

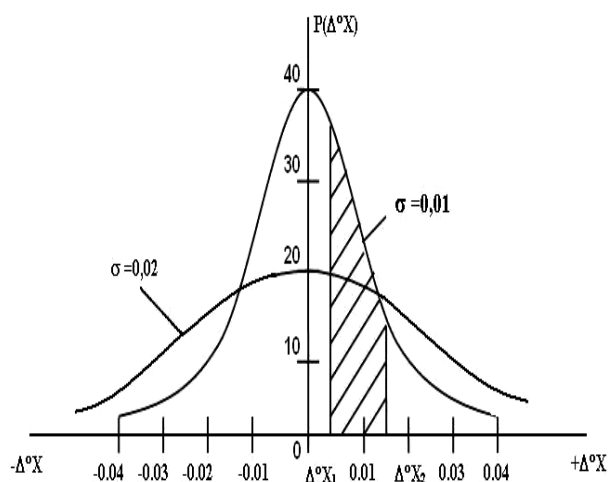
Accounting of Random Error in the Measurement Data

When doing commercial operations the errors of technological measurement results must be considered, since they determine the competitiveness of enterprises in the global economic market.

Reducing the influence of random errors on the measurement data is achieved by repeated measurements under identical conditions. If we assume that the systematic error is excluded from the measurement result (close to zero), then the most probable value of the measurand is considered as the arithmetic mean of a series of measurements X_{ev} , which is defined as follows: $X_{ev} = \bar{X} = \frac{1}{n} \sum_{k=1}^n X_k$, where X_k - the result of individual measurement; n - the number of measurements.

To assess the accuracy of measurement result we need to know the law of distribution of random errors. In practice of electrical measurements a normal Gaussian distribution law is the mostly wide-spread. The mathematical expression of this law: $P(\Delta^0 X) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(\Delta^0 X)^2}{2\sigma^2}}$, where $P(\Delta^0 X)$ – probability density of the random error; σ – a root-mean-square deviation of observations (*RMSD*) or standard deviation.

In fig.1 are shown the curves that define the nature of the probability density distribution $P(\Delta^0 X)$ for two values of the root-mean-square deviation σ ($\sigma=0,02$; $\sigma=0,01$). When $\Delta^0 X = 0,0$ then $P(\Delta^0 X) = 1/\sigma\sqrt{2\pi}$.



The standard deviation of observations is recorded through the random deviations of observation data as follows:

$$\sigma = \sqrt{\frac{1}{n-1} \sum_{k=1}^n \rho_k^2}, \quad \text{where}$$

$\rho_n = X_n - X_{ev}$; X_{ev} – mean value.

The analysis of curves (see fig.1) shows that the smaller the value a the more frequently small random errors occur, and more accurate measurements are. The curves are symmetrical relative to the ordinate axis (for a normal law), if positive and negative errors occur equally frequently.