Technical Documents for Human Thyroid Phantoms with Reference Samples of Radionuclide Barium-133 (Simulator of Iodine-131) Set PhTh-04T

Designed by
Research Institute
for Industrial and
Sea Hygiene

Produced by
Scientific and
Technical Centre
"Protection Ltd"

Saint-Petersburg, Russia
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SCIENTIFIC-INDUSTRIAL AMALGAMATION "ALL-UNION SCIENTIFIC-RESEARCH INSTITUTE FOR METROLOGY NAMED AFTER D.I.MENDELEEV"

SCIENTIFIC-RESEARCH INSTITUTE FOR HYGIENE OF SEA TRANSPORT

CERTIFICATE

for reference samples of activity of barium-133 radionuclide, a simulator for iodine-131 (set PhTh-04T) IRS 42-009-91...IRS 42-011-91

1. Purpose: The reference samples are designed for calibration of gamma-spectrometers of human exposure (whole-body counters) of the type SEG-01T (number according to the State Register 12278-90) and SEG-02T (number according to the State Register 12277-90).

2. Metrological parameters

2.1. The certified parameter: the activity of the basic radionuclide, within intervals of permissible values presented in Table 1:

Table 1

Reference sample type	Interval of permissible values of barium-133 activity, kBq
IRS 42-009-91	7.0...13.0
IRS 42-010-91	13.0...23.0
IRS 42-011-91	30.0...45.0

2.2. Error of the certified value of RS: the relative error does not exceed 6 % for confidence probability of 0.95.

The values of metrological parameters of concrete specimens of reference samples are given in the obligatory Appendix 1.

3. Additional information:

1) The ratio of the total activity of admixed gamma-emitting radionuclides to the activity of barium-133 radionuclide in the source does not exceed 3 %;

2) the values of deviation of the linear attenuation factor for gamma radiation in the material of reference samples from the linear attenuation factor for gamma radiation in soft biological tissue of human body (the error of tissue equivalence) are presented in Table 2:

Table 2

Energy of gamma radiation, MeV	Error of tissue equivalence, %	Energy of gamma radiation, MeV	Error of tissue equivalence, %
0.05	-20.0	0.66	-1.5
0.10	-7.0	0.80	-1.0
0.20	-5.0	1.50	-1.0
0.40	-3.0	3.00	-1.0

4. The document determining the procedure and conditions of application of reference samples:

Instructions for application of reference samples (obligatory Appendix 2).

5. Conditions of storage and transportation:

Temperature of ambient air from minus 50 to 50°C;

relative humidity to 100 % at the temperature of 25°C.

The set PhTh-04T should be transported by plane in heated sealed sections and by automobile transport.

6. Working life of RS specimens is one year.

7. Date of output of RS specimens is given in Appendix 1.

Director of SRIHST V.V.Dovgusha

Deputy director SIA

"ASRIM n.a. D.I.Mendeleev" V.N.Khazhuev

The metrological expertise of documentation for IRS has been performed by ASRIMRS.

Deputy director of ASRIMRS I.E.Dobrovinsky

The types of IRS 42-009-91...IRS 42-011-91 have been approved by the head institution for standardization of general technique and have been introduced in the register of the Ministry of Health of the USSR.

The date of the types approval:

The duration of the types: five years.

Deputy head -

chief designer of

SDTB "Biophyspribor" G.S.Mayorov

Appendix 1
to the certificate
(obligatory)

Results of certification of reference samples of activity of barium-133 radionuclide, a simulator for iodine-131, (set PhTh-04T)

No 7

(serial No)

Metrological parameters

Reference sample type	Basic radionuclide	Actual value of activity of the basic radionuclide as of the date of certification, kBq	Value of relative error for significant probability 0.95, %	Working life of the RS specimen, years
42-009-91 42-010-91 42-011-91	^{133}Ba	7.8 15.0 35.8	6.0	1.0

The date of the specimen production 01 August 1996

(certification date)

The results of certification are valid till 01 August 1997

SRIISM

Leading researcher A.N.Kovtun

Engineer of the 1st category C.M.Prokofyev

Appendix 2
Obligatory

APPROVE
director of SRI HST
V.V.Dovgusha
20 December 1991

THE SET PhTh-04T
Instructions for application

Deputy director
for scientific work
V.S.Bychenkov
20 December 1991

Head designer
A.N.Kovtun
5.12.1991

1991

The present instruction in combination with the registration certificate and the certificate for the concrete specimen of the set PhTh-04T is intended for acquaintance with design, purpose, technical parameters of the article, safety requirements, and establishes the procedure of application of the reference samples.

Measurements by means of the reference samples should be performed in accordance with scientific and technical documents for procedures of control tests and calibration of gamma spectrometers and radiometers of human exposure (whole-body counters). For SEG-01T and SEG-02T the calibration tests and graduation is according to the technical description of the device.

