BOOK27R

Notes:
"Auto Radiography/Arrays 8-unit/U-cylinders UO2 1970→73/D.W.M." taped to spine

Blank pages: inside front cover sheets and opposite page 1, 4, 6, 8, 12, 14, 18, 20, 24, 26, 28, 30, 36, 38, 40, 48, 50-57, 62, 64-66, 72, 76, 78, 80, 82, 84, 88, 89, 94, 96, 100, 102, 106, 107, 110, 114, 120, 126, 130, 136, 142, 154, 170-173, 176, 178, 182, 198, 233, 234, 277, 284, 295-304, inside back covers.

-pages 59, 134, 135, 138, 140, 146, 148, 155, 166, 175, 180, 184, 186, 188, 190, 192, 200 has 1 graph sheet glued to each page

-pages 144, 150, 158, 160, 162, 164, 196 has 2 graph sheets glued to each page

-pages 152 & 194 have 3 graphs glued to each page

-pages 238, 243, 246, 253, 272, 274, 286, 287, 289 have 1 graph taped to each page

-pages 224, 226, 241, 250, 258, 266, 269, 270, 283, 288, 291 have 2 graphs taped to each page

-pages 245, 264, 280, 293 have 3 graphs taped to each page

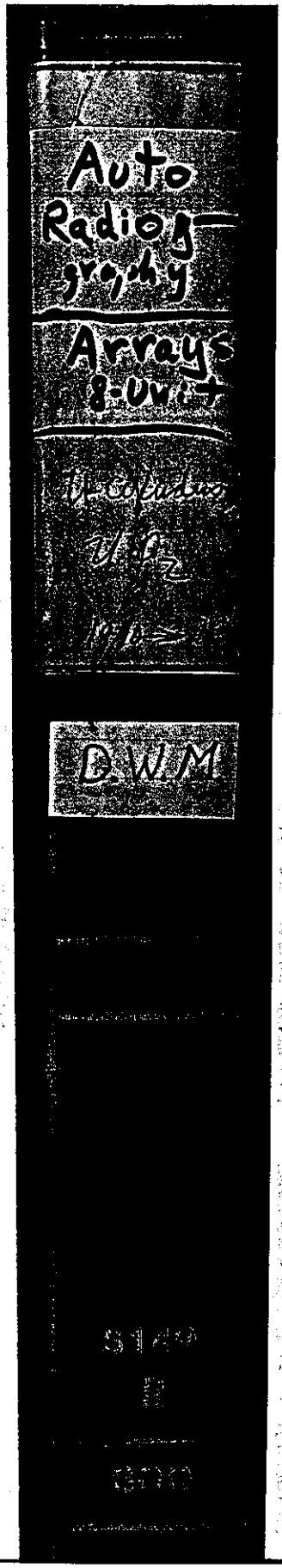
-page 72 has 8.5x11 sheet taped to it
-page 92 has picture taped to it
-page 104 has index card & small sheet taped to it
-page 108 has small sheet taped to it
-page 120 has index card taped to it
-page 123 has 8.5x17 sheet taped to it
-page 124 has yellow sheet glued to it
-page 125 has green sheet glued to it
-page 127 has 8.5x11 glued to it
-page 128 has 8.5x11 gray sheet glued to it
-page 129 has 2 (8.5x11) and 2 (8.5x17) sheets clipped to it
-page 132 has sheet glued to it
-page 202 has sheet taped to it
-page 203 has 2 small sheets taped to it
-page 204 has huge graph sheet taped to it - had to untape to copy
-page 204 also has 8.5x11 sheet taped to it
-page 205 has 8.5x17 taped to it
-page 206 has 8.5x11 glued to it
-page 207 has sheet taped to it
-page 208 has sheet taped to it
-page 209 has sheet taped to it

Page 2 of **BOOK27R** notes

-page 211 has one sheet glued and one sheet taped to it
-page 212 has 8.5x17 glued to it
-page 213 has 8.5x11 taped to it
-pages 214, 215, 216 have 1 (8.5x11) taped (original glued) on each page
-page 222 has 8.5x17 glued to it
-page 228 has 1 sheet glued to it

Scanned by:
Sheila Finch
RSICC /Oak Ridge National Lab.
August 5, 1999

Spine →



SHAW'S

PIONEERS SINCE 1831

Account Book

No. S 149

NO UNITS

Journal . . . . . .

Ledger, Single Entry . .

Ledger, Double Entry .

Record Ruled (27 Lines)

Made in 150, and 300 Pages

MADE IN U. S. A.

TO REORDER, SPECIFY NUMBER, RULING AND THICKNESS INDICATED ON BACKBONE OF THIS BOOK.

Experiments and Assemblies under
EXP. PLAN S-6
A NEUTRON IRRADIATION
FACILITY 1

A previous 8 unit array, assembled by JTT, is to be reassembled with one reflector face replaced by a 24 in long graphite reflector.

Uranium pieces to be used in assembly

	5 kg	10 kg
#1	2470	2190
2	2469 (5217)	2196
3	2457	2158
4	2473 (5210)	2189
5	2290 (5213)	2195
6	2455	2152
7	2464	2205
8	2289 (5221)	2193

Repl

Clock (Operating Time) 4691

Hammer P.S on PM-1 Repaired Prior to Exp. 1

Instrument Check on Mar 4 Source # 20 (55 mc)

PM-1		Low Trip	OK	~~Alarm~~ Hi Trip	OK
PM-2				Alarm Trip	
IC-1	3×10^{-11}	Meter Trip	OK	Fast Trip	~~Not working~~
IC-2	3×10^{-1}	Meter Trip	OK	Bldg A	OK
IC-3	$\sim 4 \times 10^{-10}$ A	Calibration	OK DWM	B	OK
IC-4	Out for Repair	Calibration		C	OK
CRM		Meter Trip			

IC-1 meter shows slow recovery after putting source on ion chamber - Fast trip not working
Only Bulb in Fast Trip Ckt. not working
Switched bulbs — bulb not burned out

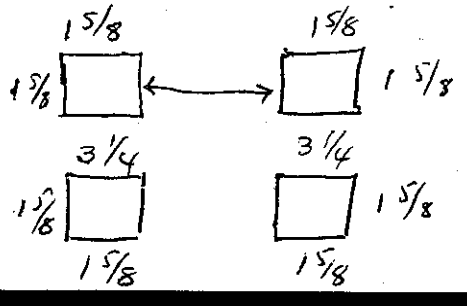
Instrument Check on Mar 4 Source #20 ~~DWM~~

PM-1		Low Trip		~~Alarm~~ Trip	
PM-2				Alarm Trip	
IC-1		Meter Trip		Fast Trip	OK Scram Table
IC-2		Meter Trip			Console Light (Red) On DWM
IC-3		Calibration			Just Bypass CC
IC-4		Calibration	(5/8 x 6")		Source in DWM
CRM		Meter Trip			Response OK

Replaced Keithley Meter →

Exp # I

Initial alignment with 2 units on movable Table, 2 units on fixed table
Spacing above Table 1 7/8". No Multiplication



separation A
at closure
measured to be

EXP. #2

Eight units. Vertical separation 3 1/4"
No TOP REFLECTOR
Red Light and Personnel check OK — Drawer CC
Exh. Fan On
Inst Bypass off.

Sub Critical	IC - 1	$0.01 \times 3 \times 10^{-14}$	
	2	$0.02 \times 3 \times 10^{-11}$	
	3	5.5×10^{-13}	Max when partly closed

Fully closed shields chamber
$\sim 3.5 \times 10^{-3}$

EXP #3

ADD TOP REFLECTOR, Check Alignment
Top Reflector is 2 1/16 above Units.

$k > 1$ 9.2 Rev supercritical Table gap ≈
9.4 Rev subcritical
9.3 Rev = 0.57 in. separation

EXP. #4 (adj Limit a source)

Moved Reflector face on back of assembly (M.V. Table)
1", gap now 2 5/8".

2^{07} PM $k > 1$ 5.5 Rev
2^{10} PM ~~k>1~~ $k \approx 1$ 6.0 Rev → 0.33 0.24 in/in

Moved Reflector face to 4" gap
2^{39} $k \lesssim 1$ constant EXP # 5
- Period = − 9 div × 21.73 = −195.57 sec ≈ −8.4 ¢

#5

1. Moved Rear Face in 0.5 in, gap now 3.5".
2. Placed 0.9 in o.d Cu Foil #1, at position 10" on 0.050 x 3¾ x 24" Al sheet, placed Al in irradiation slot.

3 10 k > 1 Tables Closed + Period 61.93 sec 14.1 ¢

3 13 40 Start Timing Foil Exposure

3 33 40 Stop Exp. Shut down.

~ 2.6 Rev for k = 1 ~ .11 in gap.

Copper foil ~ 97000 cts in 10 MIN with ~ 1 hr decay for the 20 MIN irradiation

Under

0.5" displacement of Rear Face worth 14.1
8.4
22.5 ¢

Instrument Check on Mar 5th Source (55 mc) #20

PM-1 Contact Low Trip OK Hi Trip OK

~~PM-2~~ Alarm Trip

IC-1 3×10^{-11} Meter Trip 18" OK Fast Trip OK Scrammed Table no lite

IC-2 3×10^{-10} Meter Trip 12" Bldg A OK

IC-3 4.5×10^{-10} Calibration Dwn OK B OK

IC-4 Out for Repair Calibration C OK

CRM Meter Trip Bypass OK Source Dn OK

Red Light On OK. Dwn OK ec

Lite on Fast Trip for IC-1 does not come on!

EXP #6

Repeat #5 for check on reproducibility.

9^{05} Tables closed $k > 1$ + Period 63.0 sec → 1.4 ¢

EXP. #7

Add Outer Fuel Plate with foil 55 in place

Purpose: Measure excess reactivity with fuel plate,

if possible,

Measure power-level necessary to vomit foils

9^{33} Tables closed $K > 1$ + Period 12.4 ¢

$9^{37\frac{1}{2}}$ Start Irradiation Level 2.4" Rev → 0.10" gap

$10^{37\frac{1}{2}}$ Stop "

$\frac{12.4\ ¢}{.100} = \#1.24/\text{in.}$

Δ k for Outer Plate addition — 1.6 ¢ ??

10 DOWN

watch Time

10^{37} Shut Down — Cutie Pie End 3 R

10^{50} Start Film Exposure — M — Mid 1 R

#17 — #16 — End ~ 0.5 R

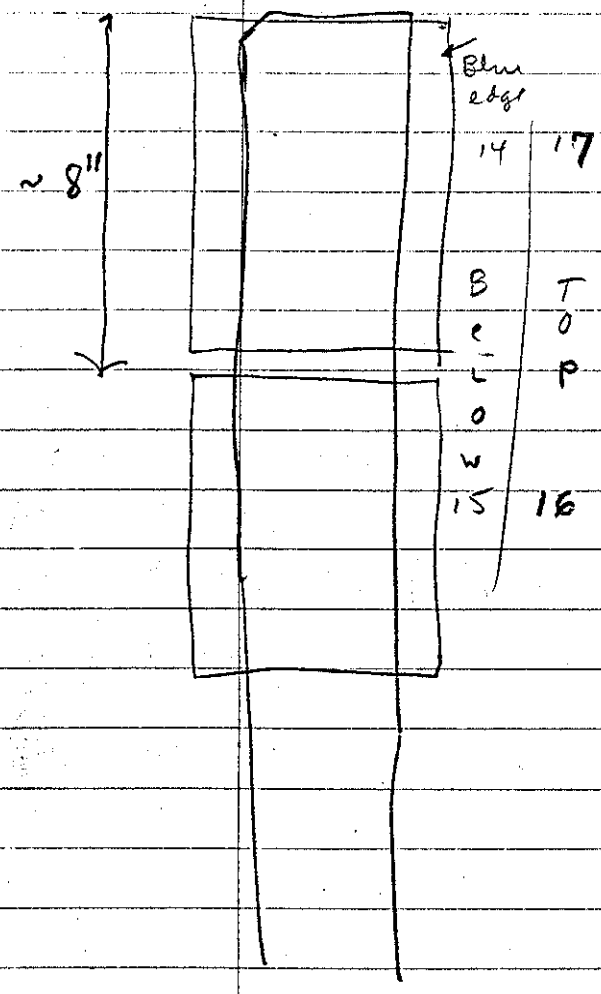
notch on top

#14 — #15

11^{40} Stop Film Exposure

Irradiation Time

Log N @ 10 for 1hr

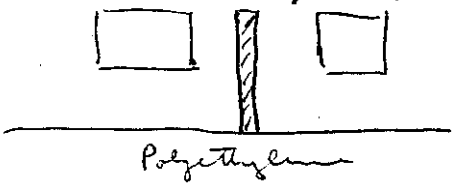


Film shows flux gradient to be too small also poor counting between films

Exp. #8

Place 1" x 2 7/8" x 6" Plastic on Fixed half setting vertically against graphite on bottom of reflector centered between units.

Small control rod design information



245 K>1 + Period 42.8 sec → 18.2 ¢

Permit Instr Scram on power rise
IC-2 range 3×10^{-10} not changed.

Plastic worth 18.2
14.0
4.2 Cents

Instrument Check on Mar 6, 70 Source 55 mc ^{60}Co

PM-1		Low Trip	4" OK Scram Hi Trip	Contact OK	
PM-2			~~Alarm Trip~~		
IC-1		Meter Trip	OK	Fast Trip	OK
IC-2		Meter Trip	OK		
IC-3	5×10^{-10}	Calibration	OK Dw	Bldg A	OK
IC-4	Out for repair	Calibration		B	OK
CRM		Meter Trip		C	OK

Keithley μμa replaced. DWM, CC.

Exp #9

Removed CH_2 reflector on rear of graphite to increase neutron leakage and gradient in the irradiation facility.

Added 1" x 3" plastic control rod shim in top reflector. Mechanical operation checked several times.

Measure Reactivity change for changing reflector face.

Check out control rod.

10^6 k < 1 Source Out, Subcritical

Control Rod at Max React.

- Period → -9.6 div/sec → -208.5 → -7.75 ¢

Vertical Gap behind units was measured to be 3 7/16" instead of 3 1/2". Changed to 2 3/4" to add reactivity

EXP # 10

Add reactivity by moving reflector face to 2¾" from 3¼"

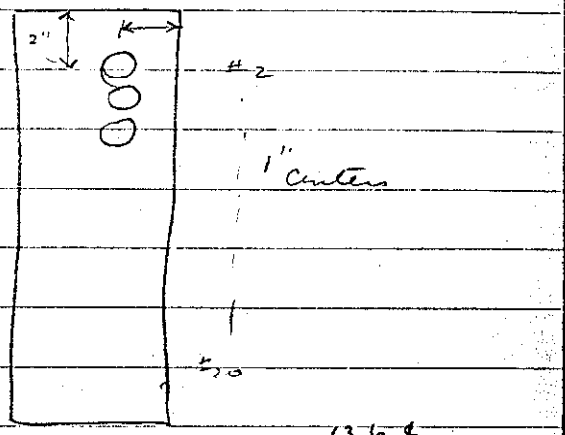
Insert Alum plate with 19 Cu Foils on 1" centers - Foil center 1¾" from edge

k > 1 1.1 Rev = .030 in.

4½ Control fully Inserted

+ Period 65.2 sec

+13.6 cents



1:40:30 Start Timing Foil Exps.

at Log N = 0.36+ Log N = 1

IC-2 @ .3.1k3X10^{-9} Level

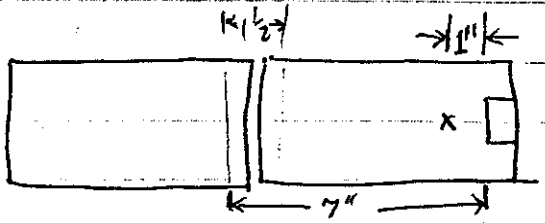
3.3 Rev 0.155" Control fully Inserted

$\frac{13.6\ ¢}{0.125\ in}$ = 1.09 ¢/in

1:41 Shut Down

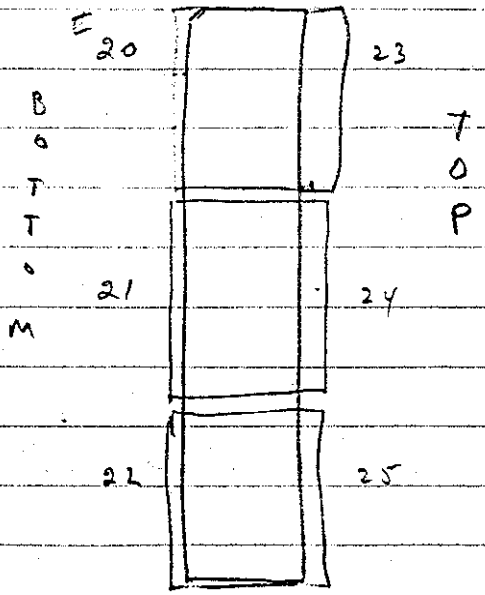
March 9

Expose Films #18, #19 with source. #18 28 mc ^{60}Co



Start exposure 9:54:45
Stop " 11:44:45 > 110 Minutes.

Type AA
5x7
Film



Start film Exp 2 39
End film Exp 4 39

Instrument Check on Mar 9 Source #20 55 mc / Co^{60}

PM-1 _____ Low Trip ✓ 2" ~~Hi~~ Trip ✓ Contact

~~PM-2~~ _____ Alarm Trip _____

IC-1 3×10^{-11} 15" Meter Trip ✓ Fast Trip ✓ 15"

IC-2 3×10^{-11} 14" Meter Trip ✓ Scrammed fast Bldg A OC

IC-3 ~~_____~~ Calibration OK " B OK

IC-4 ~~Control~~ Calibration Out for Repair " C OC

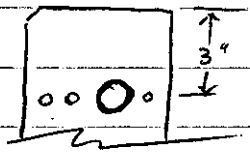
CRM _____ Meter Trip _____

✓ Bypass
✓ Insert Source
✓ Personnel Check
✓ 9 Red Lts
✓ Exh. Fan
✓ Chain

Dw M CC

Experiment #11

Taped Copper foil #21 to Outer fuel plate at 1" position (3" from end)



Moved Reflector face from 2¾" to 3" to reduce reactivity of assembly ~ 10 ¢.

Purpose: Irradiate plate so that film can be exposed

$k < 1$ Subcritical

- 9.5 div, -206.3 sec, — 7.8¢

Found assembly was not spaced properly

set vertical gap at plane of separation @ 3 1/4 in (was 3¾ - 3½)

set vertical gaps between refl & 4 units on movable tray to 3", side gaps @ 1 5/8. Gap between units = 3 1/4

Exp. #12 Mar 9, 1970

Plate Irradiation prior to Film Exposure

1 Hr at Log N = 1.0.

Source Out on period – Rev 3.5 → Control many Outs

1[10] pm Inst scram on IC-2 during range change output bypass switch was depressed but we still got a scram!

Output Bypass push button checked and it seems to short meter output OK!

Exp #13

Decrease reactivity by moving CO_2 reflector face gap at rear 3.0 to → 3 1/4+ in.

Shim Out

1[18] Pos Period Table Rev 1.6 → .055 in. separation
1.775 div/sec → ± 38.6 sec → 19.4 ¢

1[24] Start timing Irradiation for the Level at 3.8 Rev → .185 in separation
19.4/.135 = ¢1.44 / in.

2[24] Stop. See p 17 for film exposure

Instrument Check on Mar 10, 70 Source 55 mc Co^{60} #20

~~FM-1~~	~~Low Trip~~ OK	Hi ~~Alarm~~ Trip	OK
~~FM-2~~		~~Alarm Trip~~	
IC-1 3×10^{-11}	Meter Trip OK	Fast Trip	Screened Table No Lite on Panel to indicate Trip
IC-2 3×10^{-11}	Meter Trip OK	Bldg A	OK
IC-3 3×10^{-10}	Calibration Dwn	B	OK
IC-4 Out for Repair	Calibration	C	OK
~~CRM~~	~~Meter~~	Fan	✓
		Red Lite	✓
		Personnel	✓
		Source	✓
		Bypass	✓

(Relay to be replaced on order from stores)

Exp # 14

Moved Reflector face back ~1/8 & 3/16" ~(3 3/8 to 3 7/16)"

Straightened Reflected edges at (interface) plane of separation

Control Inserted.

Purpose: To irradiate Outer plate with 5A - 5S foils inserted for power distribution (relative Copper Foil #22 for normalization at 3" between 5A and 8A foils.

10^{54} k > 1 + Period 1.7 Rev 1.5 div/decade → +33.7 sec +21.1 ¢

$10^{55}\ 05$ Start timing Irradiation

Log N = 0.1 or 1×10^{-10} IC-2 ; $.355 \times 3 \times 10^{-10}$

av Read 1.15×10^{-10} to $.365 \times 3 \times 10^{-10}$

$11^{55}\ 05$ Stop Irradiation

Table @ 3.8 Rev

Control partially withdrawn approx 2".

Mar 10 Relay replaced by E.R.R.

Plate 0-1519-1 with 4A -4S foils
and 5A ~~—~~ from 0-1519-19 in 5J portion
for normalizer.

#23 Copper at 3" from edge

Exp #15

Instrument Check on Mar 11 Source 55 mc Co #20

PM-1	Low Trip OK	Hi Trip OK	
PM-2		Alarm Trip	
IC-1	Meter Trip OK	Fast Trip Scram Table Lite OK	
IC-2	Meter Trip OK		
IC-3	3×10^{-10} Calibration OK	A OK	
IC-4	Out for Repair	B OK	
CRM	Meter Trip	C OK	

Red Lite & Personnel ✓

Bypass Set ✓ Purpose: Power Dist Meas in 4A-4S Row of Foils

Fan On ✓

Source In ✓

9 4/59 k > 1 + Period 2.2 Rev

Shim Inserted Max React

9 4/58 Start timing Irradiation.

10 4/58 Stop Irradiation. IC-2 = 3.5 x 3×10^{-10}

10 48 Shut Down

---

3 15 PM Occasionally, Table Low pressure in Accumulator has scrammed table, fortunately not during operations. Checked mercoid setting and it trips slightly below 60 PSIG on the small gauge on the Table. Pressure is normally set at 80 PSIG, high pressure Air Supply varies between 80 - 100. Trip is not understood.

(It is not certain that Low pressure air scrams table -- there is no indication that there is any other mechanism.)

Instrument Check on Mar 12 Source 55 mc ^{60}Co #20

PM-1	Low Trip OK	Hi Alarm Trip Scram Table OK	
~~PM-2~~		Alarm Trip	
IC-1 3x10-11	Meter Trip OK	Fast Trip OK	
IC-2 3x10-11	Meter Trip OK		
IC-3 3x10-10	Calibration OK	Bldg A	OK
IC-4 Out for Repair	Calibration	" B	OK
~~CRM~~	~~Meter Trip~~	" C	OK

Dw M & CC

Source Response OK
Personnel Ck OK
Rod Lite OK
Bypass OK

Exp. #16

Purpose: Power Dist in Row 7 foils in Outer Plate D-15194 8A – 8S, Normalizer is 5B from plate 01519-19 in position 5J. Copper foil #24 3" from end between 5A and 8A.

8 40 15 k>1 positive period start Timing Irradiation
2.8 Rev Shim In
Level .35 - .36 x 3x10-10 I C-2
(0.1) ~1x10-10 I C-3
3.7 Rev Shim ~ Completely Inserted

9 40 15 Shutdown 1hr Irradiation

Instrument Check on Mar 13 Source 55 mc ^{60}Co #20

PM-1		Low Trip	OK	Hi Trip	OK
PM-2				Alarm Trip	
IC-1	3×10^{-11}	Meter Trip	OK	Fast Trip	OK
IC-2	3×10^{-11}	Meter Trip	Scram Table OK		
IC-3	4×10^{-10}	Calibration	Dwn	Bldg A	OK
IC-4	3×10^{-10}	Calibration	Dwn	" B	OK
CRM		Meter Trip		" C	OK

IC-4 has high leakage current of 6×10^{-12}

IC-3 is normal ~ $1-2 \times 10^{-13}$

Bypass Dwn

Source Dwn

Rel Ex & Personnel CC

Fan DWM.

EXP #17

Purpose: Irradiate Inner Plate with 7B to 7R foils and measure fission rel. Dist (7A #75 will be used later for normalizing in Subset J.

Cu foil #25 (0.4445 g)

k > 1 + Period

8 58 1/2 Start Irradiation of Inner Plate I-IC-2 .35 x 3 x 10^{-10} log N ≈ 0.1

9 58 1/2 End 1 Hr Irradiation 1×10^{-10}

Note: Irradiation for 4A-45 foils should be ca 0.2

Instrument Check on Mar 16, 70 Source 55 m-c ^{60}Co #20

PM-1 _____ Low Trip OK Hi Trip Scram Table OK

~~PM-2~~ _____ ~~Alarm Trip~~

IC-1 3×10^{-11} Meter Trip OK Fast Trip OK

IC-2 3×10^{-11} Meter Trip OK Stg A OK

IC-3 Response OK Calibration OK " B OK

IC-4 No Response Calibration OK 3×10^{-10} " C OK

Bkg ~ 2×10^{-11} ~~ARM~~ ~~Meter Trip~~

Source OK

Bypass OK

Exh Fan OK

Personnel Ck OK

Data FCC

Experiment # 18

Outer Plate Irradiation 4A – 4S, Norm 75 ± 75 Mile.

Copper foil No #26 @ 3".

Tables Closed ok >1 + Period $\frac{6}{3} = 2.0 \frac{div}{sec} \rightarrow 43.4 = +18¢$

$\frac{18}{1.5} = 1.2 \#/in$

9 55 15 Start timing 1 hr Irradiation

IC-3 log N ~0.2 IC-2 = .74 $\times 3 \times 10^{-10}$

Table Sep = 2.8 Rev = 0.15 in.

10 55 15 Stop Irradiation.

N.B. IC-4 Chamber removed from Paraffin Housing to change its sensitivity so that IC-3 & 4 pens are displayed on chart.

Instrument Check on Mar 17 Source 55 mc ^{60}Co #20

PM-1 _____ Low Trip _____ ~~Alarm~~ Hi Trip _____

PM-2 _____ ~~Alarm Trip~~ _____

IC-1 _____ Meter Trip Scram Table OK Fast Trip OK

IC-2 _____ Meter Trip OK Bldg A

IC-3 Response OK Calibration by Dr Bldg B

IC-4 2.6×10^{-10} Calibration Dr Dr C

CRM _____ Meter Trip _____

Bldg
2×10^{-13}
1.5×10^{-13}

IC-1 Meter trip did not scram on 1st try -- Fast trip OK
tried again and it was OK,

ERR discovered bad contact on reset switch. Repeated operation seems to clear difficulty. Switch Replaced. Scram trip OK.

Source dr ✓
Exh. Fan ✓
Bypass ✓
Red Light & Pen. ✓

Exp. 19

Outer Plate Irradiation Foils 8A-8S, 7S in 7J for Normalizer. Copper Foil # 27 3" from end between 6 7 A and 8 A'.

k > 1 +Period

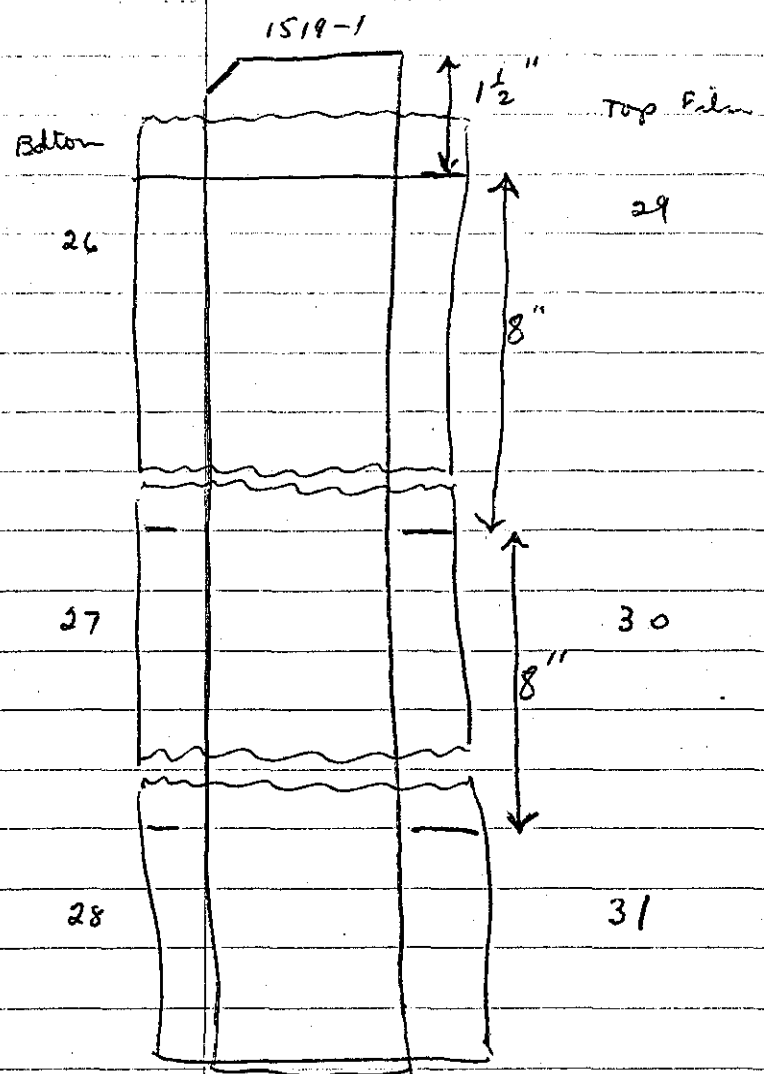
9^{21} Start Timing Irradiation

N.B. IC-3 log N output to Recorder intermittent.

10^{21} Shut down

ERR found loose Battery Term

Repaired!


1519-1
1½"
Top Film
Bottom
26
29
8"
27
30
8"
28
31

Instrument Check on Mar 18, 20 Source ^{60}Co - 55 mc #20

PM-1		Low Trip OC	Hi Alarm Trip	OC
PM-2			Alarm Trip	
IC-1	3×10^{-4}	Meter Trip OK	Rect Trip	Table Saran OC
Bldg IC-2	"	Meter Trip OC	Bldg A	OC
2×10^{-13} → IC-3	2×10^{-10}	Calibration OK	B	OC
1.5×10^{-12} → IC-4	7×10^{-10}	Calibration OK	C	OC
CRM		Meter Trip		

Bypass ✓
Source ✓
Rel Lt & Pers. Ch. ✓✓✓
Exh. Fan ✓

Dwn & CC

Exp #20

Irradiate Outer Plate 1519-1 with all foils. 4A - 4S, 5A - 5S, 8A - 8S

Cu #28 at 3" from end between 5A & 8A

8[49] k > 1 Table @ 1.0 Rev. +Period 2.025 div/sec

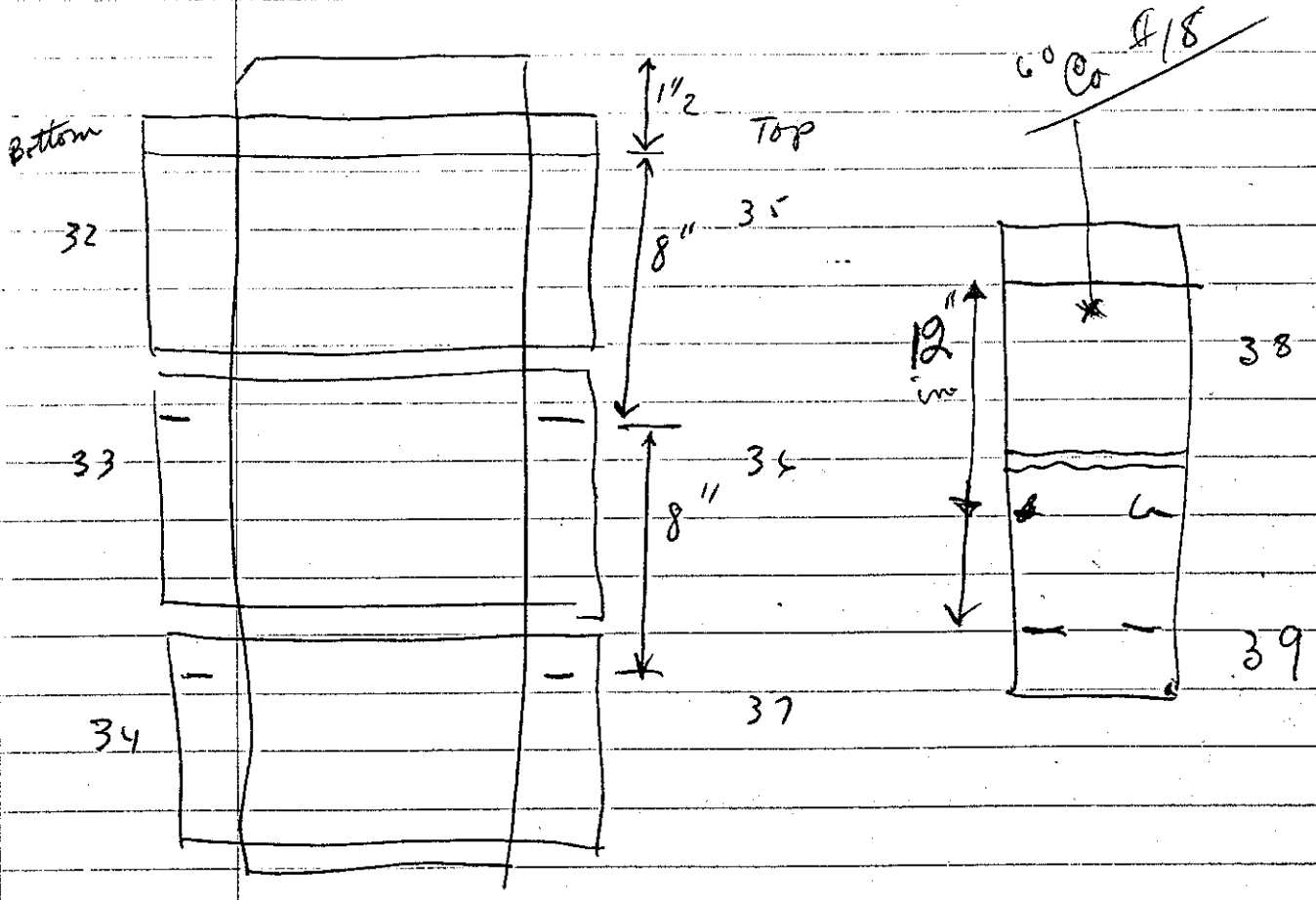
8[57] Start irradiation for 1 hr. log N ≈ 1.0 on 10^{-9}

Level @ 3.1 Rev plus Shim wanting/IC-2 $0.32^{+} \times 3 \times 10^{-9}$

9[57] Stop Irradiation

10[12] Start Film Exposure

12[12] Stop Film Exposure


Bottom
32
33
34
1½
Top
8"
35
8"
36
37
60° Co #18
12" in
38
39

Exp #21

Irradiation of Inner Fuel Plate for Film Exposure

Copper Foil #29 3 in from end.

Rad Lt. Pwr. Ok ✓
Bypass –
Source ✓
Exh Fan ✓

1⁰³ K>1 Table closed 0.0 Rev. 2.3 div ?
+ Period (lost reactivity, perhaps a bit of Xe Building

1⁰⁵ Start timing foil exposure @ ln N = 0.37
Level log N = 1.0
IC-2 = 0.32 × 3 × 10⁻⁹.

2⁰⁵ PM Stop Irradiation of Inner Plate.

2²⁰ PM Start Film Exposure.

4²⁰ PM Stop " " .

2³⁶ Start Irradiation of films 38 & 39
with ⁶⁰Co Source.

4³⁶ Stop Irradiation of film 38 & 39

New Irradiation Facility

Effectively inserted 2" plexiglass between Argus and thermal column and widen 1/8" slot to 7" so that both inner & outer fuel plate can be irradiated simultaneously.

Instrument Check on Mar 30, Source ~~The~~ 55 mm #20 ^{60}Co

PM-1		Low Trip	Scram Table	Hi ~~Alarm~~ Trip	OK
PM-2				~~Alarm Trip~~	
IC-1	3×10^{-11}	Meter Trip	OK	Fast Trip	OK
IC-2	3×10^{-11}	Meter Trip	OK	Bldg A	OK
IC-3	$\sim 2 \times 10^{-10}$	Calibration	Dwtn	B	OK
IC-4	$\sim 10^{-9}$	Calibration	Dwtn	C	OK
CRM		Meter Trip			

Source Response OK

Personnel Check & Rel Lite OK

Bypass OK

Exh Fan OK

Exp. 22

Purpose: To Establish criticality for new irradiation facility - with 2" plexiglass isolation before thermal column. Movable table unchanged. (should be out-sit.)

Placed Cu foil #2 @ 3" from end

#3 @ 12" " "

#4 @ 21" " "

10^{44} K < 1 Tables Closed IC-3 4×10^{-12}

Negative period less than 80 sec! & 8.5×10^{-12}

No meaning for react. measurement.

IC-1 $.05 \times 3 \times 10^{-11}$

IC-2 $.125 \times 3 \times 10^{-11}$

Exp* 23

Set spacing between units and rear reflector face from 3 3/8 - 3 7/16 to 2 1/2" to increase reactivity

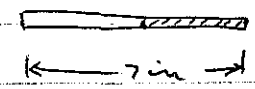
Bypass of Source ~~of~~

Cu Foils still in place at

#2 3 in.

#3 12 in.

#4 21 in.
at plate holder at extreme rh. of slot



11^14 K>1 Positive Period (need a bit more react, ~5¢)
85.2 sec → 11.2 ¢

~~11^20~~

11^19 Start Timing Irradiation k=1 2.2 Rev → .09 in.

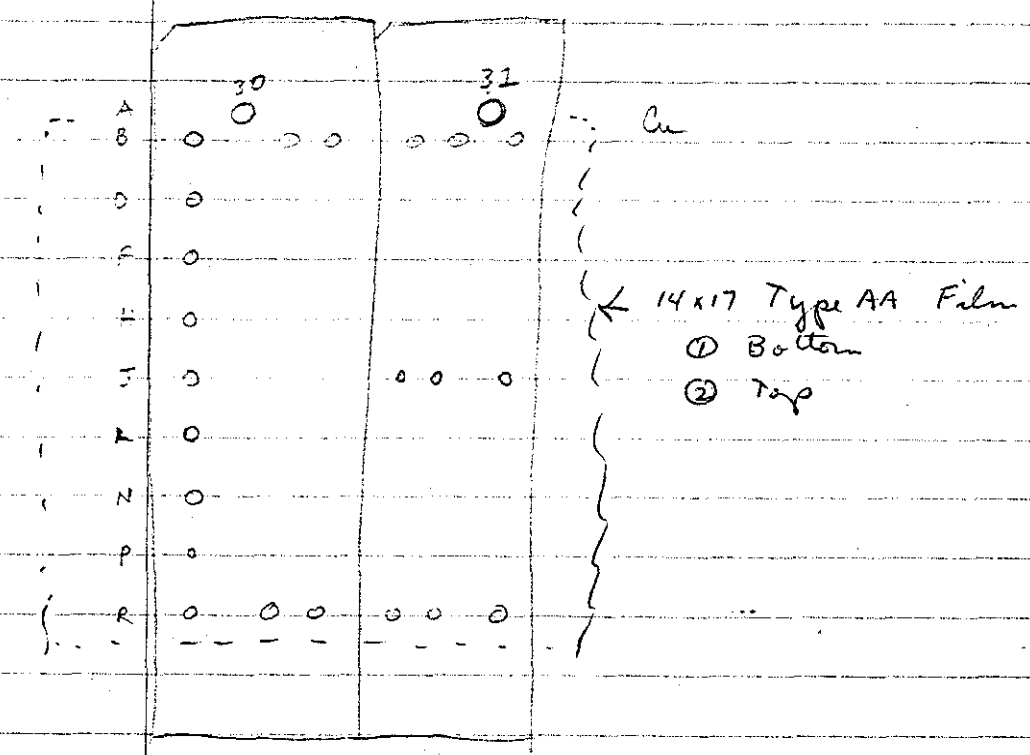
11^49 Stop " " $\frac{11.2}{.09}$ = 1.24 ¢/in.

(with Manual Scram)

Screw Tubes 6'58" 2.2 → 64.0° 61.8 Rev

Apr 2 Added a small piece of plastic ~ as big as control to Fixed Tube for added reactivity of ~.5¢

Dwm


INNER
30
31
A
B
D
F
H
J
L
N
P
R
Cu
14x17 Type AA Film
① Bottom
② Top
27
Foils
27
Foils
Left
Right

Instrument Check on April 3 Source #20 55mc ^{60}Co

PM-1		Low Trip	Hi ~~Alarm~~ Trip	Scram Table OK
PM-2			Alarm Trip	
IC-1	3×10^{-11}	Meter Trip OK	Fast Trip	OK
IC-2	3×10^{-11}	Meter Trip	Adj #	OK
IC-3	3.5×10^{-11}	Calibration OK	B	OK
IC-4	1×10^{-9} C	Calibration OK	C	OK
CRM		Meter Trip		

Red Lite & Personnel ✓
Scrams Bypass ✓
Exh Fan ✓
Source Inserted ✓

Exp π 2 ✓

Purpose: To Irradiate Inner I-692-1 and Outer 0-1519-19 Fuel Plates Simultaneously prior to Exposing Film and Counting foils

8[20] K > 1 Positive period Table Rev ~ 3.0

8[26] Start Timing Irradiation IC-2 ~ .1235X3X10^{-9}
IC-3 ~ .37 +

9[26] Stop Irradiation Level at 0.35/5 x 3 x 10^{-9}

9[41] Start Film Exposure

11[41] Stop Film Exposure

Foil Loading Same as for Exp #24

Back with I - 689 - 17

O - 1519 - 1

Cu #32

Cu #33

14 x 17 Film #3 & 4

Instrument Check on April 7, 70 Source 55 mc ^{60}Co # 20

PM-1		Low Trip	OK	Hi Alarm Trip	OK
PM-2				Alarm Trip	
IC-1		Meter Trip	Scrammed Tank	Fast Trip	OK
IC-2		Meter Trip	OK	Bldg A	OK
IC-3	$\sim 3 \times 10^{-10}$	Calibration	Auto	B	OK
IC-4	$\sim 1 \times 10^{-9}$	Calibration	Auto	C	OK
CRM		Meter Trip			

Source Response OK
Bypass set OK
Red Lite & Personnel Chek OK
Exh Fan OK

Exp # 25

Purpose Plate Irradiation, Film Exposure and Foil Counting

Same as #24

Remove plastic to reduce excess React

S Pos Period Rw = 1.5

8 40 35 Start timing Irradiation @ .135 x 3×10^{-9}

Level at ~ .36 x 3×10^{-9}

9 40 35 Stop Irradiation ~ .37

10 10 35 Start film Exposure

12 10 35 Stop " "

Foil loading for Exp #26 Use I-692-1
O-1519-19

Use slots B D F H J L N P R
with Foils A C E G I K M O Q. (These foils are unirradiated)
Use Cu #34 & 35 (each weigh 0.442 g)
Film #5 on Bottom Cu #36 Mid I-692-1 (.4425 g)
#6 on Top #37 Mid O-1519-19 (.4525 g)

Instrument Check on grid 9 Source 55 mc ^{60}Co #20

PM-1		Low Trip	OK	Alarm Trip	OK
PM-2				Alarm Trip	
IC-1		Meter Trip	OK	Fast Trip	Scram Table
IC-2		Meter Trip	OK	Bldg A	OK
IC-3	Response	Calibration	OK	B	"
IC-4	"	" Calibration	OK	C	"
CRM		Meter Trip			

Red Light Buzzer On continuously - ERR checked out found nothing wrong — operated it 10-20 Times OK.

Red Light & Pers. Ch. Appear ✓
Source In & Resp. ✓
Exh. Fan On ✓

Exp #26

Plate Irradiation I-692-1 & O-1519-19

8:56 k>1 Table ck 1.0 Rev.

8:58:30 (900 clock) Start Timing Irradiation IC-2 = .135 x3x10^{-9}

Level ah .36 - .37 x3x10^{-9}

9:58:30 Stop Irradiation

10:28:30 Start Film Exposure

12:28:30 Stop Film Exposure

Instrument Check on July 20 Source ^{60}Co

PM-1 Low Trip OK Alarm Trip OK

PM-2 Alarm Trip

IC-1 3×10^{-11} Meter Trip OK Fast Trip Scram Table

IC-2 3×10^{-4} Meter Trip OK Bldg A Trip OK

IC-3 Response OK Calibration DWM B "

IC-4 " " Calibration " C "

IRM Meter Trip

Purpose Check Chart Pos 3.

Ind. Lts Burned Out on Exh Fan — Press Diff OK

Corridor Buzzer & Personnel Check J.J.L.

Source Inserted & Det Response DWM

Bypasses Removed DWM

EXP 27

11[25] k > 1 table = 0.0 Shim Full In.

k ≈ 1.0 " 1.9 Shim out some

11[30] Shut down Scram Button.

EXP 26 Purpose Demonstrate

3[15] PM Red Lit & Pers Ch. OK Crit Exp to Schuet

Press. Diff OK Rooks

Source Insert OK Blakeney

Bypass Rem OK Shapiro

Trammell

Newton

3[30] PM k > 1 Table pos 0.0 Shim full Ins.

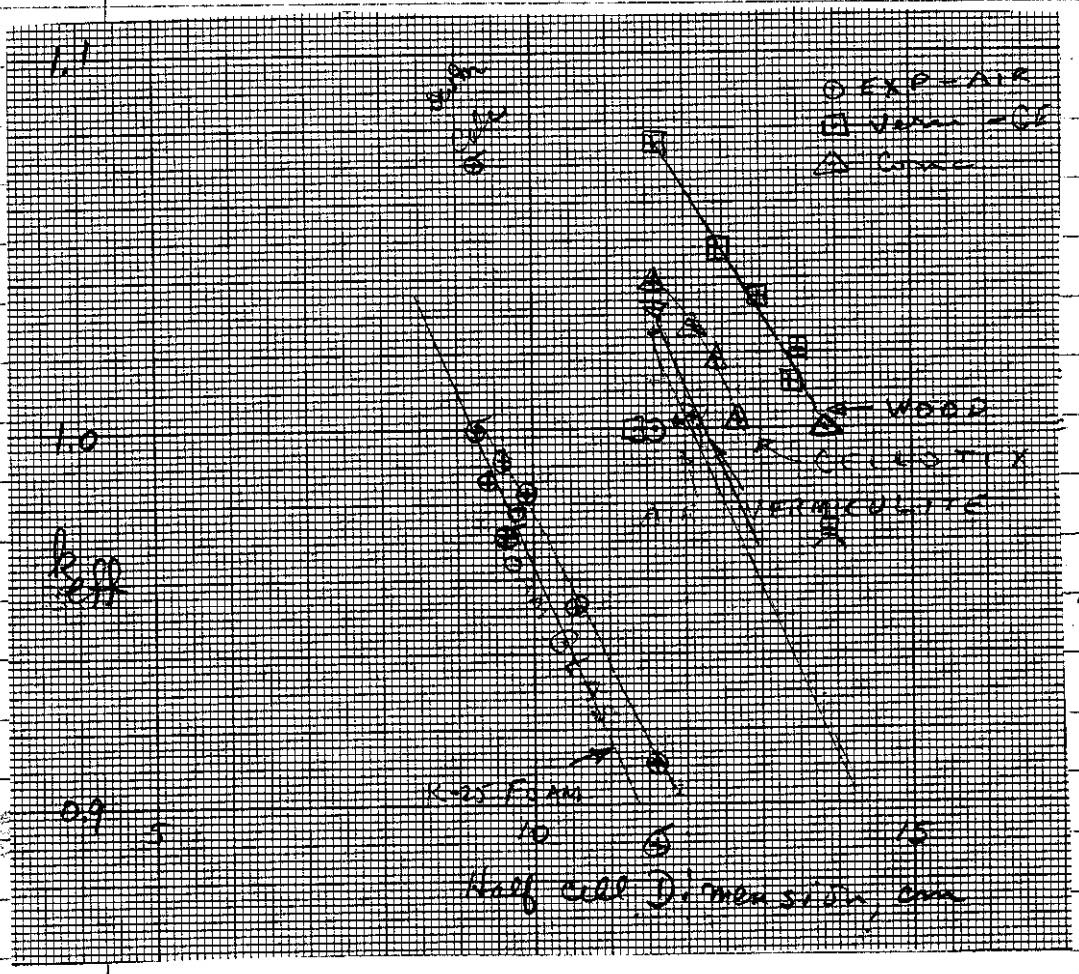
k ≈ 1.0 pos 3.1

T. Shapiro Scram Button

7.25
2.3
9.55
3.650
14.550
18.475

Calculations of ARRAYS having 20 kg units
separated by FOAMGLAS
AIR
VERMICULITE
CELLOTEX
WOOD

KENO Code
H-R X section
Reflector Spectral
ALBEDO
20K.



Original Volume of each wood Block 10,048.384 —

Total Weight 85,250

Wood Air Density 0.530 249 g/cm³

Crume 0.558

Average Cellotex Density $\frac{25660}{16 \times 7594.203}$ = 0.211 480

9.985
4.995

Crume → 0.281

K-25 FOAM PLASTIC $\frac{9.50}{17 \times 2642.935}$ = .201425

7.30
3.65

FOAM GLAS DENSITY

7.552 $\frac{7480}{17 \times 2966.55}$ = 0.148832

3.776

Measured by Crume

Reg No 432 747 g = 0.151

EXPERIMENTAL ARRAYS – 8 units WITH WOOD, CELLOTEX, FOAM GLASS AND K-25 BORATED FOAM

Wood total wt 16 Boxes 85.25 Kg ea 5.328
Cellotex " wt 16 Boxes 25.60 Kg ea 1.60
K-25 Plastic Foam " wt 17 Boxes 9.275 Kg ea .546
K-25 Borated foamglas " wt 17 Boxes 7.675 ea .451

Aug 26, 1971

Assembly without ^{235}U mockup built with wood and polyethylene making a reflected 22 in cube of wood.

Experiments 4 & 4 performed under Exp Plan S-5 for 8 unit arrays having slightly different moderators and interspersed materials simulating conditions of transport, using 20 kg units

Very similar to S-6 and S-7

The following metal cylinders U/235 were moved from storage vault Rm # 105 to Rm # 113 Aug. 20, 1971 C.C.

Units for Moderator Experiments

Unit No	Piece No	Mass	total Mass
1	2204 ✓	10.480	
	2176 ✓	10.480	20.960
2	2189 ✓	10.486	20.966
	2205 ✓	10.486	20.972
3	2168 ✓	10.490	
	2193 ✓	10.473	20.963
4	2195 ✓	10.483	
	2196 ✓	10.479	20.962
5	2170 ✓	10.491	
	2152 ✓	10.469	20.960
6	2156 ✓	10.498	
	2200 ✓	10.461	20.959
7	2162 ✓	10.519	
	2190 ✓	10.443	20.962
8	2172 ✓	10.506	
	2197 ✓	10.455	20.961

Returned to Vault (105) 9-14-71 C.C.

Instrument Check on Aug 26 Source 10 mc ^{60}

Bal. 4.65

PM-1 _____ Low Trip Scram Table OK Alarm Trip OK

PM-2 _____ _____ Alarm Trip _____

IC-1 10×10^{-10} Meter Trip OK Fast Trip OK

IC-2 _____ Meter Trip OK

IC-3 3×10^{-10} Calibration DWO A OK

IC-4 2×10^{-9} Calibration DWO B OK

CRM _____ Meter Trip _____ C OK

Red Light OK

Δρ OK

Removed one wood block (½ unit) for source to penetrate into cavity. Reflected Wood assembly, reduced thickness to 4 in. on side area of 6×12" to improve instrument response to source insertion, IC-1 on 3×10^{-11} scale .01 → .04+ when source inserted IC-3 changes slightly but log N instability masks the definite response.

Placed unit #1 on fixed table lower east

Placed " #2 on mov. Table lower east

EXP. #1

Use start-up scales of 10×10^{-11} on IC-1 and IC-2.

IC-1 = 0.07 × 10 × 10^{-11}

IC-2 = 0.01 × 10 × 10^{-11} Bkg

IC-3 = ~ 10^{-13} "

IC-4 = ~ 2×10^{-13} "

Withdraw Source to Reflector IC-1 → .03

to "Pig" IC-1 → .01

Scanned Tables — no disruption of Assembly. Operation observed to be normal

Work analysis Req 702143 Lt. Plywood

.045 wt% Cl

47.28 w/o O_2

Dens. 0.526 g/cm³

6.47 % H

5.29 % H_2O wt loss @ 110° >36.84

31.55 % H_2O wt loss @ 258°

48.19 % C

Mg	33.7 ppm	Si	135. ppm
Mn	11.8	Ti	6.7
Na	7675	Zn	2.0
Ca	202.4	P	< 3.4 / 245
Fe	40.5		387.1 ppm
K	269.9		= .14 wt%
Li	6.7		

EXP # 2

Increase to 4 units in plane. IC-1 → ~0.05 withdrawn

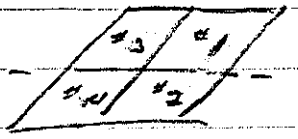
Insert prior assembly Tables

IC-1 → 0.10 x 10 x 10^{-11} Max 0.16

-2 → .01 Bkg

-3 → 1.2×10^{-13} Bkg Max 3×10^{-13} during closure

-4 ~ 2×10^{-13} Bkg



Withdraw Source to Top reflector

IC-1 → 0.045

Separate Tables

EXP #3

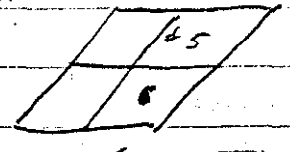
Increase to 6 units, add 2 above #1 & #2, Insert Source

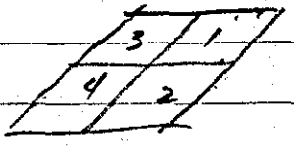
Close Tables. IC-1 0.14 x 10 x 10^{-4} Max 0.22 x 10 x 10^{-4}

2 ~.01 10×10^{-4}

3 ~ 2×10^{-13}

4 ~ 4.5×10^{-13}





Withdraw Source to

Top reflector IC-1 → .07

11:00 AM Separate Tables

Wood Analysis from JTT

S = 0.526

48.19 w/o C

6.47 w/o H

47.28 w/o O

101.94

+ .045 wt/o Cl

+ 0.139 wt/% Impr.

102.12

Req No. 702144 for EXT. Plywood, 6-21-69

6-26-69 .051 % Cl

0.501 g/cm³

Mg 40.2 ppm

Mn 16.8

Al 13.4

Ca 335.3

Fe 33.5

Na > 675.

K 268.2

Li 10.1

Ba 5.03

Si 33.5

Zn 2.

Ni 0.2

Co < .67

W < .34

6.08% H_2O loss @ 110°C

32.78 % H_2O loss @ 250°C

6.59 % H

48.24 % C

EXP. #4

Increase to 8 units

Insert Source in Reflector only, Response

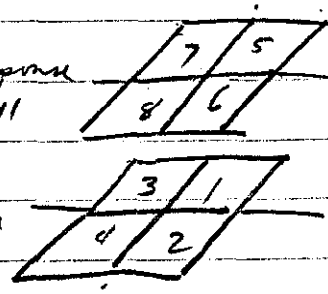
12 45 PM on IC-1, to $0.02 \times 10 \times 10^{-11}$

IC-1 = .22

-2 = $\frac{.22}{10 \times 10^{-4}}$

-3 = 3×10^{-13}

-4 = 1×10^{-12}



Approx Multiplication = $\frac{22}{2} = 11$

Using Large Source M- , and

Source Jerk Method Sub-Crit React. estimated

to be #4 Log N with Source 0022 = #4

Log N without Source 0055

extrapolating back on 80 sec period

to T=0

Measured Assembly size 55.5 (13.9) x 55.3 (high) cm

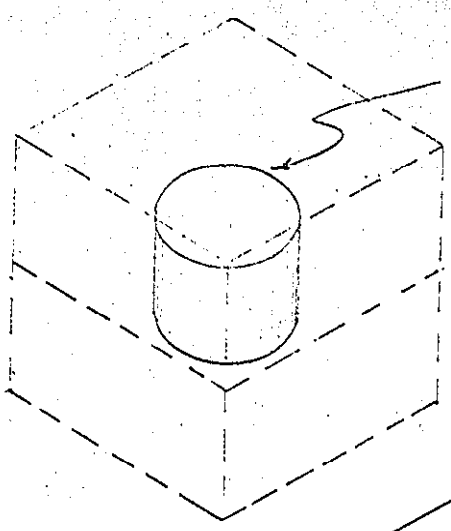
Assume 55.5 x 55.5 x 55.3 cm when bolted

Perhaps Reflector Cavity is 55.7 x 55.7 x 55.3 cm

Wood blocks are $10\frac{7}{8} \times 10\frac{7}{8} \times 5\frac{7}{16}$ in (measured) Design 10.900 x 5.450.

