

Metrological support of measuring electrical energy in the housing sector and the development of scientifically justified recommendations for their selection

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Scientific novelty of this work: the development of scientific-based practical recommendations for the choosing of measuring instruments, the control of the electrical energy consumption in the housing and communal services and the socio-economic impact to the introduction of new types of electricity meters.

Nowadays, the problem of energy saving is relevant for many fields of activity, including housing and utilities. Energy consumption is increasing and prices are rising every year. Solutions to the problem of energy saving is discussed in the media, in articles, publications and in some conferences on energy saving. Alongside with laws and regulations, organizational and technical issues have a significant role in ensuring that real savings are done and the problems of metrological support in this sphere. Obtaining reliable measurements of energy resources is one of the starting points to solve these problems.

Currently, in Kazakhstan a great attention is paid to energy efficiency. The program for energy conservation and for regulation of natural monopolies is everywhere in the country, in the region of Almaty different types of tariffs on electricity were introduced. Now in Almaty and Almaty region for domestic consumers there are two types of payment: payment by time zones and tariff, depending on the volume of the electricity consumption.

According to the paragraph 36 of the decree of the Minister of energy and mineral resources of the Republic of Kazakhstan, from February 25, 2015 № 143 "On approval of the Rules of use of electric energy and the Rules of use of thermal energy", electrical installations of consumers must be provided with the required metering devices for the accounting of consumed electricity from the supplier. This has been done to account for the power used by devices which are listed in the State registry to make sure of the uniformity of the measurements.

One of the conditions for introducing metering devices in the State Register of Kazakhstan is their compliance with modern metrological requirements.

In this regard, one of the most urgent tasks is to ensure metrological reliability and optimization of recalibration intervals (RI) for electricity meters used in the housing and communal services sector.

According to paragraph 7 of the Rules of use of electric energy, all electricity consumers should have meters. At the same time, for each category of consumers, different counters are required depending on the amount of electricity consumed. For the consumer, the important issue is the acquisition of effective means of measurement with a sufficiently large recalibration interval which characterizes the period of metrological serviceable condition of the electricity meter. Recalibration interval affects the cost of control on the electrical energy consumption.

One of the main forms of maintaining measuring instruments (MI) in good condition is periodic checking. It is metrological services according to the rules set forth in special regulatory documents. The calibration interval should be consistent with the reliability requirements of measuring instruments. Calibration must be carried out through an optimally selected interval of time, called recalibration intervals.

Recalibration intervals need to be set according to calendar time (time for the use of measuring) for MI, changes of metrological characteristics which are aging related and do not depend on the intensity of operation. RI values are recommended to choose from the following range: 0.25; 0.5; 1; 2; 3; 4; 5; 6; 9; 12; 6K months, where K - a positive integer. For the MI, in which a change in of the metrological characteristics (MC) is the consequence of wear of its elements, depending on its exploitation intensity, RI assigned to the values of operating time.

After finding the RI, MC are selected, which determines the state of metrological serviceability of the measuring instruments. As these characteristics are generally used basic

error, standard deviation of the random component of the error, and some others. If the state metrological of serviceability is determined by several MC, then some of them selected the one on which this gives the greatest percentage of defects for verification. The question of reasonable choice of the length of CI is dedicated to a large number of works [1].

Currently, there are three basic ways to determine the duration of the RI:

- based on failure statistics;
- on the basis of economic criteria;
- on free assignment of the initial RI with subsequent adjustment during the lifetime of MI. The choice of a specific method for the determination of the duration of RI depends on the availability of initial information about the reliability and stability of MI.

Application of methods of calculation of RI, based on the statistics of hidden and evident failures, requires a large amount of experimental data on the processes of changing in MC time of measuring instruments of various types.

Determination of the recalibration interval on the economic criterion consists in solving the problems of the choice of this interval of which we can minimize the operating costs MI and avoid the consequences of possible errors caused by errors of measurements. One of the definitions of RI on the economic criterion has given in recommendation RMG 74-2004 "State system for ensuring the uniformity of measurements. Methods of determination of calibration and intergalibration intervals of measuring instruments" [2].

The most universal is the method consisting in randomizing RI with subsequent adjustment of its magnitude. In case of minimal initial information is assigned an initial interval, and the results of subsequent verifications are initial data for adjustment.

This approach is discussed in recommendation MI 1872-88 "GSI. Exemplary recalibration intervals of measuring instruments. Method of determining and adjusting" and the international standard ISO 10012-1, "Requirements for guaranteeing the quality of the measuring equipment."

It should be noted that the recalibration interval has a great influence on the metrological reliability of the device and the cost of the system for monitoring the flow of electrical energy. For the right selection of electric meter, a thorough study of its metrological characteristics, including the recalibration interval should be conducted.

Until now electric meters were produced and operated, which accuracy class was 2.5.

