Lampiran 1

A. Perhitungan Ralat Densitas yang disebabkan oleh Paparan Radiasi Hambur :

$$\bar{D} = \frac{1}{n}\sum_{n=1}^{n} D_n$$

$$S_{\bar{D}} = \sqrt{\frac{\sum\left(X_i - \bar{X}\right)^2}{(n-1)}}$$

$$D_s = (\bar{D} \pm S_{\bar{D}})$$

B. Tabel A.1. Pesawat sinar-x dengan kemiringan anoda 18^0

Posisi	D1	D2	D3	$\bar{D}$	$S_{\bar{D}}$	$D_s = (\bar{D} \pm S_{\bar{D}})$	ΔD
0	1,31	1,32	1,31	1,313	0,004	1,313+0,004	0,630
4	1,47	1,48	1,47	1,473	0,004	1,473+0,004	0,470
8	1,61	1,60	1,61	1,606	0,004	1,606+0,004	0,337
12	1,74	1,74	1,75	1,743	0,004	1,743+0,004	0,200
16	1,82	1,81	1,81	1,806	0,004	1,806+0,004	0,137
18	1,86	1,86	1,87	1,863	0,004	1,863+0,004	0,080
20	1,91	1,91	1,90	1,906	0,004	1,906+0,004	0,037
24	1,94	1,94	1,95	1,943	0,004	1,943+0,004	0,000
28	1,86	1,87	1,87	1,867	0,004	1,867+0,004	0,076
32	1,77	1,77	1,78	1,773	0,004	1,773+0,004	0,170
36	1,66	1,65	1,66	1,656	0,004	1,656+0,004	0,287

Catatan : Data pengukuran sudah dikurangi basic fog sebesar 0,08

C. Tabel A.2. Pesawat sinar-x dengan kemiringan anoda $17,5^0$

Posisi	D1	D2	D3	$\bar{D}$	$S_{\bar{D}}$	$D_S = (\bar{D} \pm S_{\bar{D}})$	ΔD
0	1,16	1,17	1,17	1,166	0,004	1,166+0,004	0,727
4	1,32	1,32	1,33	1,323	0,004	1,323+0,004	0,570
8	1,44	1,45	1,44	1,433	0,004	1,433+0,004	0,460
12	1,61	1,60	1,62	1,610	0,006	1,610+0,006	0,283
16	1,75	1,74	1,74	1,743	0,004	1,743+0,004	0,150
17,5	1,81	1,81	1,82	1,813	0,004	1,813+0,004	0,080
20	1,85	1,85	1,86	1,853	0,004	1,853+0,004	0,040
24	1,89	1,90	1,89	1,893	0,004	1,893+0,004	0,000
28	1,83	1,84	1,82	1,830	0,006	1,830+0,006	0,063
32	1,75	1,74	1,74	1,743	0,004	1,743+0,004	0,150
35	1,65	1,64	1,64	1,643	0,004	1,643+0,004	0,250

Catatan : Data pengukuran sudah dikurangi basic fog sebesar 0,08

D. Tabel A.3. Pesawat sinar-X dengan kemiringan anoda 16^0

Posisi	D1	D2	D3	$\bar{D}$	$S_{\bar{D}}$	$D_S = (\bar{D} \pm S_{\bar{D}})$	ΔD
0	0,98	0,99	0,98	0,983	0,004	0,983+0,004	0,680
4	1,11	1,10	1,10	1,103	0,004	1,103+0,004	0,560
8	1,26	1,26	1,27	1,263	0,004	1,263+0,004	0,400
12	1,40	1,40	1,41	1,403	0,004	1,4003+0,004	0,260
16	1,55	1,56	1,56	1,556	0,004	1,556+0,004	0,107
20	1,62	1,63	1,62	1,623	0,004	1,623+0,004	0,040
24	1,66	1,67	1,66	1,663	0,004	1,663+0,004	0,000
28	1,60	1,59	1,59	1,593	0,004	1,593+0,004	0,070
32	1,49	1,48	1,50	1,490	0,004	1,490+0,004	0,173

