

BOOK 4R

Notes:

Blank pages: inside front cover, inside first sheet,
1,2,3,7,9-14,33,38,43,50-308,
inside back cover sheets

-one graph sheet taped on each of the following pages: 19, 21, 25, 37, 41

Scanned by:

Sheila Finch

RSICC /Oak Ridge National Lab.

March 22, 1999

97%

235 U

$U(97)O_2(NO_3)_2$

May 1967

BOOK
4

$U(97)O_2(NO_3)_2$

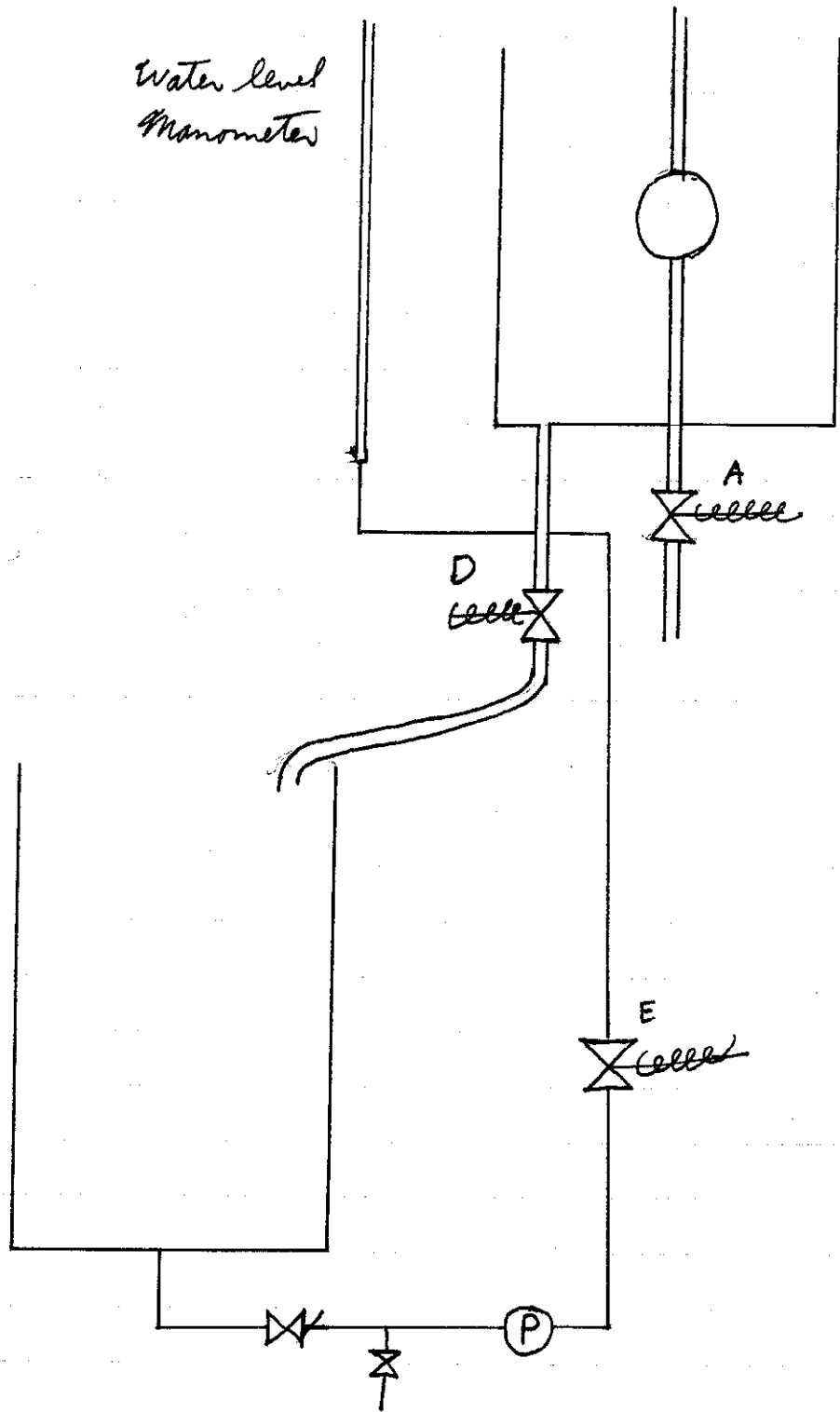
May 1968 -

S149

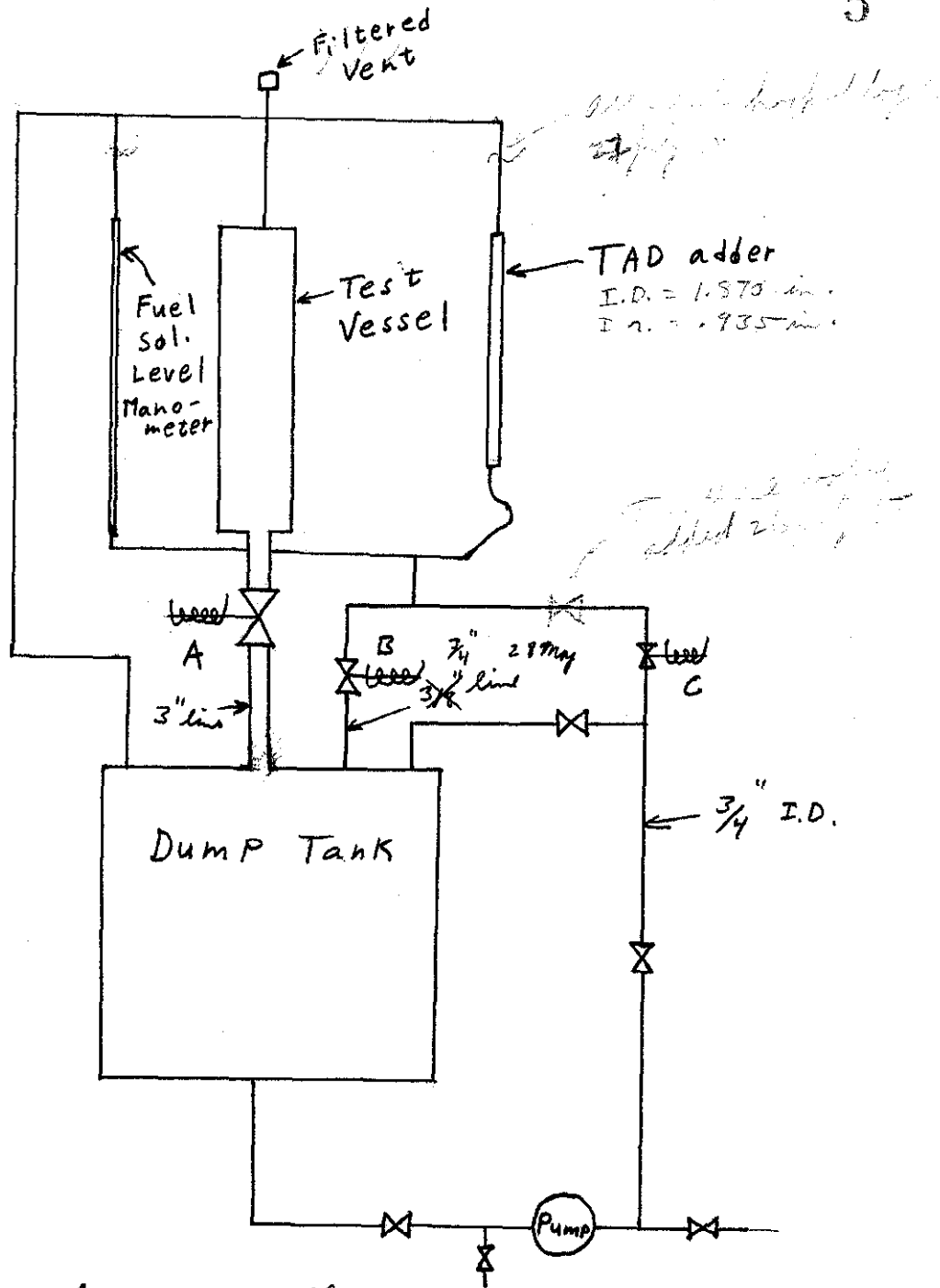
R

300

Water Refl. System



Schematic of fuel solution system



Valves A - normally open
 B - " " secondary drain valve.
 C - " closed

{ D - normally open
 E - normally closed.

20 May 68 The following $U_2O_5(N_2O_5)_2$ (97% ^{235}U) solution was put in the 3" slab dump tank. Solution had been stored on balcony of West cell.

