ЭЛЕМЕР

*Science production enterprise*

*RELIABLE INSTRUMENTS AND SYSTEMS OF TECHNOLOGICAL MONITORING*

# SURFACE TEMPERATURE CALIBRATOR

# КТП-500

## Operation Manual

## НКГЖ 408749.002РЭ

## CONTENT

## 1. PURPOSE

Surface temperature calibrator КТП-500 (hereinafter - КТП-500) is designed for determination of graduation characteristics of thermal converters and thermometers, used for measuring of the temperatures of flat surfaces of hard bodies by a contact method within the temperature range of from 50 to 500 °C during their manufacturing and calibration.

Protection degree from penetration of dust and of water into КТП-500 corresponds to IP30 according to State Standards 14254-96.

By tolerance to climatic impact during operation corresponds to КТП-500 the group of manufacturing В1 according to State Standards ГОСТ 12997-84.

## 2. TECHNICAL DATA AND CHARACTERISTICS

2.1. Range of reproduced and measured temperatures is form 50 to 500 °C.

2.2. Limits of the tolerable basic error of determination of temperature of comparator unit, °C

$$\pm\left(0{,}2 + 0{,}003 \cdot t\right)$$

where t –the value of reproduced temperature.

2.3. Temperature gradient by the radius of the working area of the comparator unit surface,°C

$$\pm\left(0{,}003 \cdot t - 0{,}05\right)$$

2.4. Radius of the working area, мм 25.

2.5. Instability of temperature maintenance during 10 minutes, °C $\pm 0{,}2$.

2.6. Unit of the last order of the indicator, °C 0,01.

2.7. Time of calibrator entrance of the operational mode, hours 2.

2.8. Limit of the tolerable additional error of determination of temperature of the thermostatic unit working area, caused by variation of mains voltage from nominal (220 V) within the limits (187…242) V, does not exceed 0,2 of the limit of tolerable basic error.

2.9. Power supply of КТП-500 is performed from the alternate current mains with frequency (50 ±1) Hz and voltage ($220^{+22}_{-33}$) V.

Consumed power is not more than 600 V·A.

2.10. Insulation of electrical circuits of КТП-500 between themselves and relative to the housing withstands during 1 minute an impact of testing voltage of practically sinusoidal form of 660 V and frequency from 45 to 65 Hz.

2.11. Electrical resistance of insulation is not less than 20 MOhm.

2.12. КТП-500 is resistant to temperature of surrounding air plus 10 and plus 35 °C.

2.13. КТП-500 is resistant to impact of humidity up to 75 % at the temperature 30 °C.

2.14. КТП-500 in transport tare withstands temperature up to plus 50 °C.

2.15. КТП-500 in transport tare withstands temperature down to minus 50 °C.

2.16. КТП-500 in transport tare possesses durability to an impact of air media with a relative humidity up to 98 % at the temperature of 35 °C.

2.17. КТП-500 in transport tare is resistant to bumping with the number of shocks 80 per minute, with quadratic value of acceleration of 30 $m/s^2$ and 1 hour durability of impact.

2.18. Overall dimensions: 530x300x145 mm.

2.19. Mass, not more than 9 kg.

2.20. Information on content of precious metals.

2.20.1. In КТП-500 contains the following precious metals:

Platina - 2,1674 gr,
Rhodium - 0,2476 gr.

## 3. COMPLETE SET

| № п/п | Name | Designation | Number |
|---|---|---|---|
| 1 | Surface temperature calibrator КТП-500 | НКГЖ 408749.002 | 1 |
| 2 | Surface temperature calibrator КТП-500. Operation manual | НКГЖ 408749.002РЭ | 1 |
| 3 | Verification certificate | | 1 |
| 4 | Coupon for guarantee repair and after guarantee servicing | | 1 |

## 4. DESIGN AND OPERATION OF THE INSTRUMENT

4.1. Physically КТП-500 is manufactured in the form of a monoblock. Its main functional parts are as follows:

- Thermostatic unit with an open working surface;
- Precision temperature regulator- measuring instrument.

4.2. Thermostatic unit is surrounded from outside by a protective ring, the temperature of which is maintained similar with the temperature of thermostatic unit. The unit with the ring is installed on the heating device. The heating device is a flat metallic disc with an incorporated heater. The working area of the unit is positioned on the outside surface of the housing of КТП-500. Outside the instrument is protected by thermal insulation and placed in the casing, blowed on by a fan, positioned on the lower panel of КТП-500.

