CIRS Tissue Equivalent Materials

Model XXX

FOR DOSIMETRY & IMAGE QUALITY STUDIES

CIRS Tissue Simulation Technology allows users to study the interaction between ionizing radiation and tissue with safety and precision. Our tissue equivalent materials (TEMS) have been validated through independent studies, continuous monitoring and worldwide use for over 35 years. All TEMs produced by CIRS meet International Commission on Radiation Units and Measurements (ICRU) Report 44 standards, which require that TEMs match the linear attenuation and stopping power coefficient of their reference tissues to within +/- 1%. (Physical densities may vary by more than 1%, as it is sometimes necessary to adjust the physical density to ensure that the linear attenuation coefficient and electron density meets ICRU Report 44 requirements.)

CIRS Tissue Equivalent Materials are available in sizes ranging from 10 x 10 cm to 30 cm x 30 cm and thicknesses of 0.1 cm through 5 cm. Materials in different shapes and sizes are also available upon request.

CIRS TEM's are easily machined and can be glued together to create a thicker bolus of material. Other formulations are available upon request.

Benefits

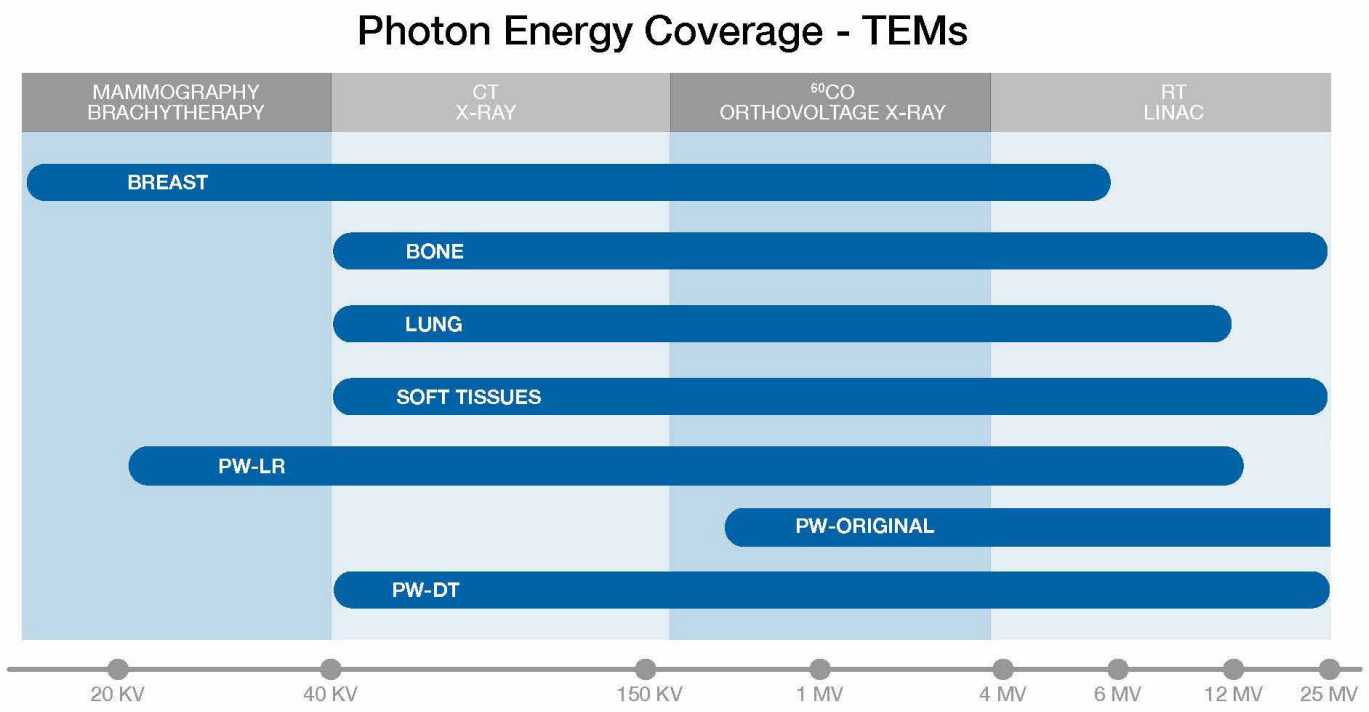
- Meets ICRU Report 44 standards for tissue equivalence in radiation therapy and diagnostic imaging
- Applies to photon, electron and proton beams
- Covers therapeutic and diagnostic energy ranges (see page 2)
- Tissue types available:
  - Lung (Inhale, exhale and medium)
  - Bone (Cortical, trabecular and average)
  - Breast (Adipose, glandular and mixed)
  - Organ Soft Tissue (Adipose Av. soft tissue, bladder, blood, brain white Mt, brain gray Mt, brain average, muscle, kidney, pancreas, heart, liver, prostate, spleen, intestine)

