DETECTOR DATA

RTI Dose Probe

INDEPENDENT X-RAY
QUALITY ASSURANCE

GENERAL

The RTI Dose Probe has a lead free design, and has characteristics that are equivalent to the former available detectors supplied by RTI like the Piranha Dose Probe, R100B, and R100. The RTI Dose Probe fulfils the relevant parts of the IEC 61674 standard for diagnostic dosemeters, MEDICAL ELECTRICAL EQUIPMENT - DOSEMETERS WITH IONIZATION CHAMBERS AND/OR SEMICONDUCTOR DETECTORS AS USED IN RADIOGRAPHY, INCLUDING MAMMOGRAPHY AND FLUOROSCOPY.

The RTI Dose Probe is compatible with the Piranha and Cobia with input for external detectors.

TECHNICAL DESCRIPTION

The detector's main part is a PIN semiconductor photo diode. The diode detects the X-rays and produces a current proportional to the intensity of the X-rays. As the diode responds differently when exposed to X-rays with different spectral content, an energy filter is placed in front of the detector to compensate for this energy dependence.
To make the detector more immune to EMI (Electro Magnetic Interference) one more component is used. As the triaxial cable is not 100 % shielded, HF components might be induced on the signal lines. To prevent these from being rectified by the diode, and thus affecting the measurements, a ferrite core which filters these components, is placed on the end of the cable close to the connector.
The currents, and charge, produced by the photo diode can then be measured with an electrometer and converted to values of the air kerma or air kerma rate (or dose and dose rate).

SPECIFICATIONS

Energy dependence	+4 to -4% (radiation quality R1, W/3 mm Al, 40 – 150 kV) +3 to -3% (radiation quality R2, W/23 mm Al, 40 – 150 kV) +7 to -8% (radiation quality M1, Mo/30 µm Mo, 25 – 35 kV)
Expanded Uncertainty (When corrections applied)	R/F: < 3% between 40 – 160 kV Mam: < 3% between 18 – 49 kV
Typical conversion factor	18 kGy/C (=µGy/nC) (radiation quality R2 and R1) 36 kGy/C (=µGy/nC) (radiation quality M1)
Reference point	3.5 mm behind the cross on the surface of the detector. The depth is marked with a rim on the detector side.
Cable length	2.0 m
Dimensions (detector housing)	19.8 x 45.0 × 7.4 mm
Weight	Approx. 85 g
Operating temperature and humidity	-10 °C to + 50 °C at <85% relative humidity

Above specifications are valid for + 18 °C to + 23 °C at <80% relative humidity. All specifications can be altered without notice.

ENERGY CORRECTION DATA

On the following pages, typical correction tables and graphs for the RTI Dose Probe are shown. These are divided into two main categories:

Radiographic range energy corrections See pages 3-6.
Mammographic range energy corrections See pages 7-12.

Radiography & Fluoroscopy Energy Corrections

CORRECTION FACTORS FOR R/F

The correction factors used for R/F W/Al are shown in table 1 and 2 on the following pages. Table 1 shows corrections based on calibration performed at radiation quality R1 (70 kV, W/3 mm Al equivalent). Table 2 show corrections based on calibration performed at R2 (70 kV, W/23 mm Al). Use the proper table based on the calibration you have for your RTI Dose Probe.

Example

The factors are multiplied with the measured value in the following manner:

Assume a total filtration of 30 mm Al, tube voltage set to 150 kV, and measured dose of 1.12 mGy using the calibration for R2 (W/23 mm Al).

Correction factor from table 2:2:	1.050
Corrected dose:	1.120 × 1.050 = 1.176 mGy

Uncertainty

The uncertainty of the typical correction factors is ±1% at a confidence interval of 95%.

Note

If performing a traditional HVL measurement by using layers of Al, The correction data shall be used in the following way.
If the Total Filtration is expected to be around 3.0 mm Al, the correction data for 0 (zero) added filtration shall be the correction factor for the total filtration of 3.0 mm Al equivalent. Consequently when adding 1 mm Al the correction factor for the total filtration of 4.0 mm Al equivalent shall be used, and so on when adding more layers of Al. Even if the total filtration is not exactly 3.0 mm Al the result will be accurate as the energy dependence of the RTI dose probe is small for small variations in total filtration.

