mm; $d_1$=13.835 mm; $d_2$=14.701 mm; $p$=2 mm;

$$\alpha_m = arctg\frac{p}{\pi \times d_2} = arctg\frac{2}{\pi \times 14.701} = 2,47^o$$

- the members that are assembled: $d$=67 mm; $l$=50 mm; $d_g$=1.1·16=17.6 mm.

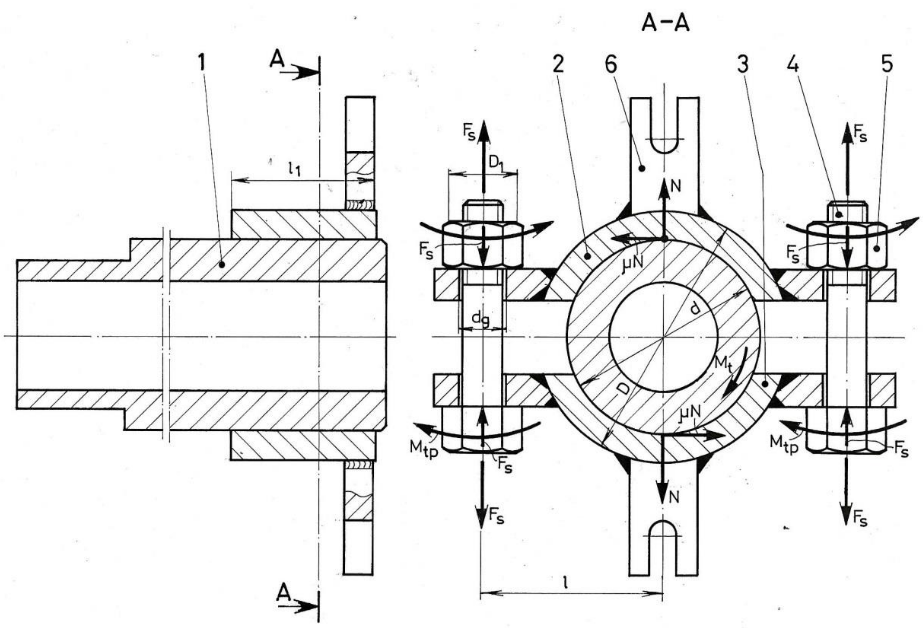


**Figure 2:** *Calculation scheme.*

**3.3 The calculation of the pivotal tightening force and the capable torsion torque of the assembly**

By tightening the bolt nut using the dynamometric wrench the initial tightening force is developed ($F_0$=$F_s$):

$$F_0 = \frac{M_{tp}}{\frac{d_2}{2} \cdot tg\left(\alpha_m + \varphi'\right) + \frac{1}{3}\mu_r \cdot D_r} = k_1 \cdot M_{tp} . \quad (5)$$

The expression of $K_1$ is obvious in the fifth equation (5) and $\varphi'$ is the reported friction angle:

$$\varphi' = arctg \frac{\mu}{\cos\frac{\beta}{2}} . \quad (6)$$

and $D_r$ is the reported diameter.

$$D_r = \frac{D_1^3 - d_g^3}{D_1^2 - d_g^2} . \quad (7)$$

$D_1$ is the diameter of the surface where the bolt nut is placed and dg is the diameter of the hole through which the screw passes.

From the second equation (2) we obtain:

$$N = 2 \times z \times F_s = k_2 \times F_s . \quad (8)$$

The torsion torque transmitted using friction is:

$$M_{tc} = \mu_c \times N \times d = k_3 \times N . \quad (9)$$

where $K_3$ can be obviously obtained from equation (9), $\mu_c$ is the friction coefficient between bracelet and the cover and the axle.

We will use μ for the friction coefficient between the threads of the fillet between the screw and the bolt nut and $\mu_r$ is the friction coefficient between the positioning side of the bolt nut and the bracelet.

**3.4 The experimental determination of the capable torsion torque of the assembly**

The scheme of the torsion test stand is presented in Figure 3.

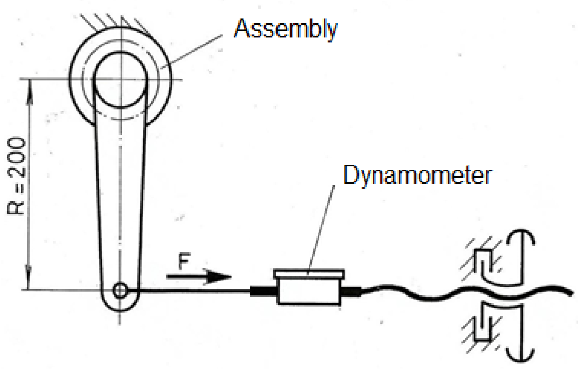


**Figure 3:** *The scheme of the torsion test stand.*

The stages needed for the experimental determination of the bracelet and cover assembly are:

- the bolt nut is tightened by applying a torsion torque with a value given on the dynamometric wrench. We determine the initial tightening force $F_0$=$F_s$, the reaction $N$, and the capable torsion torque of the assembly $M_{tc}$.

- the assembly is mounted on the stall and stresses are applied, we read from the face of the dynamometric watch the value of the force developed in the moving screw $F_s$, where there is produced the rotation of the axle 1 towards the bracket and the cap, and we determine the capable torsion torque of the assembly using the equation (9). The experimentally determined torque is:

$$M_{tm} = F_s \times R \times \eta_r . \quad (10)$$

where $\eta_r$ is the mechanical yield of the lever of the rotation stall.

- the capable torsion torque of the assembly (equation (9)) is compared to the capable torsion torque experimentally determined (equation (10)).

- the test of the assembly is repeated several times using increasing values of the bolt nut’s screwing torque

The results are presented in the table 1.

Table1. Testing results.

| Nr. crt. | $M_{tp}$ [N·m] | $\mu$ | $\mu_c$ | $\mu_r$ | $\alpha_m$ [°] | $\varphi'$ [°] | $d$ [m] | $k_1$ [m$^{-1}$] | $F_0=F_s$ [N] | $z$ | $k_2$ | $N$ [N] | $k_3$ | $M_{tc}$ [N·m] | $R$ [m] | $F_s$ [N] | $M_{tm}$ [N·m] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 40 | 0.1 | 0.08 | 0.12 | 2.47 | 6.58 | 0.065 | 0.041 | 167.2 | 1 | 2 | 334.4 | 0.52 | 179.238 | 0.02 | 9 | 180 |
| 2 | 60 | | | | | | | | 250.8 | | | 411.6 | | 220.617 | | 11.25 | 225 |
| 3 | 80 | | | | | | | | 334.4 | | | 668.8 | | 358.476 | | 18 | 360 |

## 4 Conclusions

A good correlation between the values obtain using calculations and the ones determined experimentally is ascertained.

The possible inconsistencies between the capable torsion torque of the assembly obtained using calculations and between the capable torsion torque of the assembly experimentally determined can be explained by the reading errors of the torsion torque on the dynamometric wrench, by the initial assessment and the variations of the friction coefficients.

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