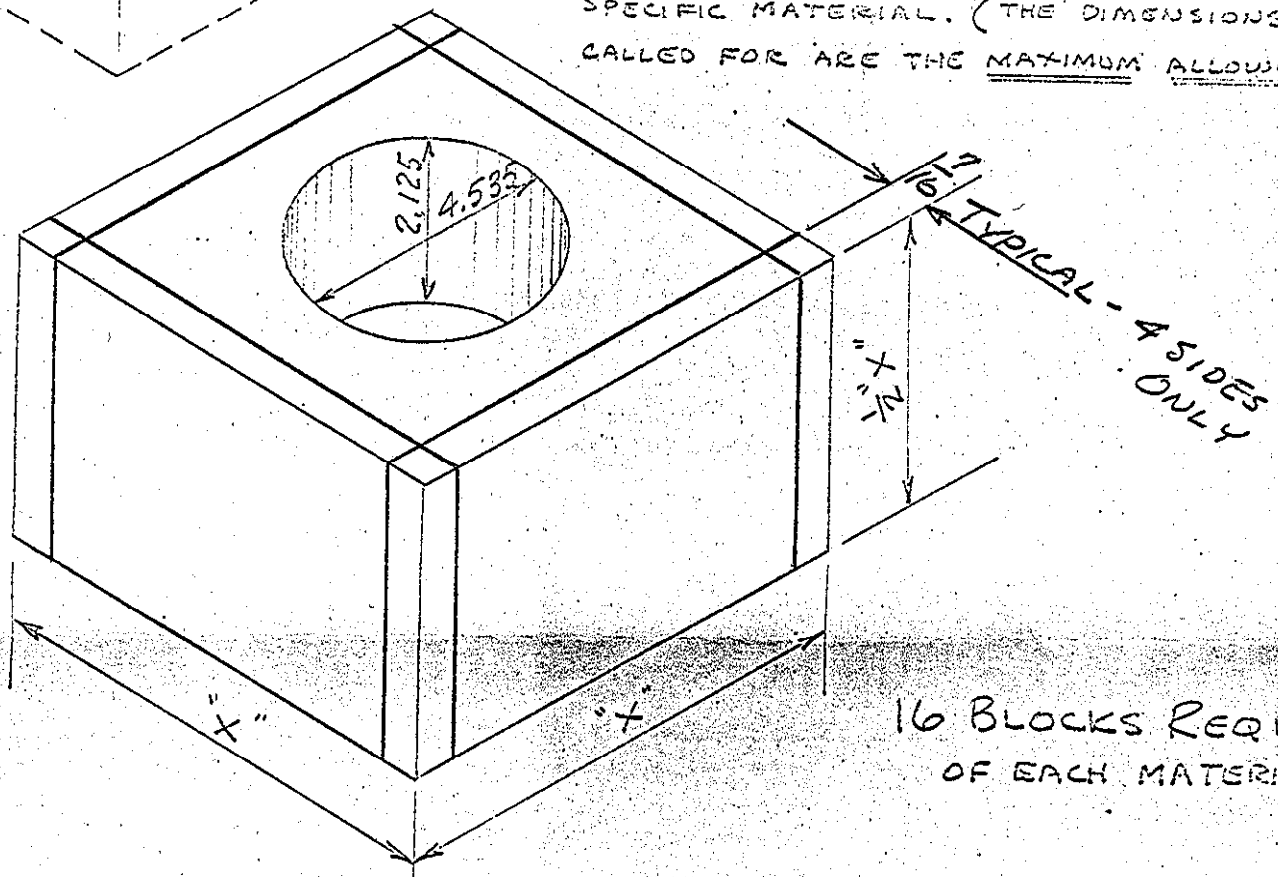
Because there are nails in the surfaces, machine

only sides to 10.0 x 10.0 x $5\frac{7}{16}$ in.



NOTES: A. - FABRICATE SO THAT BLOCKS WILL FORM A CUBE WITH STRAIGHT SIDES (WITH NO DRAFT) WHEN ASSEMBLED.

B. - DIMENSIONS SHOWN ARE AS CALCULATED. TOLERANCES ARE TO BE AS SMALL AS PRACTICAL WITH THE SPECIFIC MATERIAL. (THE DIMENSIONS CALLED FOR ARE THE MAXIMUM ALLOWED)



16 BLOCKS REQD OF EACH MATERIAL

MATERIALS:

~~FORMGLAS - "X" = 7.562~~

~~CELOTEX - "X" = 9.985~~

PLYWOOD - "X" = 10.900

NOTE: SURFACE (TOP) IS COVERED WITH TAPE DUE TO SLIGHT CONTAMINATION - DO NOT REMOVE TAPE

WASH HANDS AFTER HANDLING.

W.O. # S-544

9213
SHIPPING CONTAINER
MATERIALS STUDY

TUNNELL 7/11/69

Instrument Check on Sept 27 71 Source 10 mc ^{60}Co

PM-1		Low Trip	OK	Alarm Trip	Scram Table
PM-2				Alarm Trip	
IC-1	10×10^{-11} 6"	Meter Trip	OK	Fast Trip	
IC-2	3×10^{-11} 12"	Meter Trip	OK		
IC-3	2×10^{-9}	Calibration	Dec 70	A	OK
IC-4	1×10^{-9}	Calibration	Dec 70	B	OK
ARM		Meter Trip		C	OK

EXPERIMENT #5

WOOD BLOCKS REDUCED TO

$10\frac{11}{16} \times 10\frac{11}{16} \times 5\frac{7}{16}$ in.

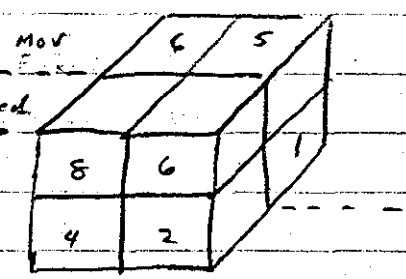
Rm Temp = 17.5°C at Work Table
Resp. on IC-2, 3.

9:55 Source Inserted, Bypass Cut, Reset,
$\Delta p = 1.5$ in H_2O, Red Light Personnel.

10:10 Source Out Super Critical
+Period @ 12.6 → 0.92 in Sqrn.
nLevel @ 13.2 → 0.97 in Sqrn

$\frac{9.30}{.05} = 186$ ¢/in.

~ 10^{20} Shut down

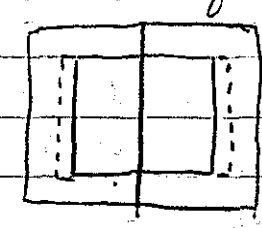


5 div/decade = $\frac{21.2}{5}$

10 8.6

→ +9.3 ¢

Add ½ void at reflector edge on rear face and front face



Measurements at Face	Moved	Fixed	Ave
Width	51.2	51.1	51.2
	51.3	51.1	
	51.4	51.2	
Height	55.3	55.3	
	"	"	55.3
	"	"	

Wood Ass
51.2 × 51.2 × 55.3

With Void
51.2 × 53.7 × 55.3

Reflector w. irregularities 51.4 × 53.9 × 55.3

Box weights after sizing/drainage and after drilling holes in Foam Glas, K-25 foam & Celotex

Wood

16 ea 4 ea 18.20
18.10
17.475
18.10
71.875 kg Wood

K-25 Foam + Fibreglass (Fibre foam)

17 ea 9.05 kg

Celotex

16 ea 25.75 kg less tape weight
.09
25.66

FOAM GLAS

17 ea 7.48 kg

8/16/85 Wood 25.6 x 25.6 x 27.64 = 18114.15
DWM x 8 = 144 913.20
— 9005.51

71875 g / 135907.69 = 0.52885

Exp #6

Supercritical

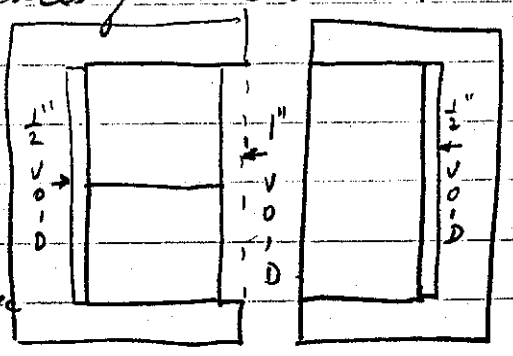
11 +Period at 11.1 Rev → 0.77" Rev, 3.7 div/sec → 80.2 → 11.7¢

Level at 11.9 Rev → 0.85" "

$\frac{11.7}{.07} = 167¢/in.$

Exp #7

Added 1" gap between faces of Tables on Mov. Table



11^{20} AM Start assembly

Source, Rel light, Scram, ΔP OK

11^{34} AM Supercritical (Sourcount) Rev = 0.0

Positive Period $\frac{6.5 \text{ div}}{\text{Decade}}$ = 141 sec

= 7.5¢

Allow power to Rise and IC-2 Mscale to shut down on 10×10^{-10} scale.

.075
.007
.00525

$k_{eff} = 1.0005$ $T = 17.5°C$

Average Unit size = 25.6 x 25.6 x 13.82 cm

with void in x dir 26.9 x 25.9 x 13.82

Units in X 2

Y 2

Z 2

Core Boundary ~~53.8~~ 56.25 x 51.2 x 55.3

Void/Cubical Void ± 26.9 ± 25.6 ± 27.65

± 27.0 ± 25.7 ± 27.65

20cm $(CH_2)_n$ Reflector ± 47.0 ± 45.7 ± 47.65

Wood weight =

EXP #8

Collotex Boxes + 8 units in prime arrangement

Boxes 10 in⁻ x 10 in.⁻ x 5⁻ Total height ~19¾⁻

2:00 PM Red Light & Buss, Δp. Source Inserted, Bypass, Reset OK

2:00 Source In Subcritical IC-1 .02 x 10 x 10⁻¹¹

2 .25 10 x 10⁻¹¹

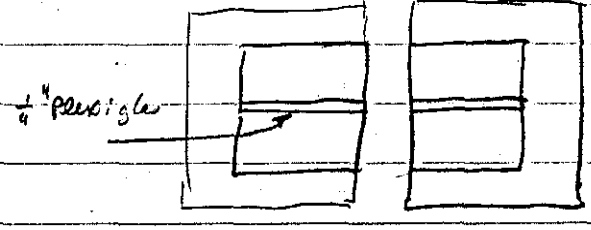
3 2.6 x 10⁻¹¹

4 3.4 x 10⁻¹²

Multiplication factor 25 on IC-3

EXP #8

Added ¼ layer Plexiglas 10 x 20 on each half between units



Source Inserted, Response, Red Lts, Δp=1.3", Bypass, reset OK

2:45 Start Assembly

3:00 Subcritical table together

IC-1 .02 x 10 x 10⁻⁴ T=18°C

2 .033 x 10 x 10⁻¹¹

7 x 10⁻¹³ 3 3.2 x 10⁻¹¹ M ≈ 50

4 3.8 x 10⁻¹².

EXP #9

Added Plexiglas baffles ½" horizontal + ½" Vertical between unit

North

7	3
5	1

interface

3:53 PM Start assembly

Source Inserted Response, Bypass, Reset

Δφ Pers Ch. Red Lite ON.

	1		
	2		
7.0×10^{-12}	3	1.8×10^{-11}	$M \approx 25$
	4	3.0×10^{-12}	

Instrument Check on Sept 3, 71 Source ^{60}Co 10 mc

Bal - 4.65 PM-1 _____ Low Trip OK Alarm Trip OK

PM-2 _____ Alarm Trip _____

IC-1 10×10^{-10} Meter Trip Scram Tables Fast Trip OK

IC-2 3×10^{-10} Meter Trip OK

IC-3 2×10^{-9} Calibration Scram A: OK

IC-4 1.3×10^{-9} Calibration Scram B: OK

CRM _____ Meter Trip _____ C: OK

EXP # 10

ADDED $\frac{1}{4}$" Plastic between units 3 DIMENSIONS

10^{30} Start Assembly, Personel check, Red Lite, Bypass, Reset, Δp OK

Source Inserted Response OK, $T = 21.5^\circ C$

10^{32} IC-2 from 0.0% to $0.1 \times 13 \times 10^{-11}$ 54 → 16 in. to full Span

3 1 to 3.2×10^{-12} " "

10^{40} ~ IC-2 .31 $\times$ 10×10^{-11} M = 25 Subcritical

IC-3 3.3 $\times 10^{-11}$ M = 30

gaps observed at interface - Separate Table.

Aligned assembly better

EXP # 11 Repeat 10

10^{45} Start Assembly. Source Inserted

55 Subcrit IC-2 $3.1 \times 13 \times 10^{-10}$

3 3.2×10^{-11}

Neg period w. source just of M-230 + 225

Mean — 56.2 sec neg period — not logical

CELLOTEX (CONT.)

Garrison trimmed ~0.25" off 4 boxes, bottom

Caliper measurement of box thickness 4.67 to 4.70

Av 4.685

Using 1/4 plates on each side 4.687

4.690

Stack Measurement

	North		South	
	Hor	Vert	Hor	Vert
	50.6	49.6	50.5	49.4
	.6	.5	.5	.5
	.6	.4	.5	.6

49.5
.65
50.15
4 = 12.54
.65
17.89 cm
Bottom Box (1/4)

Average 50.55 x 50.55 x 49.5 cm

12.64

EXP # 12

1400 Start Assembly, Red Lite + Pers, Bypass, Rest, ΔP, OK

1454 Subcritical Assembled T = 23.2 °C

IC-1

2

3 Q x 10^-10

4 Neg Period ~ 4.7 div/dec

Inserted M-227 Source For Neg Period

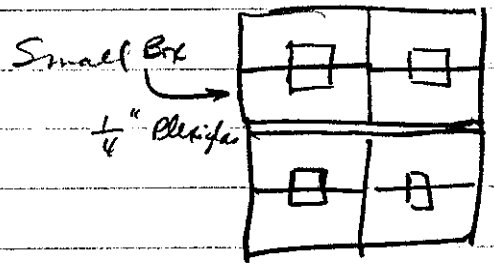
4.35 div/dec 94.5 sec ~ -30 ¢

II Inserted M-227 - M1165 For Neg Period

- 4.30 div/dec - 93.5 sec ~ -30 ¢

CELLOTEX (CONT.)

Reassembled with 1/4" plexiglass between units, Vert Dimension



Dr Magnuson

System Description

	Box 1		Bottom Row	
	±X	+Y	+Z	-Z
	±12.64	±12.64	+12.54	-12.54
	Box 2		Top Row	
2.54 · 4 = 10.16				
Cellotex	±12.64	±12.64	+12.54	-10.89
Plexiglas	±12.64	±12.64	+12.54	-12.54

System Remeasured.

N face Vertical

50.1 50.1 50.0 Includes ¼" Plexiglas at vert midplane

Horz. 50.6 50.7 50.5

S Face

V 49.9 50.0 50.0 Includes ¼" Plexiglas at vert mid. plane

Horz 50.5 50.5 50.6

Cellotex Weight 25.4 kg w. 4 trimmed Boxes as used

¼ Plexiglas Measurements

Average of 12 min. 257. mils. = 0.65 cm

$\frac{50.6}{4} = 12.65$

8/16/85 DWM

Unit vol $= \pi 5.76^2 \times 10.80 = 1125.689 \quad \times 8 = 9005.512$

Cellotex $= 25.30 \times 25.3 \times \left(\begin{matrix}25.08\\24.43\end{matrix} \div 2 = 24.755\right) \times 8 = 126763.42$

$= 25400 g / 117757.9$

$\rho = 0.2157$

Instrument Check on Sept 7, 71 Source 10 mc ^{60}Co

PM-1 Low Trip OK Alarm Trip OK
PM-2 Alarm Trip
IC-1 10×10^{-10} Meter Trip OK Fast Trip Scram Table
IC-2 $\div 3 \times 10^{-10}$ Meter Trip OK Monitor
IC-3 2×10^{-11} Calibration drum A = OK
IC-4 2×10^{-11} Calibration drum B = OK
CRM Meter Trip C = OK

Source Inserted - Inst Response OK

Exp. # 13 Cellotex with 1/4" Plexiglas

See p. 85 for description of assembly

Reflector - Personnel Check OK, Bypass set, Reset, $\Delta P = 1.6$" H_2O

Inst to starting scales.

8^{33} Start Assembly @ 8^{10} T = 26.2 Cnt. 85
8^{15} Cnt → 75
~ 8^{45} Tables Closed 8^{30} T = 24.2, Cnt. → 80
IC - 2 $.28 \times 10^{-10}$
IC - 3 3.9×10^{-10} / 2.7×10^{-11}
8^{56} Withdraw Source
- Neg Period 10.4 div/sec → -226. → 6.9 ¢

.07
.007
.0005

$k_{eff} = 0.9995$

T = 25.5°C

$\frac{1}{.8} = 1.25$

$\frac{1}{1.9}$ .52

$\frac{1}{3.6}$ .28

K-25 FOAM EXPERIMENTS

with Smit Assy, Weight of 17 Bores after enlarging holes 9.05 kg.

Exp #14 Sept 7, 1971

10^{41} Start Assembly, Source Inserted, Resp. OK, UP, Pres Ch Bypass, Inst Ranges, Reset OK

10^{5} Assembly Completed

IC-1 Bkg

IC-2 .26 v 3×10^{-11}

IC-3 $8. \times 10^{-12}$

IC-4 $\sim 1.5 \times 10^{-12}$

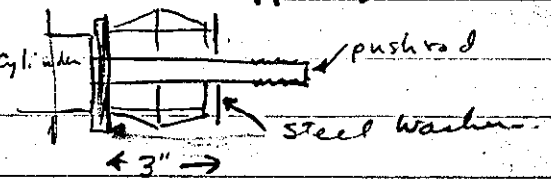
cc RICE Rush

Observed Trim Delay on Normal Reverse before Tables separated longer than believed to be normal.

Found Carter wheel hubs rubbing on Iron Plates!

Moved Iron Plate

Found Rubber Bumpers on push rod to be cut – and damaged – replaced with stoppers. Added steel washers



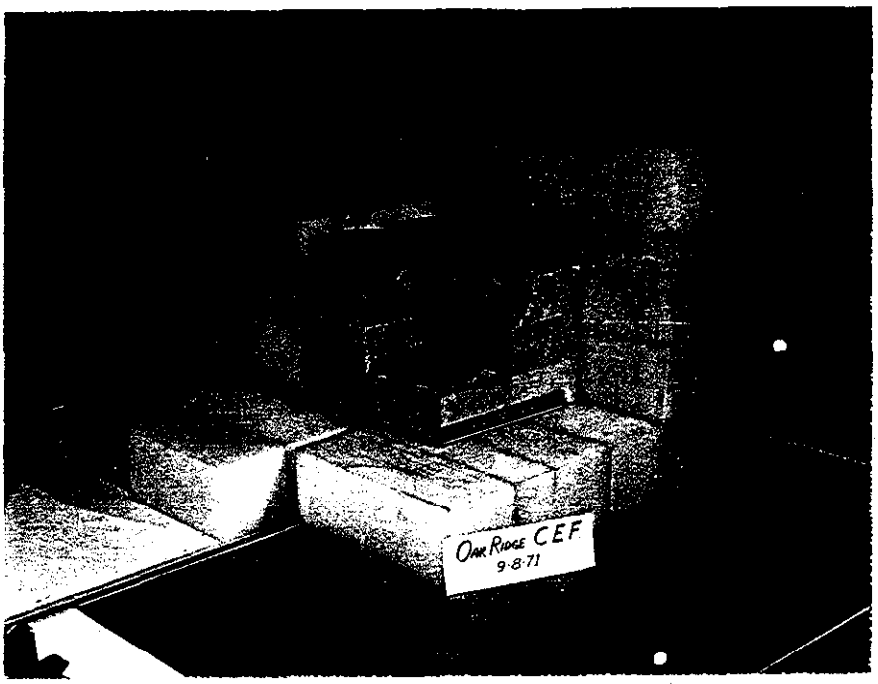
Diameter of Rubber bumpers decreased to 2.54 in, to clear back bar.

Low Pressure increased from 25 PSIG to 30 PSIG

53" → 23" in 41 sec | 0.74 in/sec or 4.44 in/min

" in 41 sec

DWR



K-25 FOAMPLASTIC - 7 UNITS OF 2x2x2 Array
Partial Reflector of Polyethylene
Shown with Tables Separated ~1 inch

4 units "K-25 foam" were machined on bottom only. Removed 1/2" of material. Original cube size for Two units ~ 7 1/4 x 7 1/4 x 7 1/4.

8 unit array was Approximately 15 9/16" cube.

Instrument Check on 9-8-71 Source 10 mc ^{60}Co

PM-1	—	Low Trip	OK	Alarm Trip OK
PM-2				Alarm Trip —
IC-1		Meter Trip	OK	Fast Trip OK
IC-2		Meter Trip	Bias	
IC-3	3×10^{-9}	Calibration	Dwm	A OK
IC-4	2×10^{-9}	Calibration	Dwm	B OK
CRM		Meter Trip		C

EXP #15

10^{00} AM Start assembly Source Inserted Response OK Bias OK Bypass, Reset, Op, - OK

10^{20}

IC-1

-2

-3 1.9×10^{-11} / In^2

-4 $.46 \times 3 \times 10^{-11}$

Shut Down

CC, RKR, DWM

Removed 0.300 in. from the above 4 boxes

EXP #16

1^{07} PM Red Lite & Buzzer Ok, Source Inserted, Bypass, Reset OP OK

Start Assembly 1^{25} Tables together

IC-1

2 unstable? $.33 \times 10 \times 10^{-11}$

3 3.6×10^{-11}

4 $3. \times 10^{-12}$

RKR, JR, CC, DWM

Place 1/8" Plexiglas between units in Horizontal Plane & self moderator increases multiplication

EXP #17 T = 21.8°C

Red Lite On, Bypass, Source Inserted, Starting Scale 0X

141 Start Assembly 1st Table Assembled = 71.3°F

IC-2 $.29 \times 10 \times 10^{-10}$

IC-3 3.0×10^{-10}

Both IC-2 & 3 Decreased when 1/8" added

Multiplication has decreased

Instrument Check on 9-9-71 Source 10 Mc ^{60}Co

Bal 4.70

PM-1 _____ Low Trip Scram Tables Alarm Trip OK

PM-2 _____ Alarm Trip _____

IC-1 10×10^{-10} Meter Trip OK Fast Trip OK

IC-2 3×10^{-11} Meter Trip OK

IC-3 2×10^{-11} Calibration Dwgs A OK

IC-4 2×10^{-11} Calibration _____ B OK

CRM _____ Meter Trip T = 21.5°C C OK

Det returned to Startup Scales 1 – 18×10^{-11}

2 – 3×10^{-11}

Source Inserted.

EXP. #17 - A.

K-25 Plastic Foam (with Fiberglass)

4 boxes reduced in thickness to Annuli

Critical expected with Tables separated 1/3 in.

Foam strength questionable for handling unit with thin bottom if the order 1/3 in.

8^{35} Start Assembly, Set Bypass, Reset, Dp, Pers. Ck OK

8^{50} On Positive Period 9.9 Rev = 0.67 in.

8^{55} Start to level. N level 10.3 Rev = 0.70 in.

+Per 6 div/dec = +130.4 sec → $\frac{8.0\,\$}{.03} = \frac{267\,\$}{\text{in}}$

267 / .1 / $1.869 / .07 / 13.09

Measurements

North

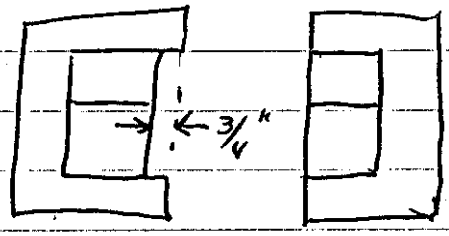
Horiz	Vert	
37.0 cm	33.2 cm	33.22
37.1	33.2	18.5
37.0	33.2	14.72
		5.4
		9.32

South

36.9	33.3
36.9	33.2
36.9	33.2
36.97	33.22
$\frac{37.0}{4} = 9.25$	$\frac{33.22}{4} = 8.3$

4/6

Moved Assembly on Movable Table so that when assembled there will be a 3/4" gap between units on North and South halves. Reflector will not have a gap.



EXP #18

Inst Scales and Bypass Set. SP-Rel. 1.0K

q18 Start Assembly

q30 Assembled — Subcritical

q32 may be slightly super critical, power rising.

q34 Start withdrawing source slowly to keep power level. Definitely Subcritical.

q45 Start measuring neg Period. ($T' = 21.4°C$)

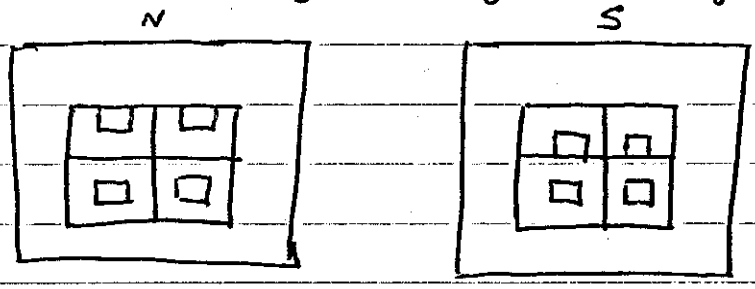
18 div/sec → -391. sec → -3.7 ¢

.007

.037
.002
/ .9
.002

EXP # 19

At the suggestion of JJ Lynn, Top 2 units on North Half were inverted, thus making The U-Metal against the top reflector and separated from the bottom units by the "original design" dimension



			Source	✓
10^{17} A	Start Assembly		ΔP	✓
10^{28}	On Positive Period	3.3 Rev. 0.17"	Bypass	✓
32	Start to Level		Just Start Scale	✓
	Approx heave	4.1 Rev. 0.22"	Reddite	✓
40	Shut down			

Pos Period 3.83 div/dec → 83.2 sec → 11.4 ¢

$$\frac{11.4}{.05} = 230\ ¢/\text{inch}$$

$$\times .22\ \text{in}$$

460

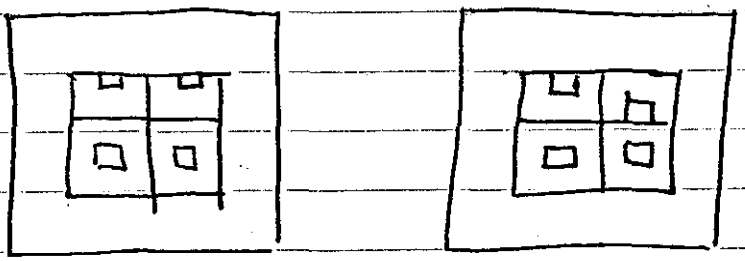
460

50.60 ¢ supercritical

K-25 Fiberfoam Plastic

EXP # 20

N S



3 units now inverted 2 on North 1 on South

16^{58}	Start Assembly	Rad Lite Pers. ✓
11^{08}	start withdraw Source – Near Critical to level	Δp ✓ Bypass ✓
11^{15}	Remove Source for Neg Period	Strip Scale ✓ Source ✓
11^{28}	Shutdown	

31 div/dec ∅ → 673 dec → -2.05 ∅

8/16/85 Dutta

$18.5 \times 18.5 \times \begin{matrix} 18.5 \\ 14.65 \end{matrix} \rightarrow 16.575 = 5672.794$

$\times 8 = 45382.35$

9005.51

$74250 / 36376.84 =$

$\rho = 0.204_{11}$

K-25 Fibrefoam

Weight of Plastic Foam Used

7.425 kg

$\rho = .20373$

9.2% fibreglass 90.8% plastic

.184987

C = .41 × .908 × .20373 = .07584	→ 3.801	-3	
H = .045	4.975	-3	
B = .032	3.299	-4	
Si = .022	8.73	-5	
Cl = .005	1.57	-5	
O = .486	.08990	3.385	-3

9.2% Fibreglass $\frac{.092}{2.23}$ × .041255 × .20373

Pyrex	B	4.455 -3	1.838-4	3.74-5 $B_T = 3.678-4$
	Si	1.853 -2	7.645-4	1.558-4 $Si_T = 2.431-4$
	Na	1.866 -3	7.698-5	1.575-5
	O	4.544 -2	1.875-3	3.820-4 $O_T = 3.767-3$

.21474 = .201425 × A²/9 / .938

Plastic Foam + Fiberglass

			Plastic Foam Analysis	
Boric Anhydride	8.2 wt%			
Anhydrous Oxalic Acid	8.2	9.416 E-03	C	41 wt%
Fiberglass	9.2	5.776 E-03	H	4.5
¼" Roving Owen Corn		3.829 E-04	B	3.2
Phenolic Resin BRL-2670	65.8	1.013 E-04	Si	2.2
		1.824 E-05	Cl	0.5
			N	0
Silicone Surfactant L-530	2.0	3.930 E-03	F	0
			Bal O	48.6
Freon 113	6.6			100.0
without F-113	93.8	9.333 E-03	O	
		4.224 E-04	B	
		2.655 E-04	Si	

9-8-71

Curtis Barlow K-25

THE HOTEL OF THE AMERICAS

K-25 FOAM

		Plastic	
H	2.389 - 3	5.776	E-03
B	1.558 - 4	4.224	E-04
C	1.81 - 3	4.416	E-03
ϕ	1.629 - 3	4.333	E-03
Si	4.073 - 5	2.655	E-04
Cl		1.824	E-05
Na		1.653	E-05

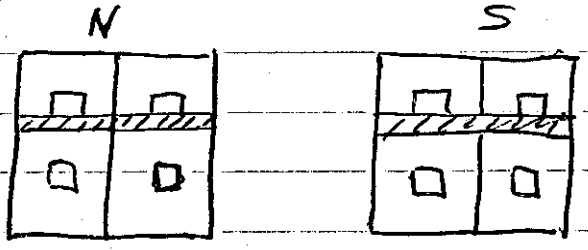
$\frac{.092}{2.23} \times$ $\times \rho \left(= \frac{.2014}{.938}\right)^3$

Pyrex glass

B	4.455 E-03 →	1.838 E-04 →	3.947 E-05
Si	1.853 E-02 →	7.645 E-04 →	1.642 E-04
Na	1.866 E-03 →	7.698 E-05 →	1.653 E-05
O	4.544 E-02 →	1.875 E-03 →	4.026 E-04

Exp #21

Insert 3/8" Plastic between units arranged normally



1 or 2 Start Assembly

Positive Period

8.8 Rev.

Level @ 9.45 Rev. 0.62

.05

Dust Source ✓

Rectifier + Pwr. ✓

ΔP ✓

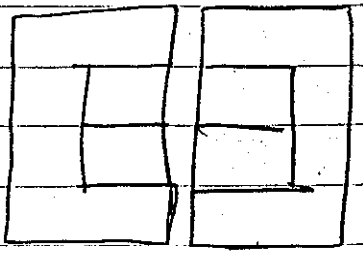
Bypass Panel ✓

Dust, Start UP Sc ✓

Reset ✓

Pos Per 3.5 div/sec = +76.0 sec = → 12.2¢

$\frac{12.2¢}{.05\text{ in} \times 2.54} = \frac{96¢}{\text{cm}}$



0.62 in

= 1.57 cm

americana
THE HOTEL OF THE AMERICAS

Foamglas

H	5.16-5
B	1.12-4
ϕ	2.62-3
Na	5.5-4
Si	1.091-3
S	2.58-5

DWM
Calc 8/16/85

	g/cm³	
H →	.00009	.0006
B	.00201	.0139
O	.06958	.4802
Na	.02099	.1449
Si	.05086	.3510
S	.00137	.0095
Stotal	.14490	100.01

	Report	g/cm³	wt%
O	2.69-3	.07144	48.52
B	1.13-4	.00205	1.39
Si	1.12-3	.05221	35.46
Na	5.65-4	.02156	14.64
		.14725	100.01

Average

H	.03
B	1.39
O	48.27
Si	35.28
Na	14.56
S	.47
	100.

EXP # 22

FOAMGLAS 8 UNIT ARRAY ~7.552 in

Source ✓
Bypass ✓
Rods ✓
Rod Ht. ✓
Δp ✓

3rd Tables together Subcritical

Ic-1 —
2 0.3.2 x10 x10^{-11}
3 4.2 x10^{-11}
4 3.1 x10^{-12}

Shut Down + trim 0.25 in. 4 boxes.

DWM

Calibrated Tables vs Revolutions

Rev	Sepn	
0	.007	
0.6	.011 − 007	= .004
2.6	.125 − 007	= .118
4.95	.275 − 007	.268
8.15	.500 − 007	493
13.80	1.000 − 007	993

CC, JJL, RKR, JA

Instrument Check on Sept 10, 71 Source 10 mc ^{60}Co

PM-1		Low Trip	OK	Hi Alarm Trip	Scram, Table
PM-2				Alarm Trip	0
IC-1		Meter Trip	OK	Fast Trip	OK
IC-2		Meter Trip	OK		
IC-3	2×10^{-9}	Calibration	Dwgh		
IC-4	1.8×10^{-9}	Calibration	Dwgh		
CRM		Meter Trip			

10^{-8} Calib Pt. Noisy

A ✓
B ✓
C ✓

EXP #23

8 units w. FOAMGLAS

4 7.552^3

4 $7.552 \times 7.552 \times 7.302$ Nom

Vertical separation 7.302" Core 15.104 x 15.104 x 14.854 in.

Horiz 7.552"

935 Start Assembly (RKR, JR at Controls)

950 Tables Closed, Sub Critical (with ~1/8" gap

IC-2 $.34 \times 3 \times 10^{-10}$

-3 1.3×10^{-10}

-4 7×10^{-12}

After 5' Wait neg period mean ~ 65 sec.

EXP #24

Straightened Stack to attempt to eliminate gap — However the foamglas is not precise.

1020 Start Assembly, Sub Critical IC-2 $.39 \times 3 \times 10^{-10}$ -3 1.35×10^{-10}

Level for 10', neg period ~ -74 sec. ?

Assembly Size Weight of Foam glas 6.80 kg

N

Hor	Vert
38.4	37.2
.5	.3
.4	.4

S

38.5	37.3
.4	.4
.3	.4

av 38.4 37.3 Cm

250
150
400 → 1 m

8/16/85 DWM

$V = 19.20 \times 19.20 \times \begin{matrix} 19.20 \\ 18.10 \end{matrix}$ av 18.65

$= 55001.088$

$- 9005.512$

$6800 / 45995.576$

$= 0.14784$

3 dimension

$\frac{38.4}{4} = \pm 9.6$

1.1

Top mm -8.5

EXP # 25

Trimmed 0.150 in. from the bottom of 4 boxes.
Cube size is now
15.104 x 15.104 x 14.704 : Nom.

1:20	Start Assembly	Source Inserted	✓
1:25	Source out on Pos. Period Tables Closed	Bypass	✓
	Gap apparent in stacks!	ΔP	✓
	11.6 div/sec → +252 sec → 4.55¢	Reset	✓
		Person Red Lt	✓

EXP # 26

Straighten Assembly – Repeat #25

		Source	✓
1:50	Start Assembly	Bypass	✓
1:55	On Positive Period Source Out	ΔP	✓
	Tables Closed	Reset	✓
	9.4 div/sec → 204.3 sec → 5.48¢	Red Lite	✓

Gained 1¢ only

T = 21.6 °C

Jones

TID-7028 p 58

Bare Cube of U (37.67) metal $\rho = 17.81\ g/cm^3$

$\rho(235) = 6.71\ g/cm^3$

Bare 10.40 in = 26.42 cm

Refl. 7.223 in = 18.34

2 R.S = 8.08 cm

R.S. = 4.04 cm

Bare Buckling if $\lambda = 2.162 \times \frac{18.70}{17.81} = 2.27$

4.50 + 26.42 = 30.96

$$B^2 = 3\left(\frac{\pi}{30.96}\right)^2 = 0.030890$$

① For Reflected Base area of 6.50 in × 6.50 in = 42.25

16.51 cm × 16.51

8.08
4.54
29.13

$$B_x^2 + B_y^2 = 2\left(\frac{\pi}{29.13}\right)^2$$

.030890
23262
007628

$B_z = .08734$ $\tilde{z} = 35.97$
12.62
23.35 = 9.19 in.

2 ea 3.25
1 ea 2.00
1 ea 0.75
9.00 in
1 ea .125
9.125 in

$\left(\frac{17.81}{18.7}\right)^2 = .907 \times$

= 8.34

9.34

② For Reflected Base Area of $6.50 \times 9.75 = 63.375$

.011631 — 24.765 cm
.007062 — 12.62
30890 — 37.385
.018693

$B_3^2 = .012197$ $B_3 = .11044$

$\tilde{3} = 28.45$
12.62
15.83 → 6.23 in.
5.65

④ For Reflected Base Area of $9.75 \times 9.75 = 95.0625$

.007062
007062
30890
14124
016766

$\tilde{3} = 24.26$
12.62
11.64 → 4.582 in.
4.156

⑤ For Reflected Base Area of $9.75 \times 13.0 = 126.75$

.007062 — 33.02
004738 — 12.62
030890 — 45.64
.011800

$B_3^2 = .019090$ $B_3 = .13817$ $\tilde{3} = 22.74$
12.62
10.12

$3 = 3.98$ in
3.61

(3) For Reflected Base Area 6.50 x 13.0

.011631
4738
16369

$B_z^2 = .014521$ $B_z = .120503$ $\tilde{z} = 26.07$
12.62
$z = 13.45$
$= 5.295$ in.
4.803

(6) 13.0 x 13.0 = 169
3089
.009476

$B_z^2 = .021414$ $B_z = .146335$

$\tilde{z} = 21.47$
12.62
8.85 cm

$z = 3.45$ in.
3.13

Bare Base area of 9.75×9.75

24.765
4.54

29.305

$$B_x^2 + B_y^2 = 2 \times \left(\frac{\pi}{21.305}\right)^2 = \begin{matrix} 3051 \\ 022985 \end{matrix}$$

B_z^2 .007905

$B_z = .08891$

$\bar{z} = 35.335$
4.54

$z = 30.795\text{ cm}$

12.12 in

Bare Base area of $3.75 \times 3 = 11.25 \times 11.25 = 126.56$

28.575
4.54

33.115 = $B_y = .09487$ (3059)

$2B_x^2 = .018000$

.01289

$B_z = .11353$

$\bar{z} = 27.671$
4.54

23.13 → 9.107 in.

=56.25

For Reflected Base Area of (3.75x3) → 7.50 x 7.50

19.05 cm x 11.05 cm

12.62

31.67

$B_x^2 + B_y^2 = 2 \times .099198^2$ .0098402

3089

19680

.011 2095

$B_z = .105875$

$\tilde{z} = 29.673$

12.62

$z = 17.05$

$= 6.714$ in.

6.71

For Reflected Base Area of 3.75 / 11.25 → 28.575

126.56

12.62

41.195

$B_x^2 + B_y^2 = 2\left(\frac{\pi}{41.195}\right)^2$

.0058158

03089

1163 2

$B_z^2 = .019258$

$B_z = .138774$

$\tilde{z} = 22.638$

$z = 10.018$ cm

3.94 in

3.57

2.66 % wt B.

8.57
B_2O_3

800
900
89%.

.0266 X .2014

2.985×10^{-4}

Y-12 prelim

Submitted samples of Fiberfoam plastic to both Y-12 & X-10 labs for analysis.

Creech Laing

V10-27-71

Call from Y-12 re B analysis.

Using method which should extract B from fiberglass — 2.66 wt% B

Residue ash spect showed 800-900 ppm B

Fractional wt residue, not known.

$.0266 \times .2014 \times 5.5728\ E-2 = 2.985\ E-4$

1.039 ± 0.006

used $4.224\ E-4$ in calc originally

Revised to $3.6736-4$ $k = 1.070 \pm 0.003$

Telephone Dam Creek 11-17-71

Preliminary Analysis Y-12

	Creech
C	46.8
H	4.6
O	34.5
F	0.1
B	2.65
Si	2.36
Ca	2.0
Mg	0.2
Al	0.2
Ba	0.6
	94.1
glass B	0.68
Cl	0.91

3.33

See p 124

122 (Left side of sheet)

ANALYTICAL DATA REPORT

~~TO~~ GENERAL ANALYSIS

~~FROM~~ To DW Magnuson

LABORATORY NUMBER	SAMPLE CODE		C %	H %	N %	S. %	
347	Borated Plastic plus fiber glass		47.1	5.12	<0.01	2.29	38

* In a
mate
appe
Spec
: silic
white
form

CONCENTRATION

☐ SAMPLES returned to sender
☐ sent to waste ☐ retained

REMARKS

UCN-2134
(3 9-60)

(Right side)

AB.

ANALYZED FOR

CONTROL NO. D 92096

SERIES NO. 9213

DATE 10-19-71

%	F	Cl	B*						
.6	—	—	2.85%						
				Total	95.96 %				

ddition to the boron in the matrix
rial, several nodules of white powder,
ximately 45mg each, were noted.
rographic analysis revealed only traces of
on in addition to the boron. The
e powder was analyzed separately and
d to contain 12.5% boron by weight.

LABORATORY SUPERVISOR

W R Laing

MEMO **AVOID ORAL INSTRUCTIONS** Date 11-19-71 19

To D. W. Magnuson, 9213

Here is a summary of the elemental analyses of the plastic foam-fiberglass material (requisition 703892):

Chemical analyses		Spectrographic	
Element	%	Element	%
carbon	46.8	calcium	2.0
oxygen	34.5	barium	0.6
hydrogen	4.6	aluminum	0.2
boron	3.3 < 2.65 in foam, 0.68 in glass	magnesium	0.2
silicon	2.36		
chlorine	0.91		
fluorine	0.10	Total	95.57%
nitrogen	0.01		

Signed E. T. Creech

UCN-486
(12356 10-70)

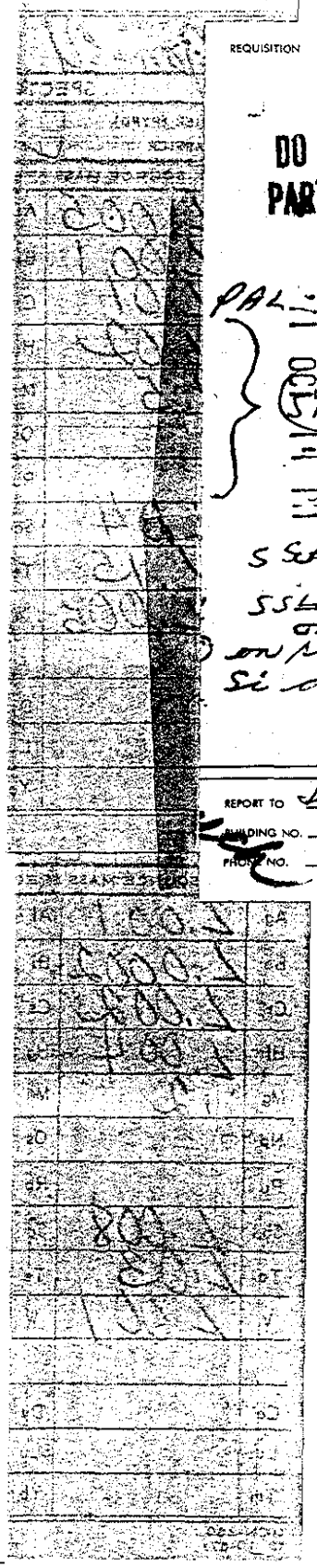
124

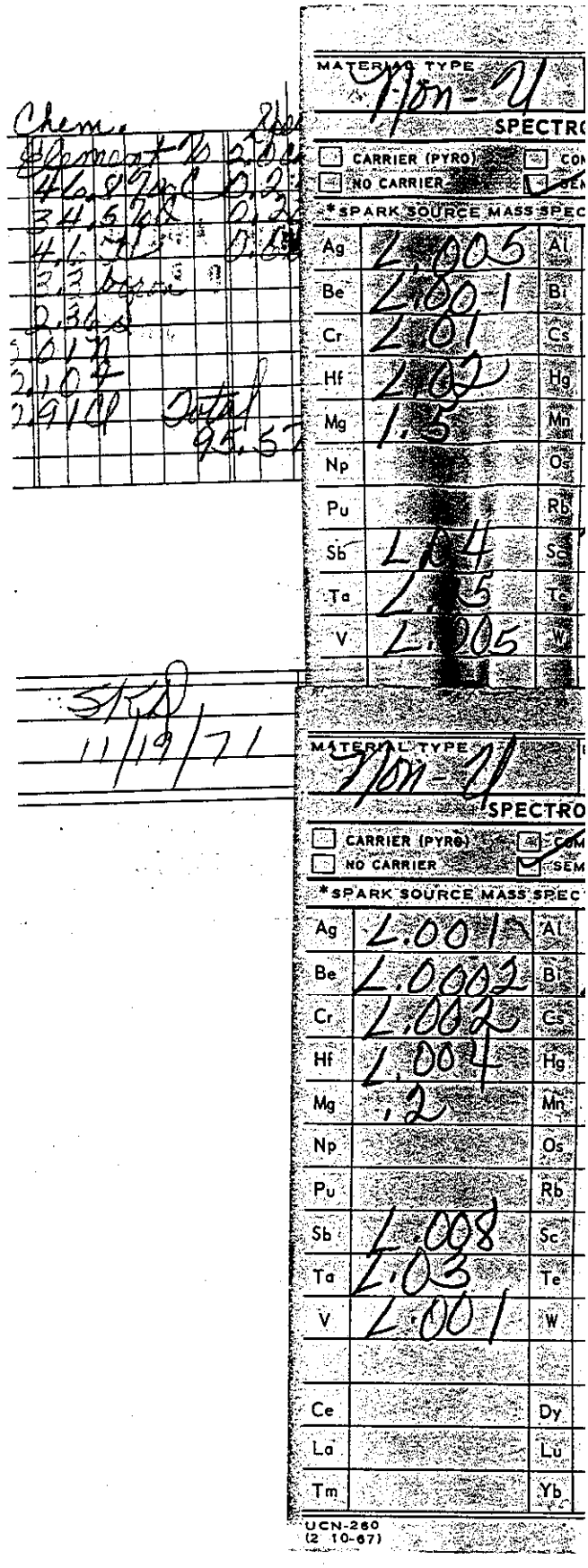
REQUISITION 703892 18

DO NOT REPORT
PARTIAL ANALYSIS
L. D. B. L.O.B. DEVELOPMENT

PAL: 11 (PL) PAL
S Sn
SSL Ee Creek 440
on residue from
Si determination

REPORT TO P.W. Magnuson
BUILDING NO. 9213
PROJ. NO. 3.5237





MATERIAL TYPE Non-U

SPECTRO

CARRIER (PYRO) CO

NO CARRIER SEM

*SPARK SOURCE MASS SPEC

Ag	L.005	Al
Be	L.001	Bi
Cr	L.01	Cs
Hf	L.02	Hg
Mg	1.5	Mn
Np		Os
Pu		Rb
Sb	L.04	Sc
Ta	L.5	Te
V	L.005	W

MATERIAL TYPE Non-U

SPECTRO

CARRIER (PYRO) COM

NO CARRIER SEM

*SPARK SOURCE MASS SPEC

Ag	L.001	Al
Be	L.0002	Bi
Cr	L.002	Cs
Hf	L.004	Hg
Mg	.2	Mn
Np		Os
Pu		Rb
Sb	L.008	Sc
Ta	L.03	Te
V	L.001	W
Ce		Dy
La		Lu
Tm		Yb

UCN-260
(2 10-67)

SPECTROGRAPHIC REPORT

DATE	BATCH NUMBER	PLATE SHEET NO.	REQUISITION NO.
10/20/71		3290	703892B

CHEMICAL METHOD	REPORTING UNIT	REPORTING BASIS
[ ] COMPLETE BURN [ ] RARE EARTH [ ] SEMI-QUANT [ ] HIGH VOLTAGE SPARK	[ ] µg/g (ppm) [X] % [ ] µg/ml [ ] TOTAL µg	[ ] AS-RECEIVED [X] DRY [ ] METAL [X] ASH

SPECTROGRAPH

7	As		Au	L.02	B	.18	Ba	L.002
L.01	Br		Ca	.18	Cd	L.04	Co	L.005
L.6	Cu	L.005	Fe	.2	Ga		Ge	
	In		Ir		K	.06	Li	.08
L.005	Mo	L.002	Na	.3	Nb	L.02	Ni	L.01
	P	L1	Pb	L.01	Pd	L.002	Pt	
L.15	Re		Rh		Ru		S	
	Se		Si	>20	Sn	L.005	Sr	
	Th	L.04	Ti	.1	Tl		U	L.3
L.08	Y		Zn	L.08	Zr	.002		

SPECTROGRAPHIC REPORT

DATE	BATCH NUMBER	PLATE SHEET NO.	REQUISITION NO.
10/20/71	[redacted]	3290	703892

CHEMICAL METHOD	REPORTING UNIT	REPORTING BASIS
[ ] COMPLETE BURN [ ] RARE EARTH [ ] SEMI-QUANT [ ] HIGH VOLTAGE SPARK	[ ] µg/g (ppm) [X] % [ ] µg/ml [ ] TOTAL µg	[ ] AS-RECEIVED [X] DRY [X] METAL [ ] ASH

SPECTROGRAPH

.2	As		Au	L.004	B	1	Ba	.6
.0022	Br		Ca	2	Cd	L.008	Co	L.001
L.15	Cu	L.001	Fe	.02	Ga		Ge	
	In		Ir		K	.008	Li	.008
L.001	Mo	L.0004	Na	.02	Nb	L.004	Ni	L.002
	P	L.2	Pb	L.002	Pd	L.0004	Pt	
L.03	Re		Rh		Ru		S	
	Se		Si	.6	Sn	L.001	Sr	
	Th	L.008	Ti	.02	Tl		U	L.06
L.02	Y		Zn	L.02	Zr	.0004		

NOTICE

The spectographic analysis on this material was by a semi-quantitative method, which gives approximate values only.

A specific method for this material is not presently available at YPL2. Development work will be required.

Nov 22, 71

FIBRE FOAM ANALYSES

	Original Analysis Foam only	X.908		Total		X-10		Y-12
C	41.	37.23		37.23		47.1		46.8
H	4.5	4.09		4.09		5.12		4.6
B	3.2	2.91		3.30		2.85 *		3.3
Si	2.2	2.00		5.80		2.29		2.36
Cl	0.5	.45		.45				.91
Balance O	48.6	44.12		49.43		38.6		34.5
Fiberglass	9.2 wt% x	1/638 = 9.81					Ca	2.0
B		0.089911	0.39				Ba	0.6
Si		0.86383	3.80				Al	0.2
Na		0.07121	0.36	.31			Mg	0.2
O		1.20671	5.34					
		2.23097						
				100.61		95.96		95.57
			* 45 mg white Nodule			12.5% B		
	Average			FIRE RESISTANT PHENOLIC FOAM		Std Ref. Def. Paducah JS-31536-1 Rev 1		
			X.201					
C	43.71			4.413 E-3		41.0 wt%		
H	4.60			5.538 E-3		4.5		
B	3.15			3.536 E-4		3.2		
Si	3.48			1.504 E-4		2.2		
Cl	0.68			2.328 E-5		0.5		
O	40.84			3.098 E-3		48.6 (by Diff)		
Ca	0.2			6.056 E-5		100.0		
Ba	0.6			5.302 E-6				
Al	0.2			8.995 E-6				
Mg	0.2			9.983 E-6				
Na	.31			1.636 E-5				
	99.77							

WCX-885 (Jan'48) Y-12 DATA SHEET

128

ORNL ANALYTICAL CHEMISTRY DIVISION
SPECTROCHEMICAL LABORATORY
BUILDING 9734, Y-12 TELEPHONE 3-7168

Request No. 25813 (347)

REQUEST AND REPORT OF SPECTROGRAPHIC ANALYSIS

CHARGE NO. 5-544	SAMPLE NO. Borated Plastic		
SUBMITTED BY D. W. Magnuson	BUILDING NO. 9213	PHONE 35237	DATE
COPY REPORT TO	BUILDING NO.		

COMPOSITION OF SAMPLE IF KNOWN

TYPE OF ANALYSIS DESIRED ☐ Qualitative, ☑ Semi-quantitative, ☐ Quantitative, ☐ Photoelectric

ELEMENTS DESIRED Gen Scan

GENERAL ANALYSIS (values in wt ppm)

Ag	<5	In		Sc			
Al	2000	Ir		Si	>10,000		
As		K	20	Sn	<10		
Au		Li	<5	Sr			
B	>5000	Mg	1000	Ta	<50		
Ba	>5000	Mn	≤10	Te			
Be	<1	Mo	<10	Th			
Bi	<10	Na	100	Ti	100		
Ca	>5000	Nb	<50	Tl			
Cd	<30T	Ni	100	U			
Co	<30	Os		V	<20		
Cr	<30	P		W	<50		
Cs		Pb	<20	Zn	<200		
Cu	10	Pd		Zr	<50		
Fe	300	Pt	<30				
Ga		Rb	<20				
Ge		Re					
Hf		Rh					
Hg		Ru					
		Sb	<30				

RARE EARTH ANALYSIS (values in wt ppm)

Sc		not detected
Y	<5	
La	<20	
Ce	<100	
Pr	<50	
Nd	<50	
Sm	<50	
Eu	<5	
Gd	<20	
Tb	<20	
Dy	<100	
Ho	<20	
Er	<5	
Tm	<20	
Yb	<2	
Lu	<5	
Th		

METAL ANALYSIS (values in _____)

Type alloy ____

Cr	
Ni	
Fe	
Mo	
Co	
Nb	
Ta	
Mn	
V	
Ti	
Cu	
Al	
Mg	
Sn	
Pb	
Zn	
Bi	
Si	

Explanation of Analysis:
Symbols Used: P-Present; T-Trace; < - less than; > - greater than; nd-not detected; no analyses made in all other cases.

☐ Qualitative Analysis - Estimate only as follows: M-major; m-minor; t-trace.

☑ Semi-Quantitative Analysis - The values reported are visual estimates taken from a standard plate and using a common graphite matrix. These values are to be interpreted as approximations only. Actual value should be within the range times ½ to times 2.

☐ Quantitative Analysis - The values reported are obtained by visual comparison of the sample with standards similarly prepared. Precision is about ± 50% of the amount present.

☐ Densitometric Analysis - The values reported are obtained by precise analytical spectrochemical methods. Precision of the method varies but is of the order of ± 10% or better.

☐ Photoelectric Analysis - Rapid electronic method. Precision _____%.

ANALYSIS PERFORMED BY	APPROVED BY	PLATE NO.	DATE REPORTED
SAM	J. A. Carter	6473	12-13-71

COMMENTS If you need lower limits, the sample can be run by Spark-Source mass Spectrometry at this location

UCN-1003 (3 10-68) RC

MEMO **AVOID ORAL INSTRUCTIONS** Date 11-19-71 19____

To D.W. Magnuson, 9313

Here is a summary of the elemental analyses of the plastic foam-fiberglass material (requisition 703893).

Chemical analyses

Element	%
carbon	46.8
oxygen	34.5
hydrogen	4.6
boron	3.3 < 2.65 in foam, 0.68 in glass
silicon	2.36
chlorine	0.91
fluorine	0.10
nitrogen	0.01

Spectrographic

Element	%
calcium	2.0
barium	0.6
aluminum	0.2
magnesium	0.2

Total 95.58% 95.58

Signed E.T. Creech

UCN-486
(12356 10-70)

124

(Left)

ANALYTICAL DATA REPORT

~~TO~~ GENERAL ANALYSIS LAB.

~~FROM~~ To DW Magnuson

ABORATORY NUMBER	SAMPLE CODE		C %	H %	N %	S. %	O, %
347	Borated Plastic plus fiberglass		47.1	5.12	<0.01	2.29	38.6

* In add
materi
approxi
Spectr
silicon
white
formed

CONCENTRATION

☐ SAMPLES returned to sender
☐ sent to waste ☐ retained

REMARKS

(Right)

ANALYZED FOR	CONTROL NO. D 92096
SERIES NO. 9213	DATE 10-19-71

F	Cl	B*		
—	—	2.85%		
			Total	95.96%

tion to the boron in the matrix
l, several nodules of white powder,
mately 45 mg each, were noted.
graphic analysis revealed only traces of
in addition to the boron. The
powder was analyzed separately and
to contain 12.5% boron by weight.

LABORATORY SUPERVISOR
W K Lang

MEMO **AVOID ORAL INSTRUCTIONS** Date 11-19-71 19

To D.W. Magnuson, 9213

Here is a summary of the elemental analyses of the plastic foam-fiberglass material (requisition 703892).

Chemical analyses

Element	%
carbon	46.8
oxygen	34.5
hydrogen	4.6
boron	3.3 < 2.65 in foam, 0.68 in glass
silicon	2.36
chlorine	0.91
fluorine	0.10
nitrogen	0.01

Spectrographic

Element	%
calcium	2.0
barium	0.6
aluminum	0.2
magnesium	0.2

Total 95.58%

Signed E.T. Creech

UCN-486
(12356 10-70)

124

(Left)

ANALYTICAL DATA REPORT

~~TO~~ GENERAL ANALYSIS LAB.

