# METHOD OF EVALUATING THE RELIABILITY OF DEMOUNTABLE ASSEMBLIES WITH CATCHING DEVICES

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**Abstract**: *The present paper proposes a method of evaluating the reliability of demountable assemblies with catching devices. After there have been identified the random variables that intervened in the sizing calculation, reliability of this type of assembly is being determined.*

***Keywords:*** *reliability, demountable assemblies, catching devices, contact pressure*

## 1. INTRODUCTION

Assemblies with catching devices, which belong to the category of assemblies based on friction forces, are used for the construction of fine mechanics devices, in fixing and mounting rotating elements on crankshafts.

These variants of assemblies have the advantage of uniform loading; they do not modify the crankshaft section and they can be moved along the rotation axis.

In assemblies with catching devices, the radial force necessary for transmitting the torsion moment is achieved by means of fastening screws. In order to assure a constant fastening pressure, it is necessary for a correct assembly standardized adjustment of the catching device of the crankshaft, a good surface quality and an accurate mounting.

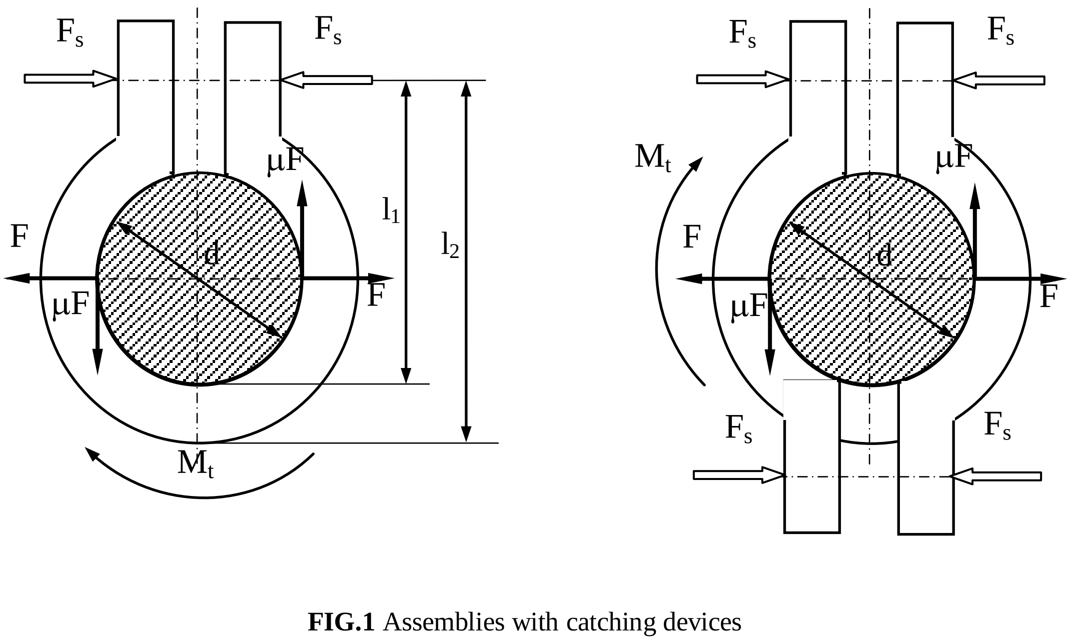


**FIG.1** Assemblies with catching devices

The moment of friction $M_f$ can be determined through the following relation [5]:

$$M_f = \frac{\pi d^2}{2} lp\mu K_{fm} K_f \quad (1)$$

where:
d – the nominal diameter of the assembly (crankshaft);
l – contact length;
p – contact pressure;
μ – friction coefficient;
$K_{fm}$ – friction modeling coefficient;
$K_{fm}$ - bending coefficient;

The equation below shows the contact pressure, resulting from relation (1):

$$p = \frac{2M_f}{\pi d^2 l\mu K_{fm} K_f} \quad (2)$$

where the friction moment is:

$$M_f = \mu F d \quad (3)$$

and F standing for the interaction force between the crankshaft and the catching device. Thus, the contact pressure can be determined through the relation:

$$p = \frac{2F}{\pi d l K_{fm} K_f} \quad (4)$$

The screw tightening force $F_s$ (figure 1 and figure 2) [1]) takes the form of:

$$F_s = \frac{F l_1}{z l_2} \quad (5)$$

Result:

$$F = \frac{F_s z l_2}{l_1} \quad (6)$$

where:
z – the total number of catching screws;
$l_1$, $l_2$ – construction sizes of the catching device.

Taking into account relation (5), the contact pressure relation becomes:

$$p = \frac{2F_s z l_2}{\pi d l l_1 K_{fm} K_f} \quad (7)$$

## 2. METHOD OF EVALUATING THE RELIABILITY

In relation (7) sizes that can be considered constant and those that are variable during functioning are identified. Thus, we note:

$$k = \frac{2z}{\pi K_{fm} K_f} \tag{8}$$

Resulting:

$$p = k \frac{F_s l_2}{d l_1} \tag{9}$$

The average of the contact pressure is expressed as:

$$m_p = \frac{m_{F_s}}{m_l} \frac{m_{l_2}}{m_{l_1}} \tag{10}$$

where, $m_{F_s}$ represents the average value of force upon a tightening screw of the assembly, and $m_l$ the average contact length.

The standard deviation of the contact pressure is determined by relation [3]:

$$\sigma_p = \sqrt{\frac{\partial p}{\partial F_s} \sigma_{F_s}^2 + \frac{\partial p}{\partial l} \sigma_l^2 + \frac{\partial p}{\partial l_2} \sigma_{l_2}^2 + \frac{\partial p}{\partial l_1} \sigma_{l_1}^2} \tag{11}$$

The admitted pressure, expressed by $p_a$ is given as a random variable defined through average and standard deviation:

$$p_a\left(m_{p_a}, \sigma_{p_a}\right)$$

The reliability of assemblies with catching pieces is expressed as [4]:

$$R(t) = P(p_a > p) = P(p_a - p > 0) = P(Y > 0) \tag{12}$$

$$R(t) = \frac{1}{\sigma_y} \int_0^\infty e^{-\frac{(y-m_y)^2}{2\sigma_y^2}} dy \tag{13}$$

The replacement of the variable is applied:

$$t = \frac{y - m_y}{\sigma_y^2} \tag{14}$$

resulting:

$$R(t) = P(p_a > p) = P(p_a - p > 0) = \frac{1}{\sqrt{2\pi}} \int_{t_0}^{\infty} e^{-\frac{t^2}{2}} dt \qquad (15)$$

where it was noted:

$$t_0 = \frac{m_{p_a} - m_p}{\sqrt{\sigma_{p_a}^2 + \sigma_p^2}} \qquad (16)$$

Thus, after calculation of relation (14), the reliability of an assembly with catching devices, irrespective of the construction variant that has been adopted.

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