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PRACTICAL RESULTS OF SELECTION AND STRENGTH TESTING OF KEYED JOINTS IN MACHINE DETAIL SCIENCE

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Abstract:
A joint with a key is said to be connected with a shaft and a hole installed on it using a key, i.e. prismatic, wedge-shaped or segmental cross-shaped details. A key joint can be a stressed or unstressed joint. A joint with a tension key develops compressive stress until the load is applied.

Keywords: prismatic key, drive shaft, intermediate shaft.

The main workability of keyed joints is their strength. In accordance with the diameter of the shaft and the above requirements, the key is selected from the standards and the joint is checked for strength.
Joints with keys consist of parts of a shaft, a key and a wheel hub (pulley or other detail hub). Keys are used to connect gears, pulleys, sprockets and other details to the shaft. Their main task is to precisely center the parts connecting to each other and to transmit the torque. But key joints cannot provide a large torque transmission.
Advantage: It is very simple in construction, relatively easy to assemble and disassemble, and is very common in engineering. Disadvantage: A groove is formed for keying the shaft and axle, so as a result, the cross-sectional area of the keyed and mounted part of the shaft and axle is reduced. This causes its strength to decrease. It leads to accumulation of excessive bending and twisting stresses in the keyway.
A joint with a key is said to be connected with a shaft and a hole installed on it using a key, i.e. prismatic, wedge-shaped or segmental cross-shaped details.
A key joint can be a stressed or unstressed joint. A joint with a tension key develops compressive stress until the load is applied.
The main workability of keyed joints is their strength. In accordance with the diameter of the shaft and the above requirements, the key is selected from the standards and the joint is checked for strength. In the standards, the dimensions of the dowels and grooves are selected in such a way that if their strength against bending is ensured, their strength against self-shearing and crushing is also ensured. Therefore, keyed joints are considered crushable.

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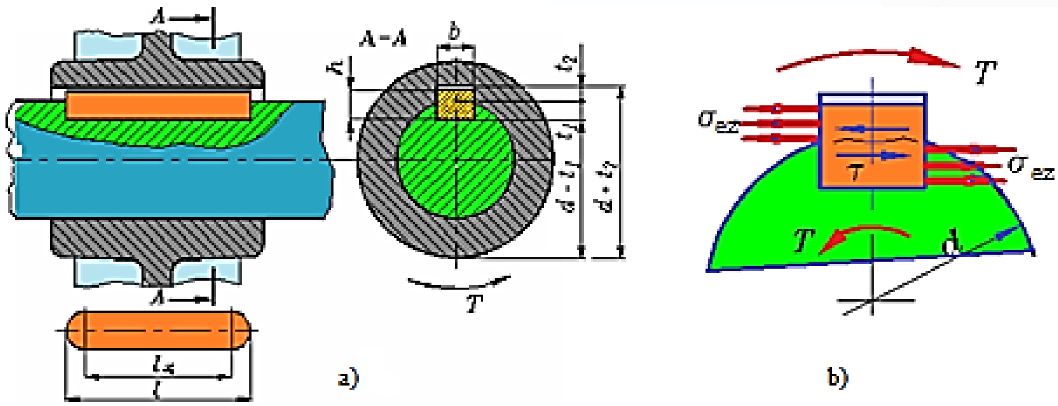
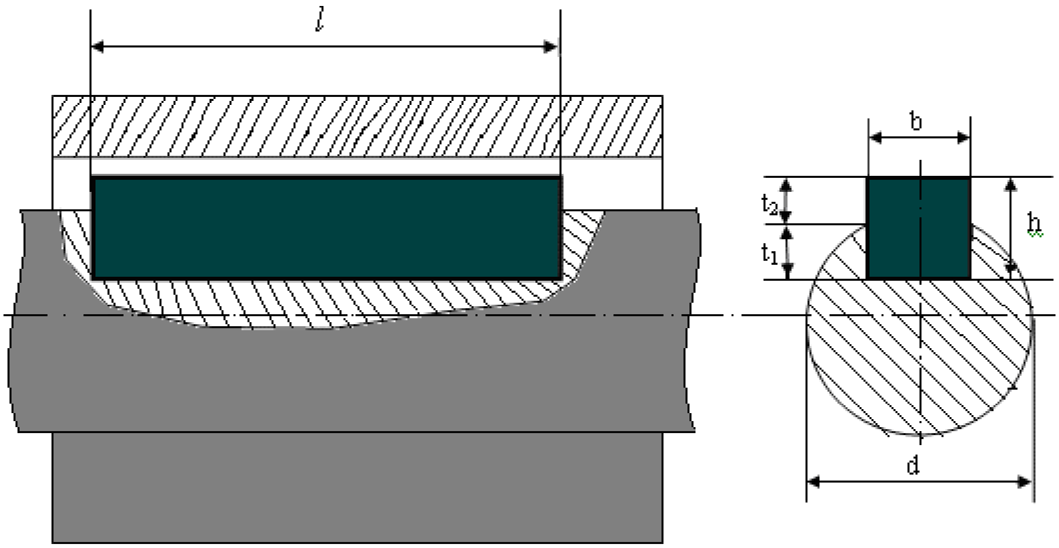


