



RADON DETECTIING INDICATOR

SIRAD MR-106N

Maintenance Manual

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1. Safety measures

The body of a radon detecting indicator SIRAD (below referred as product) is not waterproof, therefore the product shall not be used in the rain or put it into water or other liquid.

In case water or other liquid gets inside the product, fault or mechanical damage occurs during the operation, immediately apply with a warranty service coupon to the technical-maintenance centre (see page 19).

Keep the product safe from beats, dust and moisture, do not store the product in the places where deleterious chemical substances exist.

The product is recommended to store in the original package between its application.

Do not block the ventilation opening at the backside of the product, as it prevents radon from freely passing into the product and leads to the reading distortion.

Condensate generation in the measuring chamber bringing about a product fault may occur by sudden changes of ambient temperature, so the product must be held at room temperature for 24 hours before it is unpacked and put into operation.

Do not open the cap of the battery compartment with the product switched on.

If you are not going to use the product during a long time, remove the batteries from the battery compartment.

Protect the keyboard and the decorative panel of the product (see page 7) from the impact of cutting and stabbing objects.

Do not place the product nearby cellular phones and other sources of electromagnetic radiation, as this may lead to a product fault.

Do not expose the product to the impact of direct sunshine or artificial light, as it may be reason for the reading distortion.

When connecting the product to the alternating current electricity network, keep the general rules in electrical safety.

Use the product only according to its intended purpose!

2. General instruction and basic information about product

This Maintenance Manual is intended for studying operating rules and learning the product design.

There are two modifications of the product to be produced: MR-106 и MR-106N. SIRAD MR-106 is a basic model. SIRAD MR-106N is a modification which has a function of monitoring data transfer to the personal computer.

The product is designed for estimating by the value of volumetric activity (VA) of radon an equivalent of equilibrium volumetric activity (EEVA) (below referred to as radon activity) of daughter products of radon-222 isotopes in the room air. A radon activity value is interpreted by Bq/m³ (Becquerel per cubic meter) (see page 19).

The product is applied for estimating radon activity in the air of living and public rooms, allows to analyze the dynamics of its changing, to signalize excess of permissible sanitary standards in content of radon in the room air as well as to transfer the data received to a personal computer (only the model MR-106N).

The product does not require calibration by its operation.

The product does not call for a customer to have special knowledge and skills by its operation.

The product has Certificate of conformity No. 060070014 of 22nd December 2006 and is registered in the Register of measuring instrument certificating system.

The certificate is given by Federal State Unitary Enterprise (FSUE) Russian National Institute for Scientific Research in Physical and Technical and Radiotechnical Measurement of Federal Agency for Technique Regulation and Metrology.

The product has useful model patent No. 52183. It was registered in RF State Register of useful models on 10th March 2006.

The results of radon activity estimation got by means of this product may not be used for making official statements about radiation environmental conditions and a pollution rate.

When purchasing the product, claim for the product to be checked in front of you according to its working order (including the absence of mechanical damage), package contents and filling in a warranty service coupon.

In case you do not have a warranty service coupon filled in correctly, we shall have to turn down your complain about quality of the product.

The product design is always improved, so some changes not reflected in this manual may appear.

3. Description and operation of product

3.1. Product specification

The product estimates radon activity in room air by the value of radon volumetric activity with the determined value of equilibrium coefficient ($K=0.5$) between radon and its decay daughter products.

Product specification is given in Table 1.

Table 1

Scale range EEVA, Bq/m ³	50 - 10 000
Actuation levels of signaling, Bq/m ³	
first threshold	100
second threshold	200
Time of establishing an operating mode (see page 19), min., not more	20
Measurement run (see page 20), h.	4
Time of continuous exposure (see page 20), h., not more	3 360
Power supply	two batteries of type LR6 1.5 V (size "AA")
Time of continuous operation with batteries of capacity 2 850 mAh, h., not more	336
Characteristic of an external power supply: positive polarity of the plug (with central "plus") $\varnothing 5.5/2,1 \times 12$	5V of direct current, not less than 500 mA
Overall dimensions of the product, length x width x height, mm, not more	180x100x47
Weight of the product (without batteries), kg, not more	0,345

Operating conditions: in permanent living and other rooms of such type at ambient temperature from plus 10°C to plus 35°C and with relative humidity not more than 65 per cent at temperature plus 25°C.

