



# User Manual



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## 1. DEVICE FUNCTION

The Oil Product Low-temperature Characteristics Meter (hereinafter referred to as OPLCM) is designed for determination of cloud point temperature of diesel fuel in laboratory and industrial conditions.

## 2. DEVICE PERFORMANCE SPECIFICATION

2.1	The device is manufactured in the form of a compact unit.	
2.2	Weight of device, kg	3.0
2.3	Overall dimensions, mm	275x275x95
2.4	Supply voltage, V	220 ±15%
2.5	Insulation resistance	20 megaohm
2.6	Disruption voltage	5 kilovolt
2.7	Consumed power, W	300
2.8	Operation conditions, °C	from + 10 up to + 30
2.9	Humidity	no more than 98%
2.10	Sinusoidal vibrations	20 Hz acceleration 50 g
2.11	Shock load	50 g
2.12	Mean-time-between-failures, hour	no less than 1000
2.13	Mean lifetime	6 years
2.14	Type of controlled fuel	diesel fuel
2.15	Sample volume	2,5 milliliter
2.16	Temperature span, °C	from + 5 to – 60
2.17	Precision of determination of cloud point temperature, °C	1
2.18	Reproducibility of the results of cloud point temperature determination, °C	3
2.19	Display	character representation
2.20	Measuring time, min	no more than 40
2.21	Pause between measurements, min	no less than 5
2.22	Flowing water, l/min	2÷5
2.23	Temperature span of flowing water, °C	+30 ÷ +5
2.24	Quality of test-tube glass	without scratches

## 3. DEVICE COMPONENTS

The main components of the device are the following (Picture 1):

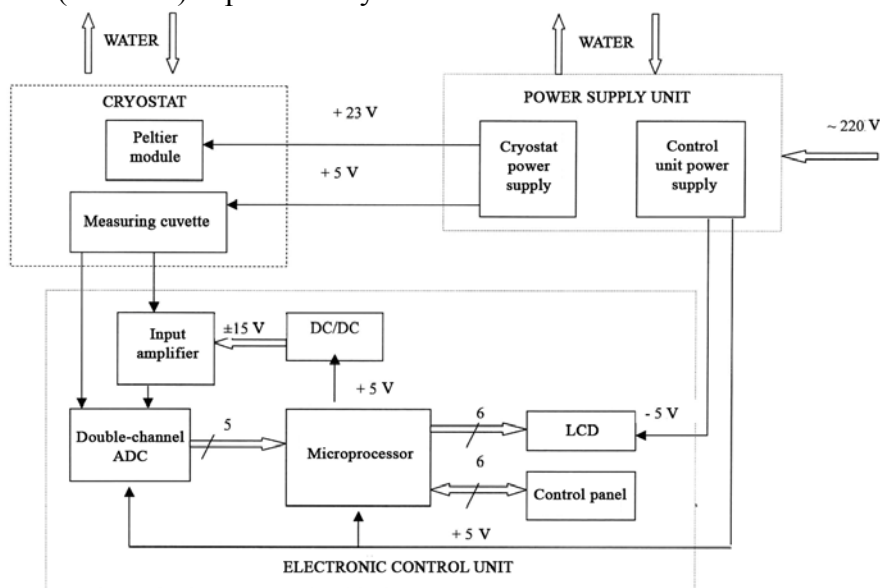
- measuring module;
- set of test-tubes;
- power cable;
- plug;
- hoses for water supply;
- set of spare parts under the list;
- set of operational documents under the list.

A hole meant for placing a sample test-tube into the cryostat is situated at the upper panel of the device.

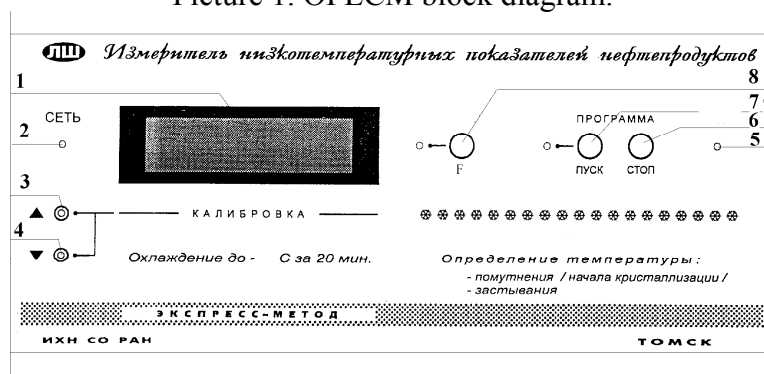
At the back panel of the device there are water supply outlets of the cryostat and power supply radiators, 220V power socket, and protective earthing terminals.

