LAMPIRAN A

KALIBRASI EFISIENSI DETEKTOR NaI(Tl)

Kalibrasi efisiensi dilakukan untuk mencari efisiensi deteksi suatu sistem spektrometer. Dalam penelitian ini dipakai efisiensi mutlak yang dihitung dengan persamaan:

$$\varepsilon(E\gamma) = \frac{cps}{dps.Y(E\gamma)}$$

Kalibrasi spektrometer NaI(Tl) dilakukan pada kondisi kerja sebagai berikut :

Detektor	: NaI(Tl) (Quartz 12512/ 3A-DZ 393)
Tegangan	: 600 V Canberra 3002
Pre Amp	: 100 V Ortec 311
Amplifier	: Ortec 570
Coarse gain	: 200 X
Fine gain	: 2 μs
Penganalisis	: MCA Ortec 7010
Accuspec	: Accuspec A ND PCAT A IO 3004 On boart ADC
Jarak Detektor-Sumber	: 1 cm

Sumber : Eu^{152}

Aktivitas (A_0) : 10 μCi (8 Februari 1986)

$= 10^{-5}$ Ci x $3,7 . 10^{10}$ Bq/Ci

$= 3,7 . 10^{5}$ Bq

Umur Paro ($T_{1/2}$) : 13,1 tahun

= 13,1 tahun x 365,5 hari/tahun

= 4788,05 hari

Tanggal Kalibrasi : 30 April 1996

Dengan waktu tunda (8 Februari 1986 sampai 30 April 1996) 3737 hari didapatkan aktivitas sumber pada saat kalibrasi spektrometer NaI(Tl) sebesar :

dps (30 April 1996) $= A_0 . e^{-\lambda t}$

$= A_0 . e^{-Ln2.t/T1/2}$

$= A_0 . 0,5^{t/T1/2}$

$= 3,7 . 10^{5} (0.5)^{3737/4788,05}$

$= 2,1540 \times 10^{5}$ dps

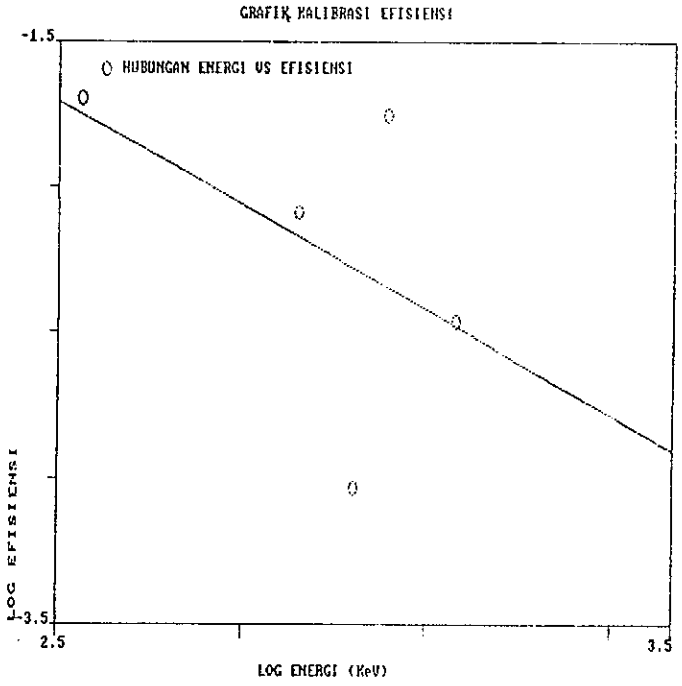
$$\varepsilon(E-\gamma) = \frac{cps}{dps.Y(E-\gamma)}$$

$$= \frac{1153}{2,1540x10^{-5}.0,2640}$$

$= 20,2759 \times 10^{-3}$

Tabel A.1 perhitungan efisiensi

E-γ (KeV)	Gamma Yield	cps	Efisiensi (10^{-3})	Log E-γ	Log Efisiensi
344.28	0.2640	1153	20.2759	2.5369	-1.6980
778.90	0.1300	228	8.1423	2.8915	-2.0893
964.05	0.1448	29	0.9298	2.9841	-3.0316
1085.83	0.1014	385	17.6269	3.0358	-1.7538
1408.03	0.2070	152	3.4090	3.1486	-2.4674



Gambar A.1 Grafik kalibrasi efisiensi.

