EPD-27
ELECTRONIC PERSONAL DOSIMETERS

Operating Manual

BICT.412118.046-01 HE

CONTENTS

This operating manual (OM) is intended to give insights into the principle of operation of the EPD-27 "DoseG", EPD-27 "DoseGX" Electronic Personal Dosimeters, their procedure of operation, and contains all the information necessary for comprehensive utilization of their technical capabilities and their proper use.

The following abbreviations and designations are used in the OM:

DE	- individual dose equivalent;
DER	- individual dose equivalent rate;
UAS	- unified access station from the kit of SHS(u)ASIDC;
SHS(u)ASIDC	- software and hardware suite (unified) of the automated systems of individual dosimetry control of personnel;

SCD	- storage and charging device;
SAA	- strict access area;
LCD	- liquid crystal display.

1 DESCRIPTION AND OPERATION

1.1 Purpose of use of the dosimeter

Electronic personal dosimeters EPD-27 are made in two modifications (see Table 1.1):

Table 1.1

Designation	Code
BICT.412118.043-01	EPD-27 "DoseG"
BICT.412118.043-03	EPD-27 "DoseGX"

EPD-27 "DoseG", EPD-27 "DoseGX" Electronic Personal Dosimeters are designed for use as part of an automated system of individual dosimetry control and a stand-alone use in order to:

- measure the individual dose equivalent $H_p(10)$ (DE) of gamma and X-ray radiation;

- measure the individual dose equivalent rate $\dot{H}_p(10)$ (DER) of gamma and X-ray radiation (hereinafter – photon ionizing radiation);
- monitor the duration of stay of the personnel in the area under control;
- managing an automated database of radiation burden on personnel within the software and hardware suite (unified) of the automated system of individual dosimetry control of personnel.

The Electronic Personal Dosimeter "DoseG" (EPD-27 "DoseGX") (hereinafter – the dosimeter) can be used at nuclear power plants, in medicine, industry, radiological laboratories and institutions that deal with sources of photon ionizing radiation.

The dosimeter meets the requirements of the international standard IEC 61526:2005.

1.2 Technical Specifications

1.2.1 Key technical data and specifications are given in Table 1.2 and Table 1.3.

Table 1.2 - Key metrological and technical data and specifications of EPD-27 "DoseG" dosimeter

Name	Unit of measurement	Value
1	2	3
Measurement and indication range of gamma radiation DE	Sv	from $1 \cdot 10^{-7}$ to 10
Main relative permissible error limit when measuring gamma radiation DE at ^{137}Cs calibration with a confidence probability of 0.95 within the range of $1 \cdot 10^{-6}$ Sv to 10 Sv	%	15

Table1.2 (continued)

1	2	3
Measurement and indication range of gamma radiation DER	Sv/h	from $1\cdot10^{-6}$ to 10
Main relative permissible error limit when measuring gamma radiation DER at ^{137}Cs calibration with a confidence probability of 0.95: – in the range from $1\cdot10^{-5}$ Sv/h to $1\cdot10^{-3}$ Sv/h (inclusive) – in the range from $1\cdot10^{-3}$ Sv/h to 10 Sv/h	%	 20 15

Table1.2 (continued)

1	2	3
Energy range of detected gamma radiation	MeV	from 0.05 to 10
Energy dependence when measuring gamma radiation DER and DE relative to 0.662 MeV (^{137}Cs) energy, not more than: – in the energy range from 0.05 MeV to 1.25 MeV (inclusive) – in the energy range from 1.25 MeV to 10 MeV	%	 ±20 ±40

Table1.2 (continued)

1	2	3
Anisotropy when gamma radiation falls in directions at angles from minus 60° to 60° in the horizontal and vertical planes relative to the main (perpendicular to the front panel of the dosimeter) measurement direction, not more than:	%	
- for ^{137}Cs and ^{60}Co radionuclides;		25
- for ^{241}Am radionuclide		60

Table1.2 (continued)

1	2	3
Complementary relative permissible error limit of photon-ionizing radiation DER and DE measurement result caused by ambient temperature deviation from 20^{o}C, in the temperature range from minus 20 to + 50^{o}C	%	5 per each 10 ^{o}C of deviation from 20 ^{o}C
Operating supply voltage of the dosimeter from Li-Po battery with a capacity of at least 400 mAh	V	3.7

Table1.2 (continued)

1	2	3
Time of continuous operation under normal climatic conditions when powered from a fully charged battery, not less than: – under the conditions of measurement of gamma radiation DER not more than 0.5 μSv/h and with switched off LCD back-light, switched off sound and vibration alarm – under the conditions of measurement of gamma radiation DER equal to 1 Sv/h and with switched on LCD backlight, switched on sound and vibration alarm	hrs	170 4

Table1.2 (continued)

1	2	3
Unstable readings of the dosimeter during 8 hours of continuous operation, not more than	%	5
Mean life of the dosimeter (including repairs), not less than	year	10
Mean time to failure, not less than	hrs	6000
Average life of the dosimeter till the first major repair, not less than	hrs	10000

Table1.2 (continued)

1	2	3
Climatic conditions of the environment: – temperature; – relative humidity at a temperature of 35 °C – atmospheric pressure	 °C % kPa	 from minus 20 to 50 95 ± 3 from 84 to 106.7
Dimensions of the dosimeter with a clip, not more than	mm	84.5×55.0×24.5
Weight without packaging, not more than	kg	0.11

Table1.2 (continued)

1	2	3
Class of external electromagnetic conditions according to DSTU OIML D 11:2018	-	E2
Class of external mechanical conditions according to DSTU OIML D 11: 2018	-	M1

Table 1.3 - Key metrological and technical data and specifications of EPD-27 “DoseGX” dosimeter

Name	Unit of measurement	Value
1	2	3
Measurement and indication range of gamma radiation DER	Sv/h	from $1 \cdot 10^{-6}$ to 10
Measurement and indication range of X-ray DER	Sv/h	from $1 \cdot 10^{-6}$ to $1 \cdot 10^{-1}$

Table1.3 (continued)

1	2	3
Main relative permissible error limit when measuring photon-ionizing radiation DER at ^{137}Cs calibration with a confidence probability of 0.95:		
– in the range from $1 \cdot 10^{-5}$ Sv/h to $1 \cdot 10^{-3}$ Sv/h (inclusive)	%	20
– in the range from $1 \cdot 10^{-3}$ Sv/h to 10^{-1} Sv/h		15
– in the range from $1 \cdot 10^{-1}$ Sv/h to 10 Sv/h		15

Table1.3 (continued)

1	2	3
Measurement and indication range of gamma and X-ray radiation DE	Sv	from $1\cdot10^{-7}$ to 10
Main relative permissible error limit when measuring gamma and X-ray radiation DE at ^{137}Cs calibration with a confidence probability of 0.95 within the range of $1\cdot10^{-6}$ Sv to 10 Sv	%	15
Energy range of detected gamma radiation	MeV	from 0.05 to 10

Table1.3 (continued)

1	2	3
Energy dependence when measuring gamma radiation DER and DE relative to 0.662 MeV (^{137}Cs) energy, not more than: – in the energy range from 0.05 MeV to 1.25 MeV (inclusive) – in the energy range from 1.25 MeV to 10 MeV	%	 ±20 ±40
Energy range of detected X-ray	keV	from 12 to 200

Table1.3 (continued)