Mat type	Req #	Net wt.	ρ g/g	S.L. net
2143	168745	15.071 kg.	0.24292	3.661 kg
"	168746	15.855	0.23683	3.755
"	168747	14.569	0.24216	3.528
"	168748	14.619	0.23914	3.496
"	168749	3.774	0.25464	0.961
				<hr/>
		63.888 kg		15.401 kg.

Density of soln = 1.5591 $\frac{kg}{l}$

Vol of soln = 40.98 l

~8.56 l removable.

20 June 68

added 2.8 l H_2O

Total Vol = 43.78 l

1 July 68

Removed 14.55 kg net.

Change made
9.526 l.

1 July 68

Removed soln

Total Vol	usable Vol.	Conc ρ U/g	Density $\frac{g}{cm^3}$
34.25 l	~25.69 l	0.2368	1.5274

Test Vessels

Nominal
Dimen.
(in.)

Calibrated
I. Dimensions

Wall Thickness

inches
mm

10" Cyl.

$r = 12.7198 \text{ cm} = 5.0078 \text{ in.}$
 $\text{dia} = 25.4396 \text{ cm} = 10.0156 \text{ in.}$

15" Cyl.

$r = 19.0717 \text{ cm} = 7.5086 \text{ in.}$
 $\text{dia} = 38.1438 \text{ cm} = 15.0172 \text{ in.}$

12" Cyl

$r = 15.2399 \text{ cm} = 5.9999 \text{ in.}$
 $\text{dia} = 30.4794 \text{ cm} = 11.9997 \text{ in.}$
 $r = 12.1026 \text{ cm} = 4.7648 \text{ in.}$

9.5" Cyl

$\text{dia} = 24.2052 \text{ cm} = 9.5296 \text{ in.}$

8.0" Cyl

$r = 10.1613 \text{ cm} = 4.0005 \text{ in.}$
 $\text{dia} = 20.3226 \text{ cm} = 8.0010 \text{ in.}$

0.050 in. *sides* } *al*
1/2 in. bottom } *al*

0.02375
0.03360
0.0149
0.0129
0.0239
0.0239

Instrument Check on 20 May 68 Source 10 m ct

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	3x10 ⁻² "	Water Trip	OK 1"	Fast Trip OK 1"
IC-2	3x10 ⁻² "	Water Trip	OK 1"	Red light OK
IC-3	Responds	Calibration	S/R.	Bldg alarm OK
IC-4	Responds	Calibration	S/R.	Press Dif 0.03"
CRM		Water Trip		

Added sol. to 3" dump tank see p. 6
 Took samples after mixing about 1 hr.
 #1 to X-10 ; #2 to Y-12.
 10" dia al cyl is installed as test vessel.
 Checked zero level in cyl. and set sol. level
 relay to zero.

Expt 1

Feed-drain rate check: Feeds 1.14 in./30 sec
 secondary drain 3.34 in./30 sec

$h > 1$ 21.58" sol. height

$h = 1$ 21.53 " " "

Room Temp 22.6 °C

Instrument Check on 21 May 68 hour. 10 mcr

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	3×10^{-4} "	Water Trip	OK 1"	Fast Trip OK
IC-2	3×10^{-4} "	Water Trip	OK 1"	Pl. Alarm OK
IC-3	Responds	Calibrator	S.J. R.	Red light OK
IC-4	Responds	Calibrator	S.J. R.	Press Dif. 0.04"
SEM		Water Trip		

Room Temp. 22.6°C

Expt 2 Same cyl as Expt 1. Placed IC-2 in paraffin pig.
 $b > 1$ 21.41 in. , $\frac{5.52 \text{ lines}}{sec}$, $\frac{8.56}{2772 \phi}$
 $b = 1$ 21.25 in.

Expt 3 added $\frac{1}{16}$ " Al plate on bottom of cyl in Expt 2.
 $b > 1$ 21.42* , $\frac{5.85 \text{ lines}}{sec}$, 8.168 ϕ
 $b = 1$ 21.28*

Expt 4 Same as Expt 2 with $\frac{3}{16}$ " Al added to bottom.
 $b > 1$ 21.46 , $\frac{5.12 \text{ lines}}{sec}$, 9.091 ϕ
 $b = 1$ 21.28₆

Instrument Check on 22 May 68 Source 10mc K

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	3×10^{-4}	Meter Trip	OK 1"	Fast Trip OK
IC-2	3×10^{-4}	Meter Trip	OK 1"	Old alarm OK
IC-3	Responds	Calibration	S/O	Red light OK
IC-4	Responds	Calibration	S/O	Press Dif 0.04"
CRM		Meter Trip		

Expt 5 - Removed extra al plates from bottom of cyl.
Placed thermocouple in in cyl so that ~ 3" ~~of~~
would be submerged in soln.

Soln Temp = 22.4°C ^{Therm} Probe at 18.2" level.

$b > 1$	$\frac{\text{Soln}}{21.415}$	$\frac{\text{Rad}}{22.43}$	$5.04 \frac{\text{lines}}{\text{sec}}$	9.206ϕ	$57.22 \frac{\text{lines}}{\text{mm soln}}$
$b = 1$	$\frac{21.255}{.16}$	$\frac{17.37}{5.06}$	$\rightarrow 31.6 \frac{\text{in Rad}}{\text{in soln}}$		

Expt 6 - Have $\frac{3}{16}$ " of extra al on bottom of cyl.
Soln Temp = 22.8°C

$b > 1$	$\frac{\text{Soln}}{21.43}$	$\frac{\text{Rad}}{15.22}$	$4.60 \frac{\text{lines}}{\text{sec}}$	9.892ϕ	$53.91 \frac{\text{lines}}{\text{mm soln}}$
$b = 1$	$\frac{21.245}{.185}$	$\frac{9.45}{5.77}$	$\rightarrow 31.2 \frac{\text{in Rad}}{\text{in soln}}$		

thermocouple in 66" long guide tube
" extends about 8" below guide tube

Instrument Check on 23 May 68 Source 10mc Y

PM-1	Low Trip	OK	High Trip	OK	
PM-2			Alarm Trip		
IC-1	3×10^{-4}	Meter Trip	OK 1°	Post Trip	OK
IC-2	3×10^{-4}	Meter Trip	OK 1°	Bl. alarm	OK
IC-3	Responds	Calibration	S/O	Red light	OK
IC-4	Responds	Calibration	S/O	Press Blf	0.04"
GRM		Meter Trip			

Expt 7 Removed extra Al from bottom of 10" Cyl.
Same as Expt 2 & 5.
Soln Temp = 22.3°C
 $t > 1$ $\frac{21.41 \text{ in.}}{.17}$ $\frac{15.55 \text{ in.}}{.17}$, $5.06 \frac{\text{line}}{\text{sec}}$, $9.175 \text{ } \mu\text{C}$, $53.97 \frac{\text{ } \mu\text{C}}{\text{in. soln}}$
 $t = 1$ $\frac{21.24}{.17}$ $\frac{10.465}{.17}$, $5.09 \rightarrow 29.9 \frac{\text{in. soln}}{\text{in. soln}}$

Expt 8 Placed $\frac{7}{16}$ " of Al against bottom of Cyl.
Soln Temp = 22.9°C
 $t > 1$ $\frac{21.394}{.194}$ $\frac{10.04}{.194}$, $4.16 \frac{\text{line}}{\text{sec}}$, $10.695 \text{ } \mu\text{C}$, $55.13 \frac{\text{ } \mu\text{C}}{\text{in. soln}}$
 $t = 1$ $\frac{21.20}{.194}$ $\frac{3.984}{.194}$, $6.056 \rightarrow 31.2 \frac{\text{in. soln}}{\text{in. soln}}$

Expt 9 Removed extra Al. Opened bypass valve and pumped soln for
~ 35 min to raise temp
Soln Temp = 26.4
 $t > 6$ $\frac{21.765}{.175}$ $\frac{11.75}{.175}$, $5.50 \frac{\text{line}}{\text{sec}}$, $8.587 \text{ } \mu\text{C}$, $49.07 \frac{\text{ } \mu\text{C}}{\text{in. soln}}$
 $t = 1$ $\frac{21.59}{.175}$ $\frac{6.20}{.175}$, $5.55 \rightarrow 31.7 \frac{\text{in. soln}}{\text{in. soln}}$

