BOOK52R

Notes:
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14-2-2

COMPUTATION BOOK

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data books #2

Course Solution Experiments #36 — 150

Used from 11/25 1947, to 5/12/48 19

HARVARD COOPERATIVE SOCIETY
Cambridge, Massachusetts

SECRET

10149

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For the Atomic Energy Commission
Jack H. Kahn for the
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RESTRICTED DATA

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H/X values very uncertain

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Experiment 37

6" Reactor Tamped $H/X \sim 45$ (43.87) 11/25/47

Personnel: Callihan
Cronin
Fox
Williams

8:00 Installation of 4" storage cylinder in place of #1 3" storage cylinder. Leak tested

9:45 Dilution of solution to $H/X \sim 45$

Broken stud on 8" reactor replaced.

11:30 Measurement of solution Heights in Storage cylinders

	#2	#3	#4	#5	#6	#9
	71.3	71.3	75.0	71.4	74.6	70.6
manometer	31.6	31.5	28.0	31.3	28.5	32.1
Ht.	39.7	39.8	47.0	40.1	46.1	38.5
Density	1.63	1.68	1.64	1.67	1.67	1.63
Ht. in storage cyl.	72.4	70.2	84.8	71.0	81.3	70.0
Ht in 6" Reactor	18.1	17.5	21.2	17.7	20.3	17.5

Trip levels – #3 – 91×100; #4 – 91×100.
Instrument Scales: 3 – 100
4 – 10
5 – 1
R.E – 25 ms.

1:35P Initial Counts – #I 13.5 #II 13.0

Filling dead volume from #6.

Cont.

Experiment 37 (Cont)

		I	II	C/C I	C/C II	
11/23/47 1:40P	H = -0.1 cm.	14.5	15.0			
		14.5	14.0			
1:50	H = 4.1 cm	16.5	17.5	0.88	0.83	{ #6 empty Tamper + eight glass chimes.
1:53	= 10.1 "	25.5	25.0	0.57	0.58	Filling from #9.
2:13	= ~~15.0~~ 15.5 "	30.0	30.5	0.483	0.476	
24	= 20.5	33.5	35.0	0.433	0.414	#9 Empty.
34	= 27.7	41.5	41.0	0.350	0.354	Filling from #2
50	= 36.6	47.0	46.0	0.309	0.315	#2 Empty.
3:02	= 45.0	54.0	53.0	0.269	0.274	Filling from #3
13	= 54.7	57.0	59.0	0.255	0.246	#3 Empty.
29	= 64.9	65.5	65.0	0.221	0.223	Filling from #5
46	= 74.0	73.0	71.5	0.199	0.206	Filling from #4.
~~4:40~~	"	73.5	73.5			
4:40	= 0.3	15.0	15.0			

DRAIN — #3 - 20.1 cm in bi'meter #6 = 17.2 cm. in 7" reactor
#4 - 20.4 " " " #8 = 17.4 " "
#5 - 20.0 " " " #9 = 17.1 " "
#6 - 13.1 " " " = 11.2 " "
#8 - 20.0 " " " = 17.1 " "
#9 - Dead volume. —

} All solution was at sometime during this afternoon out of its storage cylinder & mixed with a quantity from other cylinders. The entire batch should now be homogeneous.

Conclusions. 6" reactor tamped, H/8 = 45 not critical (H = 4 at H = 74 cm) + is probably infinitely safe..

H = 74.0 + 2.6 = 76.6 cm

H/4 =

4L 55/14

Experiment 38 Nov. 26, 1947.

7" – Tamped – Cadmium H/X ~ 45. (43.87)

Beck.
McLendon.
Fat.
Cronin.

8:20 AM Completing alignment and checking of 7" reactor.
Instrument #5 out of Commission; Cairns repairing.

12:50 PM. #5 still out; all others in good condition. Experiment to proceed. McLendon out.
Instruments checked.

		Counting Rate		C/R		
	Solution	#1	#2	#1	#2	
12:52	"Background"	12.5	13.			
12:59	"Zero" 0.7 cm	13.0	12			From cyl #9
		13.0	11.5			
1:06	10.0 cm	18.5	18.0	.70	.667	From cyl #3.
1:14	20.0	24.	24	.57	.50	Cyl. 3 empty at 15. Adding from #4.
1:20	30.2	26.	25.5	.50	.47	adding from 4. empty at 29.8cm.
1:28	39.9	28.5	26.	.45.5	.46	adding from 8.
1:35	50.1	28.5	27.	.455	.445	Bonkus & McLendon came in.
1:44	60.1	27.5	26.5		.4	

Drainback — #3 15.6
#4 15.0
#5 16 in #5
#6 15.0
#8 9.4
#9. dead volume.

Conclusion — Will not go at ∞ ——
CHB

Experiment 39 - 7" Untamped — H/x ≅ 45. 43.87

Nov. 26, 47.

Beck,
Fox
Cronin
McLendon
(Bartkus.)

Instruments Checked.

	Solution Level	Counting Rate #1	Counting Rate #2	I c/c	II	
2:32.	0.3 "zero"	118	109.3			
		118.5	109.0.			
	10.0.	90.5	85.0	1.3	1.27	Emptying #8
2:47	20.0	146.0	134.5	.81	.81	from #6
2:55	30.0	166.5	151.5	.70	.72	6 emptied 25; from 5. Fox departed.
3:01	40.3	172.5	159.5	.69	.69	from 5. (empty)
3:12	60.1	175.5	159.5	.685	.69	from # 4. and from 3.

11/30/48 DC.

H = 60.1 + 1.9 = 62.0 cm —
H/x = 43.9
ρ_aq = 1.65
Wt % x = 32.6 = 0.538 gx/cc
V = 15.39 ℓ } actual
M = 8.28 kg } measurement

Estimated $V_c = H_c = M_c = 0$

Drainback:

#3	15 · cm.
#4	15
#5	15
#6	15
~~#7~~	
#8	9.
#9	dead volume.

Conclusion: Does not go at ∞

11/28/47

$^{NH}/_{N}$ determn

Sample from solution ~30 before dilution.

#28	#27
1.8110 gms sol	1.4253 gms sol
0.8861 gms UO_3	0.6909 gms UO_3
Calc $^{NH}/_{U}$ appox = 31.12	31.82

avg = 31.47

samples sent to Analytical lab for accurate analysis.

Lab Results 12/11/47

#27 wgt of U = 0.5831 gm wgt UO_3 = 68.90
$^{H}/_{U}$ = 32.0

#28 wgt of U = 0.7475 wgt UO_3 = 0.8833
$^{H}/_{U}$ = 31.39

8

12/1/47 — Experiment 40 — 7" Reactor.
Tamp ED
H/x = ~~45~~. 43.87

Visner
Mclendon
Callihan

Replaced solenoid in safety rod support.*

Trip point #3 - 93×100
#4 94×100

Scales #3 - 100
#4 - 10
#5 out of order
Reed - - -

		I	II	I (Tamper Counters Calc)	II	
3:08P	Filling dead volume from #9					
3:15P	H = 0.2 cm	14.5	15.0			
		14.0	14.0			#9 empty -
3:25P	H = 2.9 cm.					Filling from #8.
3:27P	H = 5.1 cm.	19.5	19.5	0.732	0.744	
:32P	H = 10.2 cm	30.0	30.5	0.477	0.476	#8 empty.
39	= 13.5	39.0	37.0	0.366 ~~0.372~~	0.392	Filling from #6.
49	= 17.5	51.5	50.5	0.277	0.287	
57	= 21.0	68.0	65.0	0.210	0.223	
4:06	= 25.0	106.5	102.5	0.134	0.141	Filling from #4
13	= 27.5	158.0	153.5	0.091	0.094	
24	= 29.5	304.0	297.5	0.047	0.049	
35	= 30.6	550.5	527.0	0.026	0.028	
55	= 31.0	Critical with 9 cm control rod below solution surface.				
5:06	= 0.0	14.5	16.5			

Drain Back

#3	15 cm in 7" (not used today)	= 11 cm in 8" reactor	
#4	15 " " "	= 11 " "	
#5	15 " " " (not used today)	= 11 " "	
#6	14.7 " "	= 11 " "	
#8	9.3 " "	= 7 " "	
#9	Dead volume		

11/17/48 DC - 30.8 + 1.9 = 32.7 cm = Hc corrected for bottom
7" Stainless, Tamped
H/x = ~~43.87~~ 43.9
Sp.gr. = 1.65 ~~0.336~~ [illegible]
Wt% x = ~~0.256~~ = 0.538 ~~0.422~~ gm x/cc
V_c = 8.12 l
M_c = ~~3.43 Kg.~~ 4.37 Kg.

Conclusions - 7" reactor, tamped, H/x ≅ 45 Critical at H = 30.8 ± 0.2 cm
Due to difficulty in aligning 7" reactor it is suggested that in future the two tamped experiments be done consecutively -
DC 12/1

* Current Carrying capacity of Cd rod solenoid is 4.8 amps. Current through Cd rod and dump valve solenoids, in parallel, each with plunger, is 3.5 amps. Therefore it is recommended that 5 amp fuses be used in the trip circuit.

1/7/47 Experiment 41 8" Reactor

H/x = ~~45~~ 43.87

Tamped + Cd Shielding.

Manfitt.
Cadthaw
Cronin

Trip points #3 93x100
#4 94x100

Scales #3 – 100
#4 – 10
#5 – 1
R-E – 50 mv.
#II – out of order

		I		c/c.
12:45P	Filling from #9.			
:53	H = 1.0 cm "Zero Count"	14.0 12.0 13.0	#9 empty	
1:02	H = 5.0	14.5 15.0	Filling from #8	0.882.
1:10	=		#8 Empty	
:13	= 10.2	20.5 21.0	Filling from #3	0.627
25	= 15.0	28.0 27.5		0.469
35	= 19.3	34.5	#3 Empty	0.377
43	= 25.1	42.5	Filling from #5	0.306
51	= 30.9	53.0 55.0	#5 Empty.	0.245 0.236
2:02	= 37.6	75.5	Filling from #6.	0.172
	= 0.0	13.0 12.5		

Drain: #3 – 10 cm in 8" reactor
4 – 11 cm "
5 – 10 cm in 8" reactor.
6 – 11 cm in 8" reactor
8 – 10 " " "

Conclusion: Maximum possible height maintaining tamping = 37.6 cm. M = 6; Probably would go Critical; Decided to repeat with 35" cylinder – to be fabricated.

12/2/47 Experiment #42 8" Reactor

~~H/X = 45~~ 4387

~~Untamped~~

Tamped.

Cronin
Morfitt
Callihan

(Lowered pulse selector level on #II - seems OK).

Scales: #3 - 100
#4 - 10
#5 - 2
RE - 100 mv

Time	H	I	II	I	II	
3:46P	H = 0.0 cm.	16.0	13.5	"Zero" Count		
		15.5	14.0			
:49		(15.75)	(13.75)	Filling from #8 Cole		
54	H = 5.0	23.0	21.5	0.685	0.639	
4:00	= 8.0	35.0	30.0	0.451	0.459	
:08	= 10.4	48.0	43.5	0.324	0.316	#8 Empty.
:17	= 12.5	66.0	60.0	0.239	0.230	Filling from #3
:24	= ~~13.0~~ 15.0	103.0	95.5	0.153	0.144	
:33	= 17.0	176.0	157.0	0.090	0.088	
:44	= 18.0	259.0	224.0	0.061	0.060	Filling from #4
:51	= 18.7	397.0	361.5	0.040	0.038	
5:05	= 19.0	475.5	419.5	0.033	0.033	
18	= 19.2 (Source out.) 19.3-	Not quite critical.				
30	= 19.3 (source out)	"	"	"		
33	= 19.5	"	"	Critical with 8 cm CD rod below solution level.		
48	= 0	15.5	14.0			

DRAIN BACK:- #9 has dead volume —
Balance of solution is distributed in an unknown way among #3, 4, 5, 6 + 8. It is necessary to measure the solution heights in these cylinders since they were filled simultaneously when a cotter pin fell out of #4 + it could not be closed. It is suggested that better keep pe be provided.

Conclusions: 8" Reactor, tamped, H/X = 45 - Critical at H = 19.4 ± 0.1 cm.

11/17/48 * 19.4 + 1.45 = 20.9 = Hc corrected for bottom -

H/X = ~~43.87~~ ~~4~~43.9

8" Stainless, Tamped.

sp gr = 1.65 ~~0.326~~ 32.6 ~~0.0538~~

wt of X = ~~0.286~~ = ~~#22~~ gm/cc

Vc = 6.78 L

Mc = ~~2.86 kg~~ 3.65 kg.

* 3/3/49 Adding 1 cm zero correction because of "short" 8" cylinder -

Hc' = 21.9 cm

V' = 7.10 L

M' = 3.82 kg

12/3/47 Experiment 43 – 9" Cadmium-Tamped H/X ≈ ~~45~~ 43.87

27.6
4.7
3)23.

Beck
Morfit
Cronin

8–11:30 Removing 8" cylinder; installing, adjusting 9".

Solution Levels in Storage Cylinders.

# 3	4	5	6	8	9	
74.4	77.2	75.9	76.6	57.7		73.1
28.4	25.7	27.0	26.4	43.5	Dead Volume.	29.5
46.0	51.5	52.9	50.2	14.2		43.6
× 17.3						
80 cm	89	92.	87.	25.		76. Height in 3" cyl.
× 9/81 For 9" cyl.						
8.9	9.9.	10.	9.7	2.8		Dead Volume. Height in 9" cyl.

Reef is off. #3 on 100; #4 on 10; #5 on 1, Proc. Mon. O.K.
Background counts on 1 and 2 –

	Solution Levels	Counting Rate #1	Counting Rate #2	Co/c #1	Co/c #2	
11:30 AM.	"Background"	12	11.			
		12	11.5			
		11.5				
		12	11.5			
11:55	1.6 cm "zero"	11.5	10.5			Dead Volume filled from #9.
12:15						#8 empty at 3.6.
	10.2 cm	22	20.5	.523	.512	#6 empty at 13.8. Adding from # 5,
12:22	15.0	34.5	31.5	.332	.334	
		~~33.2~~	~~33.4~~			
12:30	20.0	60.0	55	.192	.191	Adding from # #5.
12:38	25.1	148.	132.5	.077	.079.	#5 empty at 23.1. Adding from 4. #4 on 20 scale.
12:44	26.5	250	228.5	.046	.046	#5 on 5; #4 on 50 scale.
12:54	27.5	450	411.5	.025	.0254	#4 on 100 scale.
		462	415.5	.025	.025.	
1:05 ~~12:5~~	27.6	Not Critical, But close.				
	27.7	Above Critical –				

Drain Back –

# 3	4.	5.	6	8	9
8.9	10	7.6	7.6	7.6	Dead Volume.

11/17/48 DC
27.65 + 1.15 = 28.8 cm Hc – Corrected for bottom –
9" Stainless Tamped and Cd shielded
H/X = ~~43.87~~ 43.9
wt% X = ~~0.3??~~ = ~~0.422 gm/cm³~~ $\frac{32.6}{0.326}$ = 0.538 gm/cc
~~0.44~~ = 1.65
V_c = 11.82 L
M_c = ~~4.44 kg~~ 6.36 kg

Conclusion: Critical at 27.65 cm. ± .025

Experiment 44. — 9" Tamped. H/X ≃ ~~45.~~ 43.87

2:45 Preparations ready for Tamped.

#3 on 100, #4 on 10, #5 on 2. Process monitor ok; Read out.

#3 trips out at 94 on 100; #4 at 90 on 100 scale.

	Solution Levels	Counts #1	Counts #2	S/C #1	S/C #2	
2:50.	"zero" 0.3 cm	14.	13			
		14.5	13.5			
2:55	9.0 cm.	40.5	36.0	.345	.36	From #8. Empty at 9.0
3:01	14.0	119.5	106.5	.117	.122	From #5. #4 on 20 scale.
3:12	15.5	226.	207.	.062	.061	#4 on 50, #5 on 5
3:20	16.2	412.	376.	.034	.035	
3:30	16.5	705.	650.	.0198	.020	
		717	647.			
3:45.	16.6	Not critical; But close.				
3:50.	16.7	Critical.				

Drain Back:

#3	#4	#5	#6	#8	#9
8.9	10.	7.6	7.6	7.6	Dead Volume.

Conclusion: Critical at 16.65 ± .05

11/17/48 DC – 16.65 + 1.15 = 17.8 cm Ht corrected for bottom –
H/X = ~~43.87~~ 43.9
9" Stainless Tamped.
Dfgr = 1.65 wt % X = ~~6.236~~ 326 = ~~0.4122~~ 0.538 gm/cm³
V_c = 7.30 l
M_c = ~~3.08 kg.~~ 3.93 kg.

Experiment 45 9" untamped $N_H/N_x \sim 45$ 43.87 Cronin Moffett Murray

9^00 Took samples for N_H/N_x & specific gravity*

9^15 Instruments - Scales: #3-100 #4-10 #5-2, Reed rg., processmanometer (trip88), (trip88)

9^40 Measurement of specific gravity: $\rho = 1.667$ for $N_H/N_x \sim 45$

Filling from	time	Soln. level	c_1	c_2	$(1/m)_1$	$(1/m)_2$	comments
#9	9 50	−3mm.	98	81 (NG.)			
			94.5	96			
			95.5	94			
	10^09	Filling from #8					
	10^13	7.10	70	68.5			
	10^17	9.1	89.5	89.	Rod in		#8 Empty
			—	—	Rod out		
	10^23	11.61	122.5	113.5	.775	.837	Filling from #6
	10^35	15.0	165.5	160.5	.574	.592	
	10^90	17.3	202.5	193	.468	.492	#6 Empty
	10^48	20.05	248	229.5	.383	.414	Filling from #3
	10^55	23.0	288.5	267.5	.3295	.355	
	11^01	27.0	357.	334.5	.266	.284	
	11^10	29.4	406.5	376.	.234	.253	#3 Empty
	11^48	32.8	480.0	441.	.198	.215	Filling #5
	11^23	35.7	545.5	505.5	.175	.188	#5 Empty
	11^35	37.8	615.5	565	.1545	.168	Filling from #4
	11^47	41.0	731	665	.130	.143	#4 Empty
	11^50	41.0	720	664			Check pt.
	11^53	39.5	668	607.5			Drawing in tc #4

Drain Back:

#4	#3	#5	#6	#8.0	#9
10.0	9.0	7.5	7.5	7.0	d.v.

11/30/47 EOC
H = 39.5 + 1.2 = 40.7 cm
H/V = 43.9 Sp.gr. = 1.65
Wt of V = 32.6 = 0.538 gm/cc
V = 16.70 ℓ } actual meas.
M = 8.98 kg }
Estimated:
H_c ~ 75 cm
V_c ~ 31 ℓ
M_c ~ 17 kg.

Background Count

#1 100 #2 95.

* 11/19/48 Data from Cronin's notes:

Dish 35 Gross 10.5111 gm
Tare 8.9733
Net 1.5378 gm solid oxide
3.7302 gm solution.
H/x = 43.79.