1 – picture. The force acting on a prismatic keyed joint

The ends of prismatic keys can be round flat or round on one side and flat on the other. The sizes are selected based on the standard according to the diameter of the shaft.



2 – picture. Prismatic key joint parameters

The sides of the prismatic key are checked for crushing stresses caused by the torque, that is, by the following formula.

$$\sigma_c = \frac{2 \cdot T \cdot 10^3}{d \cdot (h - t_1) \cdot (l - b)} \leq [\sigma_c] \qquad (1)$$

Torque on the shaft to which the T-key is installed,
d-diameter of the shaft in the place where the key is installed,
h-key height,
t_1 is the depth of the groove opened from the shaft for installing the key,
l-key length,

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b is the width of the key.
Key material - normalized steel 45 grade steel. Permissible value of compressive stress for steel 45 grade material will be $[\sigma_c] = 100 \dots 120$ MPa .

Permissible shear stress:

if a steel ball is installed, $[\sigma_c] = 100 \dots 120$ MPa ;

if a cast iron spigot is installed $[\sigma_c] = 50 \dots 70$ MPa .

When the calculation is done $\sigma_c \leq [\sigma_c]$ the condition must be fulfilled.

1. Drive shaft.

We select a key for the drive shaft and calculate its strength.

The driver, i.e. the first shaft, is fitted with a key only at the end of the shaft, i.e. at a place with a diameter of $d_{\vartheta 1}$. We consider the gears to be inseparable from the shaft, that is, made as a whole.

In that case $d_{\vartheta 1} = d$ and the dimensions of the dowel are selected from the table based on the value of d.

Attention. The length of the key is the width of the gear wheel, i.e. here we select the length of the hubs from the rows in the table close to the values of l_{st1} and l_{st2}.

Notes:

1. The length of the clamps is selected from the following values: 6; 8; 10; 12; 14; 16; 18; 20; 25; 28; 32; 36; 40; 45; 50; 56; 63; 70; 80; 90; 100; 110; 125; 140; 160; 180; 200 ... (500 up to).
2. The material of the clamps is pure steel with a tensile strength of at least 590 MPa.
3. The main indicators of the key are as follows:

- the application of the key
- cross section b x h
- length.

We select values from the table for the case where d_{v1}=d=20 mm, the diameter d_{v1} of the end of the driving shaft, i.e. the place where it is connected to the electric motor through the clutch, is equal to d.

b=6 mm, h=6 mm, t_1=3.5 mm, the length of the key λ is taken as λ≈4·d when the shaft is installed at the end. We assume that l=80 mm.

$$\sigma_{c1} = \frac{2 \cdot T_1 \cdot 10^3}{d_{v1} \cdot (h - t_1) \cdot (l - b)} \leq [\sigma_c] \qquad (2)$$

If we substitute the values, we get the following result.

$$\boldsymbol{\sigma_{c1} = \frac{2 \cdot 35 \cdot 10^3}{20 \cdot (6 - 3.5) \cdot (80 - 6)} = 18.9\ \text{MPa}}$$

So the condition is fulfilled. $\sigma_{c1} \leq [\sigma_c]$, $18.9 \leq 100 \dots 120$

2. Intermediate shaft.

In the intermediate shaft, the gear wheel is attached to the shaft by means of a key. Its values are recorded.