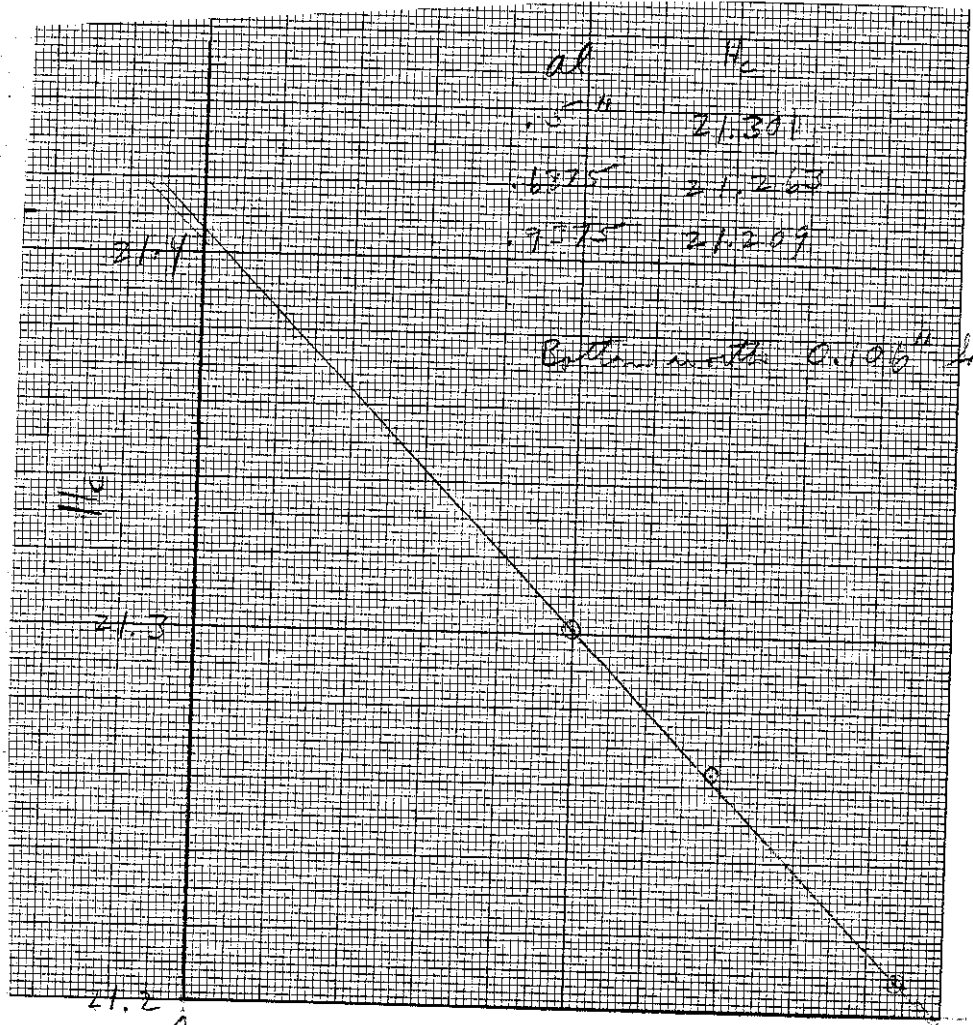
4"

7 $\frac{1}{2}$ in. dia.
7 $\frac{1}{2}$ in. dia.

$\frac{1}{2}$ in. dia.

in

$\frac{1}{2}$ in. dia.



Bottom with 0.106" hole

EUGENE DIETZGEN CO.
MADE IN U. S. A.

dl Bottom thickness (in.)

Expt 10 Repeat of Expt 9 after allowing soln. to cool in
dumpy tank for 1.5 hr.

Soln Temp = 25.2°C

$b > 1$	$\frac{\text{soln}}{\text{soln}}$ 21.67	$\frac{\text{soln}}{\text{soln}}$ 17.424	, 4.90 $\frac{\text{lines}}{\text{sec}}$, 9.413 ϕ	, 51.16 $\frac{\phi}{\text{in. soln}}$
$b = 1$	<u>21.486</u>	<u>11.80</u>			52.65 "
	.184	5.624	$\rightarrow 30.6$	$\frac{\text{in. soln}}{\text{in. soln}}$	

Expt 11 Repeat of #10 after cooling in dump ~ 1.5 hrs.

Soln Temp = 24.55°C

$b > 1$	$\frac{\text{soln}}{\text{soln}}$ 21.57	$\frac{\text{soln}}{\text{soln}}$ 16.783	, 6.15 $\frac{\text{lines}}{\text{sec}}$, 7.844 ϕ	, 54.10 $\frac{\phi}{\text{in. soln}}$
$b = 1$	<u>21.425</u>	<u>12.28</u>			54.78 "
	.145	4.503	$\rightarrow 31.1$	$\frac{\text{in. soln}}{\text{in. soln}}$	

Instrument Check on 24 May 68 Source 10 mcf

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	3X10"	Meter Trip	OK 1"	Fast Trip OK
IC-2	3X10"	Meter Trip	OK 1"	Bldg alarm OK
IC-3	Responds	Calibration	S.F.R.	Red light OK
IC-4	Responds	Calibration	S.F.R.	
CRM		Meter Trip		

Expt 12 Removed 10" Cyl. Installed 15" Cyl. Checked zero.
 Thermocouple guide tube 14" from bottom. ^{Zero at 0.03}
 tip of " ~ 5 1/2" from bottom.
 " " " at 6.1" (by response)

Soln Temp = 23.8 °C
^{std}
 b > 1 7.91 in. 3.378 in. ; 6.45 $\frac{\text{line}}{\text{sec}}$, 7.5384
 b = 1 7.91₃ 2.68₃
 b < 1 7.86₈ - .08
 b > 1 7.91₉ 3.39₀ ; 6.30 $\frac{\text{line}}{\text{sec}}$, 7.6874
 b = 1 7.91₉ 2.68₂
 b < 1 7.90₈ 1.97₂ ; 10.7 $\frac{\text{line}}{\text{sec}}$, -6.7664

Heat down
Circuit

Expt 13

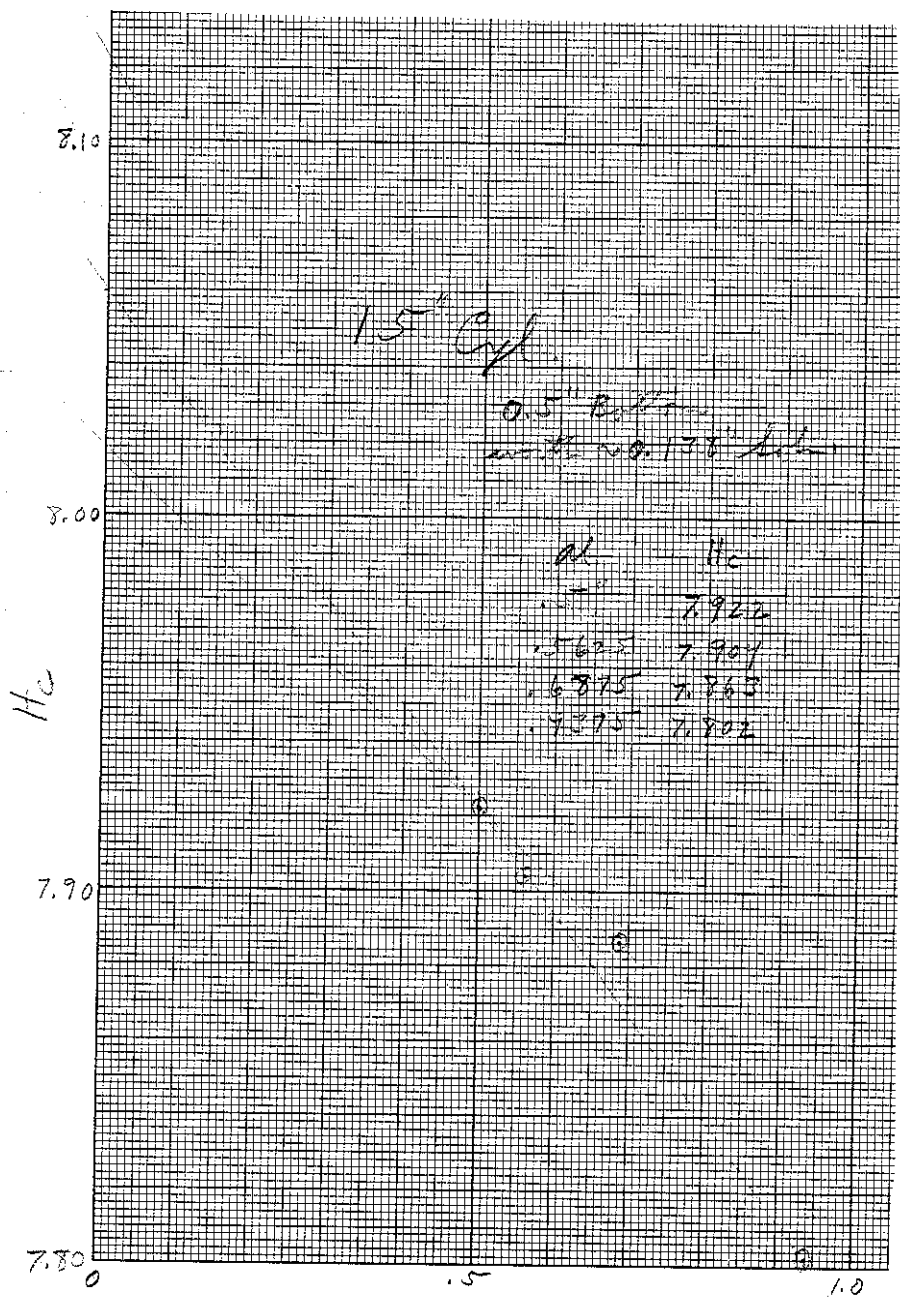
added 1/6" of al to bottom of Cyl.