DOSIMETRY

Slabs can be manufactured to accommodate a variety of detectors including ion chambers, diodes, MOSFETs, TLD and OSL dosimeters in standard or custom locations.

Standard detector location is in the middle section of the 2 cm slab in the geometrical center of the slab's area.

Location is scribed with a 10x10 cm field and external laser marks for easy positioning of slab against radiation beam's light field and lasers.



SPECIFICATIONS

TISSUE EQUIVALENT MATERIALS INCLUDE

QTY	DESCRIPTION
1	Tissue Equivalent Slab or Set
1	User Guide
-	60 Month Warranty

See pages 3-4 for detailed technical specifications on each tissue type available.

LUNG

Lung - available in Inhale (0.2 g/cc), Medium (0.3 g/cc) or Exhale (0.5 g/cc).

	THICKNESS (CM)				
SLAB SIZE (CM)	0.5	1.0	2.0	3.0	4.0
20 X 20		X	X	X	X
30 X 30		X	X	X	X

Technical data for the CIRS Lung-equivalent materials.

Recalculated Linear attenuation coefficients (cm^{-1}).

	Lung tissue (inhale)			Lung tissue (medium)			Lung tissue (exhale)		
En, MeV	Reference[2]	CIRS	Ratio, %	Reference[2]	CIRS	Ratio, %	Reference[2]	CIRS	Ratio, %
0.04	0.0537	0.0524	97.6	0.0805	0.0785	97.5	0.1342	0.1313	97.8
0.06	0.0410	0.0411	100.2	0.0615	0.0613	99.7	0.1025	0.1012	98.7
0.08	0.0365	0.0367	100.6	0.0547	0.0550	100.5	0.0912	0.0904	99.1
0.10	0.0339	0.0341	100.6	0.0509	0.0513	100.8	0.0848	0.0840	99.1
0.20	0.0272	0.0274	100.7	0.0408	0.0413	101.2	0.0680	0.0675	99.3
0.40	0.0211	0.0212	100.5	0.0316	0.0320	101.3	0.0526	0.0523	99.4
0.60	0.0178	0.0179	100.6	0.0267	0.0270	101.1	0.0444	0.0442	99.5
0.80	0.0156	0.0157	100.6	0.0234	0.0237	101.3	0.0390	0.0388	99.5
1.00	0.0140	0.0141	100.7	0.0210	0.0213	101.4	0.0351	0.0349	99.4
2.00	0.0098	0.0099	101.0	0.0147	0.0149	101.4	0.0245	0.0243	99.2
4.00	0.0068	0.0068	100.0	0.0101	0.0102	101.0	0.0169	0.0167	98.8
6.00	0.0055	0.0055	100.0	0.0082	0.0083	101.2	0.0137	0.0135	98.5
8.00	0.0048	0.0048	100.0	0.0072	0.0072	100.0	0.0120	0.0117	97.5
10.0	0.0044	0.0043	97.7	0.0066	0.0066	100.0	0.0110	0.0106	96.4
20.0	0.0036	0.0035	97.2	0.0054	0.0053	98.1	0.0090	0.0085	94.4
30.0	0.0034	0.0032	94.1	0.0051	0.0050	98.0	0.0085	0.0079	92.9
El. density, $*10^{23}$, cm^{-3}	0.663	0.668	100.8	0.995	1.008	101.3	1.658	1.648	99.4
Density, $g*cm^{-3}$	0.20	0.205		0.30	0.31		0.50	0.50	
ORDER CODE	LAA			LG3			LH		