W/3 mm Al (R1)

Set	Total Filtration (mm Al equivalent)									
kV	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	10
40	1.066	1.050	1.035	1.022	1.009	0.988	0.972	0.959	0.949	0.938
45	1.050	1.036	1.023	1.011	1.001	0.983	0.968	0.957	0.949	0.941
50	1.038	1.026	1.015	1.005	0.996	0.980	0.968	0.959	0.952	0.946
55	1.029	1.019	1.009	1.000	0.993	0.979	0.969	0.962	0.956	0.952
60	1.024	1.014	1.006	0.998	0.991	0.979	0.971	0.964	0.960	0.958
65	1.020	1.011	1.003	0.996	0.990	0.980	0.972	0.967	0.963	0.962
70	1.017	1.009	1.000	0.995	0.989	0.979	0.972	0.968	0.965	0.965
75	1.014	1.006	0.999	0.993	0.987	0.979	0.972	0.968	0.966	0.966
80	1.010	1.002	0.995	0.990	0.984	0.976	0.970	0.967	0.965	0.965
85	1.010	1.002	0.995	0.990	0.984	0.976	0.970	0.967	0.965	0.965
90	1.007	1.000	0.994	0.988	0.983	0.975	0.969	0.966	0.964	0.964
95	1.005	0.998	0.992	0.986	0.981	0.974	0.968	0.965	0.963	0.963
100	1.003	0.996	0.990	0.984	0.980	0.972	0.967	0.964	0.963	0.963
105	1.001	0.994	0.989	0.984	0.979	0.972	0.967	0.964	0.963	0.963
110	0.999	0.993	0.988	0.983	0.979	0.973	0.968	0.965	0.964	0.964
115	0.998	0.993	0.988	0.984	0.980	0.974	0.970	0.967	0.966	0.965
120	0.997	0.993	0.989	0.985	0.981	0.976	0.972	0.970	0.968	0.968
125	0.998	0.994	0.990	0.986	0.983	0.978	0.975	0.972	0.971	0.971
130	0.999	0.995	0.992	0.988	0.986	0.981	0.978	0.976	0.974	0.975
135	1.001	0.997	0.994	0.991	0.988	0.984	0.981	0.979	0.978	0.979
140	1.003	0.999	0.996	0.993	0.991	0.987	0.984	0.983	0.982	0.983
145	1.005	1.001	0.998	0.996	0.994	0.990	0.988	0.986	0.986	0.988
150	1.005	1.003	1.000	0.998	0.996	0.993	0.992	0.991	0.991	0.993
155	1.003	1.002	1.001	1.000	0.999	0.998	0.997	0.997	0.997	1.000
160	0.997	0.999	1.001	1.002	1.003	1.004	1.005	1.006	1.006	1.009

Table 1:1. Correction factors for W/3 mm Al (R1), 2 to 10 mm Al equivalent.

Set	Total Filtration (mm Al equivalent)									
kV	12	15	20	23	25	30	35	40	45	50
40	0.937	0.947	0.978	0.998	1.011	1.034	1.045	1.047	1.044	1.044
45	0.940	0.950	0.979	0.998	1.010	1.033	1.044	1.046	1.043	1.043
50	0.947	0.957	0.985	1.003	1.014	1.035	1.045	1.046	1.042	1.042
55	0.954	0.964	0.992	1.009	1.019	1.038	1.045	1.045	1.040	1.040
60	0.960	0.972	0.998	1.014	1.023	1.038	1.044	1.041	1.037	1.037
65	0.966	0.977	1.002	1.016	1.024	1.036	1.039	1.036	1.033	1.033
70	0.969	0.980	1.004	1.016	1.022	1.032	1.033	1.030	1.027	1.027
75	0.970	0.982	1.003	1.014	1.019	1.026	1.025	1.022	1.020	1.020
80	0.970	0.980	0.998	1.006	1.009	1.012	1.010	1.009	1.014	1.014
85	0.970	0.980	0.998	1.006	1.009	1.012	1.010	1.009	1.008	1.008
90	0.968	0.978	0.994	1.001	1.004	1.007	1.005	1.004	1.004	1.004
95	0.967	0.976	0.991	0.998	1.001	1.003	1.002	1.001	1.001	1.001
100	0.967	0.975	0.989	0.995	0.998	1.002	1.002	1.003	1.001	1.001
105	0.966	0.974	0.988	0.995	0.998	1.003	1.005	1.005	1.004	1.004
110	0.967	0.974	0.989	0.996	1.000	1.007	1.009	1.010	1.008	1.008
115	0.968	0.976	0.991	0.999	1.004	1.012	1.016	1.016	1.015	1.015
120	0.971	0.978	0.995	1.004	1.009	1.019	1.024	1.024	1.023	1.023
125	0.974	0.982	0.999	1.009	1.015	1.026	1.032	1.033	1.032	1.032
130	0.978	0.986	1.004	1.015	1.021	1.034	1.040	1.042	1.042	1.042
135	0.982	0.991	1.009	1.020	1.027	1.040	1.048	1.051	1.052	1.052
140	0.987	0.996	1.015	1.026	1.033	1.047	1.056	1.061	1.063	1.063
145	0.992	1.001	1.021	1.032	1.040	1.055	1.066	1.072	1.075	1.075
150	0.998	1.007	1.028	1.041	1.049	1.067	1.080	1.087	1.089	1.089
155	1.004	1.015	1.039	1.055	1.065	1.087	1.101	1.107	1.108	1.108
160	1.013	1.025	1.056	1.078	1.093	1.122	1.137	1.138	1.134	1.134

