UDC 621.314

INSTRUMENTAL TOLERANCE CREDIBILITY OF CONTROL

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Examinedquestion the reliability of the results of tool tolerance control. Grounded requirements of measurement depending on the characteristics of the controlled parameter to achieve the required reliability values.

Safety, tolerance control, instrumental reliability, object control.

The reliability of the results of control – a measure of the degree of control results objectively reflect the actual technical state of the control object. It can be presented in the form of two components - the methodological validity and reliability of tool.

Articles reliability [1] – component reliability control, defined set of parameters that are monitored, control methods and criteria adopted in her assessment of technical condition of the object.

Instrumental reliability - component reliability testing results, which is defined probabilistic properties of the object, type algorithm processing characteristics, precision characteristics of measuring instruments and more.

One of the most important types of access control is the control that sets the ratio between the values of the parameter that is controlled and set boundaries in some way (tolerances) for its rejection.

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When tolerance control «fit» is defined object with parameters, measurements which are within the set of assumptions and «unfit» – with parameters, results of which are not within.

Borders – a set of experience or expectation bounds for the parameters of the object in which it is able to perform specified functions, while maintaining their operational performance within the required time under certain conditions. The value of the operational limits established by the operating instructions or other relevant documents for those object parameters that are monitored in operation.

The aim – to develop methodologies for evaluating the reliability of the results of tool tolerance control of technical objects.

Materials and methods research. Process Model [3] exercise tolerance control is shown in Fig. 1. This allowed the complete reliability of control and possible outcomes due to control only their precision characteristics and the actual state of the control object.

