



## ***Scintillation Materials, Detectors and Electronics***

# **OPERATING MANUAL**

## ***RUGGEDIZED DETECTORS***

### **I. DESCRIPTION**

Ruggedized detectors based on polycrystal NaI (TI) and CsI (Na) scintillators are used for gamma radiation registration in the photons energy range from 20 keV to 10 MeV in the temperature range from -20°C to 175°C. Ruggedized detectors with improved mechanical and thermal characteristics are applied for gamma-ray logging in gas and oil industry.

Ruggedized detector consists of a scintillation crystal hermetically encapsulated in metal container with protective glass. To provide increased mechanical hardness ruggedized detectors have a damping system for qualitative work within product lifetime. Scintillation crystal is wrapped in reflector material for maximum light detection.

### **II. UNPACKING AND PRODUCT INSPECTION**

If on receipt of the products external damages of the packing are discovered, one should confirm the damages with the assistance of the shipping agent. The manufacturer can not replace the damaged products without documentarily confirmed damage of the packing.

It is allowed to unseal the packing only after isolation under normal climatic conditions no less than 24 hours.

Take out the certificate (certificate of technical characteristics inspection of the detector). Take out the detector and additional parts (if any), and set it in a safe place.

Make sure that all elements specified in the packing list are included into the packing. If there are several detectors in the packing, it is necessary to define the correspondence of certificates by serial numbers to each of the detectors.

The buyer shall carry out primary visual control of products in accordance with the specification within 30 (thirty) days from the date of products receipt as follows:

1. Check of appearance (any mechanical damages on the output window and housing of the container, indentations and corrosion on the metallic surface of the container; facets and foliations on the glue line, hydrolytic film sections of white, yellow-green color that is considered to be scintillator destruction resulting from its chemical interaction with moisture; ungluing of output window from scintillator for more than 30 %; chips and cracks in scintillator with dimensions more than 3 mm are not acceptable).

Appearance of detectors is controlled by visual inspection without using of magnifying facilities at the light from 10 lux to 50 lux.



Chips and cracks of smaller dimensions are not determined. Cracks and foliations of reflective envelope are considered to be construction integrity damaging.

2. Verification of the detectors marking (information about the type of the detectors, serial number of the detectors, date of production).

If at the primary visual control any of the above mentioned visual defects is not found in products, it is considered as having passed visual control and is suitable for testing.

In case of discovery of visual defects or other disparities the customer should turn in written form for explanations to the QC department of the manufacturer (QC@isc.kharkov.com) within 30 (thirty) days from the date of products receipt.

If after expiration of 30 (thirty) days from the date of products receipt the customer does not provide any information about the discovered visual defects during the primary visual control the manufacturer should not accept claims on disparity of the appearance of the products.

In case irreparable defects (mechanical damages on the output window and housing of the container, indentations and corrosion on the metallic surface of the container; facets and foliations on the glue line, hydrolytic film sections of white, yellow-green color that is considered to be scintillator destruction resulting from its chemical interaction with moisture; ungluing of output window from scintillator for more than 30 %; chips and cracks in scintillator with dimensions more than 3 mm.) are found in the products, they should be returned to the manufacturer for warranty repair or replacement.

It is necessary to provide packing with the use of original packing materials by which it is possible to make certain that no damage occurred during transportation and storage. It is also necessary to attach the proper warning labels on the packing to provide careful handling of the products.

The products should be returned with the following accompanying documents:

- brief description of reasons for return;
- return address for the shipment;
- name of the buyer and contact telephone number.



**III. TECHNICAL SPECIFICATION**

Ruggedized detectors are produced according to the design documentation.

Crystal material .....	NaI (Tl)	CsI (Na)
Density, g/cm <sup>3</sup> .....	3.67	4.51
Hygroscopic .....	high	high
Energy range .....	20 keV – 10 MeV	
Energy resolution at 662 keV ( <sup>137</sup> Cs),% .....	≤9.0	
Light output, relative units		
dia. 10 to 30, height 10 to 70 .....	≥2.8	
dia. 31 to 40, height 40 to 80 .....	≥3.2	
dia. 18 to 40, height 100 to 160 .....	≥1.6	
dia. 41 to 63, height 100 to 160 .....	≥1.8	
dia. 10 to 20, height 10 to 50 .....		≥1.8
dia. 16 to 40, height 10 to 100 .....		≥1.7
dia. 16 to 40, height 101 to 160 .....		≥1.4
Operating temperature range, °C.....	-20...+175	
Physical load .....	500g/1ms 3 shocks Y-direction Random 20g, 5-500Hz for 30 min	

**IV. TESTING PROCEDURE**

1. The measurements should be carried out under normal climatic conditions:
  - air temperature from 15 to 35°C;
  - relative air humidity from 45 to 80%;
  - atmosphere pressure from 84 to 106 kPa (from 630 to 800 mm Ht).
2. For registration of pulse height spectrum pulse height analyzers with the number of channels 1024 or 4096 with output recording device of any type which allows representing pulse height spectrum in the form convenient for processing should be used.