Catatan : Data pengukuran sudah dikurangi basic fog sebesar 0,08

E. Tabel A.4. Pesawat Sinar-x dengan kemiringan anoda $15,5^0$

Posisi	D1	D2	D3	$\bar{D}$	$S_{\bar{D}}$	$D_S = (\bar{D} \pm S_{\bar{D}})$	ΔD
0	0,84	0,85	0,84	0,843	0,004	0,843+0,004	0,707
4	0,99	0,99	1,00	0,993	0,004	0,993+0,004	0,557
8	1,13	1,13	1,14	1,133	0,004	1,133+0,004	0,417
12	1,29	1,28	1,30	1,290	0,006	1,290+0,004	0,260
15,5	1,43	1,44	1,44	1,436	0,006	1,436+0,004	0,114
16	1,46	1,45	1,43	1,446	0,004	1,446+0,004	0,104
20	1,51	1,52	1,51	1,513	0,004	1,513+0,004	0,037
24	1,55	1,56	1,54	1,550	0,006	1,550+0,004	0,000
28	1,50	1,50	1,51	1,503	0,004	1,503+0,004	0,047
31	1,44	1,43	1,42	1,430	0,006	1,430+0,004	0,120

Catatan : Data pengukuran sudah dikurangi basic fog sebesar 0,08

Lampiran 2

A. Perhitungan Matematis Posisi Intensitas Maksimum

Kondisi Pemotretan :

Tegangan : 65 kV FFD : 50,8 cm

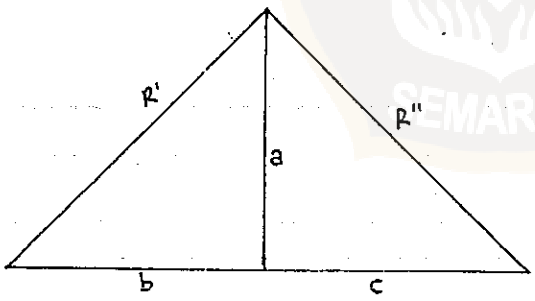
Arus : 20 mA Waktu : 1 detik

$$I = \frac{V \cdot A}{(FFD)^2}$$

$$I_{Konv} = I \times Konv$$

Tabel Konversi Efek Heel (Quin,1985)

Posisi (cm)	Prosentase (%)
36	102
32	105
28	104
24	103
20	100
16	92
12	85
8	73
4	56
0	31



Keterangan :

a : Jarak Fokus ke Film

b dan c : Posisi

R^I dan R^{II} : Jarak Fokus ke Film

Untuk mencari nilai :

(I) $R^2 = a^2 + b^2$

(II) $R^2 = a^2 + c^2$

B. Tabel A.1. Pesawat Sinar-X dengan Kemiringan Anoda 18^0

Posisi	R (m)	I (w/m^2)	Konversi (%)	$I_{Konversi}$ (w/m^2)
0	$53,89\ 10^{-2}$	4482,75	31	138965,51
4	$52,69\ 10^{-2}$	4676,25	56	261870,50
8	$51,77\ 10^{-2}$	4850,74	73	354079,47
12	$51,15\ 10^{-2}$	4961,83	85	421755,72
16	$50,83\ 10^{-2}$	5038,76	95	478682,17
18	$50,80\ 10^{-2}$	5038,76	-	-
20	$50,83\ 10^{-2}$	5038,76	100	503876,00
24	$51,15\ 10^{-2}$	4961,83	103	511068,49
28	$51,77\ 10^{-2}$	4850,74	104	504476,96
32	$52,69\ 10^{-2}$	4676,25	105	491006,25
36	$53,89\ 10^{-2}$	4482,75	102	457240,50

