НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ БІОРЕСУРСІВ І ПРИРОДОКОРИСТУВАННЯ УКРАЇНИ

Кафедра надійності техніки

Методичні вказівки для виконання лабораторної роботи:

"Justification of the limits and allowable for repairs wear parts and their connections "

Київ – 2017

Викладено методичні вказівки до виконання лабораторної роботи «Обгрунтування граничних і допустимих при ремонті зносів деталей і їх з'єднань» з дисциплін «Надійність сільськогосподарських машин» та «Надійність і ремонт машин».

В методичних вказівках наведено теоретичні відомості, послідовність виконання та вимоги оформлення лабораторної роботи, представлені індивідуальні завдання.

Ухвалено вченою радою факультету конструювання та дизайну Національного університету біоресурсів і природокористування України, протокол, №3 від 20 листопада 2017 р.

Укладачі: С.С. Карабиньош, А.В.Новицький, З.В. Ружило

Рецензенти: В.Б. Онищенко, В.І. Мельник

Tasks for performance of work.

1. Due to the hours devoted to independent work to work on the recommended literature [1].

2. According to individual tasks, calculate the limits and allowable when repairing the specified parts (Table 1).

Literature

1. Gnedenko B.V. Course of probability theory. - K .: VPC, Kyiv University, 2010. - 464 p.

2. Seno P.S. Probability Theory and Mathematical Statistics: Textbook. - 2nd form, processing. and add - K.: Knowledge, 2007. - P. 291.

3. Probability Theory, Mathematical Statistics and Probabilistic Processes: Teach. manual / Yu. M. Slyusarchuk, J. Ya. Khromiak, L. L. Dzhaval, V. M. Tsymbal; Ministry of Education and Science of Ukraine, National Academy of Sciences of Ukraine. University Lviv Polytechnic University. - Lviv: View of Lviv. Polytechnic, 2015. - 364 pp.

Theoretical preconditions for determining the limits and are allowed in repairs of damages (wear parts)

The process of accumulation of wear in the details (joints) of parts of agricultural machines proceeds according to the curve depicted in Fig. 1a. The curve has three distinct areas, the initial (1), the middle (2), and the final (3). The initial area corresponds to the period of spin, the average - normal operation and the final - accidental wear of parts. The nature of the change in speed and the acceleration of wear of parts in these areas, depending on the time of their work is shown in Fig.1.

As can be seen from the data given, the point Smax curve (Fig. 1 a) is the limiting value of the weakening of the landing in the connection, due to the wear of the connecting parts. When the landing is reduced to Smax, further work of the connection is not allowed for technical or economic reasons.

Limit and allowable during repairs, wear and tear of parts and their joints can be determined by experimental and analytical (calculation methods).

Experimental method. Limit values of wear of parts and joints are determined in the process of bench testing in the monitoring of the operation of machines in conditions of real operation. Research and observation lead to the achievement of details of marginal wear.

The limit value of wear of parts in the connection is determined by the following formula:

$$\delta_{pr} = S_{max} - S_{min} \qquad (1)$$

where S_{max}, S_{min} - limit value and initial landing value, mm.

For parts whose resource exceeds the value of the inter-repair resource of the machine (aggregate), the value of their permissible wear and tear repair is determined by the following formula:

$$\delta_{dp} \leq \delta_{rip} - \gamma \, t_{mp}, \qquad (2)$$

where γ is the average speed of wear of the connection parts .mm / moto-hours.

t_{pm} - inter-repair resource of the machine (unit), moto- hours.

The wear rate is determined by the following formula:

$$\gamma = \delta_{pr} / t_p, \qquad (3)$$

where t_p - resource of parts in the connection, moto- hours.

The experimental method requires long and expensive research (observation). In fact, it excludes the possibility of scientifically substantiating the planned warning system of maintenance (maintenance) and repair of new brands of cars before the start of their serial production.