All equipment should be grounded.

The measurements should be carried out not earlier than for 30 minutes after the last device is enabled.

3. As the source of gamma-radiation sealed radioisotopic source of ionizing radiation with certain energy is used.

In cases indicated by specification for specific types of detectors the source is used with one-hole collimator, whose diameter of holes should not exceed the thickness of the collimator (3.0 mm).

4. Before measurements are made detector is stored in darkness within 8-10 hours.
5. Before measurements are made PMT is stored in darkness under high voltage within the time PMT is stabilized under operating conditions.
6. All characteristics are measured in a completely dark state of the detector and PMT.



7. Optical contact between detector and PMT is provided by paraffinic oil (or another immersion oil) which is cleaned by ethyl alcohol from the output window of the detector and PMT after measurements are made.
8. Detector is mounted to PMT by the output window to the photocathode.
9. Gamma radiation source is installed along the axis of the detector (with deviation not more than 5°) at the distance not less than one diameter of the detector (if another distance is not specified in the specification for the specific types of detectors).

At spectrum collection integral pulse count rate shouldn't exceed  $10^4$  counts per second reached by fitting of the distance between the source of ionizing radiation and detector or fitting of source activity.

10. Pulse height spectrum is recorded within the time not more than 3.0 thousand pulses are collected in the channel corresponding to full absorption peak maximum.
11. Processing of the measurements results. The amplitude resolution is evaluated according to the following equation:

$$R = \frac{\Delta V}{V} * 100,$$

where:  $\Delta V$  – the width of full absorption peak at FWHM;

$V$  – amplitude of the signal.

Light output is evaluated according to the following equation:

$$C = \frac{V - V_o}{V_{co} - V_o} * C_o,$$

where:  $V_o$  – the value of initiate point of unit transformation parameter;

$C_o$  – the value of standard sample light output (relative units).

Ruggedized detector passed the testing if measurement data are in the range of  $\pm 5\%$  of the results for the last test at the manufacturer's company indicated in the certificate.

## **V. SAFETY CONDITIONS AND OPERATING RULES**

The product is not toxic, explosive or radioactive.

Conditions for normal operation:

1. Do not drop the product.
2. For indoor use or out door use (in dry medium).
3. Relative air humidity should not exceed 95%.
4. Physical load should not exceed 500 Hz.
5. Temperature range is from  $-20^{\circ}\text{C}$  to  $175^{\circ}\text{C}$ .



In case of damage or failure the in-house repair of the product is not allowed. Damage product should be hermetically packed in polyethylene and sent to the manufacturer.

The product should be cleaned outside with a damp cloth and ethyl alcohol. The product should be cleaned only when it is out of running. Do not dip the product into the water.

## **VI. TRANSPORTATION AND STORAGE**

The transportation of the products in the manufacturer's packing can be carried out by all means of transport to any distance with the observance of the following conditions:

1. The transportation should be carried out in clean covered places.
2. The installation and the fastening of the boxes in the transport should ensure their stable position eliminating the possibility of displacement and collision between themselves and the sides of the transport.
3. Warning marking should be observed on every stage of the transportation.
4. Avoid the fall of the boxes with the products.

The products in the manufacturer's packing should be stored indoors with good ventilation at the temperature from 15°C to 35°C (from 60°F to 95°F) and relative air humidity not exceeding 80% at the absence of corrosive impurities in the environment.

The products should be protected from huge temperature swings.

## **VIII. WARRANTY AND MAINTENANCE SERVICE**

The manufacturer warrants that the products should be free of defects in materials used for manufacturing or production process.

The manufacturer warrants the conformity to the products quality at the observance by the customer of transportation and storage conditions, and the operation rules established by this operation manual:

- 1) Storage warranty period is 24 (thirty) months from the date of the final quality control of the products at the manufacturer's enterprise.

The warranty applies only to the original customers of the product and only to the product with serial number still legible.

The warranty does not apply to the product whose performance fails as a result of misuse, mishandling, abuse, accident, physical damage or improper installation, or submersion in water. The warranty is not valid if the product has been modified or altered without manufacturer's express approval.

The manufacturer's obligation shall be limited to the repair or replacement of the product, at manufacturer's option, which has been rejected as defective within the warranty period.

The manufacturer is not responsible for damages including incidental or consequential damages resulting from improper use or failure of products operation under this warranty.

Any claim on the warranty should be made by the original customer within the warranty period. The customer should apply to the Quality Control Department (QC@isc.kharkov.com) in order to receive additional information.

All products returning for warranty repair or replacement should be packed with the use of original packing materials by which it is possible to make certain that no damage occurred during transportation and storage.



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All products returning for warranty repair or replacement should be accompanied by the documents confirming the purchase, as well as by rejection sheet, which confirms that use of the product is not possible through the manufacturer's fault.

The products replaced under warranty repair, are not subject to the payment

Returned products are found out to be in good operational state or damaged for causes which are not covered by this warranty will be subject to a service charge. After the repair is finished the products will be returned to the customer freight prepaid.