~~FROM~~ To D W Magnuson

ABORATORY NUMBER	SAMPLE CODE		C %	H %	N %	S. %	O. %
347	Borated Plastic plus fiber glass		47.1	5.12	<0.01	2.29	38.6

* In addi
materia
appropri
Spectro
silicon
white p
found

CONCENTRATION

☐ SAMPLES returned to sender
☐ sent to waste ☐ retained

REMARKS

(Right)

ANALYZED FOR					CONTROL NO. D 92096				
SERIES NO. 9213					DATE 10-19-71				
F	Cl	B*							
—	—	2.85%							
			Total	95.96%					

ion to the boron in the matrix
l, several nodules of white powdery
ately 45 mg each, were noted.
raphic analysis revealed only traces of
in addition to the boron. The
owder was analysed separately and
to contain 12.5% boron by weight.

LABORATORY SUPERVISOR
W R Laing

Oct 30, 1972

Inspected Boxed Vermiculite from GE

48 ea 2 in x 10 x 10 - some thin

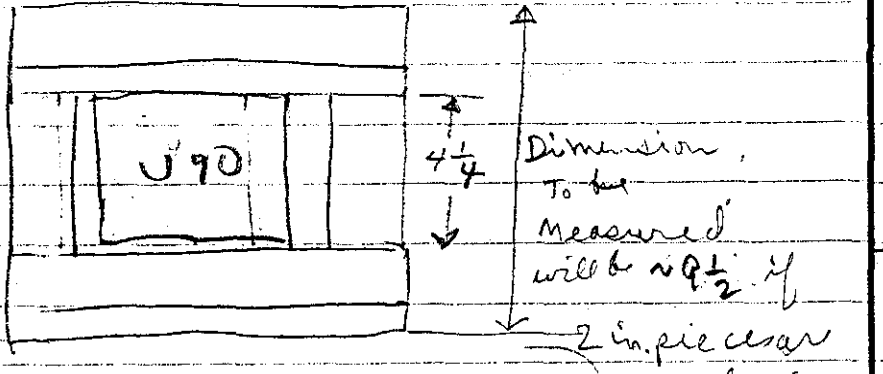
24 ea 1 in x 10 x 10 - all thin

These pieces are not very precise -

11 ea 1 in x 10 x 10 in measured 9 3/4 in the 10 x 10 dim not square

some 9 5/8 in x 9 3/4 all 10 in under size. Too fragil To bore holes for U(92) unit

∴ Have Mule garrison cut pieces to make boxes 9 1/2 x 9 1/2 x 10



2 ea 1 x 9 1/2 x 9 1/2 x 8 = 16 ea

2 ea 2 x 9 1/2 x 9 1/2 x 8 = 16 ea

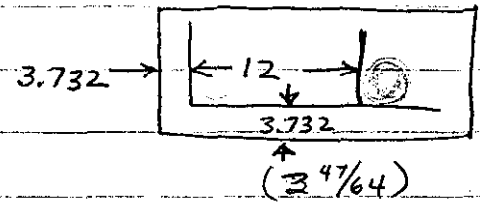
2 ea 2 x 4 1/4 x 9 1/2 x 8 = 16 ea

2 ea 2 x 4 1/4 x 5 1/2 x 8 = 16 ea

Dorn

Units 4.252 in. high
4.535 in. O.D.

Alum Shelves
4 ea 12 x 24 without scribe marks
4 ea 12 in x 24 in.
with scribe marks



Alum Boxes
4 ea 3.842 in high
4 ea 7.716 in. high

Estimate k_∞ =

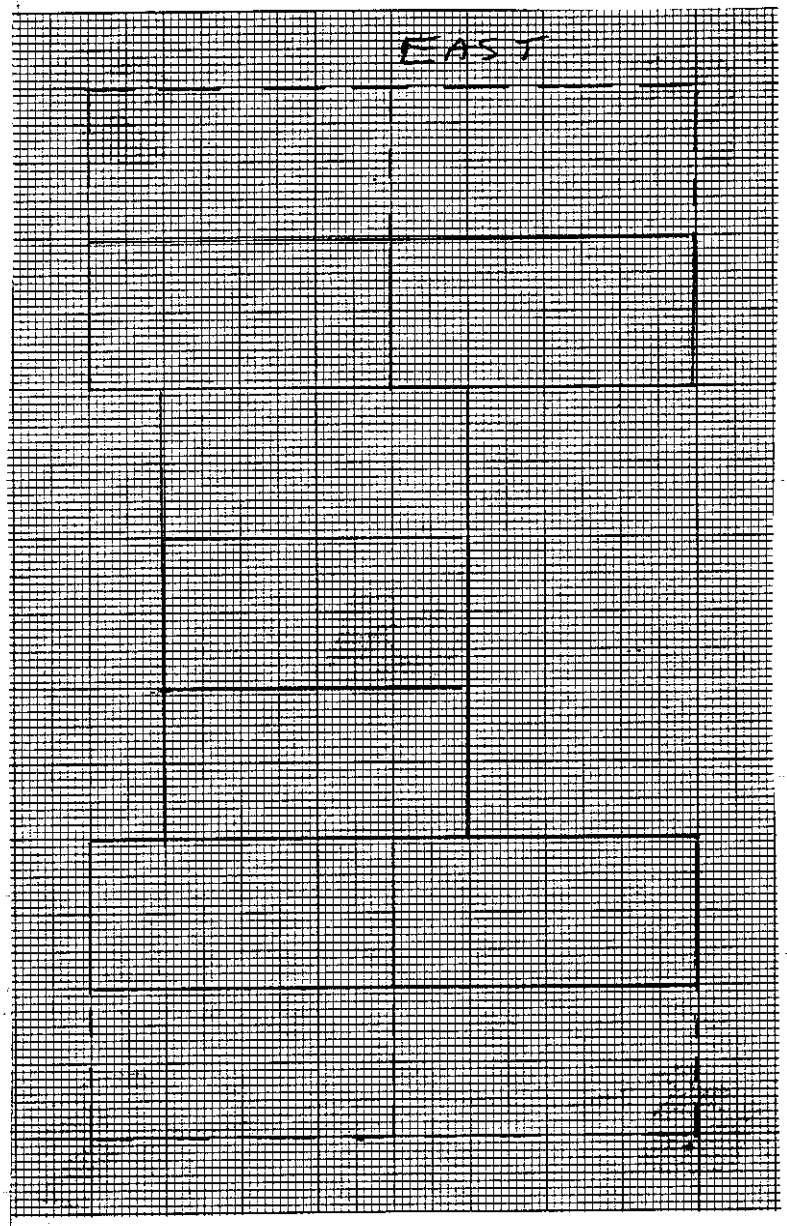
0.96 k_∞ 8 unit Concrete Reflected
12.0 in cells — using νB_M^2
Agrees in concrete

Δg estimated to be 9.3% for concrete and H_2O
corresponding to change in cell size
of 11.34 in.

Propose to build 12 in cubic cells which can be made critical by adding more U to top 4 units. Next cubical cells, 10 × 12 × 12 for example, can be made near critical without extra uranium for final data. Also, Two side reflector thickness should be reduced to 8 in from 16 in. for a Δg measurement.

Dwh Nov. 72

PLAN VIEW OF SIDE REFLECTORS

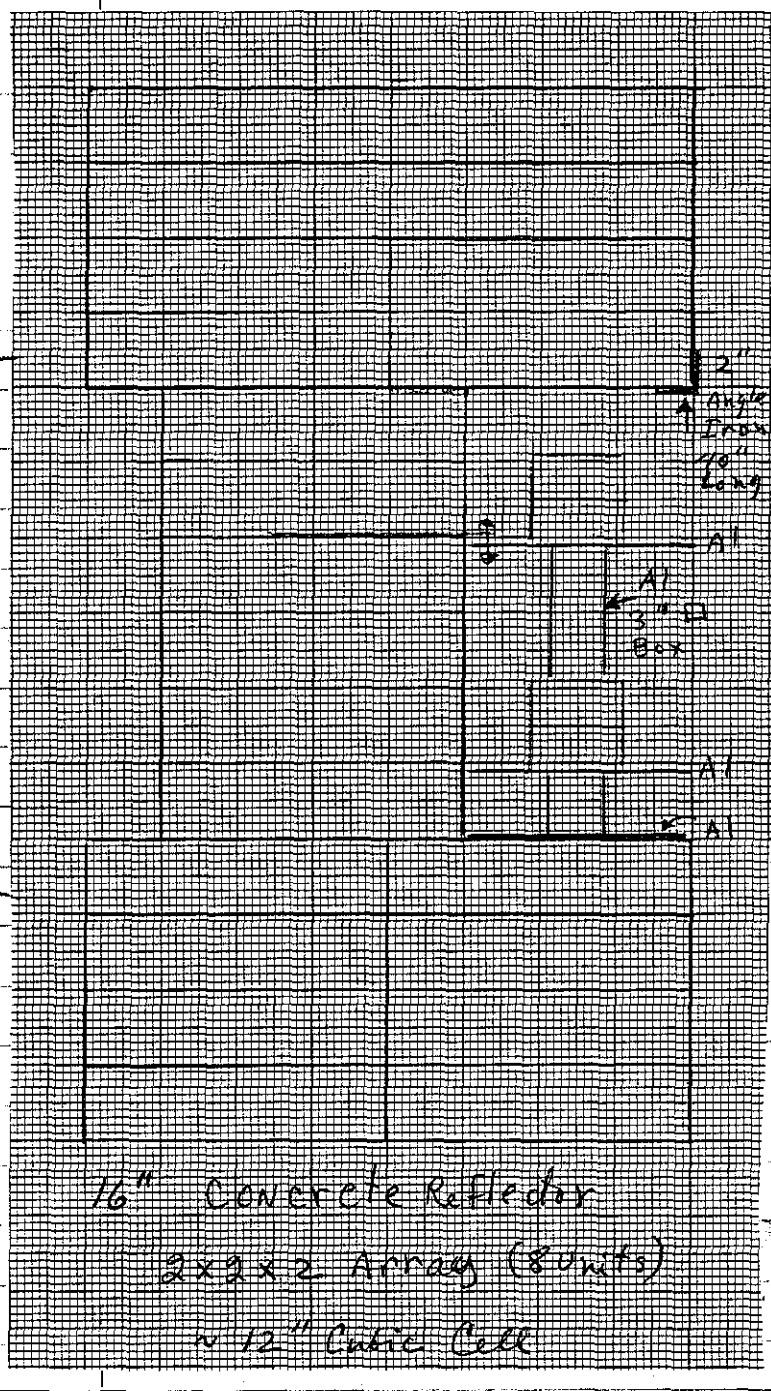


~~East~~ & West (SIDE) & Top Reflectors can be reduced to 8" thickness

EXP # 27

Clock Reading on Nov 10, 1972 4986 hours

Description of Assembly



16" Concrete Reflector

2 x 2 x 2 Array (8 units)

~ 12" Cubic Cell

See Page 63 for masses of units, av 20.962 kg

28 x 4 = 112

7.716 in. long

22 x 6 = 132

3.842 in. long

28

4 x 8 = 32 x 3 = 96

3.68

2x2x2 array 12" nom. cubic Unit cell
16 in. Concrete Reflector.

Unit 1	2176 - 2189	20.966	South (Fixed) Table
2	2206 - 2205	20.966	
3	2168 - 2193	20.963	
4	2195 - 2195	20.962	
5	2170 - 2152	20.960	North (Horiz.) Table
6	2156 - 2200	20.959	
7	2162 - 2190	20.962	
8	2172 - 2197	20.961	

167.696 = 20.962 av

Instrument Check on Nov 13, 72 **Source** ^{60}Co 1 mc

875 volts PM-1 Bal 9.85 Low Trip OK : Trip OK

IC-1 3×10^{-10} Meter Trip 5 mm Tabs Fast Trip OK

IC-2 3×10^{-10} Meter Trip OK Monitor Alarm

IC-3 $\sim 1 \times 10^{-9}$ Calibration Dwn A

IC-4 $\sim 2 \times 10^{-9}$ Calibration Dwn B

Source ↓ Bypass ↓ Instr Range ↓ C

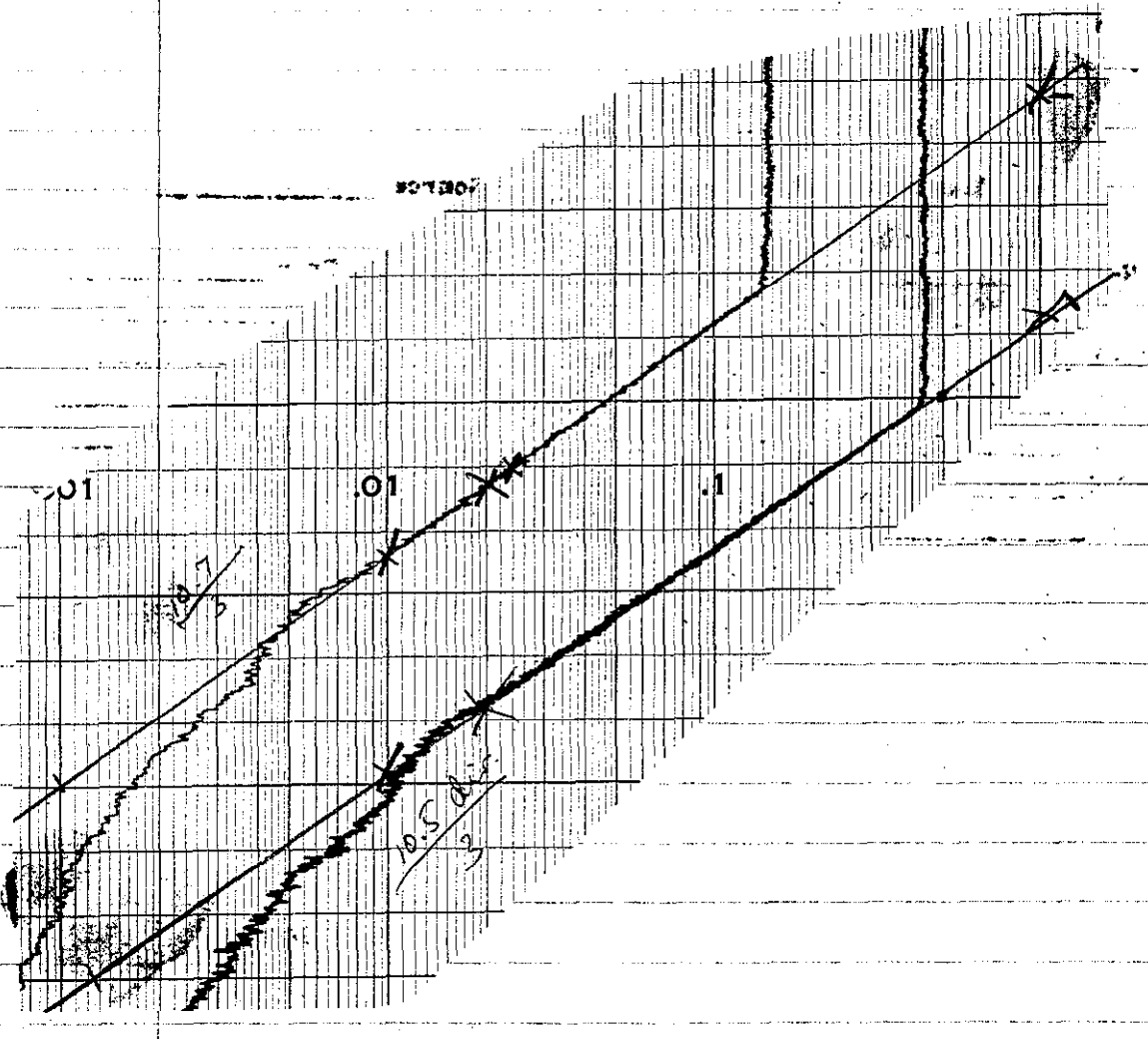
Up ↓ Reset ↓

Placed Pu-BeG (M-2) on shelf #1 of South Table

Placed Source Drive on Top of Assembly M-230

(Source must penetrate 16 in. of concrete)

not good — hence the fixed source on shelf until we achieve near delayed critical.


.01
.01
.1

Exp #27 (Cont.)

9^{45} AM Start Assembly

10^{05} AM Tables near Closure .26 ~ .27
when contact lost (Concrete stacks are not straight!)
Remove Source on Drive IC-2 $.23 \times 3 \times 10^{-11}$ + $.20^{+} \times 3 \times 10^{-11}$

Source on Drive is Adequate!

Shut Down Back stack for better alignment

EXP # 28

Add 5 kg piece to West Top unit on North Table.

10^{17} AM Start Assembly. Only Source drive power M-230

10^{30} Assembly Subcritical 0.236
Concrete on Tables at 0.244
in contact - Inspect for side) ass.

10^{33} Shut Down - "Back" stack for better alignment
IC-2 → $.09 \times 3 \times 10^{-1}$

No. 2473
EXP # 29 Add 5kg U(93) No. 2290

10^{52} Start Assembly

11^{05} Tables near closure concrete in contact 0.198 0.206
Concrete in contact east side.
Inspect IC-2 → $.175 \times 3 \times 10^{-1}$

11^{07} Shut Down

EXP # 30

Straighten Concrete — add 5kg U(93) now { 2473 5.210 ; 2290 5.213 ; 2469 5.217

11^{16} Start Assembly

11^{37} On Positive Period W .203 E .210 15.640 ±3 kg

11^{40} Start to Level

Measured size Vert

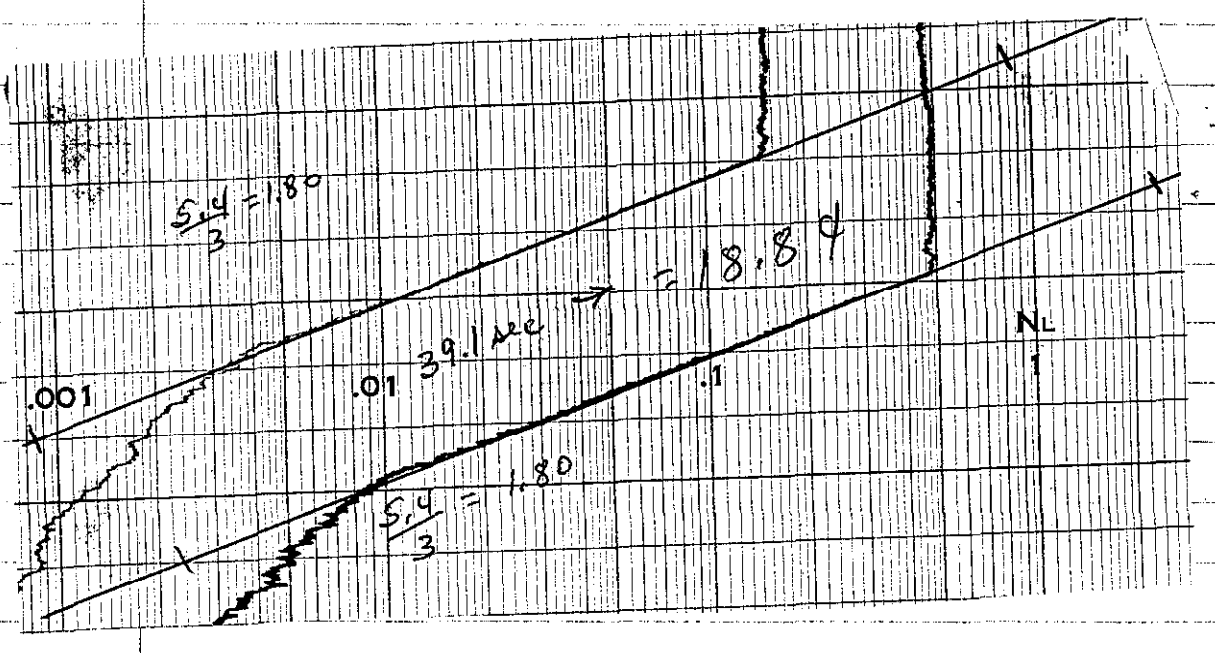
North 12 x 24 3/16 x(24 3/16 + 3/32) Top Blocks Canted

South 12 x 24 3/16 x(24 3/16 ± 3/32) "

Measured size

12 x 24 3/16 x 24 9/64 Top Blocks Canted

10 x 24 3/16 x 24 3/8 Top Blocks level !



excess .148 x .20 = .296

Exp #30 (cont.)

11[47] Level W 0.290 Δ = .087
E 0.294 Δ = .084
85

19[47] Shut down

Table $\frac{\Delta\$}{\Delta S}$ = 11.8/.085 = ~~142~~ 138.8 ¢/inch

142 x .192 = 27.3 ¢ Total excess reactivity.

Restacked south table so that cells are 4 ea
10 x 12 x 12 nominal, North Table 12x12x12 cells
Exp #31 1 Sky Piece north #

3[03] Start Assembly ΣC-2 = .16 x 3 x 10^-11
3[21] Concrete in contact W .186
Subcritical E .191

Exp #32

2x2x2 Array Add 1 Sky Piece to north now 2 ea on north 2289 and 2469

3[38] Start Assembly
3[47] On positive period W .179 Table
Concrete in Contact E .184
49 Start to level W .308 Δw = .129 $\frac{18.8}{127}$ = 148
57 Level E .309 ΔE = .125
11 Shut down av .127

November 14, 1973

Restacked North Table cells now 9 x 12 x 12

Measured cavity 9 x 24 3/16 x 24 3/8

Top blocks supported on 3/16 x 2" Angle are now level.

South cavity 10 x 24 3/16 x 24 3/8

EXP # 33

Instrument Check on 11-14-72 **Source** 10 mc ^{60}Co

875 Volts

PM-1 Bal 9.70 **Low Trip** OK : **Trip** OK

IC-1 3×10^{-10} **Meter Trip** OK **Fast Trip** Scram Tables OPIW 1.992

IC-2 3×10^{-10} **Meter Trip** OK Monitor Alarm

IC-3 1.5×10^{-9} **Calibration** DWM A OK DPIE

IC-4 1.5×10^{-9} **Calibration** DWM B OK 1.993

Red Lite OK C OK

Source Drive OK 2 x 2 x 2 Array of 20.962 kg units.

Bypass OK 4 ea unitcells 10 x 12 x 12 South

Inst Range OK 4 ea " " 9 x 12 x 12 North

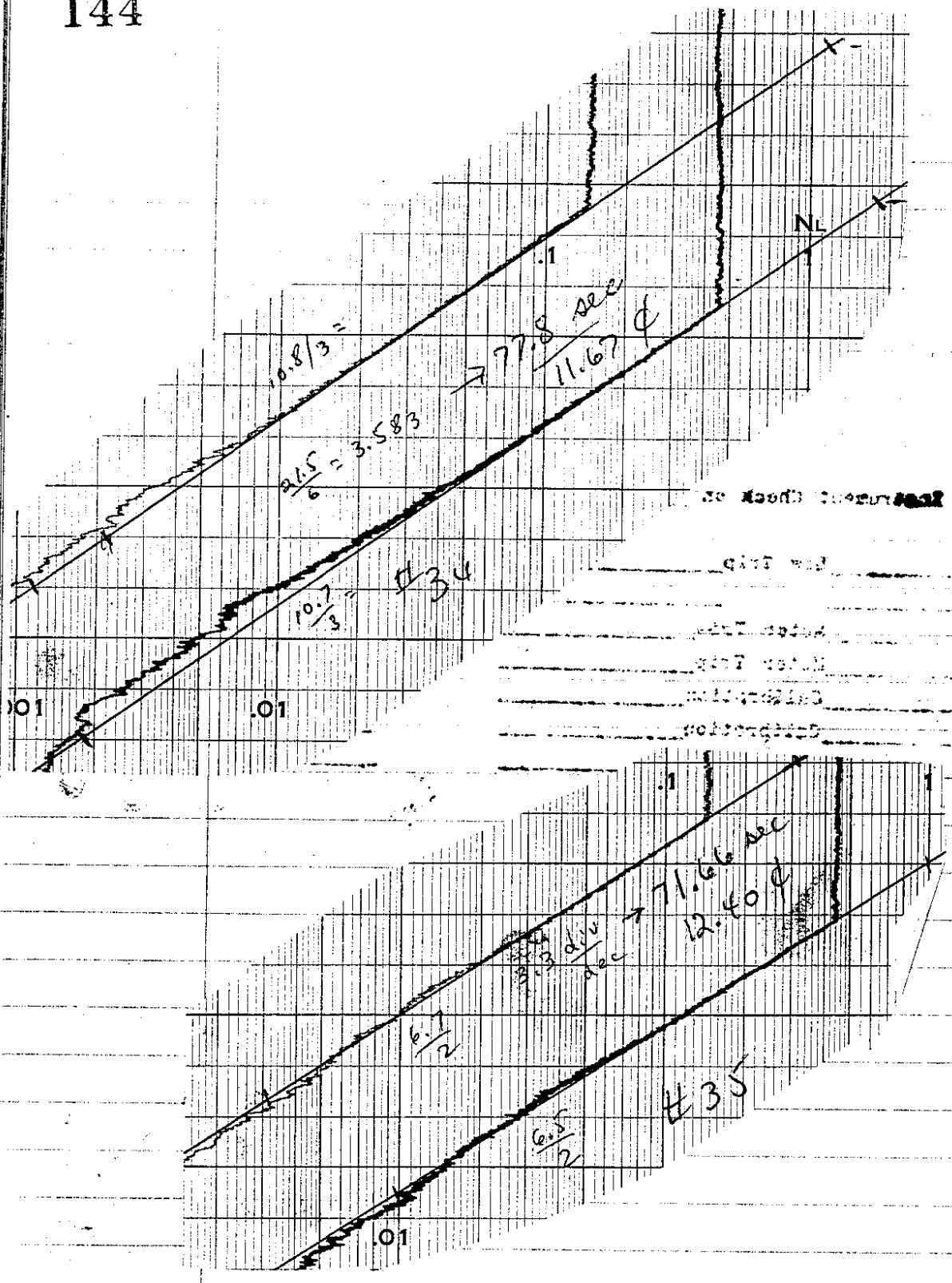
SDR OK

1:42 PM Start Assembly

1:51 Tables in contact with concrete 0.148

0.148

Subcritical IC-2 $0.35 \times 3 \times 10^{-11}$


.1
1
.01
.01
N_L
$10.8/3 =$
$\rightarrow 77.8$ sec
11.67 ¢
$\frac{9.5}{6} = 3.583$
$\frac{10.7}{3} =$ #34
.1
1
.01
$\rightarrow 71.6$ sec
12.40 ¢
$\frac{6.7}{2}$
$\frac{6.5}{2}$
#35

EXP# 34

Add 1 ea. 5 kg on west unit South Table

2[4] Start Assembly No. 2469

@ 1.015 W } IC-2 = $0.35 \times 3 \times 10^{-11}$ 5217 g extra
1.015 E }

2[17] On Positive Period DPI W .683
E .685
2[22] Start to Lr
2[29] Level DPI W .739 Δ = 056
E .741 Δ = 056

$\frac{+11.67¢}{.056} = 208.4¢/in.$

$\frac{142.3 + 208.4}{2} \times .640 = \frac{112.2}{-149.6}$ ~~133~~ ¢ super critical
-37.4¢

Exp. # 35

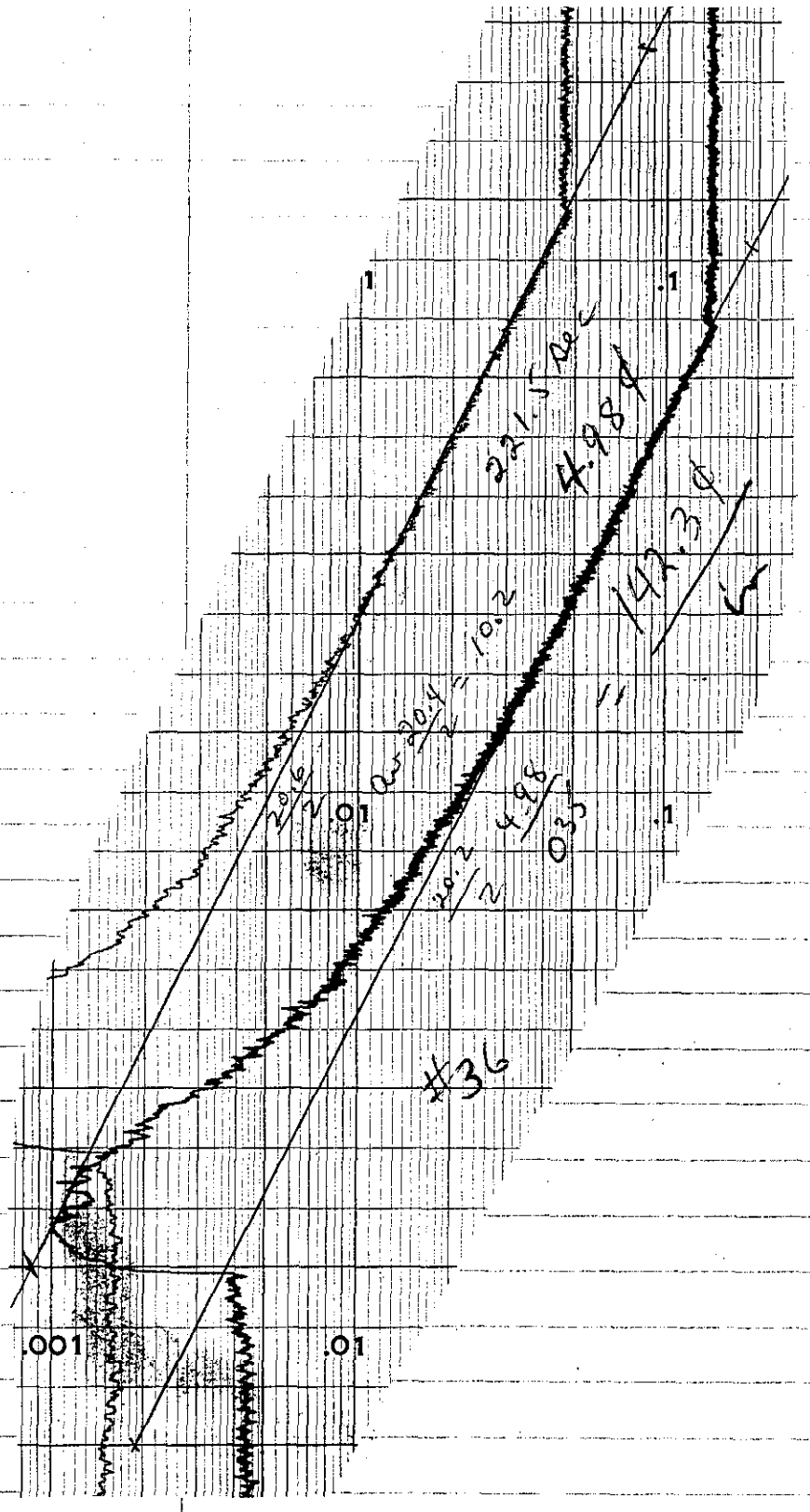
Remove 1 ea 5 Kg from west unit South table
Add 2 ea 1/4 X 5 X 5 3.8 Kg to west unit South table. 0955 – 19169 1914 – 19

3[11] Start Assembly
3[29] On Pos Period DPI W .405
E .411
42 Level W .470 Δ = 065
E 476 Δ = 065
11 Shut Down +12.40¢

$\frac{12.40¢}{.065} = 190.8¢$

$\frac{190.8 + 142.3}{2} \times 0.373 \times$ ~~140.8~~ $= \frac{62.1}{}$ ~~97.2~~ ¢ super critical

5.2 – 3.8 = 1.4 kg worth ~~62~~ ¢ Approx.
112.2 – 62.1 = 50.1¢ ~~35.8~~ ¢/kg


1
.1
.01
.001
.01
.1
#36

Exp #36

Remove 1 ea 1/4 x 5x5 U(90) *0955 → 19169

On Web Unit 1 ea 1/4 x 5x5 remains!

44.24 x 1.8 = 79.7¢

3 52 Start Assembly
4 08 Concrete in contact DPIW 0.148
E 0.150
On Pos Period
4 17 Start to level
4 24 Level 0.183 Δ = .035
Shut Down 0.185 Δ = .035

4.98 ¢/.035 = 142.3 ¢/in

142.3
190.8
333.1 / 2 = 166.55 ¢/in. av x .473 / .184 / .289 = 48.13 ¢ per 1.8 kg

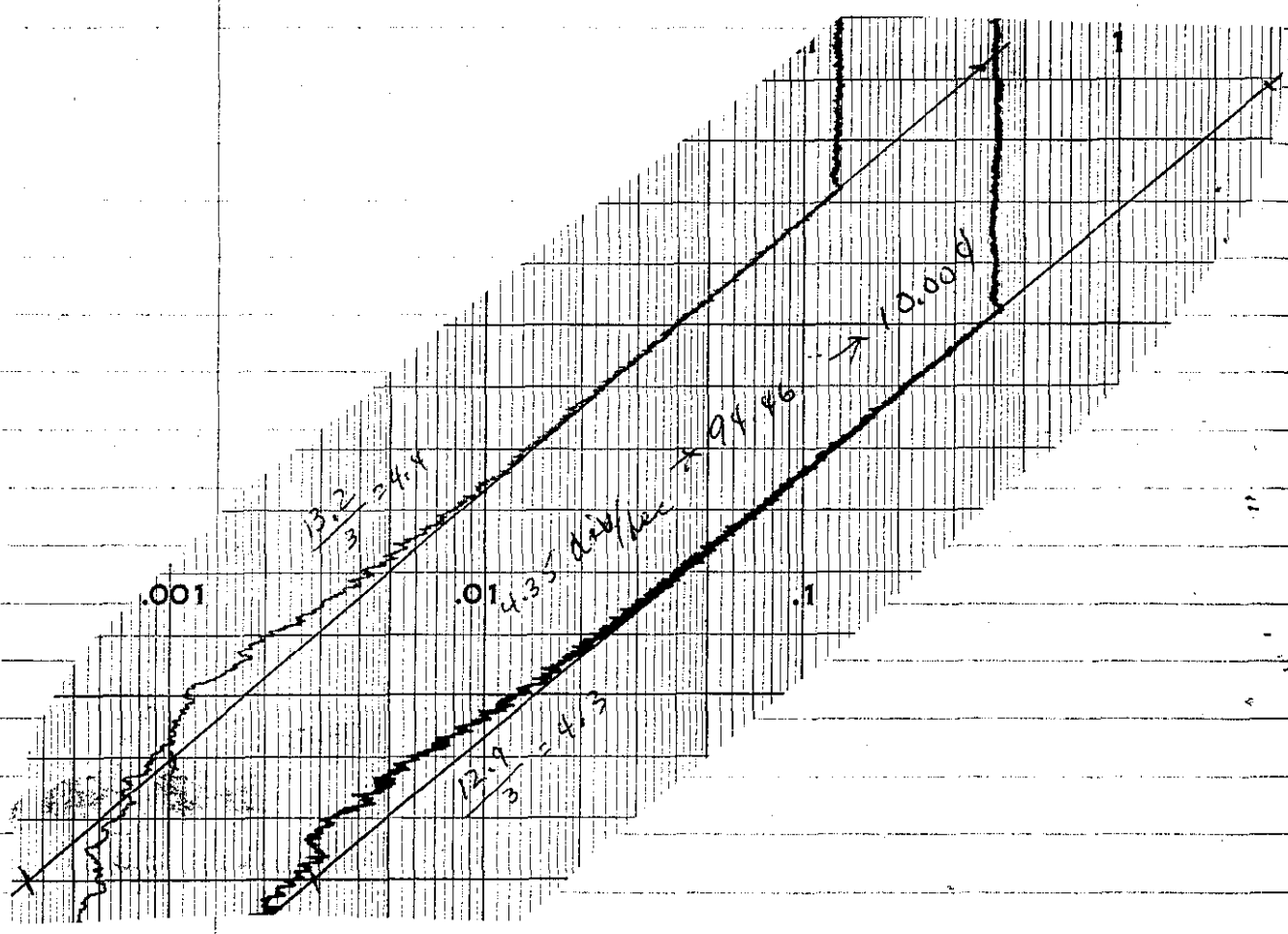
25.3 ¢/kg

---

array 2x2x2 System is subcritical by about −48 + 5 = −43¢ ± 7 = −36¢ vs −37.4¢
without 1/4 x 5 x 5 unit.
If tables closed .05 x 140 = 10.2¢ → −43+7 = −36¢

Worth of 5.2 kg of U as cyl. from Exp #34, 35, 36
112.2 − (−36) = 148.2

2 ea 1/4 + Δ (5.2 − 3.8)
= 96.26¢ + 53.3 = 149.6¢ vs 140
+ 208.4 + 190.8 / 2 = 199.6 ¢/in x .473
x .267 = 53.3 K


1
.001
.01
.1
10,000
94.46
13.2/3 = 4.4
12.9/3 = 4.3

EXP #37

Nov 15, 72 Loading for 9 x 24 3/16 x 24 3/8 North
9 x 24 3/16 x 24 3/8 South (was 10" wide)

Unloaded U(93) ~~on~~ both Tables

Unloaded concrete blocks partially on South
Made an ~~error~~ 2ea 9in cons of 3" al and 6" CH_2
Closed Tables DPI W = 0.112
DPI E = 0.113

Aligned blocks to the best of our ability
Loaded all concrete blocks DPI W = 0.106
separate tables E = 0.107
Loaded 8 units of 2 x 2 x 2 array
DWM CC

Instrument Check on 11/16/72 Source 10 mc ^{60}Co

FM-I Low Trip OK Trip OK

IC-1 3 x 10^{-10} Meter Trip OC Fast Trip OC
IC-2 3 x 10^{-10} Meter Trip Screwed MONITOR ALARM
IC-3 1.5 x 10^{-9} Calibration DWM A OC
IC-4 1.5 x 10^{-9} Calibration DWM B OC
Zero DPI W @ 1.991 DPI W @ 1.991 C OC

Source Insert Rep OK (min.) Bypass OC, Δp OK Rad Lvl Pers. OK

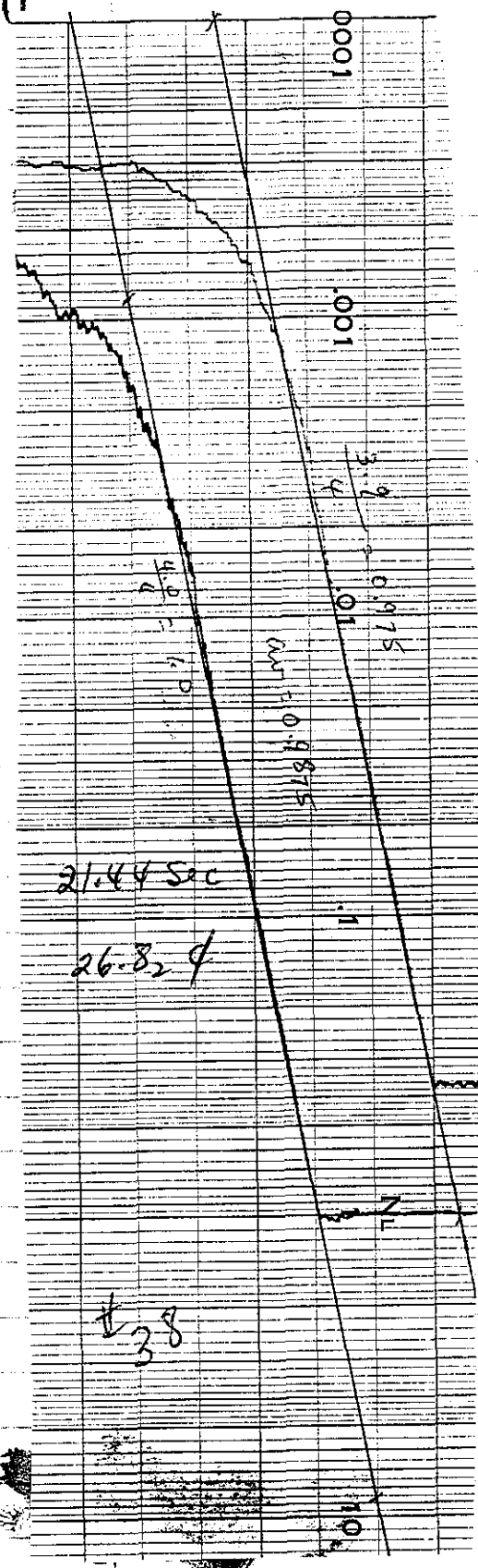
EXP #37 (Cont.)

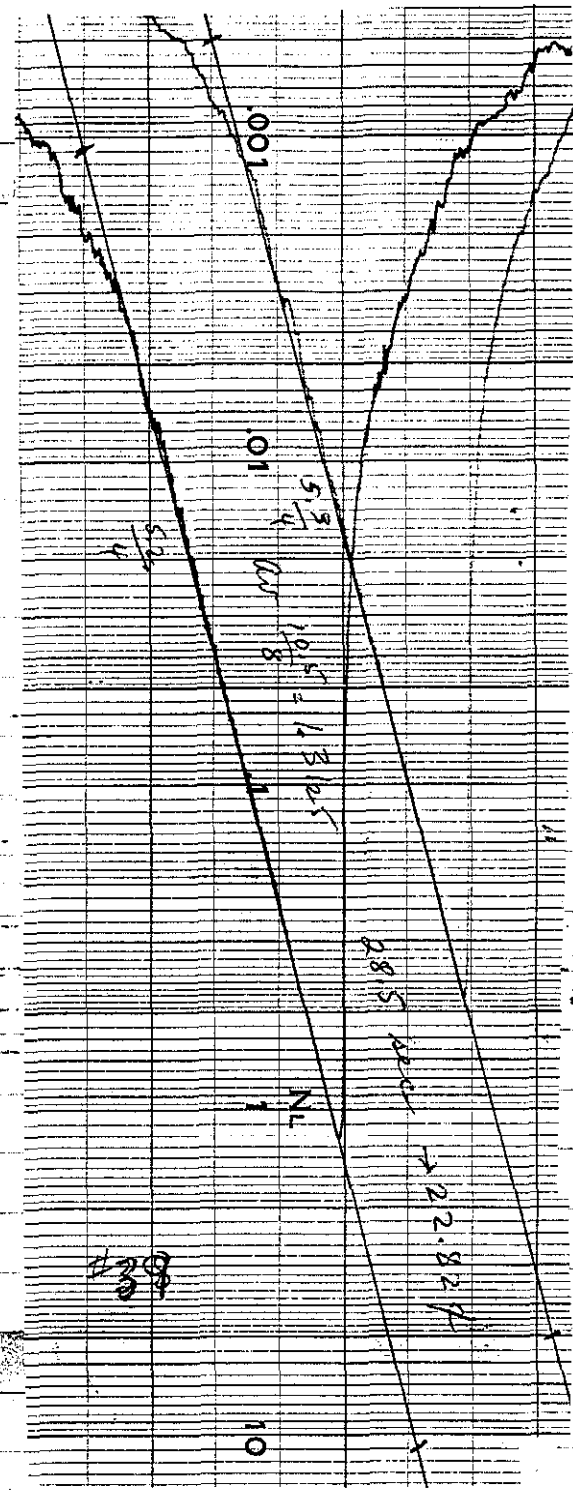
8^{48} Start Assembly
9^{05} On Pos. Period DPI W .320
E .325

9$^{10\frac{1}{2}}$ Start to Level
9^{17} Level W .371 Δ = .051
E .375 Δ = .050

371 375
106 107
265 268

+10.00 ¢/.0505 = 198.0 ¢/in
~~+46.1~~
Upper limit of Pepcu = x.266 ≈ 52.8 ¢


.0001
.001
.01
.1
1
10
N_L
$\frac{3}{4}$
$\frac{1}{2}$
$\frac{1}{4}$
$\frac{0}{4}$
$\frac{1}{4}$
$\frac{2}{4}$
$\frac{3}{4}$
$\frac{4}{4}$
$w_{sat} = 0.9875$
$w_{sat} = 0.9875$
21.44 sec
26.82 #
#38


.001
.01
.1
1
10
N_L
$\frac{3}{4}$
$\frac{1}{2}$
$\frac{1}{4}$
$w_{sat} = 1.31$
28.5 sec
22.82 #
#38

EXP #38

Add 4ea $\frac{1}{4} \times 4\frac{1}{2} \times 4\frac{1}{2}$ Steel (Hot Rolled) Plate on 4ea Top Units. To reduce reactivity

9 10	Start Assembly	W 249	
9 40	On Pos Period	E 252	
9 42	Start n Level	W 384	Δ = 0.135
9 49	Level	E 387	Δ = 0.135
11	Shut Down	26.82 / .135	= 198.7 ¢/in

Note. 4ea Fe $\frac{1}{4} \times 4 \times 4$ has increased reactivity !

384	387
371	375
013	.012

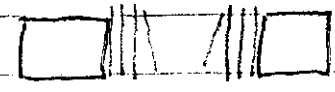
av .0125 × 198.4 = 2.48 ¢

increase in reactivity for Fe on top of units

EXP #39

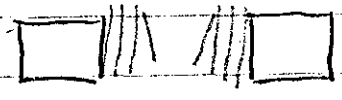
South Table

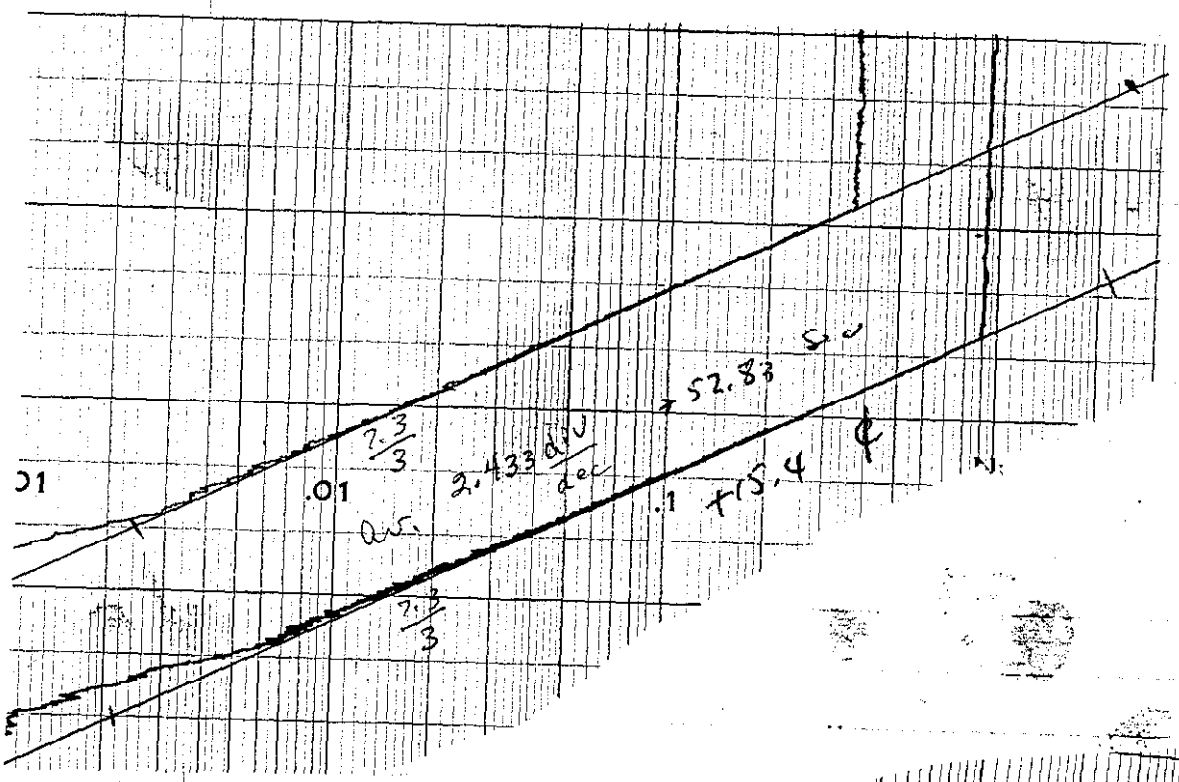
Add 12 ea $\frac{1}{4} \times 4\frac{1}{2} \times 4\frac{1}{2}$ Steel Plates to South Table, see sketch

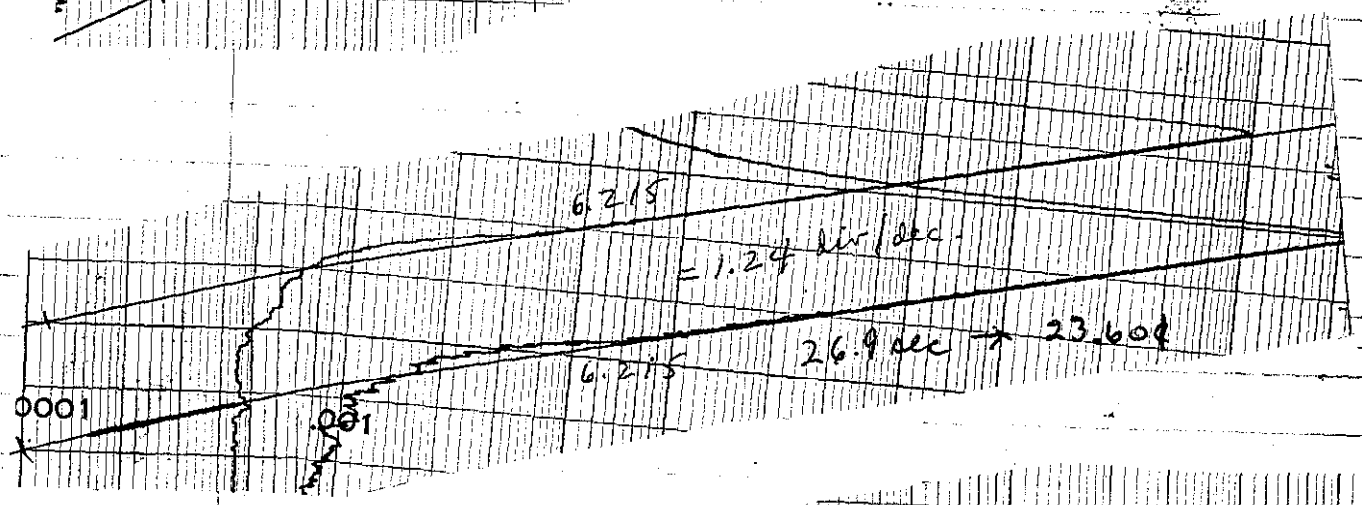


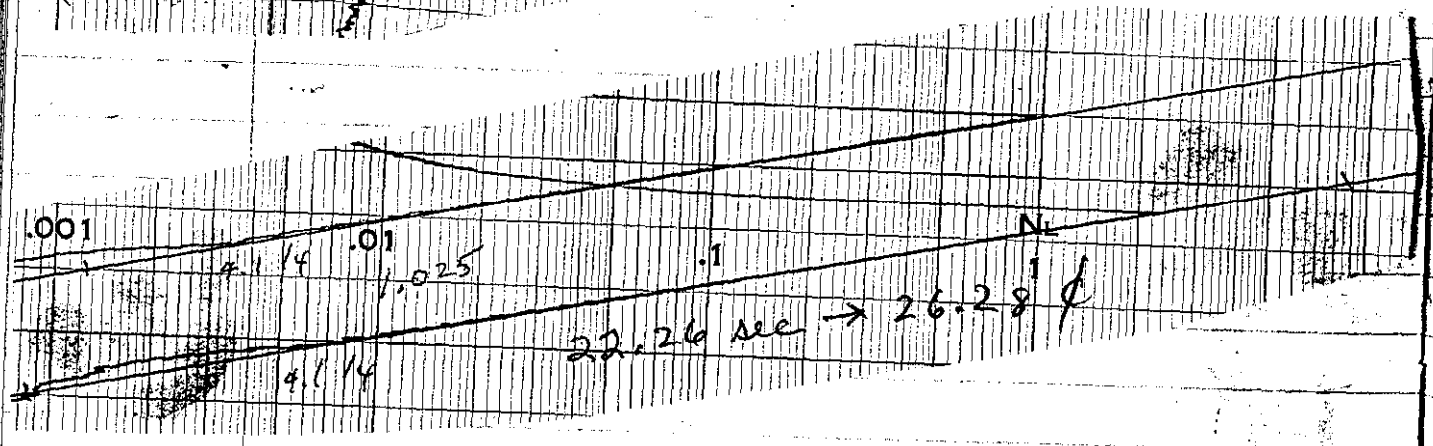
10 05	Start Assembly	114	
10 18	Tables Closed	116	
	On Pos Period		4ea added for #40
	And Period Shut down		

g = 22.82




.01
.01
2.433 div/dec
.1
52.83
7.3/3
7.3/3


6.215
= 1.24 div/dec
6.215
26.9 dec → 23.60¢
.0001
.001


.001
.01
.1
4.114
.025
4.114
22.26 dec → 26.28¢

EXP #40

Add 4 ea now 16 ea 1/4 x 4 1/2 x 4 1/2 Steel Plates

10:38 Start Assembly
10:45 On Pos Period DPI W 114
E 114
Start to Level W 204 Δ = .090 > .0905
10:59 Level E 205 Δ = 091
10:59 Shut Down, Screw Only
+15.4 / .0905 = 170.2 ¢/in

$\rho_{EXC} = \frac{4 \times 8.2 = 32.8}{48.2}$ for 2x2x2 array only
$\frac{21.8}{26.4\ ¢}$ less Alum Support

EXP #41

Remove 4 ea from adjacent to lower east unit on South table

South Table

11:00 Start Assembly E W
11:09 On Pos Period 23.6 ¢
Tables Clear DPI W. 114 E. 114
React 4 ea 1/4 x 4 1/2 x 4 1/2 Steel = (41) - (40) = 23.6
15.4
8.2 ¢
32.8

EXP #42

Add 4 ea 1/4 x 4 1/2 x 4 1/2 Fe now 16 ea (same as 40)
Add Alum mocks of Alum support structure on North table ρ (#42) - ρ (40) = ρ (Alum/2)
11:29 Start Assembly
11:37 Tables Closed DPI W 114 E 113

Manual Scram Test Shut-Down
10.9
ρ(Alum) = 2(26.3 - 15.4) = 21.8 ¢

Measured Average Dimensions of
Concrete Blocks

11 ea @ 4" = 44 1/4 in. high

7 ea @ 8" = 56 1/2 in. wide

2 ea @ 16 = 32 in. long or Deep.

Average Block Dimension

4.023 x 8.071 x 16.00 in

Average Block Weight $\frac{14000}{360} = 38.89$

38.89

$V = 519.514 in^3$ 8,51328 l

$$\text{Density} = \frac{38.89 \times 1/2.2}{8.51328} = 2.0764$$

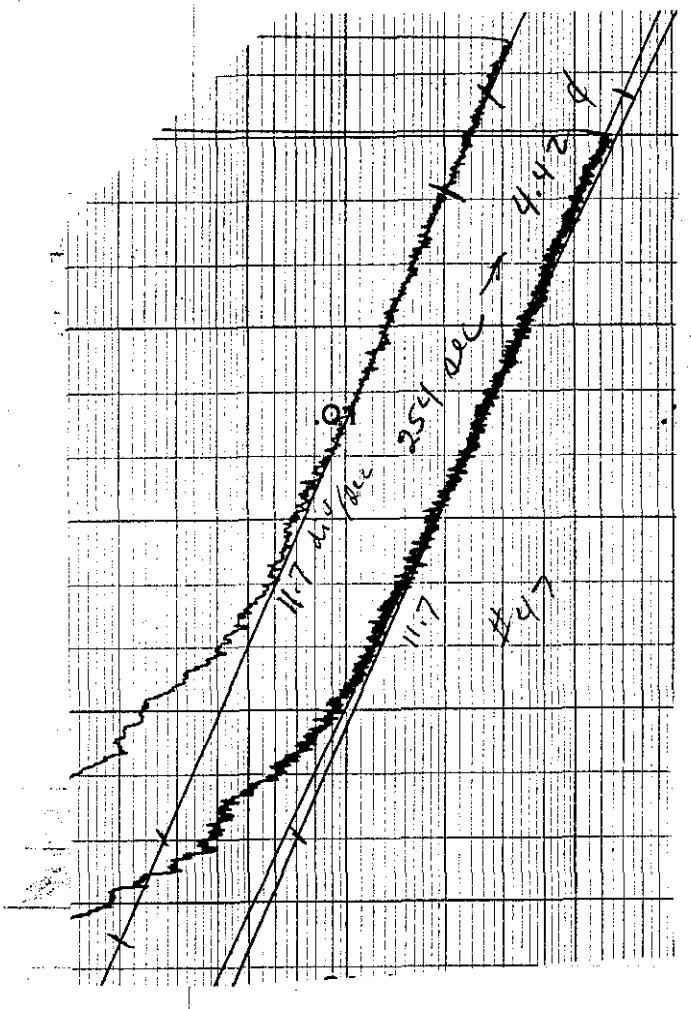
X − 16.00 = 40.64 cm
Y − 16.142 = 41.00 cm
Z − 16.092 = 40.88 cm
av 40.84 inches

12.069 = 30.66

8.046 = 20.44

Average weight = $\frac{18.314 kg}{8.51328} = 2.15_{12}$ g/cm³

from 10 blocks



#47

φ ($\frac{1}{2}$ of $16" \rightarrow 8"$ West Face) = ~~φ~~ (48.2¢) − S (47)

4.4

43.8¢ − ~~4.8~~ 3.3 = ~~39.8~~ 40.5 ¢

worth of complete reflector $16" \rightarrow 8"$ = (×12)

= 4.86 ¢

Δk = 0.0316

Correction for Tube Dispersion

	.126	128
	.106	107
	.020	021

Or .0205 × ~~197~~ = ~~20~~ 4.05 Cents

162 = 3.3

EXP #43

Reduce Concrete Thickness on EAST West and ~~Top~~ on North Half.