The product held at temperature below 0°C shall have been kept for 24 hours at the room temperature before being taken into operation.

3.2. Principles of calculating radon activity and product operation modes

The estimate of radon activity is made by one detector, but the value calculation is carried out through different algorithms. The first numerical value appears in 4 hours after the product switched on.

The product is provided for three algorithms of calculating the value of radon activity:

- 1) threshold;
- 2) current;
- 3) averaged.

The threshold algorithm estimates the value of radon activity level by measuring the speed of generating alpha particles and gives current information about its value.

The current algorithm detects the value of radon activity by the quantity of alpha particles within the minimal run registration of 4 hours.

The averaged algorithm identifies an arithmetic mean value of radon activity for every measurement time interval (see page 20) by the quantity of registered alpha particles within the interval from 4 hours to 3 360 hours depending on the amount of registration runs carried out.

The product has the next operation modes:

- 1) measurement mode (the basic mode of the product operation; values of radon activity level are registered from the moment of switching on the product till the moment of its switching off with the four-hour run);
- 2) menu mode (the product setup is exercised);

3) energy saving mode (only by power supply with batteries, the product goes to energy saving in one minute after the operation starting, and in so doing there is nothing shown on the display, but the power indicator remains in the intermittent periodic duty till the moment of going out of this mode).

Note: the results are stored in the memory of the product when changing batteries or switching off from the external power supply.

3.3. Description of the product controls

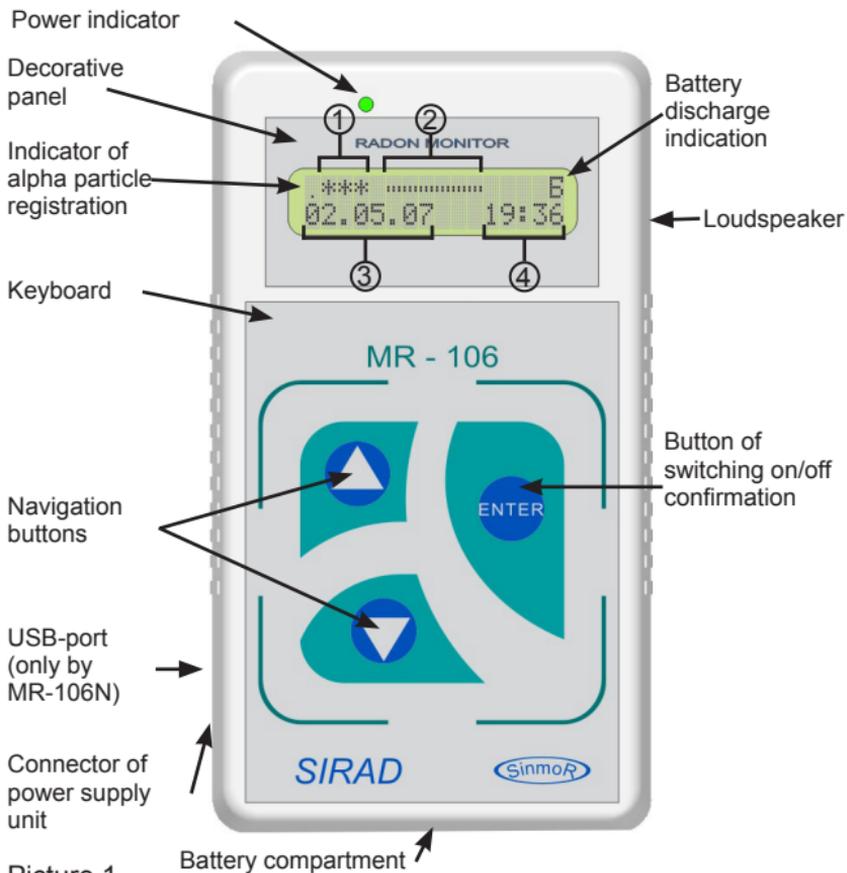
Switching on/off the product is performed by persistently (more than 3 s) pressing the button “ENTER” (see Table 2).