Soln Temp = 23.9 °C⁺
^{std}
 b > 1 7.99₉ 10.79₄ ; 6.08 $\frac{\text{line}}{\text{sec}}$, 7.9164
 b = 1 7.99₆ 10.04

lowered soln ~.04 and released

b = 1 7.98₄ 10.04

3ms.
rat 0.03



Thickness of Al electrode (in.)

Expt 14 Have $\frac{3}{16}$ " of al on bottom

Soln Temp 24.1°C

	$b > 1$	7.96	4.34 in. ; 3.67 $\frac{\text{lines}}{\text{dec}}$, 11.755 ϕ
lowered \rightarrow	$b = 1$	7.959	3.283 } 3.26
	$b = 1$	7.946	3.23

Expt 15- Have $\frac{7}{16}$ " of al on bottom

Soln Temp 24.3°C

	$b > 1$	7.895	4.286 ; 4.2 $\frac{\text{lines}}{\text{dec}}$, 10.614 ϕ
lowered	$b = 1$	7.895	3.331 } 3.202
	$b = 1$	7.88	3.333

Expt 16 Removed all al

Checked zero at 0.08 in. ^{had 1/16}

Soln Temp 24.3°C

	$b > 1$	8.011	7.202 ; 5.46 $\frac{\text{lines}}{\text{dec}}$, 8.634 ϕ
lowered \rightarrow	$b = 1$	8.006	6.374 } 6.372
	$b = 1$	8.006	6.37

Instrument Check on 28 May 68 Source 10 m c Y

FM-1		Low Trip	OK	1"	Alarm Trip	OK
FM-2					Alarm Trip	
IC-1	3×10^{-4}	Meter Trip	OK	1"	Fast Scale	OK
IC-2	3×10^{-4}	Meter Trip	OK	1"		Oldy alarm OK
IC-3	Responds	Calibration	S/O			Red light OK
IC-4	Responds	Calibration	S/O			Press Dif 0.04"
ORM		Meter Trip				

Changed secondary drain line from $\frac{3}{8}$ " to $\frac{3}{4}$ " tubing.
 15" Cyl Base. Feedrate = 1.70" in 30 sec; Drain = 2.65" in 30 sec.

Expt 17

Soln Temp = ~~22.25~~ °C $b > 1$ 6.987 Backed off and started over

Soln Temp = 22.30 °C

 $b > 1$ 7.814 7.40 $b = 1$ 7.3 Still losing reactivity

Check for air in line. Drained some soln and started over.

Soln Temp = 22.75 °C

 $b > 1$ 7.817 4.749 $b = 1$ 7.813 4.01
3.952

Soln Temp = 22.8 °C

 $b = 1$ 7.813 4.06 $b < 1$ 7.810 3.357 $b = 1$ 7.810 4.07 $b > 1$ 7.813 4.753 $b = 1$ 7.813 4.20

11:30 AM Soln Temp = 22.8+ °C

2:05 PM Held soln in system since morning runs.

Soln Temp = 22.8 °C

	Soln	Rad
b > 1	7.819	4.75
b =	7.812	4.263
b < 1	7.809	3.50
b > 1	7.819	5.03
b = 1	7.818	4.264

Soln Temp = 22.87

Check zero at - .13 in.

~~Checked~~ Investigated the worth of the thermocouple by withdrawing it from a Crit system. The effect was immeasurably small on each of three trials.

Instrument Check on 30 May 68 Source 10mct

PM-1	Low Trip	OK	1"	Alarm Trip	OK	
PM-2				Alarm Trip		
IC-1	3×10^{-4}	Meter Zero	OK	1"	Fast Trip	OK
IC-2	3×10^{-4}	Meter Zero	OK	1"		Bld. Alarm OK
IC-3	Responds	Calibration	S/R			Red light OK
IC-4	Responds	Calibration	S/R			Press Dif. 0.04"
CRM		Meter Trip				

Expt 18

Removed 15" Cyl. Installed 12" Cyl.

adjusted thermocouple so bottom of guide tube
is ~ 17" from bottom of soln. Tip of TC. at 8.15" by response.
adjusted ~~gas~~ level relay to zero.

Soln Temp = 22.9 °C

$k > 1$	10.67	2.104
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$k = 1$	10.668	1.285
---------	--------	-------

Drained some soln.

$k > 1$	10.671	18.441
---------	--------	--------

$k = 1$	10.663	17.450
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Soln Temp = 23.0 °C

Expt 19

Checked zero. OK. Have added $\frac{1}{8}$ " al on bottom

Soln Temp = 23.5 °C

$k > 1$	10.647	6.967
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$k = 1$	10.635	5.590
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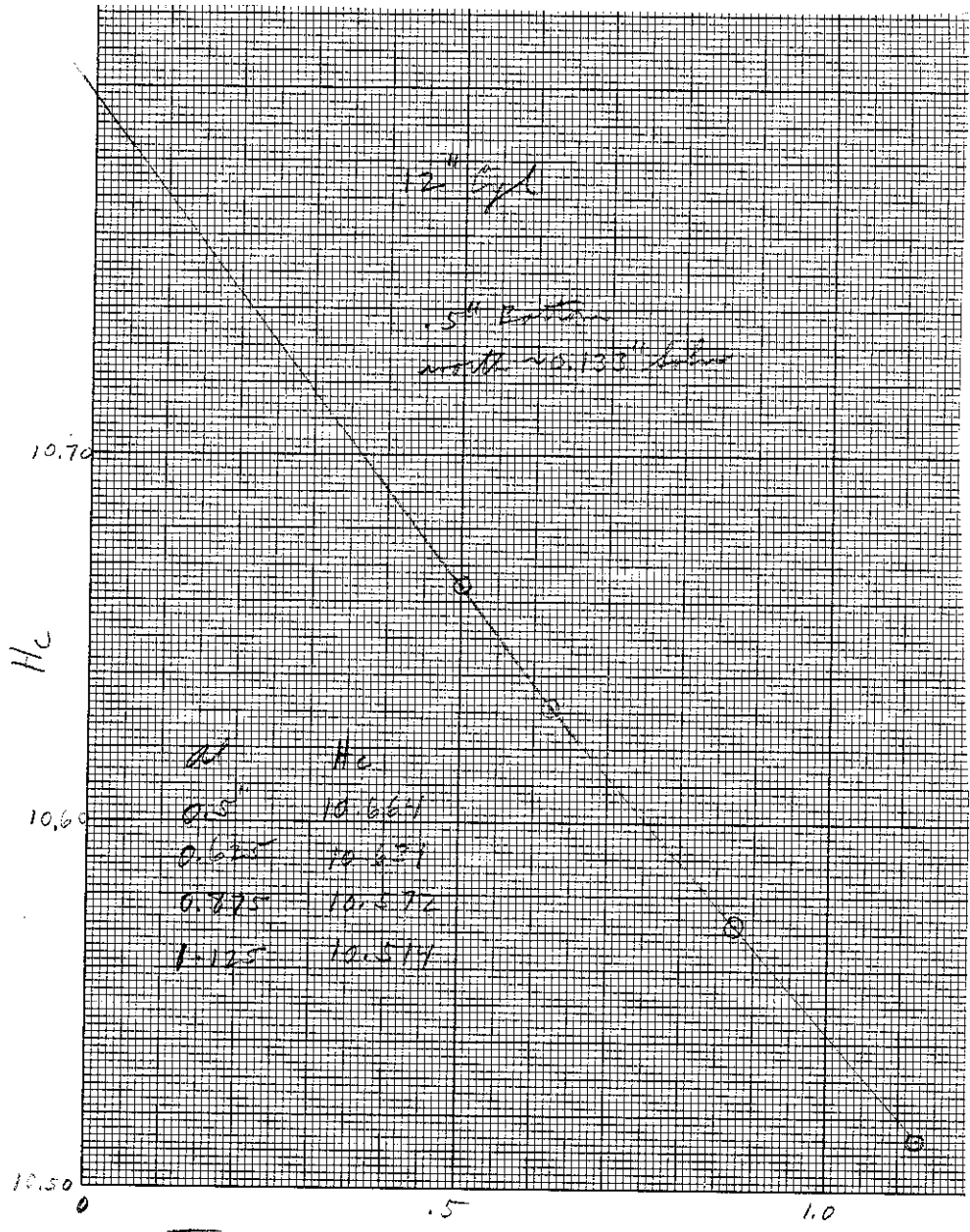
OK
 OK
 Dif. 0.04"