C. Tabel A.2. Pesawat Sinar-X dengan Kemiringan Anoda $17,5^0$

Posisi	R (m)	I (w/m^2)	Konversi (%)	$I_{Konversi}$ (w/m2)
0	$53,7210^{-2}$	4498,27	31	139446,36
4	$52,26\ 10^{-2}$	4761,90	56	266666,40
8	$51,68\ 10^{-2}$	4868,91	73	355430,40
12	$51,09\ 10^{-2}$	4980,84	85	423371,40
16	$50,82\ 10^{-2}$	5038,76	95	478862,20
17,5	$50,80\ 10^{-2}$	5038,76	-	-
20	$50,86\ 10^{-2}$	5019,30	100	501930,00
24	$51,21\ 10^{-2}$	4961,83	103	511068,49
28	$51,87\ 10^{-2}$	4832,71	104	502601,84
32	$52,82\ 10^{-2}$	4710,14	105	494564,70
35	$53,72\ 10^{-2}$	4498,27	-	-

D. Tabel A.3. Pesawat Sinar-X dengan Kemiringan Anoda 16^0

Posisi	R (m)	I (w/m^2)	Konversi (%)	$I_{Konversi}$ (w/m^2)
0	$53,26\ 10^{-2}$	4577,46	31	141901,40
4	$52,19\ 10^{-2}$	4779,41	56	267647,05
8	$51,42\ 10^{-2}$	4924,42	73	359469,69
12	$50,95\ 10^{-2}$	5000,00	85	425000,00
16	$50,80\ 10^{-2}$	5038,76	95	478682,17
20	$50,95\ 10^{-2}$	5000,00	100	500000,00
24	$51,42\ 10^{-2}$	4924,42	103	507215,26
28	$52,19\ 10^{-2}$	4779,41	104	497058,64
32	$53,26\ 10^{-2}$	4577,46	105	480633,30

E. Tabel A.4. Pesawat sinar-X dengan Kemiringan Anoda $15,5^0$

Posisi	R (m)	I (w/m^2)	Konversi %	$I_{Konversi}$ (w/m^2)
0	$53,11\ 10^{-2}$	4609,92	31	142907,80
4	$52,08\ 10^{-2}$	4797,04	56	268634,68
8	$51,35\ 10^{-2}$	4924,24	73	359469,69
12	$50,92\ 10^{-2}$	5019,30	85	426640,92
15,5	$50,80\ 10^{-2}$	5038,76	-	-
16	$50,80\ 10^{-2}$	5038,76	95	478682,20
20	$50,99\ 10^{-2}$	5000,00	100	500000,00
24	$51,50\ 10^{-2}$	4905,66	103	505283,01
28	$51,87\ 10^{-2}$	4832,71	104	502602,23
31	$53,11\ 10^{-2}$	4609,92	-	-

Lampiran 3

DEPARTEMEN KESEHATAN RI
DIREKTORAT JENDERAL PELAYANAN MEDIK

RUMAH SAKIT UMUM PUSAT DR. KARIADI

Jl. Dr. Sutomo No. 16 Semarang PO BOX 1104 Telp. 413993, 413764, 413475, Fax. 318617
E-mail : rsdk@indosat.net.id

)ONESIA
SEHAT
2010

Nomor : DL.00.02- 898
Lampiran :
Perihal : Ijin Penelitian

28 JUN 2001

Kepada Yth :
Dekan MIPA UNDIP Semarang
d.a Kampus MIPA UNDIP Tembalang
Semarang 50275

Bersama dengan ini Direktur RSUP Dr. Kariadi memberikan izin untuk melaksanakan penelitian di lingkungan RSUP Dr. Kariadi :

1. Nama lengkap & gelar : - Eko Hariyanto (J2D299002)
   - Agus Dwi Prasetya (J2D299001)
2. Jabatan/Pekerjaan : Mahasiswa
3. Judul penelitian : - Penggunaan aplikasi komputer pada perekaman gambar teknik pemeriksaan fluoroscopi
   - Analisa kemiringan anoda terhadap timbulnya efek heel.
4. Lokasi penelitian : Radiodiagnostik
5. Jangka waktu penelitian : 1 bulan