1. ICRP 23, Report of the Task Group on Reference Man (1975).
2. Woodard, H.Q., White, D.R., The Composition of Body Tissues, The British Journal of Radiology (1986) 59: 1209-1219.

BONE

Bone - available in Average, Cortical, or Trabecular

	THICKNESS (CM)			
SLAB SIZE (CM)	0.5	1.0	2.0	3.0
10 X 10				
20 X 20	X	X	X	X
30 X 30	X	X	X	X

Technical data for the CIRS Bone-equivalent materials.

Recalculated linear attenuation coefficients (cm^{-1}).

	Spongiosa (trabecular) bone tissue			Average bone tissue*			Cortical bone tissue		
En, MeV	Reference[2]	CIRS	Ratio, %	Reference[1]	CIRS	Ratio, %	Reference[2]	CIRS	Ratio, %
0.04	0.4546	0.4536	99.8	0.7884	0.7891	100.09	1.2783	1.2693	99.3
0.06	0.2802	0.2806	100.1	0.4244	0.4245	100.02	0.6046	0.6025	99.7
0.08	0.2296	0.2303	100.3	0.3251	0.3250	99.97	0.4282	0.4273	99.8
0.10	0.2058	0.2065	100.3	0.2822	0.2821	99.96	0.3561	0.3560	100.0
0.20	0.1588	0.1596	100.5	0.2098	0.2096	99.90	0.2517	0.2513	99.8
0.40	0.1223	0.1229	100.5	0.1605	0.1603	99.88	0.1903	0.1903	100.0
0.60	0.1031	0.1036	100.5	0.1351	0.1350	99.93	0.1600	0.1601	100.1
0.80	0.0905	0.0909	100.4	0.1186	0.1185	99.92	0.1403	0.1404	100.1
1.00	0.0813	0.0817	100.5	0.1066	0.1065	99.91	0.1260	0.1261	100.1
2.00	0.0568	0.0571	100.5	0.0746	0.0746	100.00	0.0884	0.0885	100.1
4.00	0.0393	0.0395	100.5	0.0521	0.0520	99.81	0.0626	0.0624	99.7
6.00	0.0322	0.0323	100.3	0.0431	0.0431	100.00	0.0525	0.0523	99.6
8.00	0.0284	0.0284	100.0	0.0383	0.0383	100.00	0.0473	0.0471	99.6
10.0	0.0260	0.0260	100.0	0.0355	0.0355	100.00	0.0444	0.0441	99.3
20.0	0.0216	0.0215	99.5	0.0305	0.0305	100.00	0.0397	0.0391	98.5
30.0	0.0206	0.0205	99.5	0.0296	0.0296	100.00	0.0394	0.0387	98.2
El. density, $*10^{23}$, cm^{-3}	3.844	3.863	100.5	5.035	5.030	99.90	5.952	5.956	100.1
Density, gcm^{-3}	1.18	1.20		1.577	1.60		1.92	1.93	
ORDER CODE	**SB-DTB**			**AB-IBN**			**CB-19F2**		

* The elemental composition and density were calculated from the average skeleton data minus cartilage.

1. ICRP 23, Report of the Task Group on Reference Man (1975).
2. Woodard, H.Q., White, D.R., The Composition of Body Tissues, The British Journal of Radiology (1986) 59: 1209-1219.

