DKG-21 M
PERSONAL GAMMA RADIATION DOSIMETER

Operating manual

ВІСТ.412118.023-02 РЭ

CONTENTS

This operating manual of BICT.412118.023-02 РЭ type is intended to inform the user about the principles of operation and rules of application of DKG-21 M personal gamma radiation dosimeter. The manual contains all information necessary for proper use of the DKG-21 M dosimeter (hereinafter called the dosimeter) and full realization of its technical possibilities.

Before operating the dosimeter, the user should be instructed on safety engineering and radiation safety, and should study this operating manual.

1 GENERAL GUIDELINES

1.1 Carefully study the operating manual (hereinafter referred to as the OM) before using the dosimeter.

1.2 The OM should always be kept with the dosimeter.

1.3 All records in the OM should be accurate and clear. Notes made in pencil, erasures and uncertified corrections are not allowed.

1.4 When the dosimeter is handed over to another company, summary records on operation shall be certified with the seal of the company, which transfers the dosimeter.

2 MAIN INFORMATION ABOUT THE DOSIMETER

The dosimeter meets the ТУ У 33.2-22362867-010:2007 technical requirements.

The dosimeter is intended to be used as a stand-alone device or as part of the automated system of personal dosimetry control ASPDC-21 (hereinafter – the ASPDC) registered in the State Register for Measuring

Instruments, and is accepted for application in Ukraine under No. У1816-07.

The dosimeter contains no precious materials.

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3 DESCRIPTION AND OPERATION

3.1 Purpose of use

3.1.1 The dosimeter is designed to measure individual dose equivalent $H_p(10)$ of gamma and X-ray radiation (hereinafter – DE) and individual dose equivalent rate $\dot{H}_p(10)$ (hereinafter – DER) of gamma and X-ray radiation, as well as support the automated database of radiation burden to the personnel in the ASPDC.

3.1.2 The dosimeter can be used at industrial enterprises and companies that deal with gamma sources.

3.2 Technical specifications

3.2.1 DER measurement range varies from 0.1 μSv/h to 1.0 Sv/h.

3.2.2 DER indication range of varies from 0.01 μSv/h to 1.0 μSv/h.

3.2.3 Main relative permissible error limit of DER measurement with 0.95 confidence probability is:

- ±20 % - in the DER range of 1.0 to 10 μSv/h;
- ±15 % - in the DER range of 10 μSv/h to 1.0 Sv/h.

3.2.4 DE measurement range varies from 0.001 to 9999 mSv.

3.2.5 Main relative permissible error limit of DE measurement with 0.95 confidence probability is ±15 %.

3.2.6 Complementary relative permissible error limit of DER and DE measurements caused by ambient temperature change from -20 to + 50 ^{0}C is ±5 % per each 10 ^{0}C of deviation from + 20 ^{0}C.

3.2.7 Energy range of registered gamma and X-ray radiation is from 0.05 to 6.00 MeV.

3.2.8 Energy dependence of DER and DE measurements in the energy range of 0.05 to 1.25 MeV relative to 0.662 MeV energy is not more than ± 25 %.

3.2.9 Anisotropy at gamma quantum incidence at solid angle of $\pm 60^0$ relative to the main measurement direction (perpendicular to the back panel of the dosimeter that is marked with the “+” symbol), not more than:

- ±25 % - for ^{137}Cs and ^{60}Co radionuclides;
- ±85 % - for ^{241}Am radionuclide.

3.2.10 Time of operating mode setting at DER measurement, not more than:

- from $1 \cdot 10^{-6}$ Sv/h to $5 \cdot 10^{-6}$ Sv/h (inclusive), maximum 30 minutes;

- from $5 \cdot 10^{-6}$ Sv/h to $2 \cdot 10^{-5}$ Sv/h (inclusive), maximum 5 minutes;

- from $2 \cdot 10^{-5}$ Sv/h to 1.0 Sv/h, maximum 3 min.

3.2.11 Time of continuous operation of the dosimeter, which is charged from a new battery under normal radiation background, is at least 4000 hours.

3.2.12 Unstable readings during an 8-hour continuous operation is not more than ± 5 %.

3.2.13 The dosimeter is powered from DC source of 2.4 to 3.2 V voltage and capacity of 560 mAh.

Note – Nominal supply voltage – 3 V.

3.2.14 Current consumption of the dosimeter at nominal voltage under normal radiation background is not more than 0.4 mA.

3.2.15 Complementary relative permissible error limit of measurements caused by supply voltage deviation from the nominal voltage value, ranging from 3.2 to 2.4 V, is not more than ±10 %.

3.2.16 Dimensions of the dosimeter is not more than 98×58×18 mm (without a clip).

3.2.17 Weight is not more than 0.14 kg.

3.2.18 The dosimeter is resistant to the external impacts:

- temperature – from - 20 to + 50 ^{0}C;

- relative humidity – up to (95±3)% at + 35 ^{0}C temperature;

- atmospheric pressure – from 84 to 106.7 kPa.

3.2.19 Regarding the resistance and strength against external impacts, the dosimeter meets the requirements of group 1.14 of boreal climatic version according to

GOST B 20.39.304-76 with restrictions to low operating and ultimate temperature.

3.2.20 The dosimeter is resistant to the influence of atmospheric precipitation (rain).

3.2.21 The dosimeter is resistant to the influence of condensed atmospheric precipitation.

3.2.22 The dosimeter has “Clock” and “Alarm clock” operating modes.

3.2.23 The alarm clock rings during one minute.

3.2.24 DER and DE threshold level values with

discreteness of a unit of a programmable digit over the whole operating measurement range can be programmed in the dosimeter from the personal computer (hereinafter – the PC) and in manual mode with the help of control buttons.

3.2.25 The dosimeter sends audio and light signals if the preset DER or DE threshold levels are exceeded.

3.2.26 DER and DE values as well as DER or DE threshold level values alternately appear on the digital liquid crystal display (hereinafter – the LCD), indicating the correspondence of information.

3.2.27 The history record of dose accumulation during the preset time interval is contained in the nonvolatile memory of the dosimeter with the discreteness of the record change of 1 min in the range of 5 to 255 min with reference to real time.

3.2.28 The dosimeter supports transmitting the history record of dose accumulation to the PC via the infrared port.

The distance of positive exchange between the dosimeter and the infrared port adapter (hereinafter – the IRPA) is in the range from 0.1 to 0.3 m.

3.2.29 With the help of the PC the dosimeter supports:

- blocking the mode of power supply switch off until data reading procedure is finished;
- blocking the modes of indication (DER, DER threshold, DE threshold, clock and alarm clock); change (DER threshold, DE threshold) and correction of clock and alarm clock settings.

3.2.30 The LCD can be switched off automatically not later than in 5 min after the switching-on of the dosimeter provided that the current gamma background

is lower than the preset threshold level. At this point, none of the control buttons of the dosimeter should be pressed.

3.2.31 The dosimeter includes the mode of automatic power supply testing and its indication:

- power supply range from 2.5 to 2.6 V – segments (from 1 to 3) start blinking in the right upper corner of the LCD;

- power supply less than 2.4 V – four segments together with the indication of audio alarm on the LCD start blinking as well as audio alarm signal is annunciated.

3.2.32 The dosimeter provides for a self-test of the LCD and loudspeaker while it is switching on.

3.2.33 The dosimeter registers and its LCD displays the signs of DER exceeding the upper limit of the measurement range during its operation.

3.2.34 The dosimeter has a feature of storage in the non-volatile memory and transmission to ASPDC software the signs of DER exceeding the upper limit of the measurement range during its operation.

