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Predicting the reliability of radio-electronic devices by the results of production defectiveness monitoring

***Abstract**. This work is devoted to modeling and optimization of radio-electronic devices production processes to ensure the desired reliability.*

Keywords: production of electronic devices, modeling, defectiveness, reliability.

The static analysis of functioning of multi-purpose radio-electronic devices confirms the tendency of monotonous increase of its reliability at almost constant refuses ratio due to the reasons of defects, admitted during designing, production and exploitation.

The part of refuses, caused by production defects, reaches the half of total refuses quantity, detected during its exploitation. Therefore, the reduction of its quantity is the real reserve of reliability increasing of current equipment type. The solution of this problem can be reached through the way of complex optimization and controlling of production processes using the results of defectiveness monitoring. As the result, we receive the determination and providing of allowable defectiveness level during every stage of technological process at the conditions of the given level of products reliability providing with minimum or allowed total revenues [1,3].

The realization of such approach to the solution of the problem of apparatus reliability increasing on a production stage is based on the known principles of modeling and optimization of technological systems. Herewith, the processes of forming the specified apparatus properties are described by models in the form of serial, parallel and combined structures of technological and control procedures with appropriate straight and reverse connections. With such formalization every process step is characterized by the formed parameter and the defectiveness level, which emerged during its forming. Therefore *n*-step technological process of apparatus production is described by a diagonal matrix of defectiveness P_{def}:

$$P_{def}=\mathrm{diag}(P_{def.1}, P_{def.2}, ..., P_{def.n}),$$

where $P_{def.i}$, $i=\overline{1,n}$ - partial stochastic column matrices:

$$P_{def.1}= P_{def.1.1}$$
$$P_{def.2}=(P_{def.2,1}, P_{def.2,2})$$
$$P_{def.3}=(P_{def.3,1}, P_{def.3,2}, P_{def.3,3})$$
$$\cdots$$
$$P_{def.n}=(P_{def.n,1}, P_{def.n,2}, ..., P_{def.n,n})$$

A connection between defectiveness P_{def} and reliability indexes I_r for the full technological process are shown by system of functions:

$$I_{r1}=F_1(P_{def.1});$$
$$I_{r2}=F_2(P_{def.2});$$
$$\cdots$$
$$I_{rn}=F_n(P_{def.n}),$$

which are received by parametric or non-parametric methods in the form of regression relationships or by analytical methods.

In these dependences as models of time operating-to-failure distribution were used one-parameter and two-parameter laws: exponential, logarithmically-normal, Waybull and diffusion monotonous and non-monotonous laws [2].

Optimization mathematical models and examples of their use in predicting and providing the reliability of equipment in the manufacturing process were presented.

Using a certain law of devices operating-to-failure time distribution made with regard to redistribution of the intensity of degradation and random failures during a period of its exploitation or γ-percentage resource. The possibility of reduction of infallible work predicting error during using two parametric laws in case of significant monotonous, and the more non-monotonous parameters drift was proven. It is typical for the long-term exploitation devices in difficult operating conditions.

The features of prediction of short-term exploitation hardware reliability where considered.

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