Dengan Regresi Linier diperoleh persamaan :

$Y = 1{,}287 + (-1{,}197)X$

dimana :

$Y = \text{Log } \varepsilon$

$X = \text{Log } E\text{-}\gamma$

Untuk energi gamma 1368,6 KeV, maka diperoleh harga efisiensi sebesar : $3{,}41 \cdot 10^{-3}$.

LAMPIRAN B

DATA HASIL UJI KEKERASAN DAN UJI TARIK BAHAN Al-2024T3

Data Uji Kekerasan

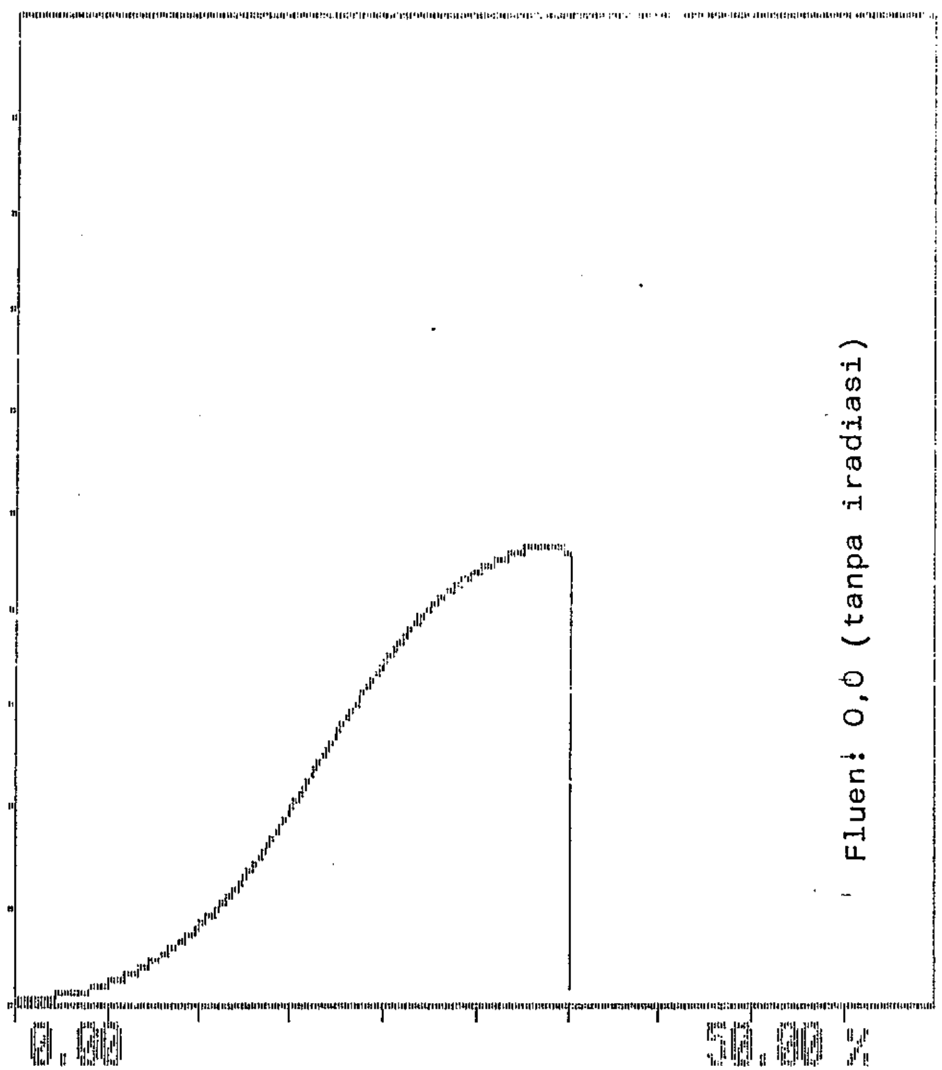
Tabel B.1 Data hasil uji kekerasan bahan Al-2024T3