3.2.35 Design of the dosimeter provides its decontamination.

3.2.36 Reliability requirements

3.2.36.1 Mean time to failure, not less than 6000 hours.

Failure criterion is nonconformity to the requirements stated in 3.2.3.

3.2.36.2 Average operating life till the first major repair, not less than 10000 hours, and average service life, not less than 10 years.

Limit tolerance state criterion is deviation of parameters from the values stated in 3.2.3 that cannot be eliminated.

3.2.36.3 Average shelf life under conditions consistent with the requirements of GOST B 9.003-80 (if stored in heated rooms and unheated storehouses in the manufacturer's package) is 10 years.

3.2.36.4 Average period of failure recovery at the authorized repair center or on the manufacturer premises without time required for shipping and verification after repair is not more than 2 hours.

3.3 Delivery kit of the dosimeter

3.3.1 The delivery kit is presented in Table 3.1.

Table 3.1 – Delivery kit of the DKG-21 M dosimeter

Type	Item	Quantity
BICT.412118.023-02	Personal gamma radiation dosimeter DKG-21 M	1
CR 2450	Battery	1

Table 3.1 (continued)

Type	Item	Quantity
BICT.412118.023-02 РЭ	Operating manual	1
BICT.412915.018	Packaging	1
	Screwdriver	1
BICT.468353.014	USB/IrDA-adapter	Delivered in separate order
	CD Software	Delivered in separate order

3.4 Design and theory of operation

3.4.1 General information

The dosimeter is designed as a mono block with a built-in detector of gamma and X-ray radiation, with a printed circuit board equipped with a circuit of anode voltage formation, digital processing, control and indication, an infrared port of data exchange, and a battery.

The detector of gamma and X-ray radiation transforms gamma and X-ray radiation into the sequence of voltage pulses; the number of pulses is proportional to the registered radiation intensity.

The circuit of anode voltage formation, digital processing, control and indication supports:

- scaling and linearization of the counting response of the detector;
- measurement of DER by measuring the average pulse frequency of the detector output;
- measurement of DE by measuring the total amount of pulses of the detector output;
- measurement of real time;

- formation and stabilization of anode voltage of the detector;
- control of operating modes of the dosimeter;
- indication of measurement results.

Power for operation is supplied by a disk-type lithium battery of CR 2450 (Panasonic).

3.4.2 **Design description**

The dosimeter is designed as a flat rectangle plastic housing (Figure B), which consists of the front (1) and back (2) panels.

Three transparent windows are positioned on the upper part of the front panel. The LCD (3), the light-emitting diode indicator (4), as well as the optical system of the infrared port (5) are placed behind the windows.

Three acoustic holes (6) of the loudspeaker alongside the THRESHOLD (7) and MODE (8) control buttons are located in the middle of the front panel. The battery compartment, which is closed with the hermetic lid (9), is located at the bottom of the front panel.

The clip (10) is on the back panel to fasten the dosimeter to clothes. The mechanical center (11) of the detector, being under the lid, is also inscribed there.

3.4.3 **Operation of the dosimeter**

3.4.3.1 The dosimeter consists of the battery (B), the control buttons MODE and THRESHOLD, the circuit of digital processing and control (DPC), the anode voltage former for the detector of ionizing radiation (AVF), the detector control circuit (DCC), the non-volatile memory (NVM) the infrared port circuit (IrPC), the loudspeaker (LS) and the LCD.

MODE and THRESHOLD buttons are used for switching the dosimeter on, determining the appropriate mode of operation and programming of threshold levels of audio alarm.

The DPC is implemented on the basis of special processor and is used for control of the operating modes of the dosimeter, control of the anode voltage former, digital processing of pulse sequences from ionizing radiation detector, signals generation, which control the LCD, as well as indication of measurement modes symbols.

The AVF is built under the circuit of standby multivibrator with transformer multiplying of voltage, and serves to form the anode voltage + 400 V, required to operate the detector.

The DCC is implemented on the basis of a number of switching and regulating elements, and serves to regulate the “dead time” of the detector.

The NVM is implemented on the basis of EEPROM and serves to record the history of time and dosage.

A piezoacoustic converter is used as the LS.

It serves to produce audio signaling when the preset threshold levels of DER and DE are exceeded, as well when the alarm clock is triggered.

An energy compensated gas discharge Geiger-Muller counter is used as the ionizing radiation detectors (IRD). It is intended to detect gamma and X-ray radiation, the parameters of which are measured by the dosimeter.

The LCD is a multiplex type four-digit display and serves to visualize the results of measurements in different operating modes of the dosimeter.

3.4.3.2 The dosimeter operates as follows.

When switched off, the circuit of the dosimeter is in a micro consuming mode (μA units), which supports only the process of real time counting by the processor.

By briefly pressing the MODE button the processor switches to the active state, and outputs the control signals for AVF, which starts generating 400 V voltage for Geiger-Muller counter operation. At the same time, the processor is switched to the priority mode of DER measurement, as evidenced by the symbol of dimension “μSv/h” on the LCD.

While assessing the intensity of the pulse flow from the Geiger-Muller counter, the processor automatically sets the interval and sub-range of measurement. With the help of the DCC the processor normalizes the duration “dead time” with high precision each time the counter is initiated, which allows taking it into account in the applied algorithm of the pulse flow processing for linearization of the counting response and extension of the dynamic range of the Geiger-Muller counter. By successive short presses of the MODE button you can choose the relevant modes of the dosimeter.

In addition, each time the processor initiates indication of signs of relevant information in the form of corresponding symbols on the LCD. By pressing the THRESHOLD button in the corresponding measurement mode, the processor switches to the programming mode of threshold levels values sound of light and audio alarm triggering or correction of clock and setting the alarm time.

Turn off the dosimeter when used independently by pressing and holding down the MODE button for more than 4 seconds.

3.5 Labeling and sealing

3.5.1 Labeling complies with the Design Documentation BICT.412118.023-02.

3.5.2 The front panel of the dosimeter is inscribed with the:

- full name of the dosimeter;
- trademark of the manufacturer;
- a sign of a legally regulated Measurement Instrument in accordance with the Technical Regulations.

3.5.3 The back panel of the dosimeter is inscribed with:

- “Made in Ukraine”;

- name of the manufacturer;
- serial number of the dosimeter according to the numeration system of the producer enterprise;
- ingress protection rating of the housing – IP54 according to DSTU EN 60529:2018;
- mechanical center of the detector with “+” symbol;
- year of manufacture.

3.5.4 Labeling quality complies with Design Documentation and is maintained during service life under all conditions and modes, except for labeling done on the individual package.

3.5.5 The dosimeter accepted by the Quality Control Department (QCD) and prepared for packing, it is sealed with a special film seal, covering the screw heads, which fasten together the upper and the lower panels, or a paste seal in the hollow above the head of the fastening screw.

3.5.6 The container has the following inscriptions in accordance with GOST 14192-96:

- Name - “DKG-21 M Personal Gamma Radiation Dosimeter”;

- Month and year of manufacture;

- The main symbols (name of the consignee and destination);

- Additional symbols (name of the shipper and point of origin);

- Information symbols (gross and net weight in kg);

- Handling marks (No.1 “Fragile, handle with care”, No.3 “Keep dry”, No.11 “Top”).

3.5.7 Shipping container with the packed dosimeters is sealed by the QCD representative of the manufacturer.

3.6 Packing

3.6.1 Packing is performed in accordance with the Design Documentation BICT.412118.023-02.

3.6.2 The dosimeter is packed in a special cardboard box, which (together with the operating manual), in its turn, is placed in a transparent polyethylene package, welded after packing performed.

