MINISTRY OF ECONOMY OF UKRAINE STATE ENTERPRISE "KYIV REGIONAL SCIENTIFIC AND PRODUCTION CENTER FOR STANDARDIZATION, METROLOGY AND CERTIFICATION"

TYPE EXAMINATION CERTIFICATE

Registered in the register of Assessment Body by No.:	^c Conformity	UA.062.C7	Г.014-23	DSTU	10111 J EN ISO/IEC 17065
Issued to:	PRIVATE ENTERPRISE "SCIENTIFIC AND PRODUCTION PRIVATE ENTERPRISE "Sparing-Vist Center", 33 Volodymyra Velykoho Str., Lviv, 79026, Ukraine, EDRPOU code 22362867				
In accordance with:	Annex 3, section "Conformity assessment procedures. Module C (type examination)" of Technical regulation of legally regulated measuring instruments approved by the CMU Resolution No. 94 of January 13, 2016				
Type of measuring instrument:	Personal Rad	iation Dosimete	r		
Type designation:	DKG-24 "PR	D GUARDER"			
Date issued:	06.03.2023	Valid	l until:	05.03	3.2033
Number of pages:	13				
Number of Designated body:	UA.TR.062				
Certificate is issued by the Conformity Assessment Body:	CAB SE ' UA.TR.062, a Sichnevogo pr 73, 4-76-16.	"KYIVOBLSTAN accreditation cert oryvu, Bila Tserk	NDARTMET tificate No. tva, Kyiv obl	ROLOGY", 10111. Leg ast, 09113, U	identification number gal (postal) address: 84, Jkraine, tel. (04563) 4-71-
On the basis of:	This certificate is issued based on the results of examination of the technical design of the measuring instrument. This certificate confirms that the type of the measuring instrument meets the applicable requirements of the Technical Regulation. The conformity of the measuring instruments being placed on the market of Ukraine and/or put into use with the type described in this certificate and applicable requirements of the Technical Regulation shall be established by one of the conformity assessment procedures according to module that follows module B as specified in the Technical Regulation.				
Deputy director of Conf	ormity Assess	ment Body	<u>/Signati</u> Signati	<u>ure/</u>	Larysa BARTKIV
Official stamp [MINISTRY OF ECONOMY	OF UKRAINE	* EDRPOU	Zignad		

[MINISTRY OF ECONOMY OF UKRAINE * EDRPOU code 22362867 * STATE ENTERPRISE "KYIV REGIONAL SCIENTIFIC AND PRODUCTION CENTER FOR STANDARDIZATION, METROLOGY AND CERTIFICATION"]

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Certificate version number	Date	Substantial changes
1	06 March 2023	Primary certificate

Requirements

The approved type of the measuring instrument meets the requirements of the following documents:

Technical regulation of legally regulated measuring instruments, approved by the Resolution of the Cabinet of Ministers of Ukraine No. 94 of January 13, 2016.

Applicable standards:

DSTU 7216:2011 "Dosimeters and radiometers of radiation control. Classification and general specifications"; DSTU EN 60529:2018 "Degrees of protection provided by enclosures (IP Code) (EN 60529:1991; A1:2000; A2:2013; AC:1993; AC:2016, IDT; IES 60529:1989; A1:1999; A2: 2013; Cor 2:2015, IDT)";

DSTU EN 61326-1:2016 "Electrical equipment for measurement, control and laboratory use. Requirements for electromagnetic compatibility. Part 1. General requirements (EN 61326-1:2013, IDT)";

DSTU EN 61010-1:2014 "Requirements for the safety of control and measuring and laboratory electrical equipment. Part 1. General requirements. (EN 61010-1:2014, IDT)".

1 Description of the measuring instrument type

The DKG-24 "PRD GUARDER" Personal Radiation Dosimeter (hereinafter referred to as the device) is intended for:

- search for (detect and localize) radioactive and nuclear materials by their external gamma radiation;

- measurement of dose equivalent rate (hereinafter – DER) of gamma and X-ray radiation (photon ionizing radiation);

- measurement of photon ionizing radiation dose equivalent (hereinafter DE);
- determining the intensity of photon ionizing radiation.

The device can be used to control unauthorized movements of radioactive materials and search for sources of radioactive radiation, as well as at enterprises and institutions that deal with sources of photon ionizing radiation.