Entering the menu mode is exercised by singly pressing the button “ENTER”.

Table 2

Appearance	Name	Description of functionality
	Navigation button “Up arrow”	Moving up across menu items, setting date and time values, increasing the volume of audible presentation, showing the charge level of batteries on the display during measurement mode.
	Navigation button “Down arrow”	Moving down across menu items, setting date and time values, decreasing the volume of audible presentation, showing the charge level of batteries on the display during measurement mode. Pressing and keeping this button before switching on allows displaying a factory number of the product.
	Button “Enter”	Switching on/off the product by pressing the button for more than 3 s, entering the menu mode by singly pressing, approving the chosen menu item by singly pressing.

3.4. Product appearance

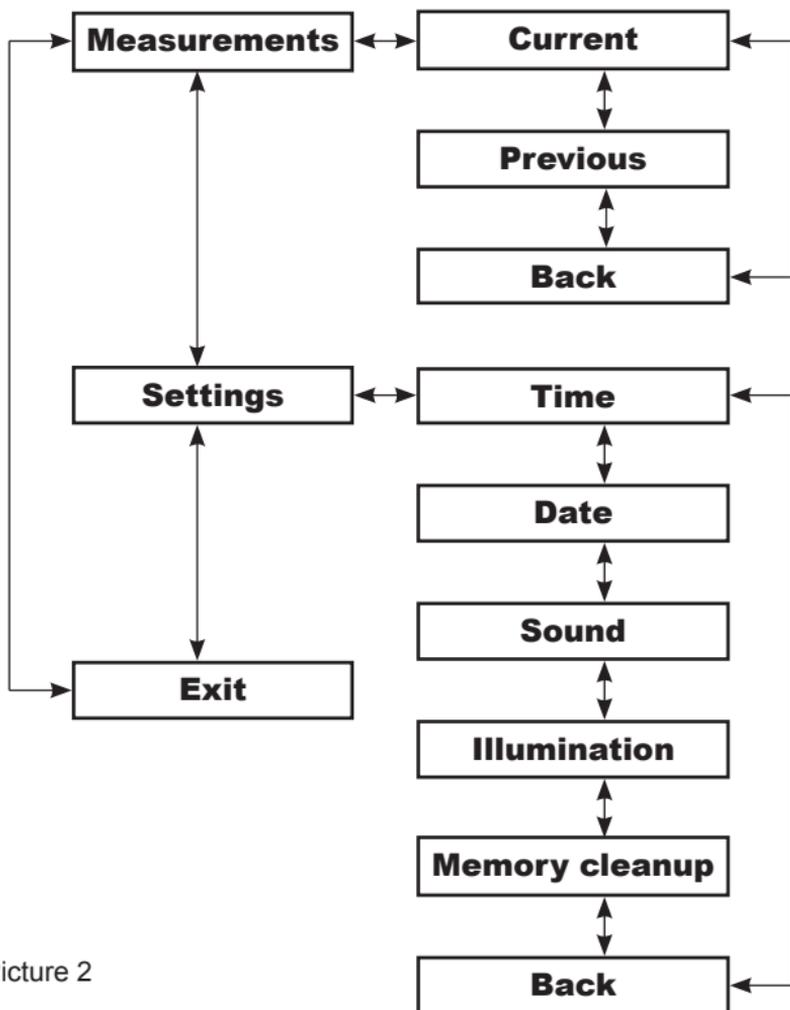


Picture 1

- field displaying threshold values of radon activity level:
 - bare field fits the level of less than 50 Bq/m^3 ;
 - symbol * fits the level from 50 to 100 Bq/m^3 ;
 - symbol ** fits the level from 100 to 200 Bq/m^3 ;
 - symbol *** fits the level of more than 200 Bq/m^3 ;
- field displaying average (current) values of radon activity level in Bq/m^3 ;
- field displaying date (within the format of day : month : year);
- field displaying time (within the format of hours : minutes).