Dish 24 Gross = 9.7553 gm
Tare = 8.7138
Net 1.0415 gm oxide from 2.5316 gm sol'n
= H/x 43.96

Conclusion: 9" untamped cylinder, $N_H/N_x \sim 45$ probably does not go critical at indefinite extension

spg. 1.667

Experiment #46 6½" Tamped N_H/N_x = {43.79 / 43.96 / 43.87} 12/4/47

Cronin
Morfitt
Murray

2:40 Ready to go. Filling dead volume from #9

Prelim. counts 12¼, 12¼
11:3/4; 11 3/4

Soln. Heights of Reactor heights

#3	#4	#5	#6	#8	#9
13.6	15.2	11.3	11.3	10.6	Dead Volume

Background Counts @ 0.2 cm

			Ave.
#1	13.5, 12.0	12.5	12.5
#2	12.0, 12.0	12.25+	12.0

Filling from:	Time:	Soln level	C_1	C_2	(C_0/C_1)	(C_0/C_2)	Remarks.
#9	3:00	4.0					#9 Empty.
#8	3:04	10.2	25.5	24.5	.490	.490	
#8	3:15	17.1	34.0	31.0	.368	.387	#8 Empty
#6	3:26	25.1	51.5	47.0	.242	.255	
#6	3:32	30.1	76.0	67.5	.165	.178	#6 Empty
#5	3:36	32.7					
#5	3:45	40.0	142.5	128.0	.0878	.0938	
#5	3:57	44.1	386.5	338.5	.032	.036	#5 Empty
#4	4:11	45.3					
	4:20	Critical with Rd @ 36 cm S@∞					
DRAIN #4		~~44.85~~ 45.0			~~48.0~~		
	4:30	Critical with Rd @ ~~40.8~~			S@∞		
DRAIN #4	4:37	44.8					
		Not Critical					

DRAIN BACK

#3	#4	#5	#6	#8	#9
13.6	15.1	12.0	11.1	16.	dr.

Conclusions: Estimated best critical point for 6½" cylinder, N_H/N_x ≃ 45, tamped, is 44.9 ± .5 cm.

Note: Calculated N_H/N_x's appear in upper right hand corner of this page.

11/17/48 BC 44.9 + 2.2 = 47.1 cm – Hc corrected for bottom –
H_W = ~~43.87~~ 43.9
6½" Stainless, Tamped
spg = 1.65

$H_W/6X$ = 32.6/0.226 = 0.538 / 0.422 gmt/cc
V_C = 10.088
M_C = ~~4.28 kg~~ 5.42 kg

Experiment 47 — 10" Reactor Cd Shielded Tamper

$^{NH}/_{rx}$ = 43.87

12/5/47

11:00 — Start of experiment

Callihan, Cronin, Macklin, Morfitt

Soln Height in 10" Reactor

#3	#4	#5	#6	#8	#9	(From Drain back)
5.7	6.3	5.0	6.7	6.7	dead Vol.	

Trip Points - #3 at 90 on 100 scale
#4 at 86 " " "

Instruments:
#3 on 100 scale
#4 " 10 scale
#5 " 2 "
Process Monitor

Background Counts at 0.9cm away: #1 = 11.5, #2 = 11.0

	Cylinder	Soln.	C_1	C_2	C_0/C_1	C_0/C_2	Remarks
11:03	#9	0.9	11½	11.0			Stopped to eat lunch
			11.5	11.0			
12:20	#9						Cyl. empty
12:30	#8	5.1	14.5	14.0	.793	.786	
	#8	7.2	—	—	—	—	Cyl empty
12:32	#6	10.0	30.5	24.5	.377	.449	
			27.5	25.5	.419	.431	
12:54	#6	12.1	38.5	35.5	.299	.310	not emptied
1:05	#4	19.90	52.0	46.0	.221	.239	
1:13	#4	16.50	85.5	78.0	.135	.141	not emptied
1:25	#5	18.50	155.5	136.5	.074	.081	
1:35	#3	19.50	269.0	236.5	.0427	.0465	
1:45	#3	19.90	387.0	339.0	.0297	.0326	
2:07	#3	20.20	Source pull not quite critical				
2:08	"	20.3	" "	"	"	"	
2:14	"	20.4	" "	"	"	"	
2:30		20.6	Critical at this point with tamper 3 mm above Soln.				

Drain back:

3	4	5	6	8	9
5.7	6.3	5.0	6.7	6	dead Vol.

11/17/48 DC 20.5 + 0.9 = 21.4 cm Hc corrected for bottom - 10" Stainless, Tamped and Cd shielded
H/X = 43.87 43.9
with 90% = ~~0.256 = 0.422~~ 32.6 / 0.336 = 0.538 g/cc
ρ_{49} = 1.65
V_c = 10.84 ℓ
M_c = ~~4.57 kg~~ 5.83 kg

Conclusion: H/X = 44; 10" Reactor - Tamped plus Cd shield - Critical at 20.5 ± 0.1 cm.

Experiment 48. — H/x = ~~44~~ 43.87 10" Cylinder, Tamped.

Dec. 5, 1947.

Beck
Moffitt.
Cronin.

3:00 — Removing column, preparing for Tamped Expt.

Instrument checked OK.

Background:

#1	#2
14.0	13.0

#4 on 10, #3 on 100, #5 on 1. Proc. monitor ok. Feed not operating.

	Solution Level	Counting Rate #1	Counting Rate #2	c/c #1	c/c #2
3:30	0.3 "zero"	14.0	13.		
		14.5	14.		
3:35	7.0	34.0	31.5	.427	.445
3:45	11.0	95.	83.0	.153	.169
3:50	13.0	237.	210.5	.061	.065
4:00	13.6	436.	390.5	.033	.036
4:07	13.75	Not critical, but close.			
4:13	13.80	"	"	"	"
	13.90	"	"	"	
4:20	14.0				

Drain Back

3	4	5	6	8	9
5.5	6.5	5.0	6.7	6	drain Vol.

Conclusion: Critical at 13.95 ± .05 cm

Check

11/17/48 DC 13.95 + 0.93 = 14.9 Cm — Hc corrected for bottom.

10" Stainless tamped

Hw = ~~43.87~~ 43.9

Apq = 1.65 ~~0.326~~ 0.538

Wt % = ~~0.236~~ 0.722 gm/cc.

Vc = 7.55 R

Mc = 4.06 kg.

19 — Collins, Geo. T Pennsylvania Salt Mfg. → Solvay gate.
John Ball →

22

Experiment 49. 10" cylinder [Untamped] H/X ≃ ~~45.~~ 43.87

Beck, Macklin, Fox } 8:30 making preparations for 10" untamped.

Unnin, Olsen } 9:30 making repairs on #5 instrument.

Trip points #3 at 88 on 100, #4 at 89 on 100.
#3 set on 100, #4 on 10 scale, #1 & #2 ok, process monitor ok.

	Solution Level	Counting Rate #1	Counting Rate #2	Co/C #1	Co/C #2	
9:40.	Background	115	102			
		115.	99.5			
9:48	0.2. "zero".	114.5	97.0			
		114.	100.			
10:08	10.2	153	128.	0.745	0.78	
		148.5	133.5			
10:19	15.1	277.5	245.5	0.41	0.41	
10:26	20.0	476.5	413.0	.24	0.24	
10:36	24.4	815	717.	.14	0.14	
Source pulled up to reduce reading on instruments.						
10:47	24.3	397.	398.	.14	0.14	∴ New "zero" = 55.7 counts (for both).
10:56	26.5	879.	773.	.07(?)	.07(?)	
Source pulled higher – (above soln level).						
11:02	26.5	221.	188.5			new zero = 27. counts/min (" ").
11:22	31.2	Not critical but close.				
11:30	31.6	Above critical				
	31.5	Above critical				

Drain back

#3	#4	#5	#6	#8	#9
5.0	7.4	7.6	7.1	7.0	Dead Vaf.

Conclusion: Critical at 31.4 ± 0.1 cm.

11/17/48 DC 31.4 + 0.93 = 32.3 cm Ht corrected for bottom –

10" Stainless Untamped
H/X = ~~43.87~~ 43.9
ρ PO_4 = 1.65, wt % X = $\frac{33.6}{0.2??}$ = 0.538 gm X/cc
V_c = 16.36 l
M_c = 8.80 kg

18 12/11/47 Exp. 41b H/X = 43.87

8" Reactor Tamped with Cd Shield

Callihan
Cronin
Fox
Morfitt

Note: This reactor is now 36" long since there was doubt as to whether a longer cyl. might not be critical see Exp 41 p. 9 this book.

8:30 AM Counters were turned off on arrival

Background (no solution)	#1	#2
	10	10
	12.5	11

Estimated Heights (8" Cylinder)

#3	#4	#5	#6	#8	#9
7.8	11.6	11.9	11.1	10.9	Dead Vol.

Counts @ 0 cm.

#1 Erratic - 16, 16.5, 15, 12.5, 16. Use 16

#2 10, 10, 10 Use 10

Time	Solution Level	Counting Rate #1	Counting Rate #2	Recip. M.U. #1	Recip. M.U. #2	Comments.
10:54	Dead Vol.					#9 Empty
10:57	4.9	18	12.5	.890	.800	Filling from #8
11.08	~~12~~ 12.0	25	21.5	.640	.465	#8 Empty
		26.5	19.5	.615	.512	From #6
11:23	23.2	40.5	34.0	.395	.294	#6 Empty
11:32	27.5	49.5	41.0	.360	.244	From #5
11:42	34.6	61.0	53.0	.262	.189	#5 Empty
		60.0	53.0	—	—	
11:53	38.0	72.5	69.5	.222	.138	From 3
12:01	45.2	~~108.5~~ 127.0	108.5	.126	.092	3 empty @ 42.1, From 4
12:10	47.5	187	165.5	.097	.060	From 9
12:23	48.6	261	227	.061	~~.044~~	
12:35	49.0	318.5	280.	.050	.036	
12:40	49.5 -	Not Critical				
12:45	49.7	Not Critical				
12:50	49.9	Not Critical				
12:52	50.1	Critical with Tamper 1mm above soln. - Actually Slightly super crit.				

Drain Back

#4	#3	#5	#6	#8	#9
11.6	7.8	11.9	11.1	12.0	dead vol

Background #1 10.5
#2 11.0

Conclusion: Critical @ 50.0 ± 0.05 cm.

11/17/48 DC 50.0 + 1.5 = 51.5 cm Ht corrected for bottom
H/X = 43.87
8" Steel cyl. Tamped and Cd shielded

Exp. 50 a

8" Reactor Untamped with Cd. Shield H/X = 43.87

Callihan
Cronin
Morfitt

2:30PM	Background	#1	#2	
	dead Vol. filled	115.5	97.5	Use 98.0
		115.5	99.0	

Callihan
Cronin
Fox
Morfitt

Time	Soln Level	Counts #1	Counts #2	Recip. Mult. c/c #1	Recip. Mult. c/c #2	Comments
2:36	13.0	141.0	126.5	.820	.774	#8 Empty
2:45	23.7	216.0	194.5	.536	.504	#6 Empty

At this point in the experiment the ionization chamber was ≈ 18 on the "50" scale & the source was pulled to 15 cm. The chamber reading dropped to 9 at this point. The above count was then repeated: #1: 102 #2 - 88.5. Since the multiplication had already been determined at this point, corresponding "backgrounds" were calculated: #2: 44.6 #1: 55.7.

3:10	[From "5"]	32.5	S=15	213.0	192.5	.257	.232	Calculated from "new" bkgd.
			S=0	259.5	233.5	.445	.420	#5 Empty @ 35.0
3:27		40.2	S=0	279.5	250.0	.413	.392	From #3

The source was reset @ 0 cm & the experiment continued in the usual way. The above attempted method does not appear generally feasible.

3:32							#3 Empty @ 42.0
3:37		53.5		294.0	267.5	.393	.366	#4 Empty

The tamper which (Cd in bottom) was at 72 cm was lowered to 61.0 The count was repeated:

301.0 274.4

Tamper was then lowered into contact.

306.0 283.0

Drainback

#4	#3	#5	#6	#8	#9
11.5	7.0	11.2	11.5	not drained	not drained

Conclusions Not Critical @ Infinite Height

Exp 41b

what $\eta_{0X} = \frac{0.326}{0.256} = \frac{0.538}{0.422}$ gm/cc

$\rho_{eq} = 1.65$

→ $V_c = 16.70\ell$

$M_c = 8.98$ kg

12/11/47

Experiment 50 b

8" Reactor Untamped

$H/x = 43.87$

Callihan
Cronin
Fox
Moffitt

Time	Soln. Height	Counting Rate #1	Counting Rate #2	Recip. Mult #1	Recip. Mult #2	Comments
4:27	12.1	113.0	97.0	1.02	1.01	From #6
4:34	20.0	168.5	149.5	.686	.651	"
4:40	24.5	189.	173.	.610	.567	#6 Empty
4:47	30.2	214.	190.	.540	.516	#5 Empty @ 34.6
4:52	—	—	—	—	—	From #3
4:55	42.5	238	213	.485	.460	#3 Empty
5:05	53.3	248.5	223	.465	.439	#4 Empty.

#13 → 4" cyl.

#9	#8	#4	#5	#3	#6	#7	#1
7.5	7.5	10 cm.	6.5 cm.	5.0 cm	5.0	12 cm	dead vol.

Background Count. 109.0 89.0

Slightly Different. Does not change basic shape or position of curve.

Conclusions: In the untamped case without Cd shielding, the solution is "safe" than with shielding. Neither case was critical or would be predicted to be critical at infinite height. The relationships between the unshielded & Cd shielded untamped results were the expected one.

$H = 53.3 + 1.5 = 54.8$ cm
$H/x = 43.9$ $\sigma_{fg} = 1.65$
$Wt^m/x = 37.6 = 0.538$ gm/cc
$V = 17,817.77$ l. } Actual Mass.
$M = 9.56$ Kg.

{Estimated} $H_c = M_c = V_c = \infty$

Calc. Dilution to H/X approx 60 from H/X = 43.87

Cyl.	Ht.	Vol(calc)	Add DD water	
#1	dead vol	3,497.7	1,252.1 gms	(4" cylinder)
#3	5	1,285.0	461.3	
#4	10	2,570.	922.6	
#5	6.5	1,670.5	599.6	
#6	5.0	1,285.0	461.3	
#7	12.0	3,084.0	1107.3	(4" cylinder)
#8	7.5	1,927.5	691.97	
#9	7.5	1,927.5	691.97	
		32,567.9	9,555.9	total
		×1.667		
		54,2906.8 gms		

This quantity of water has not yet been added to these cylinders.

Wgt. Samples sent to laboratory for corrosion check are in material balance book

NH/NX from repeat samples: #1 Conc #35 = 3.7061 gm soln
1.5211 gm oxide

80.43
36.28
H/X = 44.15

34.73% U

#2 Conc # 24 2.6123 soln
1.0854 oxide

79.45
36.28
H/X = 43.17

35.16% U

#3 Conc #38 2.1184 soln
0.8897 oxide

78.60
36.28
H/X 42.42

35.54% U

Area 3" storage cylinder

12/15/47

Cyl. No.	Calc. Vol.	Sol. Ht.	gms. H_2O to add *	measured Sampled density after dilution
1	3502 cc	24.4	1183	1.501
3	1536	19.0	~~1169~~ 519 (1.51-)	[redacted] added
4	3032	37.5	1025	1.478
5	2182	27.0	738	1.490
6	1616	20.0	546	1.492
7	4347	30.3	1469	1.485
8	2579	31.9	872	1.484
9	2644	32.7	894	1.486

12-16-47

	ΔH	Sol. Ht. (1.987)		Ht in 8" Reactor
1 (4")	28.8	57.2 cm.	=	14.2
3	29.6	58.8 "	=	8.5 cm
4	41.2	81.8 "	=	11.8
5	30.8	61.2 "	=	8.9
6	24.4	48.5 "	=	7.0
7 (4")	36.4	72.4 "	=	18.0
8	47.4	~~[redacted]~~ 74.3	=	10.8
9	38.2	75.9	=	11.0

12/15 Replaces #2 - 3" with 4" storage cylinder -
Scrubbed pit.
Dilutes solution to H/E = 60.

* See pg 34 this book for information on resulting Concentration -

Experiment 51 — 8" Reactor.

Cd shielding plus H_2O tamping.

12/16/47

$H/X \doteq$ ~~60~~ 62.60

Williams
Crowe
Fry
Callihan.

Trip points - #3 - 89+10
#4 - 89+10

Scales : #3 - 100
4 - 10
5 - 1
R.E - 25 ms.

		I	II			
10:15	"Background"	11.5 10.5 11.0	10.5 10.0 10.0			Filling from #9
10:35	H= 0.7 cm	9.5 10.0 10.0	10.0 10.0 10.0		(M^{-1})	#9 empty
10:40				I	II	
1 43	H= 8.6 cm	17.0	15.5	0.59	0.645	Filling from #3. #3 Empty.
1 50	H=12.7 cm.	22.0	21.5	0.455	0.465	Filling from #1
	Blow-back to mix solution-					
11: 10	H= 17.7 cm	27.5	27.0	0.364	0.370	
15	=22.6	~~38.5~~	~~37.0~~			#1 Empty. Filling from #6.
20	=24.8	39.5	37.0	0.253	0.270	
26	=29.3	49.5	45.5	0.202	0.220	#6 Empty -
33	=38.3	83.0	75.5 ~~75.5~~	0.120	0.132	Filling from #5, #5 Empty.
43	=42.6	132.5	120.5	0.075	0.083	Filling from #8
52	=46.1	327.5	298.0	0.031	0.034	
12:14	=47.0	635.0	566	0.016	0.018	~~Counts out~~ - Filling from #4.
20	=47.0 (Counts out - tamper 8mm above liquid surface - critical) -					

Drain back	cm in 8" reactor
#4 To 45.4 cm	13.4
#8 To 42.6	2.8
#5 To 30.0	12.6
#6 To 19.4	10.6
#1 To 8.0	14.4
#3 To 0.0	5.0
#7	18.0

Conclusion: 8", H/X = 60, Cd + H_2O tamping - critical at 46.95 ± 0.05 cm. DC.

11/17/48 DC 46.95 + 1.45 = 48.4 cm - He corrected for bottom

H/X = ~~67.6~~ 62.7

8" Stainless steel and Cd shielded

ρ_{eff} = 1.50

wt% X = ~~0.264~~ 26.4 = 0.396 gm X/cc

V_c = 15.69 ℓ

M_c = 6.21 kg

12/16/47

Experiment 52

8" Reactor
H/X = 60 62.60
Untamped.

Cronin
Williams
Fox
Callihan

Scales: 3 - 100
4 - 10
5 - 1
R.E. - 25 mv.

		I	II	M⁻¹ I	M⁻¹ II	
1:42P	"Zero" count	105.5	94.5			
		105.0	92.5			
48						Filling from #7
58	H = 10.2 cm	100.5	89.5	1.05	1.04	
2:07	= 18.2	166.5	151.0	0.632	0.620	#7 Empty. Cd control rod in.
		169.5	152.0	0.620	0.616	" " " out
17	= 23.4	205.0	182.0	0.514	0.514	Filling from #3 ; #3 Empty.
26	= 30.1	234.5	211.0	0.445	0.443	Filling from #6 (#6 empty at 37.8)
37	= 40.0	255.6	235.5	0.412	0.397	Filling from # 4
46	= 46.0	270.0	243.5	0.390	0.384	Empty #4.
55	= 58.5	285.0	255.5	0.370	0.366	Filling from #5; #5 Empty
3:08	= 70.0	286.5	258.0	0.368	0.363	Filling from #1
:40	= ~0.5 cm	111.5	99.5			

Conclusions: 8" reactor, untamped, H/x = 65, apparently would not be critical at infinite length. DC.