4 PROPER USE OF THE DOSIMETER

4.1 Operating limitations

4.1.1 Operating limitations are presented in Table 4.1.

Table 4.1 – Operating limitations

Name of operating limitations	Parameters of operating limitations
1 Ambient air temperature	From - 20 to + 50 ºС
2 Relative humidity	Up to (95±3) % at 35 ºС temperature
3 Influence of gamma and X-ray radiation	DER up to 10 Sv/h during 50 minutes

4.2 Preparation of the dosimeter for operation

4.2.1 Scope and order of external examination

4.2.1.1 Before using the dosimeter, unpack it and check if the delivery kit is complete. Examine for mechanical damages.

4.2.2 Rules and order of examination for operational readiness

4.2.2.1 Examine the control buttons before switching the dosimeter on.

4.2.2.2 Open the battery compartment and make sure the battery is inserted, connections are reliable, and there is no leakage of salts after durable storage of the dosimeter. In case there is a salt leakage, remove the battery. Clean it, if possible, or replace, if not. Insert the battery and close the battery compartment.

4.2.2.3 Please replace the battery if there are signs of the low battery on the LCD - three to four blinking segments of the battery symbol in the top right corner of the LCD when the dosimeter is switches on irrespective of the selected mode.

When completely discharged, all four segments of symbol are blinking and short beeps are generated, with a 4-second interval.

Note - Before installing a new battery, press and hold down the MODE button for at least 2 seconds.

4.2.3 **Guidelines on switching on and testing the dosimeter**

4.2.3.1 Prepare the dosimeter for operation. Do the following:

- unpack the dosimeter;

- open the battery compartment and insert the battery of CR 2450 type observing the polarity. The dosimeter should switch on and self-test the LCD and the loudspeaker for 2 s.

During the self-test, all segments of the LCD are highlighted and a single-tone beep is formed. If some LCD segments are not highlighted it indicates its failure. A malfunction of the loudspeaker is evidenced by the lack of sound signal.

As soon as the LCD self-test is finished, the dosimeter enters the DER measurement mode, as

evidenced by continuously displayed measurement units “μSv/h” on the LCD.

4.2.3.2 Press shortly the MODE button and make sure the dosimeter has entered the mode of DE indication. DE units of measurement expressed in “mSv” should appear on the LCD.

4.2.3.3 Press shortly the MODE button and make sure the dosimeter has entered the mode of real time indication, which is shown by a one-second blinking colon between the two pairs of the LCD digits.

4.2.3.4 Press shortly the MODE button and make

sure the dosimeter has entered the mode of the alarm clock setting, which is indicated by an unblinking colon between the two pairs of digits on the LCD. After setting the alarm clock (4.3.3.7) press shortly the MODE button to switch it on, which should be indicated by a “)))” symbol on the LCD.

4.2.3.5 Hold the MODE button pressed for 4 s to switch the dosimeter off.

4.2.4 **List of possible troubles and troubleshooting**

4.2.4.1 The list of possible troubles and troubleshooting is presented in Table 4.2.

Please record the possible troubles in the table of Annex F of the Operating Manual.

Table 4.2 - Possible troubles and troubleshooting

Trouble	Probable cause	Troubleshooting
1 The dosimeter does not switch on at pressing the MODE button	1 The battery is discharged 2 Poor contact between the battery and the battery compartment clamps	1 Replace the battery 2 Restore the contact between the battery and the clamps

Table 4.2 (continued)

Trouble	Probable cause	Troubleshooting
2 The “Err” symbol is displayed on the LCD after the battery has been replaced	Failure of the nonvolatile memory of the dosimeter	Send the dosimeter for repair to the manufacturer

Table 4.2 (continued)

Trouble	Probable cause	Troubleshooting
3 The “Err1” symbol is displayed on the LCD during operation of the dosimeter	Failure of the anode voltage former or the ionizing radiation detector	Send the dosimeter for repair to the manufacturer

4.2.4.2 At failure to eliminate the troubles presented in Table 4.2, or at detection of more complicated troubles, the dosimeter should be sent for repair to the manufacturer.

4.3 Use of the dosimeter

4.3.1 Safety measures

4.3.1.1 The dosimeter meets the safety requirements in accordance with DSTU EN 61010-1:2014.

4.3.1.2 The dosimeter contains electric circuits of voltage up to 400 V; demount the dosimeter when the power supply is switched off.

4.3.1.3 The dosimeter’s design excludes any electric voltages exceeding 42 V on the outside of the dosimeter.

4.3.1.4 A special protective jacket is used to prevent accidental contact with conductive parts.

4.3.1.5 Ingress protection rating is IP54 according to DSTU EN 60529:2018.

4.3.1.6 All works with the dosimeters should be performed in compliance with the requirements of valid rules and standards.

4.3.1.7 Disposal of the dosimeter should be performed in compliance with the general rules, i.e. metal is recycled or melted, and plastic parts are dumped.

Note. If the dosimeter is contaminated by any liquid or dry radionuclides and it is impossible to completely deactivate the device, the dosimeter should be buried as solid radioactive waste.

4.3.2 Operating modes of the dosimeter

4.3.2.1 The dosimeter operates in the following modes:

- switching the dosimeter on/off;
- measurement and indication of DER;

- programming of audio and light alarm threshold levels of DER;
- indication of DE to be measured;
- programming of audio and light alarm threshold levels of DE;
- indication and correction of real time;
- indication and correction of the alarm clock settings, switching the alarm clock on/off;
- power supply control;
- performance monitoring of the ionizing radiation detector.

4.3.3 **Operation procedure of the dosimeter**

4.3.3.1 **Switching the dosimeter on/off**

Press shortly the MODE button to switch the dosimeter on. When switched on the dosimeter is testing the LCD and the loudspeaker for 2 s. All LCD segments are highlighted and a one-tone sound signal is generated. If some LCD segments are not highlighted it is indicative of the LCD malfunction. No sound signal is indicative of the loudspeaker failure.

After LCD self-testing is finished the dosimeter switches to the mode of DER measurement, which is represented by continuously highlighted “μSv/h” units of measurement.

At the same time, the infrared port of the dosimeter is activated for 15 s. While the infrared port is active, you can perform the procedure of data exchange with the PC, programming of the threshold levels, intervals of dose history accumulation, and permit/prohibit certain operating modes of the dosimeter.

The blinking digits on the LCD indicate that the infrared port is active. As soon as data exchange with the PC is finished, the dosimeter starts accumulating dose history with the preset interval. Otherwise, the dosimeter starts operating in the stand-alone mode with integral dose accumulation without dose history accumulation.

Press the MODE button once again and hold it pressed for 4 s to switch the dosimeter off. If the dosimeter is switched on in the stand-alone mode, i.e. no data exchange with the PC is done, it will switch off. If during switching it on data exchange between the dosimeter and the PC took place, an attempt to switch the dosimeter off would only activate the infrared port for 15 s.

4.3.3.2 **Measurement of DER**

The mode of DER measurement is entered automatically after the dosimeter is switched on. This mode can be entered from any other operating mode by shortly pressing the MODE button. The units of measurement are expressed in μSv/h. The process of DER measurement accumulation and averaging will start after the dosimeter is switched on.

The process will continue up to 1600 s at DER values close to background. The data on the LCD will be updated each 10 s.

However, wait 2-3 minutes to get more reliable result. As the radiation intensity increases, the time of DER measurement averaging and the time of data updating on the LCD falls to minimum 2 s.

The units of measurement are expressed in μSv/h, mSv/h, and Sv/h.

The statistical error of the displayed DER measurement result is indicated by the blinking or steady decimal point.