1	2	3
Anisotropy when gamma radiation falls in directions at angles from minus 60° to 60° in the horizontal and vertical planes relative to the main (perpendicular to the front panel of the dosimeter) measurement direction, not more than: - for ^{137}Cs and ^{60}Co radionuclides; - for ^{241}Am radionuclide	%	 25 60
Energy dependence when measuring X-ray DER and DE relative to 0.662 MeV (^{137}Cs) energy, not more than	%	from -30 to 35

Table1.3 (continued)

1	2	3
Complementary relative permissible error limit of photon-ionizing radiation DER and DE measurement result caused by ambient temperature deviation from 20°C, in the temperature range from minus 20 to + 50°C	%	5 per each 10 °C of deviation from 20 °C
Operating supply voltage of the dosimeter from Li-Po battery with a capacity of at least 400 mAh	V	3.7

Table1.3 (continued)

1	2	3
Time of continuous operation under normal climatic conditions when powered from a fully charged battery, not less than: – under the conditions of measurement of gamma radiation DER not more than 0.5 μSv/h and with switched off LCD back-light, switched off sound and vibration alarm – under the conditions of measurement of gamma radiation DER equal to 1 Sv/h and with switched on LCD backlight, switched on sound and vibration alarm	hrs	170 4

Table1.3 (continued)

1	2	3
Unstable readings of the dosimeter during 8 hours of continuous operation, not more than	%	5
Mean life of the dosimeter (including repairs), not less than	year	10
Mean time to failure, not less than	hrs	6000
Average life of the dosimeter till the first major repair, not less than	hrs	10000

Table1.3 (continued)

1	2	3
Climatic conditions of the environment: – temperature; – relative humidity at a temperature of 35 °C – atmospheric pressure	 °C % kPa	 from minus 20 to 50 95 ± 3 from 84 to 106.7
Dimensions of the dosimeter with a clip, not more than	mm	84.5×55.0×24.5
Weight without packaging, not more than	kg	0.11

Table1.3 (continued)

1	2	3
Class of external electromagnetic conditions according to DSTU OIML D 11:2018	-	E2
Class of external mechanical conditions according to DSTU OIML D 11: 2018	-	M1

1.2.2 The dosimeter displays "nnnn" characters when it measures DER as a sign of DER exceeding the upper limit of the range when it is irradiated with DER from 12.0 Sv/hour to 20.0 Sv/hour.

1.2.3 The dosimeter records the events of DER exceeding the upper limit of the measurement range and displays the occurrence of such events by flashing DER value in its display mode.

1.2.4 The dosimeter’s detector self-testing is carried out continuously during its operation. In the event of the detector's failure, the dosimeter generates typical sound, vibration and light signals, and displays an "Er01" failure sign on the LCD.

1.2.5 The residual battery charge is continuously evaluated during operation of the dosimeter. The estimated residual battery charge is displayed using a four-segment status character of the battery on the dosimeter's LCD.

1.2.6 The dosimeter features an option to test the display and signaling tools.

1.2.7 The dosimeter allows programming the values of:

- warning and emergency threshold levels of photon ionizing radiation DE in the range from 1 μSv to 9.999 Sv with 1 μSv resolution;
- warning and emergency threshold levels of photon ionizing radiation DER in the range from 10 μSv/h to 9.999 Sv/h with 1 μSv/h resolution;
- warning and permissible duration of stay in the SAA in the range from 1 min to 1 min to 99 h 59 min.

1.2.8 Threshold level values can be programmed manually or during information exchange with the UAS or the USB/IrDA adapter.

1.2.9 The dosimeter generates typical sound, light and vibration signals in case of exceeding the threshold (emergency and warning) levels of DER, DE, completion of the warning and permissible duration of stay in the SAA.

1.2.10 The dosimeter reduces the intensity of vibration signal in 30 seconds after the start of its generation.

1.2.11 The dosimeter displays the duration of stay in the SAA in the form of a direct or reverse timer. The display format is selected during the data exchange with the UAS or USB/IrDA adapter.

1.2.12 The dosimeter provides for an option to deactivate signaling of exceeding the warning threshold level of photon ionizing radiation DER and DE and completing the warning duration of stay in the SAA.

1.2.13 The non-volatile memory of the dosimeter stores the following:

- current DE value;
- maximum value of photon ionizing radiation DER value (with a statistical error of not more than 25 %);
- up to 750 values of accumulated dose history;
- up to 200 values of event history, including:

- when DER threshold levels start and stop to be exceeded;
- when DE threshold levels start to be exceeded;
- all events have to be stored with reference to time.

1.2.14 The interval, at which dose accumulation history values are stored, is programmed in the range from 5 to 255 minutes with an one-minute increment.

1.2.15 The dosimeter adjustment and reading the history of events and dose accumulation history is done during information exchange with the UAS or USB/IrDA adapter.

1.2.16 The dosimeter is equipped with a charger. The charging time of the dosimeter’s fully discharged battery does not exceed 5 hours. The charge status is indicated by the LED indicator on the dosimeter’s face end. Charging should be done using the SCD or the USB/IrDA adapter.

Note. The storage and charging device (SCD) and the USB/IrDA adapter are not included in the delivery kit and are supplied separately upon request.

1.2.17 The dosimeter is resistant to the following operating conditions:

- temperature – from –20 ºC to +50 ºC;
- relative humidity – up to (95 ± 3) % at temperature 35 ºC;
- atmospheric pressure – from 84 to 106.7 kPa.

1.2.18 The dosimeter is resistant to sinusoidal vibrations by group N1 in compliance with GOST 12997-84 standard at a frequency from 10 Hz to 55 Hz, frequency bias of 0.15 mm for the frequency lower than the crossover frequency.

1.2.19 The dosimeter is resistant to 60 repeated shocks, each shock corresponding to a drop from a height of 10 cm onto a hard steel surface (DSTU IEC 60068-2-31:2013 standard).

1.2.20 The dosimeter withstands 6 drops (one drop on each side) from a height of 1.0 m onto a hard surface (DSTU IEC 60068-2-31:2013 standard).

1.2.21 The dosimeter is immune to photon ionizing radiation exposure with 10 Sv/h DER during 50 min.

1.2.22 Ingress protection rating is IP67 accordance with DSTU EN 60529:2018 standard.

1.3 Delivery kit of the dosimeters

1.3.1 The dosimeters' delivery kit includes the products and operating documentation listed in Tables 1.4 and 1.5.

Table 1.4 - Delivery kit of EPD-27 "DoseG" dosimeter

Type	Item	Quantity	Note
BICT.412118.043-01	EPD-27 "DoseG" Electronic Personal Dosimeter	1	
BICT.412118.046-01 HE	Operating manual	1	
BICT.412915.051	Packaging	1	

Table 1.5 - Delivery kit of EPD-27 "DoseGX" dosimeter

Type	Item	Quantity	Note
BICT.412118.043-03	EPD-27 "DoseGX" Electronic Personal Dosimeter	1	
BICT.412118.046-01 HE	Operating manual	1	
BICT.412915.051-03	Packaging	1	

When purchasing a batch of dosimeters intended for use in an automated dose monitoring system with a large number of users, it is necessary to use a storage and charging device/devices (capable of simultaneously charging up to 40 dosimeters) and a device/devices for programming/reading the dosimeters — the Unified Access Station (UAS) equipped with the appropriate software.