3.5. Structure of product menu

As seen from Picture 2 the menu has cyclic character. Moving across menu items can be made in any direction (either downwards, or upwards) by means of navigation buttons (see Table 2). Choosing menu items is made by the button “ENTER”.



Picture 2

4. Intended use

4.1. Operating limitations

Do not open the cap of the battery compartment when the product switched on.

Do not use the product in the rain or put it into the water. If the product got into the water, immediately apply to the technical-maintenance centre (see page 19).

Keep the product safe from beats, dust and moisture.

Do not store the product in places where deleterious chemical agents exist.

The product is recommended to store in the factory package between its applications.

Do not block the ventilation opening at the backside of the product, as it prevents radon from freely passing into the product and leads to the reading distortion.

Condensate generation in the measuring chamber bringing about a product fault may occur by sudden changes of ambient temperature, so the product must be held at room temperature for 24 hours before it is unpacked and put into operation.

Protect the keyboard and the decorative panel of the product (see page 7) from the impact of cutting and stabbing objects.

4.2. Preparation of the product to its application

Before switching on the product, learn this Maintenance Manual and the functionality of controls (see Table 2).

Mounting batteries:

- 1) remove the cap of the battery compartment of the product;
- 2) put two batteries of type LR6 (1,5 V) into the battery compartment according to polarity contacts (“+” and “-”);
- 3) set the cap of the battery compartment on the product body.

Notes:

- 1) when caring out a long-term examination, it is recommended to install fresh batteries;
- 2) do not mix old and new batteries;
- 3) batteries have different capacities, so it is recommended to use batteries with a maximal capacity or an external power supply unit for long-term examinations.

Connecting to the alternating-current mains

Connecting to the mains of 220 V 50 Hz is exercised by means of a standard adapter with output parameters: 5V of direct current, not less than 500 mA, positive polarity of a plug (with central "plus") $\varnothing 5,5/2,1 \times 12$.

Switching on the product:

Press the button "**ENTER**" and release it after switching on, a creeping line appears on the display (in doing so the product tests build-in control "**TBC**", when the product operability is checked); by successful "**TBC**" results the name of the product appears on the display and a tuneful beep sounds (by the first switching on the product suggests to establish the current date and time); by unsuccessful "**TBC**" completion a message of "**TBC error**" appears on the display and the product would switch off; in this case it is necessary to press the button "**ENTER**" again and release it; when this message appears several times, the product should be sent to the repair (see page 19).

Date and time setting:

- 1) To enter the menu system, press the button "**ENTER**";
- 2) By means of any navigation button move to the menu item "**Settings**" and press the button "**ENTER**";
- 3) When activating the submenu item "**Time**", press the button "**ENTER**" (time on the display is shown within the format of hours : minutes);
- 4) By means of any navigation button setup a figure of hours, then minutes, confirming every figure by pressing the button "**ENTER**"; after confirming the last figure or when being at this submenu for a long time, a backoff is automatically activated and turns up at first to the original menu item, and then to an exit from the menu mode;
- 5) When activating the menu "**Settings**", press the button "**ENTER**" and by means of any navigation button go to the submenu item "**Date**" and press the button "**ENTER**" (the date is displayed within the format of day : month : year);

6) By means of any navigation button setup a day, then a month, then a year, confirming every figure by pressing the button **“ENTER”**; after conforming the last figure or when being at this submenu for a long time, a backoff is automatically activated and turns up at first to the original menu item, and then to an exit from the menu mode.

Note: The model MR-106N is provided for an automatic synchronization of the date and the time when connecting the product to the computer.

Audible indication settings:

1) When activating the menu **“Settings”**, press the button **“ENTER”**, by means of any navigation button go to the submenu item **“Sound”** и press the button **“ENTER”**;

2) To increase the volume press the button **“Up arrow”**;

3) To decrease the volume press the button **“Down arrow”**;

4) To confirm the chosen sound volume, press the button **“ENTER”**, in doing so remembering the chosen settings occurs and a backoff to the original submenu item takes place.