1[22] Start Assembly

1[30] Tables Closed DP1 W .111 E .119

Subcritical IC-2 → .425 x 3x10^-11

EXP #44

Add Concrete to Top — now 16" Thick

Now East and West only 8" Thick on North Table

1[52] Start Assembly

2[00] Tables Closed W .128 E125

Subcritical

8" Here E+W on North worth more than 48.2 ¢

EXP #45

Add Concrete to East now 16" Thick

Only West on North Table now at 8".

2[20] Start Assembly pushed off at .218 — .228

EXP #46

Realigned Stacked concrete.

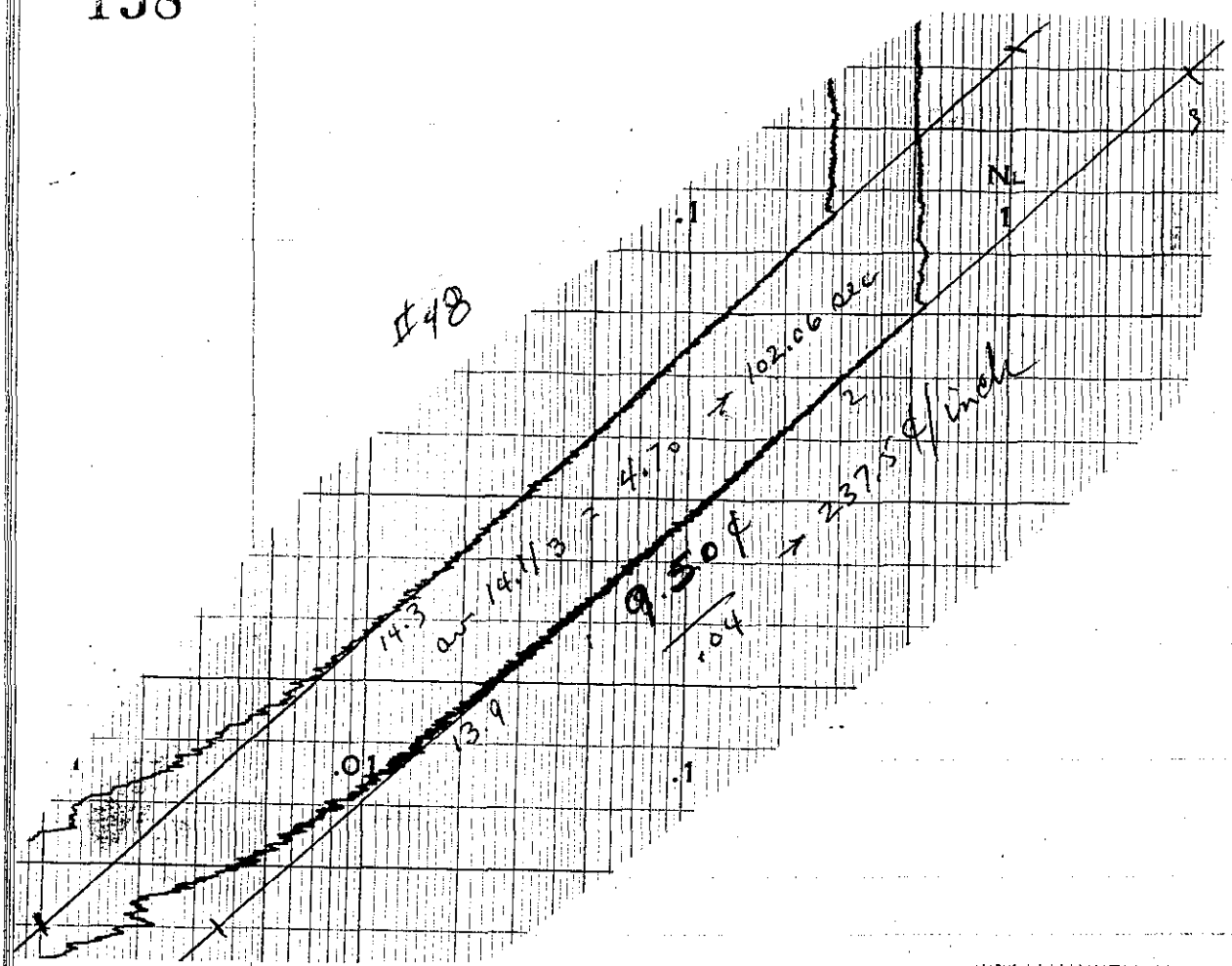
2[32] Start Assembly pushed off at .220 — .227

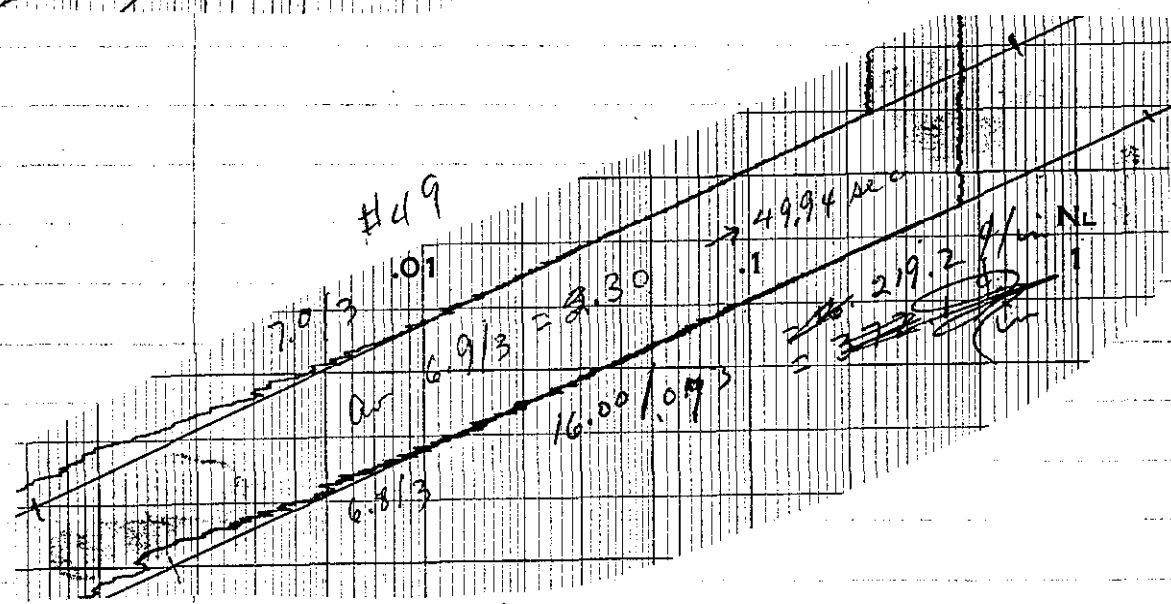
EXP #47

Realigned Stacks

2[52] Start Assembly 2[59] Tables Closed @ .126 - .128

3[07] Shut Down


#48
NL
1
.1
.01
102.6 psig
14.3
14.1/3 = 4.70
9.50 #
237.5 #/inch
13.9
.04
.1
1
2
3


#49
.01
.1
1
49.94 psig
7.0/3
6.9/3 = 2.30
6.8/3
16.00 #
.09
219.2 #/in
NL

EXP #48

Reduced 16" → 8" reflector on ~~East~~ & West ends of North and South Tables, East North Table Only 8"
added 5kg No 2469 to Top West Unit South Table.
Est Δg = −120 + 149 = +29 +

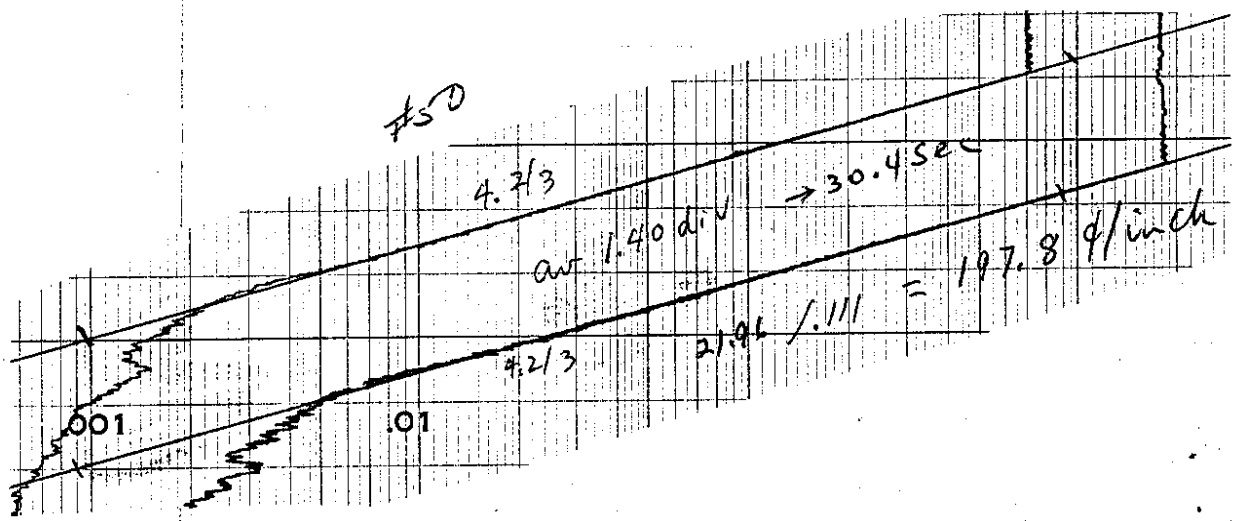
342 Start Assembly
350 On pos Period W .5175 E .523
359 Start to level
405 Level W. .558 E .563
.040 040
Shut Down .46 × 22 = 1.01 # super

EXP #49

Remove 5kg piece. No 0955 = 1916 g
Add 2ea 1/4 × 5 × 5
On South Table 3.8 kg
406 Start Assembly
416 On Pos Period DPIW .244 E .248
19 Start to Level
25 Level " .317 .321
" Shut Down 043 .043

.317 321
106 107
211 214

g(est) ∞ .2125 × 210 #/in = 44.6

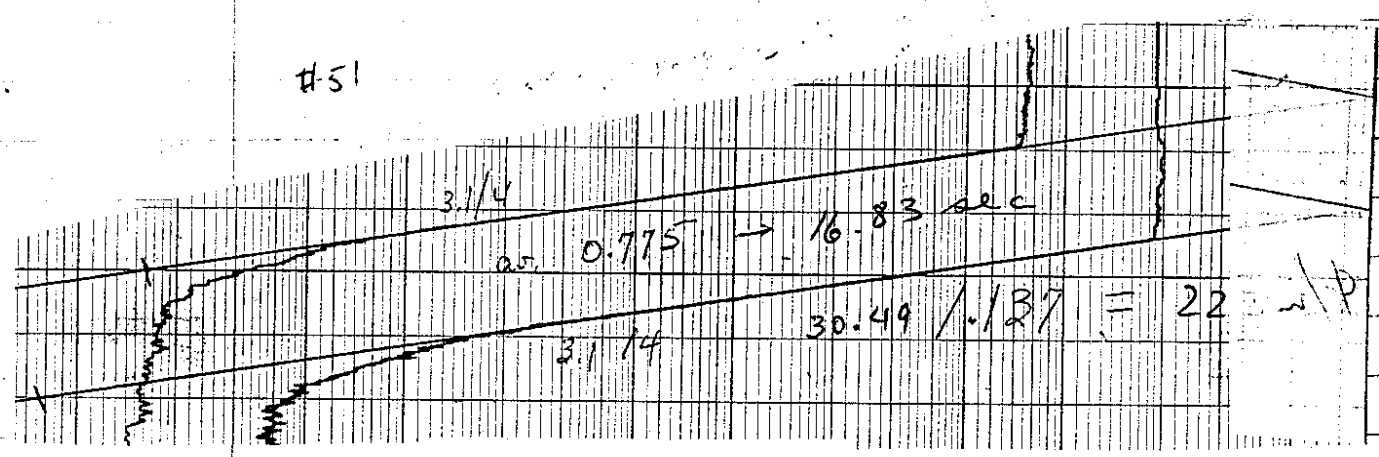


React of ½ East and West Reflector changed from 16 – 8 in.

$S(\ ) - S(50) - 157.5$
$48.2 - 22.0 \quad \frac{26.2}{131.3¢}$

for ½ E+W reflectors from 16 – 8"
West Reflector only 131.3 – 40 = 91.3 ¢

Worth of 1 ea ⅛ x 5 x 5 = 30.5 ¢



EXP # 50

Remove 2 ea 1/4 x 5 x 5 U(93) } West Unit on North
now 3 ea 1/8 x 5 x 5 U(93) on } East and West Units Top South
#1048
1914
1024

Instrument Check on 11-17-72 Source 10 mc ^{60}Co

Bal 10.0

PM-1 875 Volt Low Trip Scram Tables Hi Trip OK

IC-1 3×10^{-10} Meter Trip OK Fast Trip OK

IC-2 3×10^{-10} Meter Trip OK Rad Monitor Alarm

IC-3 1.5×10^{-9} Calibration Down A OK

IC-4 1.5×10^{-9} Calibration Down B OK

C OK

Red Lite OK

Bypass OK

DP OK

8 52 Start Assembly

9 00 Tables Closed On Pos Period DPI W.117 E.116

Start to Level

9 11 Level & Shut Down .227 228

Δ .110 .112

av .111

EXP # 50

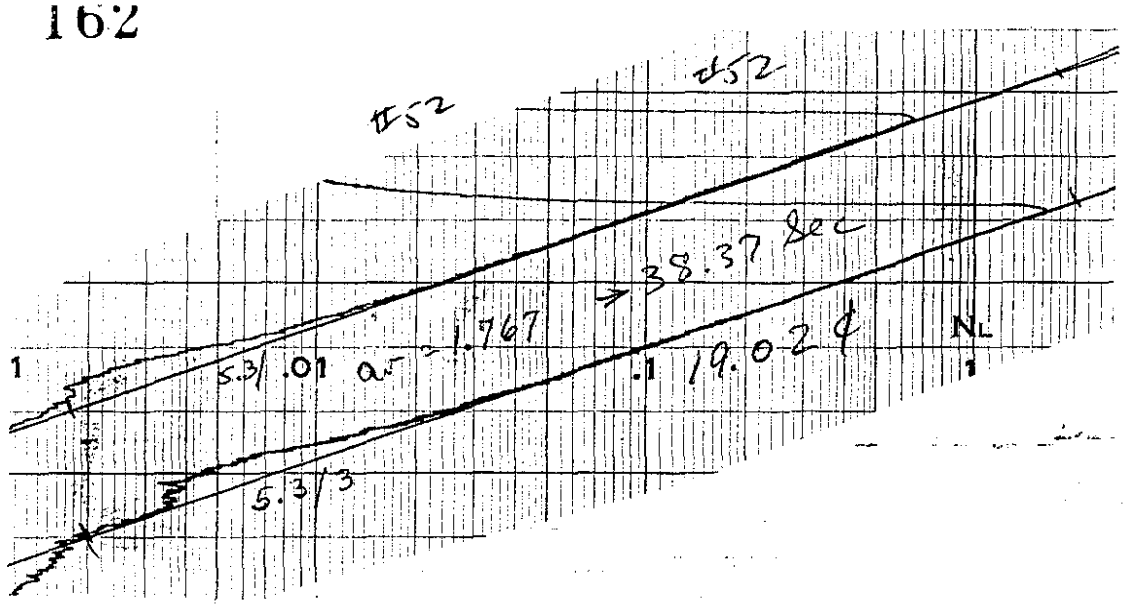
Add 1 ea now 4 ea 1/8 x 5 x 5 U(93)

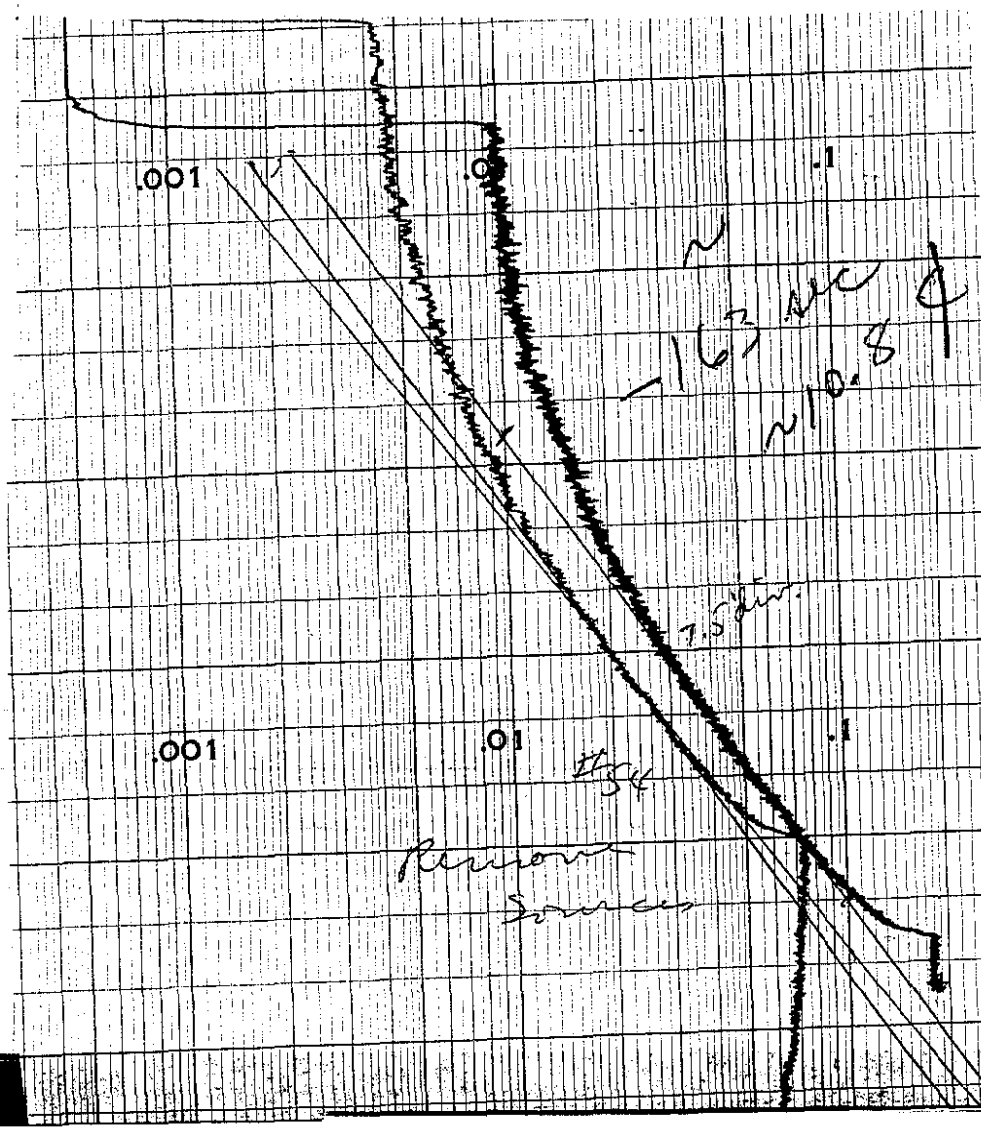
9 30+ Start Assembly - Stop to Inspect CH_2 on pad. (R.D. Parten)

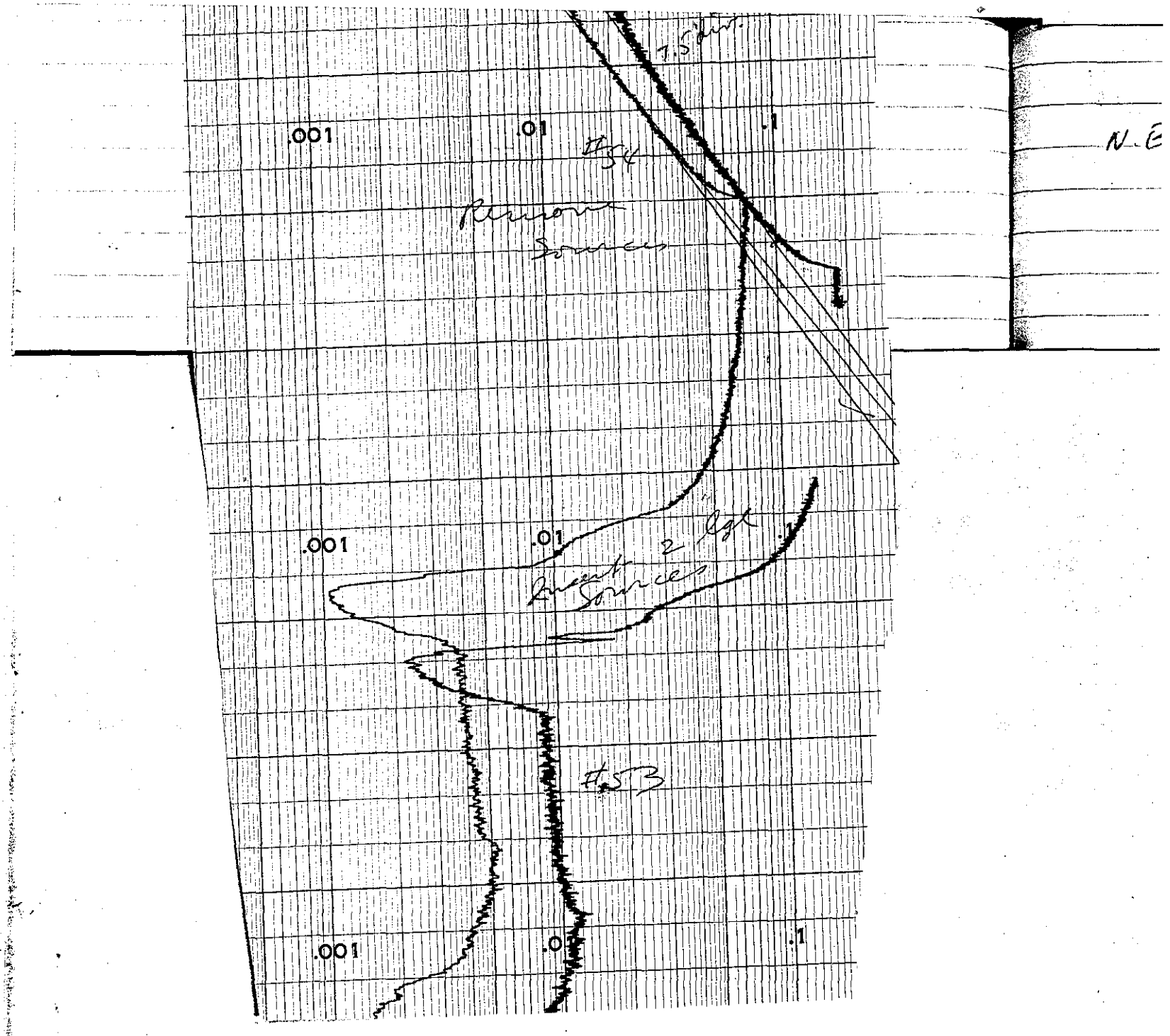
10 01+ On Pos Period DPI .224 229

10 03 Start To Level .361 .366

Level and Shut Down .137 .137


H52
H52
38.37 Sec
5.3/.01 a = 1.767
19.024
NL
1
.1
1
5.3/3


.001
.01
.1
N
163 MC
N10.8
7.5 div.
.001
.01
H54
Resonant
Source


1.5 cm.
.001
.01
.1
N. E
Ft 4
Ambient
Sources
.001
.01
.1
Ambient 2 Agt
Sources
Ft 3
.001
.01
.1

EXP # 52

Reduce Top Reflector from 16 in to 12 in.
East Reflector at 8 in on North Table
16 in on South "
West Reflect at 8 in on N & S Tables

10 43 Start Assembly
52 On Pos Period DPIW .225 = .228
10 55 Shut Down

React Change = 30.44 - 19.02 = 11.47 ¢

EXP # 53

Reduce Top Reflector from 12 in to 8 in.

11 02 Start Assembly
11 10 Tables Closed DPIW 113 ~~114~~ 118

Subcritical, slow negative period $h = \frac{.01}{10^{-11}}$
separate with screw

EXP # 54

Add 2 ea Lge. Pu-Be Sources.
Tables Closed DPIW .112 .116
Raise Power to 1.8×10^{-10} on IC-2
Remove Source for Neg Period (To Source Hole.)
τ 10.8 cents

N.B Source effects noted on EXP # 53 ! and # 54 decay

.01
.1
1
.01
.1
1
.01
.1
1

EXP # 55

~~Remove 1 ea 1/8 x 5 x 5 add 1/4 x 5 x 5.~~

~~3 ea 1/8 x 5 x 5 remain~~ (~25¢)

Add 1 ea 1/16 x 5 x 5 U(90) to top West unit on top & South half. (this unit now 3/16 x 5 x 5)

4 ea 1/8 x 5 x 5 remain. g(est) ~ +10¢

12 42 Start Assembly Table closed 1.2¢

52 On Pos Period Smco Out DP1W .111 - .115+

EXP # 56

Add 1 ea 1/16 x 5 x 5 U(90) to top East unit South Table

Now { 2 ea 3/16 x 5 x 5 } { 2 ea 1/8 x 5 x 5 }

1 17 Start Assembly

Stop for Exit Cell Run @ 1.90 in.

~ 134 Restart

136 On Pos Period. 12.7¢ .112 - .114

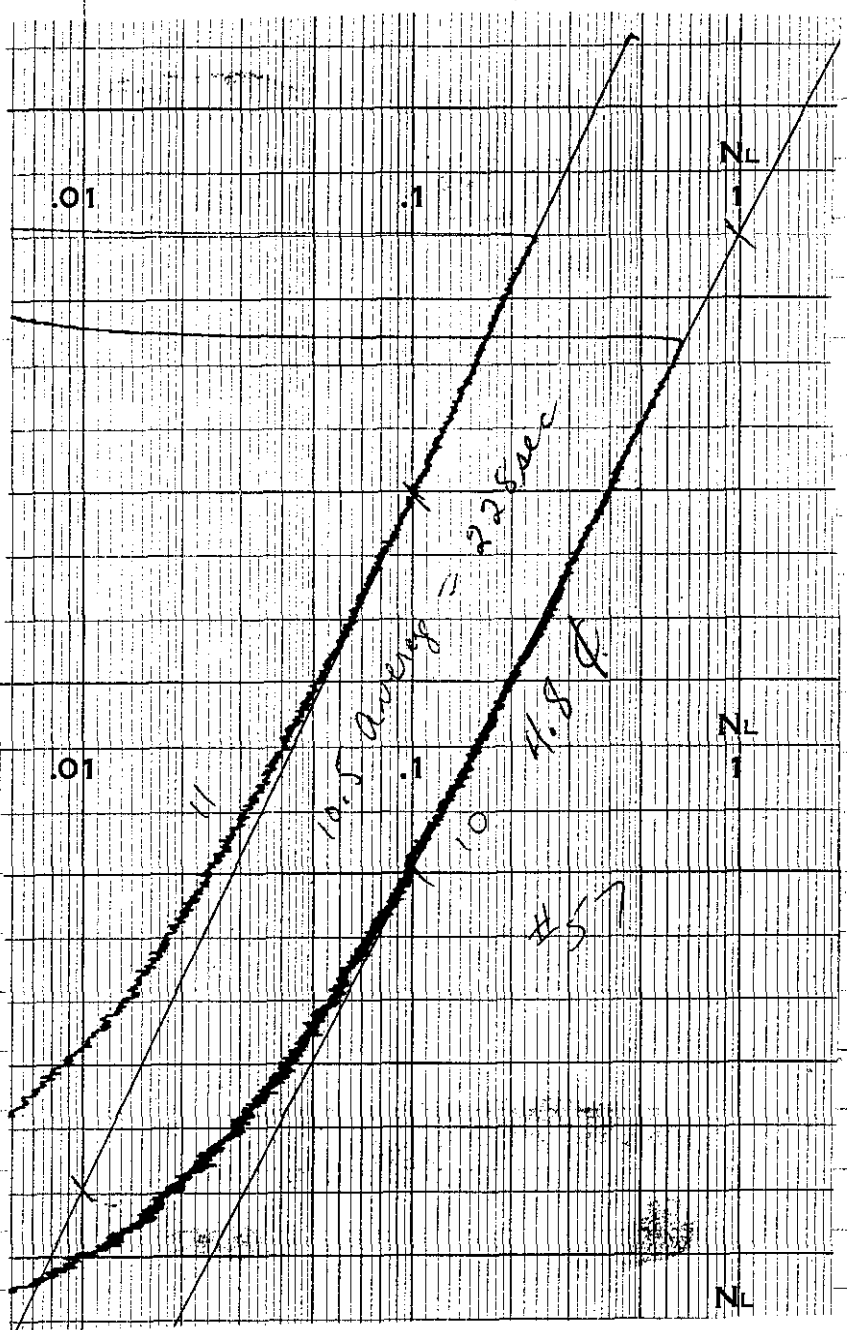
141 Shut Down.

---

g (1/16 x 5 x 5) = 12.68 - 1.2 = 11.5 ¢

g (12" → 8") = 19.02 - 12.68 + 2(11.5) = ~~30~~.

6.3
23.0
29.3 ¢



8/28/85 4.8
#57 -21.8
-17
= -.0011

See Exp 13

NS .9989

KWM

OK

EXP #57

Remove 16" → 8" concrete on East Side of South table - Add 2 ea 1/16 x 5 x 5 to units on North Table

Now Top Reflector 8" concrete
East & West Refl. 8"
Bottom - North - South 16"

Extra U 3/16 x 5 x 5 on all 4 top units!

1 50 Start Assembly
stop at 7.9° in
1 57 Remove
1 59 + Tables Closed DPIW .107 E .109
On Pos Period
2 Shut Down

React for concrete 16 → 8 on East - South Table Only

12.7 - 4.8 + 23.0 = 30.9 ¢

React for concrete 16 - 8 on E W and Top

48.2 - 4.8 + 4 ea 3/16 x 5 x 5 43.4
4 ea 1/16 = 4 x 11.5 = 46.
4 ea 1/8 = 4 x 30.5 = 122.
211.4 ¢
.0135

Summary

2×2×2 array $\rho = 48.2\,\phi$

Alum cor 21.8

2×2×2 array 26.4 ¢ $\beta = .069$

$= 1.0017$

Cell 9×12×12 nom.

EXPTS

Repeat #57

Instrument Check on _____ Source _____

FM-1	_____	Low Trip _____	Trip _____
	_____	_____	_____
IC-1	_____	Meter Trip _____	Fast Trip _____
IC-2	_____	Meter Trip _____	_____
IC-3	_____	Calibration _____	_____
IC-4	_____	Calibration _____	_____
	_____	_____	_____

8 UNIT ARRAY WITH PLASTIC BONDED VERMICULITE (PBV)

PBV is very loosely bonded - very poorly mode. Sizes are not uniform.

Material was supposed to be 1 x 10 x 10 and 2 x 10 x 10 pieces but tolerances were so poor that we cut the material on the band saw to 9 1/2 x 9 1/2

~~Failed~~

First exp. will be with cells 10 x 10 x 10" high

Core ~~Cell~~ measurements 20" x 10" x 20 1/2

20 x 10 x 20 1/2

table At 0" AND 0 Rev.

DigiTiN Reading West .100 East .100

Zero DPI at full separation gt @ 1.992

Instrument Check on Dec 1, 72 Source 10 mc ^{60}Co

PM-1 _____ Low Trip Scram Table Trip OK

IC-1 _____ Meter Trip OK Fast Trip OK

IC-2 _____ Meter Trip OK

IC-3 _____ Drive Down

IC-4 _____ Drive Down

Rad Mon
A B C
OK OK OK

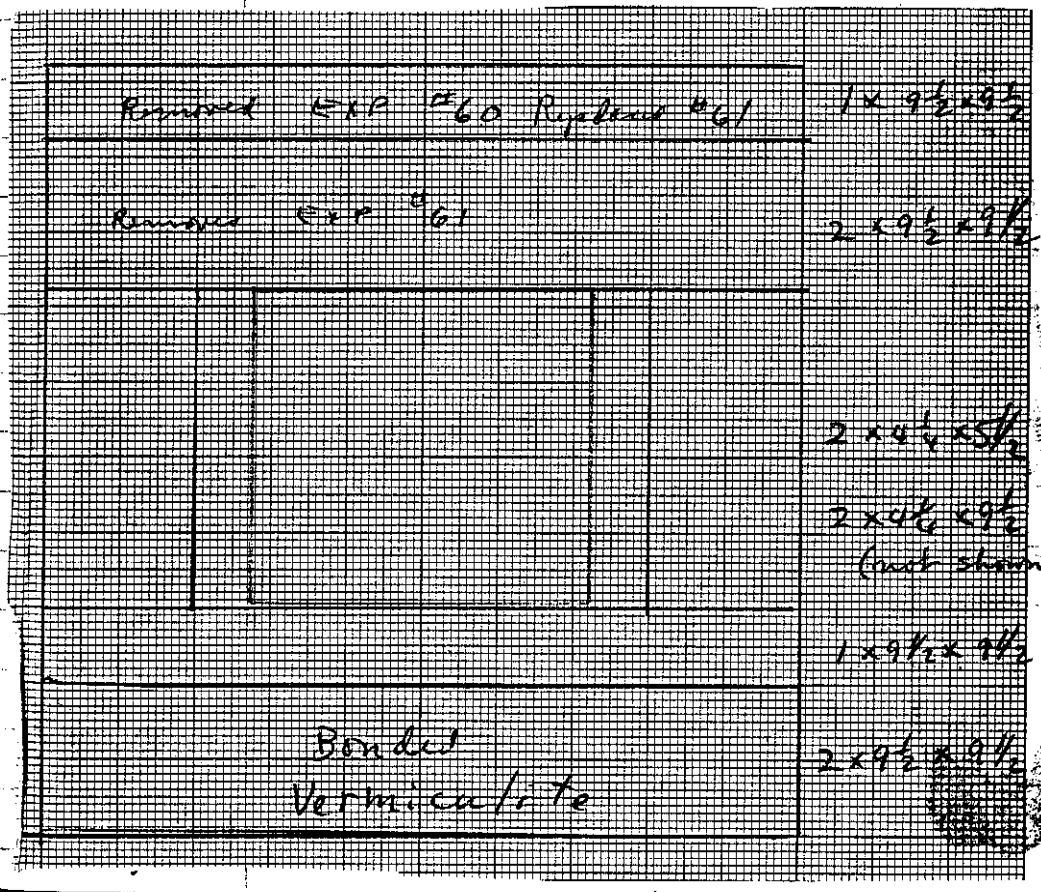
EXP #58

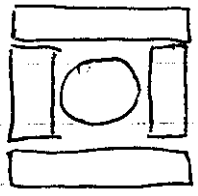
2 x 2 x 2 PBV Array CH_2 Reflectes Except for Top. Source M229 on Mg-J Fixed Table

Purpose: Check for Source Multiplication & Fast Resp. for known Sub Crit system. Zero Position Rd

DP1 W @ 0.1

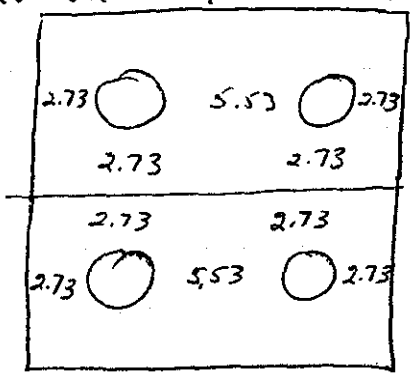
DP1 E @ 0.1





EXP #59

CH_2 Fully Reflected Core Size 20 x 20 x 20½
Source M-230 mounted on Drive on Fixed Table.
Vertical separation of units is estimated to be in the center of a 10.25 high cell.
i.e. $10.25 - 4.25_2 = 6.0$ in.
$\Delta\rho$ = ok, Bypass ok, Reas. ok.



9 31 Start Assembly
9 39 Tables Closed @ 0.100 0.100
No multiplication observed, G = 10 x 10^{-13} Ic-3
.03 → 7.05 x 3 x 10^{-11}
9 43 Shut Down

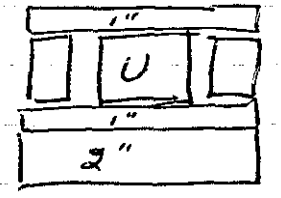
EXP #60

R
Removed 1 ea 1 x 9½ x 9½ from each cell, see note on sketch p 175.
Core Now 20+ x 20+ x 18½
11 06 Start Assembly DPIW 0.100 Source ok, Δρ, Reas. ok
11 20 Table Closed ε 0.099 Bypass ok
Ic-3 → 1.7 x 10^{-11}
-2 → .06 x 3 x 10^{-11}
11 21 Remove Source - Separate
Sub critical

EXP #61

Cell height reduced ~1" removing 1" of Vermiculite on top of each metal unit – 3 in. below

Red Hi ✓
Bypass ✓
ΔP ✓
Source ✓



1 21 Start Assembly
1 32 Tables Closed .099 .099
Subcritical

IC – 2 0.13 × 3 × 10⁻¹¹
3 → 3.7 × 10⁻¹²
4 → 7.5 × 10⁻¹³

Battery not turned on.

Instrument Check on 12-4-72 Source _____

PM-1 _____ Low Trip OK Trip OK

IC-1 _____ Meter Trip OK Fast Trip OK

IC-2 _____ Meter Trip Scram table Bldg Alarm

IC-3 _____ Calibration _____ A OK

IC-4 _____ Calibration _____ B OK

_____ Pres. 0.15 C OK

Red lite

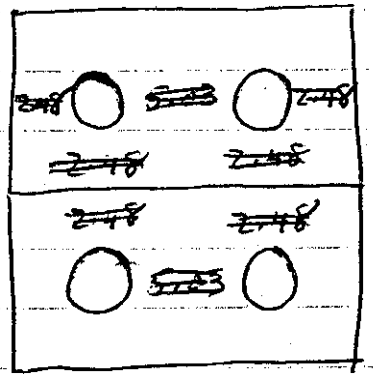
Pers OK

Exp # 62

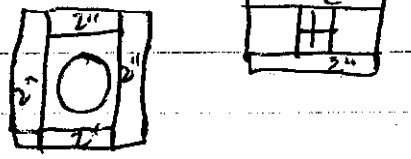
CH_2 fully Refl Core Size 19"x19"x

Source M-230 Mounted on fixed table

~~Vertical Sep. of units is estimated to be~~



Units have 2" Vermiculite on Bottom and top with 2" in center, with A 2" Box Around ea unit



2.48 was ~ 2 3/8 Dwgs 11-6-72

3 08 Start tables together

3 19 17.75 Rev 1.506 W Pos. Rev

1.506 E

18.35 Rev 1.569 W

1.568 E level

3 25 Shut Down

Instrument Check on Dec 6, 72 Source 10 mc ^{60}Co

PM-1		Low Trip	OK	Trip	Scram Table OK
IC-1	3×10^{-10}	Meter Trip	OK	Fast Trip	OK
IC-2	3×10^{-10}	Meter Trip	OK		Rad Mon alarm
IC-3	1.5×10^{-9}	Calibration	Drawn		A OK
IC-4	1.5×10^{-9}	Calibration	Drawn		B OK
					C OK

Red Lite OK
Pers OK
Cyl OK
Bypass OK
Source Inserted,

EXP #63

Vertical separation increased to 4 in. see EXP #61

Assembly on North 16½ in high 9½ x 19

South 17 in high 9½ x 19

844 Start Assembly

853 Subcritical Table Closed 0.100
0.101

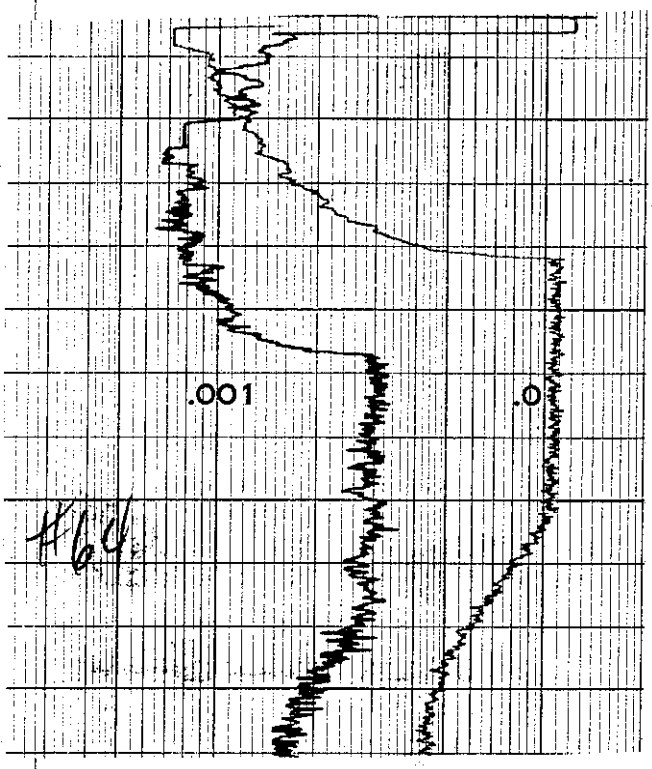
IC-2 → $.37 \times 3 \times 10^{-11}$

4 → 8×10^{-12}

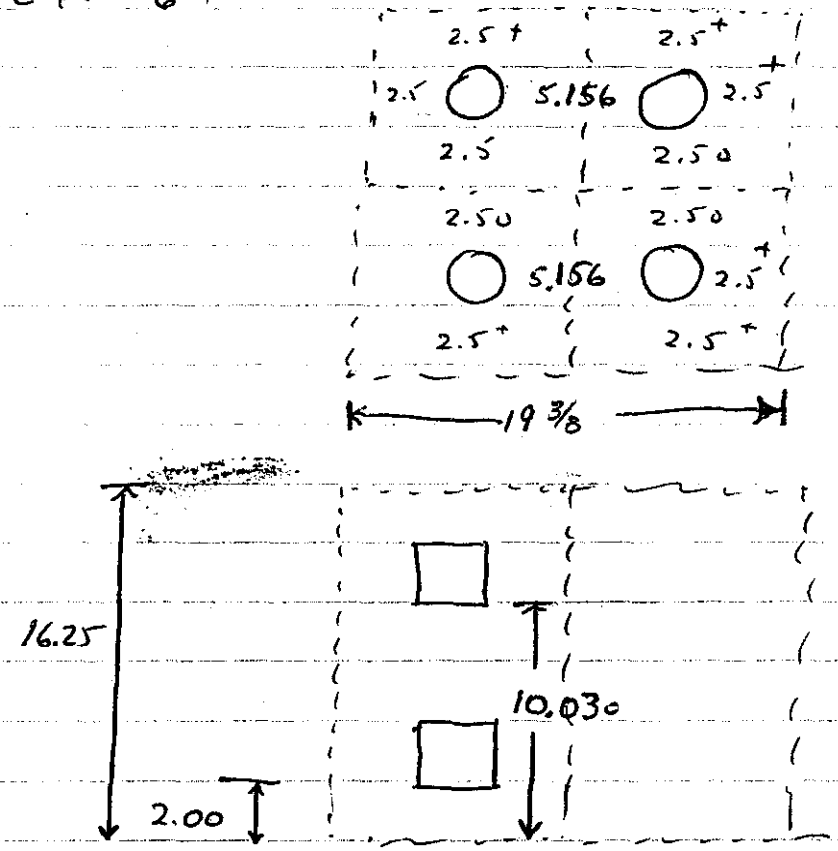
Remove Source Prompt Jump

on IC-2 → $\sim .15 \times 3 \times 10^{-11}$.

Shut Down - To Restack


.001
.0
#6d

Exp #64



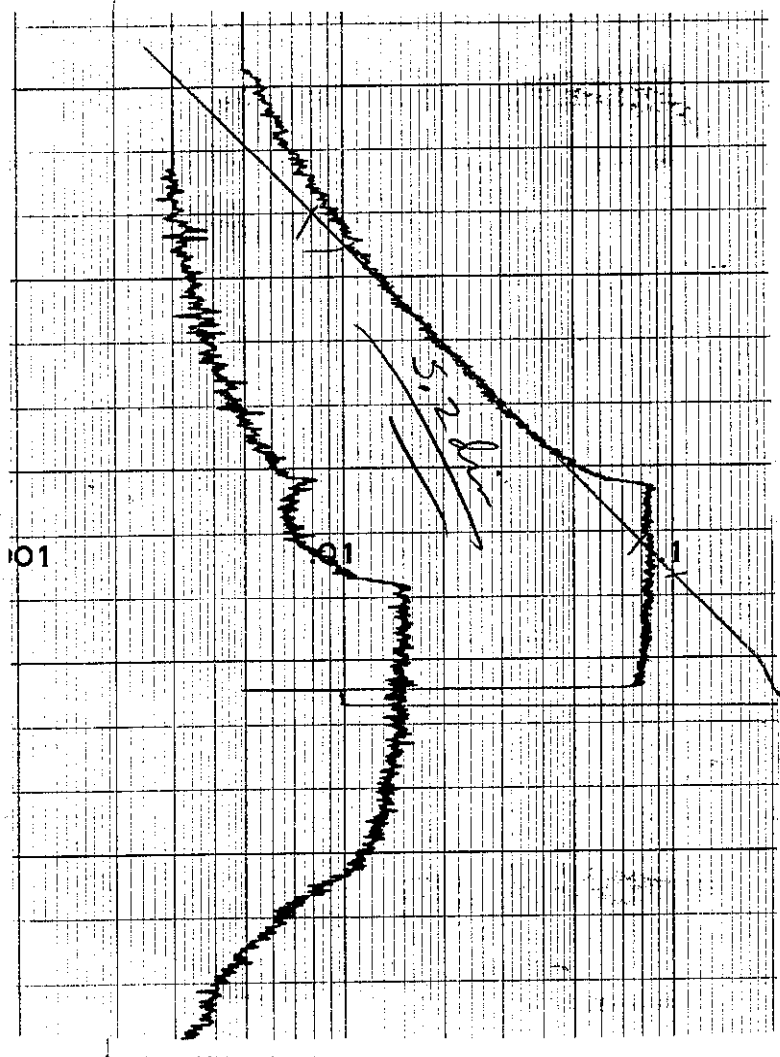
10 51 Tables Closed Subcritical ^{DPIW} .100 6 .101

IC-2 → $.48 \times 3 \times 10^{-10}$

-3/4 → 1.1×10^{-11} with drawn Source

10 55 Shut Down

~~Cut 3/4" off each plate 2x~~

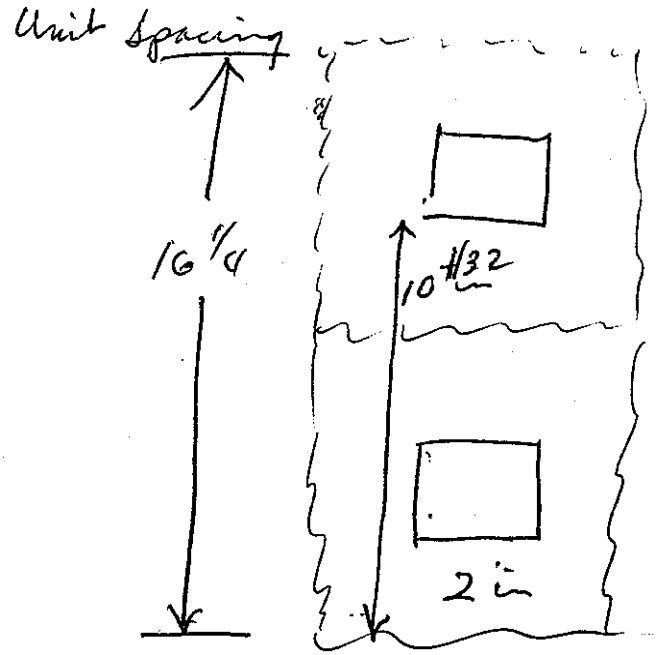

01
01
1

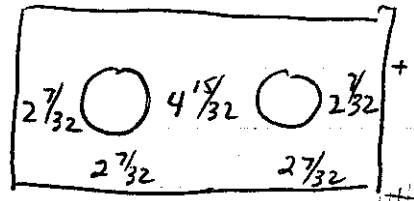
EXP #65

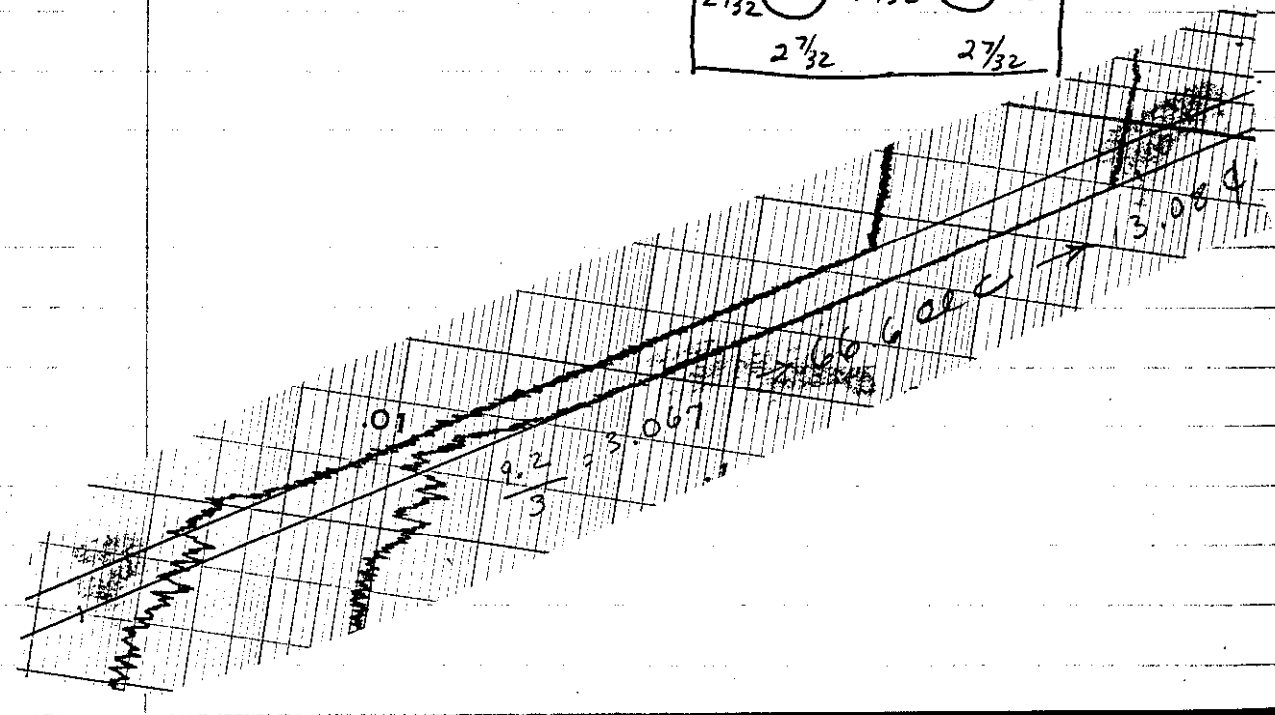
Remove 2 ea 1 x 9 1/2 x 9 1/2 } Vermiculite Pieces
2 ea 2 x 4 1/4 x 5 1/2 } From 4 Top
2 ea 2 x 4 1/4 x 9 1/2 } Cells.

11 10 Start Assembly DPIW .100
11 22 Tables Closed C .101 Source Inserted further Than #64
{IC-2 .45 x 3 x 10^-10
4 8 x 10^-11
3 1.5 x 10^-11
28 Remove Source
System appears to be closer to critical!
11 33 Shut Down $\rho = \nu - \#1$.

Cut off 3/4 from each piece of Vermiculite


Unit spacing
16 1/4
10 11/32
2 in


2 7/32
4 15/32
2 7/32
2 7/32
2 7/32


.01
9.2
3
= 3.067
3.06

Instrument Check on 12-7-72 Source 18 mm ^{60}Co

875 V PM-1 Bal 5.10 Low Trip OK Trip OK

IC-1 3×10^{-10} Meter Trip OK Fast Trip OK

IC-2 3×10^{-10} Meter Trip Screen Tables Rad Mon at

IC-3 1.5×10^{-9} Calibration Answer A OK

IC-4 1.5×10^{-9} Calibration Answer B OK

C OK

EXP #66

11[15] Start Assembly ~~Damper~~

11[27] On Positive Period Core Size 9 x 18 x 16 1/4

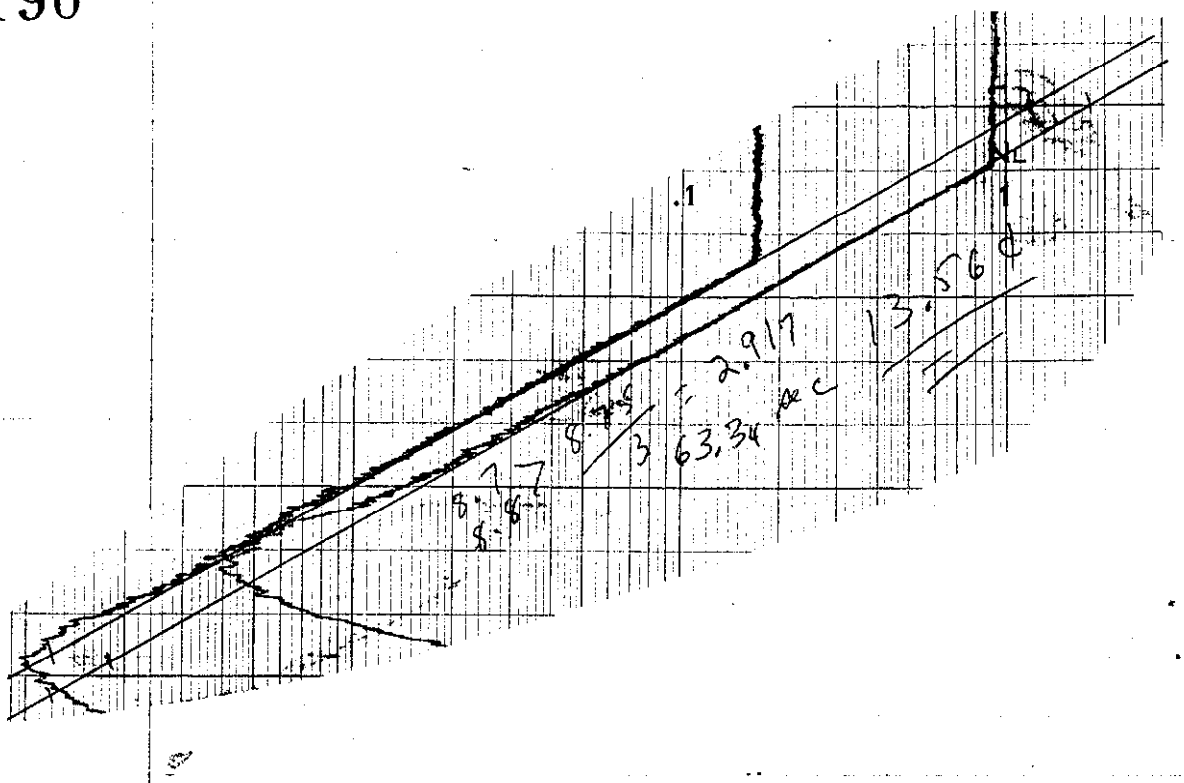
Source Out " " " " "

DP/W 1.084
E 1.084

11[31] Start To Level Check Calibration of IC-3 & 4 OK

11[38] Level DP/W 1.143
E 1.142

13.08/Δ = .058 = 225.5 #/in.


.1
2.917
13.56
63.34

EXP #67

Place 5/8" Al Bars on Top of each cell of EXP #66

Core height now 17½".