When purchasing a batch of dosimeters for use in the automated dose control system for a small number of users, it is possible to additionally supply the USB/IrDA adapters with the appropriate software.

The SCD, UAS, USB/IrDA adapters, and software **are not included in the dosimeter delivery kit and are supplied separately upon request**.

1.4 Dosimeter's design and principle of operation

1.4.1 Design of dosimeter.

The dosimeter (as shown in Figure 1.1 and in Figure 1.2 depending on the modification) is designed as a rectangular parallelepiped whose planes are replaced with the surfaces of large radii of curvature and rounded edges.

The shape and dimensions of the dosimeter were chosen for the convenience of its main way of use, namely – when worn for a long time in the upright position in a breast pocket of the overalls.

The dosimeter's housing is made of impact-resistant glass-filled plastic. It consists of two covers – the upper (1) and the lower (2) covers, connected by screws (3). A raised elastic sealing frame-gasket (4) is located between the said covers around the perimeter of their joint.

On the face beveled end of the dosimeter, there is a screen with illumination of the liquid crystal display (LCD) that is divided into two parts (5) and (6), as well as two light-emitting diode (LED) indicators – (7) “Alarm” and (8) “Charge”. The clamp (9) is secured to the top cover to hold the dosimeter in the breast pocket. Next to the clamp, there are two buttons – (10) MODE and (11) THRESHOLD, as well as the (12) “Alarm” LED (duplicates the indicator (7)).

In the back of the top cover, there is a sign (13) “+”, showing a mechanical center projection of the detector that is located under a cover at the depth of 7.2 mm. Two circular contact pads (14) are located on the bottom cover for connecting the charger, a window (15) for data communication with external devices via an infrared port, and a hook (16) for attaching a neck strap cord when clothes with breast pockets are unavailable.

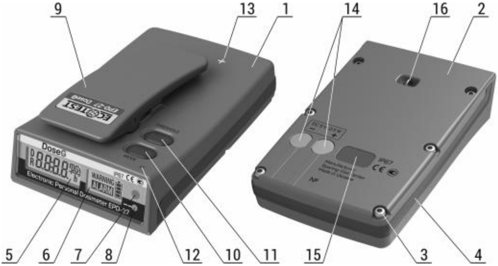

Figure 1.1 – Appearance of EPD-27 "DoseG" dosimeter (overhead view)

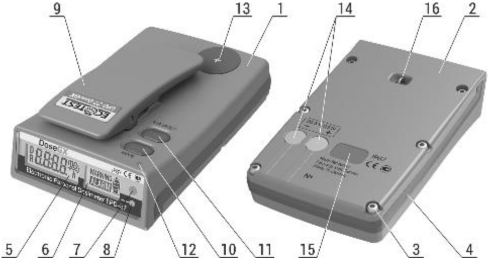

Figure 1.2 - Appearance of EPD-27 "DoseGX" dosimeter (overhead view)

1.4.2 Basic Operation of the Dosimeter

The dosimeter is presented as a monoblock unit, comprising:

- photon ionizing radiation detector (D);
- processing unit (PU);
- LCD;
- indicating unit (IU);
- alarm buzzer (AB);
- LiPo battery (B).

The dosimeter’s block diagram is shown in Figure 1.3.

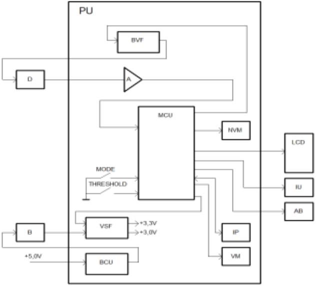

Figure 1.3 - Dosimeter’s block diagram

The photon ionizing radiation detector (D) consists of an interconnected silicon photomultiplier and a scintillator (YSO(Ce)). For thermocompensation of the detector’s characteristics, it also includes a thermal detector.

The processing unit is a microcontroller (MC)-based unit. It comprises:

- Supply voltage former (SVF);
- Bias voltage former (BVF) of the photomultiplier;

- Li-polymer battery charging unit (BCU);
- non-volatile memory (NVM);
- infrared port (IP);
- vibrating motor (VM);
- MODE and THRESHOLD buttons;
- amplifier (A).

All elements of the processing unit are assembled on a single board. A photon ionizing radiation detector is also installed on the same board.

The LCD is a sign & character liquid crystal display with a LED backlight. The LCD is connected to the processing unit using a connector.

The indicating device is designed as a flexible board with the “Alarm” and “Charge” LEDs located on it.

The indicating device and the battery are connected to the processing unit through spring contacts.

The operating principle of the detector is based on the transformation of scintillations, caused by photon ionizing radiation in a scintillator, by the silicon photomultiplier into positive polarity pulses. The number of these pulses is proportional to photon ionizing radiation DER, whereas the amplitude – to energy. These pulses are intensified by the amplifier in the processing unit.

The microcontroller measures the pulse frequency and makes its amplitude analysis. Based on this information and scaling coefficients that are stored in its non-volatile memory, the microcontroller produces measurement results of photon ionizing radiation DER and DE.

The history of DER accumulation and events is stored in the non-volatile memory.

The infrared port is intended for data exchange between the dosimeter and the adapter.

The supply voltage former converts LiPo battery voltage into stabilized voltages to power the dosimeter's units.

The bias voltage former of the photomultiplier generates voltage to power the photomultiplier.

The charging unit of the LiPo battery charges the dosimeter's battery at +5 V voltage, which is applied to the terminals of the dosimeter from an external power supply.

1.5 Labeling and sealing

1.5.1 The dosimeter’s front panel contains the name and the symbol of the device, an approval mark of the measurement instrument type, CE marking for goods and services, and the ingress protection rating.

1.5.2 The bottom cover contains the factory serial number and the date of manufacture of the dosimeter, as well as the approval mark of the measurement instrument type, CE marking for goods and services, the ingress protection rating.

1.5.3 The trademark of the manufacturer is affixed to the clip.

1.5.4 The dosimeter is sealed by the manufacturer with a paste, which closes the head of one of the screws that fasten the covers of the body with each other.

1.5.5 Removal of seals and repeated sealing is carried out by the organization in charge of repair and calibration of the dosimeter.

1.6 Packaging

1.6.1 The dosimeter, together with the operational documentation, is supplied in a cardboard box.

1.6.2 The box is fitted into a polyethylene film pouch that is welded after packaging.

2 PROPER USE

2.1 Operating limitations

Operating limitations are presented in Table 2.1.

2.2 Preparation of the dosimeter for operation

2.2.1 The scope and procedure of external examination

2.2.1.1 Before using the dosimeter, unpack it and examine for mechanical damages.

Table 2.1 – Operating limitations

Operating limitation name	Operating limitation parameters
1 Ambient air temperature	from - 20 °C to +50 °C
2 Relative humidity	up to 95 % at a temperature of 35 °C, non-condensing
3 Atmospheric pressure	from 84 kPa to 106.7 kPa
4 Photon ionizing radiation effect	DER up to 10 Sv/h for 50 min
5 Ambient temperature when charging the battery	from 0 to +40 °C

2.2.2 Rules and procedure of examination for operational readiness

2.2.2.1 Read this OM carefully before starting the operation.

2.2.2.2 By long press of the MODE button, switch the dosimeter from the "Sleep" to the "Standby" mode, as indicated by the LCD characters "StOp" and a battery symbol. If not all segments of the battery symbol are highlighted, charge the dosimeter battery according to 2.3.3.2 of this OM before the start of operation. By briefly pressing the THRESHOLD button, start the test mode of the dosimeter display and signaling means.