Note: an average sound volume is setup on default; audible indication of thresholds operates even when the sound is switched off.

Display illumination adjustment:

1) When activating the menu **“Settings”**, press the button **“ENTER”**, by means of any navigation button go to the submenu item **“Display”** and press the button **“ENTER”**;

2) By means of any navigation button chose one of the options: **“On”**, **“Off”** (the display illumination is switched off on default);

3) To confirm the chosen position, press the button **“ENTER”**, in doing so remembering the chosen settings occurs and a backoff to the original submenu item takes place.

Note: when display illumination is switched off, it has been glowing for 5 seconds after pressing any button.

Cleanup of the product memory:

- 1) When activating the menu "**Settings**", press the button "**ENTER**", by means of any navigation button go to the submenu item "**Memory cleanup**" and press the button "**ENTER**", at the same time the first option, "**Current**", out of the three ones is displayed;
- 2) Press the button "**ENTER**" to clean this memory area up, at the same time a request for confirmation cleanup arises;
- 3) By means of any navigation button chose "**Yes**" or "**No**" and press the button "**ENTER**" to clean or to cancel cleaning;
- 4) To move to the next option without changing the current one, press any navigation button, memory cleanup is made by analogy;
- 5) To exit chose the submenu item "**Back**" and press the button "**ENTER**".

Note: use three options for the product memory cleanup:

"**Current**" – allows to clean the product readings for the recent 24 hours;

"**Previous**" - allows to clean the product readings for the whole monitoring period, apart from the current values;

"**All values**" - allows to clean completely all results of monitoring.

Switching off the product:

- 1) Press the button "**ENTER**" and hold it for some seconds, while a request for confirmation of switching off the product arises on the display;
- 2) By means of any navigation button chose "**Yes**" or "**No**" and press the button "**ENTER**" to switch the product off or to cancel switching off.

Notes:

1) An adapter for connection to the alternating-current mains is not included to the delivery set;

2) Switching off is made at the basic operation mode of the product (see page 5);

3) Power indicator (see page 7) operates in permanent mode by power supply from the alternating-current mains, by power supply from batteries and by product operation in energy saving mode, power indicator operates within intermittent periodic duty;

4) By values of radon activity level from 8 000 Bq/m³ to 10 000 Bq/m³ the notice "**DANGER**" is displayed. The notice "**Limit excess**" is displayed when the measurement limit is exceeded.

4.3. Room examination rules

The examination intended for estimating radon activity in the air takes place in living and public buildings after the accomplishment of construction (reconstruction or complete overhaul) and by their use.

Examination in chosen rooms is carried out by windows and doors closed and by normal mode of ventilation operation (if it exists).

It is recommended to carry out an examination by the highest atmospheric pressure and light wind.

As a rule one estimation of radon activity is conducted in every room examined. In case the room has big dimensions the amount of examinations increases at a rate of one examination per every 50 square meters.

To identify the dynamics of changing radon activity level it is necessary to carry out a permanent monitoring of the chosen rooms, especially those, where people spend most of their time.

By several measurements the average annual value of radon activity is calculated as an arithmetic mean of the product readings.

It is necessary to keep an interval of not less than 1.5 hours after finishing the process of measuring (switching off the product) and before the beginning the measurement within the other conditions.

Examination time is determined by the customer, but measuring is recommended to do within not less than 72 hours for one room.

4.4. Rules of the product installation by the examination

When making an examination in the used buildings the quantity and the location of the rooms being subject to the examination depend on the particular situation, but, basically, are chosen on the principle that those rooms shall be examined, which have different functionality and are situated on all floors of an apartment (a cottage), including a cellar. At the same time a special attention should be paid to those rooms where people spend most of their time.

By examination the product should be located in the places where the air change rate is minimal for the results received to define the maximal values of radon activity in this room.