At the side panel of the device there is a power switch.

At the front panel of the device (Picture 2) the following control means are placed: 1 - screen of digital indicator (display), 2 - power indicator, 3 - correction button “▲”, 4 - correction button “▼”, 5 - signaling buzzer, 6 - STOP button, 7 - START button and light-emitting diode, 8 - FUNCTION button and light-emitting diode. The Oil Product Low-temperature Characteristics Meter (OPLCM) is powered by 220 V mains.



Picture 1. OPLCM block diagram.



Picture 2. Front panel of the device.

#### 4. DEVICE DESIGN AND OPERATION

The principle of operation of the Oil Product Low-temperature Characteristics Meter (OPLCM) is based on measurement of transmission capacity of diesel fuel at gradual lowering of temperature of a sample. Measurements and analysis of the result of these measurements are performed in real time by an electronic module.

4.1. The idea of this method consists in logging of amplitude of the infrared luminous flux emitted by one light-emitting diode and accepted by another light-emitting diode located on the other side of the test-tube with the sample.

4.2. The cloud point temperature is determined at the instant of cloudiness appearance of the sample that leads into reduction of the luminous flux.

4.3. The temperature of the sample is controlled by an electronic temperature sensor built in the cryostat.

4.4. Design of the device.

4.4.1. Separate function modules of the device are built into a common housing. These modules are the following: a switching power supply, a cryostat, a module of device control and displaying of the received information (Picture 1).

4.4.2. The switching power supply is mounted as a standard active oscillator circuit with the use of a ferrite core ring transformer. The controlling circuit is mounted with the use of three microcircuits of 561 series. 220V mains voltage is rectified by a diode bridge and a capacitor. 350V voltage comes from the rectifier output to a transistor-transformer transducer, which generates alternating voltage with 10 Hz frequency. The controlling circuit controls the transistors, at that at any moment one transistor is open, and another one is closed, in the following instant, on the contrary, the second transistor is open, and the first one is closed. The power supply generates four direct voltages: 23V 8A, 5V 0.5A, -5V 0.5A, 15V 1A.

4.4.3. The cryostat is mounted with the use of Peltier elements and is designed for cooling a sample of 2.5 ml volume up to temperature of -60°C. Cryostat supply is controlled by means of a pulse-width method for smooth and even cooling of the sample.

4.4.4. The main element of the electronic control module is two PIC16F628 microprocessors working synchronously from one timer. The device control microprocessor circuit generates controlling voltages for separate blocks of the circuit, processes the received information and displays the results on a character liquid-crystal display in the format easily understood by an operator.

## **5. MARKING**

Marking contents:

- Device name;
- Trademark or manufacturer name;
- Device code;
- Explanatory markings;
- Serial number of the device;
- Date of manufacturing.

## **6. OPERATION INSTRUCTIONS**

6.1. Before beginning operation of the device, carry out an external examination for the purpose of detecting malfunctions and defects which may arise during transportation and storage.

6.2. In the course of operation it is necessary to keep an eye on cooling water flow running through the cryostat radiator and its temperature as these parameters influence on cold-productivity of the cryostat.

6.3. Do not let the water run for a long time, when measurements are not performed, in order to prevent sweating of cryostat details.

6.4. It is prohibited to operate the device when fluid gets inside the housing.

6.5. To receive reliable results in case of replacement of the sample it is recommended previously to wash out the cuvette with a solvent and to dry it up, and then to fill up with the next sample.

6.6. To get precise results of measuring it is necessary to fill up with fuel of the volume specified in the certificate.

## **7. SAFETY INSTRUCTIONS**

7.1. Only the persons well-trained and examined in accordance with the electrical equipment operation requirements specified in chapters E1-3, operation and safety instructions are allowed to operate the device (Avtomizdat, Moscow, 1971).