BREAST SOFT TISSUES

Adipose and Glandular Compositions - available in:

100% Adipose	30% Glandular/ 70% Adipose
100% Glandular	50% Glandular / 50% Adipose
BR12	70% Glandular/ 30% Adipose
Swirled	100% Glandular/ 100% Adipose

	THICKNESS (CM)				
SLAB SIZE (CM)	0.5	1.0	2.0	3.0	4.0
10 X 10	X	X	X	X	X
10 X 12.5	X	X	X		
18 X 24		X	X	X	X
24 X 30	X	X	X	X	X
30 X 30	X	X	X	X	X

Technical data for the CIRS Inc. breast tissue-equivalent materials.

Linear attenuation coefficients (cm^{-1}). February 11, 2010

	Breast tissue - Glandular			Breast tissue- 70/30 (Glandular /Adipose)			Breast tissue - 50/50 (Glandular /Adipose)		
En, MeV	Reference[1]	CIRS	Ratio, %	Reference[1]	CIRS	Ratio, %	Reference[1]	CIRS	Ratio, %
0.01	4.9195	4.6315	94.15	4.2397	4.0281	95.01	3.8120	3.6543	95.86
0.02	0.7680	0.7680	100.00	0.6815	0.6802	99.81	0.6272	0.6262	99.84
0.04	0.2688	0.2708	100.74	0.2528	0.2536	100.32	0.2428	0.2433	100.21
0.06	0.2099	0.2103	100.19	0.2010	0.2008	99.90	0.1954	0.1952	99.90
0.08	0.1883	0.1883	100.00	0.1813	0.1808	99.72	0.1770	0.1765	99.72
0.10	0.1754	0.1753	99.94	0.1693	0.1687	99.65	0.1655	0.1650	99.70
0.20	0.1411	0.1410	99.93	0.1366	0.1360	99.56	0.1337	0.1333	99.70
0.40	0.1094	0.1093	99.91	0.1059	0.1055	99.62	0.1037	0.1034	99.71
0.60	0.0923	0.0923	100.00	0.0894	0.0891	99.66	0.0875	0.0873	99.77
0.80	0.0811	0.0810	99.88	0.0785	0.0782	99.62	0.0769	0.0767	99.74
1.00	0.0729	0.0728	99.86	0.0706	0.0703	99.58	0.0691	0.0689	99.71
2.00	0.0509	0.0508	99.80	0.0493	0.0491	99.59	0.0482	0.0481	99.79
4.00	0.0350	0.0348	99.43	0.0338	0.0336	99.41	0.0331	0.0329	99.40
6.00	0.0285	0.0281	98.60	0.0274	0.0271	98.91	0.0268	0.0266	99.25
8.00	0.0249	0.0245	98.39	0.0239	0.0236	98.74	0.0234	0.0231	98.72
10.0	0.0227	0.0222	97.80	0.0218	0.0214	98.17	0.0212	0.0209	98.58
20.0	0.0184	0.0177	96.20	0.0176	0.0170	96.59	0.0170	0.0166	97.65
El. density, $*10^{23}$, cm^{-3}	3.445	3.443	99.94	3.336	3.325	99.67	3.267	3.258	99.72
Density, gcm^{-3}	1.04	1.048		1.004	1.011		0.982	0.99	

ORGAN SOFT TISSUES ICRU 46

Adipose Av. Soft Tissue, Bladder, Blood
Brain White Mt, Brain Gray Mt, Brain Average
Muscle, Kidney, Pancreas, Heart
Liver, Prostate, Spleen, Intestine

Available upon request. Contact CIRS customer service at admin@cirsinc.com for more information.

	THICKNESS (CM)				
SLAB SIZE (CM)	0.5	1.0	2.0	3.0	4.0
10 X 10	X	X	X	X	X
20 X 20	X	X	X		
30 X 30		X	X	X	X

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Computerized Imaging Reference Systems, Inc. has been certified by ULDQS Inc. to (ISO) 13485:2016. Certificate Registration No.10000905-MP2016.