" Cyl.
 inside tube
 TC. at 8.15" by response

bottom

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MILLIMETER



Thickness of all Bottom in.

Expt 20. Have $\frac{3}{8}$ " al on bottom
 Soln Temp = 23.75°C
 $k > 1$ $\begin{matrix} \text{Soln} & \text{Std} \\ 10.578 & 9.370 \end{matrix}$
 $k = 1$ $\begin{matrix} 10.577 & 8.590 \end{matrix}$

Expt 21. Have $\frac{5}{8}$ " al on bottom
 Soln Temp = 24.0°C
 $k > 1$ $\begin{matrix} 10.54 & 6.158 \\ & \overline{\longleftarrow} \end{matrix}$
 $k = 1$ $\begin{matrix} 10.520 & 4.809 \end{matrix}$

Instrument Check on 3 June 68 Source 10 mCr

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	3×10^{-4}	Meter Trip	OK 1"	Test Trip OK
IC-2	3×10^{-4}	Meter Trip	OK 1"	Red alarm OK
IC-3	Response	Calibration	S/R	Red light OK
IC-4	Response	Calibration	S/R	Press Diff 0.04"
CRM		Meter Trip		

Expt 22 Removed extra Al from bottom
Checked and adjusted level setpoint.

Soln Temp = 23.05°C
 $b > 1$ 10.720 10.920
 $b = 1$ 10.705 9.940

Expt 23 Pumped soln for 15 min to raise Temp.

Soln Temp = 24.9°C
 $b > 1$ 10.732 9.690
 $b = 1$ 10.715 9.58

Expt 24 Pumped soln for 15 min.

Soln Temp = 26.2°C
 $b > 1$ 10.755 9.838
 $b = 1$ 10.730 8.25

Expt 25 Pumped soln for 18 min.

Soln Temp = 27.4 °C.

	^{Soln} k > 1	^{Std} k = 1
	10.757	7.379
	10.730	6.050

Expt 26 Have let soln cool

Soln Temp = 24.6 °C

k > 1	10.727	9.21
k = 1	10.715	8.07

Instrument Check on 5 June 68 Source 10 m.c.T

PM-1		Low Trip	OK	Alarm Trip	OK
PM-2				Alarm Trip	
IC-1	3×10^{-4}	Meter Trip	OK 1"	Fast Trip	OK
IC-2	3×10^{-4}	Meter Trip	OK 1"		Old alarm OK
IC-3	Responds	Calibration	S.P.R.		Red light OK
IC-4	Responds	Calibration	S.P.R.		Pres. Dif. 0.04"
CRM		Meter Trip			

Removed 12" Cyl. Installed 9.5" Cyl.
 Adjusted thermocouple so end of guide tube is 38"
 from bottom of Cyl.
 adjusted level relay to zero.
 Have painted a black line on level relay tube just above
 bottom micro-switch. relay reads 99534 on this line.

Expt 27 $b < 1$ Soln level 27.45 in. All of soln, that
 can be pumped, in Cyl.
 Source multiplication ~ 3 .
 ~ 32.42 l in Cyl
 ~ 8.56 l in Plumbing

Instrument Check on Thurs 68 Source 10 m cK

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip		
IC-1	3×10^{-4}	Motor Trip	OK 1"	Fast Trip	OK
IC-2	3×10^{-4}	Motor Trip	OK 1"		Bldg alarm OK
IC-3	Responds	Calibration	S.R.		Red light OK
IC-4	Responds	Calibration	S.R.		Press Diff. 0.04"
CRM		Motor Trip			

Removed 9.5" cyl.
 Installed 36" dia x 50" ~~reflector~~ reflector, H₂O tank with 10" test
 cyl in it. Adjusted thermocouple so guide tube 26" from bot.
 Adjusted level (soln) selym to zero.
 Selym reads 99895 on black line.

Expt 28. No Refl. H₂O.
 Soln Temp = 23.15° C

b > 1	21.33_2	21.25_2	54.24 $\frac{\phi}{\text{cm} \cdot \text{soln}}$
b = 1	21.196	17.21	

Instrument Check on 10 June 68 Section 10 m c f

PM-1	Low Trip	OK	High Trip	OK
PM-2			Alarm Trip	
IC-1	3x10 ⁻⁴	Water Trip	OK 1"	Test Trip OK
IC-2	3x10 ⁻⁴	Water Trip	OK 1"	Bld. alarm OK
IC-3	Responds	Calibration	S.P.R.	Red light OK
IC-4	Responds	Calibration	S.P.R.	Press Diff. 0.04"
CRM		Water Trip		

10" hpl

Checked soln zero.

adj thermocouple as tube is 15" from bottom ^{Tip at 6.2"} from bottom

Expt 29

Checked H₂O Refl zero level = -21.2 cm

Refl level at bottom (outside) of test cyl = 2.2 cm.

	Soln Temp	23.2° C	Refl.	Refl. level	502.2
a	b > 1	7.678	2.392 in.	41.2 cm	14.854 in.
	b = 1	7.676	1.92	41.2	14.854
	b = 1	7.631	0.87	47.5	17.33
b	b < 1	7.631	0.87	43.7	15.34
c	b > 1	7.705	2.98	38.7	13.87
	Soln Temp = 23.15° C				
	b = 1	7.898	2.544	38.7	13.87
	b = 1	7.698	2.655	38.2	13.67
	b = 1	7.960	10.08	23.5	7.89
	b = 1	7.956	9.77	23.8	8.00

Refl level from to same zero as soln zero

502.2 $\frac{\text{cm}}{\text{in. Soln}}$

5.47 $\frac{\text{cm}}{\text{in. Refl}}$

480.2 $\frac{\text{cm}}{\text{in. Soln}}$

Instrument Check on 11 June 68 Source 10 m.c.V

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip		
IC-1	3×10^{-4}	Meter Trip	OK 1"	Fast Trip	OK
IC-2	3×10^{-4}	Meter Trip	OK 1"	Bldg. Alarm	OK
IC-3	Response	Calibration	S.F.R.	Red light	OK
IC-4	Response	Calibration	S.F.R.	Press Dif	0.04"
CRM		Meter Trip			

Expt 30

Same as Expt 29

Check soln zero.

Checked Refl zero level = -21.2 cm

Refl level at bottom (outside) of test cyl = 1.6 cm

Soln Temp = 23.2° C

24.07 cm H₂O
below soln zero

	Soln	Tad	Refl	Refl level Common zero with soln (cm)	
$h > 1$	7.640	4.780	47.8 cm	17.69	552.2 $\frac{4}{2.5}$
$h = 1$	7.639	4.32	47.8	17.69	
$h = 1$	7.639	4.660	45.5	16.78	
$h = 1$	7.654	5.188	42.6	15.64	
Temp	= 23.3° C				
$h = 1$	7.680	5.77	39.8	14.54	
$h = 1$	7.700	6.50	37.0	13.44	
$h = 1$	7.730	7.363	34.3	12.37	
$h = 1$	7.764	8.345	31.8	11.39	
$h = 1$	7.806	9.490	29.2	10.37	
$h = 1$	7.852	10.88	26.6	9.34	
$h = 1$	7.918	12.75	24.1	8.36	
$h = 1$	8.076	17.290	21.7	7.41	

Expt 31 Have added 10" dia cyl. of Styrofoam
 1:20 PM ^{test} inside cyl. which reaches from bottom of Refl tank
 11 June 68 to bottom of test cyl.