Drain Back - data #1 - 12.9 cm in 8" reactor.
3 - 10.0 " " - "
4 - 10.0 " " " "
6 - 10.0 " " " "
7 - 20.0 " " " "
8 - ~~18.5~~ 13.3 " " " "

11/30/48 DC
H = 70.0 + 1.5 = 71.5 cm
H/x = 62.7, ρ_{eff} = 1.50
Wtd % x = ~~24.6~~ 26.4 ≡ 0.396 fuel/cc
V = 23.18 ℓ
M = 9.18 kg

Estimated - $V_c = H_c = M_c = \infty$

11/16/47 — Experiment 53 — 8" Reactor Tamper

Williams

Hx = ~~60~~ ~~62.6~~ 62.60

Cronin — Scales - 3 - 100

Fry — 4 - 10

Calibr — RE - 50 mv - unstable.

		5 - 1 I	II
4:06P	"Zero Count"	12.5	14.0
	H = -0.5cm	12.5	13.0 ~~13.5~~

				M^{-1} I	II	
4:11	Filling from #3.					
4:14	H = 5.0	19.0	18.0	0.658	0.751	
:26	= 10.5	34.5	33.0	0.363 ~~0.510~~	0.409	#3 Empty.
:33	= 13.3	48.5	46.5	0.258	0.291	Filling from #1
:40	= 16.0	71.5	68.0	0.175	0.199	
:48	= 18.0	112.0	106.0	0.112	0.129	
:55	= 19.7	182.0	174.0	0.069	0.078	
5:07	= 20.5	286.0	267.5	0.044	0.050	Filling from #4.

:13 = 21.7 (=21.5 with source out) - critical with Cd 10 cm control rod below liquid surface

:25 = 21.3 (source out) - slightly sub critical with Cd control rod completely out.

Conclusion: 8" reactor tamped, Hx = 60 - critical at 21.4 ± 0.05 cm - DC.

DRAIN BACK -

#1 - ~~23.4~~ ~~20.5~~ cm in 8" reactor = 18.5 - cm in 9" reactor.

#4 - 10.0 " " 8" " = 7.9 " "

6 - 10.0 " " 8" " = 7.9 " "

7 - 20.0 " " " " = 15.8 " "

8 - 13.3 " " " " = 10.5 " "

9 - Dead volume

11/17/48 21.4 + 1.45 = 22.9 cm - Hc Corrected for bottom.

Hx = ~~62.6~~ 62.7

8" Stainless Tamped.

$\rho_{pu} = 1.50$

Wt % = 26.4 ≡ 0.396 gx/cc

Vc = ~~9.40 L~~ 7.42 L

Mc = ~~5.96 kg~~ 2.94 kg

Exp 54. 9" Cylinder, Cadmium Tamped. $M/x \equiv 60.6, 7.6.0$ Dec. 17.

Beck
Monjitte
Fox
Cronin

#3 Chamber trips at 91, #4 at 95 on 100 scale

#4 on 10, #3 on 100, #5 on 2. Rad & Proc Monitor. OK.

	Solution	Counters #1	Counters #2	C/c #1	C/c #2	
10:00 Am.	"Background"	14	14			
	"	14	14			
10:12.	1.3 cm	13.5	12.5			
		12.	12.			
10:19	10.0	22	22.5	.568	.868	From # 8
						# 8 empty at 11:5.
	19.0	52	52.5	.24	.24	#6 empty.
10:26	23.0	88.5	93.2	.14	.135	
10:43	26.0	213	210.	.058	.054	
10:47	26.5	275	275	.045	.045	
10:52	27.1	461	459.	.027	.027	not critical with source in
10.59.	27.15	Critical with source out (level drops ~2 mm when source is pulled).				

Conclusion: Critical at 27.15 with source out (level drops two mm when source pulled).

To 19 16 35 44 44 8 36 10 1

Drain Back.

#1	4	6	7	8	9
18.5	25	9.5	15.4	9.8	Lead Vol

11/7/48 DC 27.15 + 1.15 = 28.3 cm = Hc corrected for bottom.

M_x = ~~60.6~~ 62.7

9" Stainless, Tamped + Cd shielded.

$\rho_{pp} = 1.50$

$\rho_{UO_2F_2} = 26.4 \equiv 0.396$ gm/cc

$V_c = 11.64$ l

$M_c = 4.61$ Kg.

Exp. ~~54~~ 55. 9" Unstamped. H/x = ~~60~~ 62.60 Dec ~~18~~ 17

Everything same as for previous experiment.

~~So~~	Solution Level	#1	#2	Co/C.	
11:30.	0.4 mm.	102.5	95.5	#1	#2
		102.5	93.0.		
11:50	15.9.	212.	207.5	.475	.455
11:58	24.5	374	354	.27	.265
12:06	33.1	571.	542	.178	.174
12:.	40.0	839	810	.12	.115
12.25	44.1	1136.	1096	.089	.086.

#1	#4	#6	#7	#8
16	7.5	10	16	10.

Conclusion: Does not go at 44 cm height, but probably would go at 55 cm or so.

H = 44.1 + 1.2 = 45.3 cm
H/x = 62.7 (see preceding page)
V = 18.59 R
m = 7.36 kg.

Estimated
$H_c > 55$ cm
$V_c > 22.6$ L
$M_c > 8.9$ kg.

Exp. 56 – 9" Tamped – H/x ~ 60.6 ~ 60   Dec 17.

Beck Merfitt Cronin Fox.

Same as in prev. experiment.
Instruments all prepared satisfactorily.

	Solution Level	Counting #1	Counting #2	C_o/C #1	C_o/C #2
1:45	Zero.	15	15		
	12.0	64.5	68.5	.23	.22
2:01	14.1	107	113	.14	.132
2:09	15.0	163.	167.5	.092	.09
2:15	16.0	303	312.	.05	.048
2:25	16.4	505	511	.0292	.0295
2:30	16.7	~~940~~ 928	940	.0162	.016
	16.8	Critical – some above.			

Conclusion: Critical at 16.75 ± .05

11/17/48 xc 16.75 + 1.15 = 17.9 cm. = Hc corrected for bottom
H/x = ~~60.6~~ 62.7
9' Stainless Tamped.
ρ gm = 6.50
wt U/x = 26.4 = 0.396 gm/cc
$V_c = 7.39 l$
$M_c = 2.93$ kg.

Drain Back.

	#1	#4	#6	#7	#8	#9
9" cyl.	16	25	10.	16	10.	Dead Vol. for 9"
10" cyl	13	6.1	8.1	13,	8.1	"

Exp 57. # 10" (483 508) - Cadmium Tamped. H/X 2-60 (6v.60) — Dec 17.

Beck
Moffitt
Jay
Cronin

Same as in prev. Exp.
Instruments all respond satisfactorily

		Counting Rate			
	Solution Level	#1	#2	C_o/C.	
3:36	0.3.	12.5	14	#1	#2.
		12.5	13.		
3:50	15.0	51.5	53.5	0.24	0.25
	18.2.	101.	105.5	0.124	0.128
	20.1	250	244.	0.050	0.55
		240	247.		
4:12	20.6	347	347	.036	.039
	21.0	644	647	.019	.019
	21.05	Critical			

Conclusion: Critical at 21.05.

Drain back.

#1	#4	#6	#7	#8	#9
13	6.1	7.1	14	8.1	Dead Volume.

12/17/48 ~~21.05 + 0.93 = 21.98 cm - Hc~~ 21.05 + 0.93 = 22.0 cm - Hc Corrected for bottom.
H/x = ~~62.6~~ 62.7
10" Stainless, Tamped and Cd shielded.
Sp gr 1.50
Wt % x = 26.4% or 0.396 g/cc.
Vc = ~~7.39 L~~ ~~11.65 L~~ 11.15 L
Mc = ~~2.93 kg.~~ ~~4.61 Kg.~~ 4.42 kg.

Dec 18

Exp 58 H/X ~ 60 10" Reactor Untamped

Murray
Morfitt
Fox
Cronin

9:30 Equipment checked and starting
Film badges + dosimeters issued personnel checked.

9:32 Instruments: #3 #4 #5 Proton Recd

	#3	#4	#5	Proton	Recd
Scale	100	10	2	—	50
Trip Point	94	94	—	—	—

Solution

Cylinders:	#1	#4	#6	#7	#8	#9
Ht. in 10" Reactor	13 cm	6.1	7.1	14	8.1	dead Vol.

In previous exp. (H/X = 44) Untamped = 31.4 cm
Steel Cd — Tamped = 20.5 cm
Tamped = 13.95 cm
(H/X ~ 60) Cd Tamped = 21.05 cm
Estimate of critical Ht = approx 32 cm.

	Cyl	Ht.	Counters #1	#2	C_0/C_1	C_0/C_2	
9:53	#9						
10:00	#9	0.9	82	94			Cyl empty
			81	92.5			
10:08	#8	8.3					cyl empty
10.11	#6	11.1	160	173.5	.509	536	Cd Rod in.
C			163.5	170.5	.498	.542	Cd Rod out
10:21	#6	15.8	271.5	290	.300	.320	cyl. empty
10:29	#4	22.1	534	571	.153	.163	cyl empty Cd Rod out.
10:39	#1	26.0	920	1030	.0886	.092	
~~10:50~~	~~#1~~						← Source pulled not a maximum it almost 12 cm up.
10:50	#1	27.0	—	—	—	—	Source out to 20 cm with Cd Rod out
10:55	#1	28.0					Source at 23 cm Cd Rod still out.
11:00	#1	28.6	—	—	—	—	Source at 25 cm Cd Rod out
11:08	#1	29.1	—	—	—	—	" "26" " " "
11:13	#1	29.6	—	—	—	—	" "30" " " "
11:16	#1	30.1	—	—	—	—	" 38 " " " "
11:21		30.4					" "40" " " "
11:26		30.9					supercritical
		30.7					sub critical

Source as fast as possible Rod at 19 cm
Source at 60 Rod out

Drain back to give

#1	#4	#6	#7	#8	#9
13 cm	7.4	6.2	14	8.3	dead vol.

Conclusion. Exp 58. at H/x = 60, 10" reactor untamped goes critical at 30.8 ± 0.1 cm. On untamped experiments the ionization chambers should be quite far from the reactor, to allow multiplication measurements closer to criticality. Had to stop, today, almost 5 cm from critical height.

pm

Note: Interchanged counters to try to find some temporary trouble. Cleared up of own accord, but left them reversed.

11/17/48 pm 30.8 + 0.9 = 31.7 = Hc corrected for bottom -
H/x = ~~60.0~~ 62.7
10" stainless, untamped.
Ap gr = 1.50
Wtr % X = 26.4 = 0.396 gms/cc
Vc = 16.05 ℓ
Mc = 6.36 Kg.

Exp 59 12/18/47

10" Reactor Tamped H/X ~ ~~60~~ 62.60

Murray
Morfitt
Fox
Cronin

1:16 Dead Volume full – tamper filled

	#1	#2
Background	16.0	16.0
	16	15.25
	15.25	16 3/4

Time	Cyl.	Ht.	#1	#2	C_0/C_1	C_0/C_2	Remarks
1:25	#8	7.0cm	32.5	32.0	.493	.500	
1:37	#8	8.8	43	50.5	.369	.314	cyl empty
			48.5		.327		
1:48	#1	11.0	83.0	89.0	.193	.180	Readings taken with source in solution.
2:00		13.0	195.5	202.5	.081	.0791	
		13.5	307	335.5	.052	.0478	
2:20		14.0	461	476	.031	.030	
2:30		14.2	1018	1083	.0141	.0133	CRITICAL
		14.3	—	—	—	—	Cd in source out. Tamper down

Conclusion:
10" reactor tamped H/X ~60 critical at 14.25 cm ± .05 cm. Very important: Cd rod not worth much. Should not add more solution than Cd rod is worth when approaching critical. — [initials]

Drainback:
giving

#1	#4	#6	#7	#8	#9
13	7.4	6.2	14	8.3	dead vol = 10"
30.	17.5	14.5	3.3	19.5	

11/17/48 JC 14.25 + 0.93 = 15.2 cm Ht Corrected for bottom –
H/X = ~~67.6~~ 62.7 — V_c = 7.70 l
10" Stainless tamped. — M_c = 3.05 Kg.
ρ_{pq} = 1.50
wt % X = 26.4; ≡ 0.396 gm/cc

Exp 60 – 6½ Tamped – H/x ~~60~~ 62.60 12/18/47

Beck
Mecklin
McLendon
Cronin

8:20 Checking safety devices. Dump mechanism, trip points, instrument response.
#3 trips at 90. #4 on 94.
#5, #1, #2, reed. & proc. monitors responded satisfactorily.

		Counting Rate		C_o/C		
	Solution Level	#1	#2	#1	#2	
	Background:	12	15.5			
		13	13.5			
9:06	zero .0.4	12.0	13.0			
						# 8 empty at 21.5.
9:12	34.8	72.0.	78.5	.167	.166	# 6 empty at 34.8.
9:17	40.1	110.	123.	.11	.105	
9:24	43.5	184.	204.	.065	.063	
9:30	45.7	317	358.	.038	.036	with source ~~in~~
9:35	45.0	not critical				with source out (45.4 source in).
	45.2	not critical				
	45.4	not critical				
	45.6	not critical				
9:52	45.7	Critical				

Conclusion: Critical at 45.7 ± 0.1 cm

Drain Rods:

#1	#4	#6	#7	#8	#9
30	17.5	15	33	20	Dead Vol.

11/17/48 DC 45.7 + 2.2 = 47.9 cm Hc - corrected for bottom -
H/x = ~~62.6~~ 62.7
6½" Stainless Tamped.
$\rho_{pq} = 1.50$
wt% x = ~~0.396~~ 26.4 ≡ 0.396 gm/cc
$V_c = 10.25\ell$
$M_c = 4.06$ kg.

12/22/47

Project — dilution to $H/x \cong 80^{+}$

* Samples taken from #9 for H/x measurement and density measured 1.501 @ 24°C. (1.507 @ 14°C.) from Cronin's H/x vs d chart H/x estimated @ 56 for dilution purposes. $\Delta = 0.3940$ V calculated by formula

Tank #	dia"	H_2	H_1	ΔH	V	Δ (H_2O to add)
1	4	70.0	32.5	37.5	~~5921~~ ~~3747~~	
2	4	51.5	49.3	2.2	~~200~~ 347	
3	3	~~51.2~~ 51.3	49.4	1.9	172	
4	3	71.6	30.9	40.7	3691	
5	3	51.8	48.7	~~2.7~~ 3.1	281	
6	3	69.5	32.8	36.7	3329	
7	4	73.5	29.3	44.2	~~4009~~ 6979	
~~8~~	~~3~~	~~73.6~~	~~29.3~~	~~44.3~~		
8	3	73.6	29.3	44.3	4018	
9	3	69.2	33.4	35.8	3247	

run density check!

ttl 27,985

Capacities 4" 7349 crit value $\frac{7349}{1.3940} = 5272$

3" 4223 $\frac{4223}{1.3940} = 3029$

∴ #'s 1, 4, 6, 7, 8, 9 all too full to dilute

$30/1.394 = 21.5$ liters max needed (8" cyl) soln for next run

Decision to leave #8 at present dilution & dilute the rest. (pull each cyl to dilute below $\Delta H = 33.4$ on manometer)

* 11/19/48 From Cronin notes

Dish L-3 Gross 7.0753 gm
Tare 6.4783
0.4970 gm
Net 0.5970 gm oxide
from 1.7890 gm sol — Appx. 1.501

Dish 40 Gross 9.8492 gm
Tare 8.7832
1.0660 gm oxide
from 3.1914 gm sol.

≡ 67 H/x average

Area 4" Cylinder = 80.4 cm² 80.✓
Area 3" Cylinder = 46.7 cm² 46.8

after adjusting heights in cylinders

		H_2	H_1	ΔH	Volume cc	H_2 to added cc
1	4	~~64.1~~ 68.9	~~38.0~~ 39.5	~~26.1~~ 29.4	4640	1828
2	4	68.6	39.8	28.8	4548	1792 ✓
3	3	69.0	39.5	29.5	2678	1034
4	3	66.1	36.3	29.8	2700	1064
5	3	emptied ~(1.2)				
6	5	64.5	37.9	26.6	2411	951
7	4	66.1	36.2	29.9	4720	1860
9	3	~~65.9~~	36.2	29.7	2693	1061
						9.610 ℓ

added water as per above schedule ↑ rough measuring after mixing

#	1	2	3	4	5	6	7	8	9
d	1.35	1.34	1.35	1.35	(empty)	1.35	1.35	($H/x \cong 60$)	1.35

Heights after dilution (manometric)

NB 11/30/28 See pg 46 this book for data on concentration —

#cyl.	dia	H_2	H_1	ΔH	Height in Storage Cylinder	6½" Equiv..
1	4	71.5	37.4	34.1	74.8	28.35
2	4	74.0	35.1	38.9	85.3	32.30
3	3	73.4	35.8	37.6	82.5	17.60
4	3	73.0	36.1	36.9	80.9	17.25 ×
6	3	72.8	36.3	36.5	80.1	17.1 ×
7	4	73.5	35.7	37.8	82.9	31.40
9	3	73.6	35.6	38.0	83.4	17.4 ×

 12/23/47

Experiment 61 — 6½" Reactor.

Tamped. H/X ≅ 86.~~30~~

Cronin
Fox
Williams
Callihan

Trip points #3 89 ×100
#4 89 ×100

Scale #3 – 100
#4 – 10
#5 – 2
R.E – 25 ms.

		I	II		M^{-1} I	M^{-1} II
	"Background Count"	11.5	10.5			
		11.5	10.5			
9:45 AM				Filling from #6.		
9:50	H = 0.0 cm	11.5	10.0	#6 Empty.		
10:02	H = 10.0	20.7	17.0	Filling from #9	0.556	0.588
10:07	= 19.6	31.5	27.0 26.5	#9 Empty.	0.365	0.378
10:20	= 27.7	41.5	38.0	Filling from #4	0.277	0.263
10:30	= ~~36.0~~ 36.0	56.0	50.5	#4 Empty.	0.205	0.198
40	= 45.3	98.5	92.0	Filling from #3	0.117	0.109
55	= 53.7			Filling from #2		

Z (= 53.4 source out) Critical with 21 cm control rod in tamper.
= 53.2 (source out) Critical with " " "
= 52.0 (" ") Critical " 11 cm " " "
= 51.2 Sub critical.
= 51.4 " "
= 51.7 (source out) Slightly super critical

12:05 P	= 49.1 (Source in)	160.5	150.0	0.072	0.067

Since solution in #2 was slightly less dense than other used, we blew through sight glass.

= 49.4 161.0 151.5 Indicates slight inhomogeniety so above height at criticality may be low.

12:35 = 0 11.5 10.5 –

DRAW BACK.			
# 1	loss 28.3 cm in 6.5" reactor	= 33.2 cm in 6" reactor.
# 2	28.9 " " "	= 33.9 " " "
# 3	13.4 " " "	= 15.7 " " "
# 4	17.4 " " "	= 20.4 " " "
6	18.0 " " "	= 21.1 " " "
7	31.4 " " "	= 36.8 " " "
9	Dead volume.	

Conclusions ① 6½", H/X ≅ 80 – Tamped Critical at Solution Height = ~~51.7±0.0~~ 51.6 ± 0.1 cm –
② The multiplication Curve dropped off very rapidly near critical; DC 1/4/23
~~[illegible] 51.6 [illegible]~~

11/17/48 DC 51.6 + 2.2 = 53.8 cm = Hc bottom corrected
11/22/48 DC H/X = ~~86.3~~ 86.4
6½" Stainless, tamped.
Sp gr = 1.35
wt % = 21.3 ≅ 0.288 gm/cc.

Vc = 11.51 l.
Mc = 3.31 kg.