Make sure that the dosimeter’s LCD is backlit, all its segments and "Alarm" LED indicators are highlighted, as well as a triple sound and vibration alarm is generated. After switching the dosimeter back to the "Standby" mode, if necessary, take it off into "Sleep" mode by a long press of the MODE button.

2.2.3 List of possible troubles and troubleshooting

2.2.3.1 The list of possible troubles and troubleshooting is presented in Table 2.2. Troubles during usage period shall be registered in the Table of the Annex C of the OM.

Table 2.2 - Possible troubles and trouble-shooting

Trouble	Probable cause	Solution
1	2	3
When the MODE button is pressed, the dosimeter does not switch from "Sleep" to "Standby" mode	Storage battery is low	Charge the storage battery

Table2.2 (continued)

1	2	3
In the mode of the dosimeter display and signaling means testing: - not all segments of LCD are highlighted; - LCD backlight does not switch on; - no sound alarm is generated	 Failure of the LCD Failure of the LCD Failure of the buzzer	Send the dosimeter for repair to the manufacturer

Table2.2 (continued)

1	2	3
- vibration alarm is not generated; - LED indicators "Alarm" are not highlighted	Failure of vibrating motor LEDs failure	Send the dosimeter for repair to the manufacturer
"Er01" symbol on the LCD of the dosimeter	Failure of photon ionizing radiation detector	Send the dosimeter for repair to the manufacturer

2.3 Use of the dosimeter

2.3.1 Safety measures during use of the dosimeter

2.3.1.1 All works with ionizing radiation sources during calibration and testing of the dosimeter shall be carried out in accordance with the requirements of DGN 6.6.1.-6.5.001-98 and DSP 6.177-2005-09-02 standards.

2.3.1.2 The dosimeter must be used in accordance with the instructions given in the OM.

2.3.1.3 The dosimeter shall meet the requirements of DSTU EN 61010-1:2014 standard.

2.3.1.4 A protective shell shall be used to ensure protection against accidental contact with conductive parts in the dosimeter.

The ingress protection rating is IP67 in accordance with DSTU EN 60529:2018 standard.

2.3.1.5 Disposal of dosimeters shall be carried out in accordance with the Laws of Ukraine on Environmental Protection and on Waste.

2.3.2 Operating modes of the dosimeter

The dosimeter operates within the following modes:

"Sleep"– used for storage in the warehouse. All units of the dosimeter are off, the consumption is minimum, the dosimeter responds only to presses of the MODE button in this mode. The dosimeter can be in the Sleep mode for up to six months until the fully charged battery becomes fully discharged.

"Standby" – waiting for information exchange with the UAS or USB/IrDA adapter, it is used during operation while the dosimeters are in the SCD. The dosimeter in this mode responds to queries via the infrared interface and buttons pressing. Consumption of the dosimeter is increased compared to the "Sleep" mode.

The dosimeter can be in the "Standby" mode outside the SCD for up to a month until the fully charged battery becomes fully discharged.

"Operation":

– DE display;

– DE display;

– Real time display;

– Display of time spent in the SAA/time left before leaving the SAA.

2.3.3 Procedure of the dosimeter operation

2.3.3.1 Dosimeter’s controls

The MODE (10) and THRESHOLD (11) buttons (Figure 1.1 and Figure 2.2) are intended to control the dosimeter.

The MODE button serves to switch between the dosimeter’s operating and display modes.

The THRESHOLD button is intended for viewing the current and programming the new values of alarm triggering threshold levels.

2.3.3.2 Storage battery charging

2.3.3.2.1 The battery needs to be charged by using the SCD or the USB/IrDA adapter. The dosimeter should be in the “Sleep” or “Standby” mode.

2.3.3.2.2 The battery has to be charged at ambient temperature of 0 to 40 ^{0}C.

2.3.3.2.3 The dosimeter is powered from a Li-Po battery with no memory effect. That type of battery can be charged regardless of its remaining charge.

2.3.3.2.4 To charge the battery, insert the dosimeter into the SCD cell or USB/IrDA adapter. In such a case, the “Charge” LED indicator will light up on the dosimeter’s face end. The color of this indicator reports on the charge status:

- red – charging is in process;
- green – charging is complete.

2.3.3.3 General algorithm for dosimeter operation control

When stored at a warehouse, the dosimeter shall be in the “Sleep” mode. In this mode, all dosimeter’s units are turned off and the power consumption is minimum. The dosimeter responds only when the MODE button is pressed. The dosimeter can be in the “Sleep” mode for up to six months until the fully charged battery becomes fully discharged. Before the use of the dosimeter, switch it to the “Standby” mode with a long press of the MODE button. The display of “StOP” characters on the LCD indicate that the dosimeter switched to the “Standby” mode. In this mode, the infrared port is activated in the dosimeter, meaning that the dosimeter is waiting for data communication with the UAS or USB/IrDA adapter. The dosimeter can be switched from the “Standby” to the “Operation” mode only during data communication with the UAS or USB/IrDA adapter. “IrdA” characters on the dosimeter’s LCD indicate that data communication is in process. A detailed description of the data communication between the dosimeter and the UAS is given in 2.3.3.10 of this OM. DE that appears on the LCD indicates that the dosimeter has switched to the “Operation” mode.

In the “Operation” mode, short presses of the MODE button change a display mode view as follows:

– DE display;

– DER display;

– Real time display;

– Display of time spent in the SAA/time left before leaving the SAA.

A detailed description of each display mode is given below.

The dosimeter can be switched from the “Standby” to the “Operation” mode only while communicating data with the UAS or USB/IrDA adapter. A long press of the MODE button switches the dosimeter from the "Standby" to the "Sleep" mode.

2.3.3.4 LCD backlight control

In the "Operation" mode, each press of any dosimeter's button turns on the LCD backlight for about 6 seconds. For continuous LCD backlight, press the THRESHOLD button twice (the time between presses should not exceed 0.5 s). To turn off the continuous LCD backlight, press the THRESHOLD button twice again.

2.3.3.5 Control of the remaining battery charge

In the "Operation" mode, the dosimeter constantly monitors the remaining battery charge. The control results are displayed on the LCD as a battery status symbol  consisting of four segments. With a fully charged battery, all the status symbol segments are illuminated. When the battery is gradually discharged, one segment ceases to be highlighted first, then the second one, etc. When the battery is completely discharged, none of the segments is illuminated. The battery status symbol blinks and short-term audio signals are generated.

2.3.3.6 Display of photon ionizing radiation DER

2.3.3.6.1 After being switched from the "Standby" mode to the "Operation" mode, the dosimeter starts displaying photon ionizing radiation

DE. Switching to the DE display mode is possible from any other display mode by briefly pressing the MODE button.

2.3.3.6.2 The dosimeter's LCD shows the following information (Figure 2.1):

- (1) “D” symbol indicates the display mode of DE;
- (2) DE value;
- (3) Battery status symbol.

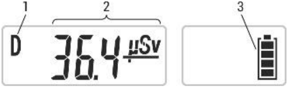

Figure 2.1 – LCD of the dosimeter
(display of photon ionizing radiation DE).