Table 1:2. Correction factors for W/3 mm Al (R1), 12 to 50 mm Al equivalent.

W/23 mm Al (R2)

Set kV	Total Filtration (mm Al equivalent) 2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	10
40	1.049	1.033	1.019	1.006	0.993	0.972	0.957	0.944	0.934	0.923
45	1.033	1.020	1.007	0.995	0.985	0.968	0.953	0.942	0.934	0.926
50	1.022	1.010	0.999	0.989	0.980	0.965	0.953	0.944	0.937	0.931
55	1.013	1.003	0.993	0.984	0.977	0.964	0.954	0.947	0.941	0.937
60	1.008	0.998	0.990	0.982	0.975	0.964	0.956	0.949	0.945	0.943
65	1.004	0.995	0.987	0.980	0.974	0.965	0.957	0.952	0.948	0.947
70	1.001	0.993	0.984	0.979	0.973	0.964	0.957	0.953	0.950	0.950
75	0.998	0.990	0.983	0.977	0.971	0.964	0.957	0.953	0.951	0.951
80	0.994	0.986	0.979	0.974	0.969	0.961	0.955	0.952	0.950	0.950
85	0.994	0.986	0.979	0.974	0.969	0.961	0.955	0.952	0.950	0.950
90	0.991	0.984	0.978	0.972	0.968	0.960	0.954	0.951	0.949	0.949
95	0.989	0.982	0.976	0.970	0.966	0.959	0.953	0.950	0.948	0.948
100	0.987	0.980	0.974	0.969	0.965	0.957	0.952	0.949	0.948	0.948
105	0.985	0.978	0.973	0.969	0.964	0.957	0.952	0.949	0.948	0.948
110	0.983	0.977	0.972	0.968	0.964	0.958	0.953	0.950	0.949	0.949
115	0.982	0.977	0.972	0.969	0.965	0.959	0.955	0.952	0.951	0.950
120	0.981	0.977	0.973	0.969	0.966	0.961	0.957	0.955	0.953	0.953
125	0.982	0.978	0.974	0.970	0.968	0.963	0.960	0.957	0.956	0.956
130	0.983	0.979	0.976	0.972	0.970	0.966	0.963	0.961	0.959	0.960
135	0.985	0.981	0.978	0.975	0.972	0.969	0.966	0.964	0.963	0.964
140	0.987	0.983	0.980	0.977	0.975	0.971	0.969	0.968	0.967	0.968
145	0.989	0.985	0.982	0.980	0.978	0.974	0.972	0.970	0.970	0.972
150	0.989	0.987	0.984	0.982	0.980	0.977	0.976	0.975	0.975	0.977
155	0.987	0.986	0.985	0.984	0.983	0.982	0.981	0.981	0.981	0.984
160	0.981	0.983	0.985	0.986	0.987	0.988	0.989	0.990	0.990	0.993

Table 2:1. Correction factors for W/23 mm Al (R2), 2 to 10 mm Al equivalent.