Soln Temp = 23.15 °C

	Soln	Rad	Refl.	Refl Comp ($\frac{1}{\rho}$)	
$k > 1$	8.377	2.783	69.6	26.27	490. $\frac{g}{m \cdot soln}$
$k = 1$	8.361	2.237	69.6	26.27	
$k = 1$	8.380	2.710	60.2	22.57	

Temp = 23.2 °C

$k = 1$	8.414	3.540	51.3	19.07
$k = 1$	8.433	3.964	48.3	17.89

Temp = 23.3 °C

$k = 1$	8.449 8.449	4.444 4.444	45.5	16.78
$k = 1$	5.442 8.483	5.442 8.483	40.7	14.89
$k = 1$	8.532	6.995	35.7	12.93
$k = 1$	8.567	7.920	33.2	11.94
$k = 1$	8.612	9.090	30.8	11.00
$k = 1$	8.648	10.110	28.9	10.25
$k = 1$	8.683	11.321	27.2	9.53
$k = 1$	8.741	13.040	25.5	8.91
$k = 1$	8.808	15.019	24.3	8.44

Instrument Check on 12 June 68 Source 10mCY

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	3×10^{-4}	Meter Trip	OK 1"	Fast Trip OK
IC-2	3×10^{-4}	Meter Trip	OK 1"	Bld. alarm OK
IC-3	Responds	Calibration	S/R	Red light OK
IC-4	Responds	Calibration	S/R	Press Diff. 0.04"
CRM		Meter Trip		

Exp 32

Removed 10" cyl.

Installed 8" cyl with styrofoam underneath.

Checked soln zero.

adjusted thermocouple or tube at 20° .

tip at 11" by response.

Temp of soln = 23.95°C

Ref.

Soln Tap Ref

k > 1	12.164	4.610	65.2	24.54
k = 1	12.12	3.78	65.2	24.04
k = 1	12.135	4.04	60.8	22.51
k = 1	12.160	4.35	56.8	21.22

Temp = 23.9°C

k = 1	12.188	4.790	53.0	19.74
k = 1	12.220	5.450	48.9	18.12

Temp = 23.5°C

k = 1	12.270	6.319	45.0	16.59
k = 1	12.31	7.083	42.4	15.56

Temp = 23.7°C

k = 1	12.498	10.721	35.7	12.92
k = 1	12.56	11.915	34.9	12.61
k = 1	12.629	13.111	34.2	12.33

Instrument Check on 13 June 68 Source 10 mct

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	3×10^{-4}	Meter Trip	OK 1"	Fast Trip OK
IC-2	3×10^{-4}	Meter Trip	OK 1"	Bldg Alarm OK
IC-3	Responds	Calibration	S/R	Red light OK
IC-4	Responds	Calibration	S/R	Press Dif. 0.04"
CRM		Meter Trip		

Expt 33

8" cyl

Removed Styrofoam from under cyl.
 Lowered Th.C. 1.5" Tip at 9.5" by response.

Temp of soln = 23.1 °C

	soln	Rad	Refl.	Diff Cm (cm)
k > 1	11.40 min.	3.057 in.	57.0 cm	21.31
b = 1	11.374	2.15	57.0	21.31

Temp soln = 23.25 °C

k = 1	11.38	2.43	54.3	20.25
k = 1	11.39	2.714	51.9	19.30
k = 1	11.41	3.045	49.5	18.36
b = 1	11.432	3.51	46.7	17.26
b = 1	11.456	3.99	44.6	16.43
k = 1	11.48	4.46	42.8	15.72
k = 1	11.51	5.03	40.8	14.93
b = 1	11.54	5.57	39.2	14.30
b = 1	11.575	6.20	37.8	13.75
k = 1	11.61	6.91	36.4	13.20
k = 1	11.664	7.893	34.8	12.57
k = 1	11.71	9.763	33.8	12.18
k > 1	11.88	12.06	32.8	11.78
k = 1	11.793	10.195	32.8	11.78

Temp = 23.3 °C

Temp = 23.3 °C

Instrument Check on 14 June 68 Source LO mck

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	OK
IC-1	3×10^{-4}	Meter Trip	OK 1"	Past Trip
IC-2	3×10^{-4}	Meter Trip	OK 1"	OK
IC-3	Responds	Calibration	1/2 R.	Bldg. alarm OK
IC-4	Responds	Calibration	1/2 R.	Red light OK
CRM		Meter Trip		Pres. Dif 0.04"

8" Cyl
 Expt 34 Have added $\frac{5}{8}$ " of Al on bottom of Cyl.
 Soln Temp = 23°C

Soln Temp Refl

$k > 1$	11.485	3.76	62.8
$k = 1$	11.43	2.71	62.8

Temp = 23.1°C Drained some soln. + water

$k > 1$	11.508	20.585	59.3	22.22
$k = 1$	11.446	19.37	59.3	22.22
$k = 1$	11.449	19.52	57.3	21.43
$k = 1$	11.449	19.62	56.2	21.00
$k = 1$	11.45	19.74	55.0	20.52

Temp = 23.15°C Removed $\frac{1}{4}$ " of Al. Now have $\frac{3}{8}$ " extra Al on bottom

$k > 1$	11.455	19.66	62.4	23.44
$k = 1$	11.405	18.57	62.4	23.44
$k = 1$	11.405	18.67	60.5	22.69
$k = 1$	11.409	18.79	58.8	22.02
$k = 1$	11.413	18.95	56.7	21.19
$k = 1$	11.421	19.11	54.9	20.48

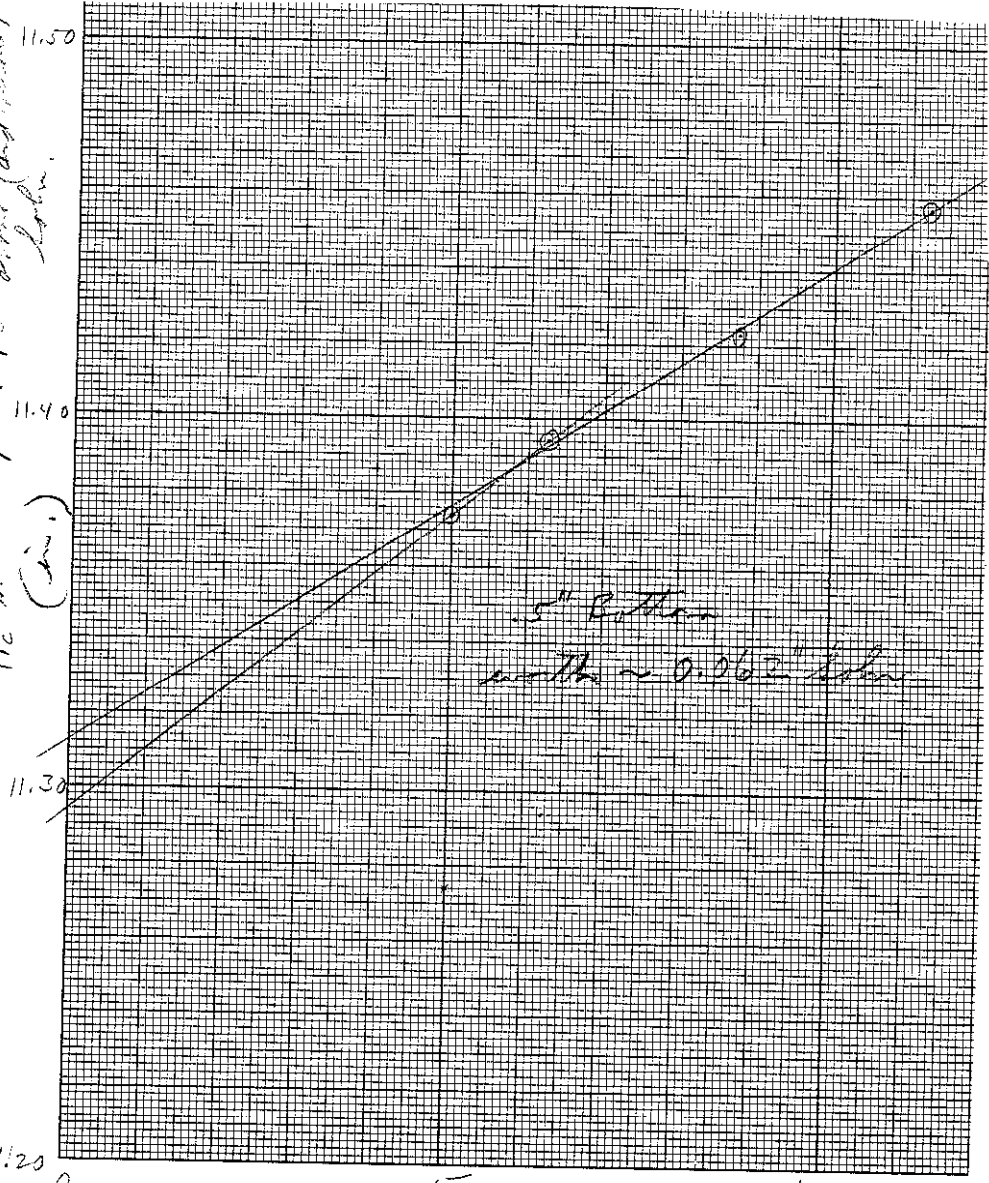
11.40
11.30
11.20

K.

