ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 5 , May 2020

Metrological Accuracy and Estimation of Extended Uncertainty of Pressure Gauge in Real Conditions of Explaution

MASHARIPOV SHODLIK MASHARIPOVICH,MAMATKULOV MUXAMADSODIK NABIYEVICH,ERKABOYEV ABRORJON XABIBULLO O'G'LI

PhD in technical sciences, associate professor, Tashkent StateTechnical University,Tashkent, Uzbekistan,
PhD in Physics and Mathematics, associate professor, Tashkent Institute of Chemistry and Technology,Tashkent, Uzbekistan.
Undergraduate, Tashkent Institute of Chemistry and Technology, Tashkent, Uzbekistan.

ABSTRACT*:* The article considers the issues of evaluation of accuracy characteristics of manometers and estimates the extended uncertainty of measurement results. In addition, the main sources of measurement results when using the measuring device in real-world operating conditions were investigated. Practical recommendations are given to improve accuracy and to reduce uncertainty of measurement results. The calculation and evaluation of accuracy is based on international standards in the field of uniformity of measurements.

KEYWORDS: accuracy, result measurements, pressure gauge, extended uncertainty, sources of uncertainty

I. INTRODUCTION

Recently, due to the increasing role of measurements in conformity assessment, the problem of their metrological provision has become important. The requirements for the quality of measurements are constantly increasing not only in terms of their technical, economic level, but also in terms of accuracy. For measurements, as for any process subject to quality control, it is necessary to highlight those indicators that Will most fully characterize the quality of the process and then periodically monitored and maintained at a given level. Information product produced during. Measurements is a measurement result which can be expressed in quantitative and qualitative form. The main indicators of measurement results quality are connected with accuracy.

II.LITERATURE SURVEY

The term "uncertainty of measurements" appeared more than 30 years ago and is related to the accuracy of measurement results. The need to develop a new concept for measuring measurement accuracy was caused by a lack of international unity in these matters. The concept was developed by international organizations: International Bureau of Measures and Weights (IOMB), International Electrotechnical Commission (IEC), International Federation for Clinical Chemistry (IFIC), International Organization for Standardization (ISO), International Union for Pure and Applied physics (IUPAC), International Union for Pure and Applied chemistry (IUPAC), International Organization of Legal Metrology (OIML). Under the auspices of these organizations. Was published in 1993, "A Guide to Expression Uncertainties in Measurements "(GUM), which immediately after publication acquired the status of an informal international standard. The management has brought consistency in evaluating the accuracy of measurement results into a wide range of measurements based on the concept of measurement uncertainty.

The concept of uncertainty was the result of development. Theoretical metrology and currently most fully. Meets the modern requirements of technological progress, and uncertainty is the only internationally recognized measure to assess accuracy. Measurement uncertainty is interpreted in two senses: wide and narrow. Broadly speaking, "uncertainty" is "doubt," for example, "when all known and assumed components of an amendment have been evaluated and made, there is still uncertainty as to the truth of the said result, that is, doubt as to how accurately the measurement represents the value of the measured value." In the narrow sense of "uncertainty," there is a parameter associated with the measurement result that characterizes the variation of values that could reasonably be attributed to the measured value.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 5 , May 2020

III. RESULTS AND DISCUSSION

Pressure measurements in the system were carried out by a pressure gauge, accuracy class 2.5 with a range of 0 to 20 kgf/cm^2. The obtained pressure value at a single measurement of 15 kgf/cm^2. It is necessary to determine the measurement result and estimate the uncertainty of the pressure measurement.

1. We make the specification of measurements

A) measurement was carried out at ambient temperature of medium - 40 ^oC;

B) range of operating temperatures of pressure gauge from -10 ^oC to 50 ^oC;

C) pressure gauge reference discreteness - 0.1 kgf/cm^2.

2. Determine the components of total pressure measurement uncertainty:

1) find the maximum value of the basic absolute error

$$\Delta = \pm\frac{K \cdot D}{100} = \pm\frac{2{,}5 \cdot 20}{100} = 0{,}5\, kgf/cm^2 \quad (1)$$

Where: K is the accuracy class of the pressure gauge; D - measuring range of pressure gauge.