12/23/47

For Cronin Calliha

Experiment 62 — 6" Reactor
Tamped
H/X = 86.3

Trip points #3 89X100 #4 89X100

Scales #3 – 100 #4 – 10 #5 – 2

RE = 25 mv

Time	Soln.	Background Count I	II	I c/c	II c/c	Cyl.
15:12	0	12.0	12.5			#9
15:15	dead vol. 1.6 cm	13.5	11.0			#9 empty
		13.5	12.0			
15.32	5.1	16	13.5	.844	.890	#2
15 55	~~15.5~~ 15.3	23.0	19.	.588	.632	
16:07	26.3	29.0	25.0	.466	.481	
16:16	38.1	32.0	30	.427	.417	#7 empty
16:25	50.2	35	32	.386	.391	#1
16:36	~~65.4~~ 65.4	38.0	34.5	356	.363	
16:46	70.3	37.0	33.5	.365	.373	
		36.5				

Drain back:

#1	has	35.4 cm in 6" Reactor	= 26 in 7" reactor.
#2	"	34.8 " " "	25.5
#3		15.7	11.5
4		20.4	15.
6		21.1	15.5
7		36.8	27.0
9		Dead Volume.	Dead Volume

	Rechecks of background	I	II
17:04	geo level	14.0	10.5

Conclusion: 6" Reactor, H/X = 80, Tamped. Not critical at 70.3 cm + probably would not be ∞ at infinite length – DC.

11/30/48 DC

H/X = 86.4 – see preceding page

H = 70.3 + 2.6 = 72.9 cm

V = 13.30 ℓ

M = ± 3.83 ℓ.

Estimated: Hc = Vc = Mc = ∞

38

12/24/43. Experiment 63. 7" Cadmium - Tamped.

$H_X = 86.3$

Beck
Viemer
Fox
McClendon

8:30 Aligning cylinder, checking instruments.

Trip points #3 - 88 #4 - 92

#4 on 50 scale #3 on 100, #5 on 2, Reel & Proc. Monitor OK.

	Solution Level	#1	#2			
10:30	Background	14.5	12.5			
		15.0	13.5			
		14.5	12.5			
	Zero: 0.9	13.0	10.5			
		13.0	10.5			
10:52	26.3	25.0	22	.52, .46	#7 Empty.	
11:06	42.0	27.0	24.5	.48	.43	#4 empty ↗ =
11:13	56.3	26.5	25.5	.49	.41	#6 empty.
11:25	70.0	26.0	24.5			

Drain back:

#1	26
2	25
3	15.5
4	15
6	15
7	27
9	dead Vol.

Conclusion: Does not go. Curve is flat beyond 25 cm.

$H = 70.0 + 1.9 = 71.9$ cm

$H_X = 86.4$ (see next page)

$V = 17.85$ L

$M = 5.14$ Kg

Estimated - $H_e = V_c = M_c = \infty$

Experiment 64. 7" Tamped. H/x = 86.3 12/24/47.

11:30 removing cadmium, readjusting for Tamped experiment. Back stud

12:30 Instrument Check — all OK.

	Solution	Counting rate #1	#2		
12:44	zero: 0.0.	14.	12.0.	13.5.	
		13.	12.5	12.	
12:56.	25.1	68.5	61.5	.197 ~~from~~ 19.5	From # 2.
12:59	27.5	84.6	78.5	.16	.153
1:07	30.0	(94.5)	105.	(.143)	.114 error in counting
		113	105	.100	.114
1:16	32.5	210.	200	.064	.06
1:27	34.0	460.	427	.029	.028
1:37	34.4	Well above critical.			

Drain Backs

#1	26	for 7" reactor. =	20 for 8" reactor.
2	25		19
3	11.5		8.8
4	15.		11.5
6	15		11.5
7	27		20.5
9	Dead Vol		

Conclusion — Critical at 34.1 ± 0.1

11/11/47 — 34.1 + 1.9 = 36.0cm He bottom corrected

11/x/47sc H/x = ~~86.3~~ 86.4

7" Stainless Tamped.

$\rho_{pq} = 1.35$

Wet $\eta_x = 21.3 = 0.288$ gm/cc.

$V_c = 8.94$ ℓ.

$M_c = 2.57$ kg.

Experiment 65. 8" Cadmium-Tamped. H/x = ~~80.~~ 86.3

Beck
Vonier
Dow
McLendon

200 – Removing 7" cylinder; installing 8" – aligning, etc.

Instrument check
4 trips at 94; # 3 at 90.

	Solution Level	Counting rate, C. #1	#2	Co/C #1	#2
3:05	Zero. 0.7 Co.	9.0	9.0.		
		8.5	9.0.		
3:22	32.4	37.5	35.5	0.24	.252
3:31	43.1	58	54.5	.155	.165
3:38	49.6	90.0	87.5	.103	.10
3:45.	53.1	159.	153.	.056	.059
3:51.	54.0	223	216.	.040	.041
	54.5	not Critical			
	54.6	not Critical			
	55.0	Critical			

Dreambacks #1 20 8" reactor.
2 12.4
3 10.5
4 11.5
6 11.5
7 20.5
9 Dead Vol.

Conclusion 55.0 ± .1 Critical

11/7/48 DC 55.0 + 1.45 = 56.5 cm - Hc bottom corrected
11/10/48 JC H/x = ~~86.3~~ 86.4

8" Stainless. Tamped + cd shielded
ρ_{opt} = 1.35
with H_{opt} = 21.3 = 0.248 gm/cc.
V_c = 18.32 ℓ
M_c = 5.28 kg.

J. C. Chadwick

12/29/47 Experiment 66 - 8" Tamped; H/X = ~~80~~ 86.3

Mauclin
Fox
Vinner
Callihan -

Trip points #3 90 x 100
#4 92 + 100

Scales #3 - 100
4 - 10
5 - 2
RE - 25 mv

#I Pulse recorder n.g.

11:10 A Filling dead volume for #9.

Time	H	I	II	M^{-1} I	M^{-1} II	
11:20	H = 0.9 cm.	~~12.0~~ ~~11.5~~ ~~12.0~~ (14.0)	12.2 11.5 12.0 11.8			#9 Empty -
11:27	H = 5.2	19.5 ~~16.5~~	16.5	0.72 ~~19.5~~	0.72	Filling from #7.
		18.0	15.0			
40	H = 10.0	28.5	24.0	0.481	0.492	
52	H = 15.0	46.0	41.5	0.305	0.285	
12:02 P	=17.9 ~~18.0~~	72.5	63.5	0.193	0.186	Filling from #1
15	= 20.5	135.0	122.5	0.104	0.096	
25	= 21.9	314.5	286.0	0.045	0.041	
33	=22.3 ~~22.4~~	504.0	459.5	0.028	0.026	
45	.	509.0	464.0	0.028	0.025	

50 = 22.5 Critical with 15 cm Cd below level of solution. (Source out).

1:00 22.7 Source in ~~22.3~~ 148.5 132.5 0.094 0.089 Top tamper raised 25 cm above sol. level.

Conclusion - ① 8" reactor tamped, H/X = 80 Critical with 22.3 ± 0.1 cm solution -
② Top tamper, at criticality ≅ 2 cm solution.
③ Cause of droop in curve (M^{-1} vs H) does not seem to be due to lack of delayed-neutron stability.

Drain Box - 1 20 cm in 8" reactor.
2 12.4 cm
3 10.5 cm
4 11.5 cm
6 11.5 cm
7 20.5 cm
9 —

11/17/48 JC 22.3 + 1.5 = 23.8 cm Ht bottom corrected
H/X = ~~86.3~~ 86.4
8" Stainless, Tamped.
sp gr = 1.35
wt % X = 21.3 = 0.288 gm/cc
V_c = 7.72 l.
M_c = 2.22 Kg.

Experiment #67

12/29/47 — 8" Reactor, Unstamped, H/x ≈ ~~80~~ 86.3

For Macklin, Vitner, Cacthen

Scales - 3 - 100
4 - 10
5 - 2
RE - 50

		I	II		M→ I	M→ II
2:10P	H = ~~0.3 cm~~ ~~0 cm~~	~~23.5~~	~~23.0~~			
		~~22.0~~	~~23.0~~			
		86.5	79.5			
		86.0	76.5			
2:25		86.3	78.0	Filling from #3.		
31	H = 11.9 cm	113.0	100.5	#3 Empty.	0.764	0.776
145	H = 23.2	163.0	152.0	Filling from #4; #4 Empty.	0.530	0.513
3:00	= 34.8	194.0	181.0	Filling from #6; #6 Empty.	0.444	0.431
17	= 53.9	213.5	193.5	Filling from #2; #2 Empty.	0.404	0.403
36	= 69.5	214.5	201.5	Filling from #1;	0.402	0.388
50	= 79.7	218.5	198.0	Filling from #7	0.395	0.396

Conclusion - 8", Unstamped, H/x = 80 — Not critical at ∞ length — ∞ —

Drain Back -

+ 1	H/x = 80	16.4 cm in 8" reactor	=	13 cm in 9" reactor
2	" "	~~23.0~~ cm in 8" reactor		18.2 " " "
3	" "	13.7 " " " "		10.8 " " "
4	" "	11.2 " " " "		8.8 " " "
5	H/x = 60	" Empty		—
6	H/x = 80	10 cm " 8" reactor.		7.9 " " "
7	H/x = 80	20.3 cm in 8" reactor		16 " " "
8	H/x = 60	Ca 4 l.		—
9	Dead volume -			

H = 79.7 + 1.5 = 81.2 cm
H/x = 86.4 (see following pag.)
V = 26.33 l
M = 7.58 Kg.

Extrapolated $H_c = V_c = M_c = \infty$

Experiment 68 — H/X = ~~80~~ 86.3

9" Reactor Tamped with Cd. Shielding

12/30/47

Callihan
Fox
Williams
Cronin

TRIP Points - #3 89 x 10
#4 94 x 10

Scales 3 - 100
4 - 10
5 - 2
RE - 25 mv

8:30 Changed Reactor - Installed 9" Cd shielded cylinder

Time	Sol'n Hts.	Counter #1	Counter #2	c/c #1	c/c #2	Cyl.
12:45P	Background	12.5	11.0			Filling dead vol. from #9 -
12:55P	H = 0.6 cm -	10.0	9.5	Calculated with		#9 Empty
		9.5	10.0	C_o = Background		
	"Zero"	9.2 ?	9.2 ?			Filling from #3
1:05	H = 5.1 cm	12.0	10.0	~~0.816~~ 0.625	~~0.980~~	
17	= 11.2	20.0	17.0	~~0.490~~	~~0.574~~	#3 EMPTY.
30	= 17.7	35.0	30.0	0.357	0.367	Filling from #2
37	= 22.6	62.5	54.0	0.200	0.202	
52	= 25.1	93.5	87.5	0.134	0.126	E (#2 low 4 cm left).
2:03	= 27.1	183.0	169.0	0.064	0.065	Filling from #1 .
18	= 28.0	335.0	309.5	0.037	0.036	
25	= 28.1 (Source out) ~~sub~~ super critical (crit. with tamper up 5 mm).					
	= 27.9 " " sub critical - (Source volume = 0.15 cm in 9" reactor).					

Drain back

#1	15.6 cm (H/X=80)	in 9" reactor.
#2	18 cm	" " "
#3	10 cm	" " "
X #4	8.8	" " "
5	Empty (H/X=60)	
6	7.9 cm H/X = 80	" " "
7	16 cm	" " "
8	(45 H/X = 60)	
9	-	

Conclusion: 9" Reactor - Water tamped plus Cd shielding - Critical at H = 28.0 ± 0.05 cm with source out.

11/17/48 DC 28.0 + 1.2 = 29.2 cm Ht bottom corrected

11/26/48 DC H/X = ~~80~~ 86.4

9" Stainless, tamped with Cd shielding
ap ρ_f = 1.35
Wet % X = 21.3 = 0.288 gm f/cc.

V_c = 11.98 ℓ

M_c = 3.45 kg.

44 12/30/47

Fox

EXPERIMENT 69

9" REACTOR, H/X = ~~80~~ 86.3, TAMPED.

WILLIAMS
CRONIN
CALLIHAN

TRIP POINTS UNCHANGED.

#3 - 10
#4 - 10
#5 - 2
RE - 25 mv

		I	II	M^{-1} I	M^{-1} II	
3:20P	H = 1.5 cm	12.5	11.5			
		12.5	11.0			
		12.5	11.3			
35	= 5.1	17.0	15.0	0.736	0.733	Filling from #7
45	= 10.0	32.5	30.0	0.385	0.367	
55	= 13.1	57.0	53.5	0.219	0.206	(3 cm left in #7)
4:07	= 15.6	121.5	109.5	0.103	0.103	Filling from #3.
:20	= 17.0	293.5 ~~293~~	265.0	0.043	0.042	

33 = 17.5 (with source) slightly subcritical. (= 17.4 cm source out).

= 17.6 (source out) Critical with 6 cm Cd control rod below solution.

Determined - Same as previous Exp: 1743.

Conclusion - 9" Reactor - Hx = 80, Tamped - Critical at H = 17.5 ± 0.05 cm with source out of the solution.

11/17/48 DE 17.5 + 1.2 = 18.7 cm = He bottom corrected
~~11/18/48 DE~~ Hx = ~~86.3~~ 86.4
9" Stainless, Tamped.
opg = 1.35
wt % X = 213 = 0.288 gx/cc.
V_c = 7.67 ℓ.
M_c = 2.21 kg.

1/30/47

Experiment 70-

9" Reactor, H/x ≥ ~~80~~ 86.3, Untamped-

For Cronin Williams Callihan

Trap points unchanged

Scales #3 - 100
4 - 10
5 - 1
R.E. - 25 mv

		I	II	N^{-1} I	N^{-1} II	
5:15P	H = 0.1 cm	88.0	82.5 cm			
		87.5	83.5			
		87.8	82.5			
						Filling from #3.
5:25	H = 10.1	110.5	101.5	0.794	0.813	#3 Empty; Filling from #7
40	= 19.9	238.5	217.0	0.368	0.380	
50	= 26.0	332.0	307.5	0.264	0.268	#7 Empty; Filling from #4
6:00	= 35.2	511.0	477.5	0.172	0.173	#4 Empty; Filling from #2.
:15	= 45.1	900.0	857.5	0.098	0.096	
35	= -0.2 cm	90.0	84.5			

DRAIN RODS:

#1 H/x = 80 15.6 cm in 9" reactor = 12.6 cm in 10" Reactor.
#2 " 18 " " " " = 14.5 " " " "
3 " 10 " " " " = 8.1 " " " "
4 " 10 " " " " = 8.1 " " " "
5 H/x = 60 "Empty"
6 H/x = 80 7.9 cm in 9" reactor = 6.4 " " " "
7 " 15.0 " " " " = 12.1 " " " "
8 H/x = 60 ca 4 ℓ.
9 H/x = 80 Dead volume

Conclusion - 9" Reactor - H/x ≥ 80, Untamped - filled to H = 45 cm - was not critical - but probably would be critical at a finite length - (ca 75 cm). at 45 cm M = 10 - [illegible]

H = 45.1 + 1.2 = 46.3 cm
H/x = 86.4 cm (see preceding page).
V = 19.00 ℓ
M = 5.47 kg

Estimated Hc ≥ 60 cm
Vc ≥ 24.6 ℓ.
Mc ≥ 7.1 kg

Experiment #71 10" Cadmium - Tamped H/x = ~~88~~ 86.3

12/31/47.

Back

For

Crowe

McFarlane

until 2:00 used in installing and adjusting 10" cylinder — and in repairing #1 Counter.

Inj pts. #3 91
#4. 88

Instruments O.K.

11/19/48 Notes from Crowe re H/x.

Dish 41 Gross 9.5614 gm
Tare 8.8251
Net 0.7363 gm oxide

Dish L-1 Gross 7.2442 gm oxide
Tare 6.8455
0.3987 gm

from sample Gross 102.975 g
Tare 100.2401
Net. 2.7351 gm

from Sample Gross 100.2405 g
Tare 98.7603
1.4802 gm

This gives H/x = 86.4 ave

	Solution Level	#1	#2		
1:59.	Background	13.	12.5		
	~~Zero~~	12.5	13.0		
	Zero.	11.5	12.0		
		11.5	12.0		
	14.6	38.5	41	.3	.29
2:28	19.8	143.5	151	.08	.08
	20.4	226.5	236	.051	.051
2:45	20.8	289.5	301.	.04	.04
3:12	21.1	440	458	.026	Source in
	21.1	Critical.			Source out

Happy New Year

Conclusion: Critical at 21.05 ± .05

CHC

Drumbeck - Same as Exp 70.

11/17/48 RC 21.05 + 0.93 = 21.98 cm He bottom correction
H/x = ~~86.3~~ 86.4
10" Steam heat, Tamped and Cd shielded.
$\rho_{gr} = 1.35$
with $\%x = 21.3 \equiv 0.288$ gm/cc.
$V_c = 11.15$ l.
$M_c = 3.21$ Kg

CHC

Experiment #72 — 10" Reactor, Tamped. — 1/14/48

Hfx = 86.3

Marcklin
Cronin
Manf. H
Calibration

Trip points: #3 - 86 #4 - 94 ×100

Scale #3 - 100
#4 - 10
#5 - 2
RE. - 25 mv.

		I	II			
		14.5	14.0			
10:50	H = 0.2 cm	13.5	13.5	#9 Empty.		
		13.5	13.5		M^{-1}	
		13.5	13.5	I	II	
11:07	H = 5.0	21.0	20.5	0.643	0.659	Falling from #7
20	= 10.1	48.0	50.0	0.281	0.270	(2 cm left in #7).
26	= 12.5	100.0	104.5	0.135	0.129	Falling from #2
34	= 13.8	237.5	236.0	0.057	0.057	
40	= 14.3	442.0	460.0	0.031	0.029	
55	= 14.5 cm (rods out) Critical with CS control rod just above solution level.					

DRAIN BACK — Same as #70.

Conclusion 10" Reactor - Hfx = 80, Tamped CRITICAL at H = 14.5 ± 0.05 cm dc.

11/17/48 dc 14.5 + 0.9 = 15.4 cm = Hc bottom corrected.

11/16/48 dc. Hfx = ~~86.3~~ 86.4
10" Stainless Tamped.
ρ_{Pu} = 1.35
wet % X = 21.3 ≡ 0.288 gm x/cc
Vc = 7.80 ℓ.
Mc = 2.25 kg.

48
11/2/48

Experiment #73.

Cronin — 10" Reactor. H/X = 86.3 Untamped.

Mackin
Morfitt
Callihan

Trip points - Same as before

Scales 3 - 100
4 - 10
5 - 2
RC - 25 m

		I	II			
~~12:28P~~	~~H = 0.2 cm~~	77.5	83.0			
		77.0	86.5			
12:30P	H = 0.2 cm	80.5	81.0			
		~~80.0~~ 80.5				
		~~80.0~~	81.0			
		80.5	81.0			
45	H = 7 cm			I	II	Filling from #7 - to 7 cm
47	H = 12.2	151.5	155.0	0.531	0.522	~~Stop~~ Filling from #1 to 15. cm
52	= 15.0	207.0	212.0	0.389	0.382	Filling #6 to 16.1 cm -
57	= 16.1					
1:00	= 19.1	313.5	323.0	0.258	0.251	Filling #4 to 19.1 cm -
07	= 21.8	423.0	436.0	0.190	0.186	Filling #3 to 21.8 -
~~20~~	= 25.9	745.5	776.0	~~0.108~~ 0.080	0.104	Filling from #2.
~~30~~	= 28.7	1391	1436	0.058	0.056	
50	= 31.0	Critical with Cd control rod just in solution —				

Conclusion - 10" Reactor. H/X = 86, Untamped. Critical at ~~30~~. 31.0 ± 0.05 cm —

11/17/48 pc — 31.0 + 0.9 = 31.9 cm He bottom corrected
11/18/48 pc. H/X = ~~86.3~~ 86.4
10" Stainless Untamped.
$\rho_{pq} = 1.35$
Wt % X = 21.3 = 0.288 gm X/cc.
$V_c = 16.16$ l.
$M_c = 4.65$ kg.