The value of DE is blinking if an event(s), where DER exceeds the upper limit of the measurement range, occurs during DE accumulation.

When one of the DE threshold levels is exceeded, the dosimeter starts generating typical audio, light, and vibration signals. A relevant transparency is displayed on the dosimeter's LCD, showing WARNING – if the warning threshold level is exceeded, or ALARM – if the emergency threshold level is exceeded.

The alarm actuated on exceeding the warning threshold level can be disabled with a long press of the THRESHOLD button (for about 8 seconds).

After turning off the alarm, the WARNING transparency remains on the dosimeter's LCD.

2.3.3.6.3 To view the current DE threshold levels, press and hold the THRESHOLD button. In this case, both warning and emergency threshold levels will be displayed alternately on the LCD (as shown in Figure 2.2 and 2.3). The highlighted WARNING transparency will be indicative of the warning threshold level, while ALARM – of the emergency one.

Figure 2.2– LCD of the dosimeter
(display of the warning threshold level).

Figure 2.3 – LCD of the dosimeter
(display of the emergency threshold level).

After the THRESHOLD button is released, the threshold level will be shown for 2 more seconds on the LCD, and then the dosimeter will switch to DE display.

To program the value for the warning or emergency DE threshold level, do the following:

- Press the THRESHOLD button and hold it until the LCD shows a necessary threshold level.

- Release the THRESHOLD button, and while the LCD is still displaying this threshold, briefly press the MODE button.

If there was no prohibition to change threshold levels during data exchange with the UAS or USB/IrDA adapter, the low-order digit of a new threshold value will start blinking, meaning that it can be programmed. A necessary value of the blinking digit is set using the THRESHOLD button. Successive short presses and releases of the

THRESHOLD button change the value per unit. A long press of the THRESHOLD button automatically changes the value and ceases to do this after releasing the THRESHOLD button.

A short press of the MODE button records a value of this digit position. Moreover, this digit stops blinking, making it possible to change the value of the next digit that starts blinking. Programming the values of all the subsequent digits is done likewise.

As soon as the threshold level is set, its value is blinking on the LCD three times, indicating that it is stored in the dosimeter's non-volatile memory. After that, the dosimeter returns to the display mode of photon ionizing radiation DE.

Important! If there is a pause for more than 30 s while programming a new threshold value, i.e. the user presses no dosimeter buttons, the dosimeter automatically switches to display of photon ionizing radiation DE. All changes made while programming the new threshold value are canceled.

Note. Setting the threshold level to a zero value turns off the alarm.

2.3.3.7 Display of photon ionizing radiation DER

2.3.3.7.1 Switching to the DER display mode is possible from any other display mode by briefly pressing the MODE button. This mode is the next one after the mode of DE display.

2.3.3.7.2 The dosimeter's LCD shows the following information (Figure 2.4):

- (1) "R" symbol indicates the DER display mode;
- (2) DER value;
- (3) Battery status symbol.

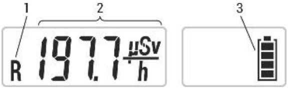

Figure 2.4 – LCD of the dosimeter (display of photon ionizing radiation DER).

If the DER value is less than 1 μSv/h, then "LO" characters are displayed on the dosimeter LCD instead of the DER value. If the DER value is greater than 12 Sv/h, the LCD shows "nnnn" characters.

The decimal point of the DER value is blinking if the estimated limits of the expected relative statistical deviations of a DER value at confidence probability of 0.95 (hereinafter – estimated limits of statistical deviations) are more than 15 % for DER of up to

1 mSv/h and more than 10% for DER in the range from 1 mSv/h to 10 Sv/h.

When one of the DER threshold levels is exceeded, the dosimeter begins generating typical sound, light, vibration signals. A relevant transparency is displayed on the dosimeter LCD, showing WARNING – if the warning threshold level is exceeded, or ALARM – if the emergency threshold level is exceeded.

The alarm actuated on exceeding the warning threshold level can be disabled with a long press of the THRESHOLD button (for about 8 seconds). After turning off the alarm, the WARNING transparency remains on the dosimeter LCD.

2.3.3.7.3 Viewing the current threshold level values and programming the new values is done in the same way as viewing and programming the DE threshold levels (2.3.3.6.3).

2.3.3.8 Real time display

2.3.3.8.1 You can switch to the mode of real time display from any other display mode by briefly pressing the MODE button. This mode is the next one after the DER display mode.

2.3.3.8.2 The following information is displayed on the dosimeter LCD (Figure 2.5):

- (1) time;
- (2) battery status symbol.

Figure 2.5 – LCD of the dosimeter
(display of time).

2.3.3.8.3 To view the date and year, one must press and hold the THRESHOLD button. In this case, the date (Figure 2.6) or year (Figure 2.7) will alternately appear on the dosimeter LCD.

Figure 2.6 – LCD of the dosimeter (date display).

Figure 2.7 – LCD of the dosimeter (year display).

Two seconds after the THRESHOLD button is released, the time on the LCD of the dosimeter will be displayed again.

2.3.3.8.4 To adjust the time, date and year, if this was not prohibited during data communication with the UAS or the USB/IrDA adapter, briefly press the THRESHOLD button. After this, while the date is displayed on the dosimeter LCD, briefly press the MODE button. In this case, the LCD of the dosimeter will display the time and the digits of minutes will start blinking.

Blinking digits indicate the possibility of their values programming. The required value is set with the THRESHOLD button. Consecutive short presses and releases of the THRESHOLD button change the value per unit. A long press of the THRESHOLD button automatically changes the value that stops when the THRESHOLD button is released.

A short press of the MODE button records the values of digits of minutes, and they stop blinking, and allows changing the digits of hours that start blinking. Programming the digits of hours is done using the THRESHOLD button similarly to programming the digits of minutes.

A short press of the MODE button records a new time value in the dosimeter's memory, after which the LCD displays a year.

The low-order digits of the year are blinking, indicating the possibility to program their value. Programming is done with the THRESHOLD button similarly to the programming of the minute's digits. The value of the year can be programmed within 2018 to 2080.

A short press of the MODE button records a new value of the year in the dosimeter's memory. After that, the LCD displays the date and month. The digits of the months are blinking, indicating the possibility to program their value. Programming is done with the THRESHOLD button similarly to programming of the minute's digit.

A short press of the MODE button records the value of the month digits, which stop blinking at that, and allows changing the date digits that begin blinking. Programming the date digits is done using the THRESHOLD button similar to programming of the hour digits.

A short press of the MODE button records a new value of the date and month in the dosimeter's memory, as evidenced by a triple blinking of the new value on the LCD and return of the dosimeter to time display.

2.3.3.9 Display of time spent in the SAA/time left before leaving the SAA.

2.3.3.9.1 You can switch to the mode of displaying the time spent in the SAA/time left before leaving the SAA from any other display mode by shortly pressing the MODE button. This mode is the next one after the real time display mode.

2.3.3.9.2 The following information is displayed on the dosimeter's LCD (Figure 2.8):

- (1) Time spent in the SAA/time left before leaving the SAA;
- (2) "h" character – a sign of the mode;
- (3) Battery status symbol.

The time is displayed in the HH:MM format, where HH - hours, MM - minutes.

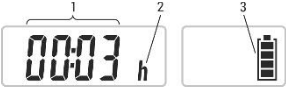

Figure 2.8 – LCD of the dosimeter
(display of time spent in the SAA/ time left before leaving the SAA).