2) Measurement uncertainty caused by temperature deviation from normal temperature (20 ^oC) - additional absolute error at temperature 40 ^oC: reduced error is calculated by this formula

$$\gamma = \pm k \cdot \Delta t \quad (2)$$

к=0,1 – for this pressure gauge (from certificate obtained)

$$\gamma = \pm 0{,}1 \cdot 20 = \pm 2\ \% \quad (3)$$

$$\Delta_t = \pm\frac{\gamma \cdot D}{100} = \frac{2 \cdot 20}{100} = \pm 0{,}4\, kgf/cm^2 \quad (4)$$

3) limit of pressure gauge reference is equal to:

$$\Delta_o = \pm 0{,}05\, kgf/cm^2 \quad (5)$$

4) Find standard uncertainty (for basic error): α for even law of distribution is $\sqrt{3}$

$$U = \frac{\Delta}{\alpha} \quad (6)$$

$$U_1 = \frac{0{,}5}{\sqrt{3}} = \frac{0{,}5}{1{,}732} = 0{,}29 \quad (7)$$

5) find standard uncertainty for additional absolute error:

$$U_2 = \frac{\Delta_t}{\alpha} = \frac{0{,}4}{1{,}732} = 0{,}23 \quad (8)$$

6) 6) find standard uncertainty for error of reference discreteness, which is equal to value of reference discreteness divided by coverage factor for uniform law of division

$$U_3 = \frac{0{,}05}{\sqrt{3}} = \frac{0{,}05}{1{,}732} = 0{,}028\, kgf/cm^2 \quad (9)$$

3. We make the budget of uncertainty

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 5 , May 2020

Pressure measurement uncertainty budget

Input values	Estimates of entrance sizes	Standard Input Uncertainty	Distributions of probability
The measured pressure	15 kgf/cm^2	-	-
Intrinsic error	-	$U_1 = 0{,}29\, kgf / cm^2$	Uniform law of distribution
Temperature error	-	$U_2 = 0{,}23\, kgf / cm^2$	Uniform law of distribution
Discretization error	-	$U_3 = 0{,}028\, kgf / cm^2$	Uniform law of distribution
y	15 kgf/cm^2	$U_S = 0{,}371\, kgf / cm^2$	-

4. Corelation: none of the input values are considered correlated with others to any significant extent.
5. Находим суммарную неопределенность выходной величины в соответствии с выражением

$$U_S = \sqrt{U_1^2 + U_2^2 + U_3^2} = \sqrt{0{,}29^2 + 0{,}23^2 + 0{,}028^2} \tag{10}$$

$$= 0{,}371\, kgf / cm^2$$

6. We calculate the extended uncertainty of the measurement result for the confidence level 0.95 according to the formula

$$U_E = k \cdot U_S = 1{,}93 \cdot 0{,}371 = 0{,}72 \tag{11}$$

Taking into account that the components are distributed according to uniform law and ratio

$$\frac{U_2}{U_1} = \frac{0{,}23}{0{,}29} = 0{,}793 \tag{12}$$

For a trust level of 0.95 s table, we get the following values from 2 table maximum values of coverage coefficients for the composition uniformly and normally distributed input values, k=1,93.

Table 2 Maximum coverage values for composition uniformly and normally distributed input values

$\frac{u_2(y)}{u_1(y)}$	$u_н(y)/u_1(y)$										
	0	**0,1**	**0,2**	**0,3**	**0,4**	**0,5**	**0,6**	**0,7**	**0,8**	**0,9**	**1**
0	**1,65**	**1,65**	**1,69**	**1,73**	**1,77**	**1,81**	**1,84**	**1,87**	**1,89**	**1,91**	**1,92**
0,1	**1,65**	1,68	1,7	1,74	1,78	1,82	1,85	1,87	1,89	1,91	1,92
0,2	**1,70**	1,73	1,75	1,78	1,81	1,84	1,86	1,88	1,9	1,91	1,92
0,3	**1,75**	1,8	1,81	1,82	1,84	1,86	1,88	1,89	1,91	1,92	1,93
0,4	**1,80**	1,85	1,85	1,86	1,87	1,88	1,89	1,91	1,92	1,92	1,93
0,5	**1,83**	1,88	1,89	1,89	1,9	1,9	1,91	1,92	1,92	1,93	1,94
0,6	**1,86**	1,91	1,91	1,91	1,91	1,92	1,92	1,93	1,93	1,93	1,94
0,7	**1,88**	1,92	1,92	1,92	1,92	1,93	1,93	1,93	1,94	1,94	1,94
0,8	**1,89**	1,93	1,93	1,93	1,93	1,93	1,93	1,94	1,94	1,94	1,94
0,9-1,0	**1,90**	1,94	1,94	1,94	1,94	1,94	1,94	1,94	1,94	1,94	1,94

