New quality of measuring capabilities

E A Zhirkova, I V Trifanov, O A Sukhanova and D M Mednikov

Reshetnev Siberian State University of Science and Technology, 31 Krasnoyarskii rabochii prospect, Krasnoyarsk, 660037, Russia

E-mail: sibgau-uxs@mail.ru

Abstract. The issues of improving the quality of measurements based on the use of information technology and the informatization of the metrological infrastructure are investigated using the example of measurements of volumetric fluid flow. The functional diagram of an automated calibration unit for checking water flow meters is analyzed. As a result of the research, a model for the formation of a new quality of measuring capabilities has been developed. The use of metrological self-monitoring of calibration facilities is justified.

1. Introduction

Currently, scientific and technological progress presents new requirements for the accuracy and reliability of measurement information. The establishment and application of scientific and organizational foundations, technical means, rules and norms necessary to achieve unity and the required measurement accuracy is a difficult task, for the implementation of which regulatory requirements are developed to ensure the uniformity of measurements, accreditation criteria in a unified system of accreditation of legal entities and individual entrepreneurs to carry out work to ensure the uniformity of measurements [1, 2].

Since 2014, the Federal Agency for Technical Regulation and Metrology (hereinafter referred to as Rosstandart) has been actively pursuing an informatization policy aimed at providing the Russian economy, world-class metrological infrastructure by providing a qualitatively new opportunity to take into account information on the calibration of measuring instruments using modern information technology capabilities, increasing the effectiveness of state metrological supervision, and ensuring traceability in the framework of electronic certification of standards of units.

The introduction of resource-saving technologies, new electricity and water metering schemes leads to the development of improved calibration schemes, as well as the revision of the reference base. So, by order of Rosstandart on February 7, 2018 No. 256, a new state calibration scheme for measuring mass and volume of liquid in a stream, liquid volume and capacity for static measurements of mass and volume flow rates was approved. In accordance with this scheme, the portable calibration unit UPS1 3 PM, used in the calibration of water flow meters, as standards of echelon 2, can now be certified only as standards of echelon 3 [3].

In this paper, we propose to consider the implementation of new measuring capabilities using the example of an automated portable testing apparatus UPPA designed for measuring, reproducing, storing, and transmitting units of the volume of liquid in a stream and volumetric flow rate of a liquid, as well as measuring the parameters of the surrounding and measured medium, time intervals.
2. Results and discussion

Installations are used for checking water meters at the place of their operation or in laboratory conditions in accordance with MI 1592-2015 and GOST 8.256-83 [4-7]. The principle of operation of the plants is based on measuring the liquid in the stream and the volumetric flow rate of the liquid using a primary flow element included in a single hydraulic circuit with a calibrated measuring instrument. The installation contains: a primary reference flow element (RFE), a measuring and computing complex (MCC), sensors of temperature, atmospheric pressure, and relative humidity of the environment, a temperature sensor of the measured medium, a control panel (CP), a functional diagram of the UPPA installation (figure 1).

![Functional scheme of the UPPA installation](image)

**Figure 1.** The functional scheme of the UPPA installation.

The units are connected to the hydraulic path in which the verified measuring instrument is located, using flexible hoses through quick-disconnect couplings. The fluid flows through the calibrated measuring instrument, the inlet hydraulic path, the primary flow element and merges through the outgoing hydraulic circuit with shut-off and control valves into the sewer or storage bank.

Volumetric flow rate and fluid volume are measured with a measuring and computing complex basing on data received from the primary flow element.

The measuring and computing complex controls the operation of the installation, automatically collects, processes and compares the received readings of the calibrated measuring instrument and the measuring instrument of the installation, as well as displays the received data on the installation display or via a Bluetooth communication interface to a peripheral device - a smartphone. Information from the calibrated measuring instrument is read out visually according to the readings of its indicator and entered into the measuring and computing complex, or the readings from the calibrated measuring instrument are marked by a fixation method using a smartphone with the Android operating system.
Figure 2. Model of a new quality of measuring capabilities based on information technology and informatization of metrological infrastructure.
An important advantage of the calibration installation UPPA, in comparison with other analogues [8-11], is the presence of a time sensor that allows you real time recording the results of calibration. After calibration of the measuring instrument in the volatile memory of the measuring and computing complex, the calibration protocol is saved, which can immediately go to the specified destination through the Internet. Installations have the ability to automatically register the environmental conditions and the measured medium.

In the course of the study, a model of a new quality of measuring capabilities was developed (figure 2), which clearly shows that the use of information technology and the informatization of the metrological infrastructure contribute to the creation of a new quality of measuring capabilities by automating calibration procedures, developing an integrated information database of calibration results, the possibility of online monitoring of completeness and reliability of calibration results.

3. Conclusion
Thus, basing on the theoretical studies:

- The issues of improving the quality of measurements on the example of measurements of the volumetric flow rate of the liquid were considered;
- The functional diagram of an automated calibration unit for checking water flow meters was analyzed;
- A model of a new quality of measuring capabilities has been developed, which is formed as a result of improving calibration schemes and implementing requirements for metrological infrastructure informatization, which ensures openness, reliability and timeliness of the provision of measurement information, as well as the use of automated control methods through integrated information networks, which serves as the basis for the introduction of resource-saving technologies;
- The use of metrological self-control of calibration facilities was justified.

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