The design of such a system, as a rule, is specified according to the initial data of the inspection of already machines that are serially manufactured, made to repair the resource and entered into major repairs.

a

в

г

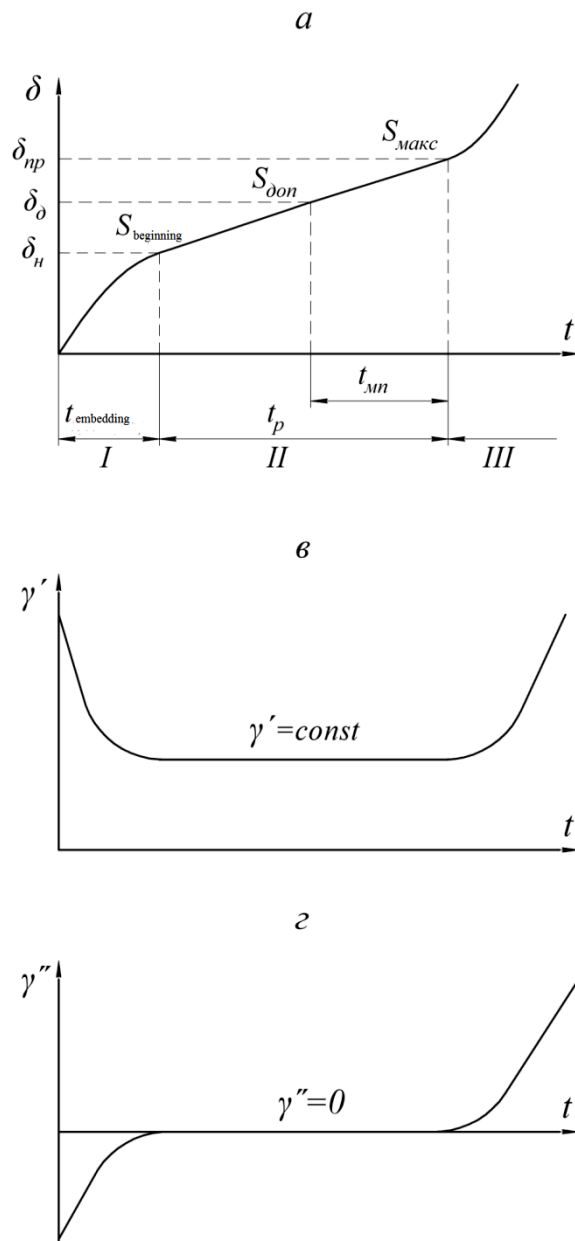Fig. 1 - Dependence of wear (a), speed (in) and acceleration (d) from the time of work of parts.

Analytical method. A method for determining the limits and permissible values for repair of wear of parts of machines and their joints based on the use of correlation dependencies between the size of wear and such structural characteristics as size, accuracy, type of landing, etc. is developed. [1].

The obtained analytical method of the value of the limit and admissible in the repair of wear of bearing surfaces (in contrast to the experimental ones) do not contain information about their resources.

However. calculated in an analytical way, the limits and allowable during repairs with sufficient degree of accuracy allow us to respond positively to this question long before the achievement of the details (or their connections) of the limit values.

To do this, it is enough to eliminate the failures or carry out technical examinations of the prototype machines in the course of testing for reliability to determine the size and speed of wear of the bearing surfaces of their main parts. The value of wear of bearing surfaces of parts is determined by micrometers, and the speed of their wear is calculated by the formula:

$$\gamma = \delta_i / t_i, \tag{4}$$

where δ_i, t_i - respectively, the amount of wear and performance of this part for the period of elimination of failure or conducting technical examination.

In the area of normal operation, the wear rate of bearing surfaces of parts remains constant ($\gamma = \text{const}$)

Then the life of the bearing surfaces of parts (tp) can be calculated by the formula:

$$T_{pi} = \delta_{pi} / \gamma_i, \tag{5}$$

where δ_{np}- limit value of wear of the bearing surface of the I-th surface (obtained by calculation)

γ_i is the speed of wear of the bearing surface of an element (defined on the site of its normal operation).

The data obtained on this site allows design bureaus, factories manufacturers to identify in the research, and repair companies in repaired machines "weak" elements and purposefully organize their work to improve reliability by improving

their designs, technology and organization of serial production, maintenance and repair.

Consequently, the justification of the limits and allowable for the repair of wear parts in an analytical way should be given advantages, because it allows you to solve the problem with minimal time, material and labour resources.

Equipping the workplace.

Methodical instructions for the performance of this work, technical documentation for the repair of tractors, micro calculator (The microcalculator is used by the student).

