

## DEPENDABLE AID FOR DEMONSTRATING DEGREE OF ACCURACY AND SYSTEM STABILITY

RSD's Spherical Phantom is a reliable aid to check mechanical and domestic treatment parameters. Comes with truncated cone for TLD (or Film Dosimetry) and TLD Dosimetric Cylinder. Also includes two spare nylon assembly rods and two spare blind nylon nuts. Optional: Truncated Cone for Ion Chamber (including molding or machining to install Ion Chamber to User's specification at the center of the sphere) and Film Dosimetric Cylinder.

When the center of the sphere is used as the target for testing the treatment unit, it must indicate the relationship between the point of maximum dose and the target. These should closely coincide for an accurate system.

A three-dimensional dosimetry cylinder at the center of the sphere measures both the deviation of the maximum dose from the target and the gradient of the dose along the three orthogonal axes of the sphere. The TLD dosimetric cylinder is a stack of dry-water disks of 44 mm in diameter. Seven of the disks have concentric rings of holes for TLD rods, 1 mm in diameter and 3 mm long. Disk #4 is in the central plane of the cylinder. A smaller target disk is at the center of this disk. It has a Hounsfield number of about 130 for visibility in a CT scan. The disks are assembled tightly by two nylon rods and round, blind nuts, which locate the cylinder precisely, linearly and angularly, in both sphere and head.

### Model Numbers

Model No.	Product Description
RS-1100A	Spherical Phantom

### Materials See page 30 for more information about RSD Materials.

RSD Soft Tissue	RSD Cortical Bone	RSD Trabecular Bone
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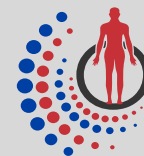
### Specifications

Packing Size	Packing Weight
41W x 41D x 41H cm	2 kg
16W x 16D x 16H in	5 lb.

The Film Dosimetric Cylinder: This is an optional cylinder, interchangeable with the TLD cylinder. It is built up of 11 film disks and 12 dry-water disks with the same nylon assembly rods and blind nuts. A simple fixture is supplied so the user can punch the film disks from film sheets.

Standard Cone: This is a dry-water cone, which fits precisely in a recess in the sphere. It accepts the dosimetric cylinder (TLD or film). It houses the dosimetric cylinder at the center of the sphere.

Optional Cone: This is molded to locate the measuring volume of an ion chamber at the center of the sphere. This cone is custom molded to suit the particular ion chamber specified by the customer.

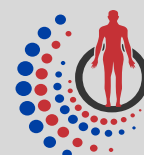


## Applications

Homogenous dry water phantom with precise spherical shape, 16 cm diameter

Displacement of maximum dose from center of sphere shows degree of accuracy and stability of the system

Checks the dose-calculation algorithm for a homogenous sphere



## Modalities

Intensity-Modulated Radiation Therapy (IMRT)

Stereotactic Body Radiation Therapy (SBRT)

Gamma Knife

CyberKnife

CT

Cone Beam CT

**Soft Tissues:** There are unlimited, small variations in density and absorption throughout the human body. Phantom soft tissue is closely controlled to have the average density of these tissues.

**Skeletons:** RSD skeletons are highly detailed polymer moldings which reproduce the shape, mass density and attenuation coefficients of cortical bone and spongiosa. RSD's proprietary moldings allow for continuous production, eliminate the restrictions of human skeleton bones (including limited availability, unethical collection of human bone specimen, variable size, and uncertain chemical composition), and avoid the loss of marrows in dried natural skeletons thereby making RSD skeletons superior to "real bone."

**Molds:** Molds for the RSD cortical bone and spongiosa were made from human skeletons consistent with the sizes of the soft tissue molds.

**ICRU 44:** RSD skeletons conform closely to the standards established by the International Commission on Radiation Units and Measurements ([ICRU Report No. 44](#)); mass density is reduced slightly to take into account a small decrease in calcium content for older patients.

## LINEAR ATTENUATION DATA

1. Monte Carlo simulation was used to calculate linear attenuation coefficients as a function of beam.
2. Monte Carlo results were validated with linear attenuation coefficients derived from Hounsfield Unit measurements at discrete energy levels.
3. RSD Phantom material linear attenuation data was compared to NIST data using ICRU Report 44 compositions of human tissues.
4. NIST data was interpolated when necessary.

MATERIALS	DENSITY (g/cc)
RSD Soft Tissue (Opaque)	1.08
RSD Soft Tissue (Transparent)	1.10
RSD Cortical Bone	1.18
RSD Trabecular Bone	1.17

RSD SOFT TISSUE					
Energy (MeV)	Mean (HU)	Calculated (M)	$\mu$ (ICRU 44)	% Difference	Ratio
00.08	60.30	0.1948	0.1932	0.0080	0.9921
00.10	52.88	0.1797	0.1795	0.0015	0.9985
00.12	57.10	0.1717	0.1709	0.0044	0.9956
00.14	52.95	0.1623	0.1624	0.0007	1.0007
00.20	--	0.1477	0.1439	0.0261	0.9746
00.30	--	0.1245	0.1246	0.0004	1.0004
00.60	--	0.0950	0.0941	0.0101	0.9900
00.80	--	0.0825	0.0826	0.0013	1.0013
01.00	--	0.0744	0.0743	0.0018	0.9982
02.00	--	0.0520	0.0519	0.0018	0.9982
03.00	--	0.0351	0.0357	0.0171	1.0174
06.00	--	0.0288	0.0291	0.0088	1.0088
08.00	--	0.0252	0.0255	0.0098	1.0099
10.00	--	0.0229	0.0232	0.0149	1.0151
15.00	--	0.0203	0.0203	0.0015	0.9985
20.00	--	0.0189	0.0189	0.0017	1.0017

RSD CORTICAL BONE					
Energy (MeV)	Mean (HU)	Calculated (M)	$\mu$ (ICRU 44)	% Difference	Ratio
00.08	1365	0.4345	0.4280	0.0151	0.9851
00.10	1048	0.3496	0.3562	0.0184	1.0188
00.12	0977	0.3211	0.3274	0.0191	1.0195
00.14	0902	0.2932	0.2986	0.0180	1.0184
00.20	--	0.2511	0.2513	0.0009	1.0009
00.30	--	0.2155	0.2137	0.0084	0.9916
00.60	--	0.1596	0.1598	0.0011	1.0011
00.80	--	0.1403	0.1402	0.0010	0.9990
01.00	--	0.1274	0.1261	0.0106	0.9895
02.00	--	0.0883	0.0885	0.0017	1.0017
03.00	--	0.0611	0.0625	0.0229	1.0235
06.00	--	0.0512	0.0525	0.0246	1.0253
08.00	--	0.0468	0.0474	0.0120	1.0121
10.00	--	0.0446	0.0444	0.0039	0.9962
15.00	--	0.0410	0.0409	0.0016	0.9984
20.00	--	0.0393	0.0397	0.0102	1.0103

RSD TRABECULAR BONE (SPONGIOSA)					
Energy (MeV)	Mean (HU)	Calculated (M)	$\mu$ (ICRU 44)	% Difference	Ratio
00.08	551	0.2849	--	--	--
00.10	515	0.2586	--	--	--
00.12	439	0.2337	--	--	--
00.14	318	0.1541	--	--	--