The device can be used in the following areas:

- customs and border service;
- military and security services (Ministry of Internal Affairs, Security Service of Ukraine, guard services);
- metallurgy and scrap metal procurement facilities;
- monitoring of vehicles, seaports and airports;
- environmental inspections;
- radioactive waste repositories.

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1.1 Design

The device consists of the following main parts: high sensitivity scintillation detecting unit of gamma radiation (GSDUh), low sensitivity scintillation detecting unit of gamma radiation (GSDUl), supply voltage formers (SVF), bias voltage formers (BVF), GPS/GNSS receiver (NAV), BLE radio module, display and processing module (DPM), graphical monochrome display (GMD), batteries (B), thermal detector (TD).

GSDUh and GSDUl consist of a scintillation detector with a silicon photomultiplier and an amplifier.

The principle of operation of the detecting units is based on the transformation of scintillations caused by photon ionizing radiation in the scintillator into voltage pulses in a semiconductor photomultiplier. These pulses are fed to the input of the amplifier where they become amplified and come to the output as pulses of positive polarity. The number of these pulses is proportional to photon ionizing radiation DER, and the amplitude is proportional to the energy.

To ensure high temperature stability of the detectors with silicon photomultiplier, the DPM carries out constant temperature compensation by measuring the exact values of temperature at the detectors, and precisely adjusts their bias voltage.

DPM processes the pulse flows coming from the outputs of GSDUh and GSDUl, and calculates the value of photon ionizing radiation DER, which corresponds to these flows considering the multichannel amplitude analysis, and the pulse count rate from GSDUh and GSDUl. Depending on the operating mode of the device, the GMD displays the readings of DER, flux intensity, intensity flow histogram, statistical error by gamma channels.

If photon ionizing radiation DER exceeds the value of 50 μ Sv/h, the GSDUh automatically turns off, and the DER value is calculated from the GSDUl, which runs constantly. The photon ionizing radiation DE is also calculated from the GSDUl.

The DPM consists of the non-volatile memory, which stores entries of the events log.

The appearance of the device is shown in Figure 1.



Figure 1 – Appearance of the device

In terms of design, the device's shape is a derivative of a rectangular parallelepiped with the replacement of planes by surfaces with large radii of curvature with rounded edges. The plastic body is dust- and moisture-proof. The working position of the device is vertical.

The ingress protection rating is IP67. The body consists of two covers (1) and (2), connected together by screws. The front cover (1) contains a graphic monochrome display (3), three control buttons (4), GAMMA (7) and BATTERY (8) indicators.

The light panel (5) for signaling when a radioactive source is detected is located in the upper part of the cover.

A USB connector for connecting peripheral devices is placed on the back surface of the device case under a protective elastic plug (6).

The device is powered by two batteries (AA size). It is possible to operate it from lithium batteries -FR6 with a total nominal voltage of 3.0 V, from alkaline batteries with a total nominal voltage of 3.0 V and nickelmetal hydride batteries with a total nominal voltage of 2.4 V. The device can also be powered from a USB port with a nominal voltage of 5.0 V.

1.2 Primary converter

The primary converter is CsI(TI) scintillation detectors with a silicon photomultiplier, which convert scintillations into a sequence of voltage pulses that are transmitted to the measuring circuit.

1.3 Processing of measurement results

1.3.1 Technical means

DPM performs the processing of pulse flows coming from the outputs of the GSDUh and GSDUl and calculates the DER value of photon ionizing radiation corresponding to these flows, taking into account the multi-channel amplitude analysis.

1.3.2 Software

Embedded software (SW) is programmed into the device once, at the production stage.

The version of the built-in SW is displayed on the graphic monochrome display of the device for a few seconds when the device is turned on. The checksum of the built-in software is not displayed on the graphic monochrome display of the device, but is calculated and compared with the reference one each time the device is turned on during its self-test. In case of mismatch, the operation of the device is blocked. This makes it impossible for the device to function with damaged software.

Identification data of the SW are listed in Table 1.

Table 1 – Device software identification data

Measuring equipment software	Software version number	Checksum (for software
(name)		identification)
Embedded SW "DKG-24"	1.0.0	—

1.4 Display of measurement results

Depending on the operating mode of the device, DER, DE, flow intensity, histogram of flow intensity, statistical error by the gamma channel, and DE accumulation time are displayed on the GMD.