1/3/48

area 3" strong cylinder = 46.8 cm²
" 4" " " = 80.1 "

Measurement of Solution Weight Prior to Dilution to H/x ~ 125.

Crown		4"	4"	3"	3"	3"	3"	4"	3"	3"
Machine		1	2	3	4	5	6	7	8	9
Morf. # Calibration	h_1	67.8	70.3	67.1	67.6	Full	67.7	Full	H/x=62	Full.
	h_2	40.3	38.1	40.9	40.6		40.4			
Manometer	Δh	27.5	32.2	26.2	27.0		27.3			
Cylinder	R_{cm}	60.3	70.6	~~67.4~~ 57.4	59.2		59.8			
Volume cc		4835	5660	~~3154~~ 2688	2770		2800			

Present H/x = 86.3
Projected H/x = 125
Present density = 1.35 gm/cc.
It is required to add water to the present solution in the amount of 31.7% of present solution by weight or 42.9% by volume.

Estimated density at H/x = 125 is 1.244 gm/cc.

Capacity 3" strong cylinder = 4223 cc.
4" " " = 7349 cc

In order to effect dilution a 3" cylinder must contain $\frac{4223}{1.429}$ = 2958 cc
= 63.2 cm solution height.
= 28.8 cm manometer "

" " 4" " " " $\frac{7349}{1.429}$ = 5145 cc
= 64.2 cm solution height.
= 29.3 cm manometer "

Level of mercury

3" Cylinder #8 was isolated (H/x 62 & full) and set aside (in the pit) a 4" cylinder was emptied in position #8 and excess solution from #2 and #9 put in it.

The manometer readings on #2, 8, & 9 just before dilution were

	2	8 (4")	9
h_1	66.7	62.4	66.6
h_2	- 41.3	- 45.0	- 41.4
Δh	25.4	17.4	25.2
cc in cyl.	55.6	38.2	55.1

Cylinders # 5 (3") and #7 (4") were left undiluted and full of H/x = 86.3 solution.

Computed cylinder height after dilution are: *

			(equivalent 10" reactor height)		8" reactor
1	86.2 cm	(4)	13.8 cm	=	21.6 cm
2	79.5	(4)	12.7		19.8
3	82.0	(3)	7.4		11.6
4	84.6	(3)	7.6		11.8
6	85.5	(3)	7.7		12.0
8	54.6	(4)	8.7		13.6
9	78.8	(3)	7.1		~~Ht~~

* 11/26/48 From Cronin's notes - Re - Corresponding ~~Near~~ H/x -

Sample L6 - 0.6009 gm U_3O_8 from
2.9675 gm solution.

Sample 26 - 0.5844 gm U_3O_8 from.
2.8758 gm solution

gives ave. H/x ≡ 123.2

Specific gravity = 1.250.

Wt % x ≡ 16.4 ≡ 0.205 gm x / cc of solution -

1/3/48

Marshall
Morfitt
Cronin
Calleton

EXPERIMENT 74

10" REACTOR, UNTAMPED, H/X = ~~125~~ 127.4

TRIP points #3 95×100 Scales 3 - 100
#4 91×100 4 - 10
5 - 1

I 92.0 II 93.5 Backgrounds @ .1 cm. R.E. - 25 mv
#1 77.0 #2 78.5

Gl	Time	Height	#1	#2	C/C #1	C/C #2	Remarks
#9	2 25	0.1 cm.	76.5, 77.5	78.0, 79.0	—	—	#9 Empty @ 2 25
#8	3 00	9.0	106.	106.5	.727	.738	#8 Empty @ 3 00
#6	3 17	16.3	211	219.5	.367	.358	#6 Empty @ 3 17
#4	3 29	23.9	422.5	439.5	.182	.179	#4 Empty @ 3 29
#3	3 41	28.8	(682.5)	(714)	(.113)	(.110)	ROD IN
			821.5	855.5	.094	.092	4.9 cm taken from #3
#2	3 51	31.0	1343.5	1394.	.057	.056	
			Source Pulled				
"	4 10	31.9	with source out		Not critical but close		S = 32
"	4 14	32.2	" "		" " "		"
	4 17	32.5	" "		" " "		S = 44
	4 22	32.9	" "		" "		S = 53
	4 29	33.1	" "				S = 60
	4 27	33.6	Critical with 11 cm Cd in soln.				S = 0
DRAIN To							
	4 29	33.4	CRITICAL WITH ROD OUT				

Conclusion ⟶ Est. critical Hc 33.4 ± .05 cm. 10" Reactor Untamped. H/X = 125

11/7/48 DC 33.4 + 0.9 = 34.3 Hc bottom corrected
11/10/48 DC. H/X = ~~127.4~~ 123.2
10" Stainless Untamped.
ρ_{pu} = 1.250
with 8% = 16.4 = 0.205 gm + / cc.
V_c = 17.38 ℓ.
Mc = 3.56 Kg.

EXPERIMENT 25

1/5/48 — 10" Reactor Tamped — H/X ~ 127.4 ~~125~~

For Meaclin Visner Callihan

Trip points #3 90 ×100 Scales 3 - 10
#4 90 ×100 4 - 10
5 - 10
RE - 50

Backgrounds.
no sol. #1 - 12.5 #2 - 14.0

	Conc.	#1	#2	M⁻¹ I	M⁻¹ II	
	H: 0.2.	15.0	16.0			
		~~15.0~~ 15.0	15.0			
10:40 P	H = 5.0	18.0	17.0	0.834	0.982	Filling from #1
:46	=10.1	37.0	38.0	0.406	0.408	
:55	=12.6	64.5	64.5	0.232	0.237	Filling from #2
11:00	=14.0	106.5	111.0	0.141	0.140	
:09	=14.9	193.0	200.0	0.078	0.078	
:20	=15.6 (some in).	391.0	419.0	0.038	0.037	
	=16.0 (some out)	Critical at fully tamped.				
	=15.9 " "	" tamped, 8 cm of Cd control rod below reactor level.				
	At 15.9 ~~out~~ Cd control rod appeared to have little effect - i.e. 16.0					
	Conc solution was critical with rod in & not completely tamped; 15.9 was critical. — drain back to evaluate rod.					
	=15.6	396.0	~~413.0~~ 413.5	0.038	0.037	Rod out.
1:42	=15.6	321.5	333.0	0.047	0.047	Rod in.

Conclusion -
① 10" Reactor, Untamped, H/X = 125 critical at 15.9 ± 0.05 cm.
② at M = 25 - Cd control rod = 1.5 mm of solution in 10" reactor.
③ It is apparent, from some observations made, that with a 10" reactor the inaccuracy of sight glass readings (ca 0.05 cm) represents the condition between critical & non-critical. For example:
Sight-glass = 15.9 cm - Condition: Sub-Critical, tamped, Control rod out -
= 15.9 " - " Critical, tamped, Control rod 8 cm below surface -
④ At this solution concentration the density and viscosity are sufficiently low to use 6 psig air pressure. A higher pressure, 10 psig, appeared to cause liquid level to increase 3 or 5 mm after closing valve. This needs to be rechecked!

Solution drained back as before -
11/17/48 sc 15.9 + 0.9 = 16.8 cm Hc bottom corrected
11/26/48 sc H/X = ~~124~~ 123.2
10" Stainless, tamped.

Wt % X = 16.4 = 0.205 gm/cc
Dgr = 1.25
Vc = 8.5 L.
Mc = 1.74 kg.

EXPERIMENT 76

1/5/48 — 8" REACTOR TAMPED. H/X ≅ ~~125~~ 127.45

Fox
Viano
Mecklin
Callihan.

#3 - 100
#4 - 10
#5 - 2
RE - 25
Filling from #1.

Time	H	I	II	M^{-1} I	M^{-1} II	Remarks
		11.0	12.0			
3:05P	H = 0. - cm.	12.0	11.0			
		11.5	11.0			
	= 5.0	15.0	14.5	0.787	0.758	
	= 11.0	24.0	23.5	0.492	0.468	#1 - Empty. Filling from #2.
	= 16.0	36.0	37.0	0.328	0.297	
3.45	= 19.0	52.5	53.5	0.225	0.206	
50	= 21.9	95.0	96.0	0.125	0.115	
4:00	= 24.0	233.5	243.5	0.051	0.045	
12	= 24.7	421.0	435.0	0.028	0.025	(Source in).
	24.9	Critical. Rod in, not completely damped				(Source out).
	24.7	"	9 cm Control rod in -			(" ")
	24.6	"	9 " " "			(" ") → dry drained + re-added! ≠
	24.4	Slightly sub critical				(" ")
	24.1	———				Source out.
	24.25					Source in -

Conclusion - ① In 8" reactor Source ≅ 1.5 mm.
② 8" Reactor - H/X ≅ 125 - Tamped - Critical at 24.5 ± 0.1 cm.
③ at 4:12 P - H = 24.7 Source in ≡ 24.55 Source out M = 40 - (Sub Critical).
later H = 24.6 " " Super critical —

This indicates again, as did Exp. 75, a severely rapid drop to the M⁻ H curve - or a large inaccuracy + irreproducibility in the sight glass readings. — DC.

Drain box - see pg - 50.

11/17/48 JC 24.5 + 1.5 = 26.0 cm = Hc bottom corrected
11/26/48 JC H/X = ~~127.4~~ 123.2
8" Stainless, Tamped.
sp gr = 1.25
wt % X = 16.4 ≡ 0.205 gm X/cc.
V_c = 8.43 l
M_c = 1.73 kg

EXPERIMENT 77

1/6/48 — 8" Reactor - UNTAMPED - H/X = ~~125~~ 123.2

WILLIAMS FOR CALLIHAN.

TRIP POINTS — 3 - 89×10
4 - 91×100

Scales 3 - 10
↙ - 100
5 - 2
RE - 25 mv

1:30P Filling from #9

		I	II
:58	H = 0.2 cm	77.5	77.0
		78.0	76.0
		(77.8)	(76.5)
	=1.0		
2:15	=14.5	110.0	109.0
30	=26.1	152.0	151.5
40	=37.8	172.0	172.0
53	=49.4	~~178~~ 178.5	179.0
3:10	=67.8	181.5	187.0
25	=80.2	182.0	186.0
30	=0	79.5	79.0

	N^{-1} I	N^{-1} II
	0.707	0.702
	0.512	0.505
	0.454	0.445
	0.436	0.427
	0.428	0.409
	0.427	0.411

#9 Empty - Filling from #8
#8 Empty - Filling from #6
Empty #6 Filling from #4
#4 Empty " " #3
#3 " " " #2
#2 " " #1

DRAIN BACK

~~Drain~~ #1	20	cm in 8" reactor = 15.8 cm in 9" reactor.
#2	20	15.8
3		
4	10	7.9
6	~~10~~ 20	7.9 ~~15.8~~
8	20	15.8
9	Dead Volume -	Dead vol.

Conclusion - 8" Reactor, Untamped. H/X = 125 - Not critical at ∞ length Dc.
H = 80.2 + 1.5 = 81.7 cm
H/X = 123.2 see preceding page.
V = 26.49 ℓ
M = 5.43 kg.

Estimated $H_c = V_c = M_c = \infty$

Experiment 78 9" reactor - Cadmium Tamped. 4/x = ~~125~~ 127.4 1/7/48.

Beck
for
Crane
McLendon.

Trip points #3 and #4 both on 90.
All instruments respond properly.

	Solution Level. Background	Counting Rate. #1	#2	Co/c. #1	#2	
9:10.		13.5	14			
			14			
9:15	Zero 0.5.	11.5	11.0			
		11.5	12.0			
9:28	16.4					# 2 empty. (15.9)
9:34	24.4	51.5	53.5	.22	.22	From # 4. (8 cm)
9:43	28.0	91.	92.	.124	.13	
9:49	30.0	188	196	.061	.061	
9:55	30.7	285	299	.04	.04	
10:01	31.0	381	415	.029	.029	Source in.
	30.8	Super-Critical with Source out.				

There were Curious and anomalous effects here. The solution with source removed was quite super-critical — the cadmium rod had to be inserted several centimeters. With the source inside the solution the assembly was definitely below critical.

Another effect noted here: the assembly was definitely less critical with the top tamper in contact, than when 1 mm and more away. Thus, raising the top tamper made the assembly more critical.

The effect of source position was investigated: Solution level 31.0 cm.

Source Position	Rod Position	Meter (100 scale)	
Touching bottom	out	40.	Lowest level of activity is with source holder 6 cm from bottom. Touching bottom and 12 cm up give same reactivity.
6 cm from bottom	out	35.	
12 " "	out	40	

From this point on, source was raised and Cad. Saf. Rod inserted to maintain level at 40 on #4 (100 scale).

14	36 (3 cm in soln)	40
16	34 (5 cm in soln)	"
18	32.7	
20	32	
22	31.5 (7.5 cm in soln)	40
24	31.5	
26	31.5	40

Position of greatest activity = Source 24 cm from "touching bottom"
Here 7.5 cm of safety rod required to hold level at 40 on #4

Source Position	Rod position	Meter Level (#4)	
28 (from bottom)	32.2	40	Here actual source is 1cm inside top tamper.
30	32.5		
34	34.0		
36	34.	40	Here actual source is at top of top tamper.
40	34.7		
45	35.		Thus, with source completely removed, 3.8 cm of rod is required to hold level at the activity with source at bottom and rod out.
65	35.2 (3.8cm in soln)	40	
100 (i.e removed)	No change.		

with source out, rod withdrawn to note effect:

out — 36 (3cm in soln) Level rose from 40 to 75 in 110 seconds.
out — 35 (4cm in sol) " fell from 75 to 50 in 400 seconds.
rod could not be withdrawn.

With rod 3cm in soln and source out, assembly behaved exactly as ~~as~~ super-critical with rod out and source at bottom, assembly was definitely not critical.
In all cases top tamper was kept in contact, though level of soln rose or fell 1–1.5 mm as source & rod were moved in or out.

Conclusion:

The assembly, with source out is critical at 30.8 ± 0.1 cm. } same amount of
The assembly, with source in is definitely sub critical at 31.0 cm } solution involved.

11/17/48 DC 30.8 + 1.2 = 32.0 cm = Hc bottom corrected.
11/26/48 DC. 9" Stainless Tamped ~~earth~~ & Cd shield
H/x = ~~127.4~~ 123.2
$\rho_f q_r$ = 1.25
wet ρ_{SV} = 16.4 = 0.705 gm/cc.
V_c = ~~16.4 = 0~~ 13.13 ℓ
M_c = 2.69 kg.

Experiment 79. 9" 1/7/48 Tamped - H/x = ~~125~~ 127.4

Back

Fox

Crain

Metcalf All instruments check. OK.

It is intended to count each link with the source in two positions:
(a) touching bottom and (b) a position of highest activity.

with source moved to position to give highest count.

Time	Selection Link	Source holder Position	#1	#2	1/(c-co) #1	1/(c-co) #2	Co/c #1	Co/c #2
	Background	0 (touching bottom)	14.5	14.5				
1:24	0.3	0	13.5	13.5				
1:32	10.1	0	29.5	30.0	.606	.606	.455	.450 From #4 (8) & #2
		0.8	27.5	~~29.0~~	—	—	~~.271~~	~~.272~~
1:48	14.0	0	~~49.5~~	49.5	.278	.278	.272	.272
		1.7	46.0	49.5	—	—	—	—
2:05	16.1	0	~~[illegible]~~	~~[illegible]~~				
		0	72.5	80.0	.17	.15	.186	.170
		2.0	72.	83.				
2:30	18.0	0	170.5	179.5	.062	.062	.079	.075
		8.5	191.0	206.5	.056	.051	.07	.065
2:38	18.5	0	268	292.	.039	.036	.05	.046
		10.	346.5	385	.03	.027	.039	.035
3:00	18.7	0	324	361.	.032	.029	.042	.037
		14.5	544	606	.0188	.0169	.025	.022

18.8 Above Critical with Source out.

Conclusion: Critical at 18.7 ± .1 with Source out.

New Technique in handling measurements and manipulating data give better approach to critical point. See Graph Exp 79.

11/17/48 DC 18.7 + 1.2 = 19.9 Cm = Hc with bottom corrected

11/26/48 DC H/x = ~~127.4~~ 123.2

9" Stainless, tamped.

Ap gr = 1.25

wt % X = 16.4 ≡ 0.205 gm X/cc.

Vc = 8.16 l.

Mc = 1.67 Kg.

Exp. 80. 9" Un Tamped - H/x = ~~125~~ 127.4 1/7/48.

Beck
Fox
Fromm
McLendon

Everything OK —

	Solution Level	Source Level	#1	#2	C/C$_o$ #1	C/C$_o$ #2	1/(C-C$_o$) #1	1/(C-C$_o$) #2
	Zero. 0.5	0	68.5	77.5				
3:40		0	68.0	77.0				
3:50	25.0	0	224.	257.	.34	.36		
		9.5	235.	260			.6	.55
4:05	40.	0	~~402~~	~~442~~	.17	.174		
		13.5	544	605			.174	.19
	44.8		478	529.	.142	.147	~~#~~	
			689	771			.16	.144

Conclusion: does not go critical, but data indicate that the 9" untamped might go if a longer cylinder were available.

Drain back:

	Ht. in 9" Reactor	cf. CKB	in 7" reactor
1	13.2 cm	15.8	26.1
2	15.8 "	15.8	26.1
3		—	
4		7.9	13.0
6		7.9	13.0
8	15.8	15.8	26.1
9	Dead Volume	d.v.	d.v.

11/30/48 JC

H = 44.8 + 1.2 = 46.0 cm
H/x = 123.2 (see following page).
V = 18.88 ℓ
M = 3.87 kg
Estimated: Hc > 70 cm
Vc > 28.7 ℓ
Mc > 5.9

Exp. 81 7" tamped $N_H/N_X = +25$ 127.4 1/8/48

Cronin
Fox
Morfitt
Mulvey

8[2g] Counts 8, 8
7½, 8+

Trip pts: #3, 88 #1, 90 on 100 scale.

In this experiment, counts will be made in two positions ⓐ with the source 8 cm off bottom & ⓑ with source at point of highest activity. Ion chambers moved back to 31 from original position to reduce power level at near critical assemblies.
Instrument positions: #3 - 100 scale, #4 on 10 scale
#5 on 2 scale. Rcd on 50 scale

Background Readings

#1	#2	
9.25	9.75	Ave #1 9.50
9.75	9.75	Ave #2 9.75
9.50	S@8cm. 9.75	S@Max

Time From	Solu Level #6	#1	#2	C_0/C_1	C_0/C_2	#1	#2	C_0/C_1	C_0/C_2
10:25	10.0	15.5	15.75	.613	.618	(Probably above max)			
10:48	#6 Empty Filling from #4			H = 13.0 cm					
10:52	17.7	25.75	27.0	.369	.361	(Probably @ max)			
11:04	22.7	33.5	36.5	.284	.267	(None detectable Flat Minimum)			
11:20	27.5	44.0	30.0	.216	.195	44.5	49.5	S@3cm above orig	
	#4 Empty Filling from #2								
11:28	32.5	64.8	72.0	.149	.136	65.0	74.0		
11:45	37.5	122.5	141.5	.0776	.0671	130	150.5	Source 8cm above orig.	
		Source 13cm up from original.				C_0/C_1 .073		C_0/C_2 = .065	
11:04	40.1	262.5	302.	.0362	.0323	683.5	7.88.	.0137	.0123

Critical @ 40.4 ± 0.05 cm.
with Control Rod @ 30 cm.