NO. 340-M DIETZGEN GRAPH PAPER
MILLIMETER

EDGE

H_c with Refl 7.48" above (and below)
Lamin.



.5" either
width ~ 0.062" lamin

11.20

Thickness of Al Bottom

ation

Removed $\frac{1}{4}$ " alNow have $\frac{1}{8}$ " on bottom

	John	Had	Refl	Temp
$k > 1$	11.42 in.	19.04 in.	62.7 in	23.56
$k = 1$	11.37	17.97	62.7	23.56
$k = 1$	11.375	18.09	60.8	22.81
$k = 1$	11.378	18.215	58.8	22.02
$k = 1$	11.38	18.39	56.7	21.19
$k = 1$	11.394	18.59	54.4	20.29

* July = 23.2 °C

Removed $\frac{1}{8}$ " alNot added al

$k > 1$	11.444	19.522	58.1	
$k = 1$	11.366	17.88	58.1	21.74
$k = 1$	11.376	18.06	55.8	20.74
$k = 1$	11.377	18.13	55.0	20.52

Instrument Check on 17 June 68 Source 10 m.c.K

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	3 x 10 ⁻¹¹	Meter Trip	OK 1"	Fast Trip OK
IC-2	3 x 10 ⁻¹¹	Meter Trip	OK 1"	Bldg alarm OK
IC-3	Responds	Calibration	S.P.R.	Red light OK
IC-4	Responds	Calibration	S.P.R.	Press Dif. 0.04
CRM		Meter Trip		

Expt 35

Have removed 8" cyl.
 Installed 6.5" cyl.
 Checked soln zero and adj. to zero. (20.11 in.)
 Adjusted thermocouple. Tip at ~ 33.4 in.
 Soln. Temp = 23.7 °C
 $k > 1$ 34.493 17.25 89.7 cm.
 $k = 1$ 33.76. 7.70 "

Temp = 23.3 °C

Lowered thermocouple. Tip at ~ 30.2 in.
 $k > 1$ 34.09 7.16 104.6 cm ← drained soln.
 $k = 1$ 33.39 0.70 104.6 23.05
 $k = 1$ 33.423 0.87 102.1 39.07
 $k = 1$ 33.444 1.21 99.6 38.08
 $k = 1$ 33.47 1.53 97.6 37.30
 $k = 1$ 33.512 2.08 94.9 36.20
 $k = 1$ 33.575 2.855 92.7 35.37
 $k = 1$ 33.655 3.90 90.5 34.50
 $k = 1$ 33.785 5.55 88.8 33.85
 $k = 1$ 34.095 9.47 87.2 33.20

Temp = 23.25 °C

Temp = 23.15 °C

Instrument Check on 19 June 68 Source 10 mCt

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2				
IC-1	3×10^{-4}	Meter Trip	OK 1"	Fast Trip OK
IC-2	3×10^{-4}	Meter Trip	OK 1"	Alarm OK
IC-3	Responds	Calibration	1.9 R.	Red light OK
IC-4	Responds	Calibration	1.6 R.	Alarm Def. 0.04
CRM		Meter Trip		

Effer 36

Added $\frac{1}{8}$ " Al to bottom of lyl
 Checked soln zero Reset relay (~ 0.02)
 Check Refl level at bottom of lyl. = 1.66m
 Soln Temp 23.25°C

	soln	Std	Refl.	
$k > 1$	34.000	8.64	103.5	drained some sol. slightly too at -03 on top before
$k = 1$	33.345	1.80	103.5	
$k = 1$	33.392	2.33	100.1	
$k = 1$	33.415	2.67	98.3	37.57
$k = 1$	33.457	3.21	95.9	36.63

added $\frac{1}{4}$ " of al. Now $\frac{3}{8}$ " extra al on bottom

Temp = 23.2°C

$k > 1$	33.923	9.358	103.9	39.78
$k = 1$	33.340	1.816	103.9	39.78
$k = 1$	33.375	2.15	101.3	38.75
$k = 1$	33.41	2.68	98.7	37.73
$k = 1$	33.453	3.283	96.3	36.78

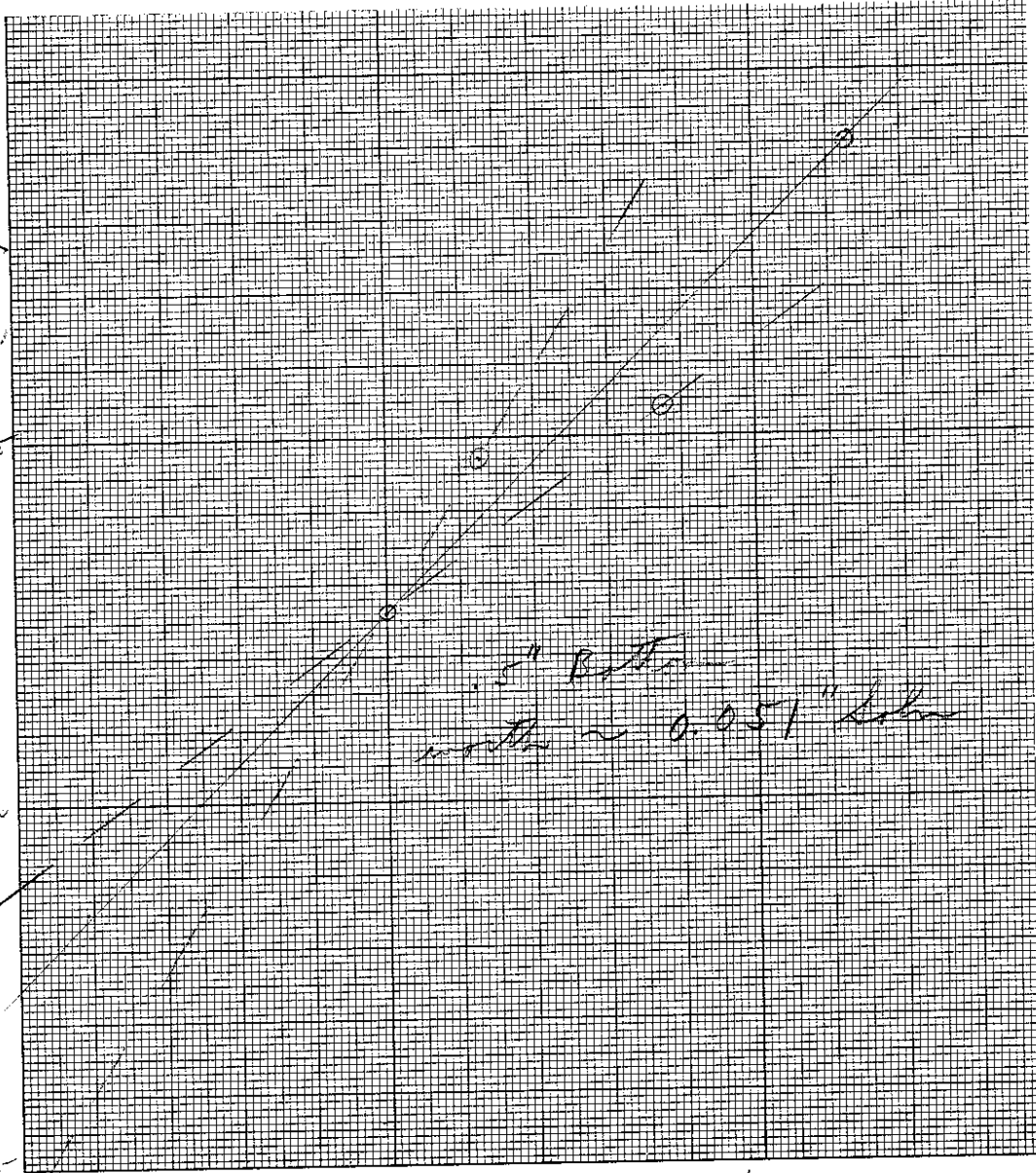
OK
OK
0.04

MADE

NO. 340-M DIETZEN GRAPH PAPER
MILLIMETER

33.40
33.35
33.30
33.25

He with Refl
" about 1.0
(in)