7.2. In order to prevent electric injuries it is necessary to observe precaution rules.

7.3. It is necessary to avoid touching on the circuit elements in case of setting or adjustment of the switched-on device with the removed covers.

7.4. Before switching on the device it is necessary to check ground connection of the housing.

## 8. DEVICE PRE-STARTING PROCEDURES

- 8.1. The room, where the device is installed, must be equipped with a socket for connection of the device to 220V alternating current network with 50Hz and water supply from a domestic water pipeline or other sources of running water, for example, AOTs-Prognoz circulation cooler.
- 8.2. Connect the both radiators of the device to the water cooling.
- 8.3. Connect the device to the electrical supply network. Ground the housing of the device.
- 8.4. Prepare a sample, for this purpose do the following activities:
  - 8.4.1. if there is any water, oil product must be deaquated in accordance with GOST 20287-74;
  - 8.4.2. before testing fuel must be mixed by means of shaking;
  - 8.4.3. prepare a clean dry test-tube for testing;
  - 8.4.4. pour out the fuel to be tested into the test-tube half-filling it (height of the sample is 22mm);
  - 8.4.5. close the test-tube with the plug.
- 8.5. Place the prepared test-tube with the sample into the cryostat and leave it for 5 minutes to let the temperatures in the cryostat and the sample become equal.
- 8.6. Supply water to the cooling system of the device.
- 8.7. Switch on power supply by POWER toggle - switch at the side panel of the device. At the same time the following text appears on the display of the device: "Water". This text reminds the operator of the necessity to control the water supply.

## 9. MEASUREMENTS CONDUCTING

The device is ready for measurement.

- 9.1 Press START button and keep this button pressed until message "DIESEL" appears. Release the button. A correction number is displayed.
- 9.2 Press START button and keep this button pressed until the correction number disappears, and then release the button. A light signal value (A) and current temperature (T) are shown on the display of the device.
- 9.3 Press START button and keep this button pressed until the symbol "\*" will appear in the second line of the display. That means a command to switch on the cryostat for cooling. Cooling rate of the sample is controlled by the microprocessor and should not exceed 3 degrees per minute.
- 9.4 The current temperature of the sample and a value of the signal received from the detector of the device will be displayed on the screen of the device during the whole period of measurement every 6 - 8 seconds. The cryostat has 17 levels of cooling; switching to the last level is accompanied by a continuous buzzer signal.
- 9.5 At determining the cloud point temperature, the following message will appear on the display: "T1=xxxxx"<sup>1</sup>, where xxxxx is cloud point temperature. The device gives out a short series of discrete signals of the buzzer and switches off the cryostat ("\*" sign disappears). The measuring is over.
- 9.6 Read the results of the measuring. Write down the cloud point temperature (Tp) in a workbook.
- 9.7 Switch off the device by means of POWER toggle - switch and cut off the water supply.
- 9.8 The cryostat warms up during 5 - 10 minutes depending on the temperature of the cryostat. Take out the cuvette, pour out the sample, wash out and dry up the test-tube. The device is ready to repeat measurements.
- 9.9 Measurement results processing.

### 9.9.1. Accuracy of the method

An arithmetic average of the results of two parallel measurements is recognized as a result of the testing. The result is to be rounded off up to an integer.

### 9.9.2. Repeatability

Two results of measurements received by one operator in one laboratory are admitted authentic (at 95 % reliable probability level), if the divergence between them does not exceed 2°C.

### 9.9.3. Results reproducibility

Two results of testing received in two different laboratories are admitted authentic (at 95 % reliable probability level), if the divergence between them does not exceed 3°C.

9.9.4. An arithmetic average of the results of two parallel measurements of  $T_p$  - cloud point temperature, which is displayed on the OPLCM screen, is recognized as the cloud point temperature of the oil product being tested.

## 10. PERFORMANCE CHECK

The performance check of the device is conducted for the purpose of determination of its operability for further operation.

Order and content of the checks is established in accordance with Table 1.

Table 1. Order and content of performance checks.