Set kV	Total Filtration (mm Al equivalent) 12	15	20	23	25	30	35	40	45	50
40	0.922	0.932	0.963	0.982	0.995	1.018	1.029	1.031	1.028	1.028
45	0.925	0.935	0.964	0.982	0.994	1.017	1.028	1.030	1.027	1.027
50	0.932	0.942	0.969	0.987	0.998	1.019	1.029	1.030	1.026	1.026
55	0.939	0.949	0.976	0.993	1.003	1.022	1.029	1.029	1.024	1.024
60	0.945	0.957	0.982	0.998	1.007	1.022	1.028	1.025	1.021	1.021
65	0.951	0.962	0.986	1.000	1.008	1.020	1.023	1.020	1.017	1.017
70	0.954	0.965	0.988	1.000	1.006	1.016	1.017	1.014	1.011	1.011
75	0.955	0.967	0.987	0.998	1.003	1.010	1.009	1.006	1.004	1.004
80	0.955	0.965	0.982	0.990	0.993	0.996	0.994	0.993	0.998	0.998
85	0.955	0.965	0.982	0.990	0.993	0.996	0.994	0.993	0.992	0.992
90	0.953	0.963	0.978	0.985	0.988	0.991	0.989	0.988	0.988	0.988
95	0.952	0.961	0.975	0.982	0.985	0.987	0.986	0.985	0.985	0.985
100	0.952	0.960	0.973	0.979	0.982	0.986	0.986	0.987	0.985	0.985
105	0.951	0.959	0.972	0.979	0.982	0.987	0.989	0.989	0.988	0.988
110	0.952	0.959	0.973	0.980	0.984	0.991	0.993	0.994	0.992	0.992
115	0.953	0.961	0.975	0.983	0.988	0.996	1.000	1.000	0.999	0.999
120	0.956	0.963	0.979	0.988	0.993	1.003	1.008	1.008	1.007	1.007
125	0.959	0.967	0.983	0.993	0.999	1.010	1.016	1.017	1.016	1.016
130	0.963	0.970	0.988	0.999	1.005	1.018	1.024	1.026	1.026	1.026
135	0.967	0.975	0.993	1.004	1.011	1.024	1.031	1.034	1.035	1.035
140	0.971	0.980	0.999	1.010	1.017	1.031	1.039	1.044	1.046	1.046
145	0.976	0.985	1.005	1.016	1.024	1.038	1.049	1.055	1.058	1.058
150	0.982	0.991	1.012	1.025	1.032	1.050	1.063	1.070	1.072	1.072
155	0.988	0.999	1.023	1.038	1.048	1.070	1.084	1.090	1.091	1.091
160	0.997	1.009	1.039	1.061	1.076	1.104	1.119	1.120	1.116	1.116

Table 2:2. Correction factors for W/23 mm Al (R2), 12 to 50 mm Al equivalent.

Energy correction factors using Cu filtrations

The table below describes the energy dependence for RTI Dose Probe when measuring after 1.5 or 2.0 mm Cu added to 3 mm Al inherent filtration. These filtrations are typically used when measuring low doses and rates at Image Intensifiers. The corrections are relative to the reference point for radiation quality R2 (70 kV, 20 + 3.0 mm Al)

Using

Set kV	Total Filtration 3mm Al +20 mm Al (R2)	3 mm Al +1.5 mm Cu	3 mm Al +2.0 mm Cu
65	1.000	1.006	1.013
70	1.000	1.010	1.015
75	0.998	1.011	1.011
80	0.990	1.008	1.004
85	0.990	1.006	1.001

Table 3. Correction factors for added Cu filtrations based on calibration for W/23 mm Al (R2).

Mammography Energy Corrections

CORRECTION FACTORS FOR MAMMOGRAPHY

The correction factors used for Mo/30µm Mo (M1) are shown in table hereunder. On the following pages correction factors for other radiation qualities are available for the RTI Dose Probe are presented.

Example

The factors are multiplied with the measured value in the following manner:

Assume an added filtration of 0.5 mm Al, Tube voltage set to 28kVp and a measured dose of 1.12 mGy

Correction factor from table 1: 0.850
Corrected dose: 1.120 × 0.850 = 1.02 mGy

Uncertainty

The uncertainty of the typical correction factors is ±1% at a confidence interval of 95%.

Mo/30µm Mo (M1)

	Added layers of Al filtration (mm)							
kV	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
22 kV	1.176	1.081	1.028	0.987				
23 kV	1.133	1.048	1.001	0.963				
24 kV	1.096	1.021	0.977	0.942	0.915			
25 kV	1.066	0.998	0.956	0.924	0.900			
26 kV	1.040	0.978	0.939	0.909	0.886	0.870	0.857	
27 kV	1.019	0.962	0.923	0.896	0.875	0.860	0.847	
28 kV	1.000	0.947	0.910	0.885	0.865	0.850	0.838	0.825
29 kV	0.984	0.934	0.899	0.875	0.856	0.841	0.829	0.818
30 kV	0.970	0.923	0.889	0.866	0.848	0.833	0.822	0.810
31 kV	0.958	0.913	0.880	0.858	0.841	0.826	0.815	0.804
32 kV	0.947	0.904	0.872	0.851	0.834	0.820	0.808	0.798
33 kV	0.937	0.895	0.866	0.845	0.828	0.814	0.803	0.792
34 kV	0.928	0.888	0.860	0.839	0.822	0.809	0.798	0.787
35 kV	0.920	0.881	0.854	0.833	0.817	0.804	0.793	0.782
36 kV	0.912	0.874	0.849	0.828	0.813	0.800	0.788	0.778
37 kV	0.905	0.868	0.844	0.823	0.808	0.796	0.785	0.774
38 kV	0.898	0.863	0.840	0.819	0.804	0.792	0.781	0.770
39 kV	0.892	0.858	0.835	0.815	0.800	0.788	0.778	0.766