The blinking point indicates that the statistical error of the indicated DER measurement result exceeds

maximum permissible error. Hence, the measurement result can be used only for rough evaluation of DER. The steady point informs that the statistical error of the DER measurement result is within the permissible range.

The main direction of the dosimeter when DER is measured is the direction perpendicular to the front (rear) panel of the dosimeter.

DER measurement result is considered to be the arithmetic mean of five last measurements in 8 min after the intensity of radiation is changed at DER levels in the range of 1.0 to 10.0 μSv/h, or within 2 min to 2 s for levels in the range of 10.0 μSv/h to 1.0 Sv/h.

Measurement intervals and subranges will be set automatically according to the intensity of registered radiation.

Note. The process of data averaging can be stopped forcedly for quick evaluation of DER. To do this, press and hold down the THRESHOLD button until “Clr” symbols appear on the LCD. Release THRESHOLD as soon as symbols are displayed. Rough evaluation of DER value will be displayed within 1 min.

4.3.3.3 Programming of audio and light DER alarm threshold levels

Audio and light alarm threshold levels of DER are programmed in the mode of DER measurement. Press the THRESHOLD button and hold it pressed for about 5 s to start programming. The low-order digit will start blinking on the LCD.

Set an appropriate value of the low-order digit by shortly pressing and releasing the THRESHOLD button. Press shortly the MODE button to proceed to programming of another digit, the latter will start blinking in its turn. The necessary value of the digit is set with short pressing and releasing the THRESHOLD button.

After the last digit is set and at next pressing of the MODE button, the LCD will blink four times, indicating that the value of threshold level has been fixed. The dosimeter will return to the mode of DER measurement.

The threshold level is stored in the nonvolatile memory of the dosimeter. Switching on and off and replacing the dosimeter’s battery does not change the threshold level.

Press the THRESHOLD button and hold it pressed not more than 2 s after a new threshold level value appears to check the value of the DER threshold level.

A blinking red LED and a two-tone audible alarm show that the programmed DER threshold level has been exceeded.

Important! If the process of the new threshold level programming is paused for more than 30 seconds (the user presses no buttons of the dosimeter), the dosimeter will automatically return to the mode of DER measurement. All changes made in the submode of new threshold level value programming will be canceled.

Notes

1 DER threshold level value of 1.0 μSv/h is set after the dosimeter is produced.

2 A preset zero value of the DER threshold level sets off the alarm system when the threshold level is exceeded.

4.3.3.4 **Indication of DE measurement**

Press shortly the MODE button to enter the mode of DE measurement indication from any other operating mode. This mode follows the mode of DER measurement.

The “mSv” symbol that appears on the LCD indicates you have entered the appropriate mode.

If during operation of the dosimeter DER exceeded the upper limit of the measurement range, the measured DE value may be incorrect (too low). In this case, a blinking decimal point in the mode of DE measurement indication may indicate to a possible incorrectness of DE value.

4.3.3.5 **Programming of audio and light DE alarm threshold levels**

Audio and light alarm threshold level of DE is programmed in the mode of DE measurement indication. Press the THRESHOLD button and hold it pressed for about 5 s to start programming. The low-order digit will start blinking on the LCD.

Set an appropriate value of the low-order digit by shortly pressing and releasing the THRESHOLD button. Press shortly the MODE button to proceed to programming of another digit, the latter will start blinking in its turn.

The necessary value of the digit is set with short pressing and releasing the THRESHOLD button.

After the last digit of the threshold level is set and at next pressing of the MODE button, the LCD will blink four times, indicating that the new value of the threshold level has been fixed, and the dosimeter will return to the mode of DE indication. The threshold level is stored in the nonvolatile memory of the dosimeter. Switching on and off and replacing the dosimeter's battery does not change the threshold level.

Press and hold the THRESHOLD button down for maximum 4 s after the threshold level value appears to check the value of the fixed DE threshold level.

Hold the THRESHOLD button pressed for more than 4 s to set the threshold value to zero. The low-order digit will start blinking at that indicating that a new threshold level value can be programmed.

A blinking red LED and a two-tone audible alarm show that the programmed DER threshold level has been exceeded.

To inform the user that the DE threshold level is likely to be quickly reached, the dosimeter sends an interrupted audio signal when 90 % of the programmed threshold level is achieved. Press any button to switch this audio alarm off.

Important! If the process of the new threshold level programming is paused for more than 30 seconds(the user presses no buttons of the dosimeter), the dosimeter will automatically return to the mode of DE measurement indication. All changes made will be canceled.

Note - The DE threshold level value of 0.000 mSv is set automatically after the dosimeter is produced indicating that the alarm is switched off.

4.3.3.6 **Setting the measure DE value to zero**

Setting DE measured value to zero is performed in the mode of DE measurement indication. To reset DE, simultaneously press and hold MODE and THRESHOLD until “CLr” symbols appear on the LCD of the dosimeter.

As soon as “CLr” symbols are displayed, release the MODE and THRESHOLD buttons.

Shortly press the MODE button to confirm the DE reset. The “CLr” symbols will blink three times and the dosimeter will return to the mode of DE measurement indication as a confirmation of reset.

To cancel reset, press shortly the THRESHOLD button, or do not press the buttons for 30 seconds (in this case, the dosimeter will automatically return to the mode of DE measurement indication).

4.3.3.7 **Indication and correction of real time**

Press shortly the MODE button to enter the mode of real time indication from any other operating mode. This mode follows the mode of indication of DE measurement.

It is indicated by a one-second blinking “:” symbol between the two pairs of the LCD digits.

The digits from the right to the left show the following: the first digit indicates minutes; the second one - tens of minutes; the third one - hours; the fourth one - tens of hours.

Press the THRESHOLD button and hold it down until two digits to the right from the “:” symbol start blinking to correct the value of real time. Release the button afterwards. The proper values of units and tens of minutes are fixed by further pressing and holding down the THRESHOLD button. The minutes can also be corrected by short pressing of the THRESHOLD button. Each pressing will change the value per unit. Press shortly the MODE button to correct the value of hours. The two digits to the left from the “:” symbol start blinking at that. The hour value correction is performed likewise. Press shortly the MODE button once again to exit the mode of real time correction.

Important! If the process of the clock settings correction is paused for more than 30 seconds (the user presses no buttons of the dosimeter), the dosimeter will automatically return to the mode of real time indication. All changes made will be canceled.

4.3.3.8 **Indication and correction of alarm clock settings**

Press shortly the MODE button to enter this mode from any other operating mode. This mode follows the mode of real time indication.

A non-blinking “:” symbol between the two pairs of digits on the LCD indicates you have entered the appropriate mode.

Press the THRESHOLD button and hold it down until the two digits to the right from the “:” symbol start blinking to correct the alarm clock settings. Release the button afterwards. Set the proper values of units and tens of minutes by further pressing and holding the THRESHOLD button. The minutes can also be corrected by short pressing of the THRESHOLD button. The value will change per unit each time in this case. Press shortly the MODE button to correct the value of hours. The two digits to the left from the “:” symbol start blinking at that. Hour values can be corrected likewise.

Press shortly the MODE button to switch the alarm clock on/off after setting the time of its triggering. A blinking sound symbol “)))” should appear on the LCD. Press shortly the THRESHOLD button; make the non blinking sound symbol appear on the LCD to switch the alarm clock on.

Press shortly the THRESHOLD button to switch the alarm clock off. The sound symbol should extinct. Fix the alarm clock settings by further short pressing of the MODE button. If the alarm clock is on, the sound symbol will be displayed on the LCD irrespective of the selected operating mode.