2.3.3.9.3 The display mode of the dosimeter operation (time spent in the SAA in the format of the direct timer, or time left before leaving the SAA in the format of the reverse timer) is programmed during data communication with the UAS or USB/IrDA adapter.

2.3.3.9.4 If the time spent in the SAA is displayed in the direct timer format, the time begins to count from 0 hours 0 minutes and is incremented to 99 hours 59 minutes. Warning and permissible time of stay in the SAA can be programmed within this range.

When the warning or permissible time of stay in the SAA is completed, the dosimeter begins generating typical sound, light and vibration signals and the relevant transparency is displayed on the dosimeter LCD, showing WARNING – if the warning time of stay in the SAA ended, or ALARM – if the permissible time of stay in the SAA ended. The warning and permissible time spent in the SAA can be changed at any time using the dosimeter buttons, if not prohibited during the data communication with the UAS or USB/IrDA adapter.

Signaling about the completion of warning time of stay in the SAA can be turned off by a long press of the THRESHOLD button (about 8 seconds). After turning off the signal, the WARNING transparency remains on the dosimeter's LCD.

2.3.3.9.5 Viewing the current values of the warning or permissible time spent in the SAA and programming of the new values is performed similarly to viewing and programming of the DE threshold levels (2.3.3.6.3).

2.3.3.9.6 If the time left before leaving the SAA is displayed in the reverse timer format, the time begins to count from the permissible time of stay in the SAA and decreases to 0 hours 0 minutes. Warning exit time from the SAA can be programmed within this range.

When the warning time left before leaving the SAA is reached, or when the timer is reset, the dosimeter begins generating typical sound, light and vibration signals, and the relevant transparency is displayed on the dosimeter LCD, showing WARNING – if the warning time left before leaving the SAA is reached, or ALARM – if the timer is reset. The warning time left before leaving the SAA can be changed at any time using the dosimeter buttons, if not prohibited during the data communication with the UAS or USB/IrDA adapter.

2.3.3.9.7 Viewing the current value of the warning time left before leaving the SAA and programming its new value is done similarly to viewing and programming of the warning DE threshold level (2.3.3.6.3). The permissible time of stay in the SAA cannot be adjusted.

2.3.3.10 Data communication of the dosimeter with the UAS or USB/IrDA adapter.

2.3.3.10.1 Data communication of the dosimeter with the UAS or USB/IrDA adapter can be carried out at any time, if the dosimeter is in the "Standby" or "Operation" modes. To do this, you need to place the dosimeter in the cell of the UAS or USB/IrDA adapter. The "IrdA" characters on the dosimeter LCD mean the start of data communication.

The UAS or USB/IrDA adapter can obtain the following data from the dosimeter during data communication:

- factory number of the dosimeter;
- current settings for its threshold levels;

- current DE;
- maximum DER value;
- dose accumulation history;
- history of events;

and communicate to the dosimeter:

- current time;
- warning and emergency threshold levels of DE;
- warning and emergency threshold levels of DER;

- permissible time spent in the SAA and time left before leaving the SAA and timer's operating mode (direct or countdown);

- interval of dose accumulation history values recording;

- permissions/prohibitions to change some threshold levels.

3 TECHNICAL MAINTENANCE

3.1 Technical maintenance of the dosimeter

3.1.1 General instructions

The list of operations performed during technical maintenance (hereinafter called the TM), the order and the peculiarities of operational phases are presented in Table 3.1.

Table 3.1 – List of operations during the TM

Operations	TM type				OM item No.
	During		Long-term storage		
	everyday use	periodical use (annually)	periodical use (every 6 months)	periodical use (annually)	
1	2	3	4	5	6
External examination	+	+	+	+	3.1.3.1

Table3.1 (continued)

1	2	3	4	5	6
Delivery kit completeness check	-	+	-	-	3.1.3.22
Performance check	+	+	-	+	3.1.3.3
Battery charging	+	-	+	+	2.3.3.2 3.1.3.4
Verification of the dosimeter	-	+	-	+	3.2

Note. "+" means that the operation is applicable for this type of TM, "–" - the operation is inapplicable.

3.1.2 Safety measures

Safety measures while carrying out TM fully comply with safety measures stated in 2.3.1 of the present OM.

3.1.3 Maintenance procedure of the dosimeter

3.1.3.1 External examination

Check the technical condition of the dosimeter’s surface, inspect for integrity of seals, absence of scratches, traces of corrosion, surface damage.

3.1.3.2 Delivery kit completeness check

Check the delivery kit for completeness as shown in Table 1.2.

3.1.3.3 Operability check of the dosimeter

3.1.3.3.1 Operability check of the dosimeter and its procedure is done according to 2.2.2 of this OM.

3.1.3.3.2 Procedure for pre-repair fault detection and rejection

The need to send 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) no dosimeter’s LCD backlight;

d) no sound alarm;

- for major repair:

a) at least one measurement channel is out of service;

b) defects of the LCD that affect the correct read-out of measurement results;

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

3.1.3.4 Battery charging

When the dosimeter is stored for a long time, its battery needs to be recharged every six months. If this requirement is not observed, the battery is discharged and becomes out of order. Charging is performed according to 2.3.3.2 of this OM, and the dosimeter should be in the “Sleep” mode.

3.2 Verification of the dosimeter

The dosimeters should be verified after repair and during operation (periodical verification – at least annually).

3.2.1 Verification operations

During verification the operations listed in Table 3.2 should be performed.

Table 3.2 – Verification operations

Operation	Verification technique No
External examination	3.2.4.1
Testing	3.2.4.2
Calculation of the main relative permissible error limit of photon ionizing radiation DER measurement	3.2.4.3
Calculation of the main relative permissible error limit of photon ionizing radiation DE measurement	3.2.4.4

3.2.2 Verification facilities

During verification, the following facilities should be used:

- УПГД-3В *Хд*1.456.183 ПС reference equipment;

- УГВ2 ДЕТУ 12-06-02 reference equipment;

- Phantom. Overall dimension: 30 cm×30 cm×15 cm; PMMA walls (polymethylmethacrylate, front wall thickness – 2.5 mm, other walls thickness – 10 mm); phantom is filled with distilled water;

- ^{137}Cs gamma radiation source of OSGI type;
- a stopwatch;
- СДКГ-23 ВІСТ.441461.012 bench.

All verification facilities should have valid certificates of verification or state metrological certification.

Note. Use of other reference measuring equipment with specifications similar to those outlined in 3.2.2 of this OM is allowed.

3.2.3 Verification conditions

Verification should be performed under the following conditions:

- ambient air temperature range within (20±5) ºC;
- relative air humidity from 30 % to 80 %;
- atmospheric pressure from 86 kPa to 106.7 kPa;
- natural background level of gamma radiation should be up to 0.30 μSv/h;
- dosimeter battery should be fully charged.

3.2.4 Verification procedure

3.2.4.1 External examination

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

- the delivery kit should be complete as stated in 1.3.1 of this OM;
- labeling should be accurate;
- QCD seals should not be violated;
- the dosimeter should be free from mechanical damage that may affect its performance.

3.2.4.2 Testing

Check if the dosimeter is ready for operation as stated in 2.2.2 of this OM.