No	Fluen (n/cm^2)	Kekerasan (KHN)		
		1	2	3
1	0.0	105.7	106.2	105.7
2	8.035×10^{09}	121.9	124.4	122.4
3	4.964×10^{10}	131.8	131.0	131.3
4	1.127×10^{12}	142.0	142.3	142.0
5	1.312×10^{12}	143.1	143.7	143.1
6	1.732×10^{12}	146.9	145.7	147.3
7	7.974×10^{12}	162.8	163.2	162.6
8	9.706×10^{12}	177.5	177.9	177.4
9	1.467×10^{13}	186.7	185.4	184.1

Data Uji Tarik

F1	DIRECTION	TENSION	
F2	AUTOMATIC	STOP	
F3	LINEAR UNITS	mm	
F4	FORCE UNITS	Kg	
F5	AREA COMP	ON	0.000
F6	CYCLING	OFF	
F7	TEST SPEED	2.540 mm/MIN	
F8	RETURN SPEED	100.000 mm/MIN	
F9	PRELOAD	0.200 Kg	
F10	SETUP SCALES	CAP = 13600 Kg	
P	PRELOAD	***	
T	TEST	*	
S	STOP	*	
C	CONTINUE	*** STOP	
R	RETURN	*	
J	JOG	***	
Z	ZERO POSITION COUNT		
X	X-Y PLOT FROM MEMORY		