№	What is to be checked, by means of what, checking procedures	Check interval	Objective
1.	Check of a cuvette state in accordance with item ___ of the present technical description.	Once a month	Oil products must not get into the cryostat cuvette. The cuvette must be clear and dry.
2.	Check of power turning-off in case of heating of the cryostat in accordance with item ___ of the present technical description.	Twice a year	The thermal protection program must turn off power in case of heating of the cryostat.
3.	Performance check of the cryostat in accordance with item ___ of the present manual.	Twice a year	The temperature achieved in the measuring cuvette for 20 minutes must not be lower than minus 60 degrees.
4.	Verification of device readings is carried out in accordance with section 9.8. of the present manual.	Twice a year	Readings of the device must not differ from the actual values more than by 2 degrees.

## 11. PROBABLE MALFUNCTIONS AND TROUBLESHOOTING

The most frequently happening or possible malfunctions are presented in Table 2.

Table 2. Device malfunctions and troubleshooting.

№	Malfunction	Probable malfunction cause	Remedy
1.	POWER indicator does not light.	The power supply system of the device is not switched on.	Switch off the device, and then switch on it again in 10-15 seconds.
2.	Extraneous symbols appear on the display of the device or the parameters of amplitude / temperature do not vary within 1 minute.	Power supply system failure	Switch off the device, and then switch on it again in 1 – 2 minutes.

№	Malfunction	Probable malfunction cause	Remedy
3.	Very crude error in determination of cloud point temperature	Equipment correction failure	Check correction number, perform correction (see Section II of the User Manual).
		Cracks, scratches on the test-tube	Replace the test-tube
		The volume of the sample essentially differs from the volume recommended in the Certificate (less).	Put the required volume of oil product and repeat measurements.
		Ingress of product in the cuvette of the cryostat	Wipe the cuvette of the cryostat with filter paper carefully.
		Presence of condensate in the cryostat	Open the cryostat and dry up the device during several hours. In order to prevent occurrence of the condensate, supply water only for the period of carrying out of the analysis.
4.	Sharp variation of amplitude and temperature of the sample from measuring to measuring.	High air humidity in the room. The device was under water cooling with the open cryostat for a long period of time.	Achieve decrease of the humidity in the room up to the normal conditions. Open the cryostat and dry up the device during several hours.

In case of detection of other malfunctions contact the manufacturer.

## 12. MAINTENANCE

12.1 Maintenance service is a basic kind of preventive works to maintain the device in a state of constant operability.

12.2 Forms of the maintenance service of the device are given in Table 3.

Table 3. Procedures and content of maintenance service.

№	Forms of maintenance service	Frequency of maintenance
1.	Maintenance check of the device in accordance with item 10 of the present manual.	As specified in section 10 of the present manual.
2.	Replacement of the glass test-tube in case of its transparency loss.	Once a half-year
3.	Replacement of the water hose in case of water leakage.	Once a year

### 13. MAKING CORRECTION OF DEVICE READINGS

The correction of device readings is carried out, if there is the necessity to perform additional adjustment of the device with the use of reference diesel fuel and for resetting of the correction number.

On switching on the device, the following message appears on the display:

**diesel**  
**+000**

The correction number in the bottom line of the screen: correction of temperature of the sample within the range of  $\pm 5$  °C. In case of the first switching on the preset value of the correction number is zero (on the display: “+000”). This number may be corrected / changed by the user. The record regarding the correction carried out must be made in a verification certificate.

For entering into correction mode, it is necessary to do the following:

1. switch on power of the device;
2. after appearance of “**diesel**” message and the correction number, press STOP button;

The following message will appear on the display:

**CORRECTION**  
**d = +/- xxx**

*Reset of correction number.*

In order to reset the correction number at zero it is necessary to press STOP button and keep it pressed until appearance of the following message:

**d = +000**

In order to quit the correction mode it is necessary to press START button and keep it pressed until appearance of the following message: “**end**”. In several seconds the device will come into the measuring mode.

*Input of correction number.*

The correction number is a number of degrees Celsius with a sign and decimal fractions, which is multiplied by 10. For example, it is necessary to change the indications of temperature by +3,3 °C. In this case the correction number will be equal to +033. Similarly, the correction number for -2,0 °C will be equal to -020. Entry of the correction number is performed with the use of the buttons ▼ and ▲ hidden under the front panel of the device and accessible through the appropriate holes.