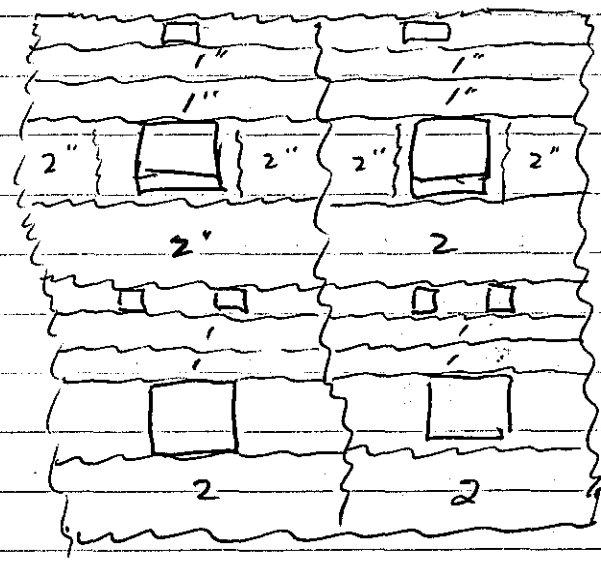
Red Lite, Dp, Bypass, Smin OK

2.50 Start Assembly

2.59 On Pos Period

DPIW 0.518

E 0.521



Start to level

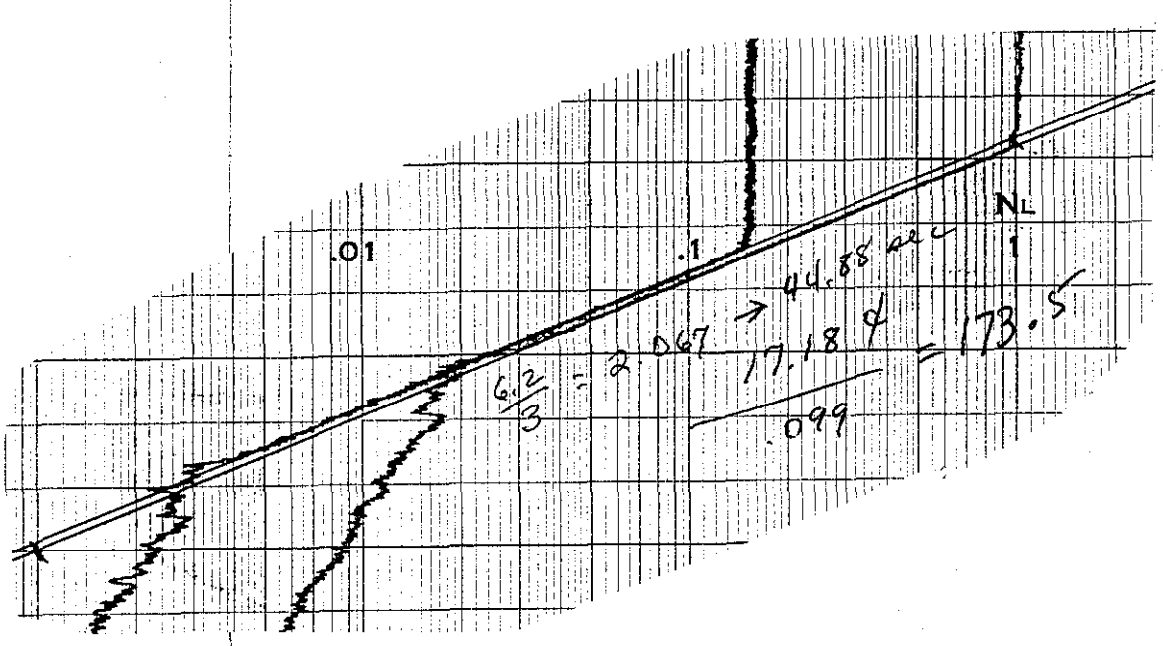
Level @ 0.584

0.586

13.86/.065 208.6 ¢/in.

8/20/85 DWM Vrasium not in center of cell

Note that Vermiculate size is 8.75 × 8.75 (±11.11 cm) and cell size is 9.00 × 9.00 (±11.43 cm)



44.88 sec

$\frac{6.2}{3} = 2.067 \rightarrow 17.18$ ¢ = 173.5

.099

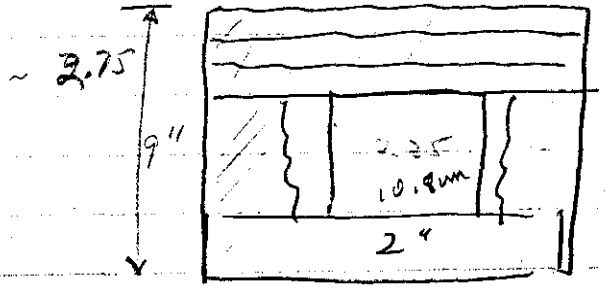
.585 − .370 = .2145 × $\frac{173.5 + 208.6}{2}$

= 41 ¢

.3705 − .1 = .2705 × 150 = 40.6

EXP #68

Increased height of South Half to 18"
Inserted 2 ea 1" nom thick pieces of
Vermiculite 1 for each cell



Instrument Check on 12-8-72 Source 10 mc ^{60}Co

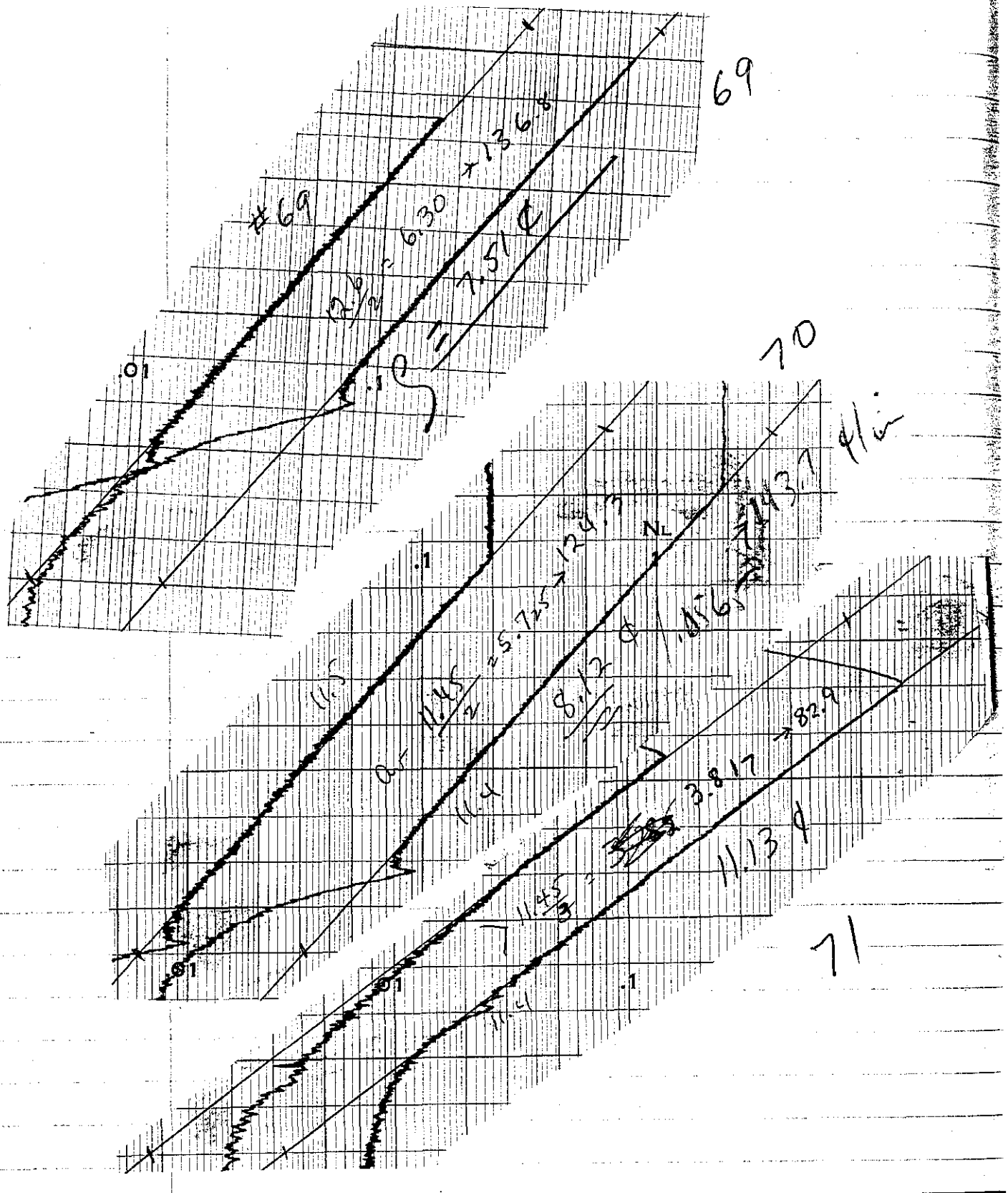
875V PM-1 Sat 5.10 Low Trip OK Trip Scram Table

IC-1	3×10^{-10}	Meter Trip	OK	Test Trip OK
IC-2	3×10^{-10}	Meter Trip	OK	Rad Mon al
IC-3	1.5×10^{-1}	Calibration	Drift	A "
IC-4		Calibration	Drift	B "
				C "

Red Lite
Bypass
DP
Source

8^{40} Start Assembly W 270 271 S
~ 8^{56} On Pos Period E 273
~ 8^{59} Start To Level
9^{10} Level DPI W .369 370 S
E .372
Shut Down 17.18 / Δ .099 = 173.5 #/in

8.6


69
#69
.01
.1
1
10
NL
71

EXP # 69

North half height increased to 18"
Entire core like # 68 Sketch.

10^00 Start Assembly
10^09 On Pos Period Tables Closed 0.100 0.099
IC-1 Scrammed Int.
Start Down To Straighten Top Rf.

EXP # 70

Purpose To measure excess reactivity and level.

10^27 Start Assembly W .100
10^35 On Pos Period E .099
~42 Start to level W .156
10^48 Level E .156

Δ = .0565

Watch linear Doubt while East ρ = 3.12 ¢
makes High Power Run.

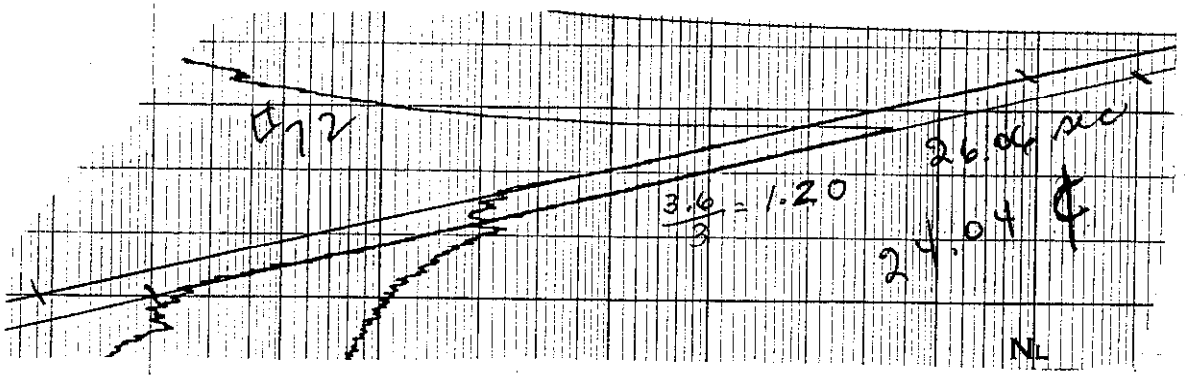
EXP # 71

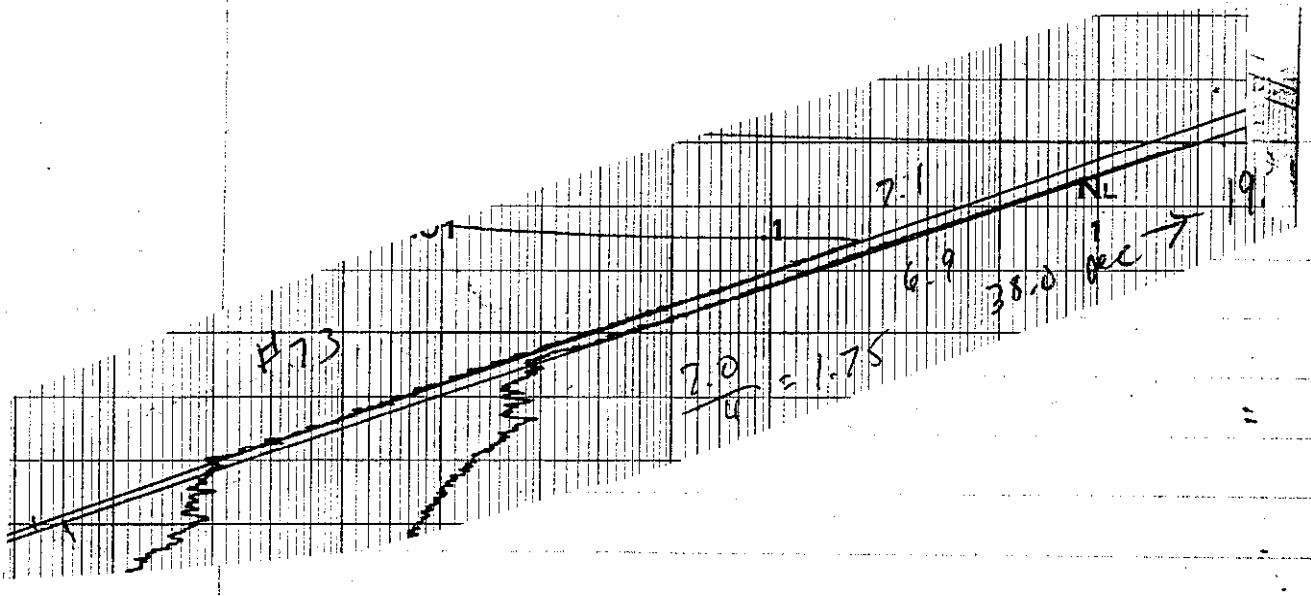
Remove 2 pc 1" x 8 3/4 x 8 3/4 Verm. from South

11^03 Start Assembly W .100
11^11 On Pos Period E .099
11^20 Start Down ~~Together~~ Separately fully

Δk = 3.01 ¢

.0301 x .0066 = .00020


#12
3.6/3 = 1.20
26.04 sec
24.04 ¢
NL


#13
7.0/4 = 1.75
7.1
NL
6.9
38.0 sec

EXP #72

Remove 4 more pc of Vermiculite from south now none on top of units.

11[24] Start Assembly
11[32] On Pos: ive Period. → {.100 .099

~34 IC-2 Trip Shut Down on 3×10[9] Scale

$\Delta k = 15.92 \times .0066 = .00105$

EXP #73

Replace 3 ea 1 × 8¾ × 8¾ on West Unit South table – remove 2ea 4¼ × 8¾, 2ea 4¼ × 4¾

11[40] Start Assembly
~11[48] On Pos Period

11[52] Shut Down

$\Delta k = 19.14$
8.12
11.02

Vermiculite weights

EXP #73 Gross 3.90

Card. Boxes 1.42 kg

2.52 kg Removed.

EXP #72

Gross 4.03

Card Boxes 1.42

6 ea 1 x 8 3/4 x 8 3/4 2.61 kg Removed

#73 + 3 ea 1 x 8 3/4 x 8 3/4 5.18

3.90

~~3.76~~

3 ea 1.28 x 2 = 2.56

vs 2.61 meas

Total Weight, 27.77

1.42

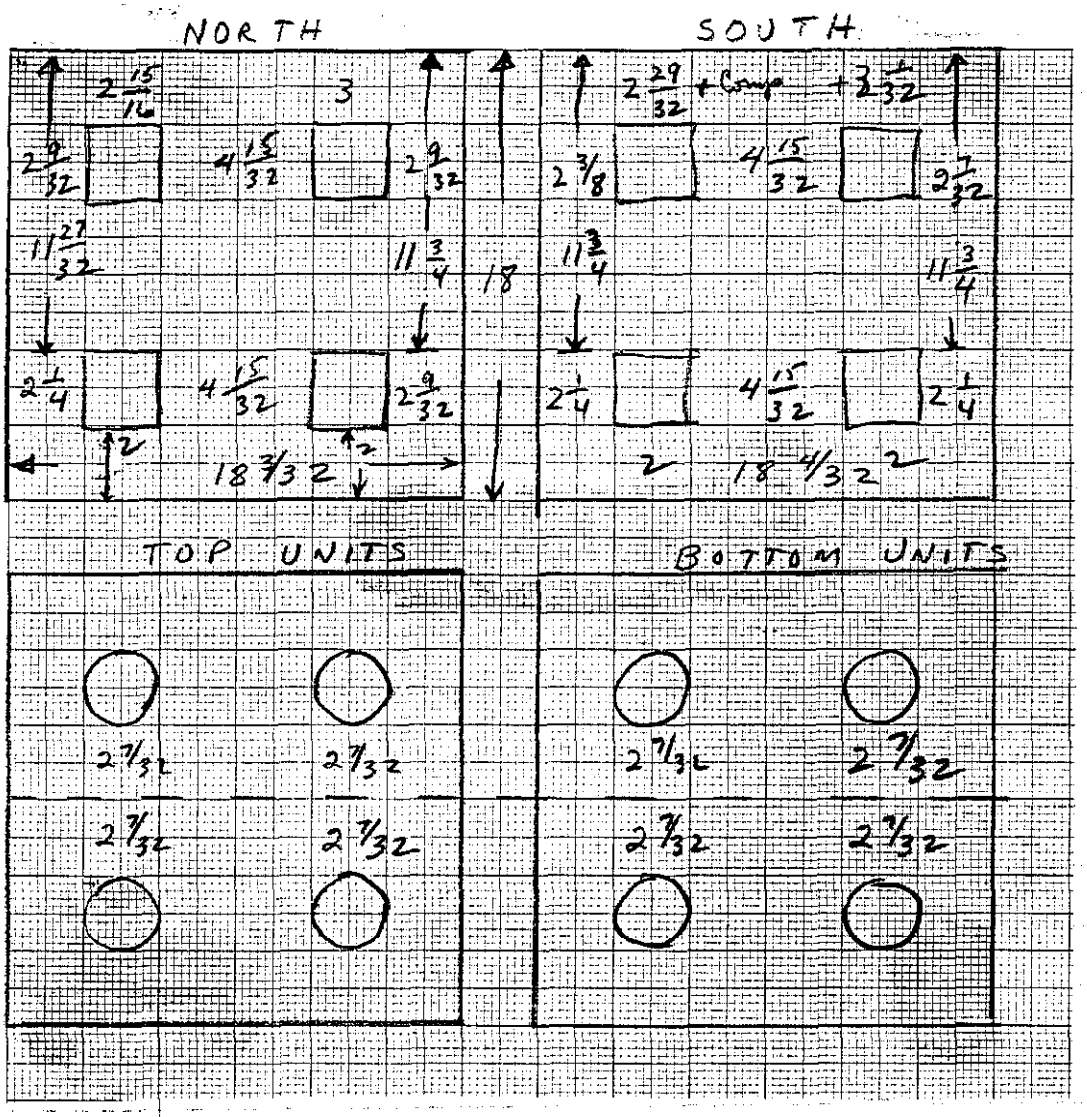
26.35 kg 3293.75 g/Box

8

9715.84

$\rho = 0.339008$ g/cm^3

Average Verm. density



p189 Bench Size 15 x 18 x 12

p113

Average separations of Units

North – SOUTH

Top layer	E	$4\ \frac{14}{32}$	
	W	$4\ \frac{14}{32}$	
Bottom	E	$4\ \frac{14}{32}$	
	W	$4\ \frac{14}{32}$	
Average		$4\ 7/16$	4.4375

EAST – West

Top Layer	N	$4\ \frac{15}{32}$	
	S	$4\ \frac{14}{32}$	
Bottom Layer	N	$4\ \frac{15}{32}$	
	S	$4\ \frac{15}{32}$	
Average		$4\ \frac{15}{32} = 4.4688$	
		Ave 4.456	

Vertical

North

E $11\frac{24}{32} - 3 = 8.75 - 4.25 = 4.5$

W $11\frac{27}{32} - 2\frac{30}{32} = 8.91 - 4.25 = 4.66$

South

E $11\frac{24}{32} - 2\frac{31}{32} = 8.78 - 4.25 = 4.53$

W $11\frac{24}{32} - 3\frac{2}{32} = 8.69 - 4.25 = 4.44$

Average 4.53

Average box	R	±X = ±Y	+Z	−Z	Vol cm³
CYL U	5.76	± 6.03	5.4	−5.4	1125.692
CUBOID AIR Verm	—	± 11.11	5.4	−5.4	1570.791
AIR	—	± 11.43	12.38	−10.48	9715.84
			11	"	Total 11 286.63

Verm only

Total all vol = 11946.17

202

PLATE NUMBER 6128 12-11-1972 9:44
SENSITIVITY 0.03552
REQUISITION 684641

DATA BELØW ØBTAINED BY VISUAL ESTIMATIØN ØF LINE DENSITIES AND SHOU
BE CØRRECT WITHIN A FACTØR ØF TWØ. IF QUESTIONS, CALL 35066

ELEMENT	WT PPM	ELEMENT	WT PPM	ELEMENT	WT PPM
4 BE <	.02	34 SE	2.0	63 EU	2.0
5 B	1.0	35 BR	1.0	64 GD <	2.0
9 F	150.0	37 RB	250.0	65 TB <	.4
11 NA	800.0	38 SR	100.0	66 DY <	1.0
12 MG	MATRIX	39 Y	.3	67 HØ <	.4
13 AL	MATRIX	40 ZR	1.0	68 ER <	1.0
14 SI	MATRIX	41 NB	1.0	69 TM <	.4
15 P	10.0	42 MØ	3.0	70 YB <	1.0
16 S	20.0	44 RU <	.7	71 LU <	.4
17 CL	1000.0	45 RH <	.2	72 HF <	1.0
19 K	MATRIX	46 PD <	.9	73 TA	10.0
20 CA	MATRIX	47 AG	MATRIX	74 W <	1.0
21 SC	3.0	48 CD <	.9	75 RE <	.7
22 TI	14000.0	49 IN	.8	76 ØS <	1.0
23 V	30.0	50 SN	2.0	77 IR <	.7
24 CR	4000.0	51 SB	1.0	78 PT	4.0
25 MN	350.0	52 TE	8.0	79 AU	1.0
26 FE	57500.0	53 I <	.3	80 HG <	2.0
27 CØ	40.0	55 CS	.9	81 TL <	.6
28 NI	80.0	56 BA	6500.0	82 PB <	.9
29 CU	20.0	57 LA <	.3	83 BI <	.5
30 ZN	20.0	58 CE	1.0	90 TH <	.5
31 GA	1.0	59 PR <	.3	92 U <	.5
32 GE	2.0	60 ND	6.0		
33 AS	3.0	62 SM	4.0		

TØTAL IMPURITIES DETECTED= 84948.620 PPM (LESS THANS AT FULL VALUE)

TØTAL BY DIFFERENCE= 91.507 % (LESS THANS IGNØRED)

52.14 % O_2
8.03 % Si
14.29 % C
2.78 % H
.02 % Mn
4.25 % Mg
2.75 % Al
1.30 % Fe
1.39 % K
.50 % Ca
.06 % Cr
10.81 % N

98.32 %

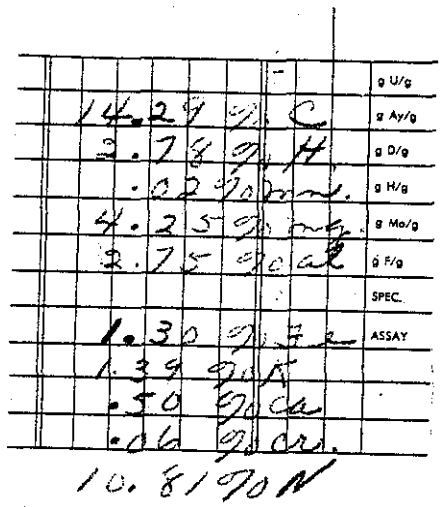
CHECK DESIRED ANALYSIS
g U/g
g Ay/g
g D/g
g H/g
g Mo/g
g F/g
SPEC.
ASSAY
Ox
N
Si
C
H
Mg
Al
Fe
K
Ca
Cr
Mn

REQUISITION 684641
Vermiculite

Jim Franklin
Neil
Neutrach
Neutrach
270 SPL
AA 215 SPL
REPORT TO D.W. MAGNUSON
BUILDING NO. 9213
PHONE NO. 3-5237

REQUISITION 684641 18/20

Jim Franklin
Neutrach
Neutrach PT
270 SPL
AA 215 SPL
REPORT TO D.W. MAGNUSON
BUILDING NO. 9213
PHONE NO. 3-5237



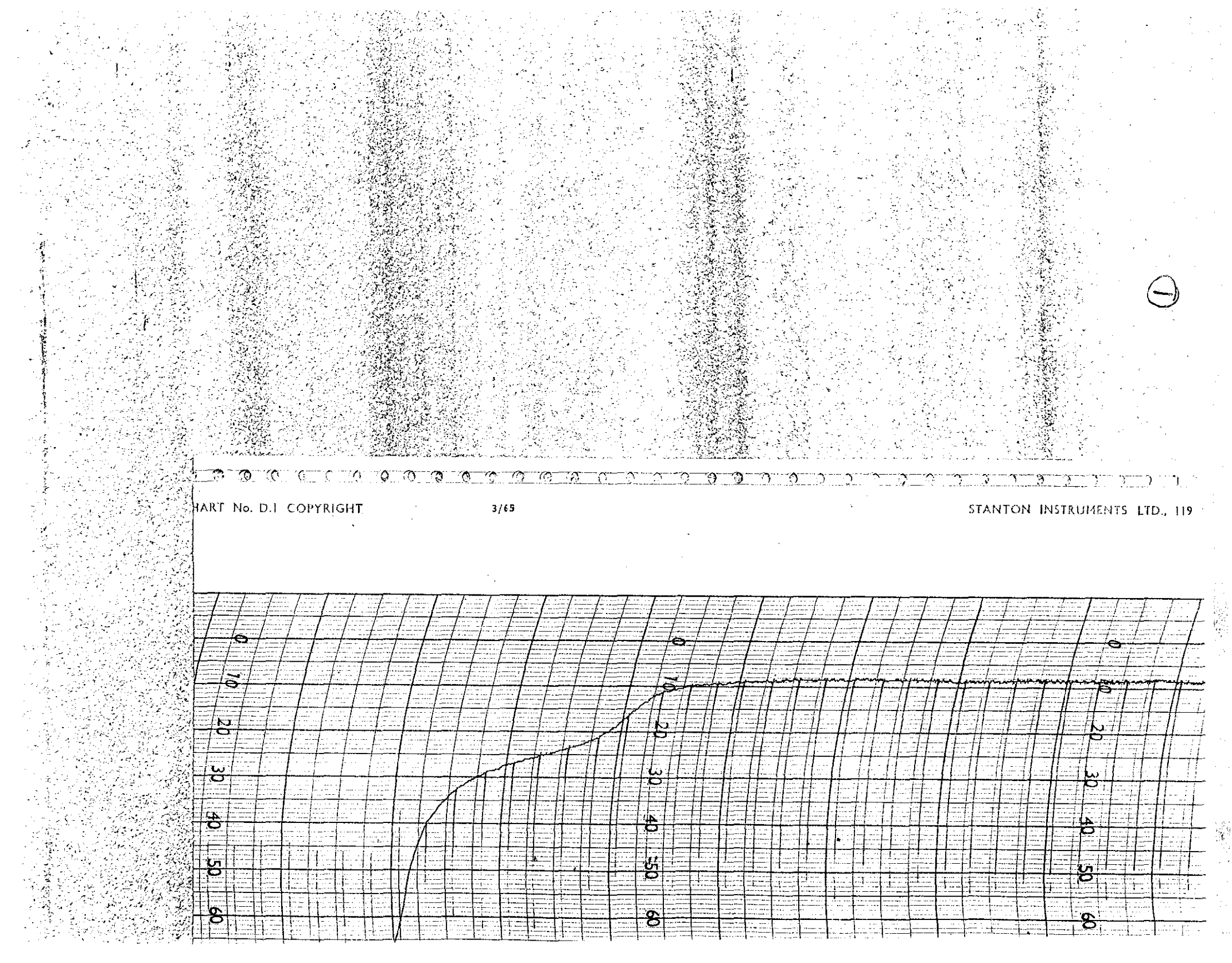
52.14 % O_2

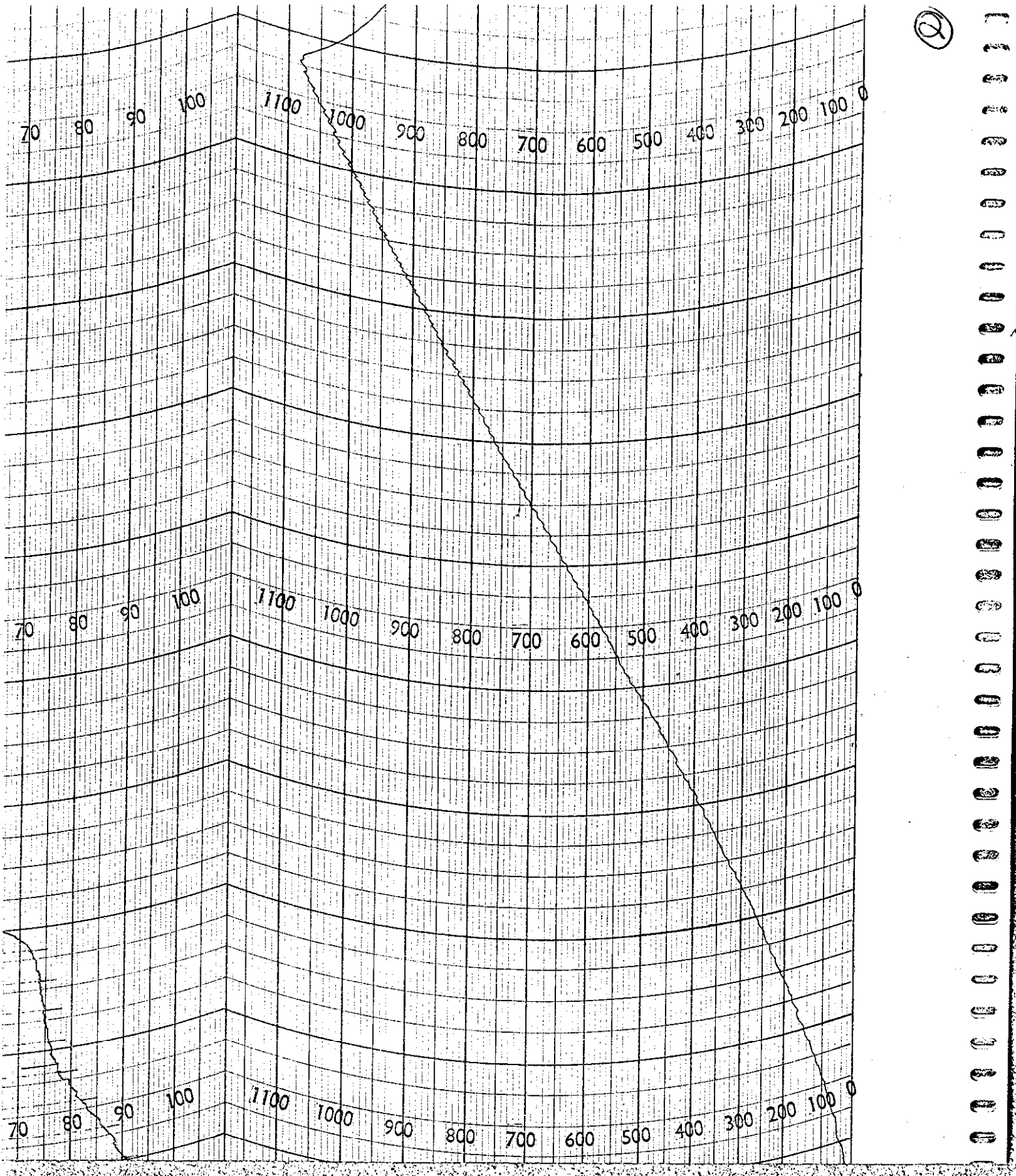
8.03 % Li

J. L.	REPT. BY
12.15.72	DATE
	DEPT.

Rec'd

12-7-72


HART No. D.I COPYRIGHT
3/65
STANTON INSTRUMENTS LTD., 119
0
10
20
30
40
50
60


70 80 90 100 1100 1000 900 800 700 600 500 400 300 200 100 0
70 80 90 100 1100 1000 900 800 700 600 500 400 300 200 100 0
70 80 90 100 1100 1000 900 800 700 600 500 400 300 200 100 0

(3)

STANTON INSTRUMENTS LTD., 119 OXFORD ST., LONDON, W.1.

← wt loss, mg

0 10 20 30 40 50 60 70

Original sa
weight immedia
loses wt agai
Stable by 575°C

0 10 20 30 40 50 60 70

START

(4)

Magnesium 11-16-92

TGA

144.5 mg

→ ← Temperature → ←

°C

80 90 100 1100 1000 900 800 700 600 500 400 300 200 100 0

ple wt 144.5 mg - starts to lose

g - wt loss levels out at about 180°C,

at 250°C and ~~330~~ 500°C. Wt is

80 90 100 1100 1000 900 800 700 600 500 400 300 200 100 0

ORNL ANALYTICAL CHEMISTRY DIVISION
SPECTROCHEMICAL LABORATORY
BUILDING 9734, Y-12 TELEPHONE 3-7168

Request No 26435

REQUEST AND REPORT OF SPECTROGRAPHIC ANALYSIS

CHARGE NO.	SAMPLE NO.
S-544	727

SUBMITTED BY D. W. Magnuson

BUILDING NO.	PHONE	DATE
9213	3-5237	

COPY REPORT TO

BUILDING NO.

COMPOSITION OF SAMPLE IF KNOWN: Plastic bonded Vermiculite

TYPE OF ANALYSIS DESIRED: ☐ Qualitative, ☑ Semi-quantitative, ☐ Quantitative, ☐ Photoelectric

ELEMENTS DESIRED

GENERAL ANALYSIS (values in %)

Ag	<.01	In		Sc			
Al	1	Ir		Si	M		
As		K	.7	Sn	<.02		
Au		Li	<.005	Sr	<.1		
B	.01	Mg	3.	Ta	<.05		
Ba	.04	Mn	.07	Te			
Be	<.001	Mo	<.02	Th			
Bi	<.02	Na	.05	Ti	.03		
Ca	.3	Nb	<.05	Tl			
Cd	<.05	Ni	<.02T	U			
Co	.05	Os		V	<.02		
Cr	.1	P		W	<.05		
Cs	<.05	Pb	<.02	Zn	<.2		
Cu	<.01	Pd		Zr	<.05T		
Fe	1	Pt	<.05				
Ga	<.05	Rb	<.05				
Ge	<.05	Re					
Hf		Rh					
Hg	<.05	Ru					
		Sb	<.05				

RARE EARTH ANALYSIS (values in %)

Sc	
Y	<.005
La	<.02
Ce	<.1
Pr	<.05
Nd	<.05
Sm	<.05
Eu	<.005
Gd	<.05
Tb	<.05
Dy	<.1
Ho	<.05
Er	<.005
Tm	<.05
Yb	<.002
Lu	<.005
Th	

METAL ANALYSIS (values in)

Type alloy	
Cr	
Ni	
Fe	
Mo	
Co	
Nb	
Ta	
Mn	
V	
Ti	
Cu	
Al	
Mg	
Sn	
Pb	
Zn	
Bi	
Si	

Explanation of Analysis:

Symbols Used: P-Present; T-Trace; < - less than; > - greater than; nd-not detected; no analyses made in all other cases.

☐ Qualitative Analysis - Estimate only as follows: M-major; m-minor; t-trace.

☑ Semi-Quantitative Analysis - The values reported are visual estimates taken from a standard plate and using a common graphite matrix. These values are to be interpreted as approximations only. Actual value should be within the range times ½ to times 2.

☐ Quantitative Analysis - The values reported are obtained by visual comparison of the sample with standards similarly prepared. Precision is about ± 50% of the amount present.

☐ Densitometric Analysis - The values reported are obtained by precise analytical spectrochemical methods. Precision of the method varies but is of the order of ± 10% or better.

☐ Photoelectric Analysis - Rapid electronic method. Precision _____%.

ANALYSIS PERFORMED BY	APPROVED BY	PLATE NO.	DATE REPORTED
SMM	J. C. Carter	6542	11-16-72

COMMENTS

UCN-1003
(3 10-69) RC

ANALYTICAL DATA REPORT

~~TO~~ GENERAL

FROM To DW M

LABORATORY NUMBER	SAMPLE CODE		Mg %	Al %	Fe %
727	Plastic Bonded Vermiculite		5.27	3.78	2.86
		Mg Al Fe Si	19.74		
		H			
		C			
		Cl			
		O			

CONCENTRATION

☐ SAMPLES returned to sender
☐ sent to waste ☐ retained

UCN-2134
(3 9-60)

ANALYSIS LAB.

ANALYZED FOR

CONTROL NO. D 94305

SERIES NO. 9213

DATE 11-2-72

gANSON

S.	TGA	LOI			Spec.					
7.83%	▲	60.0% @ 1000°C			Carter					
					11-2-72					
	See TGA chart									
	for wt. losses + temperatures									

REMARKS

LABORATORY SUPERVISOR

W R Laing

Dec 11, 1972

D. W. Magnuson

Here is the composition of your sample of plastic bonded vermiculite (CD 94305).

Element	wt. %
Mg	5.27
Al	3.78
Fe	2.86
Si	7.86
Ca	0.30
Cr	0.10
K	0.70
Mn	0.07
C	17.10
H	3.00
N	13.50
O	45.46
	100.00

W R Laing

Vermiculite

BILL CATING

PLAST BONDED LEM

For
S = 0.33%

		wt %	
Mg	3	5.27	.000 443
Al	1	3.78	.000 286
Fe	1	2.86	.000 105
Si		7.86	.000 572
Ca	.3	0.30	.000 015
Cr	.1	0.10	.000 004
K	.7	0.70	.000 037
Mn	.07	0.07	.000 003
C		17.10	.002 908
H		3.00	.006 079
N		13.50	.001 969
O		45.46	.005 803

100.00%

208

ANALYTICAL REQUISITION
EXCEPTION SHEET

REQ. NO. 684639

DATE REPORTED: 12-1-72

EXCEPTION NO.: 4686

SHOWN	SHOULD BE
Answer .256%All	Answer .793%All
Dept. Code 273%Fe	Dept. Code 520%Fe
Batch No. 11.96%Ca	Batch No. 22.19%Ca
Material Type 9.56%Mg	Material Type 9.82%Mg
Charge Code	Charge Code
Credit Code	
Net Sample Wt.	Net Sample Wt.

Explanation of Correction: Sample Reran

NAME OF PERSON RECORDING EXCEPTION: G. M. Owen

DATE SUBMITTED:

IBM CARD PUNCHED BY:

DATE PUNCHED:

UCN-1998
(2 3-61)

Concrete Analysis
Rerun on 68439

.793	Al
.570	Fe
22.794	Ca
9.182	Mg
4.85	Si
48.96	O2
87.149	Total,
10.62	C
1.12	H
2.17	H_2O
100.05	

REQUISITION 684639

Jim Franklin

} 270 SPL

} - SPL

} AA SPL

} Wash acl PT

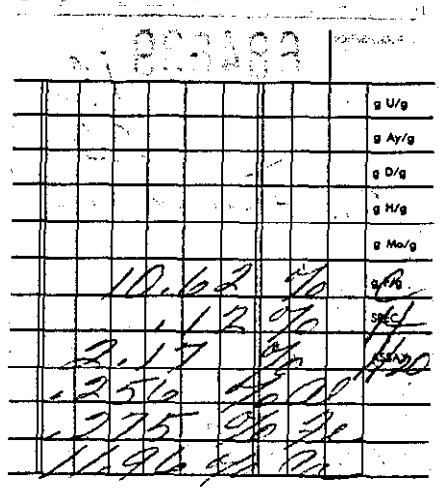
REPORT TO D.W. MAGNUSON
BUILDING NO. 9213
PHONE NO. 3-5237

4.85% Li
48.96% O2

00
12-15-72

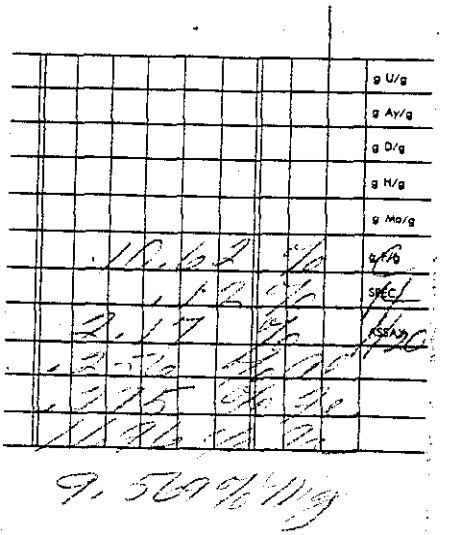
			Spect	Chem
Chem	H	0.12	.30 → .79	.49
	H_2O	2.17	1.75 → .57	-1.18
	Mg	9.18	4.05 → 4.85	.80
Spect	Ca	22.79		1.29
	C	10.62		1.18
	O	48.96		± .11
		93.84 vs 91.45		
Imp. Spect		8.55		
		102.39		

Original Report + Analyses



9.569%U/g

AO	REPT. BY
12-1-72	DATE
	DEPT.



P. 50% U/g

CO	REPT. BY
12-1-72	DATE
	DEPT.

Original Report of Analyses

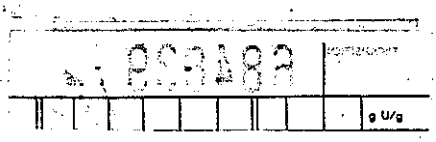


PLATE NUMBER 6127 11-23-1972 9:37
SENSITIVITY 0.03552
REQUISITION 684639

DATA BELOW OBTAINED BY VISUAL ESTIMATION OF LINE DENSITIES AND SHOULD BE CORRECT WITHIN A FACTOR OF TWO. IF QUESTIONS, CALL 35066

ELEMENT	WT PPM	ELEMENT	WT PPM	ELEMENT	WT PPM
4 BE <	.02	34 SE	8.0	63 EU <	2.0
5 B	4.0	35 BR	3.0	64 GD <	5.0
9 F	20.0	37 RB	8.0	65 TB <	1.0
11 NA	2500.0	38 SR	700.0	66 DY <	4.0
12 MG	MATRIX	39 Y	.9	67 HO <	1.0
13 AL	3000.0	40 ZR	6.0	68 ER <	3.0
14 SI	40500.0	41 NB	.6	69 TM <	1.0
15 P	50.0	42 MO	4.0	70 YB <	4.0
16 S	3500.0	44 RU	2.0	71 LU <	1.0
17 CL	500.0	45 RH	.7	72 HF <	4.0
19 K	9500.0	46 PD	3.0	73 TA <	6.0
20 CA	MATRIX	47 AG	MATRIX	74 W <	3.0
21 SC	.9	48 CD	90.0	75 RE <	.7
22 TI	1500.0	49 IN <	.8	76 OS <	1.0
23 V	5.0	50 SN	20.0	77 IR <	.7
24 CR	40.0	51 SB	1.0	78 PT <	4.0
25 MN	550.0	52 TE <	.8	79 AU <	1.0
26 FE	17500.0	53 I <	.9	80 HG <	2.0
27 CO	.4	55 CS	.9	81 TL <	.6
28 NI	300.0	56 BA	450.0	82 PB	30.0
29 CU	30.0	57 LA	50.0	83 BI <	.5
30 ZN	4500.0	58 CE	20.0	90 TH	5.0
31 GA	2.0	59 PR <	1.0	92 U	2.0
32 GE	4.0	60 ND <	4.0		
33 AS	30.0	62 SM <	4.0		

TOTAL IMPURITIES DETECTED= 85498.420 PPM. (LESS THANS AT FULL VALUE)

TOTAL BY DIFFERENCE= 91.451 % (LESS THANS IGNORED)

212

ANALYTICAL DATA REPORT

~~TO~~ GENERAL ANALYSIS LAB.

~~FROM~~ To D.W. Magnuson

LABORATORY NUMBER	SAMPLE CODE		lbs./cu ft. Den.	LOI @1000°C	Loss @ 110°C %	SiO_2 %	R_2O_3 %
607	Concrete		100.4 @21°C	41.4%	1.13%	7.65	2.27 (Fe +
			Spec. Carter				
		100.4 × 2.2 28.300	= 1.6126				
		100.4 / 62.5	= 1.6064				

CONCENTRATION

☐ SAMPLES returned to sender
☐ sent to waste ☐ retained

REMARKS

UCN-2134
(3 9-60)

SIS LAB.

ANALYZED FOR

CONTROL NO. D 94278

SERIES NO. 9213

DATE 10-30-72

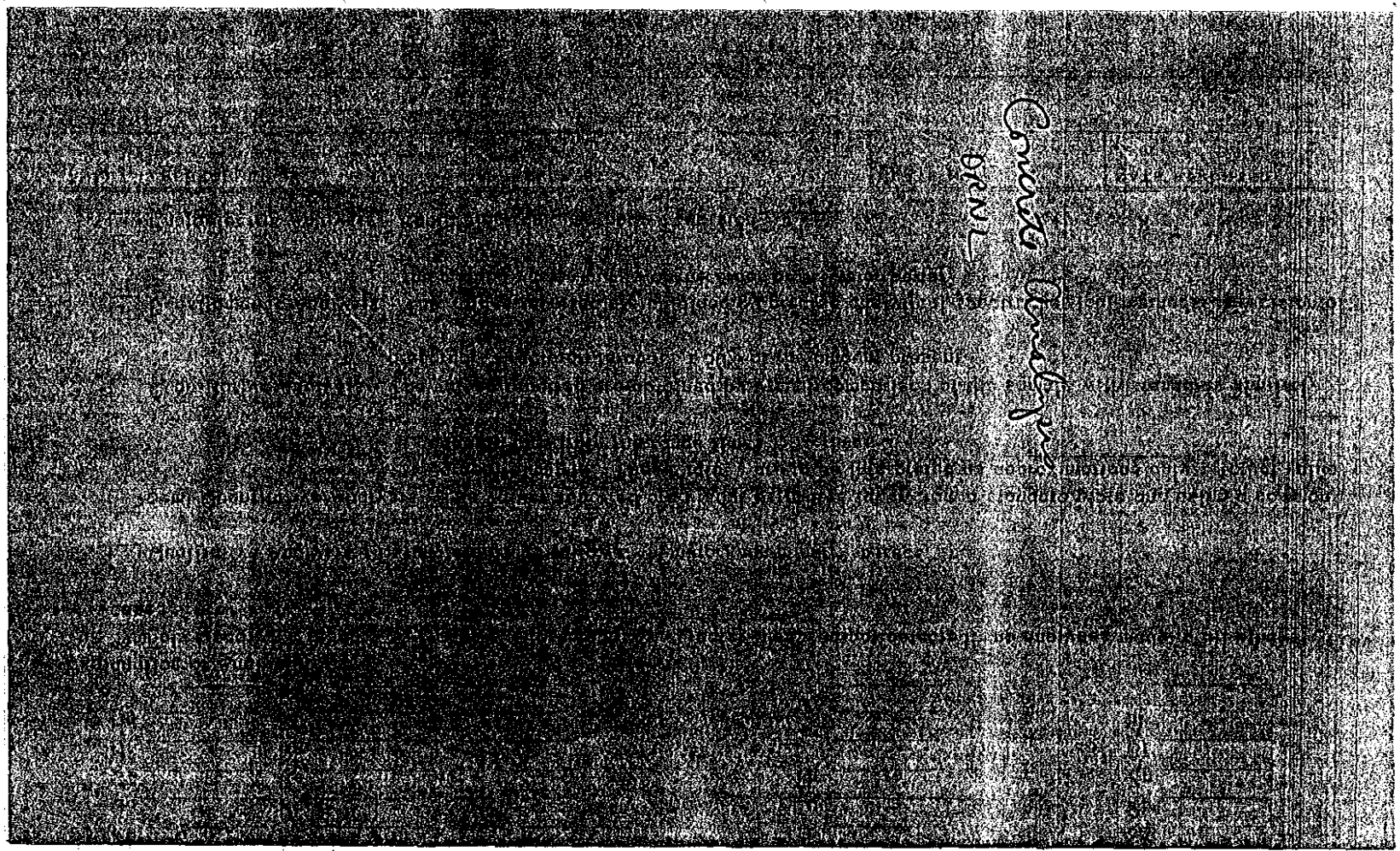
% R_2O_3	Fe %	Ca %	Mg %	SO_3 %	P_2O_5 %	Na_2 %	K	CO_2 %	H_2O %
2.27	0.55	22.4	9.49	0.34	0.033	0.026	0.62%	52.3	Combined 1.43
(Fe+Al)									1.13
									2.56 Total
								Total	97.109
									1.13
									98.239

[Brady]

LABORATORY SUPERVISOR

ORNL ANALYTICAL CHEMISTRY DIVISION
SPECTROCHEMICAL LABORATORY
BUILDING 9734, Y-12 TELEPHONE 3-7168

Request № 26484



213

ORNL ANALYTICAL CHEMISTRY DIVISION
SPECTROCHEMICAL LABORATORY
BUILDING 9734, Y-12 TELEPHONE 3-7158

Request № 26484

REQUEST AND REPORT OF SPECTROGRAPHIC ANALYSIS

CHARGE NO. S-545		SAMPLE NO. 607	
SUBMITTED BY D. W. Magnuson	BUILDING NO. 9213	PHONE 3-5237	DATE
COPY REPORT TO	BUILDING NO.		

COMPOSITION OF SAMPLE IF KNOWN: concrete

TYPE OF ANALYSIS DESIRED: ☐ Qualitative, ☑ Semi-quantitative, ☐ Quantitative, ☐ Photoelectric

ELEMENTS DESIRED

GENERAL ANALYSIS (values in wt %)

Ag	<.01	In		Sc			
Al	1.5	Ir		Si	M		
As		K	.4	Sn	<.02		
Au		Li	<.01 T	Sr	.05		
B	.01	Mg	>5	Ta	<.05		
Ba	~.01	Mn	.1	Te	<.05		
Be	<.001	Mo	.01	Th			
Bi	<.02	Na	.05	Ti	.03		
Ca	M	Nb	<.05	Tl			
Cd	<.05	Ni	<.02	U			
Co	<.05	Os		V	<.02		
Cr	<.05	P		W	.1		
Cs	<.05	Pb	<.02	Zn	.3		
Cu	.01	Pd		Zr	<.05		
Fe	.3	Pt	<.05				
Ga	<.05	Rb	<.05				
Ge	<.05	Re					
Hf		Rh					
Hg	<.05	Ru					
		Sb	<.05				

RARE EARTH ANALYSIS (values in wt %)

Sc	
Y	<.005
La	<.02
Ce	<.1
Pr	<.05
Nd	<.05
Sm	<.05
Eu	<.01
Gd	<.02
Tb	<.05
Dy	<.1
Ho	<.05
Er	<.005
Tm	<.02
Yb	<.005
Lu	<.005
Th	

METAL ANALYSIS (values in _____)

Type alloy	
Cr	
Ni	
Fe	
Mo	
Co	
Nb	
Ta	
Mn	
V	
Ti	
Cu	
Al	
Mg	
Sn	
Pb	
Zn	
Bi	
Si	

Explanation of Analysis:

Symbols Used: P-Present; T-Trace; < - less than; > - greater than; nd-not detected; no analyses made in all other cases.

☐ Qualitative Analysis - Estimate only as follows: M-major; m-minor; t-trace.

☑ Semi-Quantitative Analysis - The values reported are visual estimates taken from a standard plate and using a common graphite matrix. These values are to be interpreted as approximations only. Actual value should be within the range times ½ to times 2.

☐ Quantitative Analysis - The values reported are obtained by visual comparison of the sample with standards similarly prepared. Precision is about ± 50% of the amount present.

☐ Densitometric Analysis - The values reported are obtained by precise analytical spectrochemical methods. Precision of the method varies but is of the order of ± 10% or better.

☐ Photoelectric Analysis - Rapid electronic method. Precision _____ %.

ANALYSIS PERFORMED BY	APPROVED BY	PLATE NO.	DATE REPORTED
SAM	J. A. Carter	6552	12-13-72

COMMENTS

UCN-1003
(3 10-69) RC

Nov 17, 1972

D.W. Magnuson

Here are the results reported on Control Sheet D 94278 calculated as Atom %. The Sample is concrete.

	Element	Atom %	$\times 10^{24}$	g/cm³
12.011	C	15.96	.011 02	.2197
1.008	H	5.26	.003 63	.0061
28.086	Si	2.33	.001 61	.0751
55.847	Fe	0.18	.000 12	.0111
40.08	Ca	10.22	.007 05	.4690
24.312	Mg	7.14	.004 93	.1989
39.102	K	0.29	.000 20	.0130
22.9898	Na	0.024	.000 02	.0008
32.064	S	0.080	.000 06	.0032
30.9738	P	0.0055	.000 004	.0002
26.9815	Al	0.53	.000 37	.0166
16.	O	57.98	.040 02	1.0628
			.069 027	2.0765

99.9995

M R Lacy

18.123 02766 av AT. WT

ρ = 2.0764 .069028 Total atoms

Calculation No. D94278

Analysis of Concrete

ORNL Calc

WT No.

Calculation of Atomic % D-94278

607

	Oxide	weight % Oxide	% O	* % M	At. wt.	moles	At %
.010 915	CO_2	38.4	27.92	10.48	12.01	0.8726	15.96
.003 599	H_2O	2.56	2.27	0.29	1.008	0.2877	5.26
.001 595	SiO_2	7.65	4.07	3.58	28.09	0.1274	2.33
.000 123	Fe_2O_3	0.79	0.24	0.55	55.85	0.0098	0.18
.006 992	CaO	31.34	8.94	22.4	40.08	0.5589	10.22
.004 883	MgO	15.73	6.24	9.49	24.32	0.3902	7.14
.000 178	K_2O	0.75	0.13	0.62	39.10	0.0158	0.29
.000 016	Na_2O	0.04	0.01	0.03	23.00	0.0013	0.024
.000 055	SO_3	0.34	0.20	0.14	32.07	0.0044	0.080
.000 004	P_2O_5	0.03	0.02	0.01	30.98	0.0003	0.0055
.001 362	Al_2O_3	1.48	0.70	0.78	26.98	0.0289	0.53
.039 673	O	99.11	50.74	48.37			
			99.11				
	ΣO			50.74	16.00	3.1712	57.98
				Total moles		5.4685	99.9995

* this column is the wt. % of the element associated with oxygen - C, H, Si, Fe, Ca, Mg, K, Na, S, P and Al, in order - The total oxygen content is 50.74 %.