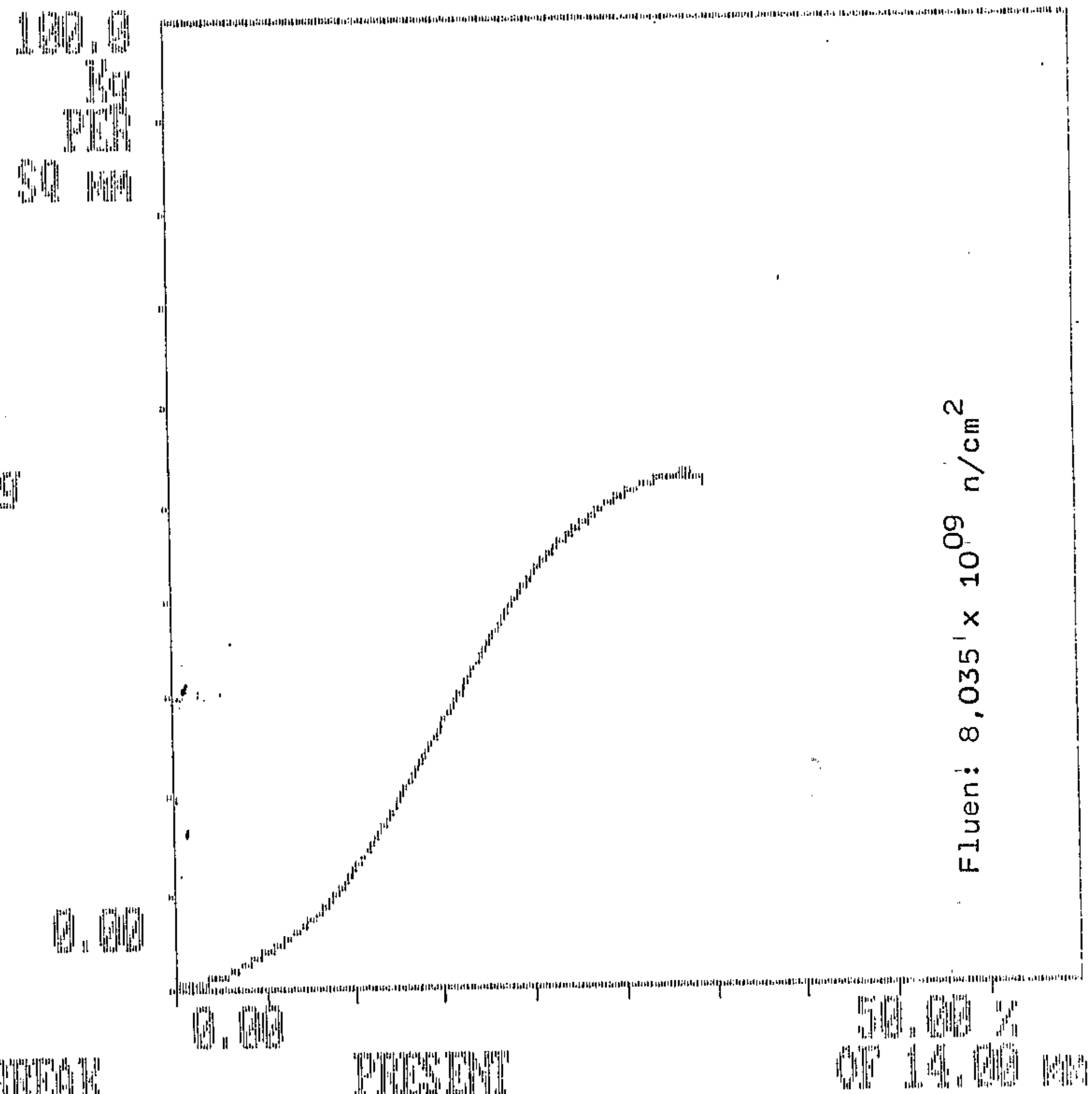
Alt-Q TO QUIT PROGRAM



POSITION 4.2132

	@ PEAK	@ BREAK	PRESENT
EXTENSION	28.620	30.081	30.094
LOAD	46.633	45.335	-1.298

F1 DIRECTION TENSION
F2 AUTOMATIC STOP
F3 LINEAR UNITS MM
F4 FORCE UNITS Kg
F5 AREA COMP ON 8.000
F6 CYCLING OFF
F7 TEST SPEED 2.540 MM/MIN
F8 RETURN SPEED 100.000 MM/MIN
F9 PRELOAD 0.200 Kg
F10 SETUP SCALES CAP = 13600 Kg
P PRELOAD ***
T TEST *
S STOP *
C CONTINUE *** STOP
R RETURN *
J JOG ***
Z ZERO POSITION COUNT
X X-Y PLOT FROM MEMORY
Alt-Q TO QUIT PROGRAM