3.2.4.3 Calculation of the main relative permissible error limit of photon ionizing radiation DER measurement

3.2.4.3.1 With a long press of the MODE button, switch the dosimeter from “Sleep” to “Standby” mode.

3.2.4.3.2 In technological software of СДКГ-23 ВІСТ.441461.012 bench, set the warning and alarm threshold levels of photon ionizing radiation DER and DE to zero values along with the warning and permissible time of stay in the SAA.

3.2.4.3.3 Perform information exchange with the dosimeter using the “Programming” procedure in technological software.

3.2.4.3.4 Switch the dosimeter to the display mode of photon ionizing radiation DER. Fix the dosimeter on the phantom, located in the УПГД-3Б carriage, so that the collimator’s mechanical center coincides with the dosimeter's mechanical center that is marked with a "+" sign on the top cover of the dosimeter.

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. The distance between the cover surface and the detector's center is 7.2 mm.

3.2.4.3.5 Place the УПГД-3В carriage together with the phantom and the dosimeter in the position, where $\dot{H}_{p0}(10)$ = (100.0 ± 10.0) μSv/h.

3.2.4.3.6 In one minute after the start of the dosimeter exposure to radiation, make ten measurements of photon ionizing radiation DER at a 30-second interval.

3.2.4.3.7 Calculate the average value ($\overline{\dot{H}}_{p\Sigma}(10)$) by the following formula (3.1):

$$\overline{\dot{H}}_{p}(10) = \frac{\sum_{i=1}^{5} \dot{H}_{pi}(10)}{10} \qquad (3.1)$$

3.2.4.3.8 Calculate the main relative permissible error limit of DER measurement in percentage by the method according to DSTU GOST 8.207:2008 standard.

3.2.4.3.9 Calculate a confidence limit of the main relative permissible error by the following formula:

$$\varepsilon = t \cdot S\,, \qquad (3.2)$$

where

t = 2,26 - is Student's coefficient at confidence probability P = 0,95 and n = 10;

S - a relative root-mean-square deviation of the measurement result calculated by the formula:

$$S = \frac{1}{\overline{\dot{H}}_p(10)} \sqrt{\frac{\sum_{i=1}^{n}\left(\dot{H}_{pi}(10) - \overline{\dot{H}}_p(10)\right)^2}{n(n-1)}} \qquad (3.3)$$

3.2.4.3.10 Calculate the relative non-excluded systematic error limit of measurement result Θ by the formula:

$$\Theta = 1{,}1\sqrt{\left(\frac{\overline{\dot{H}}_p(10) - \dot{H}_{p0}(10)}{\dot{H}_{p0}(10)}\right)^2 + \left(\frac{\delta\dot{H}_{p0}(10)}{2}\right)^2}\ , \qquad (3.4)$$

where $\delta\dot{H}_{p0}(10)$ - is the main relative permissible error limit of photon ionizing radiation DER of УПГД-3В.

If $\frac{\Theta}{S} < 0{,}8$, then $\delta\overline{\dot{H}}_{p}(10) = \varepsilon \cdot 100$.

If $\frac{\Theta}{S} > 8$, then $\delta\overline{\dot{H}}_{p}(10) = \Theta \cdot 100$.

If $0{,}8 < \frac{\Theta}{S} < 8$, then $\delta\overline{\dot{H}}_{p}(10) = K \cdot S_{\Sigma} \cdot 100$, where K is a coefficient that depends on the ratio of a random error to a non-excluded systematic error and is calculated as follows:

$$K = \frac{\varepsilon + \Theta}{S + \frac{\Theta}{\sqrt{3}}}, \qquad (3.5)$$

where S_Σ is an estimate of the total root-mean-square deviation of the measurement result calculated by the formula:

$$S_\Sigma = \sqrt{S^2 + \left(\frac{\Theta}{\sqrt{3}}\right)^2} \qquad (3.6)$$

3.2.4.3.11 Place the УПГД-3В carriage together with the phantom and the dosimeter in the position, where $\dot{H}_{p0}(10)$ = (100.0 ± 10.0) μSv/h. In one minute after the start of the dosimeter exposure to radiation, make ten measurements of photon ionizing radiation DER at a 30-second interval. Calculate the main relative permissible error limit of measurement results as covered in 3.2.4.3.7 – 3.2.4.3.10 of this OM.

3.2.4.3.12 Carry out information exchange with the dosimeter using the “Read” procedure available in technological software. Make sure that the dosimeter has switched from the “Operation” to the “Standby” mode.

3.2.4.3.13 Consider the main relative permissible error limit as a maximum value of all the errors obtained.

3.2.4.3.14 If the main relative permissible error limit of DER measurement at a confidence probability of 0.95 is not more than:

- 20 % in the DER range from 10.0 to 1000 μSv/h;
- 15 % in the DER range from 1000 μSv/h to 10.0 Sv/h,

proceed to the next verification procedure.

3.2.4.3.15 If the main relative permissible error limit of DER measurement does not meet the requirements of 3.2.4.3.14 of this OM, the dosimeter cannot be verified and should be sent for repair.

3.2.4.4 Determining the main relative permissible error limits of photon ionizing radiation DE measurement

3.2.4.4.1 Follow the steps in 3.2.4.3.2 and 3.2.4.3.3 of this OM. Fix the dosimeter that works in the mode of photon ionizing radiation DE display on the phantom located on the УПГД-3В carriage in such a way that the mechanical center of the УПГД-3В collimator coincides with the mechanical center of the dosimeter’s detector, which is marked with a "+" symbol on the dosimeter’s upper cover.

3.2.4.4.2 Place УПГД-3В carriage together with the phantom and the dosimeter in the position, where photon ionizing radiation

DER from the source with ^{137}Cs radionuclide is equal to $\dot{H}_{p0}(10)$ = (100.0 ± 10.0) μSv/h and simultaneously turn on the stopwatch and feed the source into the collimator.

3.2.4.4.3 After a measurement time calculated by the formula $t = 360 + t_{\partial}$, s, where t_{∂}, s is a time during which the source is fed to the collimator, record the result of photon ionizing radiation DER measurement.

3.2.4.4.4 Calculate the main relative permissible error limit of photon ionizing radiation DER measurement in percentage by the formula:

$$\delta H_p(10) = 1{,}1\sqrt{\left(\frac{H_p(10) - H_{p0}(10)}{H_{p0}(10)}\right)^2 + \left(\frac{\delta H_{p0}(10)}{2}\right)^2}\ , \quad (3.7)$$

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

$\delta H_{p0}(10)$ – the main relative permissible error limit of photon ionizing radiation DE of УПГД-3В, calculated by the formula:

$$\delta H_{p0}(10) = \sqrt{\left(\delta \dot{H}_{p0}(10)\right)^2 + \left(\delta t\right)^2}\ , \qquad (3.8)$$

where δ_t – the main relative permissible error limit of photon ionizing radiation DE exposure time measurement, which should not exceed 5 %, is calculated by the formula:

$$\delta_t = \frac{1{,}1\sqrt{(\Delta t_c)^2 + (\Delta t_p)^2 + (\Delta t_\partial)^2}}{t}, \qquad (3.9)$$

where Δt_c – permissible error limit of the stopwatch;

Δt_p = 1 s – error caused by human reaction;

Δt_∂ = 1 s – error caused by the process during which the collimator opens.