The measurement results are stored in the non-volatile memory, which is part of the DPM.

1.5 Allowed functions and features

Access to various functions of the device is determined by the level of access assigned to the user. Allowed functions are described in the Operating Manual BICT.412139.009 HE.

1.6 Technical documentation

- general description of the measuring equipment;
- assembly drawing BICT.412139.009CE;
- dimensional drawing BICT.412139.009ГЧ;
- electric schematic diagram BICT.412139.009Э3;
- list of elements BICT. 412139.009ПЭЗ;
- calculation of reliability indicators;
- test reports;
- Operating Manual BICT.412139.009 HE "Personal Radiation Dosimeter DKG-24 "PRD GUARDER".

Technical documentation is kept by the designated body with OB UA.TR.062.

2 Technical data

2.1 The main technical and metrological characteristics of the personal radiation dosimeter DKG-24 "PRD GUARDER"

Table 2

Specification	Unit of measure	Standardized values
The general range of indication and measurements of photon ionizing radiation DER: - indications - measurements from GSDUh - measurements from the GSDU1	μSv/h	from 0.01 to 10^7 from 0.01 to 50 from 50 to 10^7
 I he general range of indication and measurements of photon ionizing radiation DE: - indications - measurements 	μSv	from 0.1 to $9.9 \cdot 10^6$ from 1.0 to $9.9 \cdot 10^6$
The indication range of photon ionizing radiation counting rate	cps	from 1 to 1000000
Main relative permissible error limit when measuring photon ionizing radiation DER with a confidence probability of 0.95 (^{137}Cs) - in the range from 0.01 µSv/h to 1.0 µSv/h	%	15+2/M, where M is a dimensionless value that is numerically equal to the DER value measured in μ Sv/h
- in the range from 1.0 μ Sv/h to 10 ⁷ μ Sv/h		15
Main relative permissible error limit when measuring photon ionizing radiation DE with a confidence probability of 0.95 (¹³⁷ Cs)	%	15

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Specification	Unit of measure	Standardized values
Energy range of photon ionizing radiation being detected	MeV	from 0.02 to 10.0
Energy dependence of the device readings when measuring photon ionizing radiation DER and DE in the energy range from 0.05 MeV to 3.00 MeV relative to the energy of 0.662 MeV (¹³⁷ Cs)	%	±25
Anisotropy for GSDUh and GSDUl detectors when gamma radiation falls on them in directions at angles from + 60 to minus 60° in the horizontal and vertical planes relative to the main measurement direction, marked with "+" symbol, should not exceed: - for isotopes ¹³⁷ Cs and ⁶⁰ Co - for ²⁴¹ Am isotopes	%	±30 ±75
Time of operating mode setting of the device, no more	min	1
Calibration time by gamma background level	S	from 10 to 90
The response time to over ten-fold change in photon ionizing radiation DER	S	0.25
Rated supply voltage of the device from two galvanic cells (AA): - lithium and alkaline - nickel metal hydride batteries - from the USB port	V	3.0 2.4 5.0
 Time of continuous operation of the device when powered under the conditions of gamma radiation background of no more than 0.5 μSv/h: with the display backlight turned off, the alarm not activated, the navigation receiver and Bluetooth turned off, no less than: for two new FR6 type lithium batteries or two new Energizer Max E91 alkaline batteries; for two new, fully charged nickel-metal-hydride batteries with a capacity of 2700 mAh; with the display backlight turned off, the alarm not activated, the navigation receiver and Bluetooth turned on, no less than: for two new FR6 type lithium batteries or two new Energizer Max E91 alkaline batteries; for two new FR6 type lithium batteries or two new energizer Max E91 alkaline batteries and Bluetooth turned on, no less than: for two new FR6 type lithium batteries or two new Energizer Max E91 alkaline batteries; for two new FR6 type lithium batteries or two new energizer Max E91 alkaline batteries or two new energizer Max E91 alkaline batteries; for two new FR6 type lithium batteries or two new energizer Max E91 alkaline batteries; for two new, fully charged nickel-metal-hydride batteries with a capacity of 2700 mAh 	hour	400 300 55 40

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Specification	Unit of measure	Standardized values
Operating temperature range	°C	from -20 to +60
Additional permissible relative error limit when measuring photon ionizing radiation DER and DE caused by temperature changes in the operating temperature range from -20 °C to $+60$ °C	%	±5, per each 10 °C of deviation from 20 °C
Overall dimensions of the device without a case, no more	mm	$60 \times 110 \times 30$
Weight of the device, no more	kg	0.21

The volume of non-volatile memory allows storing up to 65536 records of the registered event.