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 5 , May 2020

7. The measurement result is recorded as

$$P = (15 \pm 0{,}72)\, kgf / cm^2 \quad (8)$$

IV.CONCLUSION

Estimation of measurement uncertainty at the pressure gauge shows that the main fraction is related to the main instrumental errors of the pressure gauge. As well as temperature significantly affect the reliability of the final measurement result. Therefore, it is recommended to comply with the operating requirements of the measuring device.

REFERENCES

[1] MasharipovSH.M., KenjaevaZ.S. Assessmentofuncertaintyduringdevelopment of a methodology for performance measurements applied in the field of metrological control and supervision // Proceedings of the 6th International Youth Conference "Perspectives of Science And Education", (November 10, 2019, Cultural Center Slovo/WORD. New York, USA 2019. Pp. 72-74.
[2] Masharipov SH.M., Fattoyev F.F., Mahmudjonov M.M. Issues improvement and optimization of control of regulated product parameters with required accuracies and accuracies// Proceedings of the 6th International Youth Conference "Perspectives of Science And Education", (November 10, 2019, Cultural Center Slovo/WORD. New York, USA 2019. Pp. 75-76.
[3] Masharipov SH.M., Miralieva A.K., Fattoyev F.F., Rahmatullaev S.A. Algorithm for using the rule of three sigms in processing results of measurements and increasing the reliability of experimental data // European Sciences review. Scientific journal (Austria, Vienna).– № 9-10 – 2019 (September – October).–P.35-38.
[4] Masharipov SH.M., Miralieva A.K., Fattoyev F.F., Rahmatullaev S.A. Development of the method of calculation of uncertainty of measurement results and evaluation of accurate characteristics in the field of analytical measurements// European Sciences review. Scientific journal (Austria, Vienna).– № 9–10.-2019 (September–October) .P.39-41.
[5] Masharipov SH.M., Fattoyev F.F. Development and research of the influence on accuracy of the main sources of uncertainty in the measurement of humidity and other physicochemical measured values. International journal of advanced research in science, engineering and technology (IJARSET), Volume 7, Issue 1, January, 2020, pp.12362-12369. //Internet access:http://www.ijarset.com/upload/2020/january/3-Shodik240819-02.pdf
[6]A.P. Lepyavko. Uncertainty of Thermal Measurements: Lecture Project - Moscow: ASMS, 2008. 42 p.
[7] Zayats, N. I. Estimation of measurement uncertainty: academic. Manual for Students of the Specialty "Physical Chemical Methods and Devices of Product Quality Control"/N. I. Zayats, O. V. Stasevich. - Minsk: BGTU, 2012. 91 p.
[8] Shalamov, A.N. Processing of results and evaluation of measurement accuracy at Multiple observations: educational manual/A.N. Shalamov, B.A. Kudryashov, T.M. Rakovchik. - M.: MADI, 2016. - 164 p.

AUTHOR'S BIOGRAPHY

MASHARIPOV SHODLIK MASHARIPOVICH – PhD in technical sciences, associate professor, Department of Metrology, Standardization and Certification, Faculty of Electronics and Automatics, Tashkent State Technical University named after Islam Karimov, Tashkent, Uzbekistan;

ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 7, Issue 5 , May 2020

MAMATKULOV MUXAMADSODIK NABIYEVICH-PhD in Physics and Mathematics, associate professor, Tashkent Institute of Chemistry and Technology, Tashkent, Uzbekistan., Tashkent, Uzbekistan.	
ERKABOYEV ABRORJON XABIBULLO O’G’LI-Undergraduate, Tashkent Institute of Chemistry and Technology,Tashkent, Uzbekistan., Tashkent, Uzbekistan.