Important! If the process of the alarm clock setting is paused for more than 30 seconds (the user presses no buttons of the dosimeter), the dosimeter will automatically return to the mode of indication and correction of alarm clock settings. All changes made will be canceled.

Note - The alarm clock will continue working even after the power supply of the dosimeter is off (provided that the batteries are inserted). The dosimeter will automatically enter the mode of real time indication when the alarm clock goes off.

Press any control button to switch off audio signal of the alarm clock. Otherwise, audio signal will be disabled automatically in a minute after the alarm clock rings.

4.3.3.9 **Battery status control**

The mode of battery status control is turned on automatically at switching on the dosimeter. It is indicated by the four-segment battery symbol displayed in the right upper field of the LCD.

The number of segments blinking starting from the last right one shows the level of battery discharge.

Blinking of three and more segments means that the battery should be replaced with a new one.

4.3.3.10 **Operability check of the detector**

The mode of detector’s operability check is switched on as soon as the dosimeter is on. If the detector fails, the “Err1” symbol is displayed on the LCD, which means the dosimeter should be sent for repair.

5 TECHNICAL MAINTENANCE

5.1 Technical maintenance of the dosimeter

5.1.1 General instructions

The list of operations performed during technical maintenance (hereinafter called TM) of the dosimeter, the order and the peculiarities of operational phases are presented in Table 5.1.

Table 5.1 - List of operations during technical maintenance

Operations	TM type			OM item No.
	during		During long-term storage	
	everyday use	periodical use (annually)		
External examination	+	+	+	5.1.3.1
Delivery kit completeness check	-	+	+	5.1.3.2
Operability check	+	+	+	5.1.3.3
Power supply disconnection	-	+	+	5.1.3.4
Verification of the dosimeter	-	+	+	5.2
Note. “+” means the operation is applicable for this type of TM; “-” means the operation is not applicable.				

5.1.2 Safety measures

5.1.2.1 TM safety measures fully comply with safety measures stated in item 4.3.1 of the present OM.

5.1.3 Maintenance procedure of the dosimeter

5.1.3.1 External examination

External examination of the dosimeter should be performed in the following order:

- check the technical condition of surface, inspect for integrity of seals, absence of scratches, traces of corrosion, surface damage of the dosimeter;
- check the condition of clamps in the battery compartment.

5.1.3.2 Delivery kit completeness check

Check if the delivery kit is complete according to Table 3.1.

5.1.3.3 Operability check of the dosimeter.

Operability check of the dosimeter is performed according to item 4.2.3 of the present OM.

5.1.3.3.2 Procedure for pre-repair fault detection and rejection

The need to transfer the dosimeter for repair and the type of repair is determined by the following criteria:

- for mid-life repair:

a) deviation of parameters from control values during periodic verification of the dosimeter;

b) minor defects of the LCD that do not affect the correct readings of measurement results;

c) the lack of sound and light alarm;

- for major repair:

a) disability of measurement channel;

b) defects of the LCD that affect the correct readings of measurement results;

c) serious mechanical damage to the parts that affect the security access to the dosimeter circuit.

5.1.3.4 Power supply switch off

Power supply should be switched off before the long-term storage of the dosimeter. Do this as follows:

- switch the dosimeter off;
- open the lid of the battery compartment;
- remove the battery;
- examine the battery compartment, check the contact clamps accuracy, clean the battery compartment from contamination and contact clamps from oxides;
- make sure there is no humidity, no salt spots on the surface of the battery, and no damages of the insulated coating.

5.2 Verification

5.2.1 The DKG-21 M dosimeter should be verified after manufacture, repair or during use.

IMPORTANT! Devices used in the automated dosimetry control system and are handed over for verification must be unlocked as regards the prohibition of access to all their modes of operation (indication of individual dose equivalent, individual dose equivalent rate, programming of alarms triggering by threshold levels of individual dose equivalent and its rate).

5.2.2 The interval between verifications should not exceed 12 months.

5.2.3 Verification operations are presented in Table 5.2.

Table 5.2 - Verification operations

Operation name	Verification technique No.
External examination	5.2.7.1
Testing	5.2.7.2
Calculation of main relative permissible error limit of DER measurement in the DER range of 1.0 μSv/h to 1.0 Sv/h	5.2.7.3, 5.2.7.4
Calculation of main relative permissible error limit of DE measurement	5.2.7.3, 5.2.7.5
Presentation of verification results	5.2.7.6

5.2.4 Verification facilities are presented in Table 5.3.

Table 5.3 - Verification facilities

Name	Regulatory Document or Main Technical Specifications
УПГД-3Б testing equipment	DER range from 0.01 μSv/h to 1 Sv/h. Energy range from 59 KeV to 1.25 MeV. Main relative permissible error limit of DER and DE measurements is 4 % at 0.95 confidence probability

Table 5.3 (continued)

Name	Regulatory Document or Main Technical Specifications
Phantom	Dimensions: 30 × 30 × 15 cm; PMMA walls (polymethylmethacrylate, front wall thickness – 2.5 mm, other walls thickness – 10 mm); phantom is filled with distilled water
Control aneroid barometer M-67	Л62.832.003 ПС. Pressure measurement range from 81.3 to 105.3 kPa (from 610 to 790 mm Hg). Pressure measurement error is ± 0.107 kPa (0.8 mm Hg)

Table 5.3 (continued)

Name	Regulatory Document or Main Technical Specifications
Aspiration psychrometer MB-4M	ЛІ82.844.000 ПС. Temperature measurement range from - 30 °C to + 50 °C. Temperature measurement error is ± 0.1 °C. Relative humidity measurement range from 10 to 100 %. Relative humidity measurement error from ± 12 % at t = - 10 °C to ± 2 % at t = 30 °C

Table 5.3 (continued)

Name	Regulatory Document or Main Technical Specifications
Stop-watch	Measurement range from 1 s to 59 min
Notes 1. Measurement equipment shall be applied according to the law in the field of metrology and metrological activity. 2 Use of other measuring instruments, tools and equipment with specifications similar to those outlined in Table 5.3 is allowed.	

5.2.5 Verification should be performed in accordance with safety measures presented in 4.3.1 of the OM.

5.2.6 Verification conditions

Verification should be performed under the following conditions:

- ambient air temperature range within (20±5) °C;
- relative air humidity from 30 to 80 %;
- atmospheric pressure from 86 kPa to 106.7 kPa;
- natural background level of gamma radiation should not exceed 0.3 μSv/h;
- power supply voltage within (3.0±0.2) V.

5.2.7 **Verification procedure**

5.2.7.1 External examination

5.2.7.1.1 During external examination the dosimeter should meet the following requirements:

- the delivery kit should be completed as stated in Table 3.1;
- labeling should be accurate;
- QCD seals should not be violated;
- the dosimeter should be free from mechanical damage that may affect its performance.

5.2.7.1.1.2 If the requirements in 5.2.7.1.1 are satisfied, proceed to the next verification operation.

5.2.7.1.1.3 If the delivery kit is not completed as stated in Table 3.1, verification should be stopped until the delivery kit is complete.

5.2.7.1.1.4 If labeling and sealing requirements are not satisfied, and the dosimeter has the signs of mechanical damages that affect its performance, it cannot be verified and should be sent for repair.

5.2.7.2 Testing

5.2.7.2.1 Perform operations stated in 4.2.3.

5.2.7.2.1.1 If all operations stated in 4.2.3 are performed, proceed to the next test operation.

5.2.7.2.1.2 Even if a single operation stated in 4.2.3 cannot be performed, the dosimeter should not be verified and should be sent for repair.