The device ensures operability under the following conditions:

- ambient temperature from minus 20 °C to 60 °C;

- relative humidity up to 98% at a temperature of 35 °C, non-condensing;

- atmospheric pressure from 84 kPa to 106.7 kPa.

The device is resistant to (when on) the influence of sinusoidal vibrations in the frequency range from 10 Hz to 55 Hz with a displacement amplitude of 0.15 mm.

The device is resistant to (when on) single shocks with the following parameters:

- the shock pulse duration -6 ms;

- maximum shock acceleration -50 m/s^2 .

The device is resistant to (when on) drops on each of the six sides from a height of 0.75 m.

The device is resistant to (when on) the influence of a continuous or alternating magnetic field with a frequency of (50 ± 1) Hz and a strength of 400 A/m.

The device is resistant to (when on) the influence of photon ionizing radiation corresponding to DER up to 100 Sv/h for 5 min.

The ingress protection rating of the device in compliance with DSTU EN 60529:2018 - is IP67.

The device meets the electromagnetic compatibility requirements of DSTU EN 61326-1:2016 standard for group 1, class B equipment.

With regard to electrical equipment safety, the device meets the requirements of DSTU EN 61010-1:2014 standard.

Mean time to failure – is not less than 10,000 hours.

The average first overhaul period is not less than 15,000 hours.

The average life of the device is not less than 10 years.

The average shelf life of the device is not less than 10 years.

The average time to restore the device, excluding the time of delivery of spare parts and metrological calibration, is no more than 3 hours.

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2.2 Delivery kit

The delivery kit of dosimeters includes

- Personal Radiation Dosimeter DKG-24 "PRD GUARDER" 1 piece;
- Connecting cable (USB shielded) 1 piece;
- Operating manual 1 copy;
- Housing 1 piece;
- Case 1 piece;
- $\sim 2.5 \text{ mm hex L-shaped key} 1 \text{ piece.}$

Note. The device is supplied with two alkaline batteries. Nickel-metal hydride batteries and a charger for charging them are supplied optionally.

3 Interfaces and compatible external devices

3.1 Interfaces

The reading device – USB. The radio channel module – Bluetooth.

3.2 Compatible external devices

Information exchange between the device and:

- a personal computer (hereinafter - PC) takes place via USB

- a mobile phone based on Android OS is carried out via a Bluetooth connection.

Information exchange between the device, PC and mobile phone does not affect the metrological characteristics and operation of the dosimeter.

It is possible to operate the device from an external power source via a USB cable.

4 Requirements for production, commissioning and use

4.1 Production requirements

When manufacturing dosimeters, production is provided with technological instructions for operations, the list of which is approved by the production director.

There are no additional requirements for production.

4.2 Commissioning requirements

The requirements for commissioning are described in BICT.412139.009 HE "Personal Radiation Dosimeter DKG-24 "PRD GUARDER". Operating Manual".

4.3 Operating requirements

The devices must be operated in accordance with clause 2.1 of this certificate and the requirements described in BICT.412139.009 HE "Personal Radiation Dosimeter DKG-24 "PRD GUARDER". Operating Manual".

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5 Supervision over of the measuring instrument in operation

5.1 Documentation for evaluation

- a copy of the type examination certificate;

- operating documentation - BICT.412139.009 HE "Personal Radiation Dosimeter DKG-24 "PRD GUARDER". Operating Manual".

5.2 Identification (hardware and software)

The version of the built-in software is displayed on the graphic monochrome display of the device for a few seconds when the device is turned on.

The checksum of the built-in software is not displayed on the graphic monochrome display of the device, but is calculated and compared with the reference one each time the device is turned on during its self-test. In case of mismatch, the operation of the device is blocked.

6 Protection facilities

Protection against physical interference is provided by sealing. The device is sealed by the manufacturer. The device is sealed with paste in the recess of the lower cover.

