The paper contains algorithms, methods, formulas, and nomograms for the best choice of means of measurement for monitoring product parameters when there are complete initial data or when certain initial data are lacking.

I have previously [1] raised topics concerned with selecting means of measurement, which is a basic operation in designing a metrological support system for any product, since the means of measurement is the basis of the metrological support, and it governs how the major aspects of such support are handled: accuracy and reliability in the measurements or tests, reliability in monitoring, and unified measurements.

Reducing the accuracy of means of measurement adversely affects the product quality in accordance with a power law, while raising the accuracy increases the measurement costs, makes the design more complicated, raises the mass and size of the means of measurement, and reduces the stability in the presence of influencing factors.

Means of measurement should be chosen on the basis of the following principles: optimizing the measured and monitored parameters, optimizing the accuracy and reliability characteristics, incorporating all factors and characteristics that influence the accuracy and reliability, the definition of alternative approaches to selecting the best form for the means of measurement, and optimizing the parameter measuring and monitoring system by reference to the accuracy.

Selecting means of measurement can be managed by algorithms involving the monitoring of product parameters and measuring these parameters, including cases where one does not have complete initial data.

The selection stages are common to all three algorithms, so they are best represented as a general algorithm (Fig. 1), in which events 1-4 and 14-19 are common to all the algorithms, while there is measurement monitoring and a lack of complete initial data in the additional event 13. The events that apply only to the algorithm for selecting means of measurement for monitoring are 6-12, and those for measuring parameters are 7, 9, 20, and 21, while the algorithm for choosing the means of measurement in the absence of complete initial data relates to events 5 and 22-27.

SYMBOLS AND CONTENTS FOR EVENTS IN THE MEASUREMENT MEANS SELECTION ALGORITHM

1. Definition of the initial data on selecting means of measurement and monitoring.
2. Separation of the initial data relating to the choice of means for monitoring and for measurement.
3. The initial data are complete (Yes, No).
4. Definition of the lacking initial data.
5. Using ways of choosing means of measurement in the absence of complete initial data.
6. Choosing the best means of measurement for monitoring parameter i successively for i = 1, n, in which n is the number of product parameters monitored.
7. Optimum choice of means of measuring parameter j successively for all j = 1, m, where m is the number of parameters measured.
8. Examination of a monitored parameter and of the conditions under which the measurements will be made and then definition of the specifications to be met by the chosen or newly developed means of measurement.

9. Analysis of the measured parameter and of the conditions under which measurements will be made and then definition of the specifications that should be met by the chosen (newly developed) means of measurement.

10. Preliminary determination of the type of means of measurement in order to establish the measurement error distribution (normal or uniform).

11. Selecting nomograms for the ratio \( R \) between the total error in the measurement results \( \Delta x \) and the permissible deviations in the monitored parameter \( \delta_p \), \( R = \Delta x / \delta_p \) by reference to permissible values for the probabilities of spurious failure \( P_{sf} \) and unobserved failure \( P_{uf} \), together with the permissible deviation of the monitored parameter \( \delta_p \) and the distributions for the deviations from the nominal value of the monitored parameter as well as the measurement errors (Figs. 2-5).

12. Determining \( R \) from the nomograms for a particular \( \delta_p \):
   - parameter \( \delta_p \) is two-sided symmetrical (from \( P_{sf} \) and \( P_{uf} \) one determines \( R_1 \) and \( R_2 \), and the smaller of them is taken as the calculated value);
   - one-sided (from \( 2P_{sf} \) and \( 2P_{uf} \) one determines \( R_1 \) and \( R_2 \) with the smaller of them taken as the calculated value).

13. Calculation of the acceptable value for a total error of the measurements \( \Delta_{x_{a}} \).

14. Definition of the methods and means of measurement that satisfy the requirements for \( \Delta_{x_{a}} \) and also the required values for the technical characteristics defined from the initial data.

15. Designing a measurement scheme that includes lines connecting the monitored (measured) parameters to the means of measurement for the various means of measurement, with definition of the measurement error components (instrumental, methodological, and subjective) and calculation of the actual total error.