5.2.7.3 DER and DE measurements should be performed on the phantom with 30x30x15cm dimensions, with PMMA walls (polymethylmethacrylate, front wall thickness - 2.5 mm, other walls thickness – 10 mm); the phantom should be filled with distilled water.

5.2.7.3.1 During measurement the dosimeter should be placed close to the phantom surface, directed to gamma source. The indicator of the dosimeter should be directed towards gamma source.

5.2.7.4 Calculation of main relative permissible error limit of DER measurement is performed as follows.

5.2.7.4.1 Prepare the dosimeter for DER measurement and program zero value of DER threshold level.

5.2.7.4.2 Fix the dosimeter on the phantom according to item 5.2.7.3 in the УПГД-3Б carriage so that the mechanical center of the УПГД-3Б collimator coincides with the mechanical center of the detector. Take five measurements of background DER ($\dot{H}_{рфi}$ (10)) in УПГД-3Б with 10 s interval in thirty minutes after the dosimeter is switched on. Calculate the average DER value in μSv/h by the formula:

$$\overline{\dot{H}}_{p\phi}(10) = \frac{\sum_{i=1}^{10} \dot{H}_{p\phi i}\ (10)}{5} \qquad (5.1)$$

5.2.7.4.3 Place the УПГД-3Б carriage together with the phantom and the dosimeter in the position, where DER from the source with ^{137}Cs radionuclide is $\dot{H}_{p0}(10)$ = (8±1) μSv/h. Take five measurements of DER with 10 s interval in eight minutes after irradiation of the dosimeter was started.

Calculate the average DER value ($\overline{\dot{H}}_{p\Sigma}(10)$ by the formula (5.1). Calculate the DER value without gamma background DER of the УПГД-3Б by the formula

$$\overline{\dot{H}}_{p}(10) = \overline{\dot{H}}_{p\Sigma}(10) - \overline{\dot{H}}_{p\phi}(10) \qquad (5.2)$$

Note - The distance between the mechanical center of the source and the mechanical center of the dosimeter's detector is considered to be the distance between the mechanical center of the source and the plane, which is perpendicular to the direction of gamma-quanta beam

spreading, and passes through the mechanical center of the dosimeter in this plane.

5.2.7.4.4 Calculate the main relative permissible error limit of DER measurement in percentage following the procedure according to recommendations of DSTU GOST 8.207:2008.

5.2.7.4.5 Perform operations 5.2.7.4.3, 5.2.7.4.4 for DER $\dot{H}_{p0}(10)$ = (8±1) μSv/h in 3 minutes after the dosimeter irradiation start provided that DER measurement time is 5 s, n = 5 and t = 2.78.

5.2.7.4.6 Perform operations 5.2.7.4.5 for DER $\dot{H}_{p0}(10)$ =(900±100) mSv/h.

5.2.7.4.7 Maximum value of all received errors is the limit of main relative permissible error of DER measurement.

5.2.7.4.8 If the main relative permissible error limit of DER measurement at 0.95 confidence probability does not exceed:

- 20 % in the DER range of 1.0 to 10 μSv/h;
- 15 % in the DER range of 10 μSv/h to 1.0 Sv/h,

proceed to the next verification operation.

5.2.7.4.9 If the main relative permissible error limit of DER measurement does not meet the requirements stated in 5.2.7.4.8, the dosimeter cannot be verified and should be sent for repair.

5.2.7.5 Calculation of the main relative permissible error limit of DE measurement in the DER range of 1.0 μSv/h to 1.0 Sv/h, in the DE range of 0.01 to 9999 mSv is performed as follows.

5.2.7.5.1 Prepare the dosimeter for DE measurement. The initial DE readings should be “0.000 mSv”.

5.2.7.5.2 Fix the dosimeter on the phantom as stated in 5.2.7.3 in the УПГД-3Б carriage so that the mechanical center of the УПГД-3Б collimator coincides with the mechanical center of the dosimeter’s detector.

5.2.7.5.3 Prepare the dosimeter for DE measurement and place the УПГД-3Б carriage together with the phantom and the dosimeter in the position, where DER from the source with ^{137}Cs radionuclide is

$\dot{H}_{p0}(10)$ = (80±10) μSv/h and at the same time switch on the stop-watch and place the source into the collimator.

5.2.7.5.4 In the period of time (according to the stop-watch) expressed in seconds and calculated by the formula $t = 3600 + t_{\partial}$, where t_{∂} is the period of time expressed in seconds used to place the source into the collimator, take DE measurement result. Switch the dosimeter off afterwards.

5.2.7.5.5 Calculate the limit of main relative

permissible error of DE measurement in percentage by the formula

$$\delta H_p(10) = 1{,}1\sqrt{\left(\frac{H_p(10) - H_{p0}(10)}{H_{p0}(10)}\right)^2 + \left(\frac{\delta H_{p0}(10)}{2}\right)^2}, \quad (5.3)$$

where $H_{p0}(10) = \dot{H}_{p0}(10) \cdot t$ - DE of УПГД-3Б equipment;

$\delta H_{p0}(10) = \sqrt{\left(\delta \dot{H}_{p0}(10)\right)^2 + \left(\delta t\right)^2}$ - main relative permissible error limit of DE of УПГД-3Б equipment;

$$\delta t = \frac{1.1\sqrt{(\Delta t_c)^2 + (\Delta t_p)^2 + (\Delta t_д)^2}}{t}$$ - main relative permissible error limit of DE exposure time measurement that should not exceed 5 %;

Δt_c - permissible error limit of the stop-watch;

Δt_p = 1 c - error caused by response of a user;

$\Delta t_д$ = 1 c - error caused by the process of placing the source into the collimator.

5.2.7.5.6 The result of the dosimeter verification is considered positive if the main relative permissible error limit of DE measurement at 0.95 confidence probability does not exceed 15 %.

5.2.7.5.7 If the limit of main relative permissible error of DE measurement does not meet the requirements stated in 5.2.7.5.6, the dosimeter cannot be verified and should be sent for repair.

5.2.7.6 Presentation of verification results

5.2.7.6.1 Positive results of periodic verification and verification after repair are registered in the Table of Appendix F, or by issuing a certificate of verification of legally regulated measuring equipment.

5.2.7.6.2 If the dosimeter is recognized inapplicable for use as a result of verification, it gets the certificate of inadequacy.

6 STORAGE

6.1 The dosimeters should be stored packed under conditions according to category 1 (Л) GOST 15150-69, safe from mechanical damage in dry, ventilated and clean storehouses at the ambient temperature from +5 to +40 °C and relative humidity up to 80 % at + 25 °C temperature. The storehouse should be free of dust, vapors of acids, alkali and gas that may cause corrosion.

6.2 Maximum shelf life of the dosimeters in packing is 3 years.

7 SHIPPING

7.1 Conditions of the dosimeter shipping comply with GOST 15150-69.

7.2 Packed dosimeters may be shipped in any kind of closed vehicles in compliance with conditions 4 (Ж2) GOST 15150-69 (ambient air temperature from - 30 to + 50 °C; relative humidity up to 100 % at + 35 °C) when the following rules are observed:

- by railway transport – in a clean box car;
- by air transport – in pressurized compartments;

- by water transport – in a dry hold;
- by motor transport – in a closed car.

7.3 The dosimeters in shipping container should be placed and fixed in the vehicle to ensure their stable position throughout the way without displacement, and to avoid shocks.

7.4 Observe the inscriptions on the shipping container at loading and unloading the dosimeters.

7.5 The dosimeters must not be exposed to the influence of atmospheric precipitations during loading-unloading.

7.6 The dosimeters may be delivered by parcel post in conformance with the rules established by the Ministry of Infrastructure of Ukraine, as well as applicable international rules.