Dengan ketentuan sebagai berikut :
- Pihak peneliti dapat mentaati peraturan serta tata tertib yang berlaku di RSUP Dr. Kariadi
- Selesai penelitian yang bersangkutan diharuskan menyerahkan 2 Exp. hasil penelitian sebagai laporan kepada Direktur RSUP Dr. Kariadi
- Biaya penelitian sesuai dengan SK Direktur yang berlaku
- Sebelum mulai penelitian supaya datang ke Bidang Diklit untuk mendapat penjelasan.

Demikian, untuk menjadikan maklum.

Direktur,

Dr. H. Gatot Suharto, M.Kes, MMR
NIP : 140 068 226

Tembusan Kepada Yth :
1. Wadir Penunjang Medis & Pendidikan RSUP Dr. Kariadi
2. Kabid Diklit RSUP Dr. Kariadi.
3. Ka. Inst. Radiodiagnostik RSUP Dr. Kariadi
4. Ka. Inst. Diklat RSUP Dr. Kariadi
5. Yang bersangkutan
6. Arsip.

:UM 00010

Lampiran 4

MOBILE X-RAY APPARATUS

MODEL KCD-10M-7/KCD-10M-7A

TOSHIBA MEDICAL SYSTEMS

TOSHIBA

1. OUTLINE

This is a capacitor discharge type mobile X-ray apparatus designed for clinical diagnostic use in hospitals and clinics.
This apparatus posseses the functions of automatic X-ray tube recharging and wave-tail cutoff, and enables radiographic control by the grid of a rotating anode. High safety, short- time radiogrphic operations can thus performed on almost all sections of the patient's body. Also, the capacitor discharge system used in this apparatus eliminates the need for large power supply facilities and so allows direct use of the ordinary power supply that is provided to hospitals and clinics.

2. APPARATUS COMPOSITION

(1) X-ray tube unit

(2) High potential generator (high tension transformer and an X-ray control)

(3) Mobile carriage (including an X-ray tube supporting mechanism)

(4) Others (high potential cables, a hand switch)

(5) Accessories

3. MAJOR OPERATIONAL CHARACTERISTICS

(1) Maximum tube voltage	: 100 kV
(2) Tube current	: DRX-66D ; 300 mA at 50 kV 150 mA at 100 kV
(3) Effective focal spot size	: 1,5mm
(4) Target Angle	: 15,5^0
(5) Anode	: W, 80 mm Ø
(6)High potential generation	: Capacitor discharge method
(7) Tube voltage adjusment range	: 40 – 100 kV (continuously variable)
(8) Capacitor charging time	: Approx. 20 seconds from 0V to 100kV
(9) Residual charge discharge method	: Using the "DISCHARGE" push button on the control panel (Approx. 1 second from 100 kV to 0V)

CM535-06c

ROTATING ANODE X-RAY TUBE ASSEMBLY
CIRCLEX 1.5MG10AN-103
CIRCLEX 1.5MG10BN-10
(CONDENSER OPERATION)

03307

INSTRUCTION MANUAL

SHIMADZU CORPORATION
KYOTO JAPAN

1. SPECIFICATION

The CIRCLEX 1.5MG10AN-103 or the CIRCLEX 1.5MG10BN-10 is the grid controlled rotating anode X-ray tube assembly of miniature type. It is suitable for mass chest survey, the mobile X-ray unit and other low current radiography up to 300mA.

The X-ray tube assembly consists of the tube shield type RX-103 or RX10 with the X-ray tube CIRCLEX 1.5MG10AN or BN inserted.

Combined X-ray units are as follows.

X-ray tube assembly	X-ray unit
CIRCLEX 1.5MG10BN-10	SM-125L-20 (125kV)
CIRCLEX 1.5MG10AN-103	MC-100L-10 (100kV)

1.1 Technical Data

See Table 1.