Mammography

Mo/25µm Rh (M3, M21)

kV	Added layers of Al filtration (mm) 0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
23 kV	1.121	1.055	1.026	1.004	0.985			
24 kV	1.085	1.031	1.004	0.985	0.967	0.950		
25 kV	1.057	1.012	0.986	0.970	0.953	0.938		
26 kV	1.034	0.995	0.972	0.958	0.941	0.928	0.920	
27 kV	1.015	0.982	0.959	0.947	0.931	0.918	0.911	
28 kV	1.000	0.971	0.950	0.938	0.923	0.910	0.904	0.894
29 kV	0.988	0.962	0.942	0.930	0.917	0.903	0.897	0.888
30 kV	0.979	0.954	0.935	0.924	0.912	0.897	0.891	0.882
31 kV	0.971	0.948	0.929	0.919	0.907	0.891	0.886	0.878
32 kV	0.964	0.942	0.924	0.914	0.902	0.887	0.882	0.874
33 kV	0.959	0.937	0.920	0.909	0.898	0.883	0.878	0.870
34 kV	0.954	0.932	0.916	0.905	0.894	0.879	0.874	0.867
35 kV	0.949	0.928	0.912	0.901	0.890	0.876	0.871	0.863
36 kV	0.945	0.924	0.908	0.898	0.886	0.873	0.868	0.860
37 kV	0.941	0.920	0.905	0.894	0.882	0.870	0.865	0.857
38 kV	0.937	0.916	0.901	0.891	0.878	0.867	0.862	0.853
39 kV	0.933	0.912	0.898	0.887	0.875	0.863	0.859	0.850
40 kV	0.930	0.908	0.895	0.884	0.872	0.860	0.856	0.847

Mo/(0.3 mm Al + 0.3 mm Cu) - M13

kV range	Added layers of Al filtration (mm) 0.0	0.1	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5
45 -49 kV	1.000	1.000	1.001	1.002	1.003	1.004	1.005	1.006	1.007	1.008	1.009

Rh/30 µm Ag (M22)

kV	Added layers of Al filtration (mm) 0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
26 kV	1.037	0.999	0.970	0.947	0.928	0.913	0.900	0.885
27 kV	1.017	0.981	0.953	0.931	0.913	0.900	0.887	0.875
28 kV	1.000	0.965	0.938	0.917	0.900	0.887	0.876	0.865
30 kV	0.968	0.937	0.912	0.893	0.878	0.867	0.857	0.849
32 kV	0.944	0.915	0.892	0.874	0.861	0.850	0.842	0.835
34 kV	0.925	0.898	0.876	0.860	0.847	0.838	0.830	0.824
36 kV	0.910	0.885	0.865	0.849	0.838	0.828	0.821	0.815
38 kV	0.898	0.875	0.856	0.842	0.830	0.821	0.814	0.808
40 kV	0.887	0.867	0.850	0.836	0.825	0.815	0.808	0.802
42 kV	0.877	0.860	0.844	0.831	0.820	0.810	0.802	0.796

Rh/25µm Rh (M4)

kV	Added layers of Al filtration (mm) 0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
26 kV	1.039	1.001	0.973	0.949	0.931	0.915	0.901	0.887
27 kV	1.017	0.983	0.956	0.933	0.917	0.902	0.888	0.876
28 kV	1.000	0.967	0.941	0.919	0.904	0.890	0.877	0.866
29 kV	0.981	0.952	0.927	0.906	0.893	0.879	0.867	0.856
30 kV	0.966	0.939	0.915	0.895	0.883	0.870	0.858	0.848
31 kV	0.952	0.927	0.905	0.886	0.873	0.861	0.850	0.841
32 kV	0.941	0.917	0.896	0.877	0.865	0.854	0.843	0.834
33 kV	0.930	0.908	0.887	0.870	0.858	0.847	0.837	0.828
34 kV	0.921	0.899	0.880	0.863	0.852	0.841	0.832	0.823
35 kV	0.912	0.892	0.874	0.857	0.846	0.836	0.827	0.818
36 kV	0.904	0.886	0.868	0.852	0.841	0.831	0.822	0.814
37 kV	0.897	0.880	0.863	0.848	0.837	0.827	0.819	0.810
38 kV	0.891	0.875	0.859	0.844	0.833	0.824	0.815	0.807
39 kV	0.885	0.870	0.855	0.840	0.830	0.821	0.812	0.804
40 kV	0.880	0.866	0.851	0.837	0.827	0.818	0.809	0.801
41 kV	0.875	0.862	0.848	0.834	0.824	0.815	0.807	0.798
42 kV	0.870	0.859	0.844	0.831	0.822	0.813	0.805	0.796
43 kV	0.866	0.856	0.841	0.828	0.819	0.810	0.802	0.794