8 DISPOSAL

Disposal of the dosimeter is performed in compliance with DSTU 4462.3.01, DSTU 4462.3.02, the Laws of Ukraine “On Environmental Protection” and “On Waste”, i.e. metals are recycled or melted, and plastic parts are dumped.

Note - If the dosimeter is soiled by liquids or dry radionuclides, and it is impossible to completely decontaminate it, it should be buried as solid radioactive waste at the enterprises of UkrDO Radon, or other applicable facilities.

9 WARRANTY

9.1 The manufacturer guarantees the conformity of the dosimeter to the ТУ У 33.2-22362867-010:2007 technical requirements provided that the customer observes the guidelines for its use, shipping and storage conditions presented in the ВІСТ.412118.023-02 РЭ operating manual.

9.2 The warranty period of the dosimeter use shall terminate and be of no further effect in 24 months after the date of putting it into operation or after the warranty period of storage terminates.

9.3 The warranty period of storage of the dosimeter

is 6 months after its manufacture date.

9.4 The warranty period is prolonged for the time when the dosimeter has been under warranty repair.

9.5 Warranty is invalid in case of use, shipping and storage violations, any mechanical damages, or if the warranty seals are violated. In this case, the repair is performed at the user’s expense.

9.6 After the warranty period terminates, the repair of the dosimeter is performed under separate contracts.

9.7 Warranty and post-warranty repair is done only by the manufacturer.

10 PACKING CERTIFICATE

The DKG-21 M personal gamma radiation dosimeter of BICT.412118.023-02 type with _____ serial number is packed by the Private Enterprise “SPPE “Sparing-Vist Center” in accordance with the requirements specified in ТУ У 33.2-22362867-010:2007.

_____ _____

(position) (signature / print full name)

_____

(year, month, date)

11 CERTIFICATE OF ACCEPTANCE

The DKG-21 M personal gamma radiation dosimeter of BICT.412118.023-02 type with _____serial number is manufactured to meet the technical requirements specified in ТУ У 33.2-22362867-010:2007, and is accepted for use.

QCD head _____

(signature / print full name)

Stamp here

12 PERFORMANCE RECORDS OF THE DOSIMETER

12.1 Performance records of the dosimeter are provided in Table 12.1.

Table 12.1

Date	Purpose	Period		Duration	Who operated	Signature	Note
		Start	End				

13 CLAIMS

13.1 In case of failure or troubles during the warranty period of the dosimeter, the user should draw up a statement of claim and send the dosimeter to the producer-enterprise.

13.2 All claims are registered in the Table 13.1.

Table 13.1

Date of failure	Claim summary	Action taken	Note

14 ACCEPTANCE AND WARRANTY

The DKG-21 M personal gamma radiation dosimeter of BICT.412118.023-02 type with _____ serial number, repair type _____made by the manufacturer PE “SPPE “Sparing-Vist Center” is accepted in accordance with the requirements specified in ТУ У 33.2-22362867-010:2007 and acknowledged fit for use.

Life till scheduled repair_____during service life _____ years,

shelf life included _____

PE “SPPE “Sparing-Vist Center” guarantees the conformity of the dosimeter to the technical requirements specified in ТУ У 33.2-22362867-010:2007 provided that the customer observes the requirements of the operating manual.

QCD head _____

(signature / print full name)

Stamp here _____

(year, month, date)

APPENDIX A

Anisotropy of DKG-21 M dosimeter (vertical plane)

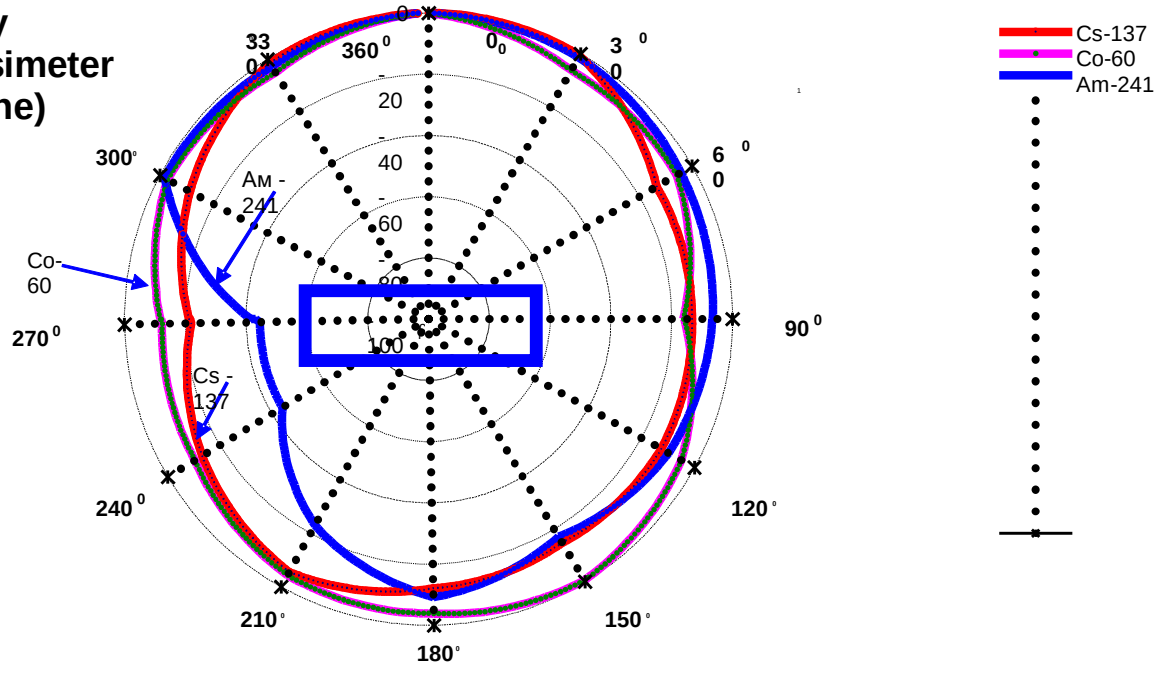

Figure A.1

Anisotropy of DKG-21 M dosimeter (horizontal plane)