7 Labeling and inscriptions

Labeling of devices must comply with BICT.412139.009 HE and contain:

- name and conventional designation of the product;

- name of the manufacturer;
- indication of the ingress protection rate;
- factory number of the device and date of manufacture according to the numbering system of the enterprise;
- the inscription "Made in Ukraine".

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8. Drawings



Figure 2 – Dimensions of the device



Figure 3 - Labeling locations, device compliance labeling locations, and sealing locations

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Figure 4 - Photo of the general view

9 Instructions for examination of the devices used

Documents for verification:

- type examination certificate;
- certificate of compliance;
- BICT.412139.009 HE "Personal Radiation Dosimeter DKG-24 "PRD GUARDER". Operating Manual".

Metrological verification

Verification of legally regulated measuring instruments in operation is carried out in accordance with the current legislation of Ukraine.

10 Terms of placing on the market

Labeling must be in accordance with the requirements of the Technical Regulations of legally regulated measuring instruments. Availability of a type examination certificate.

Additional Information:

Test reports:

1 Test report of the SEPARATED SUBDIVISION (SS) "CERTIFICATION AND METROLOGICAL TESTING CENTER "LORTA" OF THE STATE ENTERPRISE "LVIV STATE PLANT "LORTA" No. 01-06/22 dated 17 June 2022, accreditation certificate No. 20042.

2 Test report of the SS "CERTIFICATION AND METROLOGICAL TESTING CENTER "LORTA" OF THE STATE ENTERPRISE "LVIV STATE PLANT "LORTA" No. 02-06/22 dated 27 July 2022, accreditation certificate No. 20042.

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3 Test report of the SS "CERTIFICATION AND METROLOGICAL TESTING CENTER "LORTA" OF THE STATE ENTERPRISE "LVIV STATE PLANT "LORTA" No. 01-07/22 dated 01 July 2022, accreditation certificate No. 20042.

4 Test report of the SS "CERTIFICATION AND METROLOGICAL TESTING CENTER "LORTA" OF THE STATE ENTERPRISE "LVIV STATE PLANT "LORTA" No. 02-07/22 dated 06 July 2022, accreditation certificate No. 20042.

5 Test report of the SS "CERTIFICATION AND METROLOGICAL TESTING CENTER "LORTA" OF THE STATE ENTERPRISE "LVIV STATE PLANT "LORTA" No. 03-07/22 dated 07 July 2022, accreditation certificate No. 20042.

6 Test report of the SS "CERTIFICATION AND METROLOGICAL TESTING CENTER "LORTA" OF THE STATE ENTERPRISE "LVIV STATE PLANT "LORTA" No. 04-07/22 dated 07 July 2022, accreditation certificate No. 20042.

7 Test report of the SS "CERTIFICATION AND METROLOGICAL TESTING CENTER "LORTA" OF THE STATE ENTERPRISE "LVIV STATE PLANT "LORTA" No. 05-07/22 dated 07 July 2022, accreditation certificate No. 20042.

8 Test report of the SS "CERTIFICATION AND METROLOGICAL TESTING CENTER "LORTA" OF THE STATE ENTERPRISE "LVIV STATE PLANT "LORTA" No. 06-07/22 dated 08 July 2022, accreditation certificate No. 20042.

9 Test report of the SS "CERTIFICATION AND METROLOGICAL TESTING CENTER "LORTA" OF THE STATE ENTERPRISE "LVIV STATE PLANT "LORTA" No. 07-07/22 dated 08 July 2022, accreditation certificate No. 20042.

10 Test report of the SS "CERTIFICATION AND METROLOGICAL TESTING CENTER "LORTA" OF THE STATE ENTERPRISE "LVIV STATE PLANT "LORTA" No. 08-07/22 dated 11 July 2022, accreditation certificate No. 20042.

11 Test report of the TESTING LABORATORY OF THE STATE ENTERPRISE "KYIV REGIONAL RESEARCH AND PRODUCTION CENTER FOR STANDARDIZATION, METROLOGY AND CERTIFICATION" No. 3BT 013 IR C dated 28 October 2022, accreditation certificate No. 20151.

Applicant – PRIVATE ENTERPRISE "SCIENTIFIC AND PRODUCTION PRIVATE ENTERPRISE "Sparing-Vist Center" Address: 33 Volodymyra Velykoho Str., Lviv, Ukraine 79026; EDRPOU code 22362867.

State Classifier of Goods and Services code of the product – 26.51.41.