Rh/(0.3 mm Al + 0.3 mm Cu) - M14

	Added layers of Al filtration (mm)										
kV range	0.0	0.1	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5
45 -49 kV	1.000	1.000	1.001	1.002	1.002	1.003	1.004	1.005	1.005	1.006	1.007

W/0.5 mm Al (M7)

	Added layers of Al filtration (mm)							
kV	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
22 kV	1.184	1.084	1.021	0.973	0.940	0.912		
23 kV	1.144	1.049	0.990	0.944	0.913	0.887		
24 kV	1.108	1.019	0.962	0.918	0.889	0.865		
25 kV	1.076	0.992	0.936	0.895	0.866	0.843		
26 kV	1.048	0.967	0.913	0.874	0.845	0.824		
27 kV	1.023	0.945	0.892	0.854	0.826	0.805		
28 kV	1.000	0.924	0.873	0.836	0.808	0.788	0.773	
29 kV	0.980	0.906	0.855	0.820	0.792	0.773	0.756	
30 kV	0.961	0.889	0.839	0.805	0.777	0.758	0.741	0.729
31 kV	0.945	0.873	0.824	0.790	0.764	0.745	0.728	0.715
32 kV	0.930	0.858	0.811	0.777	0.751	0.733	0.716	0.703
33 kV	0.916	0.844	0.798	0.765	0.740	0.722	0.705	0.692
34 kV	0.904	0.832	0.786	0.753	0.729	0.711	0.695	0.682
35 kV	0.892	0.820	0.775	0.743	0.720	0.702	0.686	0.673
36 kV	0.881	0.809	0.765	0.733	0.711	0.693	0.678	0.665
37 kV	0.871	0.799	0.756	0.725	0.703	0.686	0.670	0.658
38 kV	0.862	0.790	0.748	0.717	0.696	0.678	0.664	0.652
39 kV	0.853	0.782	0.740	0.710	0.689	0.672	0.657	0.646

W/0.7 mm Al (M15, M28)

	Added layers of Al filtration (mm)									
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
20 kV	1,263	1,218	1,173	1,129	1,086	1,044	1,002	0,962	0,921	0,883
22 kV	1,180	1,138	1,097	1,056	1,018	0,980	0,944	0,909	0,875	0,843
24 kV	1,109	1,069	1,031	0,994	0,959	0,926	0,893	0,863	0,835	0,808
26 kV	1,049	1,011	0,975	0,941	0,909	0,879	0,850	0,823	0,799	0,776
28 kV	1,000	0,963	0,929	0,897	0,867	0,839	0,813	0,789	0,767	0,748
30 kV	0,957	0,923	0,890	0,860	0,831	0,805	0,781	0,760	0,740	0,723
32 kV	0,924	0,890	0,858	0,829	0,802	0,778	0,755	0,735	0,716	0,701
34 kV	0,896	0,863	0,833	0,804	0,778	0,755	0,733	0,714	0,696	0,682
36 kV	0,874	0,842	0,812	0,784	0,759	0,736	0,715	0,696	0,679	0,666
38 kV	0,856	0,825	0,795	0,768	0,743	0,720	0,699	0,681	0,665	0,652
40 kV	0,841	0,810	0,781	0,754	0,730	0,707	0,687	0,669	0,653	0,640
42 kV	0,829	0,798	0,769	0,743	0,718	0,696	0,676	0,659	0,643	0,630
44 kV	0,817	0,786	0,758	0,732	0,708	0,686	0,667	0,650	0,635	0,622
46 kV	0,804	0,774	0,747	0,721	0,698	0,677	0,658	0,642	0,628	0,616
49 kV	0,783	0,754	0,727	0,703	0,681	0,662	0,645	0,630	0,618	0,608