The main metrological characteristics studied are:

- The maximum permissible relative error, expressed in percent. It depends on the accuracy class, the value of the current in the load, the power factor. At nominal values of current power factor error (%) is equal to the number denoting the class of accuracy. Accuracy class of the meter is specified on its panel.

- The sensitivity threshold is the smallest value of the starting current, which begins with a continuous check of readings of electric energy. I.e., for each counter contains a so-called threshold value at which the counter starts counting electricity.

- The creep meter is also an important metrological characteristic. He determines that if in the circuit there is no current and voltage is above or below nominal (within tolerance limits), then the meter should register electrical energy.

The calibration interval of the electricity meter (calibration interval or recalibration interval) is important for the consumer characteristics - can range from 6 to 16 years. For all types of electricity meters, recalibration interval is set when the entry in the State register of measuring instruments is specified in the description of the type of means of measurement for each type, as well as the passport on metering device.

Table 1.

Types of counters	Recalibration interval, in years
Single-phase induction	16
Three-phase induction	6 – 8
Single-phase electronic	8 – 16
Three-phase electronic	6 – 16
Electronic multi-tariff	6 – 14

In general, the recalibration interval for different types of counters are shown in the Table 1 above.

The results of the comparative analysis of the electronic meters and induction characteristics are shown in Table 2.

Comparison of characteristics of electronic and induction meter

Table 2.

Feature	Electronic counter (meter)	Induction meter
accuracy class	0,2..2	2..2,5
type of indicator	LCD, Electromechanical	Mechanical
the combination of active and reactive energy	+	-
reconciling the energy in two directions	+	-
the ability to measure power quality	+	-
the possibility of multi-tariff metering	+	-
storing the measured data	+	-
the influence on accuracy of measurements of the network characteristics and load	-	+
the ability of detection of theft of electricity	+	-
the presence of interfaces	+	-
the ability to use AMR	+	-
sensitivity to lightning and switching surges	+	-
electricity consumption	minor	significant
the period of verification	16 years	8 years

We studied the advantages and disadvantages of electric meters.

The old ones, still installed in most of the apartments are induction, single – rate meters, that is, they round the clock, consider the consumption of electricity at the same price, and to consider separately the "day" and "night" tariff can only new electronic dual tariff or multi-tariff meters.

One of the shortcomings of the old single-rate Electromechanical meters is - wrong calculation of energy consumption at a load above the rated and the rated load of the old counters is exceeded everywhere. Indeed, in recent years the number of powerful appliances in the apartments has increased significantly and continues to grow. Another obvious drawback is the increase of danger. In the operation of the old meter, especially when the load are in excess of rated, there is a high risk of its failure and a risk of electrical fires.

Electronic two-tariff counters not only meet modern requirements and standards and have exceptional accuracy, the error rate of individual models of electronic meters is up to 0.5%.

A new two-tariff counters have a number of additional functions, such as displaying the current power consumption, "memorizing" the results of the previous settlement period, remote removal of indicators thanks to digital interfaces, as well as other useful additional services. They serve on average 25-30 years, and help to save energy and therefore your money.

Along with the advantages of the new meters they also have disadvantages:

1. If the normal count is approximately 2200 tg, multirate 9,000 tg and above.
2. In addition, by itself, such as a counter is a very complex device with an autonomous power from lithium batteries. These counters are checked by the state every 16 years, as well as single-rate meters, but they need a replacement of the lithium battery in a shorter delay.

In this work based on research conducted by the aforementioned metrological characteristics of modern electric meters, as well as the recalibration interval and metrological reliability, practical recommendations of their choice.

Recommendations regarding the selection of an electric meter.

If you select a single-rate or a multi-rate meter, you need to calculate everything when you use the electrical power in daytime, on-peak or semi-peak time, there is still money to save by installing the multitariff counter.

Experts say that consuming electricity during night time, we will cost approximately 4 times less than during the daily rate. Savings on electricity in the "peak zone" has of approximately 25% of the daily rate.

In each case it is necessary to calculate the efficacy of multi-rate meters, depending on region, type of settlement (rural or urban), the type of stove (gas or electric), consumers, and other factors.

Electricity meters must be subjected to verification in the following cases:

- 1 Expired recalibration interval
- 2 Broken sign verification (calibration seal)
- 3 Suspicion on the consumer for improper operation of the device
- 4 Notice of verification of metering devices from the power supplying organization or other authorized persons
- 5 When installing a new measuring instrument, to pay attention to the year of calibration: on newly installed meters, verification not older than 12 months must be sealed

On the basis of the work, it was found that in spite of the above disadvantages in practice used mostly classical induction meters. They are quite reliable.

References

1. Sergeev AG, Krokhin VV - Metrology: Logos, 2001. - 408 p.
2. MI 2187-92 "GCI. Methods for determination of calibration intervals and the intercalibration intervals of measuring "