Multiplication with rod @ 10 cm. 152.0

Drainage Same as previously.

11/17/48 DC 40.4 + 1.9 = 42.3 cm - He bottom corrected.
11/20/48 DC H/X = ~~127.4~~ 123.2
7" Stainless tamped.

Wet $\%_0 X = 16.4 \equiv 0.205$ gm/cc
Ap gr. = 1.25

$V_C = 10.502$
$M_C = 2.15$ kg.

Exp. #82 6½" Tamped. $N_4/N_x \simeq$ ~~125~~ 127.4 1/8/~~68~~

Cronin
Fox
Morrill
Murray.

Ready & go. @ 3:17 PM.

All counts taken with source as shown.

Time:	Soln.	Source 8 cm (true)	#1	#2	B/C,	B/C₂	Remarks
3:17	12 cm.	8 cm	8.75 9.0	9.25 9.12	Use #1 9.0 #2 9.25		DV from 9.

Solution Levels	#1	#2	#4	#6	#8	#9
H for 6½" cyl	30.5	30.5	15.2	15.2	30.5	dV.

3:22. Filling from #8.

3:37	15.0	8 cm.	18.0	18.5	0.500	0.500	
3:45	30.8	"	28.5	32.0	.316	.289	#2 Empty

NB → At a height of approximately 38 cm. the tamper motor jammed & could not be operated with the switches from the control room. Upon drainback, we tried again & the thermal cut-outs opened. No fuses were blown. The Top of the cylinder was tightened up with no success. The main coupling was loosened & the Top ~~bea~~ split bearing loosened. The motor then gave satisfactory operation. The tamper was not jammed in the cylinder. The trouble appeared to be due to a tight bearing at the top but this is by no means certain.

The dead volume was then filled from #9, & #2 recapped & refilled the cylinder to a height of

4:45	31.1	"	27.5	29.0	.327	.319

Since check on counting was satisfactory the experiment was continued, filling from #6

4:51	44.0	8 cm.	38.5	39.0	~~.185~~ .233 ✓	.237 ✓ ~~.189~~
		#6 Empty - @ 44.0 Filling from #4.				
4:58	55.3	"	51.25	52.5	.175 ✓	.170 ✓
5:04	60.7	"	56.5	59.0	.159 ✓	.157 ✓
		~~8~~ 17 above original position 8 cm	63	67.5	.143 ✓	.137 ✓
5:24	70.0		97	105	.093 ✓	.088 ✓
		39 cm above original.	107	113	.084 ✓	.082 ✓
5:40	75.0	8 cm.	194	212	.046	.044
		61 cm above original	253	279	.035	.033

→ Not critical at max height available. Probably critical @ 78.0 cm.
Drainback ~~int. original contains as above~~. See next page

Note. In taking #4 back, drained back too much into #4 Solution heights need to be remeasured before starting next experiment.

6½" Stainless – Tamped –
H = 75.0 + 2.2 = 77.2 cm
Wtx = 123.2 ; spgr = 1.25
Wt% x = 16.4 = 0.205 gm x/cc.
V = 16.52 ℓ.
M = 3.39 kg

Estimated Hc = ~~78 cm~~ 78 + 2.2 = 80 cm
Vc = ~~16.76~~ 17.12
Mc = ~~3.47~~ kg. 3.50 kg

Project - Dilute to H/x = 175*

$\Delta = (.377)\left(\frac{1}{1+.281}\right) d \cdot V$ Starting H/x = 127.4 d = 1.25

$= 0.294\, d \cdot V$

$= 0.368\, V$

Cylinders adjusted so that full height at next dilution shall be < 88 cm (91 cm max capc.)

∴ manometer should be $< 88 \left(\frac{1.25}{2.96}\right)\left(\frac{1}{1.368}\right) = 27.2$ cm $> \Delta H$

(111) 46.9 cm² 3" cyl
(193) 80.4 cm² 4" cyl

Solution Heights After Redistribution

Cyl.	No.	H_1	H_2	ΔH	Vol	$\Delta H\left(\frac{2.96}{1.25}\right)$ · area	Vol H_2O Add'l	Total Vol.
4	#1	66.8	41.2	25.6	4940		1818	6758
4	#2	~~66.9~~	~~42.2~~	~~23.7~~				
		66.5	41.4	25.1	4840		1781	6621
3	3	67.5	40.5	27.0	2995		1102	4097
3	4	66.8	41.4	25.4	2820		1037	3857
4	5	67.1	41.4	25.7	4960		1825	6785
3	6	~~illegible~~	~~illegible~~	~~illegible~~	Full of H/x = 127.4 (Storage)			
4	8	67.5	40.5	27.0	5210		1917	7127
3	9	67.3	40.9	26.4	2930		1078	4008

① Arranged to pull source into attic - Installed new stainless steel cable.
② Summarized data in new note book "Summary of Solution Experiments" - plotted data.

* 11/26/48 sc From pg 54 Book #22 - entry dated 1/24/48.
solution specific gravity 1.1864 = 1.19
average H/X = ~~174.1~~ 174.
~~= 12.4 wt %~~
What % x = 12.4 %
= 0.148 gm U/cc solution.

EXPERIMENT #83 6½" Reactor. Tamped. 1/13/48.

H/X ≅ 175

Williams
Cronin
Fry
Callihan

Trip points #3 - 84×100
#4 - 81×100

Scales #3 - 100
4 - 10
5 - 2
RE - 25 mv.

1:20P Filling from #9

1:27P H = 0.7 cm

			I	II	I	II	
			10.5	11.0			Source 4 cm from bottom
			11.0	11.5			

H in 6½ reactor.	H in 8" reactor							
				2.5	3.5			Source in attic.
32.7 cm	21.5			10.0	12.0			Source 4 cm from bottom -
				10.5	11.5			
			=3.4	~~14.5~~	~~16.5~~			#9 Empty; filling from #4.
32.1	21.1		=10.1	14.5	16.5	0.724	0.647	
19.8	13.0	2:07	=21.7	~~17.5~~ 17.0	20.5	0.600 ~~0.624~~	0.561	#4 Empty; Filling from #8
19.0	12.5	:14	=31.7	20.0	22.5	0.525	0.511	
33.4	22.0	:22	=41.7	21.5	25.0	0.488	0.460	
		:32	52.0 ~~=51.9~~	22.5 21.5	27.0	0.467 0.488	0.426	
35.0	23.0	50 ~~39~~	=70.1	24.0	26.5	0.437	0.434	Filling from #2
19.6	12.9							

Conclusion: 6½" - H/X = 175, Tamped - Not critical at ∞ length - M ≅ 2.5 at 70 cm.

11/30/48 DC

H = 70.1 + 2.2 = 72.3 cm

H/X = 174; ρ_{pg} = 1.19

Mol % X = 12.4 = 0.168 gm X/cc

V = 15.47 ℓ

M = 2.29 kg.

Estimated - Hc = Mc = Vc = ρ.

64

1/13/48

EXPERIMENT 84

Fry

8" Reactor, Untamped, H/X = 175

Williams

Cronin

Carlson.

Trip point done as before

Scales #3 - 10

#4 - 10

#5 - 2

R.E. - 25 mv.

		I	II	M I	M II
3:35P	Filling from #9.				
50	H = 0.6 cm	86.0	83.0		
		84.0 / 85.0	84.5 / 83.8		
	= 2.0				
4:05	= 20.6	145.5	155.5	0.584	0.538
16	= 39.9	171.5	186.0	0.495	0.450
20	= 42.7				
26	= 55.1	169.0	187.0	0.503	0.448
34	= 67.5	174.5	186.5	0.487	0.450
44	= 84.3	171.0	180.5	0.497	0.465
5:07P	= 0	87.5	84.0		

#9 Empty, Filling from #8

#8 Empty, Filling from 5

#5 Empty; Filling from #4

#4 Empty. Filling from #3

#3 Empty. Filling from #1

11/30/48 H = 84.3 + 1.5 = 85.8 cm

H/X = 174 (see following page).

V = 27.82 L.

M = 4.12 kg.

Estimated $H_c = V_c = M_c = \infty$

Conclusion: 8", Untamped. H/X = 175 - Not critical at ∞ length.

Drain Back

#1	21.5 cm in 8" reactor.	= 17 cm in 9" reactor
2	21.1 " " " "	= 16.6 " " "
3	12.5 " " " "	= 9.8
4	12.6 " " " "	= 9.9.
5	23.4 " " " "	= 17.7 " " "
6	Full H/X = 127.	
7	" " = 86.3	
8	20 cm in 8" reactor	= 15.8 " "
9	Dead volume.	

EXPERIMENT 85 1/13/48

Cronin Williams Fox Calkins

8" Reactor, Tamped, H/X = 175.

Trip points down as of 8:30

Scale - #3 - 50
#4 - 10
#5 - 2
RE - 25 mv.

		I	II		
5:24P	H = 0.1 cm (-)	9.5	11.0		
		9.0	10.5	M	
		9.3	10.8	I	II
5:32	H = 5.1 cm.	12.0	13.5	0.775	0.800
38	= 9.9 cm	16.5	18.5	0.564	0.584
50	= 15.0	22.0	26.0	0.422	0.415
56	= 22.0	40.0	47.5	0.232	0.228
6:04	= 26.0	76.5	90.5	0.124	0.119
12	= 28.0	166.0	200.5	0.057	0.053
22	= 29.0	437.5	532.0	0.021	0.020
50	= 29.2	766.5	956.5	0.012	0.011

Filling from #1.

#1 Empty. Filling from #2.

Source in

SOURCE 4 cm from bottom of pot.

Removed source, traffic, n level went through minimum, then level started to increase necessitating putting control rod in 14 cm. At this control position, level continued to increase Cx. linearly with time for 4 2/3 min. Level of solution during this time is 29.0 - same geometry as at 6:50P.

Drain back to 28.8 cm, source out, with control rod 8 cm in solution - n level rose linearly but at less rate than above.

Drain back to 28.7, source out, with 3 cm control rod in, n level rose linearly but at still less rate.

Drain back to 28.6 cm source out, n level still slowly rising - with 3 cm control rod.
Drain back to 28.5" " " control rod out, n level fell slowly.
Replaced source (to 4 cm) raising tamper correspondingly, level in sight glass = 28.7

7:30	= 28.7	327.5	399.5	0.028	0.027

Source in -
Removed source - solution level dropped to 28.5 - retamped - Cx control rod out - n level fell slowly as above

DRAINBACK - see pg 64.

Conclusion ① 8", Tamped, H/X = 175 Critical at 28.6 cm source out -
② " " 29.3 " " in, from corner - extrapolated volume

11/17/48 SC 28.6 + 1.5 = 30.1 cm - He bottom corrected
11/20/48 SC H/X = 174
8" Stainless Tamped.
k_{eff} = 1.19

Wt% X = 12.4 ≡ 0.148 gm X/cc
V_c = 9.76 ℓ.
M_c = 1.44 kg.

66 1/19/48

Experiment 86

To examine effect of moving the displaced solution ("hole") which occurs, in the usual experiment as the source is moved in and removed from the solution.

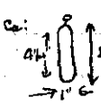
Visiner
Fry
Macklin
Callihan

Method - 8" Reactor, H/K = 175, tamped except top - Similar to #85 except absence of top tamper. A replica of the source holder - stainless steel ca 5" long, 1" diameter, has been prepared and can be moved in the reactor in a manner analagous with the source. Replica is 4.5 cm from reactor axis center (radially) and source bob is 9.5 cm from axis center.

With replica out of solution the experiment will be started in the usual manner —

Volume of source - 60cc
" " source replica - 65cc.

Dimension of Ca:



TRIP points #3 - 92 x 10, #4, 91 x 10
Scales #3 - 100; #4 - 10, #5 - 2, E.E - 50 mv
Source 4 cm from reactor bottom.

11:25 A — Filling lead volume from #9. #9 Empty.

		I	II	M^{-1} I	M^{-1} II	
11:30 A	H = 0.7 cm.	13.0	14.5			
		13.0	14.5			
	(Lowered)					
12:05	H = 10.0	13.0	14.0			Filling from #8
20	= 20.3	26.0	30.0	0.500	0.485	#8 Empty - Filling from #5
30	= 25.2	43.0	49.0	0.305	0.296	
35	= 29.0	100.0	110.0	0.130	0.132	
40	= 30.5	223.0	254.0	0.061	0.057	
50	= 31.3	810.0	913.0	0.016	0.016	(Control rod = 7 mm)

1:15 — 31.1 Source out crit with rod at height 15 cm from bottom (Power level 38 on #4) (drain 1/min)
1:16 — 31.0 Source out " " " " " 20 cm " " (Power level 45 on #4)
" " " " " 19 cm " " (Power level 38 on #4)
1:25 — 30.8 Source out Not critical.
1:28 — 31.1 Source out Critical — 13.5 from bottom (Power level 38)
1:38 — 30.9 Source out Critical — 21.5 " " (Power level 38 on #4)
1:45 — 31.25 Source out Critical. 65cm³ = 2mm Collidge 9.0

Dummy inserted; subcritical,
Source inserted in effort to raise level,
rod also taken out.
Source out, rod out, dummy in, Not critical.
2.05 — 32.0 Both bobs in. control rod in Not critical
2.10 — 32.5 Dummy in, source and c.r. out Not critical
2.25 — 32.7 " " " " Not critical
2.28 — 33.1 both bobs in Source out Ca Rd at 24 cm from bottom

Hts meas. with both bobs in

CRITICAL

Here Length of Bob = 13.4 cm

2:35 H = 33.1 Dummy in Source out. Critical source out Cd Rod at 17.5 from bottom power level at 38 on #4. Bot of Dummy at (11-1) cm from bott of reactor.

{Also critical with bot of bob (7.5-1.) cm from bottom having gone thru a minimum Cd rod same.

{Bottom of bob is (9.2-1) from bottom of reactor. Cad rod 18.5 cm from bottom. Critical.

Time	Bot of bob from bot of reactor cm.	Height of center of bob above bottom of reactor (cm)	Cad rod from bottom cm.	Extrapolated critical height with source out, safety rods and control rods completely removed	H	
	10	16.7	17.5	32.70 cm		
	6.5	13.2	17.5	32.70		
	8.2	14.9	18.5	32.73		
	3.5 - 1 = 2.5	9.2	4.5	32.38		
	15.5 - 1 = 14.5	21.2	5.0	32.39		
	13.0 - 1 = 12.0	18.7	15.0	32.64		
3:00	6.0 - 1 = 5.0	11.7	14.5	32.63		
3:03	6.0 - 1 = 5.0	11.7	19.2	32.65	H = 33.0	Dummy in Source out.
3:07	1 - 1 = 0.0 (checked by pos. bottom)	6.7	7.5	32.13	H = 32.8	Dummy in Source out.
	18.0 - 1 = 17.0	23.7	4.0	32.04		
	18.0 - 1 = 17.0	23.7	13.0	31.98	H = 32.5	Dummy in Source out.
3:15	20.4 - 1 = 19.4	26.1	18.0	~~31.64~~ 31.64	H = 32.0	Dummy in Source out.
3:30	28.1 - 1 = 27.1	33.8	9.5 (Dummy out)	31.20	H = 31.5	Dummy in Source out.
					H = 30.9	Dummy in Source out.
					30.8	Dummy out Source out.
3:35	33.8 - 1 = 32.8	39.5	15.8	30.83	H = 31.1	Dummy out Source out.
	57.5 - 1 = 56.5	63.2	16.5	30.86	H = 31.05	Dummy out Source out.
	34.5 - 1 = 33.5	40.2	15.8	30.83	H = 31.05	"

Exp. 86 (Cont)

Conclusions:

① A plot was made of the position of the source holder replica vs. effective solution height at criticality (i.e. a sight glass reading at criticality was corrected for the displacement of the replica, and for the amount of control rod required at that condition).
This plot shows a minimum of solution required when the center of the replica is at center of solution (axially). (This solution height = 32.73 cm). With the center of replica at 6cm from bottom of reactor (normal source position – bottom of replica touching bottom of reactor) H_s = 32.13 cm. With replica raised to this H_s = 30.86. The maximum effect of this void corresponds to 1.87 cm of solution, with the void at this ~~out~~ radial position from the reactor axis (4.5 cm). The effect due to motion of void within solution is greater than its removal from the solution, i.e. displacement (position) effect vs. density of active material effect.

② Reference to the multiplication curve for this experiment, after its correction for source holder displacement, shows the above ① to overcorrect the "drop" in the extrapolation. This is probably due to the replica being nearer the reactor axis (during the ~~extraction~~ evaluation of the displacement effect at criticality) than was the source (in its holder) during the multiplication measurements.

③ Critical height in this experiment = 30.9 cm. – without top tamper
" " Exp. 85 = 28.6 " – with top tamper.
Top tamper is equivalent to 2.3 cm of solution under these conditions.

Experiment 87 1/20/48

Jot 8" Reactor, Tamped - except top, H/X ≅ 175

Cronin
Williamson
Leachman -

Purpose - To re-run Exp. 86 using the same n source as usual but with it removed from the (60 cc) stainless steel case. The source was heavily coated with paraffin & attached directly to the cable. The source diameter is ca 7/8" (= 2.1 cc). The source is 9.5 cm (radially) from the axis reactor, (this quantity is going to be uncertain because the source cable is not taut due to bouyance of solution, etc). This experiment as shows distinguish between the effect, at the high multiplication end of the curve, of a void and of source displacement. Source is 4 cm from bottom of reactor. (Ca 1/2 curie)

Trip Points - #3 85 x 100
#4 - 86 x 100

Scales #3 - 100
#4 - 10
#5 - 2
RE - 50 ms.

		I	II	M I	M II	
10.55A	Filling dead volume from #9					
11:00	H = 0.6 cm	16.5	15.5			#9 empty.
		15.5	16.0			
		16.0	15.8			Filling from #8.
11:16	H = 10.5 cm	12.0	12.5			
		12.0	12.5	1.33	1.26	This indicates source may have more source in #86 at 10 cm C = C_0.
:30	= 15.1	17.5	18.0	0.914	0.878	
	= 20.3	28.0	29.0	0.572	0.545	#8 Empty; Filling from #5.
50	= 25.4	49.5	51.5	0.323	0.307	
12:01P	= 28.0	89.0	96.0	0.180	0.165	
:07	= 29.0	139.0	145.5	0.115	0.108	
:18	= 30.1	298.5	328.5	0.054	0.048	
27	= 30.5	601.0	648.5	0.027	0.024	{Source raised to above max. point now ≅ 24 cm from bottom, after this pt.
50	= 30.8					Critical with 1 cm $ Cd control rod below solution surface.

With reactor critical the large source holder replica was lowered into the solution. The reactivity increased, due probably to the tamping effect noted in #86, then as the slug entered the liquid, the level dropped rapidly & went through a minimum as the slug passed the (vertical) center of the solution.

Replaced source at to 4 cm from bottom of reactor. Drained back to 30.5 cm.