At the same time the product should be placed not lower than 50 cm from the floor, not closer than 25 cm to the walls and 50 cm to heating elements, a conditioner, windows and doors.

4.5. Calculation of radon activity

During the cycle of registration every registered alpha particle of decay of radon isotope daughter products is followed by a message on the display in the form of blinking rectangle at the left corner of the display (see page 7.) and by a beep (under the condition that the product operates in the measurement mode and the audible indication switched on).

The product calculates the quantity of alpha particles and presents the results on the display in Bq/m³ (Becquerel per cubic meter).

4.6. To overview the monitoring results

It is necessary to do the next actions in order to see the monitoring results:

- 1) Enter the menu by pressing the button "**ENTER**";
- 2) When the menu item "**Measurement**" is activated, press the button "**ENTER**";
- 3) By means of any navigation button chose one of the submenu items "**Current**" or "**Previous**" and press the button "**ENTER**", in doing so the current values of monitoring results for the recent 24 hours or the previous averaged results for every date of the examination respectively appear on the display; when being at this submenu item for a long time a backoff at first to the original menu item automatically will take place and then an exit out of the menu mode.
- 4) In order to exit chose the submenu item "**Back**", press the button "**ENTER**".

4.7. Estimation of monitoring results

The value of radon activity in the room examined should be considered as an averaged value, the current value may be used when analyzing the dynamics of changing the radon content during the period of the measurement (see page 20).

According to the Norms of Radiation Safety (NRS-99) in the buildings used the averaged annual value of radon daughter product activity in the air of the living room shall not exceed 200 Bq/m³.

The averaged annual value of activity of radon isotopes in the air of the rooms of the housing and public buildings put into operation shall not exceed 100 Bq/m³.

By readings of 200 Bq/m³ and more it is necessary to reduce the time of being in this room, regularly to air it and to apply to State Sanitary and Epidemiological Service of RF Public Health Ministry and get competent information about the risk level and recommendation of the way of behavior in such conditions.

ATTENTION! If the message “**DANGER**” appears on the display from time to time, it indicates about the increasingly high value of radon activity (more than 8 000 Bq/m³). In such a case it is recommended to quit this room and to apply to State Sanitary and Epidemiological Service of RF Public Health Ministry for interpretation of the measurement results and for carrying out a radiation examination of the room.

5. Run a computer

This manual paragraph only refers to model MR-106N.

Computer requirements:

- 1) RAM not less than 128 MB;
- 2) Availability of hard disk space not less than 100 MB;
- 3) OS: Windows 98/ME/2000/XP or a later version.

To transfer data to the computer it is necessary to install the software (below referred to as SW) beforehand, which is delivered together with the product on a CD, to the hard disk of the computer, and then to connect the product with the computer by means of USB A-B cable (does not included into the delivery set) and follow the instruction on the monitor.

The manual on using SW is on the same CD or on the Internet address: <http://www.sinmor.ru>. An updated version of SW may be found on the mentioned web site.

6. Maintenance

The product maintenance is made by the customer after studying this Maintenance Manual.

The product maintenance provides for:

- 1) removing dust from the outside surface of the product;
- 2) cleaning the keyboard surface from possible dirt with a soft cotton rag faintly wet with ethanol;
- 3) when noticing a message “B” on the display the batteries are to be changed without waiting for their full depletion;
- 4) by a long pause (more than one month) in the product operation, the batteries should be removed from the battery compartment.

The product does not require calibration when used by the customer.

7. Transportation and storage

The transportation of the product in the manufacturer package may be done by means of all types of covered transport and to any distance

Placing and fastening of shipping containers with the packed product in vehicles shall provide for steady position of shipping containers and absence of its movements during the transportation.

By transportation of the product protection from precipitation should be provided.

The conditions of product transportation in packages shall suit the storage conditions of GOST 15150-69:

- The temperature range is to be from plus 5°C to plus 40°C;
- The relative humidity at temperature of plus 25°C is to be not more than 98 per cent.