This is the correct %

.1119

Concrete

	ORNL	Y-12			
C	10.48	10.62	10.55	.50	05
H	.29	.12			
		.24			
		.36	.33		
AR	.78	.79₃ .256	.78		
~~Fe~~	~~.55~~	~~.295~~	~~.41~~		
Ca	22.4	22.79₄ 11.96	22.60	49	11
Mg	9.49	9.18 9.57	9.41	37	04
		1.24			
Na	.03	.25	.14		
~~Ar~~	~~.78~~	~~.30~~	~~.54~~		
Si	3.58	4.85 4.05 appr	4.21	.19	02
Cl		.05	.05		
S	.14	.35	.25		
K		.95	.95	94	01
Ti		.15	.15		
Mn		.055	.05		
Fe	.55	.57 ~~.75~~	0.56		
Zn		.45	.45		
Sr		.07	.06		
Ba		.045	.04		
O	50.74	48.96	49.85	.64	21
	49.85	49.0	100.43		

Average analyses
Y-12 — X-10
Adjusted to 100 %

Element	wt %	gm/cm³	Atom Density X10²⁴
H	0.33 wt %	.0071	4.24 E-03
C	10.50	.2258	1.13 E-02
O	49.65	1.0675	4.02 E-02
Na	0.14	.0030	7.90 E-05
Mg	9.37	.2015	4.99 E-03
Al	0.78	.0168	3.75 E-04
Si	4.19	.0901	1.93 E-03
S	.25	.0054	1.00 E-04
Cl	.05	.0011	1.90 E-05
K	.94	.0202	3.11 E-04
Ca	22.49	.4835	7.27 E-03
✓ Ti	.15	.0032	4.0 E-05
Mn	.05	.0011	1.2 E-05
Fe	.56	.0120	1.29 E-04
✓ Zn	.45	.0097	8.9 E-05
✓ Sn	.06	.0013	8.9 E-06
✓ Ba	.04	.0009	3.9 E-06
	100.00	2.15	

Assume Concrete Density is 18.314 kg
1 average size of block is 4.023
8.071
16.00

See p 155 av density = 2.15 g/cm³

Analysis 70455 Y-12 Creech
of sample given to JTT on ADC from GE
Spec Analysis date 1-17-72

wt%

2.3% H_2O placed direct solution

4.9% H_2O heated @ 110°C

2.88% Cl
23.10 % C_H
4.00 %
31.39% O
8.39% Si
25.59 % N
Density 0.5731 g/cm³

By Jo. L 1-31-72

H atoms: 4% × .5731 = .022924
= .01370 × 10²⁴

Na	.2	Ag	<.002
Pb	<.004	Be	<.0004
Si	7	Cr	0.1
Ti	0.3	Hf	<.007
Zn	<.03	Sb	<.01
B	<.004	Ta	<.05
Ca	<.01	V	.004
K	<2	Al	.9
Nb	<.007	Bi	<.004
Sn	<.002	Cs	<.07
Zr	.0007	Mn	.03
Ba	.05	Rb	<.05
Co	<.007	W	<.03
Li	<.007	Cu	.002
Ni	.009	Mo	<.0007
U	<.1	P	<.4
		Th	<.01
		Au	<.007
		Ca	.2
		Fe	2

Vermiculite Density 0.339 g/cm³

Average Analysis X-10 & X-12

	wt %			GE Report GE-BU-4-1 Rev 1
H	2.89	.00980	.00586	.0134641
C	15.70	.05322	.00267	.00245
N	12.15	.04119	.00177	.002317
O	48.80	.16543	.00623	.0081691
Mg	4.76	.01614	.00040	.000625
Al	3.27	.01109	.00025	.0003268
Si	7.95	.02695	.00058	.0007205
K	1.05	.00356	.000055	.000188
Ca	0.40	.00136	.000020	
Ti	0.80	.00271	.000034	
Cr	0.08	.00027	.0000031	
Fe	2.15	.00729	.000 0786	.000139
Mn	0.05	.00017	.000 0019	
Cl	0.10	.00034	.000 0058	.0001397
Ba	0.65	.00220	.000 0097	
	100.80			

UO_2 Exp.

with small packages of UO_2 containing ~423 g of UO_2 in each can.
(200 cans available)
clock @ 50/2 or 334 hrs/year

N.B. IC-3 & IC-4 log amplifiers are now Keithley Model 2600 Logarithmic Pico ammeters! (Solid State)

May 10, 1973

Stacked UO_2 cans in a 7x7 base array with eggcrate of 1" plastic, 3 rows of plastic and 3 rows of cans on South Fixed Table 4 rows of cans and 3 rows of Plastic on North movable table

EXP # 1

Source Multiplication check at 7x7x2 array size

Pu Be-6 source in 1" gap between 1" plastic and 6 in Refl Slab on Movable Table. Pu Be-230 on Drive outside of 6" reflector Ch 2

11⁴⁰ Start Assembly

11⁵⁰ Tables Closed — No Source Multiplication

~~IC-3~~ $1.2 \times 10^{-12} \rightarrow 9.0 \times 10^{-13}$

IC-4 $2.2 \times 10^{-3} \rightarrow 2.7 \times 10^{-13}$

IC-2 $.05 \times 3 \times 10^{-11} \rightarrow .06_5 \times 3 \times 10^{-11}$

UO_2 ANALYSES 18 cans @ 20 kg

RAT
SEQ
CAN
U
U
U
U
PERM

	SU	16 367	16 361	16 344	16 365	16 363	16 350	16 350	16 350	16 358	16 363	16 348
	U	17 572	17 566	17 555	17 563	17 561	17 551	17 552	17 554	17 557	17 563	17 550
		20 005	20 000	20 001	20 004	20 005	19990	19990	20 001	20 005	20 002	19997
	RATCH #	31-6176	31-6178	31-6180	31-6182	31-6184	31-6186	31-6188	31-6190	31-6192	31-6194	31-6196
	CCO. X10	450251	450252	450353	450254	450356	450357	450358	450359	450360	450361	450362
	Gm U/Gm	878400	87830	877720	877980	877810	877970	875030	877650	877630	87806	87762
	U-234	.99	1.00	.99	.98	.98	.99	1.00	1.00	.99	.99	.99
	U-235	93.14	93.14	93.10	93.18	93.18	92.16	93.15	93.14	92.17	93.17	93.15
	U-236	.21	.20	.20	.19	.19	.20	.30	.37	.36	.36	.37
	U-238	5.66	5.66	5.71	5.65	5.65	5.65	5.55	5.49	5.48	5.48	5.49
PPM	H_2O	254	286	316	302	283	329	249	224	246	217	181
	AL	22	19	14	16	17	20	18	18	18	18	18
	AU	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	B	.2	.2	<.1	<.1	.4	<.1	.3	.2	<.1	<.1	<.1
	BA	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
	BE	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1
	CA	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	CD	<.1	<.1	<.1	.1	<.1	<.1	<.1	.1	<.1	<.1	<.1
	CO	<1	1	2	<1	<1	2	3	3	1	4	1
	CR	39	40	40	42	39	45	47	54	50	55	52
	CU	36	40	46	45	42	45	38	38	33	26	34
	FE	150	195	181	181	166	218	194	233	209	215	183
	LI	<.2	<.2	.3	.3	.3	.3	.3	.5	.3	.4	.4
	MG	40	97	134	80	96	86	52	49	27	30	42
	MN	5	6	5	9	5	14	6	9	12	7	5
	MO	28	26	45	21	32	32	38	38	18	40	20
	NA	4	3	3	3	3	3	2	2	2	2	3
	NB	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	NI	74	76	71	79	73	86	73	76	73	73	57
	PB	8	5	7	<5	6	<5	6	7	<5	7	<5
	PD	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	SB	<2	<2	<2	<2	<2	<2	<2	2	<2	2	<2
	SI	146	162	159	158	147	169	180	198	189	201	142
	SN	12	16	<10	<10	<10	<10	18	20	<10	20	20
	SR	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
	TI	4	<4	<4	<4	<4	4	<4	<4	<4	<4	<4
	V	<1	<1	<1	<1	1	<1	<1	1	<1	<1	<1
	W	<100	<100	142	<100	<100	<100	129	129	<100	<100	<100
	ZR	13	<10	13	<10	<10	<10	12	12	<10	12	<10

348	16361	16348	16361	16360	16360	16366	16364	294439
550	17564	17554	17562	17564	17565	17566	17564	316083
197	20004	19999	20001	20002	20002	19999	19999	360006
196	31-6198	31-6200	31-6202	31-6204	31-6206	31-6209	31-6211	
362	458363	458364	458365	458366	458367	458368	458369	
762	87802	87775	87807	87809	87818	87835	87824	87799
99	1.00	.99	.99	1.00	1.00	.98	.98	.0099
15	93.15	93.13	93.16	93.15	93.14	93.19	93.17	.9315
37	.45	.46	.45	.46	.47	.44	.38	.0034
49	5.40	5.42	5.40	535	535	5.41	5.47	.0552
1	338	206	269	271	289	372	224	270
8	17	22	21	25	21	18	20	19
'	<1	<1	<1	<1	1	<1	<1	<1
1	.2	<.1	<.1	<.1	<.1	<.1	<.1	<.1
2	<2	<2	<2	<2	<2	<2	<2	<2
1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1
0	<10	<10	<10	<10	<10	<10	<10	<10
1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1
1	4	3	2	<1	2	<1	3	2
2	83	54	91	91	94	64	56	60
4	41	43	44	41	46	37	37	40
3	278	284	320	287	302	239	224	226
4	.5	.5	.5	.5	.6	.5	.4	.4
2	41	33	28	24	26	16	40	52
7	9	9	9	9	.4	4	10	8
0	18	17	35	26	30	15	24	28
	6	5	6	6	5	4	4	4
0	<10	<10	<10	<10	<10	<10	<10	<10
7	73	74	77	74	78	57	62	73
5	7	5	5	<5	6	<5	<5	6
	<1	<1	<1	<1	<1	<1	<1	<1
-	<2	2	<2	<2	<2	<2	<2	<2
2	202	204	211	190	207	161	148	176
0	22	25	12	28	29	21	21	18
20	20	<20	<20	<20	<20	<20	<20	<20
4	6	<4	<4	<4	<4	<4	<4	<4
1	<1	<1	<1	<1	<1	<1	<1	<1
00	<100	<100	130	<100	110	<100	<100	<100
0	<10	11	12	<10	11	<10	<10	<10
								872
					H_2O	0.280	#1	30

O =

(Bal) O = .112411
.000902
87799

Note
New Paint on
Water Window
Water filling completed May 14, 1973

Expt # 2

Add one 7x7 Array, Stack now has Both 7x7 Arrays Separated with 1" Plexiglas Pu Be-6 Source between Plexiglas And Polyethylene on Movable table.

2^{45}
2^{55}

Start tables together

Tables Closed — Bad reading — no noise.

IC-2 (02) → 09 x3 x10^{-11}

3 1.05 x10^{-12} to 8.5 x10^{-13} M = —

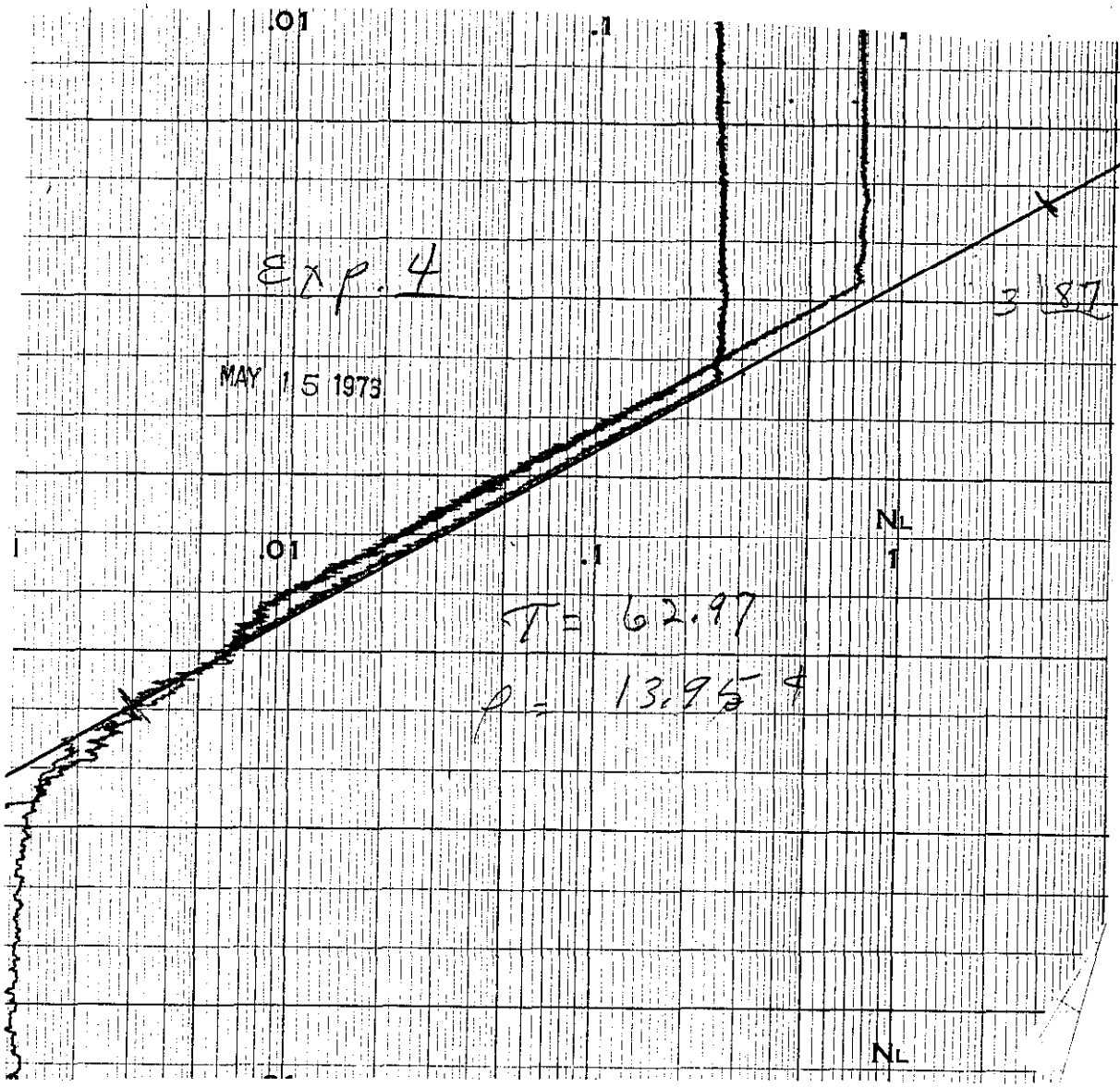
4 2.4 x10^{-13} to 5.1 x10^{-13} M = 2

OK to put 4th layer on tables

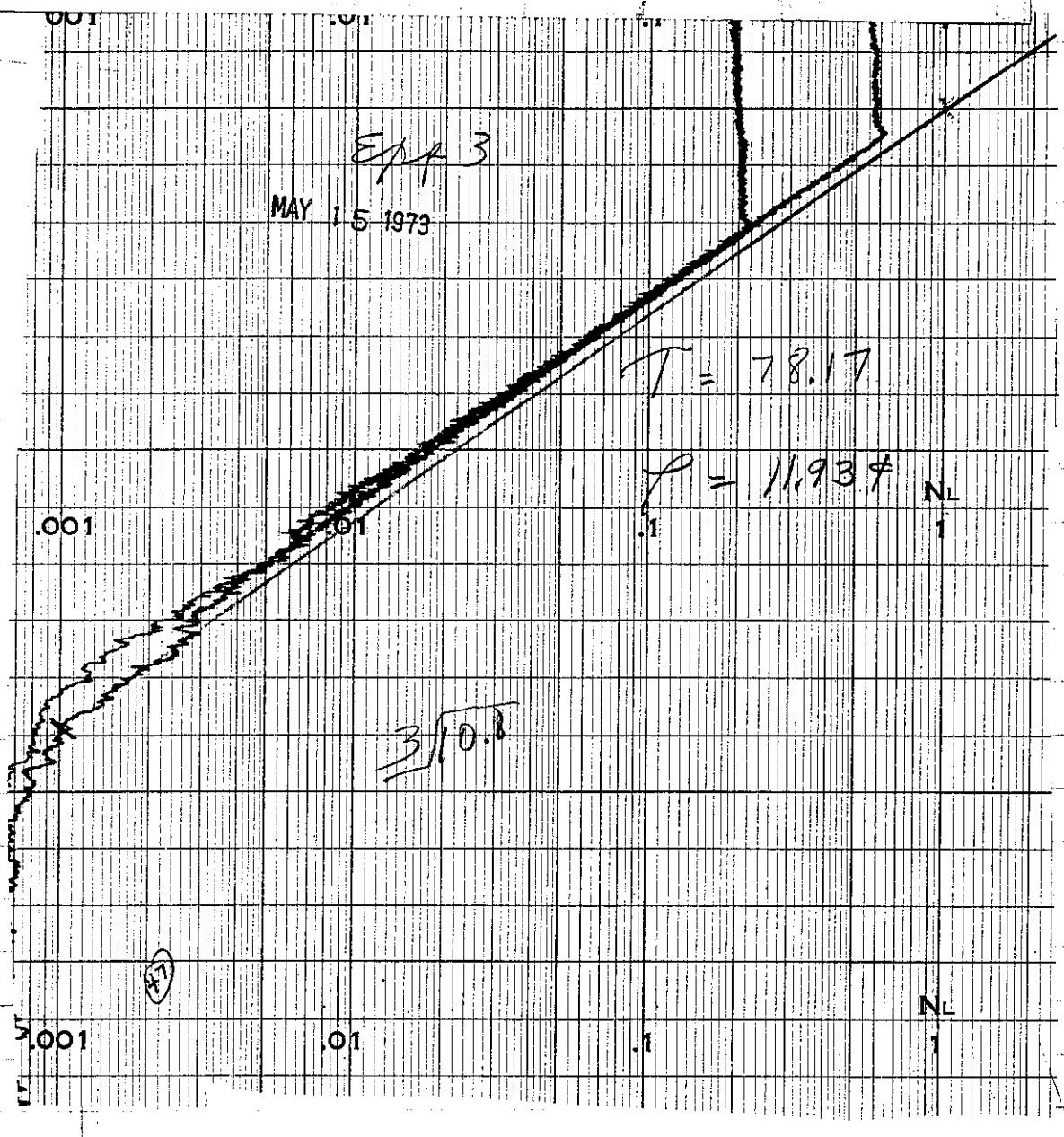
Stack = 7x7x4 (196 cans) egg crate, 1" plywood.

Cans # 250, 262A, 98 & 112A not used.

224



22


.001
.01
.1
1
N_L
EXP 3
MAY 15 1973
τ = 78.17
ρ = 11.93 #
3/10.8
47
.001
.01
.1
1
N_L

MAY 15 1973

Instrument Check on MAY 15 1973 Source (66 Co) #20

PM-1 Gel Low Trip OK Hi Trip OK
875V.
IC-1 3×10^{-10} Meter Trip OK Fast Trip OK
IC-2 3×10^{-10} Meter Trip Servo (OK)
IC-3 Calibration JJL
IC-4 Calibration JJL

Rad Mon
A OK
B OK
C OK

Stack = 7 X 7 X 4 (196 cans) egg crate.

Exp 3. 1" Plexiglas

3:10 Start tables together.

Positive period. Level

W = .989 W = 1.027

E = .989 E = 1.027

$\Delta S = .038$

$\rho = 11.93 / .038 = 314$ ¢/in

Exp 4 - Removed 2 cans from SE corner
" " " SW corner

192 Cans.

3:45 Start tables together.

Positive Period

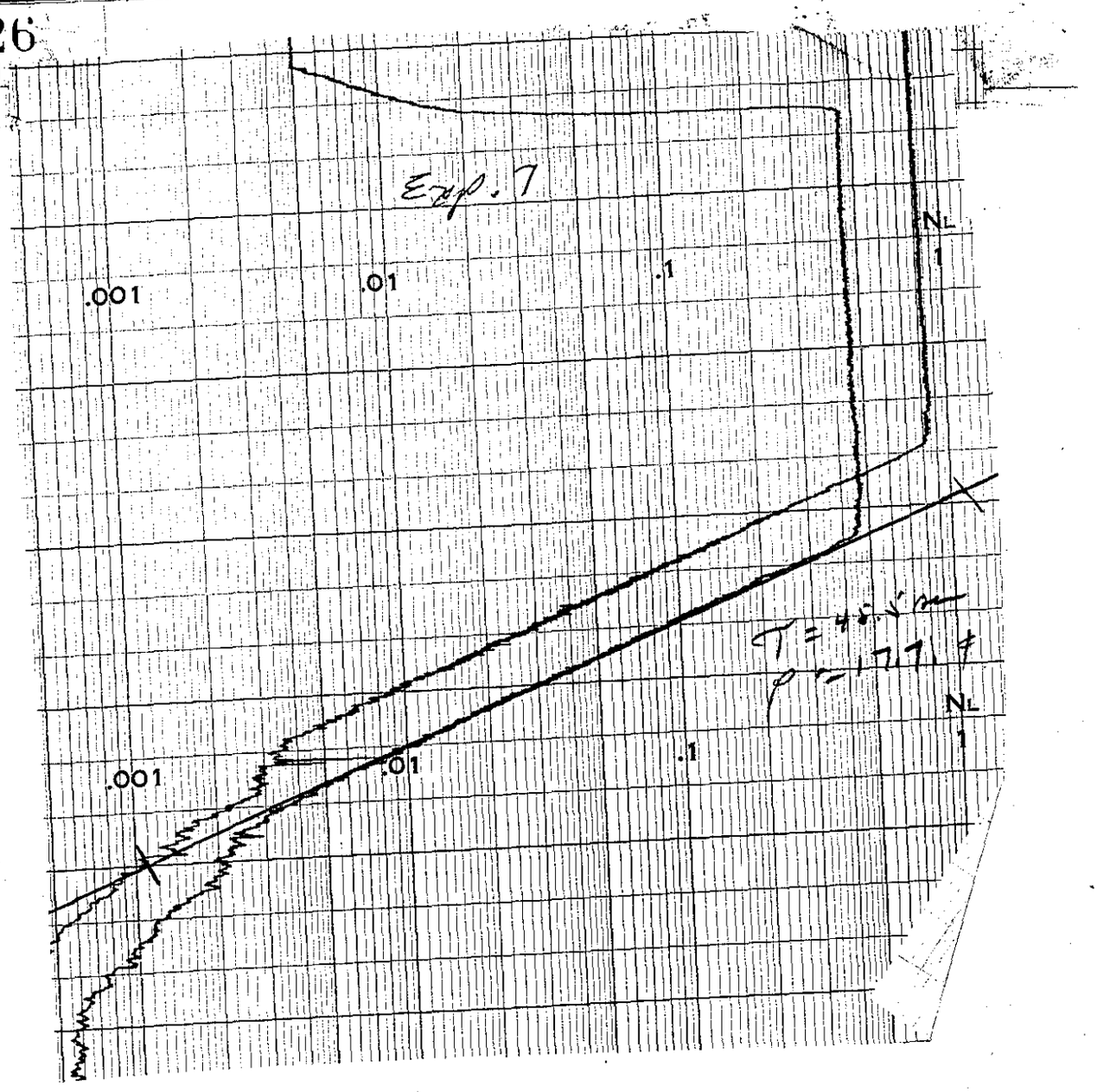
W = .857 Level

E = .859 W = .903

$\Delta S = .047$ E = .904

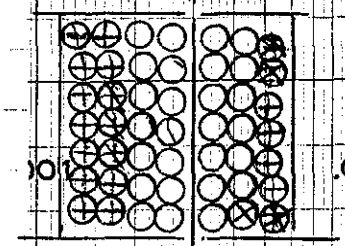
$\rho = \frac{13.95}{.047} = 297$ ¢/in

$13.95 / .045 = 313$ ¢/in DWM 8/14/85


Exp. 7
.001
.01
.1
1
NL
.001
.01
.1
1
NL

MAY 16 1973

Exp 5.



.01

1

N_L

3 | 7.9

τ = 57.18

ρ = 14.95 #

⊗ = off for Exp 4

⊕ = " 5

⊕ = " 6

⊕ = Returns for Exp. 7

N_L

MAY 16 1973

Instrument Check on MAY 16 1973 Source #20 (60Co)

PM-1 _____ Low Trip ok High Trip ok

_____ _____ _____

IC-1 3×10^{-10} Meter Trip Scram(H) Rect Trip _____

IC-2 3×10^{-10} Meter Trip [redacted] ok RAD. MON.

IC-3 _____ Calibration JJL A ok

IC-4 _____ Calibration JJL B ok

_____ _____ C ok

Exp. 5

Stack = 182 Cans.

Back row of each side of top tier ~~removed.~~ off.

Positive Period –

$W = .413$

$E = .417$

LEVEL –

$W = .468$

$E = .472$

$\Delta S = .055$

$P = 14.95\ \#$

$272\ \#/in.$

Exp. 6

Stack = 175 Cans.

Removed 2nd Row of movable table.

1:30 PM Sub Critical.

Exp. 7 Stack = 178 Cans.

Returned 3 cans to center of row 2 Movable Table.

1:48 Positive period. $W = .101$ | Level $W = .225$

Tables closed $E = .102$ | $E = .229$

$P = 17.71\ \#$

$\Delta S = ?$ $.124$ $.127 > .1255$

Integrated Scale Curve from .227 to 1.027
at an average area of $\frac{@2.60 + 3.10}{2} = @2.85$

$.8 \times 2.85 = 2.28$

$.10 \rightarrow .227 \quad + \quad .18\,¢$

$\overline{@\ 2.46}$ excess react.

$\times .0068 = 0.0167$

for Table @ 1.027 Min.

$k_{eff} = 1.0167$

$1 + .177\,@ = 1.0012$

.93⁵

No.	% U	UO_2	g U			
4	87.48	1693	1481.04			
39	87.52	16498	14439.05	DWM	@	2.3 × .0068
35	87.44	14639	12800.34	8/12/85		
41	87.38	17060	14880.81	14907.03		
20	87.65	8430	7388.90			= 1.01564
6	87.53	2524	2209.26			
3	87.80	1274	1118.57			
148 48	87.82	20399	17914.40			
196		82517	72232.37	72255.59	67	
DWM		421.005		= 368.53 g U		
8/12/85 DT			196			
Aw = 87.568		= 87.53635 g U/g		343.29 g ^{235}U		

Height including 4 layers of Plexiglas

NORTH	56.3	SOUTH	56.7	Av
	56.0		56.3	56.2
	55.9		56.2	

North - South including 6 layers of Plexiglas

MOVABLE	70.3	FIXED	70.3 . 70.2
	70.3		70.0

East - West including 6 layers of Plexiglas

MOVABLE	39.0	FIXED	31.9 70.6
	39.0		31.3

Av $70.4 \times 70.4 \times 56.2$

assume s.c

$\frac{72.9}{7} \times \frac{72.9}{7} \times \frac{56.2}{4} = 10.41 \times 10.41 \times 14.05$ Average cell size

Total weight of Plexiglas 149.4 kg

$\times \frac{1}{1.182}$

Total volume = 129.40 liters

1st estimate of average Plexiglas thickness

= 2.32 cm

70.40
2.32
72.72

$\frac{72.72}{7} = 10.39 \times 10.39 \times 14.05$ = 97278.4930

$8.07 \times 8.07 \times 11.73$ = 149 727.3551

147,551.1379

$(72.72^2 - 70.40^2)\,56.2 =$ 18,660
129,400
148,060

2nd Estimate = 2.34 cm

70.40
2.34
72.74

$\frac{72.74}{7} = 10.39 \times 10.39 \times 14.05 \times 196$

$8.05 \times 8.05 \times 11.71 \times 196 =$ 148 732.1059

148 546.387

$72.74^2 - 70.40^2)\,56.2 =$ 18824
129.4
148.224

volume
757.91 cm³
× .0568

Use 2.34 for Plastic Thickness

Void ± 4.025 × ± 4.025 + 11.71 −0.0

Clay ± 5.195 × ± 5.195 + 14.05 −0.0

148.55 / 343.3 × 5.68 E−02 / 2.56317×10⁻³

196×

$\frac{4}{x} = 48.9_2^3$

11.71 cm height vs 11.59 measured

Average weight of 20 ea Kerr McGee cans
137.06

Average weight of 15 ea UNC cans
139.13

Av of 35 cans
137.95 g

Assume carbon steel 7.82 g/cm³
Volume 17.64 cm³ per can

For can 3.77 cm i.d. × 11.535 } 17.666 cm³ (radius)
3.825 o.d. × 11.59
× 7.82
= 138.15 grams

Above is measurement on
one can 2.957 i.d inch
Fuel height 1.405 inch or 1 13/32
can height 4 9/16 inch

8 cans, measured Depth of void

1 27/32	1 29/32
1 30/32	1 28/32
1 27/32	1 24/32
1 25/32	1 31/32

Can od
≈ 2.985 in
dia or 7.582 cm
Rad 3.791 cm
id = 3.736

Ave of 9 (1.764 .324 .359) within 20%
in.
= 4.48 cm height of void

Oxide Volume & Density

$421 / \pi\, 3.736^2 \times 4.48 = 421\,g / 196.34\ cm^3$

$= 2.144\ g/cm^3$

2 PM June 5, 1973

Temporary storage for 20 kg of $U(93)O_2$ in South assembly area will be on 3 ft centers on floor — may be against corner wall JT Thomas concurred in the temporary storage

Art Magnuson

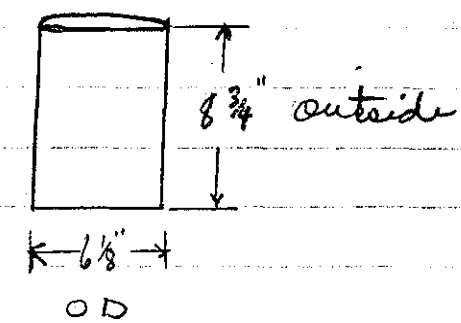
2:30 PM

8 Containers each having 20 kg of $U(93)O_2$ were delivered in Y-12 Foam glass shipping Containers — Cans of UO_2 were removed and set in South assembly area. Contamination levels range from 160 to 2120 d/min, typical of materials from Y-12.

After vacuuming, dust and wiping cans with damp sponge, contamination was reduced to a range of 0 to 108

by C. C. (DWM)

Containers



25#

JUN 6 1973

Instrument Check on JUN. 6 1973 Source #18 (60Co)

DWM
JJL
CC

FM-1 Time Grid OK Height OK

IC-1 3×10^{-10} OK OK

IC-2 3×10^{-10} OK (Scram) Rad Mon

IC-3 OK A OK

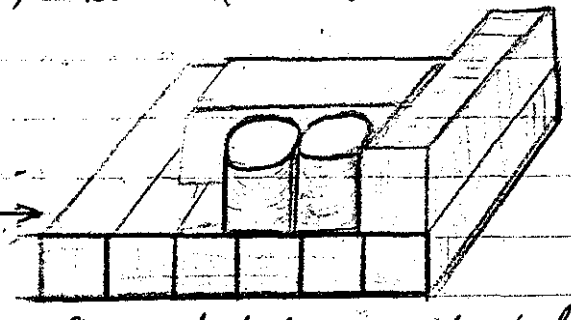
IC-4 Calibration OK B OK

C OK

Exp 1 - 2 Containers on N
2 " S
4 Units Poly Reflected on bottom, West and (North + South) Back sides.

$k < 1$, No inst. response.

one table



Exp. 2 - The above Completely Reflected.

$k < 1$, No inst. response.

JUN. 7 1973

Instrument Check on JUN. 7 1973 Source Co 60 (#20) 231

PM-1 _____ Low Trip OK Hi Trip OK

IC-1 3×10^{-10} Meter Trip OK (Scram) Fast Trip OK

IC-2 3×10^{-10} Meter Trip OK

IC-3 _____ Calibration ok

IC-4 _____ Calibration OK

Rad Mon.
A ok
B OK
C OK

Exp 3.

8 Units Completely reflected

$k < 1$, no inst. response.

JUN. 8 1973 - Received 10 Containers of UO_2 20 Kg each -

238

JUN. 1 1 1973

JUN 1 1 1973

Instrument Check on [illegible] Source 420 (^{60}Co)

PM-1 [illegible] Low Trip OK (Scram) Trip OK

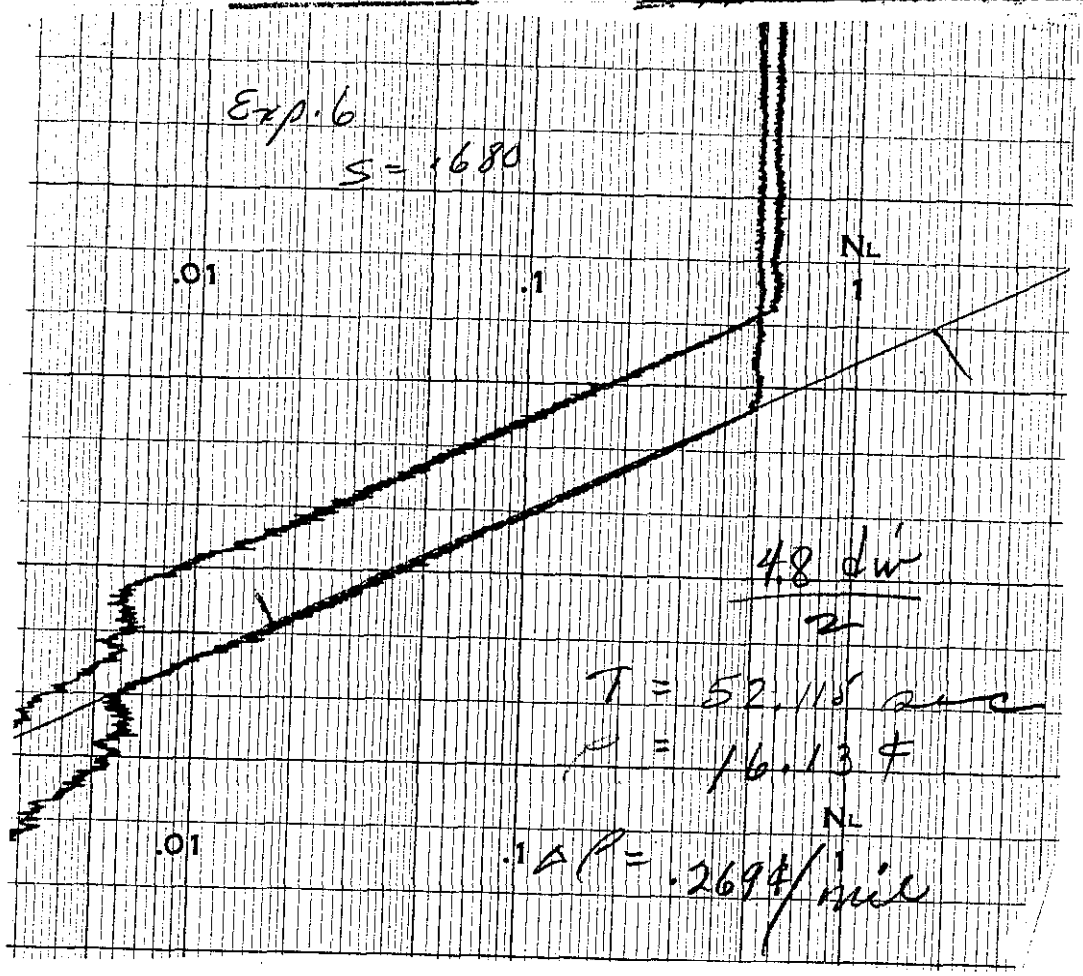
IC-1 3×10^{-10} Meter Trip OK Fast Trip OK

IC-2 3×10^{-10} [illegible] OK Rod Mon —

IC-3 [illegible] OK A OK

IC-4 [illegible] OK B OK

C OK



$\frac{4.8\ dw}{2}$

$T = 52.11^{\circ}$ 2 mc

$\omega = 16.13 \pm$

$\Delta\rho = .269\%/min$

(Co)

OK

OK

Red mon. —

OK

OK

OK

Exp I — 8 containers on S.
4 " on N.

12 Units

Completely reflected.

$k < 1$, IC 2 from .04 → .07
4 " .0035 → .008

Exp 5 — Added 2 units to S.

14 Units Completely reflected.

IC 2 from .04 → .1
$k < 1$ 4 " .00035 → .001

Exp 6 —

16 units Completely reflected.

$k > 1$, $W = .678$
$E = .682$ $P = +16.13^4$

$\Delta S = .060$ $W = .739$
$E = .742$ $\Delta P = .0269$

Exp 7 - Removed 1 unit (from NE Corner).

15 Units IC 2 8 → 50

k < 1, IC 4 .045 → .006

What is zero on west and East positions and

Instrument Check on JUN. 13 1973 Source ~20 (60Co)

JUN. 13 1973 PM-1 Low Trip OK Hi Trip OK

IC-1 Motor Trip OK (Scram) Fast Trip OK

IC-2 Motor Trip OK Rad Mon -

IC-3 Calibration OK A OK

IC-4 Calibration OK B OK

C OK

Exp 8 - Spaced the back row of each table an additional 1/4" (i.e. the original separation was ~ 1/8" due to can construction)

16 Units

$k > 1$, $W = .364$ $\rho = 12.63$ #

$E = .371$

$\Delta S = .061$

(T∞) $W = .425$ $\Delta \rho = .207$ #/mil

$E = .433$

Exp 9 - all rows now spaced 1/4" in the N-S direction.

16 Units

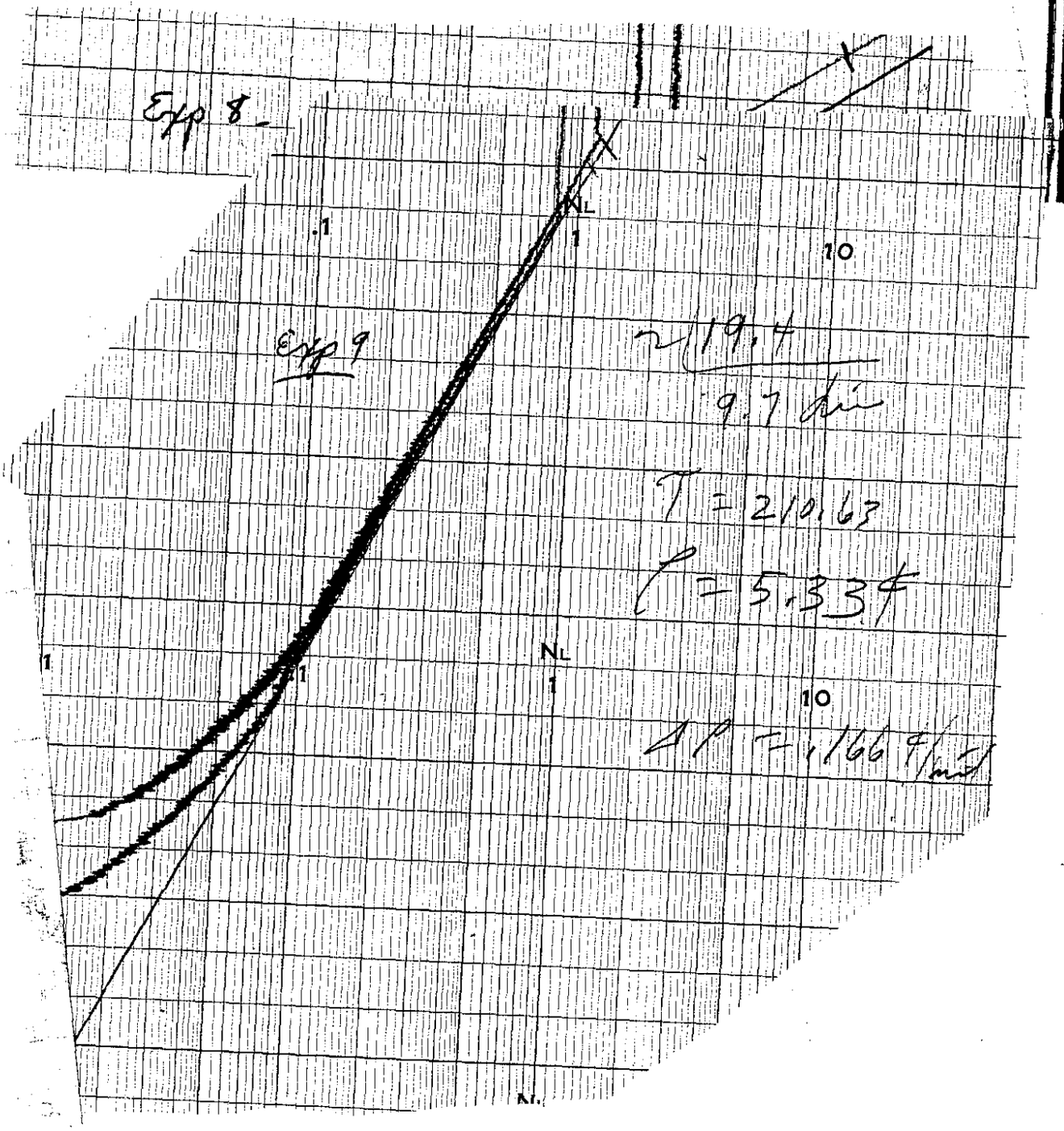
$k > 1$, $W = .101$ (closed) $\rho =$

$E = .104$

$\Delta S = .032$

(T∞) $W = .131$

$E = .137$ $\Delta \rho = .166$ #/in

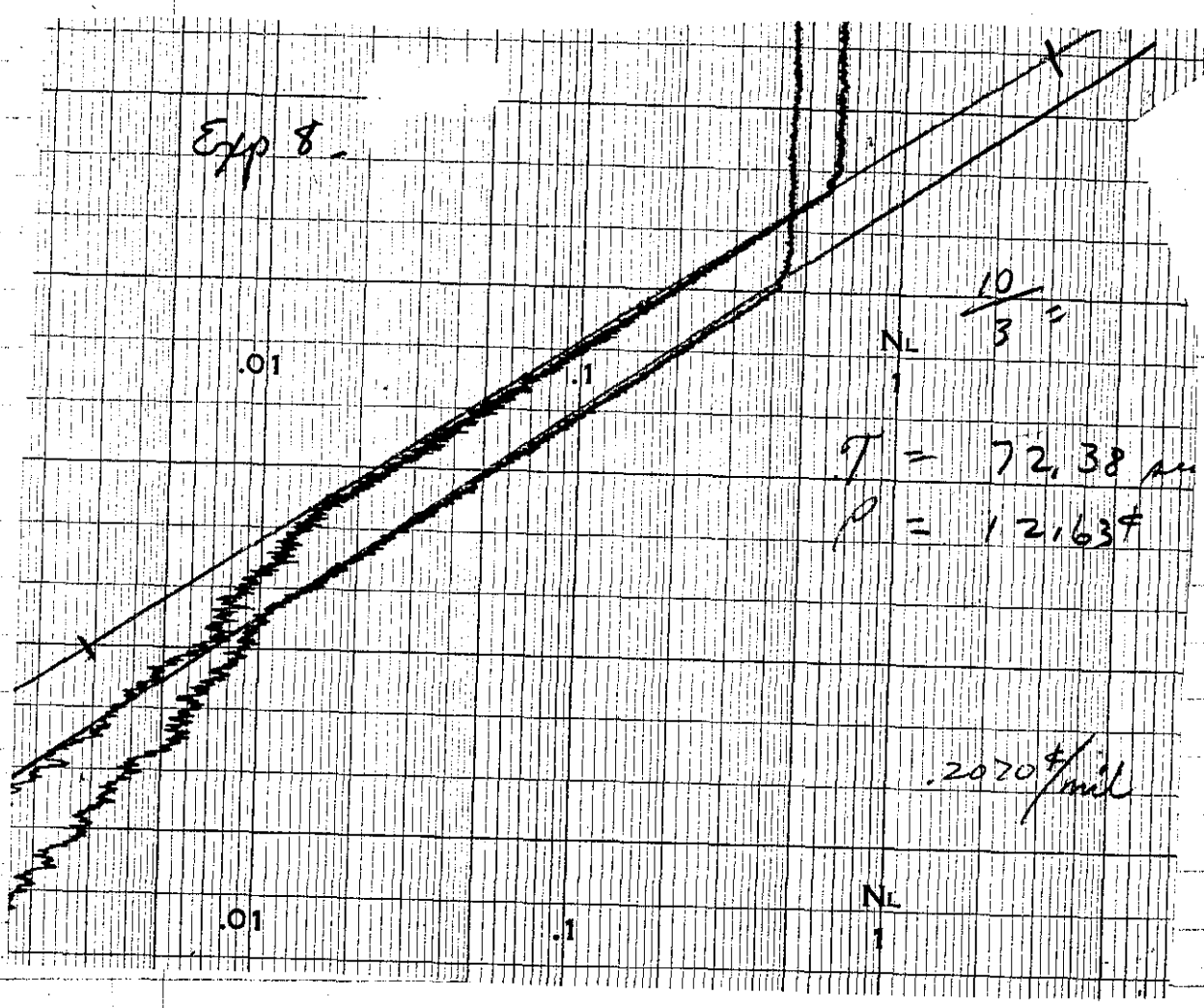


$\tau = \frac{19.4}{9.7 \text{ hr}}$

$T = 210.6°$

$C = 5.33\%$

$\Delta P = .166$ psi/hr


Exp 8 -
.01
.1
1
N_L
$\frac{10}{3}$ =
T = 72,38 in-
P = 12,634
.2070 #/mil
.01
.1
1
N_L

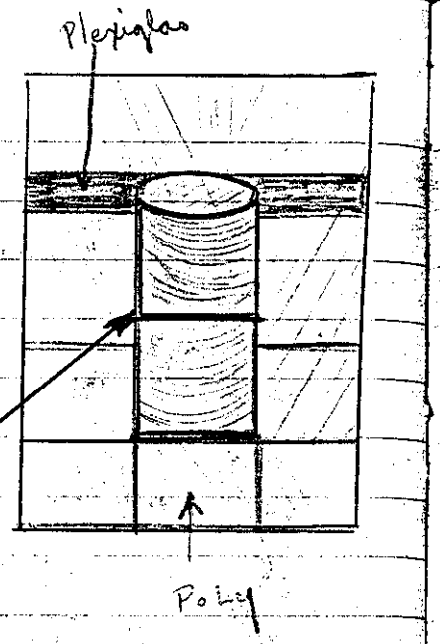
JUN. 13 1973

Exp 10 - Two Tier

4 Units | - 2 each table.

$k < 1$, no inst. response

$\frac{1}{16}$" al
(6"x6")



Exp 11 -

8 units | - 4 units each table

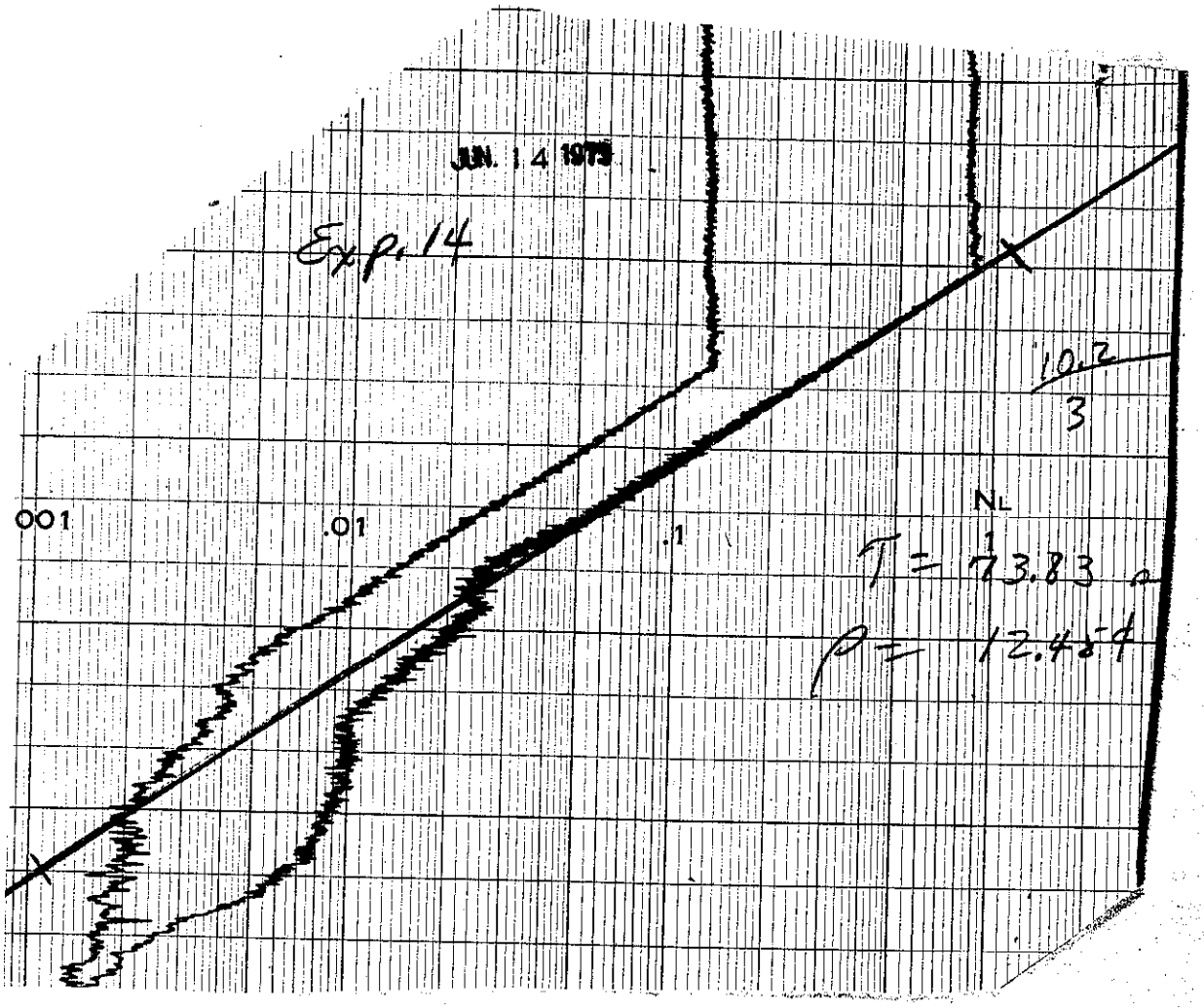
$k < 1$, no inst response -

Exp 12 -

12 Units | 6 units each table,

$k < 1$, I_c 2 .4 → 2.5

I_c 4 .0008 → .009


JUN. 14 1973
Exp. 14
10.2
3
001
.01
.1
NL
T = 73.83 ρ
ρ = 12.43-4

JUN. 14 1973

Instrument Check on JUN 14 1973 Source 60Co (#20)

PM-1 _____ Low Trip OK Hi OK

IC-1	3×10^{-10}	OK	OK
IC-2	3×10^{-10}	OK Scram	RAD. MON.
IC-3		OK	A OK
IC-4		OK	B OK
			C OK

Exp 13

12 UNITS

Removed the Al shims from between units.

$k < 1$, Ic 2 , .4 → 2.3

4 .0008 → .01

Exp. 14 - Add two pcs (1" x 1⅞" x 9") plexiglas between cans of fixed table.

12 units

$k > 1$, $w = .266$

$E = .272$ $\rho = 12.45$ #

$\Delta S = .040"$

T ∞, $w = .306$

$E = .312$

$\Delta \rho = .311$ #/mil

.309" X .24#/mil = 74 #

JUN. 14 1973

Exp 15 - Removed 1 pc of plexiglas added for Exp. 14.

12 Units

$k > 1$, $w = .104$ $\rho = 5.15^{\#}$

$E = .104$

$\Delta S = .030"$

$T \infty$ $w = .130$

$E = .136$

$\Delta \rho = .172^{\#}/mil$

Exp 16 - The 2 pcs plexiglas of Exp. 14 cut to make 4 pcs ($1 \times 1\frac{7}{16} \times 4\frac{1}{2}$) and placed in symetric positions.

