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METROLOGICAL CERTIFICATION OF MEASURING INSTRUMENTS ACCORDING TO THE CONCEPT UNCERTAINTY OF MEASUREMENT

It is accepted that measurement instruments are technical devices which are characterised by standardised metrological characteristics. The reliability of measurement devices is determined by their ability to withstand the metrological parameters of regulated limits. A result obtained beyond these set boundaries is classified as a metrological failure. The correspondence of metrological characteristics to their standardised values is established during the course of verification (metrological control) or metrological certification of measurement devices. The introduction of the concept of measurement uncertainty to international standards for the evaluation and definition of the characteristics of precision measurements [1, 2] and the evaluation of quality electrotechnical items [3] requires the development of methods for the assessment (establishment) of the inter-verification interval of the measurement device, the procedure of which should be based on the theory of uncertainty of measurement.

Based on the values of uncertainty of type A, standardised and theoretically possible expanded measurement uncertainty and operational expanded uncertainty of the measurement under the assumption of symmetry of the distribution of uncertainty, the first assessment of the inter-verification interval of the measurement device T_1 may be calculated using values of uncertainty as follows:

$$T_1 = t\frac{ln\left(\frac{U_E}{k_{2P-1}u_{Amax}(\bar{x})}\right)}{ln\left(\frac{U_N}{k_P u_{Amax}(\bar{x})}\right)}, \quad (1)$$

where k_{2P-1} is the coverage coefficient, corresponding confidence probability 2P-1, i.e. a probability value that corresponds to the probability of metrological serviceability of the measurement device at the time of the definition of the inter-verification interval of the measurement device; where t is the operational longevity of the measurement device.

The coverage coefficient ratio k_{2P-1} is determined from the Student table based information about the confidence probability 2P-1 and the effective number of degrees of freedom ν_{eff} .

The second evaluation of the inter-verification interval T_2 may be calculated by the formula:

$$T_2 = t\frac{U_E - k_{2P-1}u_{Amax}(\bar{x})}{U_N - k_P u_{Amax}(\bar{x})}. \quad (2)$$

Based on calculated values of inter-verification intervals T_1 and T_2 , an inter-verification interval is determined for a measurement device, which is assumed to be equal to the minimum value between the values of T_1 and T_2, i.e.:

$$T = min[T_1, T_2]. \quad (3)$$

Thus, the proposed method of determining the inter-verification interval for the means of measurement permits the establishment or specification of an inter-verification interval based on the concept of the uncertainty of measurement. This method meets international requirements for evaluating the accuracy of measurements, adhering to international unity for measurement definitions and can be used in the metrological certification of measuring instruments [1 - 3].

List of references:

1. ISO/IEC Guide 98-1:2009 «Uncertainty of measurement – Part 1: Introduction to the expression of uncertainty in measurement».

2. Сопрунюк П. М., Василевский А. Н., Чабанюк Ю. А. Неопределенность результатов измерений при контроле асинхронности вращения электромеханических преобразователей // Системи обробки інформації. – 2006. – Вип. 7. – С. 72-75.

3. Vasilevskyi O.M. Calibration method to assess the accuracy of measurement devices using the theory of uncertainty // International Journal of Metrology and Quality Engineering. – 2014. – Vol. 5. – Issue 04. – 403.