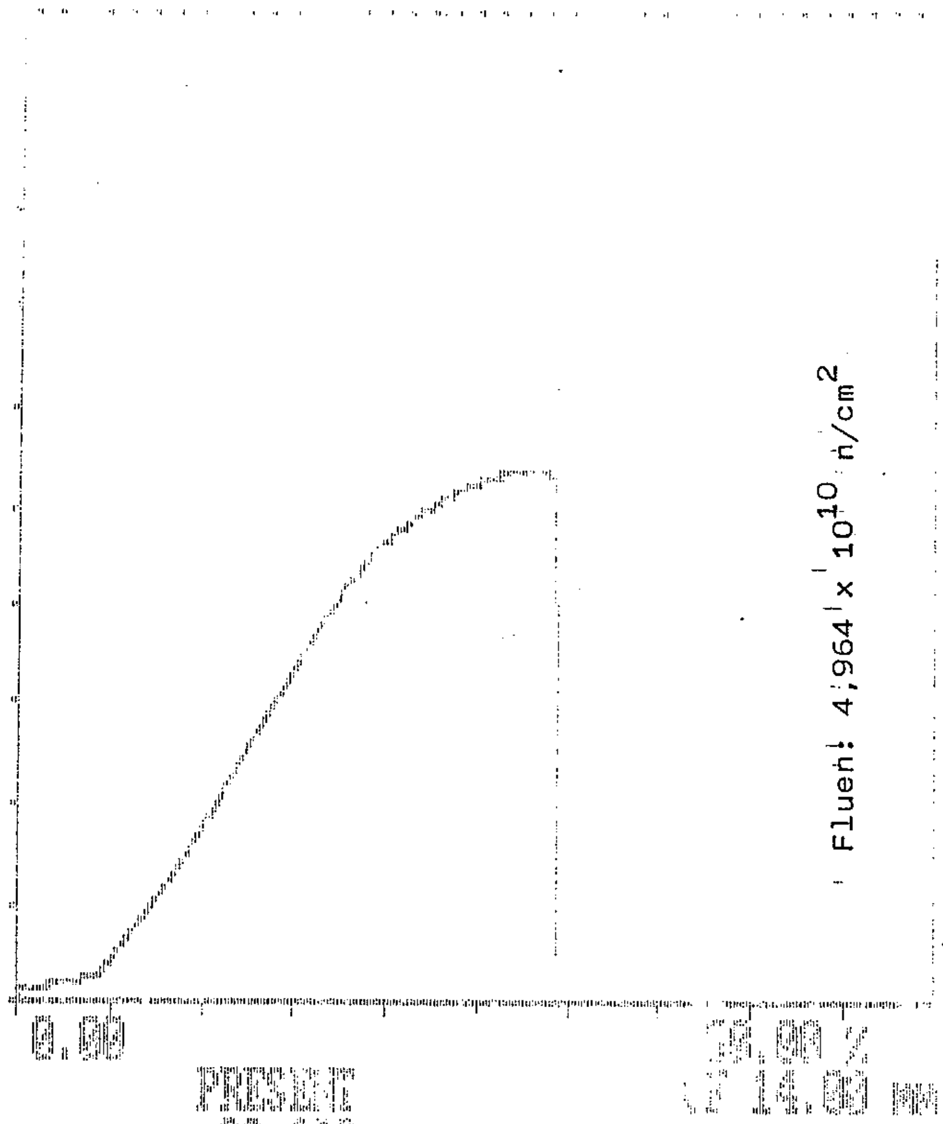


POSITION 4.1472

	@ PEAK	@ BREAK	PRESENT
EXTENSION	28.280	29.469	29.623
LOAD	52.685	51.988	-1.298

F3	LENGTH UNITS	mm	
F4	FORCE UNITS	Kg	
F5	AREA COMP	ON	0.000
F6	CYCLING	OFF	
F7	TEST SPEED	2.540 mm/MIN	
F8	RETURN SPEED	100.000 mm/MIN	
F9	PRELOAD	0.200 Kg	
F10	SETUP SCALES	CAP = 13608 Kg	
P	PRELOAD	***	
T	TEST	*	
S	STOP	*	
C	CONTINUE	*** STOP	
R	RETURN	*	
J	JOG	***	
Z	ZERO POSITION COUNT		
X	X-Y PLOT FROM MEMORY		