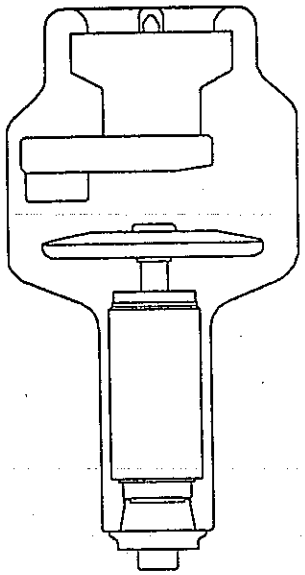
Table 1

Max. operating voltage			kV_p	100(A), 125(B)
Effective focal spot size			mm	1.5
X-ray tube anode	Max. heat storage capacity		HU	60,000
	Max. cooling capacity		HU/min.	14,000
X-ray tube assembly	Max. heat storage capacity		HU	800,000
	Max. cooling capacity		HU/min.	12,000
Max. continuous load HU/sec.	X-ray tube	Anode stationary		240
		Anode rotating		260
	X-ray tube assembly			200

Max. radiographic rating		See radiographic rating chart.
Filament characteristic		See filament characteristic chart.
Emission characteristic		See emission characteristic chart.
Cut-off grid voltage	V	−2000
Max. voltage between filament and grid	V	−3000
Target		Tungsten disc; target angle 18°; focal track diameter 40 mm
Anode rotation		Anode should rotate anticlockwise, seen from cathode; revolution speed, Over 2,700 rpm for 50Hz, over 3.200 rpm for 60 Hz,
filtration		Approx. 1.5 mm Aℓ
X-ray field		Covered 35 cm X 35 cm at 65 cm from focus.
X-ray protection		Less than 65 mR in an hour at one meter from focus except utilized beam.
Min. ambient temperature	°C	−10
Weight	kg	Approx. 16
Stator		100V, 3.3A (starting) 40V, 1.4A (running) Starting time 0.8 sec. Split condenser 24 μF.

Documentazione Tubo a raggi X
Tube Documentation
Documentation du Tube

X40C 1.0/2.0



Nr. Di matricola	
Tube No.	30132
Nr de srie	

CE 0051

Questa documentazione deve essere fornita all'utilizzatore del complesso tubo-guaina
The contents of this documentation must be transmitted to the user of the tube-asseembly
Le contenu de cette documentation doit étre transmis àl'utilisateur de la gaine équipée

Documentazione N° Documentation N° N° de Documentation	Revisione Edition Version	Data di edizione Date of release Date de l'édition	Testo originale Original text Texte original
40CHAK	A	26.08.99	italiano / italian / italien

I.A.E Spa via Fabio Filzi, 53 – 20032 CORMANO (MI) Italy
Tel : ++39-0266303255 Fax. : ++39-026152544
http : // www.iae.it e-mail : iaexray@iae.it

Caratteristiche – Spesifications - Spesifications

Macchie focali efectiva Effective focal spot Foyer optique	1,5 mm
Velocità di rotazione dell'anodo Anode speed Vitese de l'anode	3000 min^{-1}
Diametro anodico Anode diameter Diamètre de l'anode	90 mm
Materiale anodico Anode material Materiau de l'anode	Wolfram
Angolo Anodico Anode angle Pente de l'anode	16 ^{0}
Campo di radiazione Radiation field Champ de rayonnement	a 70 cm 38 cm a 100 cm 55 cm
Filtrazione inerente Inherent filtration Filtration inhérente	0.7 mm Al eq
Capacita termica anodica Maximum anode heat content Chaleur maximale accumulée dans l'anode	105 kJ 140 kHU
Dissipazione termica continua massima Maximum continous heat dissipation Dissipation thermique continue maximale	440 W
Alta tensione nominale Nominal X-ray tube voltage Haute tension nominale	130 kV
Massima corrente di fillamento Max. filament current Courant dans le filament max.	5,4 A

ati fomiti nella presente documentazione si intendono riferiti a:

e data indicated in this documentations refer to:

s donneés indiqueés dans cette documentation sout calculéspour:

tenza anodica di equilibrio termico		% della capacitá termica anodica	
uivalent anode input power	100 W =	% of max. anode heat content	47%
issance anodique d'equilibre thermique		% de chaleur max. accumulée dans l'anode	