In the thermostatic unit there are three radial channels for placing thermal converters. In the upper channel, close to working surface of the thermostatic unit, a platinum thermal converter of resistance is located, with the help of which measurement and regulation of temperature of the thermostatic unit is performed. In two other channels, the distance between them being 10 mm, there are thermo-electrical converters ХА (К) are situated with individual static features (ИСХ), that are used for determination of the temperature gradient along the height of the thermostatic unit. Gradient error is determined when calibrating КТП-500 at the manufacturing factory and automatically is taken into account in the readings of the indicator КТП-500. The value of the error is used when performing verification and it is provided in the Appendix.

4.3. Temperature measuring regulator has got two channels of regulation. In the channel of regulating of temperature of thermostatic unit the platinum thermo-converter of resistance is used, in the channel of regulating of temperature of protective unit - thermal – electrical converter with НСХ ХА (К).

Measuring–regulator of temperature comprises:

- 8-channel commutator;
- 18-digit ADC;
- microcontroller;
- digital-to-analog converter;
- thyristor amplifier;
- 2-digit 5-digit indicator;
- power supply source for feeding of thermal converters.

Commutator is designed for connection in a certain sequence of input signals to ADC.

ADC together with microcontroller makes measuring of output signals of thermal converters, their treatment, computation of the temperature in accordance with НСХ or ИСХ of thermal converters, calculation of the value of control signal (by ПИД law of regulation), produces a signal of readiness.

Digital to analog converter produces the control signal to thyristors for feeding of the heater. The indicator is designed for reflection of temperature modes КТП-500, as well as for installation of the setting. In its upper row the current temperature is indicated. In the lower row depending on the signal of readiness is reflected either a preset temperature (temperature of setting) or the time during which the calibrator is working in operating mode. After assigning the setting its temperature is displayed, at the same time in the left corner of the lower part the symbol «=» is displayed. When the deviation rate of the current temperature from the preset one does not exceed 0,5 °С during 3 minutes, the countdown is started as well as indication of time of working of the calibrator in the present (operational) mode. In the left corner there a conventionalized letter «t» appears. Format of the indicated time: *hours, minutes.* For assigning a setting there are five buttons: ⏎ - input (output) in the mode of editing (temperature measuring), buttons ►, ◄ shifting orders and buttons ▲, ▼ changing of the number of the corresponding order.

On the vertical part of the front panel there are two switches: «Network» and «Blocking».

Double-pole switch «Blocking» is designed for switching on of the system of blocking of power supply circuits of heaters. Blocking is designed for disconnection of power supply in case of an emergency. It operates in case of deviation of the current temperature from the preset one for ± 20 °С, for example, in case of a short-circuit in a thermal converters circuits.

After the temperature of the blocked channel of КТП-500 returns the zone of preset limits power supply of the heaters is continued.

## 5. SAFETY MEASURES INSTRUCTIONS

5.1. To operate КТП-500 personnel should be trained in accordance with «Regulations of technical operations of consumers electrical devices" and "regulations of technical safety when operating electrical devices of consumers", approved by Gostehnadzor, and should study the present certificate.

5.2. Surrounding environment should not be combustible, it should not contain salty mists, aggressive gases and vapours in concentrations destroying metal and insulations.

5.3. Prior to starting operations it is necessary to check the quality of grounding of КТП-500.

5.4. After transporting or storage of КТП-500 at the temperature of air below plus 10 °С it is necessary to hold it before unpacking in a dark dry premisses at the temperature from plus 10 to plus 35 °С during 24 hours.

5.5. Elimination of faults and all preventive operations should be performed only when the instrument is disconnected from the mains, temperature of verified КТП-500 should not exceed the temperature of surrounding media.

5.6. In order to avoid burns one should not touch surfaces of the display of the unit, having a high temperature.

## 6. PREPARATION FOR OPERATION

6.1. Unpack КТП-500. Make a surface examination, during which the following items should be checked:

- complete set and correspondence to the section 3 of the present certificate;
- absence of mechanical damage, affecting operational characteristics of КТП-500;
- correspondence of the factory number of КТП-500 to the one provided in the certificate.

6.2. Testing

6.2.1. Connect the ground loop to the clamp of grounding of КТП-500.

6.2.2. Connect КТП-500 to the mains. The fanning ventilator of the unit starts working.

6.2.3. Set the switch «Blocking» into the position «Вкл.» (Switched on). Switch on the tumbler «Circuit».

Digital indicator displays service information, and afterwards starts operating in the working mode. It should display the temperature close to the room temperature. The temperature should remain constant within the limits of 3-5 °С.