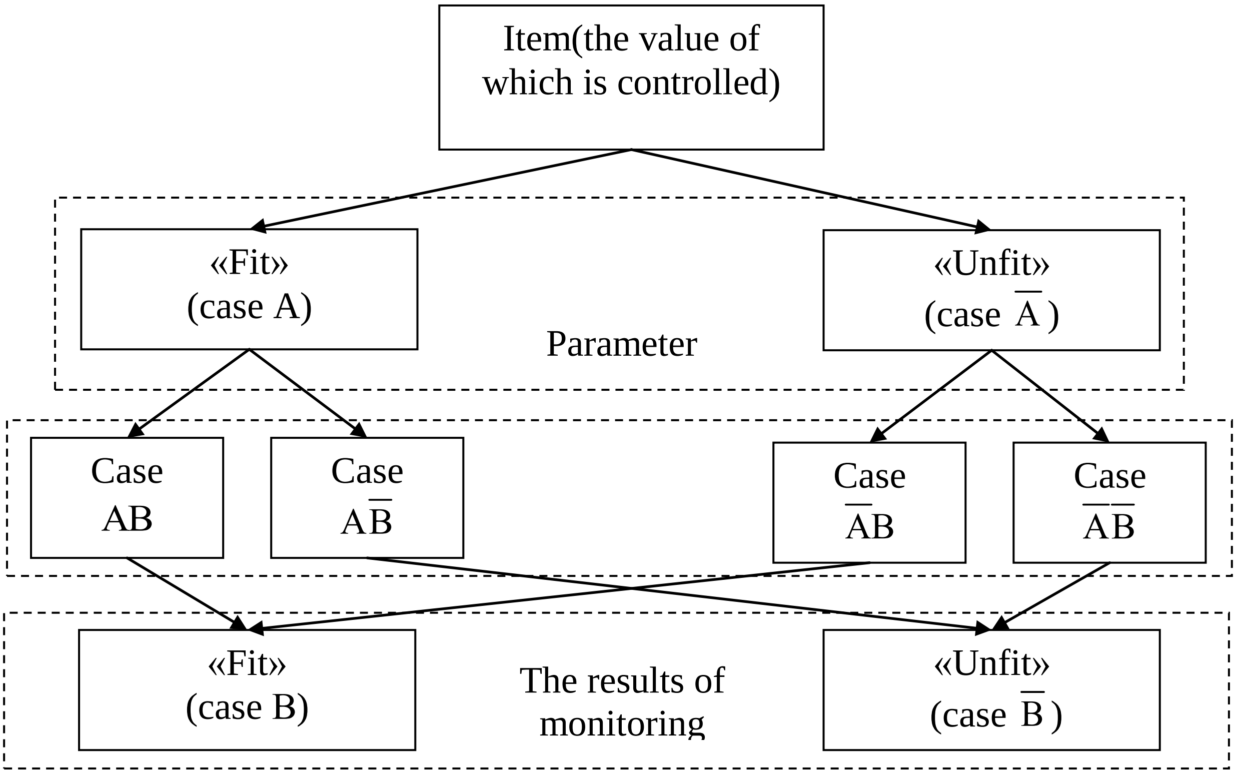

Fig. 1. Model implementation process tolerance control

Legend:

A – case, which is that the value of the parameter that is monitored is within the tolerance field (object «fit»);

$\overline{A}$ – case, which is that the value of the parameter that is monitored is not within the tolerance field (object «unfit»);

As a result, control or obtain a result that identifies an object suitable control (control result is within prescribed tolerances) – event B, or outcome that defines the object of control unusable (the result is outside the control of the established tolerances) – case $\overline{B}$. Due to inherent measuring errors of measurement devices the results can not be regarded as absolute.

From the above model process control shows that the occurrence of the event or perhaps $\overline{B}$ together with the case A, or with the case as according $\overline{A}$. To mathematical logic can be written:

$$B=AB+\overline{A}B.$$

A similar case can be written as:

$$\overline{B}=A\overline{B}+\overline{A}\overline{B},$$

where AB – complicated case, which is that the actual value of the parameter that is monitored, and the results of control is within the tolerance field;

$\overline{A}\overline{B}$ – complicated case, which is that the actual value of the parameter that is monitored, and the results of control is not within the tolerance field;

$\overline{A}B$ – complicated case, which is that the actual value of the parameter that is monitored is not within the tolerance field and result control is within the tolerance field;

$A\overline{B}$ – complicated case, which is that the actual value of the parameter that is monitored is within the tolerance field and result control It is situated not within the tolerance field.

Cases $AB, \overline{A}\overline{B}, \overline{A}B, A\overline{B}$ make full squad of events is:

$$P(AB)+P(\overline{A}B)+P(A\overline{B})+P(\overline{A}\overline{B})=1.$$

Status control object to control is uncertain [2] (the actual value of the unknown parameters are monitored and their position relative to the field of assumptions). Problem of control lies in the decision of this uncertainty. So, first of all interested in the probability of an object under control and the degree of compliance with this fully express the conditional posteriori probability $P(A/B)$ and $P(\overline{A}/\overline{B})$, which respectively are a numerical measure of the reliability of the results on solution «fit» and the decision «unfit».

Research results. Thus, the reliability of the results under control on solution «fit» is necessary to understand the conditional probability of finding the parameter that is controlled within the tolerance field, provided that the results of control «fit» – $P(A/B)$.

Let us denote:

d_f – instrumental reliability testing results on solution «fit»;

d_{uf} – instrumental reliability testing results on the decision is not «unfit».

Under the hypotheses of theorem Bayes probability $P(A/B)$ and $P(\overline{A}/\overline{B})$ define the following relations:

$$d_f = P(A/B) = \frac{P(AB)}{P(B)};$$

$$d_{uf} = P(\overline{A}/\overline{B}) = \frac{P(\overline{A}\overline{B})}{P(\overline{B})}.$$

Позначимо:

$f(x)$ – differential law rospodilu controlled parameter values;

$f(y)$ – differential distribution of errors of law controls;

a,b – limits of the tolerance field.

If we denote by x – setting that is controlled through y – error controls, the result z is a random variable that is equal to the sum of random variables X and $У$.