1. GENERAL DIRECTIONS

1.1. The set PhTh-04T is the set of reference samples of activity of barium-133 radionuclide, a simulator for iodine-131 - the set of thyroid phantoms.

1.2. The thyroid phantom includes: the radionuclide source (the model of thyroid) and the scatterer (the model of neck). The complete set of shipment and the grading of components are given in the registration certificate.

1.3. Service conditions are in accordance with the certificate.

1.4. In order to avoid the failure of the radionuclide sources and the possibility of contamination of the environment, mechanical damages of the sources and action of acids and alkalis on them is not allowed.

2. SAFETY REQUIREMENTS

2.1. During operations using the set PhTh-04T, the requirements of "Basic sanitary rules for works with radioactive substances" - OSP-72/87, of "Standards of radiation safety" - NRB-76/87, and of the present instructions should be followed.

3. TECHNICAL DATA

3.1. The index of the reference sample, the type of the phantom, and the age of the man being modelled are given in Table 1.

Table 1

Reference sample index	Type of thyroid phantom	Age of the man being modelled, years
IRS 42-009-91	1	6
IRS 42-010-91	2	14
IRS 42-011-91	3	20

3.2. General view of the thyroid phantom is shown in Fig. 1.

3.3. Actual values of activity of barium-133 radionuclide in reference samples are given in the certificate (Appendix 1).

3.4. Anthropometric parameters reproduced by the thyroid model are presented in Table 2.

Table 2

Parameter	Values of thyroid model parameters [1]					
	Type 1		Type 2		Type 3	
	Single lobe	Both lobes	Single lobe	Both lobes	Single lobe	Both lobes
Mass, g	2.0	4.0	3.9	7.8	9.3	18.6
Vertical dimension, mm	35	35	45	45	54	54
Transverse dimension, mm	12	33	14	40	19	54
Thickness, mm [2]	10	-	12	-	16	-
Minimal thickness of integumentary tissues, mm	5	-	8	-	16	-

Comment: [1] The mass and dimensions of the model concern the radioactive material of the thyroid models.

The density of the radioactive material is 0.86 g/cub.cm.

[2] Presented is the calculated value of the average thickness.

4. PURPOSE OF THE ARTICLE COMPONENTS

4.1. The scatterer plays the role of simulator for soft biological tissue of human type - covering tissues of the thyroid.

4.2. The radionuclide source simulates the activity of barium-133 radionuclide, the simulator for the incorporated iodine-131 radionuclide homogeneously distributed in the tissue of the thyroid. The general view of the source is shown in Fig. 2.

4.3. The scatterer together with two radionuclide sources inserted in its cavities forms the corresponding reference sample - the thyroid phantom in correspondence with Table 1.

4.4. The scatterer is simultaneously the background phantom of the thyroid.

5. SPECIFIC FEATURES OF APPLICATION

5.1 When the works on calibration of the devices are performed, the detection unit should be oriented with respect to marks drawn on the surface of the scatterer. The marks correspond to the centers of the models of the left and the right lobes of the organ.

5.2. When the reference sample-phantom is used as a part of a whole-body phantom, it is placed above the block "breast" in accordance with the instructions "The set UPh-02T. Instructions on application".

5.3. When measurements of people are performed with spectrometers and radiometers not equipped with a special collimator, the background phantom should be used as a part of the background whole-body phantom, according to point 5.2.