Before put into operation the product should be stored in the manufacturer package at ambient temperature from plus 5°C to plus 40°C and with the relative atmospheric humidity up to 98 per cent at temperature plus 25°C.

Without package the product should be stored at ambient temperature from plus 10°C to plus 35°C and with the relative humidity up to 80 per cent at temperature plus 25°C (without moisture condensation).

The product held at temperature below 0°C shall be kept at room temperature for 24 hours before the package opened and the product put into operation.

8. Manufacturer warranty

The manufacture guarantees the product suits requirements 11CP.000000.000-01TY when the consumer follows the terms of operation, storage and transportation stated in this Maintenance Manual.

According to GOST 12997-84 the warranty period of the product operation is 18 months since the day of sale through retail distribution.

The warranty gives a right for free removal of manufacturing faults and exchange of defective parts, if these defects occur during the warranty period and are caused by faults made by manufacturer.

The warranty refers only to the product.

The product is not subject to warranty service in the next cases:

- Absence of a warranty service coupon adequately filled in;
- Breaching the warranty stamp on the product;
- Unauthorized opening, repairs, software alteration;
- Violation of the operation norms mentioned in this Maintenance Manual;
- When using without following its intended purpose;
- In case of foreign objects, liquid, insects and other waste getting inside the product;
- Presence of mechanical and other types of damage caused by the application of the product not according to its intended purpose or as a result of careless usage;

9. Current repairs

The repairs of the product are made by the manufacturer OOO SINMOR at the address:

2 Building, 3 Podol'skikh Kursantov street, Moscow, 117545
Tel./fax (495) 316-96-33.

The period of repairs is specific for every particular situation and is determined by the availability of spare parts.

The product is taken to repairs only with a complete set (see Table 3).

Table 3

Name	Quantity
Radon detecting indicator SIRAD	1
Box-container	1
Package with silicagel	1
CD with software for SIRAD MR-106N	1
Maintenance Manual	1

10. Reference information

EEVA - equivalent of equilibrium volumetric activity of daughter products of isotopes of ^{222}Rn – weighted total of volumetric activity of short-lived radon daughter products - $^{218}\text{Po}(\text{RaA})$, $^{214}\text{Pb}(\text{RaB})$, $^{214}\text{Bi}(\text{RaC})$, (Po- polonium, Pb- lead, Bi- bismuth).

VA - volumetric activity – the proportion of the quantity of spontaneous transformation of substance nuclei per unit of time, which exist in the given volume, by the volume.

1 Bq/m³ – a system unit of decay activity measurement, which corresponds to one spontaneous transformation of substance nuclei per unit of time within a unit of volume.

Time of establishing the operation mode – the time in which radon gets inside the measurement compartment of the product.

Measurement cycle – minimal period of time which is necessary for collecting and processing information about the level of radon activity.

Time of continuous exposure – total time of monitoring from the moment when the product is switched on at the first time till the moment when the product memory is completely filled.

Measurement time interval – time interval from the moment of the product switched on till the moment of its switching off which is multiple of the measurement cycle (24-hours or less than 24 hour may serve as a measurement time period, but not less than 4 hours every day).

Radon (^{222}Rn) - radioactive gas, which does have no taste, no color and no smell. Radon and its daughter products exist in the atmosphere due to its natural radioactive elements - heavy metals (uranium, radium), existing in the Earth crust.

Because of their physicochemical properties radon does not completely remain in soils or water, but gets into the atmosphere. Radon coming from the Earth surface into free atmosphere quickly disperses in it due to vertical convection and turbulent mixing. As a results further terms of the radon decay chain appear to be in large amounts in the air in the form of aerosols. Finally, a part of them accumulates in respiratory tracts with producing irradiation of pulmonary tissues.

In those cases when radon gets into closed air space, for example, into underground mines or into buildings, higher levels of radon happen to appear. In such places the level of radon increases in proportion to decreasing ventilation speed.

The most radiation-dangerous among radon decay products are alpha emitters, as alpha particles have a high degree of ionization in tissues.

The presence of radon and its daughter decay products in the air causes internal irradiation of people.