$d_{k2} = d = 35$ mm, b=10 mm, h=8 mm, t_1=5 mm, l=45 mm (l length l_{st1}=50 mm 45 mm of the standard line close to it is taken).

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$\sigma_{c2} = \frac{2 \cdot T_2 \cdot 10^3}{d_{k2} \cdot (h - t_1) \cdot (l - b)} \le [\sigma_c]$ (3)

By substituting the values, we get the following result.

$$\boldsymbol{\sigma_{c2}} = \frac{\mathbf{2 \cdot 127.4 \cdot 10^3}}{\mathbf{35 \cdot (8 - 5) \cdot (45 - 10)}} = \mathbf{69.3\ MPa}$$

Let's check the result: 69.3≤100...120 conditions are fulfilled.

3. Drive shaft

We select a key for the part of the drive shaft where the chain transmission star is installed and calculate its strength.

A key is installed in the place where the gear wheel is installed on the drive shaft and at the end of the shaft, i.e. d_{k3} and d_{v3} - diameter.

Values are recorded.

$d_{v3} = 55$ mm, $d_{v3} = d = 55$ mm, b=16 mm, h=10 mm, t_1=6 mm, l=4d=220 mm.

In that case,

$\sigma_{c3} = \frac{2 \cdot T_3 \cdot 10^3}{d_{v3} \cdot (h - t_1) \cdot (l - b)} \le [\sigma_c]$ (4)

We get the following results.

$$\boldsymbol{\sigma_{c3}} = \frac{\mathbf{2 \cdot 648.6 \cdot 10^3}}{\mathbf{55 \cdot (10 - 6) \cdot (220 - 16)}} = \mathbf{28.9\ MPa}$$

In this case, the condition was fulfilled.

$d_{k3} = 66$ mm, $d_{k3} = d = 66$ mm, b=20 mm, h=12 mm, t_1=7.5 mm, l=80 mm (l_{st2}=84 mm because).

Then we get this result.

$\sigma_{c4} = \frac{2 \cdot T_3 \cdot 10^3}{d_{k3} \cdot (h - t_1) \cdot (l - b)} \le [\sigma_c]$ (5)

If we substitute their values, we get the following.

$$\boldsymbol{\sigma_{c4}} = \frac{\mathbf{2 \cdot 648.6 \cdot 10^3}}{\mathbf{66 \cdot (12 - 7.5) \cdot (80 - 20)}} = \mathbf{72.8\ MPa}$$

So, the condition has been fulfilled.

All the results show that all the selected dowels have sufficient strength.

Mechanical engineering creates a technical base necessary for the development of industry and agriculture. Therefore, the task of every worker and engineer is to design new machines that fully meet modern requirements, are highly efficient, durable, and have a high efficiency. it is necessary to achieve that it is comfortable and safe, fully satisfying the requirements set by the State standards.

In addition, it is necessary that the parts should be quickly and easily replaced with new ones when they fail.

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LITERATURE

1.Nazarov A.A. Principles of education that develop an innovative approach to engineering professional activities / International Journal of Early Childhood Special Education (INT-JECSE) / https://www.iiste.org/journals.

2. A.Nazarov and others. Methods for Conducting a Course Project on Machine Parts / TEST INGineering management./ https://ejmcm.com/article_3873.html May – June 2020. ISSN: 0193-4120 Page No. 26595 – 26598.

3. Nazarov A. A. Principles of education that develop an innovative approach to engineering professional activities. / European Journal of Research and Reflection in Educational Sciences. Vol.8No.8,2020 ISSN 2056-5852. / https://www.idpublications.org/wp-content/uploads/2020/07/Full-Paper-PRINCIPLES-OF-EDUCATION-THAT-DEVELOP-AN-INNOVATIVE-APPROACH-TO-ENGINEERING-PROFESSIONAL.pdf.

4. Murtazaev E. M., Nazarov A. A., Nurova O. S. Training of Gears From the Course Machine Parts / https://media.neliti.com/media/publications/337075-training-of-gears-from-the-course-machin-c6b40ed9.pdf.

5. Nazarov A. A. Completion of the course project on the subject "Machine details"./Oriental Renaissance: innovative, educational, natural and social sciences/ https://cyberleninka.ru/article/n/completion-of-the-course-project-on-the-subject-machine-details.