Switch on the device, come into the correction mode. Using a thin screwdriver or a match press button “▲” (3, Picture 2), if you choose +, and press button “▼” (4, Picture 2), if you choose -, and keep this button pressed until the required number will be set on the display (with a sign!).

For the above-mentioned example:

**d = + 033**      or  
**d = - 020.**

To finish correction procedures press START button and keep it pressed until appearance of the following message: “**end**”.

Write down the correction number with its sign in the verification certificate.

At all following switching on the device, it is necessary to check the displayed correction number with the number written down in the verification certificate.

### 14. STORAGE RULES

4.1 The devices should be stored in a dry and heated room.

4.2 There must not be any corrosive dust and vapor in the storage room.

4.3 Environmental conditions of the storage room must meet the storage requirements stated in GOST 15150-69.

4.4 In case of long-term storage, routine inspections must be conducted at least once in two years.

## 15. PACKAGE AND TRANSPORTATION

15.1 The device is packed in a box prepared by the manufacturer.

15.2 The following items are placed into this box: OPLCM device, spare parts, device documentation.

15.3 Prepare the device for packaging as follows:

- take out the plug with the test-tube;
- disconnect the hoses, pour out water from the radiators;
- unscrew the container with test-tubes.

15.4 At packing into the shipping box packing materials must be used that can reduce vibration and prevent mixing inside the box.

15.5 The technical documentation placed in a damp-proof polyethylene package is put in the shipping box.

15.6 The packing list containing the list of enclosures is put in the shipping box.

15.7 Marking of the shipping container must be performed in accordance with GOST 14192-77 and contain a distinctive text and warning marks.

15.8 The devices may be transported by rail, air transport, and closed body vehicles.

15.9 It is prohibited to make any knocks and pushes during loading and unloading of the devices.

15.10 After transportation of the devices under negative temperature conditions it is necessary to keep them indoors at temperature of 20<sup>0</sup>C for at least 24 hours.

## 16. DEVICE CERTIFICATION

Certification is carried out by the factory accepting the device into operation for each device. Every device receives a certificate corresponding to the appropriate form.

## 17. INFORMATION ON ACCEPTANCE AND CERTIFICATION

The OPLCM device having factory number \_\_\_\_\_ corresponds to the technical specifications TU and is accepted as serviceable.

Locus sigilli

Date of manufacture \_\_\_\_\_

Quality Control Department representative \_\_\_\_\_

### CUSTOMER REPRESENTATIVE OPINION

The OPLCM device having factory number \_\_\_\_\_ corresponds to the technical specifications 4215-025-60283547-2005TU and is accepted as serviceable.

Locus sigilli

Customer representative \_\_\_\_\_

\_\_\_\_\_ Date

## **18. PACKAGE CERTIFICATE**

Date of packaging \_\_\_\_\_

Packer \_\_\_\_\_

## **19. PRODUCT WARRANTY**

- 19.1 The manufacturer guarantees device quality conformance to the present equipment certificate subject to observance of transportation, storage and operation conditions.
- 19.2 Warranty period of storage is 18 months from the date of device manufacture.
- 19.3 Warranty assurance is 12 months from the date of sale.
- 19.4 The warranty period is to be prolonged by the period of time from the moment of making a complaint (unsatisfactory equipment claim) up to putting the device into operation by the factory - manufacturer.
- 19.5 Warranty repair of the OPLCM device is carried out by the manufacturer.
- 19.6 The manufacturer is a sole proprietor SHATOX

## **20. INFORMATION ON UNSATISFACTORY EQUIPMENT CLAIM**

- 20.1. In case of detection of any defect during the warranty period and finding of shortage (at unpacking the device), the user must make a complaint to the factory - manufacturer.
- 20.2. The unsatisfactory equipment claim is not raised in the following cases:
  - a) when the warranty period has expired;
  - b) when the user has broken the rules of operation, storage, transportation provided for by the operation documentation.
- 20.3. Every detected defect and all repair works must be documented in the list of unsatisfactory equipment claim registration (Table 4).

## **21. INFORMATION ON PERIODICAL CERTIFICATION**

- c) Periodical certification is carried out every year.
- d) A certificate is written out for the period of one year.