12 Bottom
width ~ 0.051" below

0/

Thickness of 12 Bottom

0.03 on top edge

bottom

Added $\frac{1}{4}$ " of alFlow $\frac{5}{8}$ " extra al on bottom

Temp. 23.2°C	h	John	Tad	Refl.	Comm. ^{Def.} _{Year}
	$h > 1$	33.99 ₈	10.38 ₅	105.0 _{cm}	40.21 _{in}
	$h = 1$	33.35 ₆	2.19	105.0	40.21
	$h = 1$	33.38 ₈	2.53	102.3	39.15
	$h = 1$	33.41 ₉	2.89 ₁	99.8	38.16
	$h = 1$	33.46	3.43	97.3	37.18
	$h = 1$	33.50 ₅	3.97 ₈	95.3	36.39


Removed all extra al.

Temp. 23.35°C	h	John	Tad	Refl.	Comm. ^{Def.} _{Year}
	$h > 1$	33.89	9.05	104.4	39.97
	$h = 1$	33.30	1.44 ₁	104.4	"
	$h = 1$	33.32 ₃	1.75 ₅	101.7	38.91
	$h = 1$	33.36 ₈	2.20	99.2	37.93
	$h = 1$	33.41 ₀	2.84 ₃	96.6	36.90
	$h = 1$	33.46 ₅	3.54	94.0	35.88
	$h = 1$	33.58 ₄	5.09 ₃	90.8	34.62
	$h = 1$	33.83 ₅	8.35	88.2	33.59

Instrument Check on 20 June 68 Source 10mc K

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2				
IC-1	3×10^{-4} "	Meter Trip	OK 1"	Test Trip OK
IC-2	3×10^{-4} "	Meter Trip	OK 1"	Blk alarm OK
IC-3	Response	Calibration	S/R.	Red light OK
IC-4	Response	Calibration	S/R.	Press Dif. 0.04"
CRM	Meter Trip			

Expt 37

Added Styrofoam ~~to~~ under test cyl. 

Checked soln zero. Reset relay (-0.02)

Temp = 23.4°C*

23.5°C

	soln	Tab	Refl.	
k > 1	34.458	6.006	104.7	← drained soln
k = 1	34.030	0.35	"	"
b = 1	34.055	0.602	102.3	"
b = 1	34.096	1.12	100.0	"
k = 1	34.155	1.738	97.6	"
k = 1	34.205	2.59	95.1	"
k = 1	34.270	3.412	93.3	"
b = 1	34.375	4.769	91.4	"
b = 1	34.594	7.772	89.7	"
Sub. dif.	34.678	8.503		← drain water

20 June 68 added 2.8 l of H₂O to soln.

Instrument Check on 21 June 68 Source 10mCi

PM-1	Low Trip	OK	Alert Trip	OK	
PM-2			Alert Trip		
IC-1	3×10^{-11}	Meter Trip	OK 1"	Fast Trip	OK
IC-2	3×10^{-11}	Meter Trip	OK 1"	Old alarm	OK
IC-3	Responds	Calibration	S/P.R.	Red light	OK
IC-4	Responds	Calibration	S/P.R.	Press dif.	0.04"
CRM		Meter Trip			

Expt 38

6.5" Cyl Refl.

Checked zero (soln).

Temp	k	Soln	Std	Refl.	Refl.
Temp = 23.4°C	k > 1	32.186	4.566	104.1	← main soln.
	k = 1	31.627	1.603	"	39.85
	k = 1	31.643	1.702	102.4	39.19
	k = 1	31.658	1.923	100.0	38.57
	k = 1	31.68	2.217	97.8	37.97
Temp = 23.6°C	k = 1	31.719	2.680	95.3	37.38
	k = 1	31.759	3.220	92.9	36.74
	k = 1	31.805	3.825	90.7	36.13
	k = 1	31.860	4.552	88.7	35.51
	k = 1	31.923	5.278	87.1	34.91
Temp = 23.5°C	k = 1	32.000	6.35	85.7	34.31
	k = 1	32.120	7.951	84.3	33.72
	k = 1	31.644	1.699	103.9	39.78

1 July 68. Removed 14.55 kg net soln from system. = 9.526 l.

Instrument Check on 8 July 68 Source 10 m c r

FM-1	Low Trip	OK	Alarm Trip	OK
FM-2			Alarm Trip	
IC-1	3×10^{-11}	Meter Trip	OK 1"	Fast Trip OK
IC-2	3×10^{-11}	Meter Trip	OK 1"	Old alarm OK
IC-3	Responds	Calibration	S/O OK	Red light OK
IC-4	Responds	Calibration	S/O OK	Press Dif. 0.01"
CRM		Meter Trip		

Expt 39 ~~Have~~ recalib. Press Dif gauge. The difference in air pressure between the cell and the control room has probably been nearer 0.01" of water for some time than the .04" recorded.

Have removed the 6.5" lyl and installed the 9.33" (6.964 l) sphere
 Checked soln zero = $7.00 \pm .03$ on Selwyn.
 Soln Temp = 23.0°C
 $b \ll 1$ with soln at 20.02 " (~ 3.7 " in upper stem)
 Multiplication ≈ 2
 Water Refl 10" above top of sphere.

Instrument Check on 11 July 68 Source 10mCr

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip		
IC-1	3×10^{-4}	Meter Trip	OK 1"	Fast Trip	OK
IC-2	3×10^{-4}	Meter Trip	OK 1"	Bldg Alarm	OK
IC-3	Responds	Calibration	S.P.A. OK	Red light	OK
IC-4	Responds	Calibration	S.P.A. OK	Probe Def.	0.01"
CRM		Meter Trip			

Expt 40 Have removed 9.33" sphere and Refl. tank.
Installed 12.5" (2.) dia sphere for
unreflected run.

Checked soln zero = 27.19 ± 0.05 in. on Selwyn.
Soln Temp = 24.3°C

$b \ll 1$ with soln at 41.16" (~ 1.56 " in upper stem)
Multiplication ≈ 2 on IC-3
Shut down

Expt 41

7:30 PM

Pumped soln into sphere again. Unfortunately filled too
full and ^{small quantity of} soln escaped from top of level manometer and
top of sphere. Clean up initiated immediately.

stem)

Instrument Check on 24 July 68 Source 10m cK

PM-1	Low Trip	OK 1"	Alarm Trip	OK
PM-2				
IC-1	3×10^{-4}	Meter Trip	OK 1"	Fast Trip OK
IC-2	3×10^{-4}	Meter Trip	OK 1"	Old alarm OK
IC-3	Responds	Calibration	OK 1/2 R	Red light (See Note)
IC-4	Responds	Calibration	1/2 R OK	Press. Diff. 0.01"
CRM		Meter Trip		

Have finished cleaning up the spill and reassembled the system. Most of the clean up time was spent looking for and removing spots of ^{233}U scattered by the excursion of Jan 1968.

Have installed the 6.5" dia cylinder unreflected in order to have a subcritical system while investigating the pump and flow control problem. This system can not be made critical ~~so~~ so will not use red light

25 July Continued flow measurements

26 July Installed a manually operated valve in feed line down stream from bypass line. See figure on p. 5. Also changed the diaphragm in the bypass valve.

Will continue flow measurements with above system and will calibrate the combination consisting of the bypass valve and the new throttle valve.

15 Aug. ~ 2 wks ago a clean piece of $\frac{1}{4}$ " al plate
was hung in the water in the refl. water holding tank.
H. flow counts > 1100 c/min ≈ 6900 d/min with a air proportion
survey probe. Same as 135 d/min. Should
not use this water in the newly cleaned
reflector tank.