Alt-Q TO QUIT PROGRAM



POSITION	4.1135		
	@ PEAK	@ BREAK	PRESENT
EXTENSION	28.012	29.255	29.392
LOAD	53.740	52.507	2.877

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F1  DIRECTION   TENSION              100.0
F2  AUTOMATIC         STOP               Kg
F3  LINEAR UNITS      mm                PER
F4  FORCE UNITS       Kg              SQ mm
F5  AREA COMP         ON     8.000
F6  CYCLING           OFF
F7  TEST SPEED          2.540 mm/MIN
F8  RETURN SPEED  100.000 mm/MIN
F9  PRELOAD             0.200 Kg
F10 SETUP SCALES      CAP = 13608 Kg
 P  PRELOAD   ***
 T  TEST        *
 S  STOP        *
 C  CONTINUE    *** STOP
 R  RETURN      *
 J  JOG       ***
 Z  ZERO POSITION COUNT
 X  X-Y PLOT FROM MEMORY
Alt-Q TO QUIT PROGRAM                  0.00
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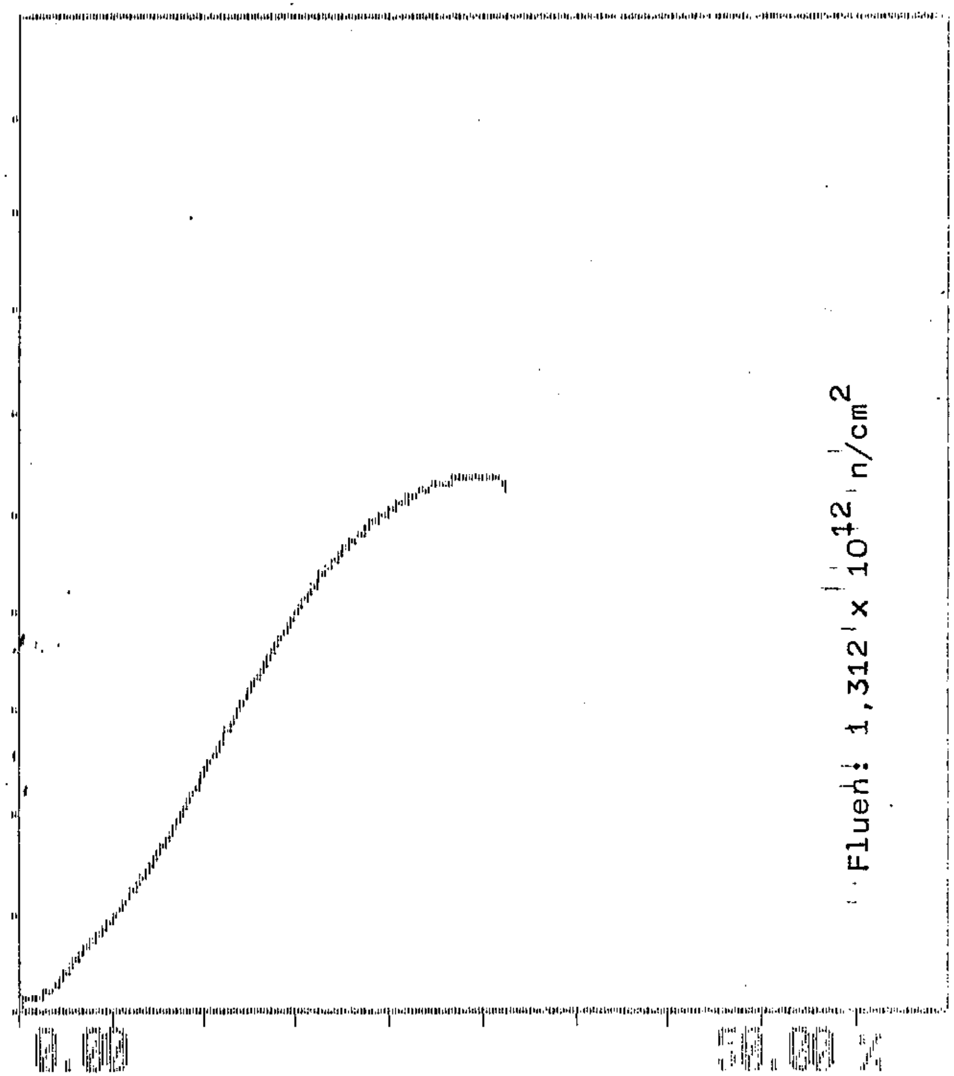
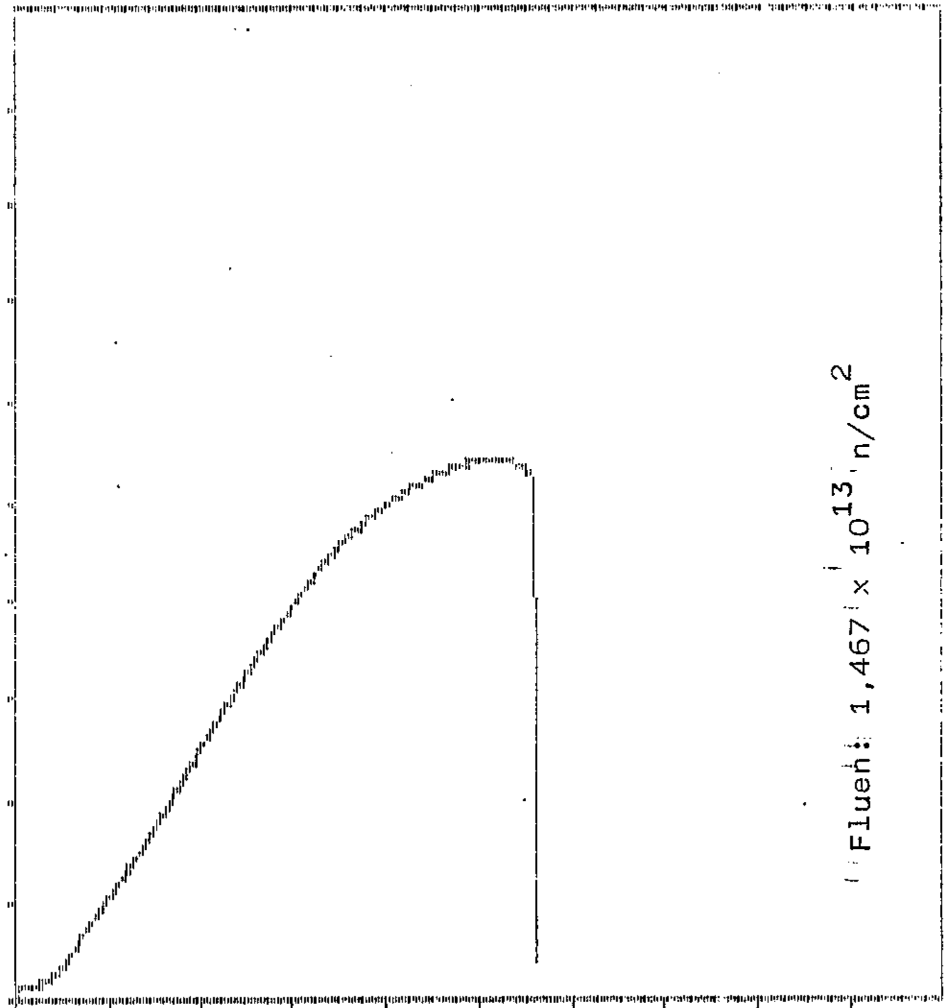