Contents and procedure of work execution. This work is performed in the following sequence:

Before performing the laboratory work, the technique of calculating the limit and permissible wear of parts and their joints is studied.

According to the individual task (Table 1) the technical documentation studies the structure of the unit (which includes the specified details) and requirements for its installation couplings [2].

For the original information contained in tab. 1 .... 10 using the regression equations [1], according to the option, the limits and allowable for repair of the specified parts are calculated.

A report is prepared on the laboratory work performed and it seems to the teacher to lead the class.

Scheme of calculations and the form of the report are given in solving a specific example.

Faculty of KD

Faculty of KD
Course IV, group I

Report on laboratory work "Definition of limits and permissible when repairing the wear of parts and their joints" Option number 2

Name, designation of the part. Name and nominal size of working surfaces mm. Tolerance, mm 1.	Landing in the drawing tension g (-) clearance (+) MM	The tolerance size	The tolerance	Permissible and marginal displacement, µm	Coefficient redistribution of wear, mm 1	Wear of parts, mm	Size of parts, MM	gaps (+) is connected to mm — Permissible and marginal when repairing Tensions
1. Fan drive housing 236-1303102 The surface of the slot for the bearing = 52	-0,010 +0,033	0,030	0,043	$\dfrac{0,062}{0,130}$	1	$\dfrac{0,043}{0,090}$	$\dfrac{52,033}{52,080}$	$\dfrac{+0,052}{+0,120}$
2. Ball bearing 205K The outer surface of the bearing roller bearings = 52-0,013		0,013				$\dfrac{0,019}{0,039}$	$\dfrac{51,981}{51,961}$	

Permitted and limiting repairs Tensions (-) gaps (+) connected, mm (+0,052) / (+0,120)

Dimensions of parts, mm 52,033 / 52,080, 51,981 / 51,961

Wear of parts, mm 0,043 / 0,090; 0.019 / 0.039

Example. Connection is made of the case of the fan of the tractor K-150 236-1308102 - bearing of the ball bearing 205K. Diameter of the nest under The ball bearing is $D = 52$ mm, and the outer bearing of the bearing $D = 52$-0,13 mm. It is necessary to determine their limits and allowable when repairing wear (dimensions).

This problem is solved in the following sequence (1):

1. Determine the nominal gaps (S_{max}) and tension (N_{max}) in the compound according to formulas 32 and 33 :

$$S_{max} = D_{min} - d_{max} = 51{,}990\text{-}52{,}0 = \text{-}0{,}010 \text{ mm},$$
$$S_{max} = D_{max}\text{-}d_{im} = 52{,}020\text{-}51{,}987 = 0.033 \text{ mm}.$$

where D_{min}, D_{max} - minimum and maximum dimensions of the hole, mm;

d_{min}, d_{max}-minimum and maximum dimensions of the bearings, mm;

2. In accordance with formula 34, define the tolerance field on the size of the slot (TD) and the clips (Td)

$$TD = Es - (\text{-} No) = 0{,}020 + 0{,}010 = 0{,}030 \text{ mm};$$
$$Td = es\text{-}ei = 0.013 - 0{,}00 = 0{,}013 \text{ mm}.$$

1. By formula 37 determine the landing tolerance (Tsk):

$$Tsk = TD + Td = 0.030 + 0{,}013 = 0{,}043 \text{ mm}.$$

2. According to the formulas P 26 of Table. 2 Annex 2 as a transitional landing we define the boundary (I_{spr}) and allowable (I_{sodop}) during repairs of the combined parts surfaces:

$$I_{spr} = 60 + 0{,}1 \cdot D + 2{,}4 \cdot T_{sk} = 60 + 0{,}1 \cdot 52 + 2{,}4 \cdot 43 = 168{,}4 \text{ мкм} = 0{,}170 \text{ мм};$$
$$I_{sдоп} = 10 + 0{,}1 \cdot D + 1{,}5 \cdot T_{sk} = 10 + 0{,}1 \cdot 52 + 1{,}5 \cdot 3 = 79{,}7 \text{ мкм} = 0{,}08 \text{ мм}.$$

Work passed (la)

Work with the evaluation accepted (la)

20____ p.