12 units

$k > 1$ $w = .184$ $\rho = 16.72^{\#}$

$E = .191$

$\Delta S = 58.5$ mils

$T \infty$ $w = .243$

$E = .249$

$\Delta \rho = .286^{\#}/mil$

Exp 17 - Removed 1 pc plexiglas. ($1 \times 1\frac{7}{16} \times 4\frac{1}{2}$)

12 Units

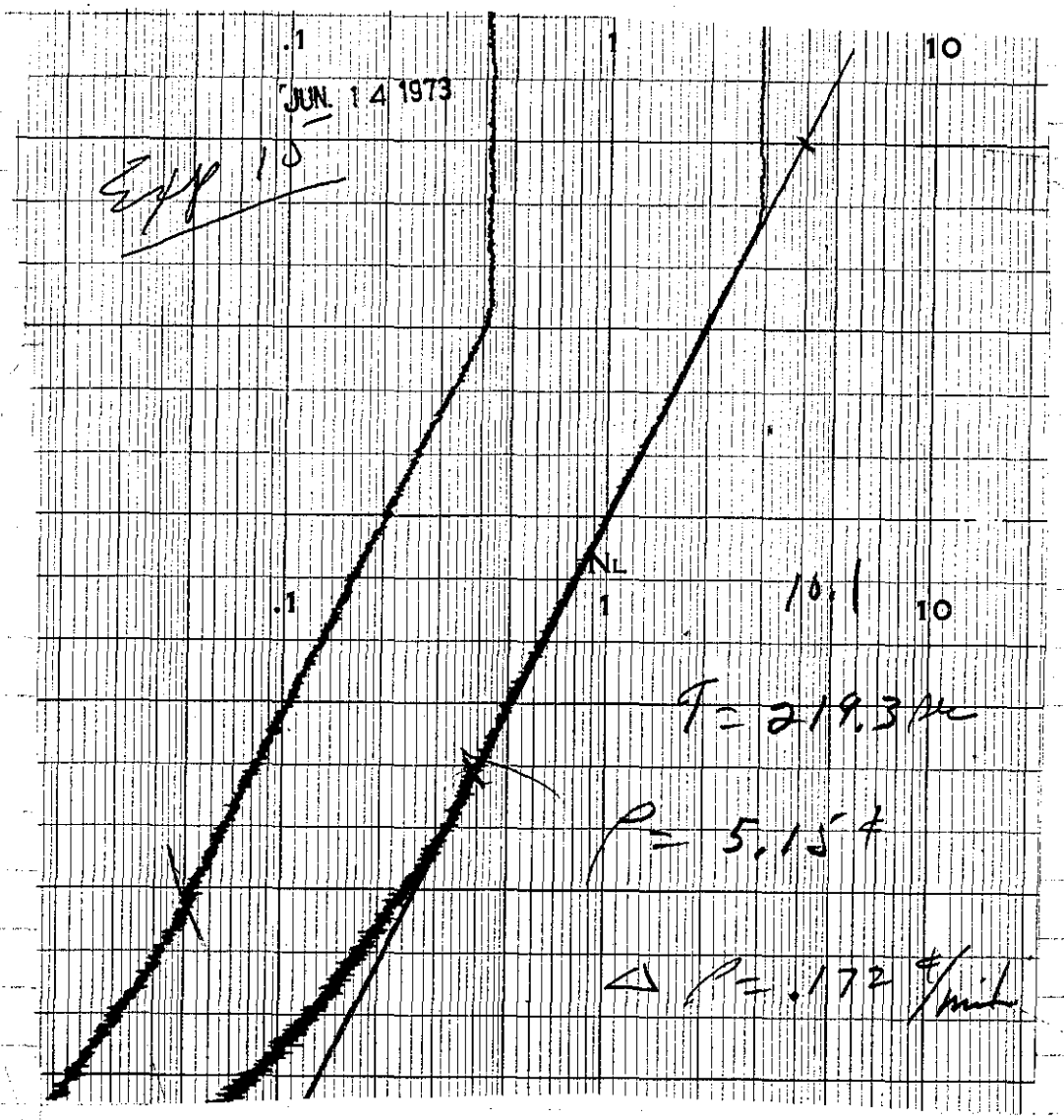
$k > 1$, $w = .100$ $\rho = 12.30^{\#}$

$E = .102$ $\Delta S = .062"$

∞ $w = .161$

$E = .165$

$\Delta \rho = .198^{\#}/mil$

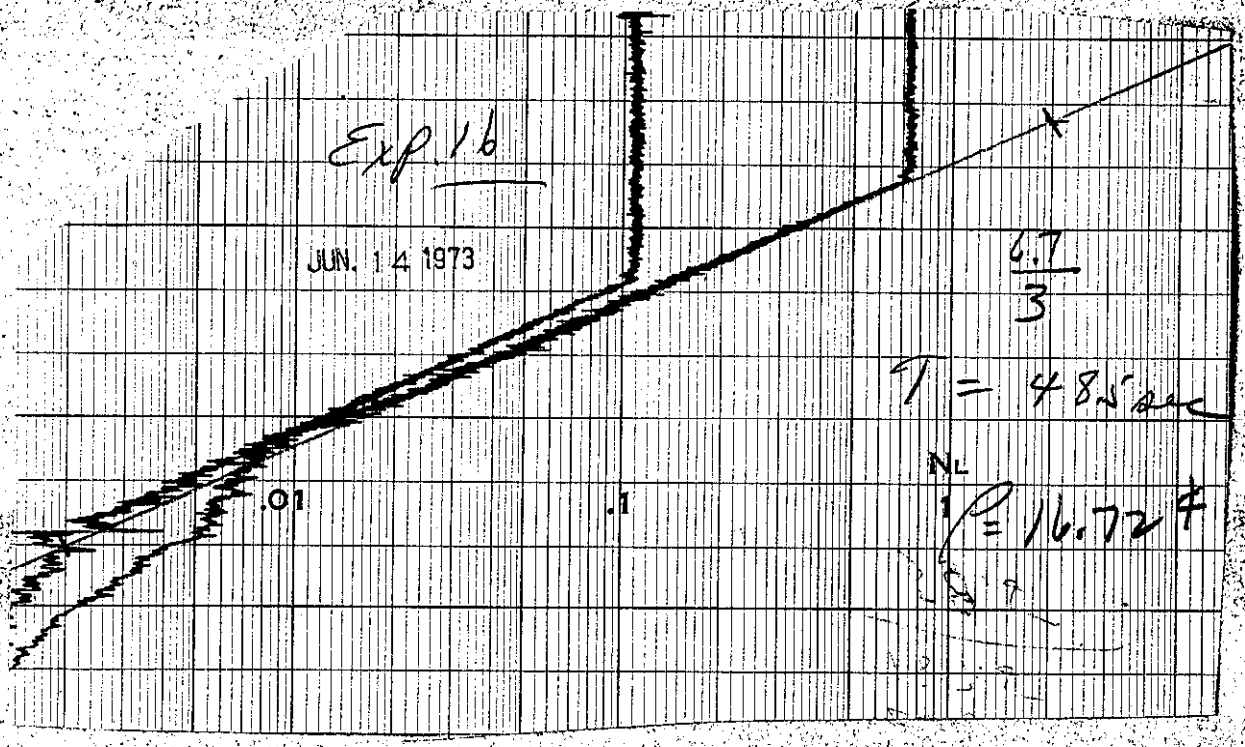


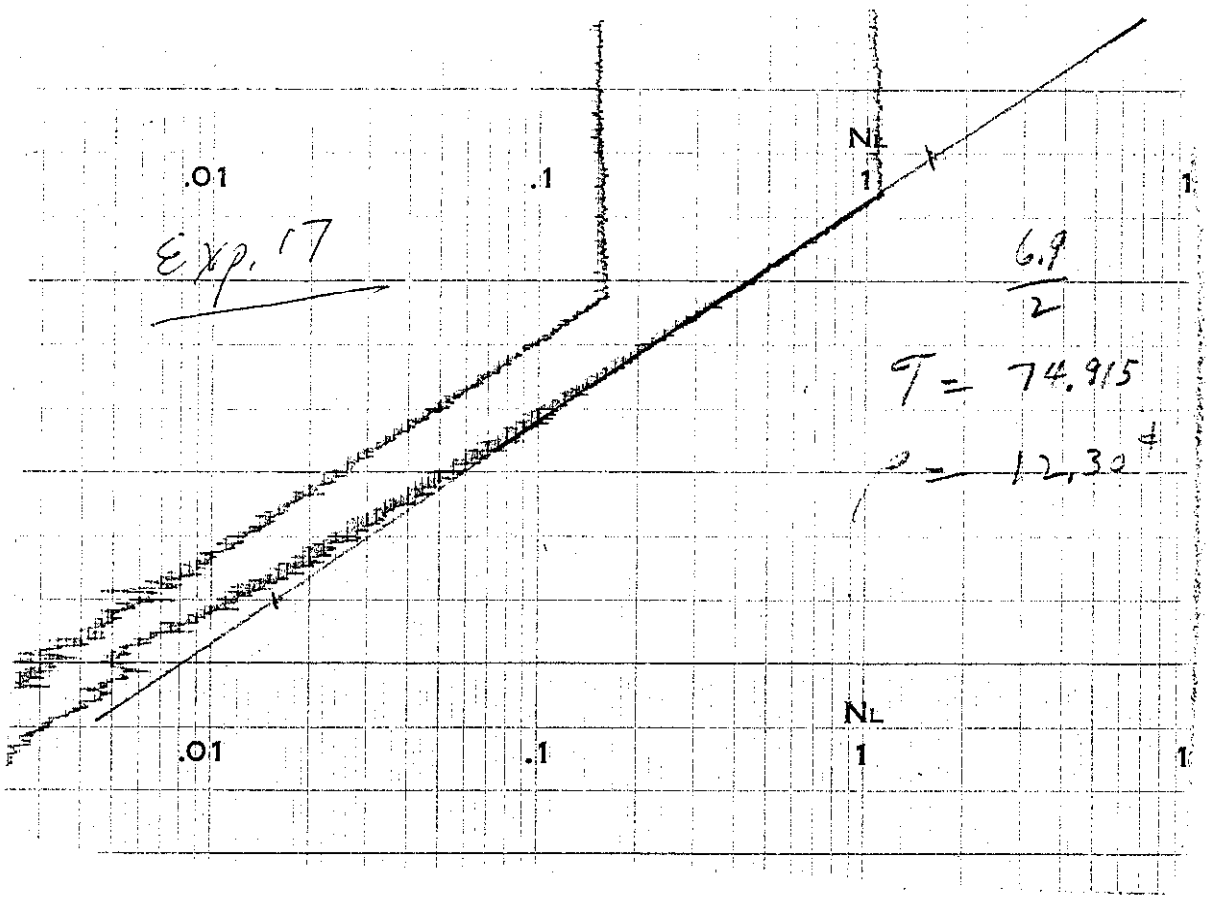
Exp 17 .246 .286 #/mi

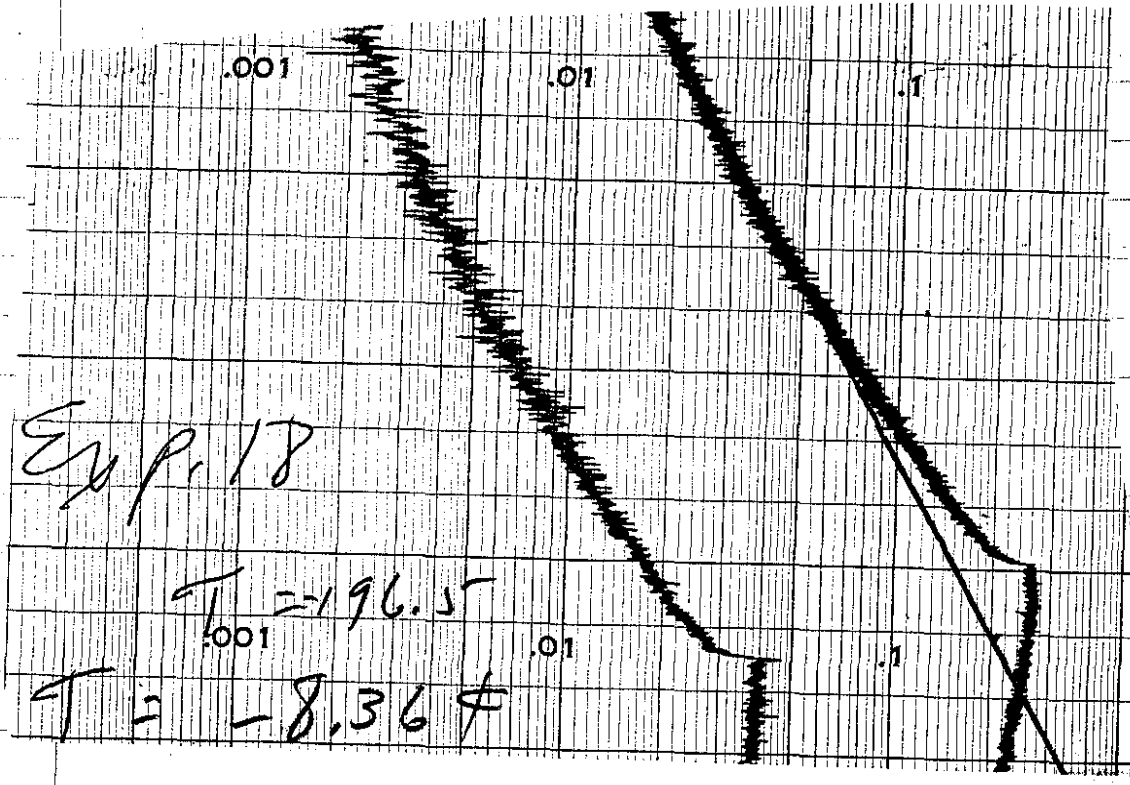
VS −.163 .197

Exp 16 83 mil 2|.484

X .242 # = 20 #/ pc plexiglass


Exp. 16
JUN. 14 1973
.01
.1
6.7/3
τ = 48 sec
N_L
1
P = 16.72 #


.01
.1
1
N_L
Exp. 17
6.9
2
$\bar{T}$ = 74.915
σ = 12.32
.01
.1
1
N_L



Exp. 18

$T_1 = 196.5°$

$T = -8.36°$

Poly Box measurements

		W	Center	E.
Height	Moveable Table	44.5 cm	44.5	44.6
	Fixed "	44.8	44.8	44.6
		Bottom	Center	Top
E-W Dim	Moveable "	47.0	47.2	47.0
	Fixed "	47.0	47.1	47.2

Moveable " 15.6 cm

N-S Dim 15.6 "

Fixed " 15.55 "

N-S Dim 15.55 "

16 units Planar Array

$T = \infty$ Take Gap = 0.7405 − 0.1025 = 0.638

T = 0.680

ΔS .0605 16.13 ¢

16 Units Spaced 1/4" in one row

$T = \infty$ Gap 0.429 − 0.1025 = 0.3265

T = + Gap .3675 ρ = 12.63

.0615

16 Units Spaced 1/4 in row NS Direction

$T = \infty$ 0.134

T = + 0.1025

.0315 ρ = 5.53.

React Summary

0.1025 → 0.134	5.53
0.134 → .3675 = .2335 × $\frac{.166+.207}{2}$ =	43.55
.3675 → .429	12.63
.429 → .680 ⇒ .251 × $\frac{207+269}{2}$ =	59.74
.680 → .7405	16.13
(Average worth = $2.1/in × .638 = $1.34)	137.58 ¢

$1.38 × .0068 = 0.0094

k (16 units close pack) = 1.0094

3 x 2 x 2 Array (12 units)

#12 Subcritical close packed

#13 w. 2 ea 1 x 1½ x 9 plexiglas between unit

T = ∞ .309

T = + .269 ρ = 12.45

#14 w. 1 ea 1 x 1½ x 9

T = ∞ .133

T = + .1025 ρ = 5.15

.269 − .133 = .136 × $\frac{172 + 3''}{2}$ = 32.84

k_{ex} = 2 pc 50.44 ¢

k_{ex} = 1 pc 5.15

worth per piece 45.29

ρ (Unperturbed system) = −45.29 + 5.15 = −40.14 ¢

= −.4014 × .0068 = −.0029

k = 0.9971

#16 4 pc plastic

T = ∞ .246

T = + .1875 +16.72

#17 3 pc plastic

T = ∞ .163

T = + .101 12.30

(.1875 − .163) $\frac{198 + 286}{2}$ = 6.17

k_{ex} = 35.19

2pc

=18 Table Closed .101 $\varrho - 8.36$

18 − 17 = −8.36 − 12.30 = −20.66

worth 1pc × 2 = .4132

836

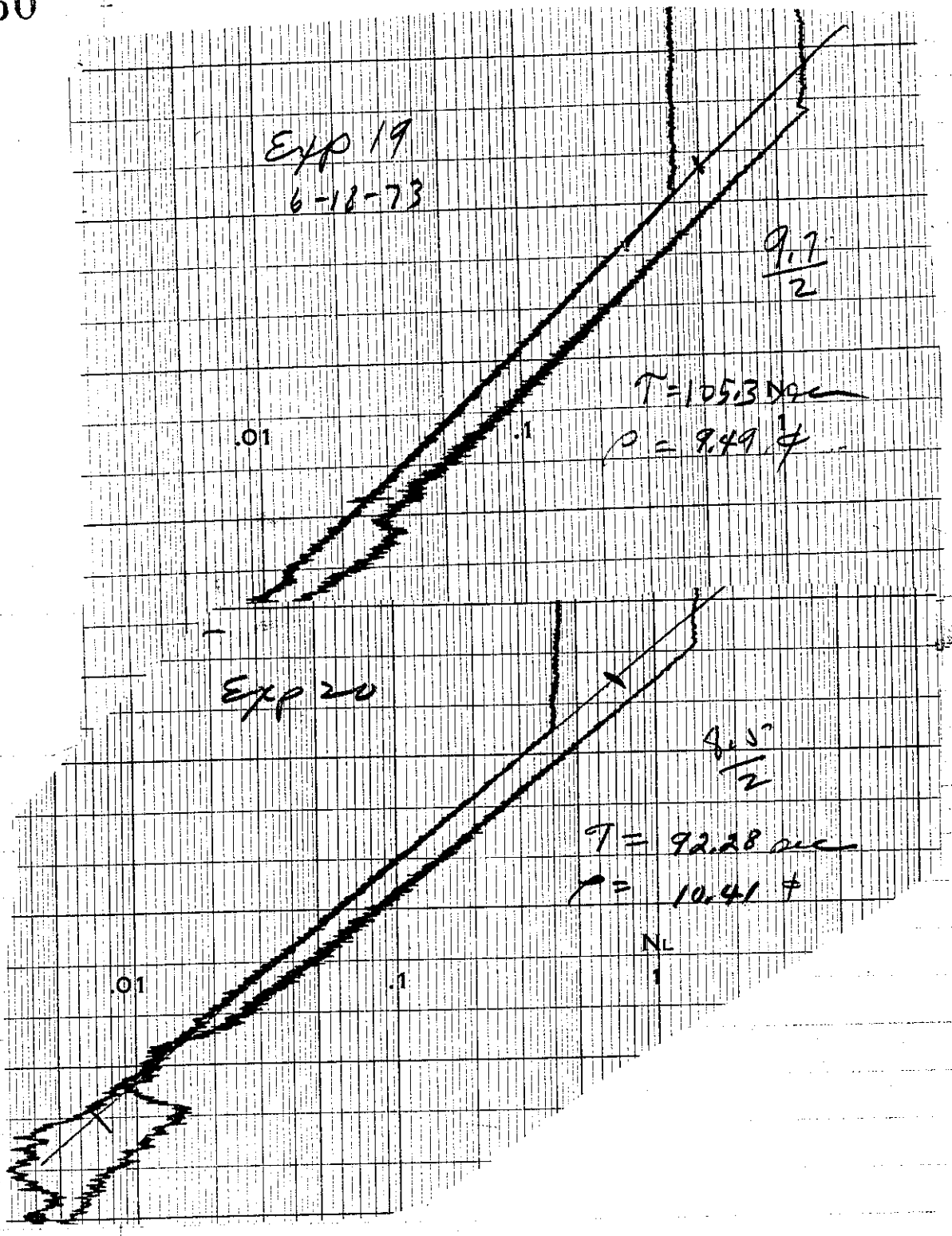
ϱ (unperturbed sys) −.4968

Average 452.9
49.68
94.97

$\frac{94.97}{2}$ = 47.5 ¢ × .0000068 = .0032

$k = 0.9968$

for 12 unit 3 × 2 × 2


Exp 19
6-18-73
9.7
2
T = 105.3 sec
ρ = 9.49 #
.01
.1
Exp 20
9.5
2
T = 92.28 sec
ρ = 10.41 #
NL
.01
.1
1

JUN. 18 1973

Instrument Check on JUN. 18 1973 Source ^{60}Co #28

JSL, JET, DWM.

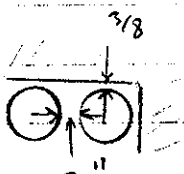
FM-1	Low Trip ✓		Trip ✓
	SCRAM TABLES		
IC-1 3×10^{-10}	Meter Trip ✓	Fast Trip	
IC-2 3×10^{-10}	Meter Trip ✓		
IC-3	Calibration ✓	1.6×10^{-9}	
IC-4	Calibration ✓	1.6×10^{-7}	

RAD. MONT.
A ✓
B ✓
C ✓

Exp 19 -

18 units

units spaced 3/4".
(Poly walls 3/8" from units.)



at Center of cans (not at lip)

$k > 1$, $w = 1.472$

$E = 1.476$ $\rho = 9.49\ ¢$

$\Delta S = .032$

T_∞ $w = 1.504$

$E = 1.508$

$\Delta \rho = .296\ ¢/mil$

252

JUN 19 1973

JUN 19 1973

Instrument Check on _____ Source 60% #20

JWL, CC, JET

[illegible] Low Trip OK Hi Trip OK Scram

[illegible]	$E 3 \times 10^{-10}$	Meter Calib OK	Rad Mon
10^2	3×10^{-10}	Meter Calib OK	A OK
10^3		Calibration OK 1.6×10^{-9}	B OK
[illegible]		Calibration OK 1.6×10^{-7}	C OK

08:45 A

Exp 20 -

18 Units

Units Now Spaced 1".

$k > 1$, $W = .651$

$E = .652$ $\rho = 10.41$ ¢

$\Delta S = .0485$

∞ $W = .700$

$E = .704$

$\Delta \rho = .215$ ¢/mil

Exp 21 -

18 Units

Units Spaced 1⅛".

$k > 1$, $W = .100$

$E = .100$ $\rho = 19.48$ ¢

$\Delta S = .137$

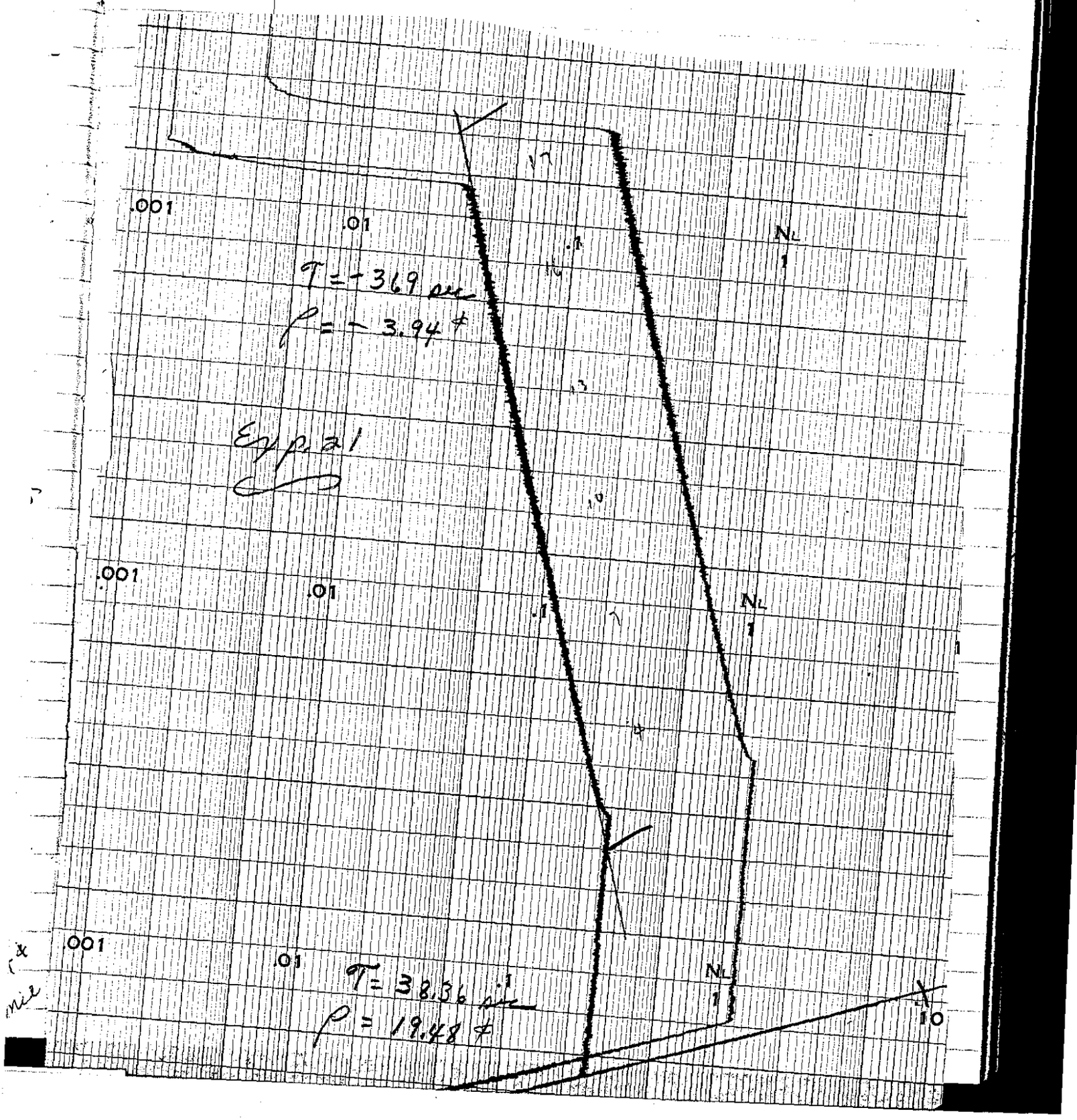
∞ $W = .236$

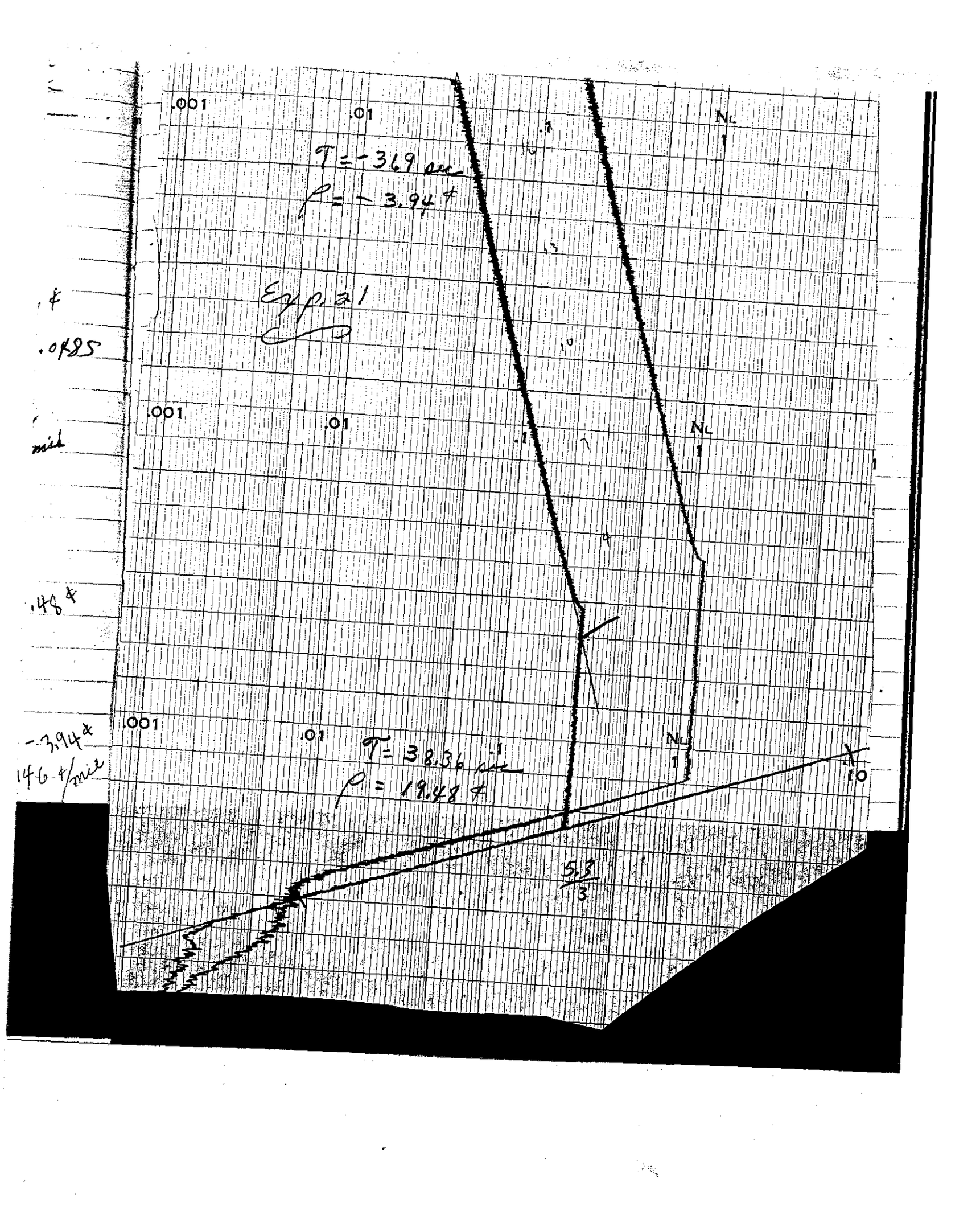
$E = .238$

$\Delta S = .027$ $\rho = -3.94$ ¢

$W = .263$ $\Delta \rho = .146$ ¢/mil

$E = .265$


.001
.01
.1
1
N_L
$\tau = -3.69$ psf
$\rho = -3.94$ #
Exp 21
.001
.01
.1
1
N_L
.001
.01
$\tau = 38.36$ psf
$\rho = 19.48$ #
1
N_L
10


.001
.01
.1
1
NL
T = -3.69 sec
ρ = -3.94 #
Exp. 21
.001
.01
.1
1
NL
.001
.01
T = 38.56 sec
ρ = 19.48 #
1
NL
10
5.3
3
.#
.0485
mid
.48#
-3.94#
146 #/mi

Measurements

	Width E-W	Length N-S		Height Vert
		North		
	54.5	35.2	35.3	44.6
	.6	.2	.2	.5
	.4	.1	.0	.5
		.1	.1	
		35.15		
		South		
	54.5	19.3	19.6	44.6
	.6	.2	.5	.7
	.6	.1	.3	.5
			.2	
Ave	54.5	19.3		44.6

Total 54.45

Reflector Inside Dim

54.48 x 54.48 x 44.6

Each Cell

18.16 x 18.16 x 22.30 cm

Can meas

wall thickness = .011 =

overall height		Outer Diameter	6.3/64
			6.0469
		Indent on Top & Bottom	= 15.359
8 3/4 = 22.225 cm			5/32 = .156 21
			= .397 cm
			.056 cm
			.453 cm

Inside height
22.225
.453
21.772
/2 = 10.88

ID = 15.359
−.056
15.303

Inside radius 7.65 cm

Outside +.03	7.68 cm	Fe	
Inside	+ 10.88	10.91	1.1 4.999 16
	− 10.55	− 10.91	

Assumed Analysis
.8789/g U
93.14 wt% ^{235}U
Am H_2O 285 μg/g
3 analyses

Inside volume = 4000.67 = 20000 = 4.999_{16} g/cm³

UO_2 4.999_{16} g/cm³

U × .876 = 4.389 g/cm³

^{235}U = 4.088 g/cm³ → .01048

^{238}U = 0.301 g/cm³ → .00076

H_2O = 0.0014 g/cm³ → H .000 093

0.000 046 5

Bal O = 0.6086 g/cm³ .022 917

H/^{235}U: .00887

Σ_s = 0.1966 σ_p (238) = 259

JUN. 20 1973

JUN. 20 1973

IC-1	3×10^{-10}	Scram OK	RAD. MON.
IC-2	3×10^{-10}	OK	A OK
IC-3	5×10^{-8}	OK	B OK
IC-4	1.5×10^{-9}	OK	C OK

2:30 PM

Exp 22 –

12 Units

Fixed Table – 6 units in 2 tiers. Tiers spaced with 1" plexiglas. Units spaced 2".

Moveable Table – 6 units, 1 tier. 1" plexiglas on top of units. Units spaced 2".

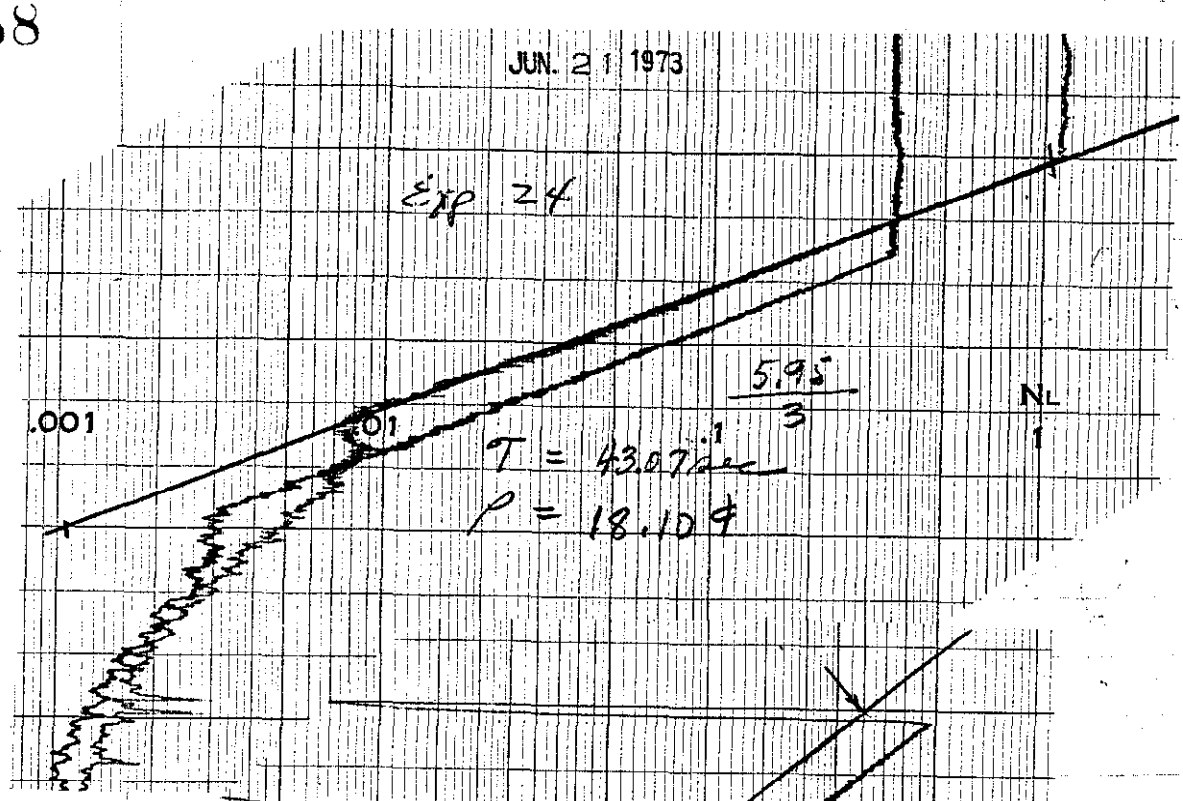
$k < 1$, no inst. response.

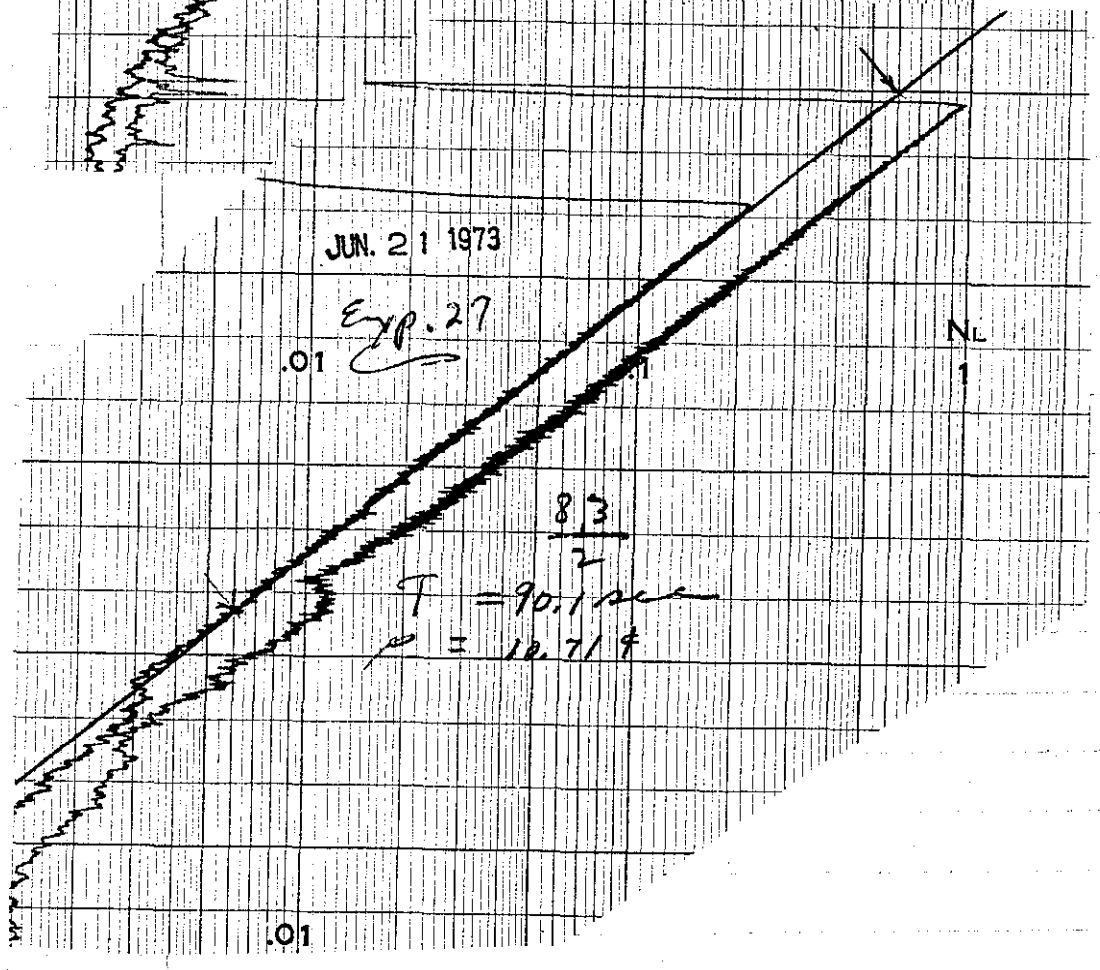
Exp 23

15 Units

Added 3 front cans to the second tier of Moveable table.

$k < 1$, no response.


JUN. 21 1973
Exp 24
5.9s
3
T = 43.07 sec
ρ = 18.10 ϕ
.001
.01
.1
NL
1


JUN. 21 1973
Exp. 27
8.3
7
T = 90.1 sec
ρ = 18.71 ϕ
.01
.1
NL
1
.01

JUN. 21 1973

Instrument Check on JUN. 21 1973 Source Co60 (40)

PM-1 Low Trip ok Trip ok

IC-1 3×10^{-10} Meter Trip ok Fast Trip ok

IC-2 3×10^{-10} Meter Trip ok (Screams) Rad Mon-

IC-3 6×10^{-10} Calibration ok A ok

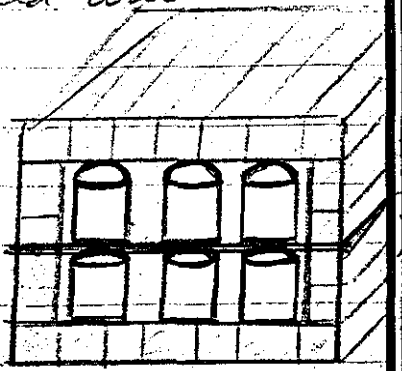
IC-4 1×10^{-8} Calibration ok B ok

C ok

DWM
JJL
CC

Exp 24 –

18 Units | Two tiers with 1" plexiglas separating tiers and units spaced 2".



$k > 1$, $w = .834$

$g_{ex} \approx 149.5\,\phi$ $E = .834$

$P = 18.10\,\phi$

$\Delta S = .074"$

Do Not Use data P.29 & 260 (upper plexiglas in assembly 5)

$w = .908 - .101 = .808$

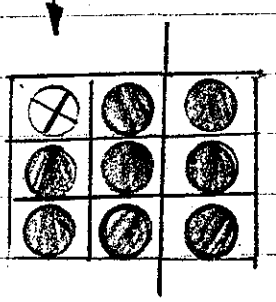
$E = .909 - .101$ $\Delta P = .245\,\phi/\text{mil}$

Average $\frac{\Delta P}{\Delta R} = \frac{245 + 125}{2} = 185\,\phi/\text{in}$

$\times .805 = 149.48\,\phi$

Exp 25 –

17 Units | Northeast corner, top tier, can removed.



$k < 1$,

Exp 26 — 17 Units

Added 2 pcs (1" x 1 7/16" x 4 1/2") plexiglas to symetric positions on front of moveable table.

$k < 1$,

Exp 27 — 17 Units

Added 4 pcs (1" x 1 7/16" x 4 1/2") plexiglas to symetric positions about center core of Top tier.

$k > 1$, $W = .101$

$E = .100$ $\underline{\rho = 10.71\text{¢}}$

Exp 28 — 17 units

Removed 1 pcs.

$k < 1$, $\underline{\rho = -.69\text{¢}}$

$\underline{1 \text{ pc} = 11.4\text{¢}}$ x 5 = -57

-57.7¢

Then Exp 25 ≅ -58¢

I can [illegible] wood. 11.5 + .6 = 12.1

Table [illegible] 11.5

1 pc plexi 1 x 17/16 x 4 1/2 = 11.4¢

Core or Assembly Size, 1" & 2" spacers used to construct assembly should be ~ 8.05 x 8.05 x 8 3/4 in all sizes. Small with 1" plastic can unit is 24 1/8 x 24 1/2 x 18 1/2.

Exp = 1 without [illegible] = +1% sigma crit.

18 Unit Array - 2" spacing with 1" plexiglas between tiers.
[2 Tier]

See p. 259

Measurements Cm -

	Moveable Table	Fixed Table	
VERT-	47.0	47.1	
	47.1	47.0	Avg-
	47.0	46.9	47.017
E-W	61.5	61.3	
	61.4	61.4	
	61.5	61.2	61.383
N-S	38.1	23.1	
	38.2	23.2	
	38.2	23.0	
	38.3	22.8	
	38.3	22.9	
	38.1	22.9	61.183
	38.2	22.983	

JUN. 22 1973

Instrument Check on JUN. 22 1973 **Source** 60 Co (#28)

PM-1 _____ Low Trip ok (Scram) Trip OK

IC-1 3×10^{-10} Meter Trip OK Past Trip OK

IC-2 3×10^{-10} Meter Trip OK RAD. Mon.

IC-3 1.2×10^{-9} Calibration OK A OK

IC-4 4.5×10^{-8} Calibration OK B OK

C OK

Exp 29 — Repeat of Exp 24 as described.

18 Units $k > 1$, $W = .100$ $E = .101$ IC 2 = $\frac{73.5}{59.5}$ in 250 sec $\rho = 1.07$ ϕ

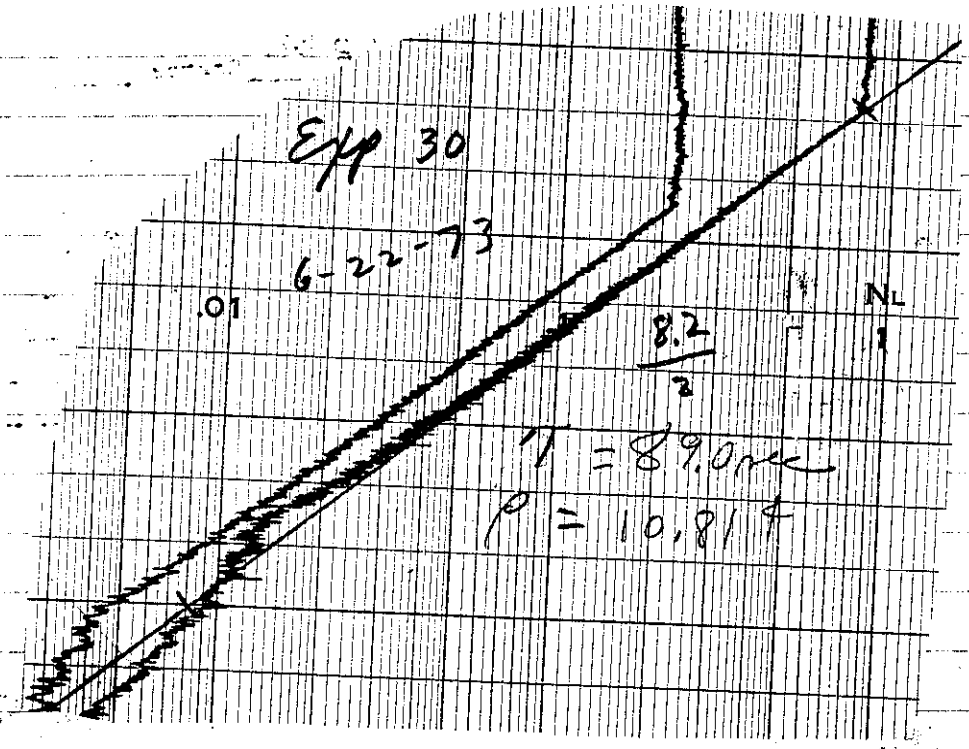
2" Spacing + 1" plexiglas between tiers.

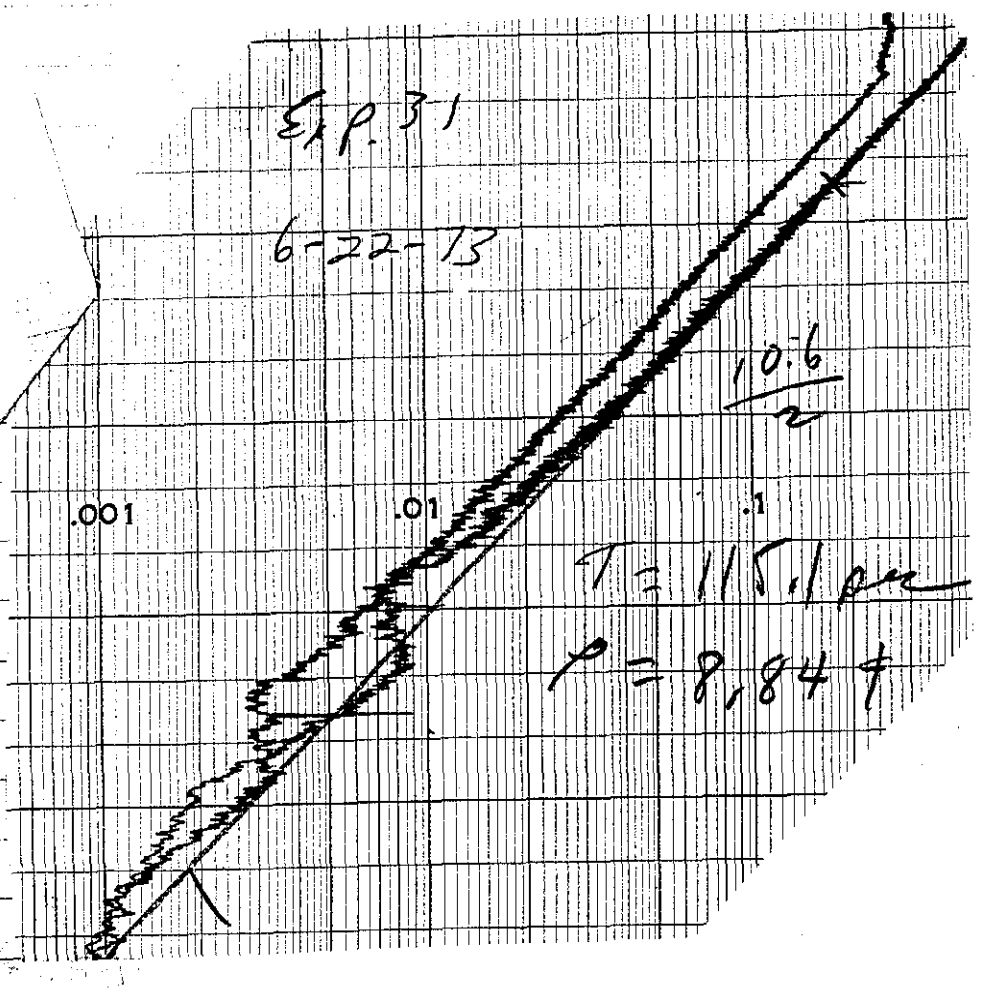
Exp 30. Added ½" plexiglas between tiers of fixed table only.

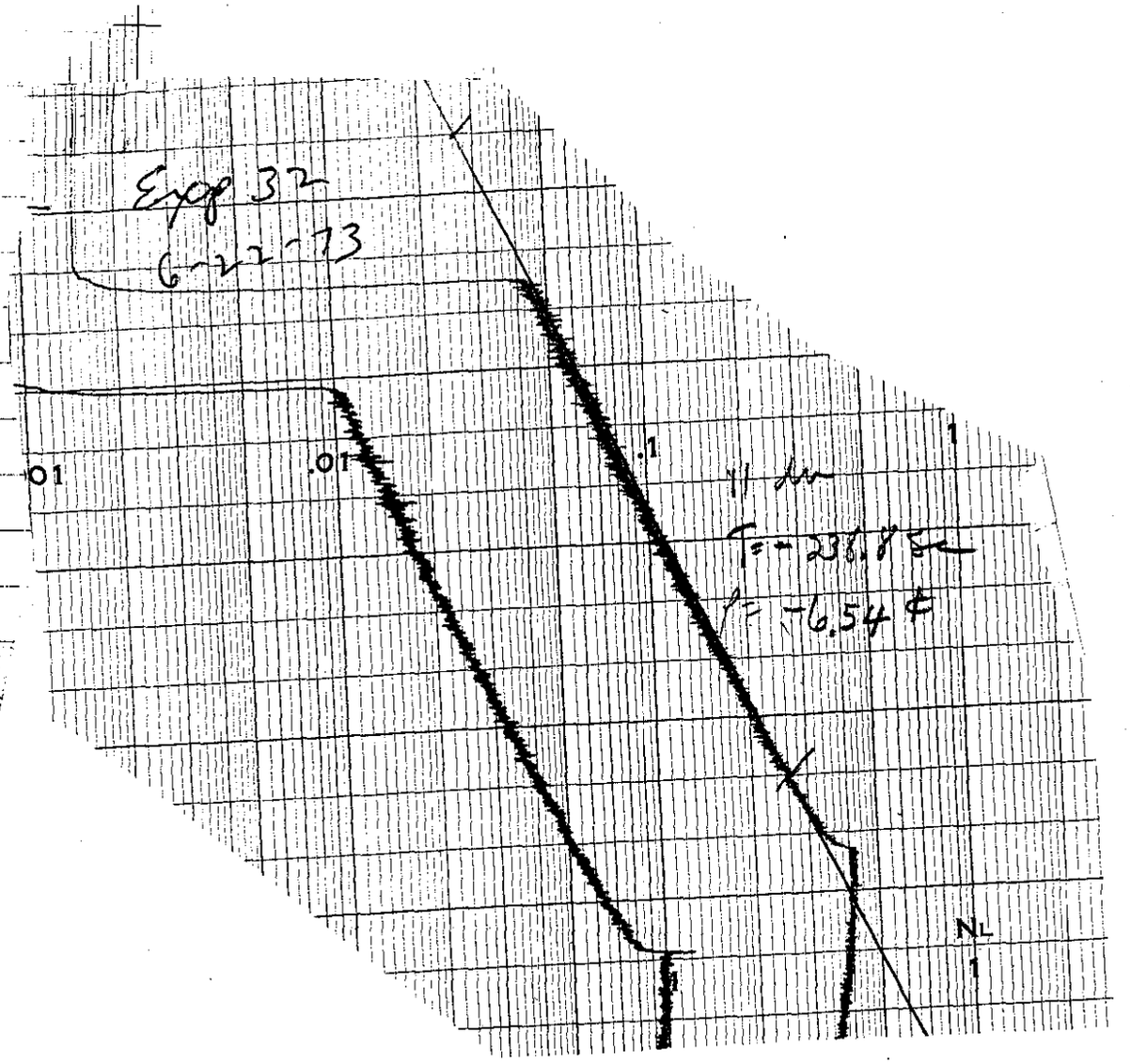
18 Units $k > 1$, $W = .463$ $E = .465$ $\rho = 10.81$ ϕ

$\Delta S = .050$

$T \infty$ $W = .513$ $E = .515$ $\Delta\rho = .216$ ϕ/mil


Exp 30
6-22-73
.01
NL
1
8.2
2
T = 89.0 sec
ρ = 10,814


Exp. 31
6-22-13
10.6
2
.001
.01
.1
T = 115.1 psia
ρ = 8.84 #


Exp 32
6-22-73
.01
.01
.1
1
NL
1

Exp 31 –

18 units

2" Separation edge to edge (see #29)
1½" Plexiglas between tiers.

2 Tiers

$k > 1$, $W = 1.078$

$E = 1.078$ $\rho = 8.84$ #

$\Delta s = .035"$

∞ $W = 1.113$ $-.101 = 1.012$

$E = 1.113$

$(0 - 808) + (808 - 1.012) \times 253$ $\Delta\rho = .253$ #/mid

$\rho_{ex} = \sim 149.5 + 51.6 = \#\ 2.0_{11}$

$k = 1.0137$

Exp 32 –

17 units

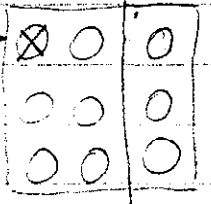
Removed NE top tier unit.

$k < 1$, $W = .101$

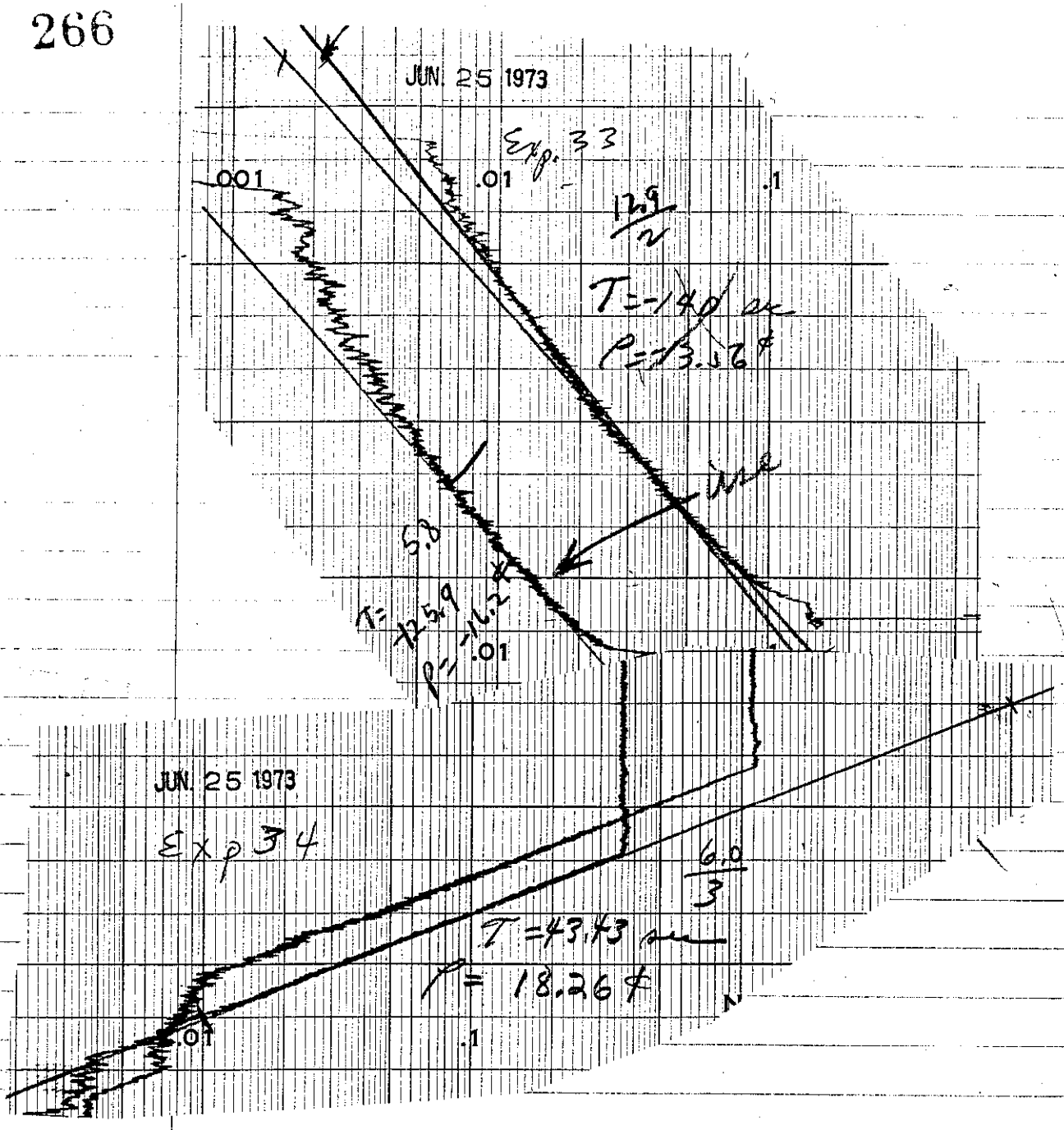
$E = .102$ $\boxed{\rho = -6.54\#}$

$k = 0.9996$

Removed NE Unit →



ρ for NE unit = $\#\ 2.0_{75}$


JUN. 25 1973
Exp. 33
.001
.01
.1
129/2
T=140 sec
P=13.26 #
5.0
T=12.59
P=.01
JUN. 25 1973
Exp 34
6.0/3
T=43.43 sec
P=18.26 #
.01
.1

JUN. 25 1973

Instrument Check on JUN. 25 1973 Source Co 60 (#20)

FM-1 _____ Low Trip OK _____ Trip OK (Scram)

IC-1 3×10^{-10} Meter Cvtn OK Past Trip OK

IC-2 3×10^{-10} Meter Cvtn OK Rod Mon

IC-3 1.5×10^{-9} Calibration OK A OK

IC-4 3.5×10^{-8} Calibration OK B OK

C OK

~~Exp 33~~ — 2" Separation edge to edge of units.
2" Plexiglas separation of tiers.

17 units

$k < 1$, $w = .100$
$E = .102$
$\rho = -16¢$

$k = 0.9989$

Exp 34 - added NE Corner top tier unit.

18 units

$k > 1$, $w = 1.001$
$E = 1.003$
$\rho = 18.26¢$
$\Delta S = .0725$

∞ $w = 1.072$
$E = 1.073$
$\Delta\rho = .259¢/\text{min}$

If this point was the same as the previous one
$\Delta k = (31-34) = .041 \times 259 = 10.64$
$\Delta k \text{ ex} = \frac{\$ 1.1}{k = 1.0129}$

Exp 35

18 Units

2" separation of units edge to edge.
2½" plexiglas separating tiers.

