Medical Imaging: **Data Sheet 2011-2012**

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Mass attenuation coefficient of Aluminium:

Photon energy (keV)	Mass attenuation coefficient of Aluminium ($cm^2.g^{-1}$)
5	192.4
10	26.05
20	3.423
30	1.131
40	0.5675
50	0.3684
60	0.2778
70	0.2302
80	0.2018
90	0.1832
100	0.1705
110	0.1607
120	0.1533
130	0.1474
140	0.1421
150	0.1378
160	0.1339
170	0.1306
180	0.1275
190	0.1247
200	0.1219

Density of Al: 2.7 $g.cm^{-3}$

Characteristic radiation lines:

	$K_{\alpha1}$	$K_{\alpha2}$	$K_{\beta1}$	$K_{\beta2}$
Molybdenum (Z = 42)	17.44	17.34	19.73	19.95
Tungsten (Z = 74)	59.48	58.12	67.87	69.65

Production of radionuclides:

^{14}N (p, α) ^{11}C or ^{10}B (d, n) ^{11}C

^{16}O (p, α) ^{13}N or ^{12}C (d, n) ^{13}N

^{14}N (d, n) ^{15}O or ^{15}N (p, n) ^{15}O

^{18}O (p, n) ^{18}F

^{50}Cr (n, γ) ^{51}Cr

^{56}Fe (d, n) ^{57}Co

^{68}Zn (p, 2n) ^{67}Ga

$^{99}Mo \xrightarrow{\beta^-} {}^{99m}Tc$

$^{109}Ag(\alpha, 2n)^{111}In$ or $^{111}Cd(p, n)^{111}In$

^{127}I (p, 5n) $^{123}Xe \xrightarrow{EC} {}^{123}I$

^{124}Xe (p, 2n) $^{123}Cs \xrightarrow{EC \text{ or } \beta^+} {}^{123}Xe \xrightarrow{EC} {}^{123}I$

^{124}Xe (n, γ) $^{125}Xe \xrightarrow{EC \text{ or } \beta^+} {}^{125}I$

^{235}U fission products: ^{99}Mo, ^{131}I, ^{133}Xe

^{203}Tl (p, 3n) $^{201}Pb \xrightarrow{EC \text{ or } \beta^+} {}^{201}Tl$

Detection of radiation:

Scintillator	**Photon yield (per keV)**	**μ (cm^{-1}) (511 keV)**	**Decay time (ns)**
NaI(Tl)	38	0.34	230
BGO	8	0.95	300
LSO	20-30	0.88	40
GSO	12-15	0.70	60

Radionuclide data:

Nuclide	**Half-life**	**Decay mode**	**E_β (MeV) max. (average)**	**γ-rays (keV)**	**char. x-rays (keV)**	**β^+ range in water (mm)**	**β^+ fraction**
^{11}C	20.3 m	β^+	0.961 (0.386)	511		1.0	0.99
^{13}N	10.0 m	β^+	1.19 (0.492)	511		1.3	1.00
^{15}O	2.07 m	β^+	1.72 (0.735)	511		2.0	1.00
^{18}F	110 m	β^+	0.635 (0.250)	511		0.6	0.97
^{51}Cr	27 d	(EC, γ)		320			
^{57}Co	270 d	(EC, γ).		122,136			
^{67}Ga	78.3 h	(EC, γ)		93, 185, 300			
^{99m}Tc	6.0 h	IT		140.2			
^{111}In	2.83 d	(EC, γ)		171, 245			
^{123}I	13.2 h	(EC, γ)		159			
^{125}I	60.1 d	EC			~30		
^{131}I	8.04 d	(β^-, γ)	(0.192)	364			
^{133}Xe	5.24 d	(β^-, γ)	(0.101)	81			
^{201}Tl	3.04 d	EC			~70		

Mathematics:

Gaussian distribution: The integral of the Gaussian probability distribution function, P_G, over the range $x = (\mu - n\sigma)..(\mu + n\sigma)$ is tabulated below:

n	P_G
1	0.683
2	0.954
3	0.997

Density and Speed of sound in Materials

Material	Density kg/m^3	Speed m/s
Air	1.3	330
Water	1000	1500
Blood	1060	1570
Fat	925	1450
Muscle	1075	1590
Bone	1908	4000
Quartz	2650	5750
PZT	7750	4350
PVDF	1750	1943

Useful constants in Ultrasound Imaging:

Speed of sound in Tissue: c = 1540 $m.s^{-1}$

Adiabatic gas constant: γ = 1.4

Density of water: ρ_0 = 1000 $kg.m^{-3}$

Atomospheric pressure: P_0= 100 kPa

Useful constants in MRI:

Gyromagnetic ratio of ^1H:

$\gamma = 267.513 \times 10^6$ $rad.s^{-1}.T^{-1}$ or;

$\gamma = 42.58$ $MHz.T^{-1}$