P 125/20/40

Kurven, Diagramme, Tabellen
Curves, diagrams, tables
Courbes, diagrammes, tableaux
Curvas, diagramas, tablas

PANTIX-Drehanodenröhre
Normaltourige Diagnostik-Drehanodenröhre mit 2 Brennflecken verschiedener Größe und Belastbarkeit. Bevorzugte Verwendung dieser robusten Röntgenröhre an Generatoren kleiner und mittlerer Leistung.

Der Anodenteller aus Wolfram mit 80 mm Durchmesser erlaubt den Einsatz für alle Routine-Untersuchungen an Durchleuchtungs-, Wand- und Schichtgeräten sowie an Raster-Aufnahmetischen.

Tube à anode tournante PANTIX
Tube de diagnostic à anode tournante, à vitesse normale, avec 2 foyers de taille et capacité thermique différentes. Utilisation préférentielle de ce tube radiogène robuste avec des générateurs de petite et moyenne puissance.

Le disque anodique en tungstène de 80 mm ϕ permet l'utilisation du tube pour toutes les explorations de routine avec des appareils de radioscopie, des statifs muraux et des appareils de planigraphie ainsi qu'avec des tables de prise de clichés au Potter.

PANTIX — rotating-anode tube
Standard-speed diagnostic rotating-anode tube with 2 focal spots of different size and rating. Preferred use of this rugged X-ray tube on generators of low and medium output.

The tungsten anode disk of 80 mm diameter allows the tube to be used for all routine examinations on fluoroscopic units, wall stands and planigraphic equipment as well as on Bucky examination tables.

PANTIX — tubo de ánodo giratorio
Tubo de ánodo giratorio de velocidad normal, para diagnóstico con 2 focos de diferente tamaño y capacidad de carga. Este modelo, de calidad muy sólida, se utiliza preferentemente con generadores de baja o mediana potencia.

El plato anódico, de tungsteno y 80 mm ϕ, se presta para todos los exámenes de rutina con equipos radioscópicos, murales y tomográficos, así como con mesas Bucky.

Brennfleck Focal spot Foyer Foco		P 20 ✓		P 40	
Optischer Brennfleck (IEC / 336 / 1982) Optical focal spot (DIN 6823 / 1) Foyer optique Mancha focal efectiva		1,5		2,0	
Nennspannung Nominal voltage Tension nominale Tensión nominal		125 kV			
Anoden-Neigungswinkel Target angle Pente anodique Angulo de inclinación		17,5°			
Größe des Strahlenfeldes Field coverage Dimensions du champ couvert par les rayons Tamaño del campo de radiación		FFA 50 cm = 30 cm 60 cm = 35,6 cm 70 cm = 40 cm 75 cm = 43 cm			
Mittlerer Brennfleckbahnradius Mean radius of focal path Rayon moyen de la piste focale Radio medio de la pista focal		~ 32 mm			
Abstand Brennfleck-Blendenflansch Distance focus to collimator flange Distance foyer-bride du diaphragme Distancia foco-brida del colimador		~ 80 mm			
Heizung Filament heating Chauffage Calefacción	Durchleuchtung fluoroscopy radioscopie radioscopia	~ 5,5 A	3,5 V	~ 5,5 A	6,0 V
	Aufnahme radiography radiographie radiografía	max. 8,5 A	~ 8 V	max. 8,9 A	~ 14 V
Kathodendraht-Durchmesser Filament-wire diameter Diamètre du fil du filament Diámetro del filamento		0,3 mm		0,3 mm	
Anode Anodo		W, 80 mm ϕ, ~350 g			