POSITION 3.6944

	@ PEAK	@ BREAK	PRESENT
EXTENSION	24.901	28.216	28.384
LOAD	53.773	52.345	-1.298

F1 DIRECTION TENSION
F2 AUTOMATIC STOP
F3 LINEAR UNITS mm
F4 FORCE UNITS Kg
F5 AREA COMP ON 0.000
F6 CYCLING OFF
F7 TEST SPEED 2.540 mm/MIN
F8 RETURN SPEED 100.000 mm/MIN
F9 PRELOAD 0.200 Kg
F10 SETUP SCALES CAP = 1360.0 Kg
P PRELOAD ***
T TEST *
S STOP *
C CONTINUE *** STOP
R RETURN *
J JOG ***
Z ZERO POSITION COUNT
X X-Y PLOT FROM MEMORY
Alt-Q TO QUIT PROGRAM



POSITION 3.9179

	@ PEAK	@ BREAK	PRESENT
EXTENSION	25.786	27.922	27.985
LOAD	54.246	52.170	-1.246

LAMPIRAN C

CONTOH PERHITUNGAN FLUEN NEUTRON

$$F = \phi \times t_{ir}$$

dengan,

$$\phi = \frac{C \times BA \times \ln 2}{m \times N_A \times a \times \sigma \times Y \times \varepsilon \times T_{1/2} \left(1 - 0.5^{t_r / T_{1/2}}\right) 0.5^{t_d / T_{1/2}} \left(1 - 0.5^{t_c / T_{1/2}}\right)}$$

$$= \frac{2524 \times 27 \times 0.693}{1.0029 \times (6.02 \times 10^{23}) \times 1 \times (1.16 \times 10^{-25}) \times 1 \times (3.41 \times 10^{-3})} \times \frac{1}{(1 - 0.5^{7200/54072}) \times 0.5^{330/54072} \times (1 - 0.5^{300/54072})}$$

$= 1.116 \times 10^{6}$ neutron/cm^2.dt

$$S_\phi = \sqrt{\left(\frac{\partial \phi}{\partial c} S_c\right)^2 + \left(\frac{\partial \phi}{\partial \sigma} S_\sigma\right)^2}$$

$$\frac{\partial \phi}{\partial C} = \frac{BA \times \ln 2}{m \times N_A \times a \times \sigma \times Y \times \varepsilon \times T_{1/2} \left(1 - 0.5^{t_r / T_{1/2}}\right) 0.5^{t_d / T_{1/2}} \left(1 - 0.5^{t_c / T_{1/2}}\right)}$$

$$= \frac{27 \times 0.693}{1.0029 \times (6.02 \times 10^{23}) \times 1 \times (1.16 \times 10^{-25}) \times 1 \times (3.41 \times 10^{-3})} \times \frac{1}{(1 - 0.5^{7200/54072}) \times 0.5^{330/54072} \times (1 - 0.5^{300/54072})}$$

$$= 442.155$$

$$S_C = \sqrt{C}$$
$$= \sqrt{2524}$$
$$= 50.239$$

$$\frac{\partial \phi}{\partial \sigma} = -\frac{C \times BA \times \ln 2}{m \times N_A \times a \times \sigma^2 \times Y \times \varepsilon \times T_{1/2} \left(1 - 0.5^{t_r/T_{1/2}}\right) 0.5^{t_d/T_{1/2}} \left(1 - 0.5^{t_c/T_{1/2}}\right)}$$

$$= -\frac{2524 \times 27 \times 0.693}{1.0029 \times (6.02 \times 10^{23}) \times 1 \times (1.16 \times 10^{-25})^2 \times 1 \times (3.41 \times 10^{-3})} \times \frac{1}{(1 - 0.5^{7200/54072}) \times 0.5^{330/54072} \times (1 - 0.5^{300/54072})}$$

$$= -9.621 \times 10^{30}$$

$$S_\sigma = 3 \times 10^{-27} \text{ cm}^2$$

$$S_\phi = \sqrt{(442.155 \times 50.239)^2 + (-9.621 \times 10^{30} \times 3 \times 10^{-27})}$$
$$= 0.036 \times 10^6 \ neutron/cm^2$$

$$F = \phi \times t_{ir}$$

$$= (1.116 \times 10^{6}) \text{ neutron/cm}^2\text{.dt} \times 7200 \text{ dt}$$

$$= 8.035 \times 10^{9} \text{ neutron/cm}^2$$

$$S_F = \sqrt{(\frac{\partial F}{\partial \phi} S_\phi)^2 + (\frac{\partial F}{\partial_{t_{ir}}} S_{t_{ir}})^2}$$

$$\frac{\partial F}{\partial \phi} = t_{ir}$$

$$\frac{\partial F}{\partial t_{ir}} = \phi$$

$$S_F = ((7200 \times 0{,}036 \,.\, 10^{6})^2 + (1{,}116 \,.\, 10^{6} \times 0{,}05)^2)^{1/2}$$

$$= 0.259 \times 10^{9} \text{ neutron/cm}^2$$

$$F = (8.035 \pm 0.259)\ 10^{9} \text{ neutron/cm}^2$$