W/50 µm Ag (M10, M16, M27)

kV	Added layers of Al filtration (mm) 0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
22 kV	1.147	1.105	1.081	1.059	1.042	1.024		
23 kV	1.108	1.071	1.047	1.028	1.013	0.996		
24 kV	1.076	1.043	1.020	1.002	0.989	0.973		
25 kV	1.050	1.020	0.998	0.981	0.969	0.953	0.939	
26 kV	1.030	1.001	0.980	0.964	0.952	0.937	0.921	
27 kV	1.013	0.986	0.965	0.950	0.938	0.924	0.908	
28 kV	1.000	0.973	0.953	0.938	0.926	0.913	0.899	0.889
29 kV	0.989	0.962	0.944	0.929	0.917	0.904	0.891	0.882
30 kV	0.980	0.954	0.935	0.921	0.908	0.896	0.885	0.875
31 kV	0.973	0.946	0.928	0.913	0.901	0.890	0.880	0.869
32 kV	0.967	0.939	0.922	0.907	0.895	0.884	0.874	0.863
33 kV	0.961	0.933	0.916	0.901	0.890	0.879	0.869	0.858
34 kV	0.956	0.928	0.910	0.895	0.884	0.874	0.863	0.852
35 kV	0.951	0.922	0.905	0.890	0.879	0.869	0.857	0.847
36 kV	0.946	0.917	0.899	0.885	0.875	0.864	0.852	0.842
37 kV	0.941	0.911	0.894	0.879	0.870	0.859	0.846	0.837
38 kV	0.936	0.906	0.889	0.874	0.865	0.854	0.840	0.832
39 kV	0.931	0.901	0.883	0.869	0.860	0.849	0.835	0.827

W/75 µm Ag (M11)

kV	Added layers of Al filtration (mm) 0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
22 kV	1.134	1.105	1.088					
23 kV	1.097	1.076	1.060	1.042	1.029	1.015	1.006	
24 kV	1.068	1.051	1.036	1.020	1.007	0.995	0.987	
25 kV	1.044	1.029	1.016	1.002	0.989	0.979	0.970	
26 kV	1.026	1.012	0.999	0.987	0.975	0.965	0.957	
27 kV	1.011	0.998	0.985	0.974	0.963	0.954	0.945	
28 kV	1.000	0.987	0.975	0.964	0.953	0.944	0.936	0.929
29 kV	0.991	0.978	0.966	0.956	0.945	0.937	0.929	0.921
30 kV	0.984	0.971	0.960	0.949	0.939	0.931	0.923	0.914
31 kV	0.978	0.965	0.955	0.944	0.934	0.926	0.917	0.909
32 kV	0.973	0.961	0.951	0.939	0.929	0.921	0.913	0.905
33 kV	0.969	0.957	0.947	0.935	0.926	0.917	0.909	0.902
34 kV	0.965	0.953	0.943	0.931	0.922	0.914	0.905	0.899
35 kV	0.961	0.950	0.940	0.928	0.919	0.910	0.902	0.896
36 kV	0.957	0.946	0.936	0.924	0.916	0.907	0.898	0.893
37 kV	0.953	0.943	0.932	0.921	0.913	0.904	0.895	0.889
38 kV	0.949	0.939	0.928	0.917	0.909	0.900	0.891	0.885
39 kV	0.945	0.935	0.924	0.913	0.905	0.896	0.887	0.882

W/50 µm Rh (M6, M12, M17)

kV	Added layers of Al filtration (mm) 0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
22 kV	1.093	1.075	1.056	1.038				
23 kV	1.061	1.043	1.024	1.006	0.990			
24 kV	1.040	1.021	1.002	0.985	0.971	0.961		
25 kV	1.025	1.005	0.987	0.970	0.957	0.947	0.937	
26 kV	1.015	0.994	0.976	0.960	0.948	0.937	0.928	
27 kV	1.007	0.985	0.968	0.953	0.941	0.929	0.921	
28 kV	1.000	0.978	0.961	0.947	0.935	0.924	0.915	
29 kV	0.993	0.972	0.956	0.942	0.930	0.919	0.910	
30 kV	0.986	0.966	0.950	0.937	0.924	0.914	0.905	0.895
31 kV	0.979	0.960	0.944	0.931	0.918	0.909	0.899	0.889
32 kV	0.973	0.954	0.938	0.925	0.912	0.903	0.894	0.883
33 kV	0.966	0.948	0.932	0.919	0.906	0.897	0.888	0.877
34 kV	0.960	0.941	0.926	0.912	0.900	0.891	0.881	0.871
35 kV	0.954	0.935	0.920	0.906	0.894	0.884	0.875	0.865
36 kV	0.948	0.929	0.914	0.900	0.888	0.876	0.869	0.859
37 kV	0.943	0.923	0.908	0.893	0.882	0.869	0.863	0.853
38 kV	0.938	0.917	0.903	0.888	0.877	0.862	0.857	0.847
39 kV	0.933	0.912	0.897	0.882	0.871	0.856	0.851	0.840