6.2.4. With the help of control buttons the temperature of 50 °С should be set.

For safety purpose it is envisaged that heating may be dropped during editing. After exiting from the mode of editing the indicator will be blank after 5-7 seconds.

6.2.5. Install the switch «Blocking» in the position «Switch off.». Heating is on. Readings of the digital indicator should grow.

## 7. OPERATION PROCEDURE

7.1. Operation procedure of КТП-500

7.1.1. Preparation and operation of calibrated thermal converters is performed in accordance with operational documentation.

7.1.2. Switch on the tumbler «Circuit».

7.1.3. With the help of control buttons one should set the required temperature value.

7.1.4. After termination of the time of КТП-500 entering the operational mode one should switch on the switch «Blocking».

7.1.5. Take the readings of the digital indicator КТП-500 and determine characteristics of calibrated thermal convertors at the present temperature.

7.1.6. Repeat the operation according to items 7.1.3…7.1.5 consequently for all the remaining temperature points.

It is necessary to switch off blocking when changing over to a new temperature.

7.1.7. After ending work switch off КТП-500 in the following sequence:

- set the tumbler «Circuit» in the following position;
- disconnect КТП-500 from the circuit.

## 8. CALIBRATION TECHNIQUE

8.1.Calibration of КТП-500 is performed by the bodies of State metrological service or by other authorized institutions. Requirements for organization, procedure of calibration and the form of resulta presentation is determined by ПР 50.2.006-94 "ГСИ. Calibration of measuring instruments. Organization and procedure of calibration".

8.2. Interval between calibrations - 1 year.

8.3. Requirements for calibration, calibration instruments and operations during its performance are determined by the document on calibration "Calibrator of the surface temperature. Calibration technique» НКГЖ 408749.002МП.

## 9. STORAGE AND TRANSPORTATION REGULATIONS

9.1. КТП-500 is transported by all types of transport in covered vehicles. Tare fastening in transport vehicles should be performed in accordance with regulations valid for corresponding types of transport means.

9.2. Conditions of transportation of КТП-500 correspond to the conditions 5 by State Standards 15150-69 at the temperature of ambient air from minus 50 to plus 50 °С with consideration of protective measures from shocks and vibration.

9.3. Conditions of storage of КТП-500 in transport tare in the storehouse of the manufacturer and of a client should correspond to conditions 1 by State Standards 15150-69.

## 10. ACCEPTANCE CERTIFICATE

10.1. Surface temperature calibrator КТП-500 factory number №_____ safety category ___4Н_____ by ОПБ-88/97 was manufactured and accepted in accordance with obligatory requirements of state standards, of actual technical documentation and was acknowledged to be fit for operation.

Head of the quality control department

Seal place _____ _____
(personal signature) (decoding of the signature)

_____
(year, month, date)

## 11. PACKAGING CERTIFICATE

11.1. Surface temperature calibrator КТП-500 factory number №_____ was packed by the science – production enterprise «ELEMER» in accordance with requirements, envisaged by the actual technical documentation.

_____ _____ _____
(position) (personal signature) (decoding of the signature )

_____
(year, month, date)

## 12. RESOURCES, TERMS OF LIFE AND STORAGE AND GUARANTEES OF THE MANUFACTURER (SUPPLIER)

12.1. Resource of the surface temperature calibrator КТП-500 is 10000 hours during the life term of 5 years including storage term of 6 months from the manufacturing date in packaging of the manufacturer in storage room.

The indicated resource, life term and storage term are valid only in case if a client abides by the requirements of actual operation documentation.

12.2. Guarantee term of operation is 12 months from the selling date.

12.3. In case of operation ability failure of КТП-500 it may be repaired at the producing works at the address:

124460, Moscow, Zelenograd,
korp. 1145, entrance 1, SPE «ELEMER»
Tel.: (495) 925-5147
Fax: (499) 710-00-01
E-mail: elemer@elemer.ru

12.3.1. Without a guarantee sheet with filled in repair card КТП-500 can not be accepted for repair.

## 13. OPERATING TIME REGISTER

| Date and time of operation | Surname, Given names and signature | Date and time of operation | Surname, Given names and signature | Date and time of operation | Surname, Given names and signature |
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## APPENDIX A

Gradient correction by height between an incorporated platinum thermometer of resistance and the surface of the thermostatic unit can be calculated from the formula

$$\Delta T_H = a + b \cdot t + c \cdot t^2$$

where $a$, $b$, $c$ – coefficients, determined when calibrating КТП-500.

$a$ = _____

$b$ = _____

$c$ = _____