$k > 1$, $w = .?$
$E = .?$ $\rho = 12.18¢$

∞ $w = .571$
$E = .575$
($\Delta S = .69$ Calc)

~~Exp 36~~ Repeat of Exp 35

18 units | $k > 1$, $w = .474$ $\rho = 17.06^{\#}$

$E = .478$ ~~$\rho = 17.18^{\#}$~~

$\delta = .097"$

$w = .571$

$E = .575$

$\Delta\rho = \frac{17.06}{.097} = 176^{\#}/in$

$k_{av} = 727$

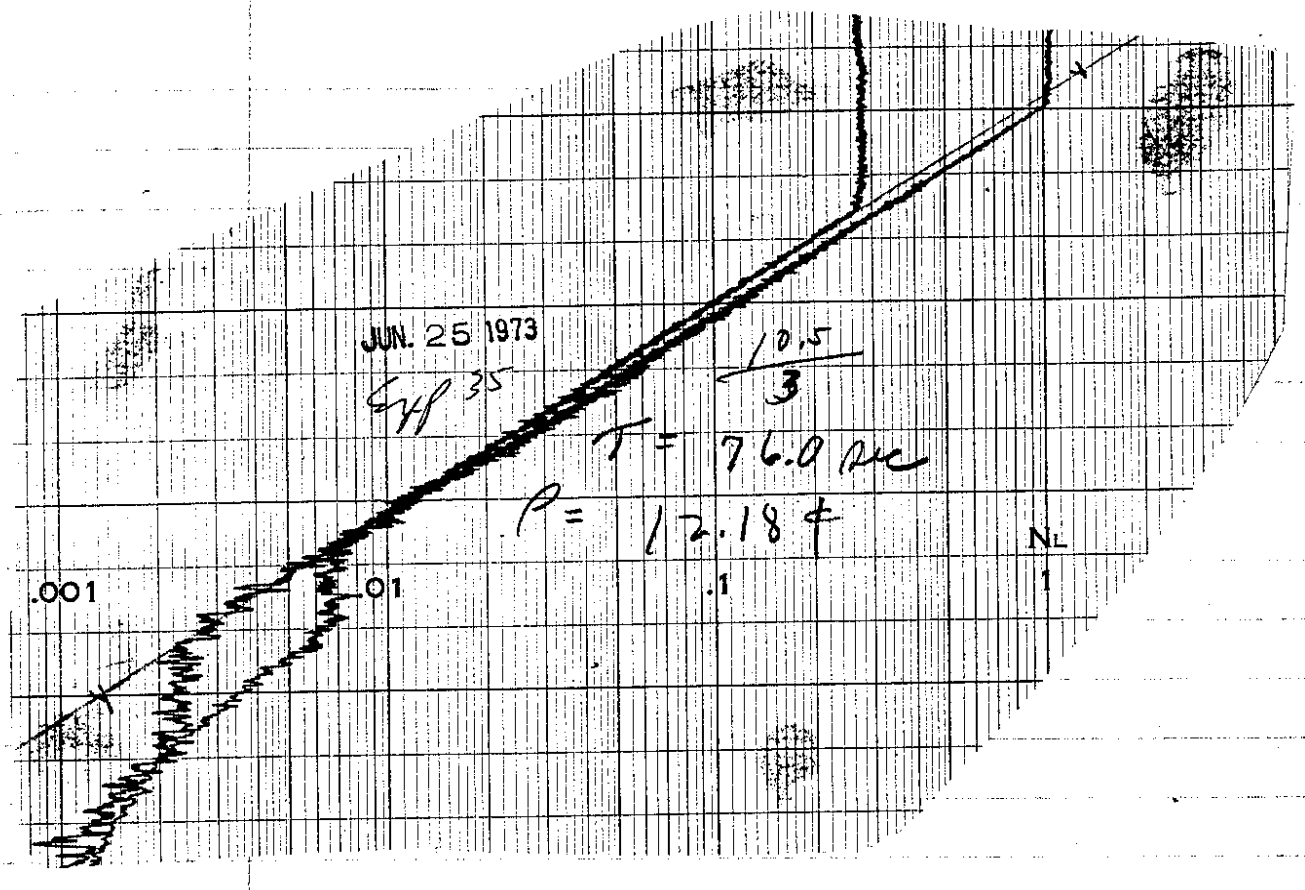
$k = 1.0049$

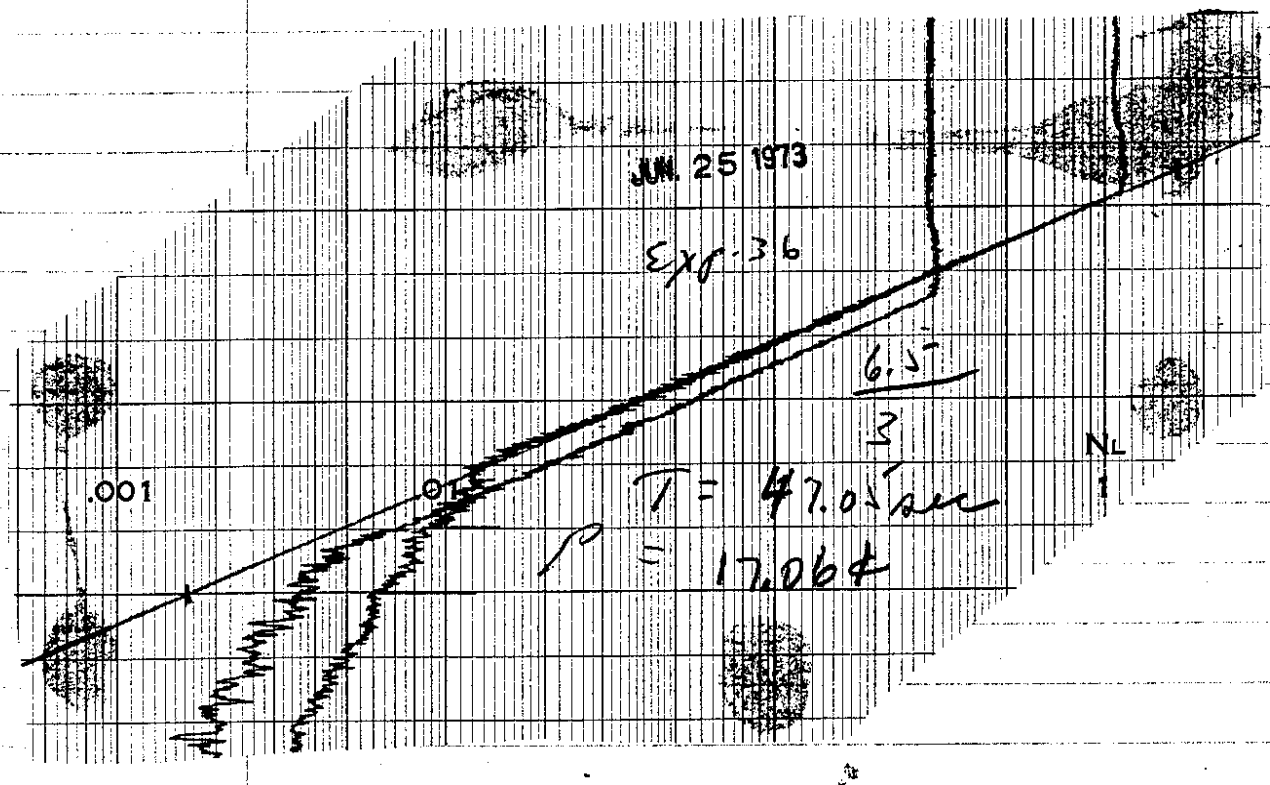
Average thickness

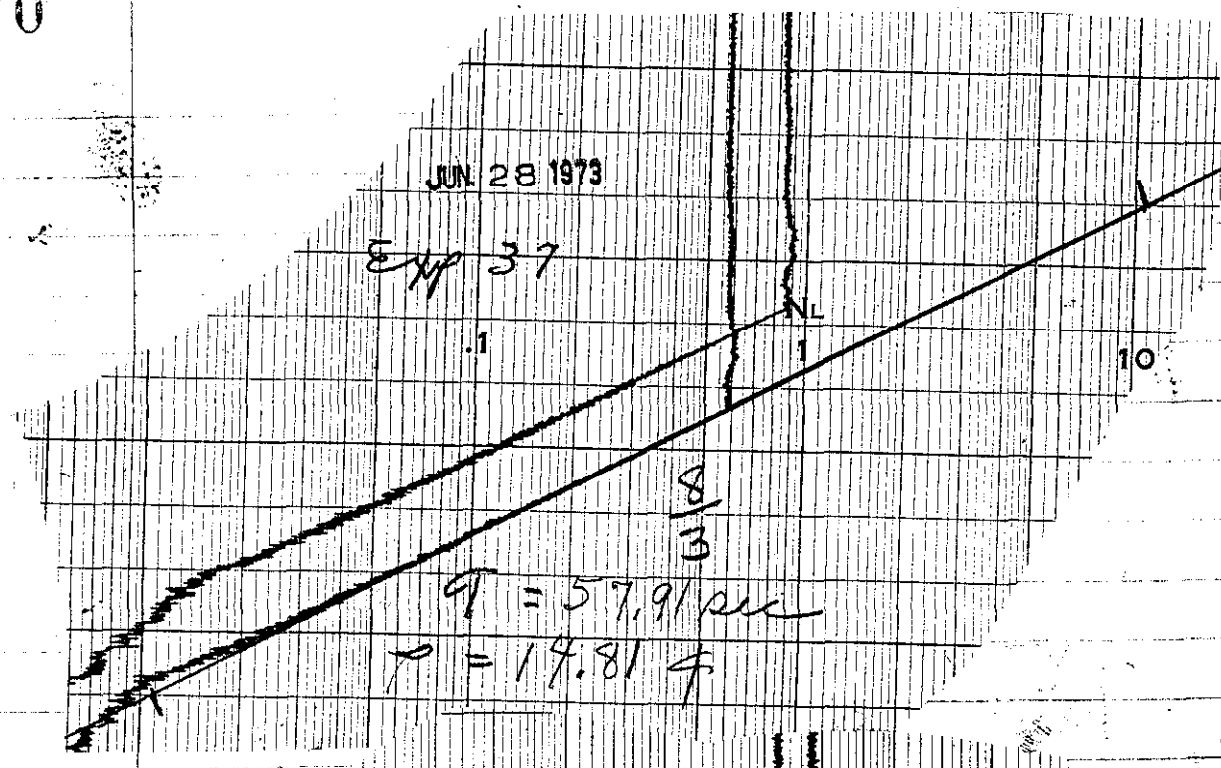
	1/2"	1"	1"
South	.481	.961	.917
North	.497 x2	.975 x2	.982 x2
Av	.492	.970	.934

Top	Mid	Bottom
1.25 cm	2.46 cm	2.37 cm

EXP No		
29	1"	± 1.18
30	1½"	± 1.81
31-34	2"	± 2.41
35-36	2½	± 3.04


JUN. 25 1973
Exp 35
10.5
3
T = 76.0 Sec
P = 12.18 #
.001
.01
.1
1
NL

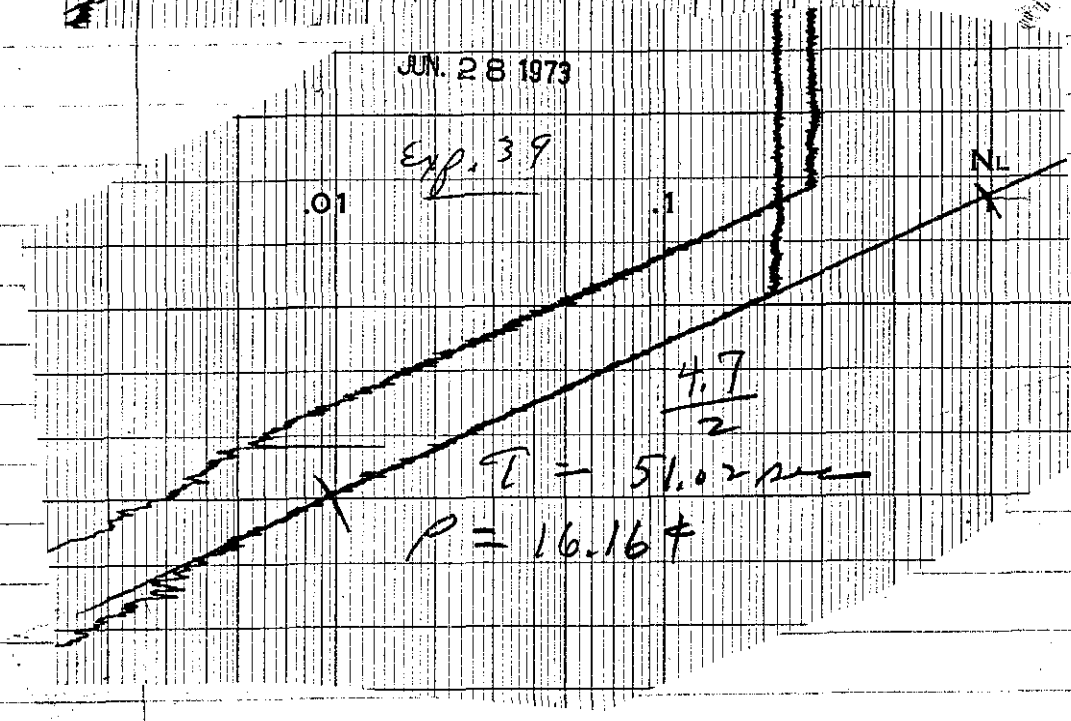

JUN. 25 1973
Exp. 36
6.5
3
T = 47.0 Sec
P = 17.06 #
.001
.01
1
NL



$\frac{8}{3}$

$T = 57.91$ sec

$P = 17.81$ #



$\frac{4.7}{2}$

$T = 51.02$ sec

$P = 16.16$ #

JUN. 28 1973

Instrument Check on JUN. 28 1973 Source 60 Co (#2)

FM-1 _____ Low Trip ok Trip ok

IC-1 3×10^{-10} Meter Trip _____ Fast Trip ok Scram

IC-2 3×10^{-10} Meter Trip _____ had more -

IC-3 2×10^{-8} Calibration _____ A ok

IC-4 7×10^{-9} Calibration _____ B ok

C ok

Exp 37 - Plexiglas 3 dimensions.

18 units | 2 Tiers separated by 2" plexiglas. Units on 10" centers, placed in 1" thick walled cells of 10" X 10" X 10¾".

No Top Reflector on Moveable Table.

$k > 1$, $w = .948$

$E = .947$ $\rho = 14.81^{\#}$

$\Delta S = .055''$

$w = 1.000$

$E = 1.002$

$\Delta \rho = .269^{\#}/\text{mil}$

Exp 38 -

17 units | Removed 1 unit NE Top. Reflector Complete.

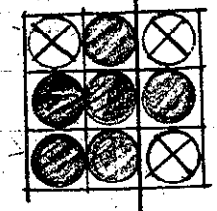
$k > 1$, 24.75" Revolutions

2.3"

Exp 39

15 units

Removed 2 top corner units from fixed table.



$k=1$, $W=.919 > .9215$
$E=.924$

$\rho = 16.16\#$

$\Delta S = .070"$

∞ $W=.989 > .9915$
$E=.994$

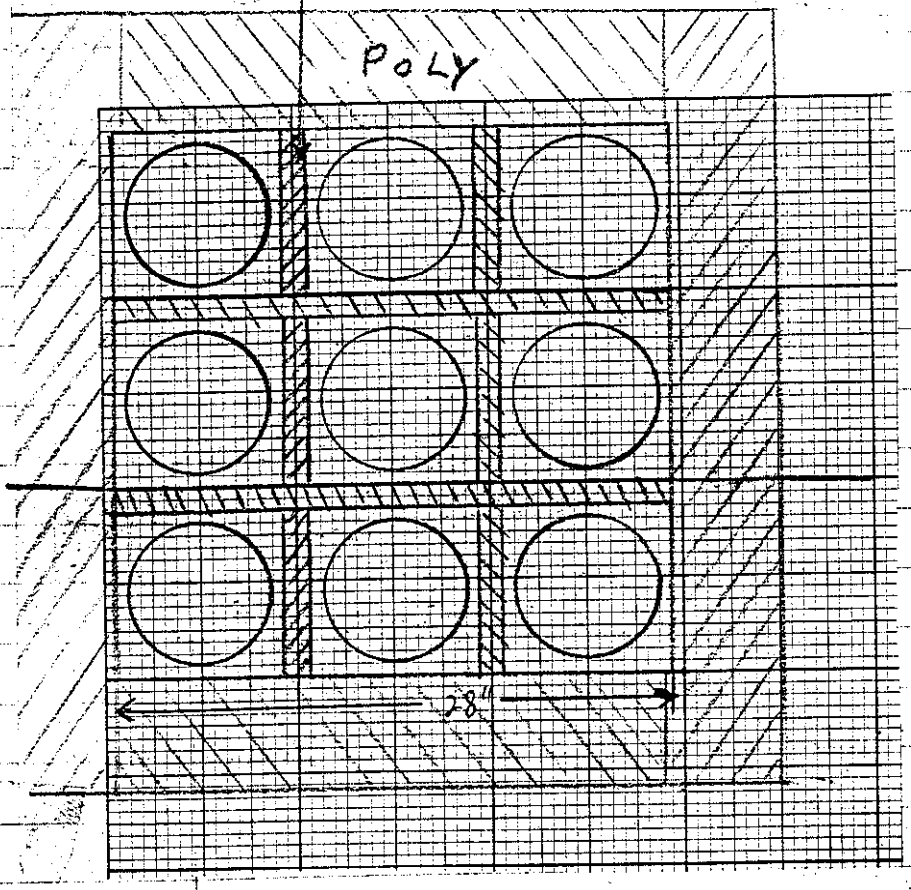
$\Delta \rho = .231\#/mil$

$Av\ \frac{S}{in} = \frac{231+130}{2}$
$= 180$
$\times .8915$

$S_{ex} = \#1.6$
$k \approx 1.0109$

1" PLEXIGLAS

Expo-37 DIETZGEN GRAPH P
16X16 PER INCH



JUN. 29 1973 Instrument Check on JUN. 29 1973 Source 6 Co (#20)

PM-1 _____ Low Trip OK Trip OK

IC-1 3×10^{-10} Meter Trip OK Fast Trip OK

IC-2 3×10^{-10} Meter Trip OK (Screen)

IC-3 9×10^{-10} Calibration OK

IC-4 6×10^{-9} Calibration OK

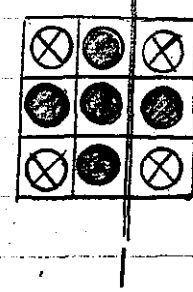
RAD MON –
A - OK
B - OK
C - OK

Exp 40 –

14 Units

Removed NW corner unit from top tier.

$k < 1$



Exp 41

15 units

Top 3 cans from fixed table off.

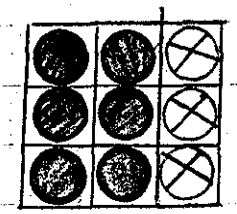
$k > 1$

$w = 1.052$

$E = 1.055$ 1.0535

$\rho = 16.90$ ϕ

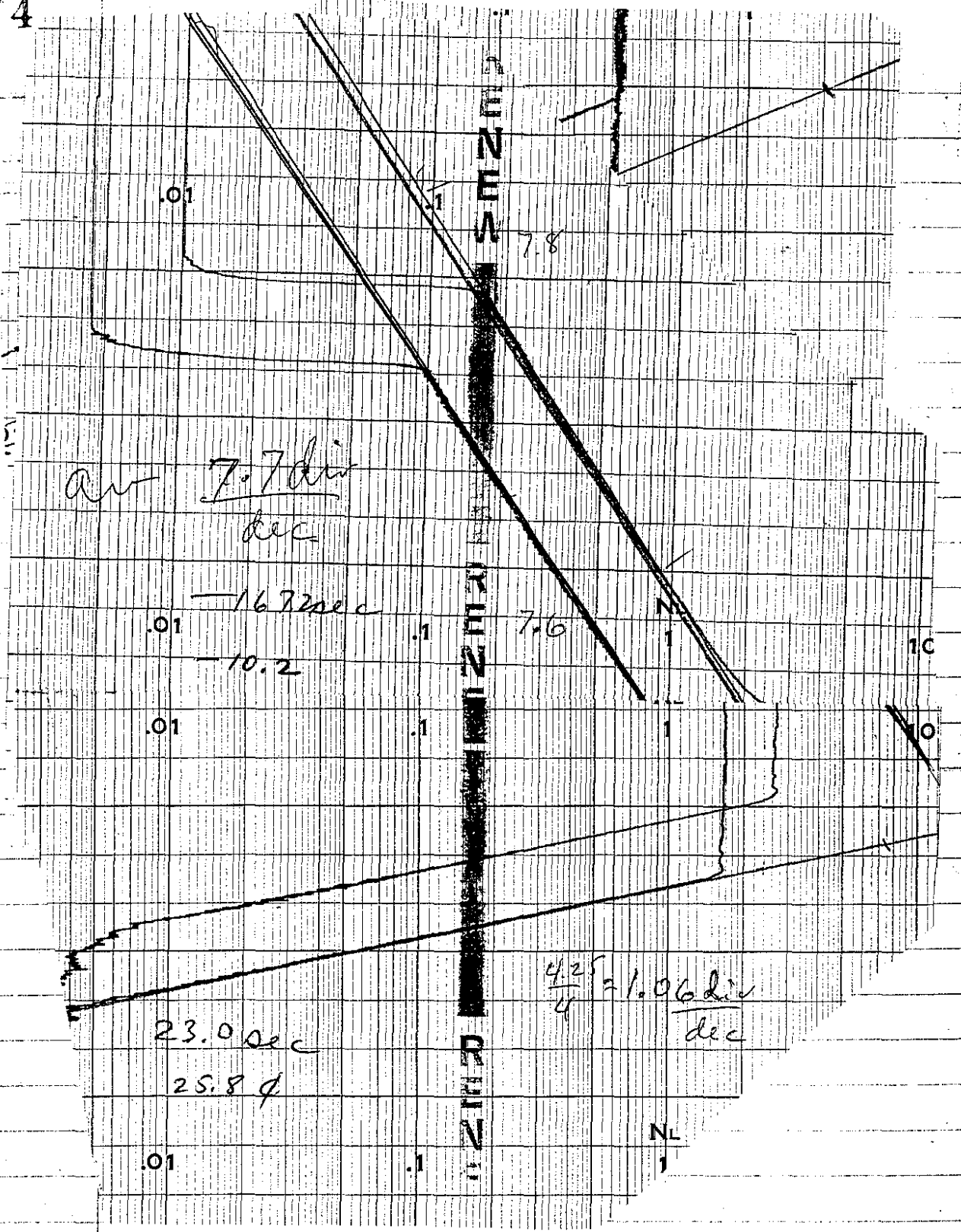
$\Delta S = .090$



$w = 1.142$

$E = 1.145$ 1.1435 $\rho = .188$ ϕ/mi

$\times 1.040 \times .0068 = .010$ $k_{ef} \approx 1.010$

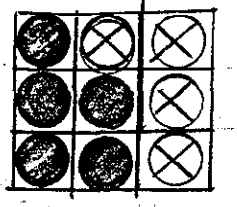

.01
.1
7.8
7.6
1
10
.01
.1
1
.01
.1
1
NL
NL
av 7.7 div/dec
16.2 sec
10.2
23.0 sec
25.8 q
4.25/4 = 1.062 div/dec

Exp 42 -

14 Units

Removed the center unit from East Top Tier Row.

$k < 1$

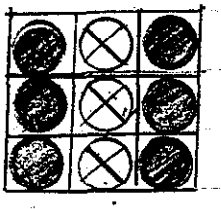


Exp 43 -

15 Units

Center Row [W-E] Top Tier Off.

$k < 1$



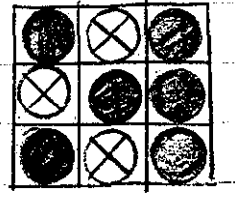
Exp 44 -

15 Units

Moved Center unit of back row, moveable table, to center of Array.

$k < 1$

W = .100
E = .105



Exp 45 –

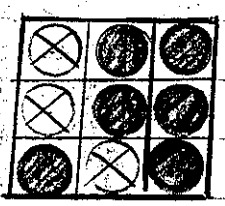
15 Units

Moved top NE Unit to Center Row.

$k < 1$,

$W = .100$

$E = .105$



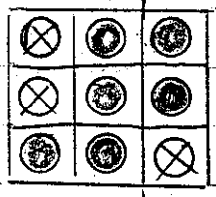
EXP 46

15 Units

$k > 1$ W .100 } .103

$k_{ex} = 1.0018$ E .106

$T = +23.0$ $\rho = +25.8¢$ (fast fiss.n)



$k = 1$ W .298 ~~1250¢/in~~

E .305 > .3015 1299¢/in

$T = -167.2$ $\rho = -10.2¢$ $\Delta S = .1985$

$k < 1$ W .3565

E .364 .360

.3015

.0585 → 174.4¢/in

Note: Weigh all plastic used for vertical moderator. 2 8×8¾ and 8×8¾ pieces.

278

JUL 2 1973

Instrument Check on JUL 2 1973 Source 60 Co (#20)

PM-1 _____ Low Trip OK _____ Trip OK

IC-1 3×10^{-10} Meter Trip OK (Scram) Test Trip OK

IC-2 3×10^{-10} Meter Trip OK

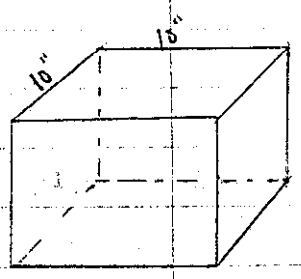
IC-3 4×10^{-9} Calibration OK

IC-4 6×10^{-8} Calibration OK

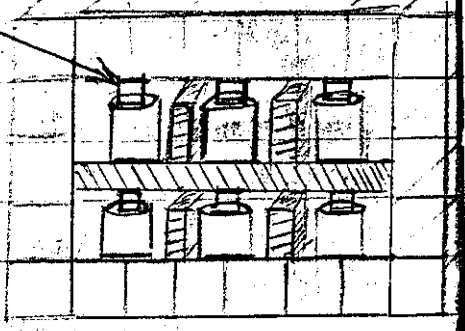
Rod Man —
A — OK
B — OK
C — OK

Exp 47 — SW Top Tier Unit out. Center 2" plexiglas and top reflector raised 1 5/8" (al (unistrut used for separation)

17 Units



≒ Unit cell



$k > 1$,

$W = 1.263$

$E = 1.268$

$\rho = 13.96\%$

∞ ... $W = 1.326$

$E = 1.331$ $\Delta S = .063$

$\Delta \rho =$

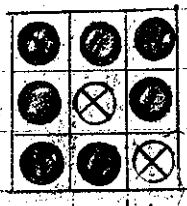
Exp 48 — Removed center unit from array —

16 Units

$k < 1$

$W = .100$

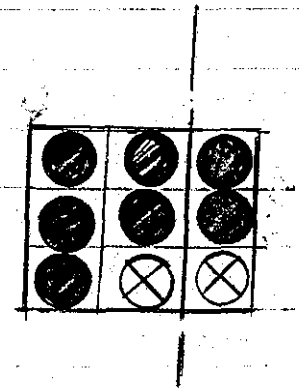
$E = .105$



Exp 49

16 units

Center unit 1/2 West side and South Corner off.



$k < 1$,

$w = .100$

$E = .106$

Exp 50

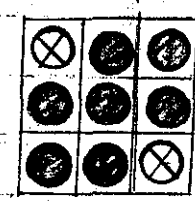
16 Units

$k_{ex} = 1.0012$

NE & SW corner units off.

$k > 1$, $w = .100$

$E = .104$



$\ell = 17.71^{\#}$

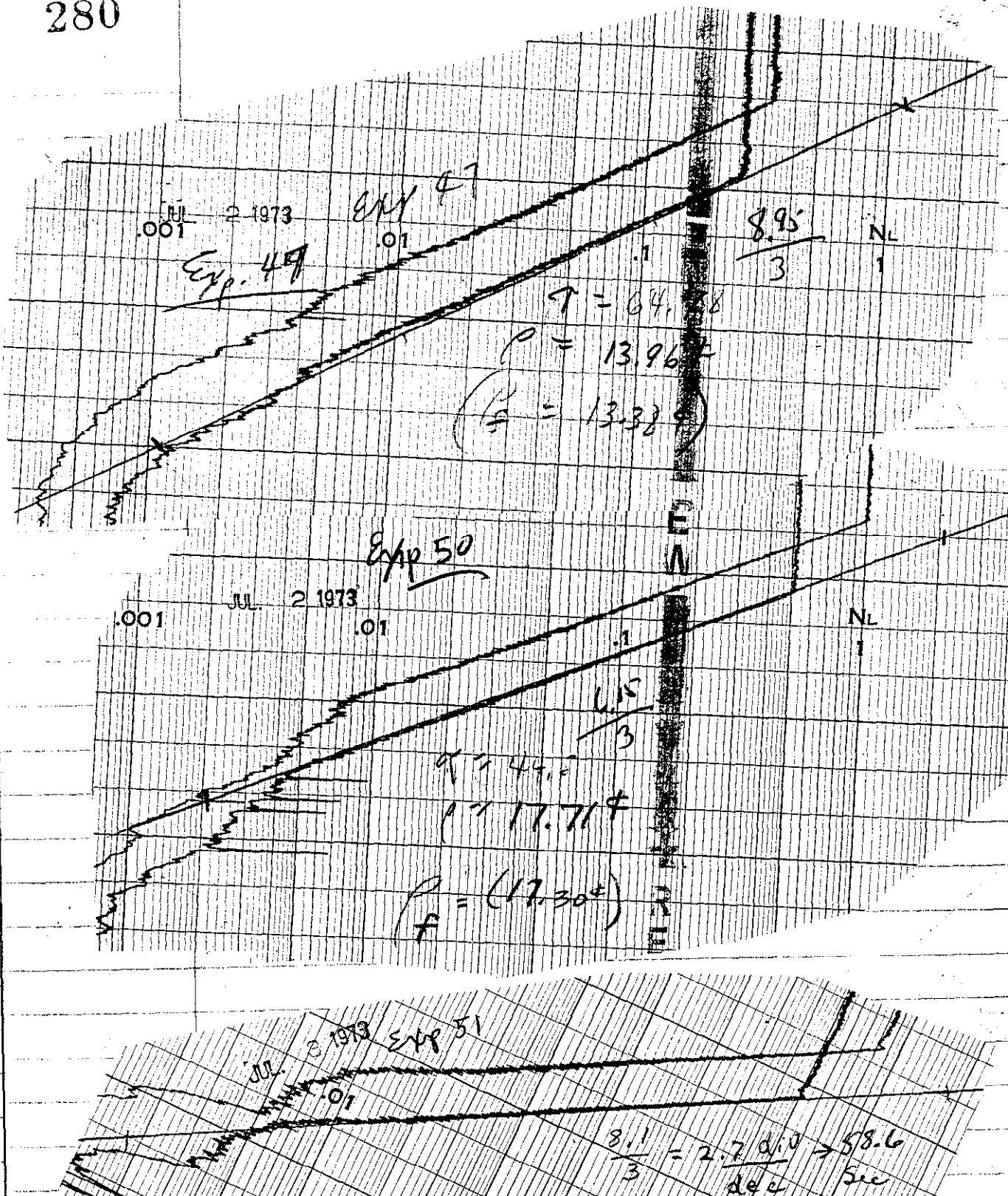
∞ $w = .249$ $\Delta S = .150$

$E = .254$

$\Delta P / \Delta S = 118 \#/in.$

$1\frac{5}{8}$" Unistrut Al makes a cell $\pm Z = \pm 2.064$ cm

4.128


JUL 2 1973
.001
.01
.1
1
NL
Exp. 49
8.95
3
τ = 64.8
f = 13.96 ±
(f = 13.38)
Exp 50
JUL 2 1973
.001
.01
.1
1
NL
4.5
3
τ = 44.
f = 11.71 ±
f = (11.30±)
JUL 2 1973 Exp 51
.01
8.1
3
= 2.7 d.v
div
→ 58.6
sec

14.33

Instrument Check on JUL 3 1973 Source Co 60 (#20)

JUL. 3 1973

FM-1	Low Trip OC	Hi Trip OC	
IC-1 3×10^{-10}	Meter Trip OC	Fast Trip	Scram Tables
IC-2 3×10^{-10}	Meter Trip OC		Monitors
IC-3 4×10^{-10}	Calibration OK		A OC
IC-4 7×10^{-10}	Calibration OK		B OK
			C OC

Restrictions OC
Source OK
Personnel OC

Exp # 51 -- 18 units of UO_2
Restack with 3" □ Al tubing for spacers on top of cans of UO_2 instead of 1⅝ Al Unistrut. i.e. Void ± 2 = ± 3.81 cm

k>1 W .845 E .851 } .848 ρ = 14.33 ¢

k=1 W .907 E .913 } .910 $\frac{\Delta\rho}{\Delta\Delta} = \frac{14.33}{.062} = 231$ ¢/in

$\Delta\Delta = .062$

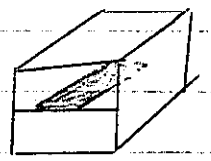
Est $\rho_{ex} = \frac{231+139}{2} \times .807 = 1.5 \rightarrow .010_2$

$\frac{320}{2} = 185$

$k \approx 1.010$

Exp # 52 — Placed 6" x 12" x .037" pc cd. on moveable table on center bottom tier can. A (6 x 12 dim N to S)

18 units



k < 1

Exp 53 — 18 Units

Placed 6" x 6" x .037" on center can of array.

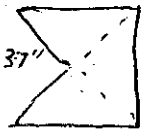
$k \geq 1$, $w = .100$

$\epsilon = .104$

Exp 54

18 Units

3/4 of 6"x6"x.037" Cd on Center Can of array



$k > 1$ $w = .100$, ϵ 0.104 $\rightarrow .102$ $\rho = 7.35$ ¢

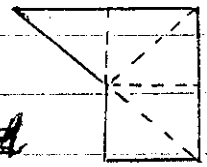
$k = 1$ w 0.182

ϵ 0.186

Exp 55

18 Units

5/8 of 6"x6"x.037 Cd on bottom Center can of array.



No External Source.

$k > 1$ w 101

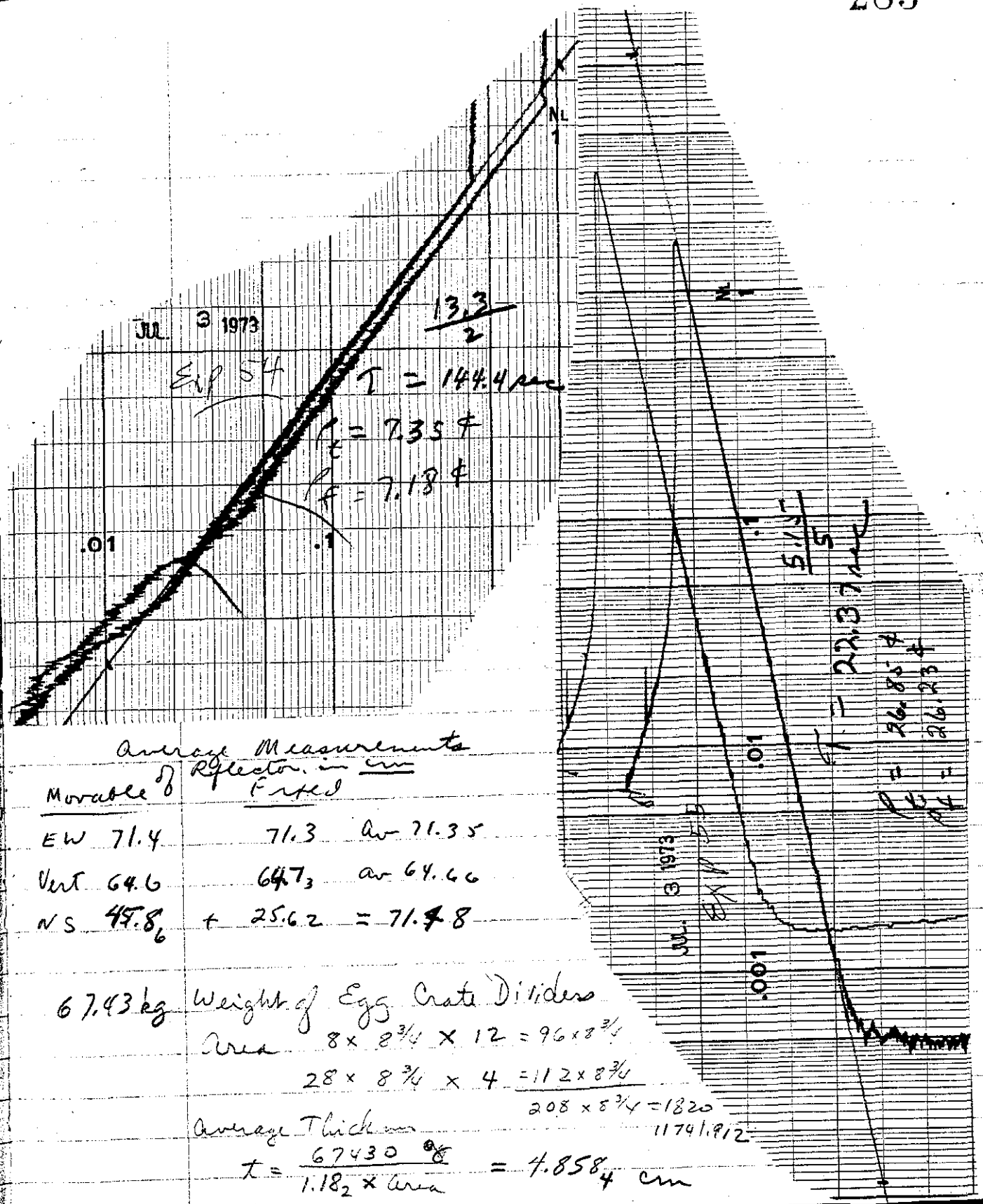
$k = 1.00$ ϵ 102 $\rho = 26.85$ ¢

Shut Down without levelling for $k = 1$

$\rho_{ex} = \rho(55) + 5.5\rho(55 - 54) = 26.9 + 97.5 = 1.244$ ¢

$k_{ex} = 1.0$

$\frac{1}{8}$ of Cd $\rho c = 19.5$



Exp 54

$\frac{13.3}{2}$

$T = 144.4$ cm

$f_t = 7.35$ ¢

$f_f = 7.18$ ¢

$T = 22.3$ cm

Average Measurements of Reflector in cm

Movable	Fixed	
EW 71.4	71.3	av 71.35
Vert 64.6	64.7$_3$	av 64.66
NS 45.8$_6$	+ 25.62	= 71.48

67.43 kg Weight of Egg Crate Dividers

Area $8 \times 8\frac{3}{4} \times 12 = 96 \times 8\frac{3}{4}$

$28 \times 8\frac{3}{4} \times 4 = 112 \times 8\frac{3}{4}$

$208 \times 8\frac{3}{4} = 1820$

11741.912

Average Thickness

$$t = \frac{67430 \text{ gm}}{1.18_2 \times \text{Area}} = 4.858_4 \text{ cm}$$

JUL. 9 1973

Instrument Check on [redacted] Source Co 60 (#20)

JUL. 9 1973

PM-1 Low Trip OK (SCRAM) Trip OK

PM checked (Repaired) by ERR

IC-1 3×10^{-10} Meter Trip OK Count Trip OK

IC-2 3×10^{-10} Meter Trip OK Rad. Mon.

IC-3 1×10^{-9} Calibration OK A OK

IC-4 8×10^{-9} Calibration OK B OK

C OK

Rad Lite OK, Source OK, Personnel - OK

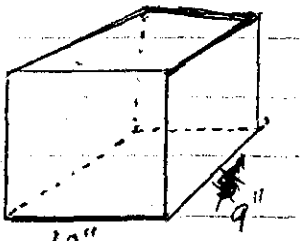
Exp 56

18 Units

1" plexiglas egg crate in 3 dimensions, two tier.

See p. 278 for array structure.

~ unit cell



Can 8¾" + Unit Sp (1⅝") + 1" Plexiglas

$k > 1$, 24.7 Revolutions

2.14"

∞, 25.23

286

Instrument Check on JUL 1 0 1973 Time _____

JUL 1 0 1973

PM-1 _____ Low Trip ok _____ Trip ok (5 rods)

IC-1 3×10^{-10} Meter Trip ok Past Trip ok

IC-2 3×10^{-10} Meter Trip ok Red Man —

IC-3 4×10^{-10} Calibration OK A - OK

IC-4 7×10^{-8} Calibration OK B - ok

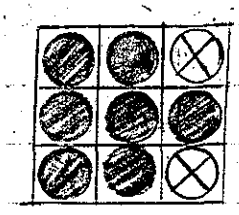
C - OK

Red Lite ok, Source ok, Personnel OK.

Exp 57

16 units

Removed corner units, top tier, from fixed table.

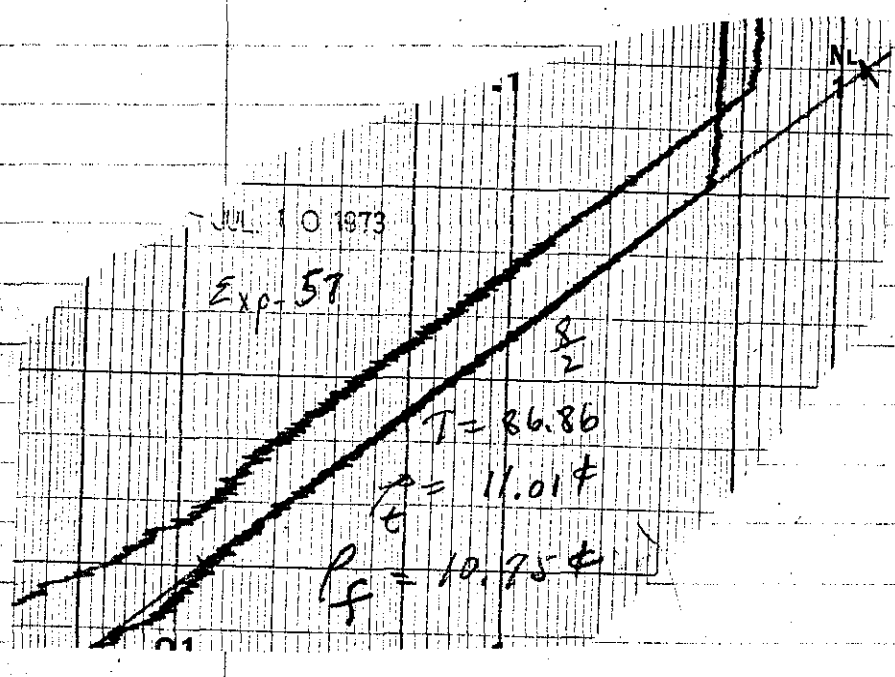


$k > 1$, ∞

$w = .650$
$E = .650$
$\rho = 11.01$ #

$w = .710$
$E = .710$

$\Delta S = .060$
$\Delta \rho = .183$ #/mil



JUL 1 1 1973

Instrument Check on JUL 1 1 1973 Source Co 60 (H_2O)

PM-1 _____ Low Trip OK Trip OK

IC-1 3×10^{-10} Meter Trip OK (scram) Feet Trip OK

IC-2 3×10^{-10} Meter Trip OK

IC-3 9×10^{-10} Calibration OK

IC-4 6.5×10^{-8} Calibration OK

Rad. Mon. –
A – OK
B – OK
C = OK

RED LITE = OK SORCE = OK

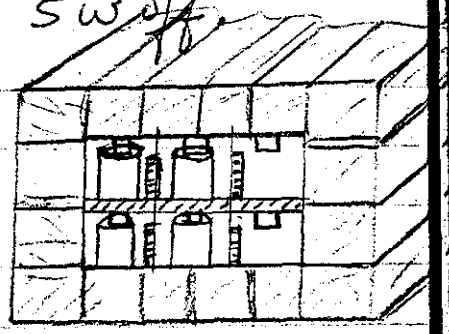
Personnel = OK

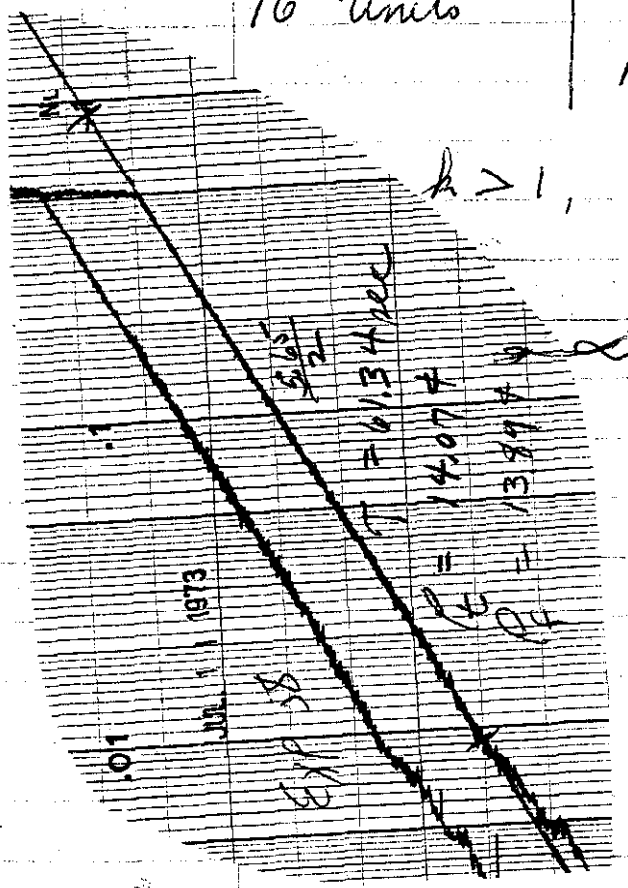
Exp 58

16 Units

Corner units 7 SW off.

Fixed Table →





$k > 1$, $w = .800$

$E = .800$

$\rho = 14.07$ #

∞ $w = .870$ $\Delta S = .070$

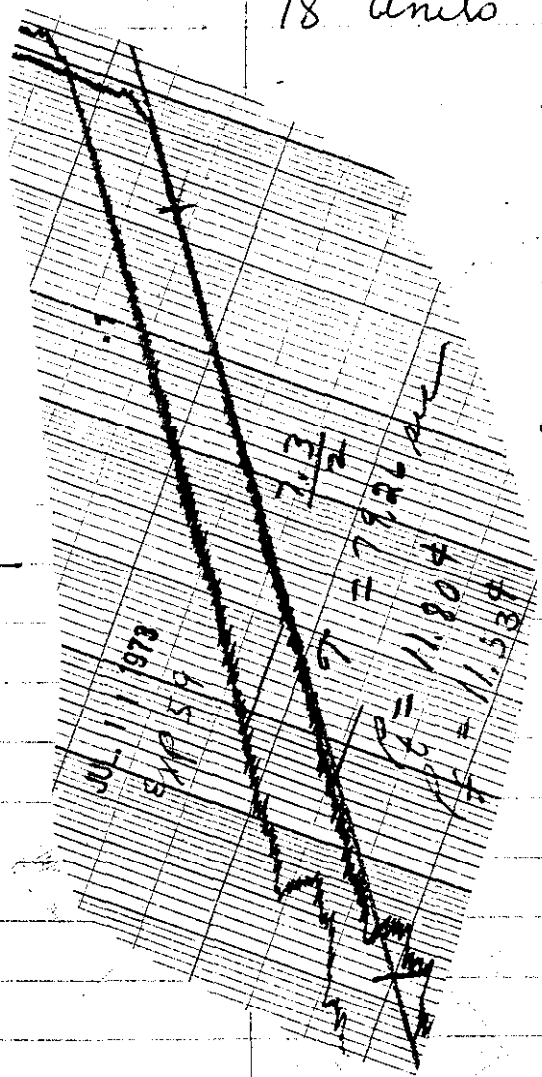
$E = .870$ $\Delta \rho = .201$ #/mil

Exp 57	.570	.183	
vs	−.710	.201	
Exp 58	.160	2|384	
		.192	

$\rho = 30.7$ #

Exp 59 -

18 units | Restacked using 3" □ Al tubing for spacing on top of the UO_2 cans.



$k > 1$, $w = 1.162 \rightarrow 1.160$

$E = 1.159$

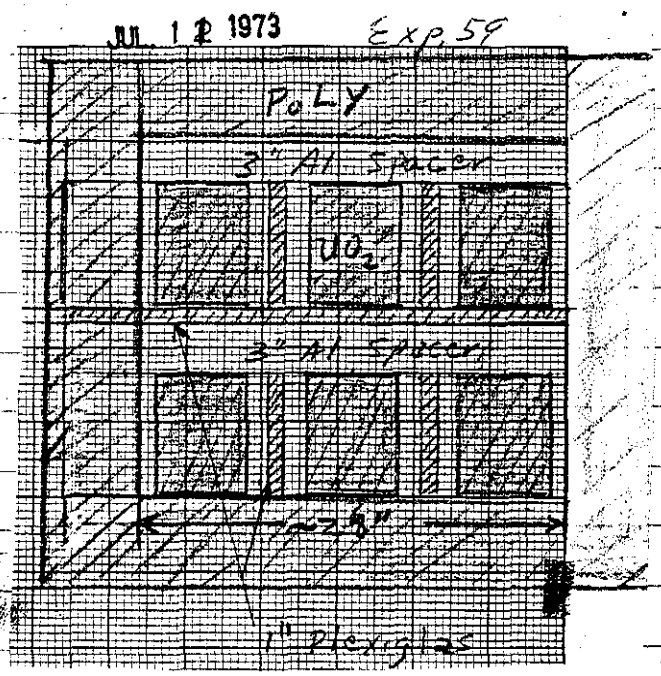
$\rho = 11.80\ \#$

∞ $w = 1.211 \rightarrow 1.209$

$E = 1.207$

$\Delta S = .049"$

$\frac{11.8}{69} = .171$ #/in.



Power $\frac{117 + 171}{2} = \frac{288}{2} = 144$ #/in

$\rho_{2x} = 144 \times 1.107 = 159\ \#$

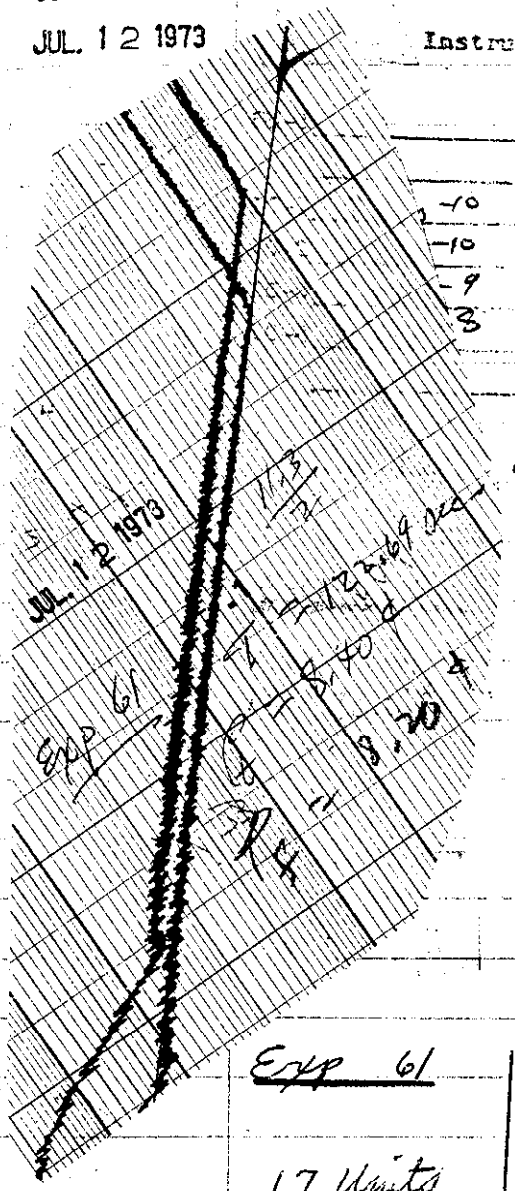
JUL. 1 2 1973 Instrument Check on JUL. 1 2 1973 Source Co 60 (#20)

Low Trip ok Trip ok

-10 ok
-10 ok Scram
-9 ok
-3 ok

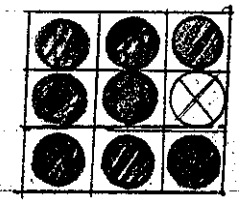
ok
Rod Drop
A - ok
B - ok
C - ok

ok, Source ok, Personnel - ok,



Removed top tier center Unit from fixed table.

$k < 1$ $w = .101$
$E = .101$

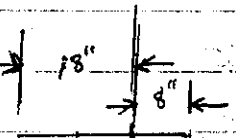


Exp 61

17 Units

∴ SW top tier Units off

$k > 1$, $w = .102$
$E = .100$



$\rho = 8.40$ ¢
$\rho = 8.20 > 8.3$

∞ $w = .174$
$E = .172$ 183/101

$k = 1.0006$

$\Delta \leq .002$

$\Delta \rho =$ ~~.044~~ ¢/mil
115 ¢/inch

Pages 285-289 1" Moderator Thickness.

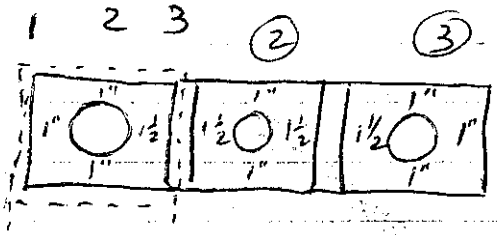
All cells not alike!

3 = 1 1 2 3

and 1 2 3

3 = 2 1 2 3

Type 1



Nominal Base areas 9 x 9 1/2 9 x 10 9 x 9 1/2

Exp. 62 -

18 Units

Restacked with 1" plexiglas egg crate, unit cells being 9" X 9 3/4" X 13".

$k > 1$, $w = .524$

$E = .524$

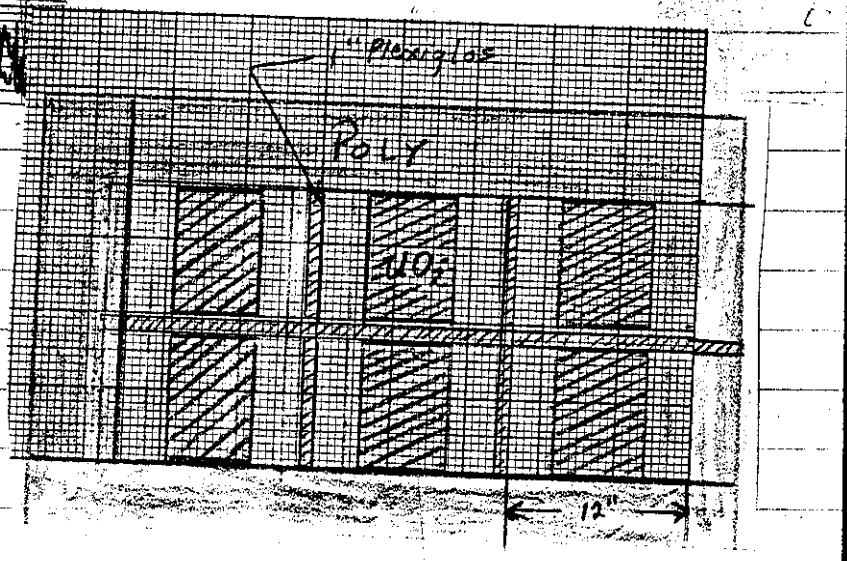
$\ell = 15.71$ #

$w = .598$

$E = 599$

$\Delta S = .074"$

$\Delta \ell = .212$ #/mil



JUL. 13 1973

JUL. 13 1973

Low Trip ok (Scram) Trip ok

IC-1 3×10^{-10} Test Trip ok

IC-2 3×10^{-10} ok

IC-3 4×10^{-9} ok

IC-4 1×10^{-8} ok

Rod Mon =
A = ok
B = ok
C = ok

Exp 63 -

18 Units

Placed 4 pcs cd △ 1/8 g (6"x6"x.037") symetrically about center can & top tier.

k > 1, w = .101
E = .100
ρ_t = 22.02 #

∞ w = .243
E = .242
ρ_t 21.5
av ρ 21.76

Δs = .042"
$\Delta \rho$ = .155 #/mil

Exp 64

18 Units

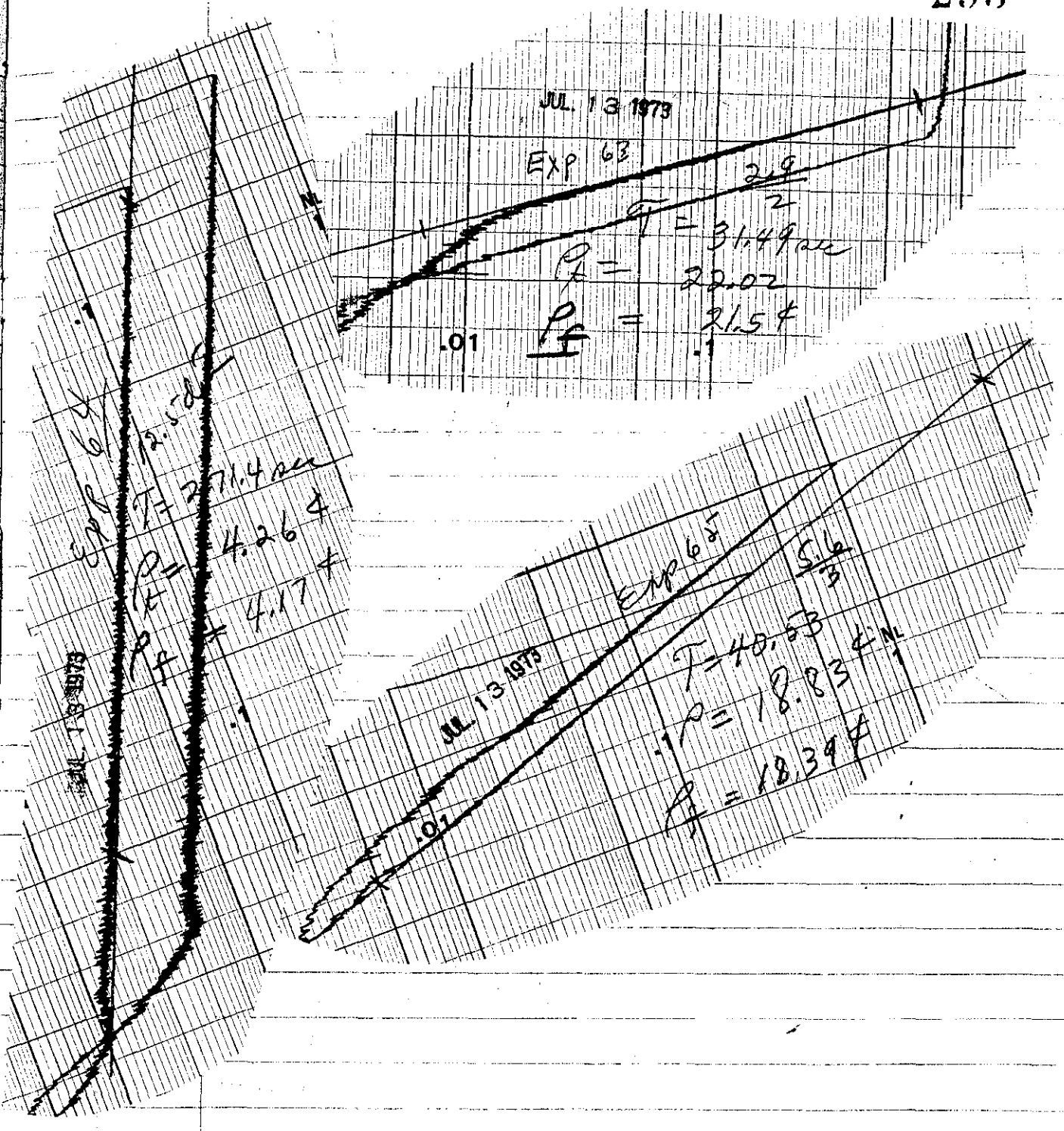
Place 1 △ pc cd on piped table near center can.

1/4 g (6"x6"x.037")

k > 1, w = .101
E = .100

ρ_t = 4.26 #
4.17 av 4.2 #

△ pc cd = 17.76 #


JUL. 13 1973
Exp 63
$\frac{2.9}{2}$
$\bar{T}$ = 31.49 psi
P_t = 22.02
P_f = 21.5 #
.01
.1
NL
JUL. 13 1973
Exp 64
$\frac{5.6}{3}$
$\bar{T}$ = 40.53
P_t = 18.83 #
P_f = 18.34 #
.1
.01
NL
1
JUL. 13 1973
$\bar{T}$ = 271.4 psi
P_t = 4.26 #
P_f = 4.17 #
.1
NL

Exp 65 –

18 units

Removed 1 Δ pc added for Exp 63.

$k > 1$, $W = .101$

$E = .101$

$\rho = 18.83$ ✓

$\frac{1}{8}$ Δ pc $= 14.13$ ✓ $\rho_s = 18.39$

18.61 ✓

4.21

14.4

ρ_{ex} (63) $= 4 \times 14.4 + 21.8$

$= 57.6$

21.8

$79.4 \times .0068$

$k_{eff} = 1.0054$ Exp 63