W/0.3 mm Cu - M18

kV range	Added layers of Al filtration (mm) 0.0	0.1	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5
45 -49 kV	1.000	1.000	1.001	1.002	1.003	1.004	1.005	1.006	1.007	1.008	1.009

Correction data for various phantoms/added filtrations

kV	**Mo / 30 µm Mo + 2 mm Al M0 M1d**	**Mo / 30 µm Mo + 3 mm Al & PMMA (GE IQST) M1e**	**Mo / 25 µm Rh + 40 mm PMMA M3a**	**Mo / 25 µm Rh + 3 mm Al & PMMA (GE IQST) M3e**	**Rh / 25 µm Rh + 3 mm Al & PMMA (GE IQST) M4e**	**W / 50 µm Rh + 40 mm PMMA M6a**	**W / 0.5 mm Al + 2 mm Al M7d**
22 kV	1.041		1.058			1.007	1.202
23 kV	1.038		1.048			1.006	1.159
24 kV	1.034		1.038			1.004	1.121
25 kV	1.027	1.081	1.028	1.056	1.053	1.003	1.086
26 kV	1.019	1.055	1.019	1.037	1.034	1.002	1.054
27 kV	1.010	1.028	1.009	1.018	1.016	1.001	1.026
28 kV	1.000	1.000	1.000	1.000	1.000	1.000	1.000
29 kV	0.990	0.972	0.991	0.982	0.985	0.999	0.977
30 kV	0.979	0.943	0.982	0.965	0.970	0.998	0.957
31 kV	0.969	0.915	0.973	0.948	0.957	0.997	0.939
32 kV	0.958	0.888	0.965	0.931	0.944	0.996	0.923
33 kV	0.948	0.863	0.957	0.915	0.932	0.995	0.909
34 kV	0.938	0.844	0.949	0.900	0.920	0.994	0.896
35 kV	0.929		0.941			0.993	0.886
36 kV	0.920		0.934			0.992	0.876
37 kV	0.913		0.927			0.992	0.868
38 kV	0.905		0.920			0.991	0.861
39 kV	0.899		0.914			0.990	0.855
40 kV	0.894						0.850
41 kV	0.889						0.845
42 kV	0.884						0.841
43 kV	0.881						0.837
44 kV	0.877						0.833
45 kV	0.874						0.830
46 kV	0.871						0.826
47 kV	0.868						
48 kV	0.865						
49 kV	0.861						

MAMMOGRAPHY TOMOSYNTHESIS CORRECTION FACTORS

This section describes the angular dependence for the RTI Dose Probe. The angular dependence is described as well as the influence it gives on a continuous tomosynthesis scan over a range of angles. These correction factors are also valid for Piranha Dose Probe (PDP), R100B and R100.

Introduction

Solid State detectors have a sensitive volume that can be approximated as very narrow surface. That gives a theoretical angular dependence that follows the cosine theorem. Then different detectors are designed differently in terms of collimation and material that attenuates and scatter more or less radiation in front of the sensitive volume.
This document describes the angular dependence for the RTI Dose Probe in the mammography energy interval. Based on the angular dependence for discrete angles, correction factors are derived for use in mammography tomosynthesis.

Tomosynthesis correction factors

Table 1 below shows the correction factors to use for different incident angles of the radiation.

Table 1. Correction factors for discrete angles.

Angle (θ)	Corr
0°	1,000
5°	1,018
10°	1,050
15°	1,087
20°	1,14
25°	1,20
30°	1,28
35°	1,38
40°	1,52

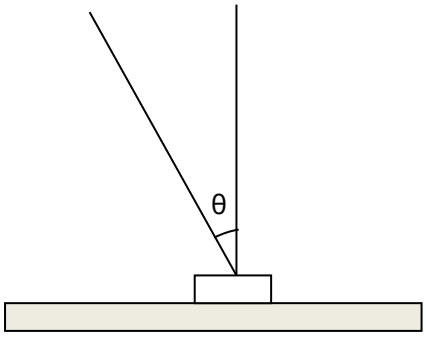

Table 2 shows correction factors for tomosynthesis scans of different scanning angle ranges. Note that these correction factors are valid only for a continuous scan speed and constant tube output over the entire scan. If not the factors in table 1 has to be used to calculate a weighted correction factor.

Table 2. Tomosynthesis Correction factors

Tomo range (θ)	Corr
±5°	1,009
±10°	1,021
±15°	1,036
±20°	1,055
±25°	1,076
±30°	1,10
±35°	1,13
±40°	1,16

Note:
With Ocean the ***Beam Correction Factor*** can be used to apply these corrections.