6. STORAGE AND TRANSPORTATION

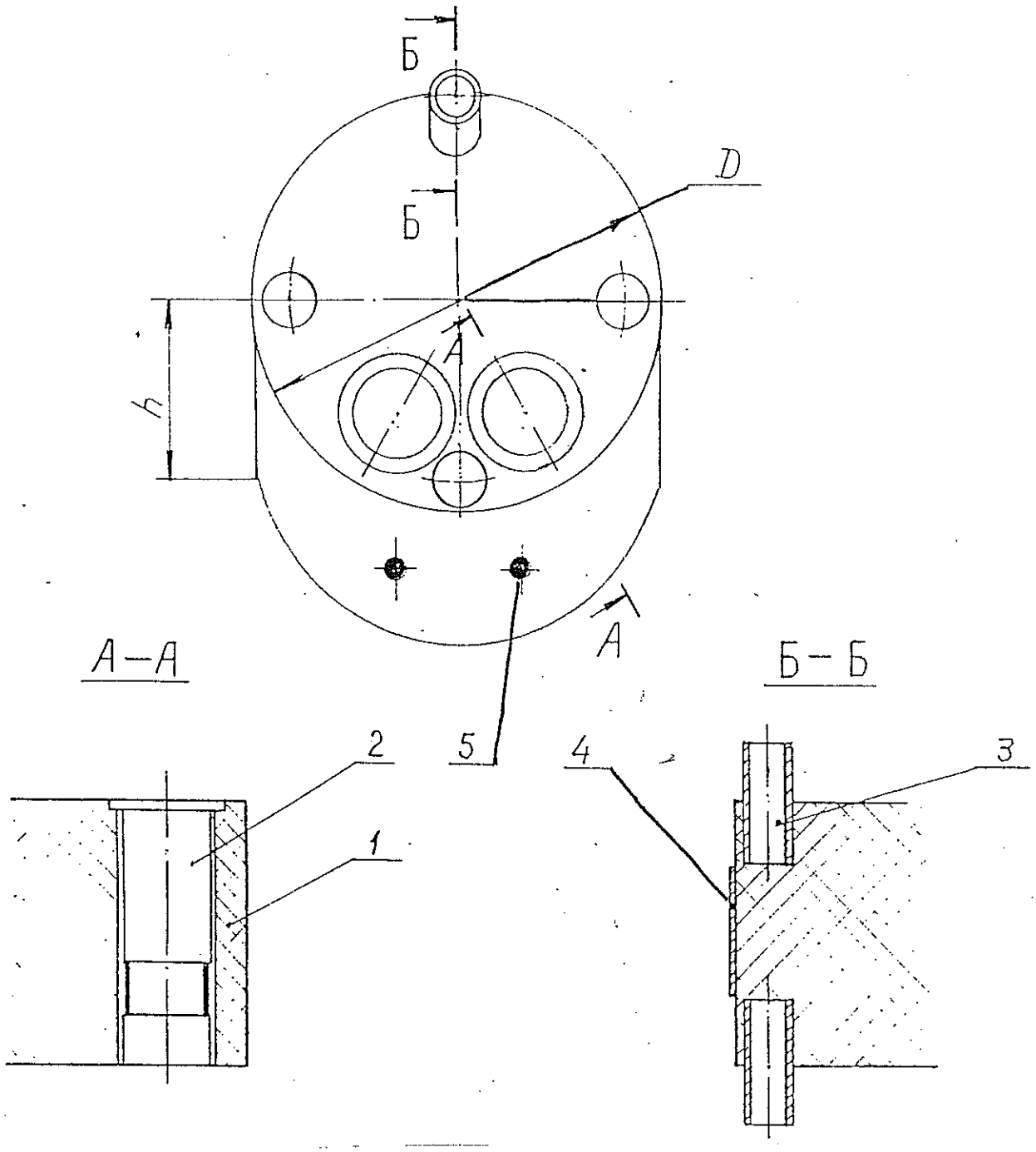
6.1. Conditions of storage and transportation for the set PhTh-04T are in accordance with the certificate.

6.2. Transportation of the set PhTh-04T is performed in the package that excludes damage of the article.

6.3. During transportation, the requirements of the "Rules of safety for transportation of radioactive substances" (PBTRV-73) should be followed.

6.4. The set PhTh-04T should be stored in the market container. The article does not require service during storage.

THYROID PHANTOM

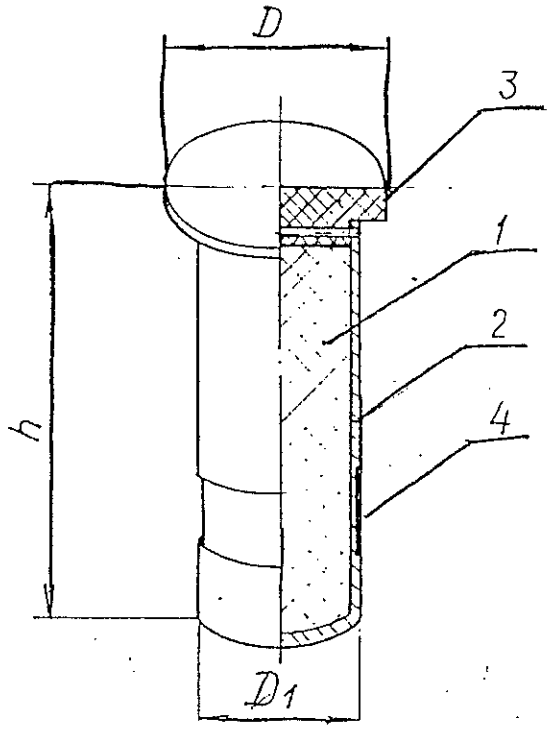


Type	D	h
3	110	60
2	85	51
1	65	41

1 - scatterer
2 - source
3 - connector
4 - control label
5 - mark

Fig. 1

SOURCE



Type	D	D1	h
3	25	21	60
2	20	16	51
1	18	14	41

1 - active part of the source
2 - capsule
3 - plug
4 - control label

Fig. 2

LIST OF ABBREVIATIONS

IRS	-	Industry Reference Sample
SRIHST	-	Scientific-Research Institute for Hygiene of Sea Transport
PhTh	-	Phantom of Thyroid
SIA ASRIM	-	Scientific-Industrial Amalgamation "All-Union Scientific-Research Institute for Metrology"
ASRIMRS	-	All-Union Scientific-Research Institute for Metrology of Reference Samples
SRIISM	-	Scientific-Research Institute for Industrial and Sea Medicine