2:30P	H = 30.5	535.0	578.5	0.030	0.027	
		542.0	584.0			
	= 30.5	134.5	142.0	0.119	0.111	With 65 cc stainless steel source holder replica at the center of reactor - giving minimum σ multiplication. These values of M^{-1}, compared with above M^{-1} - ℓ Curve shows the stainless slug to be worth about 1.5 cm solution at this reactivity. This checks yesterdays value of 1.87 cm at criticality.

Conclusions:

① Using source of small volume (~2cc) inside solution (4cm from bottom of reactor) the usual multiplication curve extrapolates to a critical mass value 1mm greater than that actually observed (30.8cm vs 30.9). Todays value checks the value obtained yesterday with both source and replica completely removed.

② As source is raised from the 4cm position when reactor is near critical there is a small rise in activity, followed by the usual decrease. There is no initial fall.

③ With reactor near critical the source, later replica was submerged with a great regressing effect. At M = 10, 65 cc of void is equivalent to removing about 1.5 cm of solution. Checks yesterdays value of 1.87 cm at criticality.

④ Source was suspended on end of 15 mil stranded stainless cable. About 50 cm above it was a counterweight to take up slack. Cable between source and counterweight tended to kink and source probably moved as solution was being added. No serious effect was noted in the data. It seems possible that this sized source can be used satisfactorily if "void" effect is so undesirable —

For William Cronin Callahan

Experiment 88.

1/20/48

8" Reactor. H/X = 175, Tamper except Top.

Source mounted outside reactor in tamper

Purpose: To reexamine the effect of mounting the source (Ca 1/2 curie) outside of the reactor in the tamper, on the shape of the multiplication curve.

Method: Source is mounted in its usual stainless steel holder - (5 1/4" x 1") (60 cc) outside reactor, in water tamper, 1 cm away from outside reactor, 13 cm above bottom of reactor.

		I	II			Trip pts	Scales
3:36 P	H=0.1	7.5	8.0		3	-85 x100	100
		7.5	8.0	M^{-1}	4	-86 x100	10
				I II	5		2
3:45	=10.1	6.0	5.5		Rc		25 mv.
~~50~~	=15.4						
50	=18.1	7.5	7.0	1.00	1.14		
55	=20.6	13.0	12.5	0.576	0.640		
4:03	=26.5	33.5	38.0	0.224	0.210		
:10	=28.1	53.0	55.5	0.142	0.144		
:25	=29.2	90.0	98.5	0.083	0.081		
30	=30.1	210.0	233.0	0.036	0.034		
40	=30.5	330.5	363.0	0.023	0.022		

These data are following, now, those of Exp. 87 + extrapolate to the same critical point. or is unnecessary to carry the reactivity further.

Raising the source from this position lowers the activity. Lowering it decreases the activity slightly.

—

Source lowered to level of reactor bottom.

5:00	H=14.6	14.5	~~12.~~ 13.0	0.690	0.692	
	=20.5	16.5	15.0	~~0.488~~ 0.604	0.600	
:10	=25.2	22.0	22.0	0.397	0.409	
15	=~~30.0~~ 30.1	108.0	114.0	0.093	0.079	
23	=10.3	12.0	12.5	0.933	0.720	
28	=-0.2	10.0	9.0	-	-	
32	=-0.2	9.0	7.5	with source returned to 13 cm above reactor bottom - see 3:36 P values -		

Experiment 88 (Cont).

Conclusions:

① With source in tamper at at level of bottom of reactor, a (multiplication)$^{-1}$ curve which is initially flat + then falls rapidly is obtained.

② With source at about the mid-point of the final Critical cylinder the (multiplication)$^{-1}$ curve is ~~linear~~ practically linear and extrapolates to the previously determined value.

Drain back - See pg 64.

Experiment 89

1/21/48

Fox

9" Reactor - Tamper plus Cd shielding, H/X ≈ 175

McLendon Cavileer

Source: ½ curie in 2cc holder placed in reactor 4cm from bottom. Stainless steel counter weight (3" × 2" dia) at end of stainless steel cable - source suspended from rod by string. (12 cm on scale = source at bottom)

Trip points - #3 - 91 ×100 Scale #3 - 100
#4 - 86 #4 - 10
#5 - 2
RE - 100

1:25P	Filling dead volume from #9.					
:30	H = 0.8 cm	I 11.5	II 10.0			#9 - Empty.
		9.5	11.0			
		10.0	10.5	M⁻¹		
		10.3	10.5	I	II	
:48	= 5.1			(Blew out sight glass & set tamper zero)		Filling from #8.
	= 10.0	14.0	13.0	0.736	0.808	
:58	= ~~16.8~~ 16.9	20.5	22.0	0.502	0.478	#8 Empty -
2:06	= 22.0	29.0	30.5	0.355	0.344	Filling from #5
:14	= 27.9	48.0	52.0	0.215	0.204	
:30	= 32.6	105.5	116.5	0.098	0.090	#5 Empty - Filling from #3
:35	= 34.5	203.0	227.0	0.051	0.046	
:43	= 35.2	336.0	368.0	0.031	0.029	
3:10	Critical at 36.1 ± 0.1 cm.					

Drainback - See pg 64.

Conclusions:

① 9" reactor with Cd shielding and H_2O tamping critical at $36.1^{+0.1}$ cm H/X ≈ 175.

② Source in position & conditions described gave very satisfactory results. Multiplication curve is quite linear and extrapolates to critical condition to within 1 mm.

③ This observation was made: System near critical (slightly below) with top tamper about 5 mm above surface. Lowering tamper first raises the reactivity, tamper effect, lowering it still further, to contact, makes system sub critical again, probably Cd shielding effect. DC

11/17/48 DC 36.1 + 1.2 = 37.3 Cm - He bottom corrected.

11/26/48 DC H/X = 174.9

9" Stainless steeped and Cd shielded

$\rho_{gm} = 1.19$
wt% ± = 12.4 ≡ 0.148 gm ×/cc

$V_c = 15.30$ ℓ

$M_c = 2.26$ kg.

74 1/21/48

Experiment 90

For Mchenden Callihan

9" Reactor. Unstamped, H/x̄ = 175

Source - Same as in # 89-
Trip point " " " "
Scales # 3 - 100; #4 = 10; #5 - 2, RE - 100 mv.

		I	II			
3:42 P	H=0.6cm	71.0	71.0			
		71.5	69.5			
3:48				M^{-1} I	M^{-1} II	Filling from #8.
4:01	H=17.2	138.0	144.0	0.516	0.484	#8 Empty, Filling from #3.
:11	=27.1	206.0	222.5	0.346	0.316	#3 Empty, Filling from #4
:19	=32.4	246.0	261.0	0.290	0.269	
:26	=37.1	273.5	297.0	0.260	0.237	#4 Empty, Filling from #2
37	=45.0	325.5	352.0	0.219	0.200	

Conclusion: 9" Reactor unstamped, H/x̄ = 175 - probably not be critical at ∞ extension - M^{+1} = 5 at 45 cm.

DRAIN BACK:

#1	~ 17 cm in 9" reactor.
#2	16.1 " " 9" "
#3	10 " " 9" "
4	10 " " 9" "
5	~17.7 " " 9" "
6	Full - H/x̄ = 127
7	" - H/x̄ = 86.3
8	18 cm in 9" reactor.
9	Dead volume.

H = 45.0 + 1.2 = 46.2 cm
H/x̄ = 174 (see following page)
V = 18.96 ℓ
M = 2.81 Kg

Estimated $H_c = V_c = M_c = \infty$

1/22/48

Experiment #91

9" Reactor Tamped $H/X \cong 175$

Cronin
Fox
Morfitt
Murray

Trip points #3 - 92 #4 - 91

#3 100 Scale #4 - 10 Scale #5 2 Scale

Source 10 cm from bottom. In reactor. Wax covering only.

Source + counter check #1 6 1/2 #2 7.

Background 7.0, 7.0; 7.0, 7.0

Time	H	C_1	C_2	C_0/C_1	C_0/C_2	
9:40	5.0	7.0	8.0	1.0 .538	.875 .538	Filling from 5.
9:44	10.2	13.0	13.0	~~.461~~	~~.461~~	#5
9:52	15.8	39.5	92.5	.177	.165	#5 Virtually Empty.
10:04	17.6	63.5	70.0	.110	.100	Filling from #1.
10:17	19.0	121	131	.058	.053	
10:22	20.0	243	270.5	.029	.026	Source Moved - Replaced. Flat Maximum.
10:31	20.5	414	458	.0169	.0153	
10:42	20.8	Not Critical				Feeding from 3 for Both control.
10:53	21.0	Critical with Rod @ 19 cm.				

Est. Criticality H: 21.0 cm.

Source back

Conclusion: The 9" cylinder Tamped is critical @ 21.0 cm @ $N_X/N_H \cong 175$.

After Drain back:

			Height in 12" reactor
#1	15.8	in 9" reactor	8.9 cm
#2	16.1	" 9" "	9.0
3	10	" " "	5.6
4	10	" " "	5.6
5	15.8	" " "	8.9
6	Full $H/X = 127$		
7	" $H/X \cong 86.3$		
8	18.0	" 9" reactor	10.1
9	Dead Volume		Dead Volume.

11/17/48 DC
11/26/48

21.0 + 1.2 = 22.2 cm H₂O bottom corrected

$H/X = 174$

9" Stainless, Tamped.

$\rho_{fg} = 1.19$

with $\%X = 12.4 \equiv 0.148$ gm X/cc

$V_c = 9.11$ ℓ

$M_c = 1.35$ kg.

1/22/48

Experiment #92

Cronin
Fox
Morlin
Murray

Background @ K — 12" Reacta, Cd Shielding, Tamped
$N_H/N_X \cong 175$

S @ 6.0 cm ~~from~~ from bottom

Time	H	C_1	C_2	C/C_0	C_2/C_0	
12:42	0.2	5.0, 5.5	5.5, 5.5	—	—	Use 5.5 @ background
12:51	5.1	9.5	9.75	—	—	Filling from #2 empty @ 8.7
1:00	10.1	15.0	14.5	.367	.378	Filling from #8
1:10	13.0	25.5	25.5	.216	.216	
1:16	16.3	72.0	76.0	.076	.072	Stopped Filling from #8
1:25	17.4	153.0	159.0	.036	.035	Filling from 5.
1:38	18.0	300.5	326.	.018	.017	
1:52	18.3	670	731	.008	.008	
1:59	18.5	Not critical S = 28 cm. (14 cm off bottom)				
2:08	18.75	Just barely subcritical. Period of dropping two thirds one division per 2 minutes				

Conclusion: Criticality of 12" Reacta, Tamped & Cd Shielded occurs at a height of 18.8 cm with $N_H/N_X \cong 175$.

Drain back: per exp #92.

11/18/48 DC 18.8 + 0.7 = 19.5 cm = He bottom corrected.
11/26/48 DC $H/X = 174.9$
12" Stainless, Tamped & Cd shielded
$a_{fg} = 1.19$
with $\%X = 12.4 \equiv 0.148$ gm/cc
$V_c = 14.22$ ℓ
$M_c = 2.10$ Kg.

1/22/48

Experiment #93

Cronin
Fox
Murfitt
Murray

12" Reactor Untamped $N_H/N_X \simeq 175$

Background Counts #1 - 74 75 #2, 76 75½ ave. 75

source at 6 cm from bottom.

Time	H	C_1	C_2	C_1/C_0	C_2/C_0	notes
2:43	0	75	75	1.00	1.00	Filling from # 2
2:46	10.0	70½	72½	1.06	1.04	Filling from #2 Empty at 8.5
2:45	14.9	182	190½	~~.412~~ .242	~~.394~~ .254	~~Stopped~~ filling from #8
3:02	~~16.3~~ 17.1	296	311	.253	~~.241~~	Filling from #5.
3:08	19.0	435½	468½	.172	.160	
3:15	21.0	787	857	.095	.0875	
3:28	22.3	1421	1454	.053	.052	22.3 stopped filling from #5
3:35	23.2	1502	1598	.050	.048	Filling from #4

counters haywire, maybe because level too high.

3:50 23.7 not critical.

4:00 24.0 critical.

Conclusion: Criticality of 12" reactor, ~~Tamped~~ Untamped = 24 cm. $N_H/N_X \simeq 175$.

Drain back. As per exp 92.

11/17/48 DC
11/26/48

240 + 0.7 = 24.7 cm = Hc, bottom corrected.

H_H/N_X = 174.8

12" Stainless, ~~Tamped~~ Untamped.

ρ_r = 1.19

with η_X = 12.4 = 0.148 gm X/cc

Vc = 18.02 ℓ

Mc = 2.67 kg

Exp 94 - 12" Tamped 1/26/48

HW = 175

Bach
Mackin
Day
Visser

12" reactor in position. Instruments checks.
#3 & #4 trip at 92 on 100 scale.
#1 & 2 counters ok.
#5 ok
Reed & Process monitor ok.
Source 3 cm from bottom.

Time:	Level	Counting Rate #1	Counting Rate #2	c/c #1	c/c #2
12:20.	Background	27.5.	28.0.		
	zero 0.5 cm.	10.0	14.0		
	5.4	16.0	17.0	.62	.82
	8.7	26.0	32.0	.382	.44
	11.0	43.0	52.	.23	.27
	13.0	130.	164.	.077	.085
	13.4	189.5	245.	.055	.059
	13.7	259.0	332.	.039	.042
1:31	14.0	805.	985.	.012	.014
	14.1	did not go - but close.			
	14.2	well above critical			

Conclusion: Critical at 14.15.

11/10/48 DC 14.2 + 0.7 = 14.9 cm
-He bottom corrected.

11/10/48 HW = 174.0
12" Stainless Tamped.
$\rho_{eff} = 1.19$
Wt U_{NO_3} = 17.4 = 0.148 gm U/cc
V_c = 10.87 ℓ
M_c = 1.61 kg.

Drainback		for 12" reactor	for 10" reactor
1	8.9	8.9	12.8
2	9.0	9.	12.9
3	5.6	5.4	7.8
4	5.6	5.6	8.0
5	8.9	8.9	12.8
8	10.1	10.1	14.5
9	Dead vol.	Dead Vol.	

Experiment 95 10" Reactor.

H/X = 175

Macklin
Vierum
~~Fox~~ Buck

Tamped

10" reactor Installed and checked.
Trip point #4 - 85, #3, 92.

Time	Level	Counting Rate #1	Counting Rate #2	C₀/C #1	C₀/C #2
4:00	Background				
4:09	zero 0.5	8.0	10.0		
4:20	15.2	84.0		.095	.098
	15.7	112.5	143.5	.071	.070
4:40	16.3	166.5	206.0	.048	.047
	16.8	429.0	519.	.019	.019
	17.0	not critical. But close			
	17.15	slightly below critical			
	17.2	Critical			

Conclusion — Critical at 17.2 ± .05.

Valve on #4 Storage cylinder found leaking — 100cc of soln found in pit.

Drainback
- # 1. 14.8
- 2. 14.9
- 3 9.
- 4. none — leak
- 5. 14.8
- 8 14.5
- 9 Dead Vol.

11/17/44 DC 17.2 + 0.9 = 18.1 cm - Hc bottom corrected.
11/20/48 DC H/X = 174.0
10" Stainless, tamped.
Sp gr = 1.19
wt % X = 12.4 = 0.148 gm X/cc
V_c = 9.17 L
M_c = 1.36 Kg.

1/27/48 – Fox & Cronin repairing leaking valve on #4 storage cylinder. Replaced #3 and 4 3" storage cylinders with 4" cylinders.

1/28/48. Experiment 96. 10" Untamped H/x = 175.

Beck
McLendon
Fox
Cronin.

9:00 AM Check list — Instruments OK.
Trip Points #4 at 84, #3 at 88.
Source at 13 cm (7 cm scale reading)

	Solution Level	#1 Counting Rate	#2 Counting Rate	#1 C/C	#2 C/C
	Background	72	94		
9:20		73	101.		
9:28	zero. 0.0.	73	113.		
9:47	25.0.	353.	436	.203	.23.
9:54	30.	710.	833.	.102	.12
10:01	32.9	1206	1375.	.06	.72
10:07	34.0	1488	1345	.049	
	34.5	not critical – repeated additions of 2 mm each and test for critical			
10:29.	37.8	Final reading at Critical			

Conclusion: (1) Critical at 37.8.

(2) Detectors on untamped experiments should be moved back to reduce levels.

11/17/48 DC 37.8 + 0.9 = 38.7 cm – He bottom corrected
11/26/48 DC. H/x = 174.0
10" Stainless untamped.
ρ_{Pu} = 1.19
wht % Pu = 12.4 = 0.148 gm Pu/cc.
Vc = 19.61 ℓ
Mc = 9.90 kg

Measurement of Soln' Ht's. —

	#1	#2	#3	#4	#5	#6 (3" cyl)	#7	#8	#9 (3" cyl ↓)
	70.5	71.5	70.2	33.6	71.0	H/K 127	H/K 86.3	70.9	71.5
	37.2	36.4	37.7	32.7	37.0			37.4	36.7
Δh	33.3	35.1	32.5	0.9	34.0	—	—	33.5	34.8
$\frac{2.96}{1.186} = 2.496$	83.1	87.5	81.1	2.25	84.9			83.6	86.9 / 74.4 / 12.5 in 7" Reactor
$\frac{80.2}{257} \approx \frac{314}{1}$	26.1	27.5	25.5	.706	26.6				4.075
Volume	6.665	7.018	6.504	.180	6.809			6.705	~~6.967~~ Total Volume 37.775 Liters

Suggest: #8 be filled and used for storage and put 3.5 liters in #5 for storage and adjust #1 2, 3, 4 so that approx 5.2 liters in each cylinder or 20 cm in a 7" Reactor. In #9 should have approx 2.5 liters.

This would give on dilution a total volume of 30 Liters and require 12 Liters of DD water for dilutions on H/K of 250

Exp. 97 7" tamped, $N_H/N_x \simeq 175$ 1-29-48

Cronin
Fox
Morfitt
Murray

Tripp's #3 86
#4 92

#2 Counter making erroneous counts - input voltage changed from dial reading of 8.5 to 10.

9:10 Filling dead Volume.

	Cylinder	Soln Ht.	C_1	C_2	C_0/C_1	C_0/C_2	
9:17	#9	0.2 cm.	6.5	6.25			
			6.25	6.0			used as C_0
	#9	2.0 cm	—	—			#9 empty
9:30	#5	15.0 cm	13.5	12.5	.463	.480	
9:38		25.0 cm	25.5	24.5	.245	.245	
		28.5	—	—			#5 empty
9:48	#3	32.3	37.5	37	.167	.162	
10:00		40.0	54.5	54.5	.110	.115	
10:06		50.0	143.5	146.0	.044	.041	
10:13	#3	53.3	—	—			#3 empty
10:17	#2	55.0	Not critical but very high power level.				
10:45	#2	54.85	1113	1138	.0055	.005	Rod even with top of soln
10:51		55.15	not critical with source out.				
11:10		56.45	Critical with rod 2.5 cm bw soln				

Conclusions: 7" tamped reactor at $N_H/U \simeq 175$
critical at $\simeq$ 55.4 cm. (Probably will not go at $N_H/U_x \simeq 250$)

11/17/48 DC
11/26/48 DC

55.4 + 1.9 = 57.3 cm - Hc to bottom cemented
H_{Ux} = 174 g
7" Stainless, tamped.
ρ_{Sx} = 1.19
with N_H = 12.4, = 0.148 gm x/cc
V_c = 14.22 ℓ
M_c = 2.10 kg.