3.2.4.4.5 Place УПГД-3В carriage together with the phantom and the dosimeter in the position, where photon ionizing radiation DER from the source with ^{137}Cs radionuclide is equal to $\dot{H}_{p0}(10) = (100.0 \pm 10.0)$ mSv/h, record the photon ionizing radiation DE readings on the dosimeter after the previous measurement to make it possible to subtract them after obtaining the result of the next measurement. Simultaneously turn on the stopwatch and feed the source into the collimator, after which, in accordance with 3.2.4.4.3, record the readings, and make calculations in accordance with 3.2.4.4.4, taking into account the previous value of photon ionizing radiation DE.

3.2.4.4.6 The limit of the main relative permissible error of DE measurement is assumed to be the maximum value of the errors obtained.

3.2.4.4.7 If the limit of the main relative permissible error of DE measurement with 0.95 confidence probability does not exceed 15 %, the result of the dosimeter calibration is considered satisfactory.

3.2.4.4.8 If the limit of the main relative permissible error of DE measurement does not meet the requirements of 3.2.4.4.7, the dosimeter shall not be verified and is sent for repair.

3.2.4.5 Presentation of verification results

3.2.4.5.1 Satisfactory results of periodic verification are certified by issuing the certificate of the established form or registration in the table of Annex D of this OM.

3.2.4.5.2 The dosimeters that do not meet the requirements of the verification procedure shall not be allowed to manufacture and use, and get the certificate of inadequacy.

4 CERTIFICATE OF ACCEPTANCE

The EPD-27 "DoseG " Electronic Personal Dosimeter BICT.412118.046-01 with ________________ serial number meets specifications ТУ У 26.5-22362867-067:2021 and has been accepted for use

Date of issue ___________________________

Stamp here

QCD Representative: _______________

(signature)

5 PACKING CERTIFICATE

The EPD-27 "DoseG " Electronic Personal Dosimeter BICT.412118.046-01 with ____________ serial number is packed by Private Enterprise “SPPE “Sparing-Vist Center” in accordance with the requirements outlined in ТУ У 26.5-22362867-067:2021.

Date of packing ____________________

Stamp here

Packed by: _______________

(signature)

6 WARRANTY

6.1 The manufacturer guarantees the conformity of the dosimeter with the specifications provided that the customer observes the guidelines for its use, transportation and storage presented in the Operating Manual BICT.412118.046-01 HE.

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

6.3 The guaranteed storage life of the dosimeter is 6 months after its manufacture date.

6.4 Free repair or replacement during the guaranteed period of use is carried out by the manufacturer, subject to the customer's compliance with the rules of use, transportation and storage.

6.5 In case of troubleshooting the dosimeter (according to the claim), the guaranteed period of use is prolonged for a period during which the dosimeter was not used due to the detected troubles.

7 REPAIR

7.1 In the event of a failure or troubles during the warranty period of the dosimeter use, the user should draw up a statement about the necessity of repair and send the dosimeter to the manufacturer to:

Ukraine, 79026, Lviv,
33 Volodymyra Velykoho St.
PE "SPPE "Sparing-Vist Center",
tel.: (032) 242-15-15; Fax: (032) 242-20-15

7.2 All incoming claims are registered in Table 7.1.

Table 7.1

Date of failure	Claim summary	Action taken	Note

7.3 Warranty repair is carried out only by the manufacturer.

Post-warranty repair is carried out by the manufacturer or the appointed company.

Information about the repair of the dosimeter is recorded in the Table of Annex E of the OM.

8 STORAGE

8.1 The dosimeters should be stored packed under conditions according to category 1 (Л) under GOST 15150-69 standard.

8.2 The dosimeter must be stored in “Sleep” mode. Before putting into storage, the dosimeter’s battery must be charged and recharged every six months during storage. If this requirement is not met, the dosimeter’s battery runs out of charge and fails. Charge according to 2.3.3.2 of this OM, while the dosimeter must be in Sleep mode.

8.3 Shelf life before putting into use is up to 6 months or up to one year, subject to recharging the battery in 6 months after the start of storage.

8.4 Additional information on storage, checking during storage and servicing of the dosimeter shall be recorded in Annexes A, B, C, F of this OM.

9 TRANSPORTATION

9.1 Transportation and storage conditions comply with GOST 15150-69.

9.2 Packed dosimeters must be transported by rail and road transport of closed type, as well as by air in sealed compartments. Transportation can be carried out by one or several modes of transport in a random order, with not more than four instances of reloading.

9.3 Packed dosimeters during transportation withstand the influence of air temperature from minus 20 ºC to plus 50 ºC, relative humidity (95 ± 3) % at temperature plus 35ºC and atmospheric pressure from 84 kPa to 106.7 kPa.

9.4 Packed dosimeters can withstand transportation by rail and air without distance constraint.

9.5 Packed dosimeters withstand shipment by road:

- with asphalt and concrete covering at a distance of 200 km to 1000 km;
- paved and unpaved road at a distance of 50 km to 250 km at a speed of up to 40 km/h.

9.6 Packed dosimeters withstand the impact of shock loads, which values are given in Table 9.1.

Table 9.1 – Impact of the dosimeter to shock loads

Shock acceleration peak value, m/s^2 (g)	Duration of shock acceleration impact, ms	Number of shocks
750 (75)	2 - 6	200
150 (15)	5 - 20	2000
100 (10)	5 - 20	8800

10 DISPOSAL

Disposal of the dosimeters is carried out in accordance with the Laws of Ukraine on Environmental Protection and on Waste.

Disposal of the dosimeter in not dangerous for the maintenance staff and is environmentally friendly.

ANNEX A

PUTTING IN PROLONGED STORAGE AND REMOVAL FROM STORAGE DURING USE

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

ANNEX B

STORAGE

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

ANNEX C
TROUBLE RECORD DURING USE

Date and time of trou-ble. Operat-ing mode	Type (external mani-festa-tion) of trouble	Cause of trouble, number of working hours of the failed ele-ment	Action taken and claim note	Position, name and signature of the person responsible for solving the trouble	Note

ANNEX D
PERIODIC VERIFICATION OF KEY SPECIFICATIONS

Verified specification		Date of measurement	
		20	
Name	Value according to specifications	Actual value	Measured by (position, signature)
1 Main relative error limit of DER measurement at ^{137}Cs calibration with 0.95 confidence probability, %	20 in the range from 10 μSv/h to 1 mSv/h; 15 in the range from 1 mSv/h to 10 Sv/h		

ANNEX D

D-1

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

ANNEX D

Verified specification		Date of measurement			
		20		20	
Name	Value according to specifications	Actual value	Measured by (position, signature)	Actual value	Measured by (position, signature)
2 Main relative error limit of photon ionizing DE measurement at ^{137}Cs calibration with 0.95 confidence probability, %	15				

ANNEX D

D-2

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

ANNEX E

REPAIR

Name and symbol of the component part of the dosimeter	Reasons for repair	Date		Name of the repair organization	Number of hours worked before repair
		of acceptance for repair	of repair completion		

ANNEX E
REPAIR

Type of repair (middle-life, major, etc.)	Name of repair work	Position, name and signature of the responsible official	
		who performed repair	accepted after repair

ANNEX F
VERIFICATION AND INSPECTION RESULTS

Date	Verification or inspection type	Verification or inspection result	Position, name and signature of the inspector	Note
1	2	3	4	5

ANNEX F

1	2	3	4	5