Probable outcome in the field of access control is determined by the formula:

$$P(B) = \int_a^b f(z)dz.$$

Probable outcome of control outside of the tolerance field defined by the formula:

$$P(\overline{B})=\int_{-\infty}^{a} f(z)dz+\int_{b}^{\infty} f(z)dz.$$

Provided that the parameter that is monitored, and the results are in the control box access (case AB), defined by the inequalities:

$$\begin{cases} a \le x \le b \\ a \le x+y \le b \end{cases}$$

or

$$\begin{cases} a \le x \le b \\ a-x \le y \le b-x \end{cases}.$$

Therefore, the probability $P(AB)$ can be defined in general as follows:

$$P(AB)=\int_{a}^{b} f(x)\left[\int_{a-x}^{b-x} f(y)dy\right]dx.$$

Provided that the value of the controlled parameter and the result is outside the control of the tolerance field (case $\overline{A}\overline{B}$), defined by the inequalities:

$$\begin{cases} -\infty \le x \le a \\ b \le x \le \infty \\ -\infty \le x+y \le a \\ b \le x+y \le \infty \end{cases}$$

or

$$\begin{cases} -\infty \le x \le a \\ b \le x \le \infty \\ -\infty \le y \le a-x \\ b-x \le y \le \infty \end{cases}.$$

Therefore, the probability $P(\overline{A}\overline{B})$ can be generally defined as follows:

$$P(\overline{A}\overline{B})=\int_{-\infty}^{a} f(x)\left[\int_{-\infty}^{a-x} f(y)dy+\int_{b-x}^{\infty} f(y)dy\right]dx+$$

$$+\int_{b}^{\infty} f(x)\left[\int_{-\infty}^{a-x} f(y)dy+\int_{b-x}^{\infty} f(y)dy\right]dx.$$

Hence, the general expression for the reliability of the results of control over decisions «fit» and «unfit» can be written:

$$d_{п}=\frac{p(AB)}{P(B)}=\frac{\int_{a}^{b} f(x)\left[\int_{a-x}^{b-x} f(y)dy\right]dx}{\int_{a}^{b} f(z)dz}; \qquad (1)$$

$$d_{н}=\frac{p(\overline{A}\overline{B})}{P(\overline{B})}=\frac{\int_{-\infty}^{a} f(x)\left[\int_{-\infty}^{a-x} f(y)dy+\int_{b-x}^{\infty} f(y)dy\right]dx+\int_{b}^{\infty} f(x)\left[\int_{-\infty}^{a-x} f(y)dy+\int_{b-x}^{\infty} f(y)dy\right]dx}{\int_{-\infty}^{a} f(z)dz+\int_{b}^{\infty} f(z)dz}. \qquad (2)$$

Figure 2 and figure 3 shows dependences intsrumentalnoyi accuracy of the solution «fit» – d_f and solutions «unfit» – d_{uf} the ratio of the rms deviation of the control σ_m and controlled setting σ_s, which are based on formulas (1) and (2).