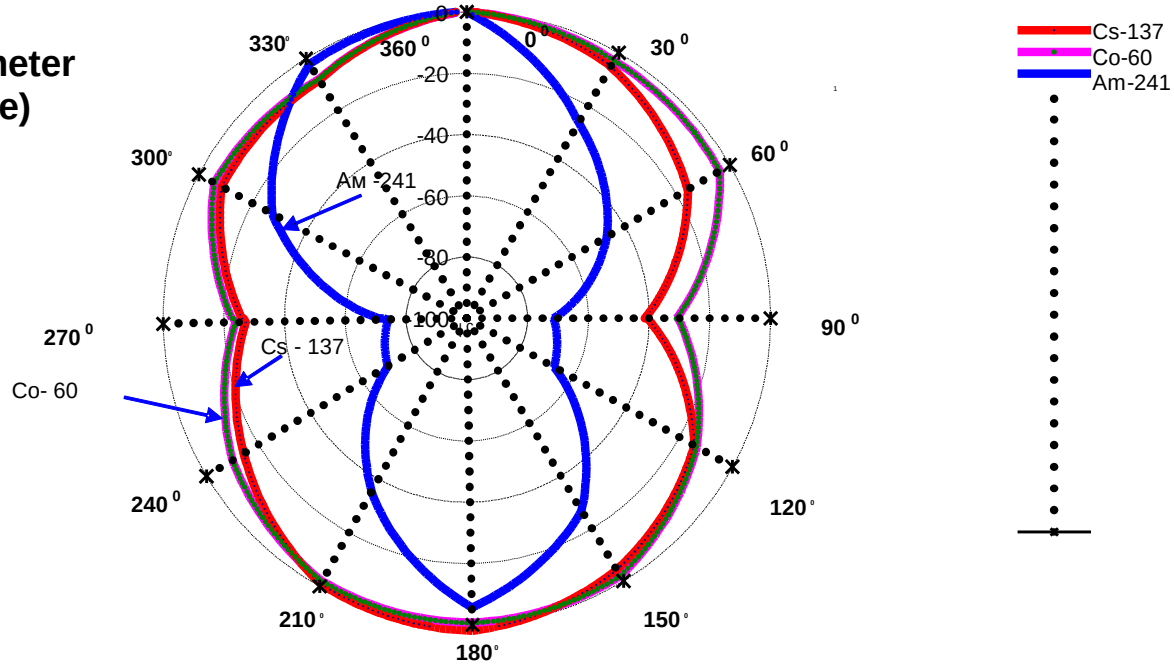

Figure A.2

APPENDIX B

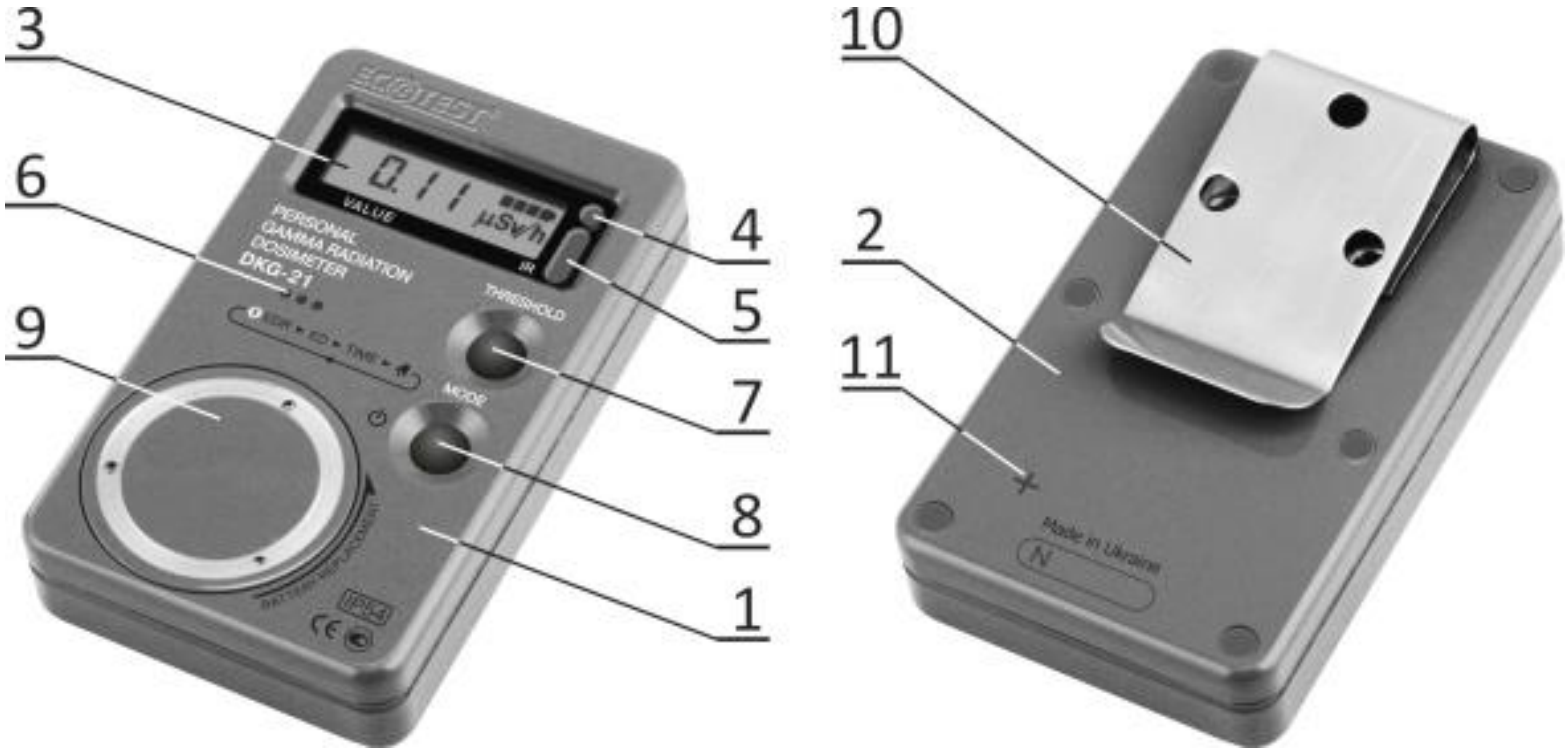

Figure B – Appearance of the dosimeter

APPENDIX C

PUTTING IN PROLONGED STORAGE AND REMOVAL FROM STORAGE

Date of putting in prolonged storage	Method	Date of removal from storage	Name of the enterprise in charge of putting the unit in prolonged storage or removing from storage	Date, position, and signature of the responsible official

APPENDIX D

STORAGE

Date		Storage conditions	Position, name and signature of the responsible official
of placing in storage	of removing from storage		

APPENDIX E
TROUBLE RECORD DURING USE

Date and time of trouble Operating mode	Type (external manifesta-tion) of trouble	Cause of trouble, number of operation hours of the failed element	Action taken and claim note	Position, name and signature of the person responsible for solving the problem	Note

APPENDIX F

VERIFICATION OF KEY SPECIFICATIONS			
Verified specification		Date of measurement	
Name	Value according to specification	year 20	
		Actual value	Measured by (position, signature)
1 Main relative error limit of DER measurement with confidence probability of 0.95, % in the DER range: - of 1.0 μSv/h to 10 μSv/h - of 10 mSv/h to 1.0 Sv/h	 ±20 % ±15 %		

APPENDIX F

F-1

Date of measurement					
year 20		year 20		year 20	
Actual value	Measured by (position, signature)	Actual value	Measured by (position, signature)	Actual value	Measured by (position, signature)

APPENDIX F

VERIFICATION OF KEY SPECIFICATIONS			
Verified specification		Date of measurement	
Name	Value according to specifi-cation	year 20	
		Actual value	Measured by (position, signature)
2 Main relative error limit of DE measurement with 0.95 confidence probability	±15 %		

APPENDIX F

F-2

Date of measurement					
year 20		year 20		year 20	
Actual value	Measured by (position, signature)	Actual value	Measured by (position, signature)	Actual value	Measured by (position, signature)

APPENDIX G

REPAIR

Name and type of the component part	Reason for repair	Date		Name of the repair organization
		of arriving for repair	of completion of repair	

APPENDIX G

REPAIR

Number of hours worked before repair	Type of repair (midlife, major, etc.)	Name of repair works	Position, name and signature of the responsible person	
			who performed repair	who accepted after repair

APPENDIX H
VERIFICATION AND INSPECTION RESULTS

Date	Verification or inspection type	Verification or inspection result	Position, name and signature of the verification officer	Note

LIST OF ABBREVIAITONS

ASPDC	- automated system of personal dosimetry control
LS	- loudspeaker
IRD	- ionizing radiation detector
DER	- individual dose equivalent rate
PC	- personal computer
SW	- software
DCC	- detector control circuit

IrPC - infrared port circuit
DPC - digital processing and control circuit
AVF - anode voltage former
LCD - digital liquid crystal display
DE - individual dose equivalent
NVM - nonvolatile memory
B - battery