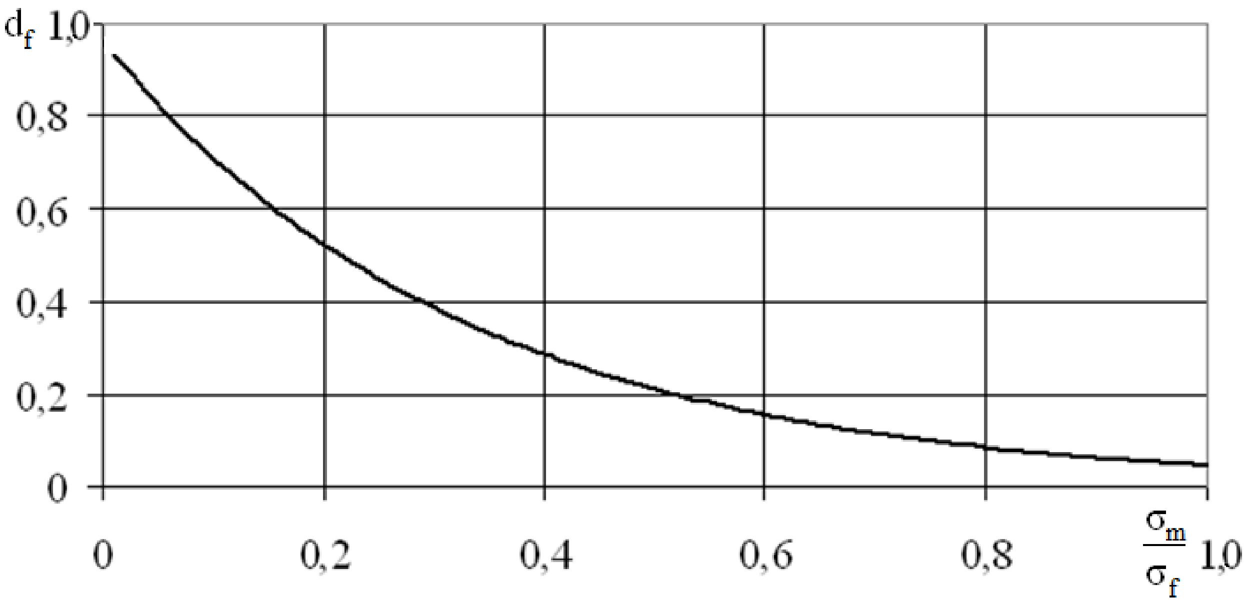

Fig.2. Depending intsrumentalnoyi accuracy of the solution «unfit»

By increasing the $\frac{\sigma_m}{\sigma_s}$ instrumental reliability of the control value decreases. By increasing the size of the tolerance field parameter that is controlled, instrumental reliability testing results on solution «unfit» – is increasing, and the decision «unfit» – is reduced.

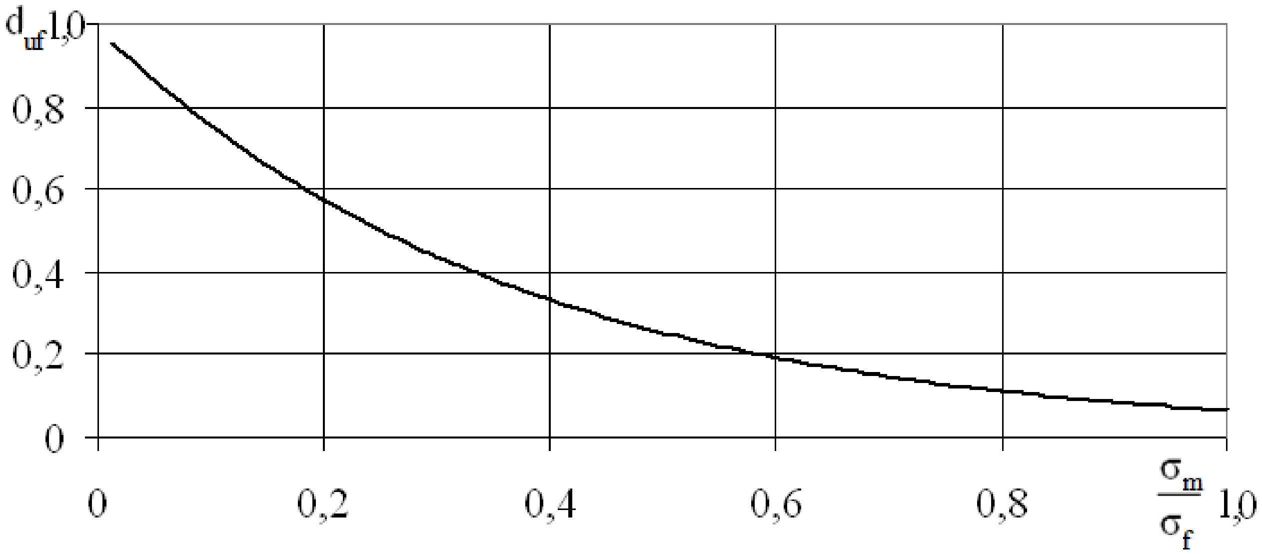

Fig.3. Depending intsrumentalnoyi accuracy of the decision «unfit»

Conclusions

To assess the quality control tolerance must be used a priori (to assess the performance of control systems) or posteriori (for quality control object whose state is unknown) characteristics of reliability control.

List references

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Рассмотрен вопрос инструментальной достоверности результатов допускового контроля. Обоснованы требования к средствам измерения в зависимости от характеристик контролируемого параметра для достижения необходимой величины достоверности.

Надежность, допусков контроль, инструментальная достоверности, объект контроля.

The question of the reliability of the results of the instrumental limit test. Justified demands to the measurement depending on the characteristics of the controlled parameter to achieve the required amount of confidence.

Reliability, tolerance control, instrument reliability, the object of control.