Dilution to H/X = 250*

Storage

	#1	#2	#3	#4	#5	#6	#7	#8	#9
Drain back	20.0cm.	20.0cm	20.0cm	20.0cm	H/X 175	N H/X 127	H/X 863	H/X 174.0	10 cm
Volume Water to Add. =	5.14 2.198	5.14 2.198	5.14 2.198	5.14 2.198					2.57 1.099

Total Volume = 33.029 Liters after dilution

92 × 16/99 = 3.

** 11/26/48 JC Notes from page 55, Note book 22. Re measuring H/X — Entry dated 7/4/48 —

Specific gravity 1.15

Average H/X = 226

Wt % X = ~~0.0~~ 9.95 ≡ 0.114 gm X/cc of solution.

Exp. 98 7" Reactor Tamped - H/x = ~~250~~ 225.76 1/29/48

Beck
Macklen
Crowin

Solution diluted to H/x = 225.

1:20 P. Instruments checked.
Traj points. #3, 80; #4, 83;

Time	Solution Level	Counting Rate #1	Counting Rate #2	C./c. #1	C./c. #2
1:45.		4.5	5.0		
2:00	zero. 0.5	5	4.5		
2:10	30.0	19	18.5	.26	.27
2:25	48.	38.5	39	.13	.13
2:40	60.	53.5	52.5	.085	.085
1:45	68.	62.5	61.5	.18	

Conclusion: Does not go Critical at 68cm height. And probably would not at indefinite height. H4/Nx 225.76, 7" reactor tamped

11/30/48 DC
H = 68.0 + 1.9 = 69.9 cm
H/x = 226; ρ_p/ρ_w = 1.15
Wt % x = 9.95 = 0.114 gm x/cc
V = 17.35 ℓ
M = 1.98 kg

Estimated - H_c > 100 cm
V_c > 24.8 ℓ
M_c > 2.8 kg

Drain back 7" 8"
#1 - 28 cm 21 cm
#2 - 28 cm
#3 - 28
#4 - 28
#9 - Dead volume, plus some extra.

Note: Specific Gravity of a well mixed sample from #1, 2, 3, 4, 9, = 1.149.

Experiment 99 — 8" Reactor (Untamped) H/x = 225.76/250 — 2/2/48

Martin — (Probably not be critical but will give opportunity to mix solution).

Top Visual Calibration — Source: 12 cm from bottom; ~~5~~ 5/8" brass sphere, paraffin enclosed

	3	4	5	RE
Trip points:	83×100	83×100		
Scales	100	10	2	25

10:20 A — Filling from #9

H = 0.3 cm	I	II	
	73.5	78.0	
	73.0	77.0	CAS Sight glass zero + for leaks.
	73.3	77.5	

	H = 1 cm	I	II	M^{-1} I	M^{-1} II	
						#9 Empty. Filling from #4
10.40	= 22.3 cm	85.0	86.0	0.863	0.902	#4 Empty; Filling from #3
52	= 34.8	115.0	122.0	0.638	0.635	
11:05	= 44.2	120.0	127.0	0.610	0.610	#3 Empty; Filling from #2.
15	= 65.4	121.0	133.5	0.606	0.580	#2 Empty; Filling from #1
30	= 84.3	122.0	135.0	0.601	0.594	mixed solution -

Drain 10 cm into #2; Empty #1 - (Ca 2.5 cm) Mixed solution.

Conclusion - 8" reactor, untamped, H/x = 225.76/~~250~~ will not be critical at ∞ extension -

DRAINBACK: #1 - 22 cm in 8" reactor
#2 - 22 "
#3 - 22 "
#4 - 22 "
#9 - Dead Volume

11/30/48 JC — H = 84.3 + 1.5 = 85.8 cm
H/x = 226 (see preceding page).
V = 27.82 ℓ.
M = 3.17 kg

Extimated $H_c = K_c = M_c = \infty$

9/1/48 Experiment #100

Vigneau

8" Reactor, Tamped, $H/x = \frac{225.76}{250}$

Mackelvie

Trip pt - as in #99 ; Source - as in #99

Fry

Scales 3-100, 4-10 5-2 RE - 25mv

Callihan

		I	II			
1:15P	H = -0.7cm	4.5	5.5			
		5.0	5.0			
		4.8	5.3	I	M⁻¹ II	
1:25P	= 4.9cm.	4.0	5.0			Filling from #4
:35P	= 15.0	10.0	13.0	0.440	0.408	
40	= 20.1	18.0	23.0	0.267	0.230.	(1.9cm left in #4).
50	= 23.2	27.0	32.0	0.178	0.166	Filling from #3
55	= 27.5	46.0	55.5	0.104	0.096	
2:07P	= 31.0	93.0	112.0	0.052	0.047	
15	= 33.0	207.5	243.0	0.023	0.022	
20	= 34.0	510.0	601.0	0.009	0.009	
30	= 34.3					Sub critical
32	= 34.6					Sub critical.
35	= 34.9					Critical with control rod 3cm below surface of solution.

DRAIN BALL - SAME AS EXP #99

Conclusion: 8" Reactor, tamped, $H_c = \frac{225.76}{250}$ Critical at 34.8 ± 0.1 Cm.

11/17/48 DC 34.8 + 1.5 = 36.3 Cm = Hc ~~at~~ bottom corrected.

11/26/48 DC. Hx = ~~225.8~~ 226

8" Stainless tamped.

$\rho_{UO_2} = 1.15$

with $\%_{U^{235}} = 9.95 = 0.114$ gm U/cc.

Vc = 11.77 L.

Mc = 1.34 kg.

EXPERIMENT # 101

2/3/48

For Cronin Cacciatore

9" Reactor, H_2O tamped, Cd shielded, $H/X = \frac{225.76}{250}$

Source: 1r curie, paraffin enclosed, (2cc) 12 cm from reactor bottom –

	3	4	5	PE
TRIP POINTS	83	82	—	—
Scales (start)	100	10	2	25

Time	Cyl.	Soln Ht.	Counters I	Counters II	C_0/C_1	C_0/C_2	Remarks
10:30	9	6 mm	5.5	6.0			#9 empty
			6.0	6.5			
			6.0	6.0			
			5.5	6.5			
		avg.	5.8	6.3			
10:50	4	5.2	4.5	5.0			
11:00	4	17.9	10.5	12.5	.552	.504	#4 Empty
11:15	3	25.1	20.0	23.5	.290	.268	
	3	32.5	35.5	42.0	.164	.150	#3 Empty
11:30	3	35.2	47.5	57.	.122	.110	
11:45	2	40.0	91.5	114.5	.064	.055	

Drain Back

#2 – 4.8 cm ?
#3 – ~~18.~~ 18.2
#4 – 17.~~6~~ = 17.0
#9 Dead Vol. plus.

Conclusion: 9" reactor, H_2O tamped and Cd shielded, $H/X = \frac{225.76}{250}$ was not critical at maximum possible height – 40.0 cm – volume M = 16. Extrapolation of the multiplication curve indicates criticality at H = 45 cm. —

H = 40.0 + 1.2 = 41.2 cm –
H/X = 226 (see preceding page).
V = 16.90 ℓ.
M = 1.93 kg

Estimated: Hc = 45 + 1.2 = 46.2 cm
Vc = 18.96
Mc = 2.16 kg.

EXPERIMENT # 102

2/3/48 — 9" REACTOR, TAMPED, H/X ≈ ~~250~~ 225.76

Cronin
Fox
Callihan -

Trip points and source same as in #101.
Scales — 3 - 100 5 - 2
4 - 10 RE - 25

	Sol'n Ht.	Cyl	#I	#II	C_0/C_I	C_0/C_{II}	
1:15	0		5.5	5.5			
			5.0	5.5			
			6.0	5.5			
			5.0	6.0			
			4.5				
	average	=	5.2	5.5			
1:25	~~#~~ 11.9	~~3~~	10.5	11.5	.495	.478	
	18.5	3	32.5	40	.160	.137	#3 Empty
1:50	20.1	4	50.0	60	.104	.092	
1:55	21.9	4	105.0	123 124.5	.452	.0448	
2:05	23.2	4	251.0	297.5	.021	.0186	
2:16	23.7		423.0	499.5	.0123	.0111	
2:25	24.0		not critical				
2:31	24.2		slightly supercritical with Rod all out.				

Conclusion — { Critical at 24.1 + 10.1 Cm
9" Reactor. Tamped, H/X = ~~250~~ 225.76

Drain back: 1 - 17.5 cm, H/X ≈ 250, in 9" reactor. = 9.8 cm in 12" Reactor
2 - 17.5 " " " " " = 9.8
3 - 18.5 " " " " " (overly full). = 10.4
4 - 17.0 " " " " = 9.5
5 - ? H/X ≈ 175
6 - ? ≈ 127
7 - ? ≈ 86
8 - ? ≈ 175
9 - Dead volume H/X ≈ 250

11/17/48 DC — 24.1 + 1.2 = 25.3 Cm = Hc bottom corrected
11/24/48 DC — H/X = ~~x x 5 8~~ 226
9" Stainless, Stayed.
ρ_{pp} = 1.15

with % X = 9.95 ≈ 0.114 gm X/cc.
V_c = 10.38 ℓ
M_c = 1.18 kg.

EXPERIMENT # 103 — 2/4/48

For Cronin McLendon Cullihan

12" Reactor, H/X = 250, Cd shielded, H-O Tamped

Source - 1 v c, 2 cc - 12 cm from bottom - (paraffin enclosed only).

Trip points: #3 - 92 x 100
+14 - 86 +100

Scales: 3 - 100
4 - 10
5 - 2
RE - 25 mv

		I	II	M⁻¹ I	M⁻¹ II	
2:21	H=0.7	4.0	5.0			
		(4.0)	(4.5)			
		5.5	4.0			
2:36	4.9	3.5	4.0	.615		Adding from #4.
2:43	9.5	6.5	7.0	~~.615~~	.643	#4 - M.T.
2:58	15.1	17.5	22.0	.228	.205	Adding from #3
3:04	16.6	31.0	39.0	.129	.115	
3:10	17.7	50.5	62.0	.080	.073	
3:18	18.9	104.5	129.5	.038	.035	To 18.9 from #3
3:26	19.6	222.	266.0	.017	.018	Adding from #2
3:46	20.0	613.	745.	.0060	.0065	
4:00	20.2	Critical —		Top Tamper on; Source out!		

Conclusion: Critical at 20.2 cm. — 12" Reactor. H/X = 226 - H-O tamped + Cd shielded.

Drain back: Same as # 102.

11/7/48 DC 20.2 + 0.7 = 20.9 cm Hc bottom corrected.
11/20/48 DC H/X = ~~205.8~~ 226
12" Stainless, Tamped, Cd shield
ρpu = 1.15
wt % X = 9.95% = 0.114 gm Pu/cc.
Vc = ~~15.10 L~~ 15.25 L
Mc = ~~1.72 kg.~~ 1.74 kg

7/4/48

Cronin
Fox
Callihan

Exp. 104

12" Reactor Un Tamped H/X = 225.76

Trip points (same as Ex 103).
Scales - #3 100 #4 10 #5 2 RE 25

			Cylinder	I	II	I	M^{-1} II
4:50 P	H = 0.6 cm			63	71.5		
				63.5	69.5		
				62.0	71.0		
				(62.8)	(70.6)		
5:05 P	H = 10.5 cm		1 empty	38.0	42.2		
:12	= 15.0		2	83.5	~~89~~ 97.5	0.752	0.724
:22	= 20.1		2 Empty	314.5	370.0	0.200	0.191
:32	= 21.6		3	500.5	591.0	0.126	0.119
:40	= 23.2		3	955.5	1119.5	0.066	0.063
50	= 24.6		3	Not critical -			
53	= 25.0		3	" "			
55	= 25.4		3	" "			
6:00	= 25.7		3	Critical with 10 cm Cd control rod in solution.			
05	= 25.6		3	" " 8 " " " " " "			
10	= 25.55		3	" " 5 " " " " " "			
12	= 25.5			" " Cd control rod out.			

DRAIN BACK :
1 - 10.0 cm in 12" reactor H/X = 225
2 - 10.1 " " " " "
3 - ~ 10.4 " " " " "
4 - 9.5 " " " " "
5 - ? H/X = 175
6 - ? = 127
7 - ? = 86
8 - ? = 175
9 - Dead volume - "

Conclusion: 12" Reactor - untamped - H/X = 226 - Critical at 25.5 cm -

11/7/48 JC: 25.5 + 0.7 = 26.2 cm - He bottom ~~tamper~~ corrected.
11/26/48 JC: H/X = ~~225~~ 226
12" Stainless untamped.

What % X = 9.95 = 0.114 gm/cc
$\rho_{opt} = 1.15$
$V_c = 19.11$ ℓ
$M_c = 2.18$ kg.

2/5/48 Exp. 105

Cronin
Fox
Murray

12" Tamped H/X = 225.76

trip pts 95 each

Scales #5-2, #4-10, #3-100, Reed-25. Source 6 cm from bottom.

Tamper ran off bottom, took off a few threads.

10^AM ready to go.

Time	H	Cylinder	#1	#2	$(M^{-1})_1$	$(M^{-1})_2$	Comments.
10^00			~~4.0~~	~~4.5~~			
			~~4.0~~ Source moved	~~5.0~~			
			5 3/4 (6)	7.0 (6 1/2)			
			6 1/4	6 1/4			

Collar on tamper screw at top slipped. By error, had left off bottom bearing. Replaced and readjusted.

11^30	H = 5.3	4	8.0	9.0	.75	.72	
11^35	H = 7.1	4	10.0	12.0	.60	.54	Stopped filling from 4
11^45	H = 10.1	3	19.0	23.0	.32	.28	
11^50	H = 12.0	3	31.0	38.0	.19+	.17	
11^55	H = 14.0	3	84	99.5	.071	.065	Stopped filling from 3
12^00	H = 14.6	2	137	163.5	.044	.040	
12^10	H = 15.3	2	367	441	.016	.015	
12^35	H = 15.8	2	critical.				

Conclusion: 12" tamped cylinder critical at 15.8 cm with $N_H/N_X = 225.76$.

Drain batch. Same as in Exp 104.

11/17/48 DC 15.8 + 0.7 = 16.5 cm - Hc bottom corrected.

11/26/48 DC H/X = ~~225.8~~ 226

12" Stainless, tamped.

$\rho_{gr} = 1.15$

wt% X = 9.95 ≡ 0.114 gm X/cc

$V_C = 12.04$ ℓ

$M_C = 1.37$ kg.

2/5/48

Cronin
Fox
Murray

Exp 106

10" tantamped, $N_H/N_X \simeq 225.76$.

Soln. heights:

1	14.4
2	14.5
3	15.0
4	13.7
5, 6, 7, 8	of the concentrations
9	D.V.

Time	Cylinder	H.	#1	#2	R_H,	R_H,	Comments
2:35	dead vol. #9	0	67 (66.5) 66	70.5 (70) 69.5			
	#4	12.8					empty
2.45	#3	15.0	54	55.5			
		18.9	93.75	105.5	.71	.66	
3.00	#3	27.4	248	279.5	.27	.25	empty
	#2	33.0	422	477	.16	.15	
	#2	40.0	1061	1241	.063	.056	
	drain back to same as above moved counters back.						
3.50	dead vol.	0	20 (19.75) 19.5	17 (17.25) 17.5			
4.05	#4	13.3					#4 empty
	#3	20.6	455	40	.43	.43 .57	
4.15	#3	28	90	70½	.22	.245	#3 empty
	#2	35.2	194	158	.10	.11	
4.30	#2	38.0	271	229	.073	.075	Stopped filling #2
	#1	40.0	379.5	325	.052	.053	
4.40	#1	42.1	623.	5495	.032	.031	
	#1	43.9	1217	1109	.016	.0155	
		46.1	critical with rod past way in. (8cm)				
		45.7	critical exactly				

Conclusion; 10" untamped critical at ~~45.7~~ cm. $N_H/N_X \simeq 225.76$.

11/7/48 DE 45.7 + 0.9 = 46.6 cm bottom corrected, $H/X = \frac{226}{\cancel{225.8}}$; 10" stainless untamped; $\rho_{eff} = 1.15$; wt % X = 9.95; = 0.114 g U/cc.
$V_c = 23.61$ ℓ $M_c = 2.69$ kg.

2/9/48 **Exp 107** 10" Reactor, Tamped. H/X = 225.76

Flushed air header line with water from ~~Cyl~~ union just within cylinder storage pit, back to tee + block valve where vacuum is normally applied; also drained some through vent valve. This was necessary since in the draining back on 2/5 a cylinder was overfilled + solution was collected in pr vacuum pump trap (flask).

Visner
Fox
Maudlin
Carrithers

1 rc Source, paraffin enclosed, 12 cm from reactor bottom.

				3	4	5	RC
		Trip points		88×10	83×10		
		Scales		100	10	2	50 mv.
		I	II				
10:30A	H = 0.0cm	5.0	6.0				
		5.0	6.0				
	= 0.7 +0						
				I	M^{-1} II		
1:57	= 14.4	24.0	26.0	0.208	0.231		
11:06	= 16.5	55.0	60.0	0.091	0.100		
15	= 17.5	89.0	98.0	0.052	0.061		
19	= 18.5	274.0	246.5	0.018 0.020	0.020		
27	= 18.9	631.0	688.0	0.008	0.007		
38	= 19.0	Sub critical.					
42	= 19.2	Critical with 10 cm Cd rod below solution level.					
44	= 19.1	Critical with Cd control rod bottom at solution level.					

#9 Empty.; Filling from #4.
#4 " ; Filling " #3

11/17/48 DC 19.1 + 0.9 = 20.0 cm the bottom corrected
H/X = ~~225.8~~, 226
10" Stainless, Tamped.
ρ_{pg} = 1.15
wbt %U = 9.95 = 0.114 gm U/cc.
V_c = 10.13 ℓ.
M_c = 1.15 kg.

Conclusion 10" Reactor, H/X = 225, Critical at 19.1 cm.

10.2 cm into #1, 2, 3, 4
5.8 cm into #9 [redacted]
Old (3") #6 removed to storage new (4") #6 filled full of H/X 225.76
extra few liters to re-evaporation apparatus for eventual storage

added DD. water to #1, 2, 3, 4 9 {0.436 by volume Calc. by FCronin 2/6/48}
2270cc 1282cc

The above procedure was calculated to give a dilution to H/X = 325

EXPERIMENT 10B

2/10/48

10" REACTOR Steinless UNTAMPED H/X = 325

Fox
Cronin
Callihan

TRIP points #3 91x100 #4 83x100.

Scales #3 - 100, #4 - ~~10~~ 5, #5 - 2, R-E - 25 mv.

Cylinders 1, 2, 3 & 4 have solution = 14.5 cm in 10" reactor

" 9 has dead volume

Source - 12 cm from bottom, paraffin enclosed.
Counters all away from reactor 130 cm

		I	II			
10:25A	H = 0.0 cm	15.5	25.5 (?)			
		15.0	20.0			
		16.0	20.5			
	1'	15.5	20.3			
35	H = 2.0 + 14	I	II	I	II	#9 Empty. Filling from #4
50	= 16.3	18.0	36.0 (?)			#4 Empty - Mixed & reduced H 3mm.
		17.5	26.0	0.886	0.776	
		18.0	26.5			Filling from #3
11:05	= 25.1	43.0	88.0 (?)			(Mixed)
		42.0	77.0			
		42.0	71.0			
		41.5	58.0			
		41.5	54.0	0.374	0.376	
11:27	= 30.7	60.0	77.0?	0.258	0.264	#3 Empty - Mixed.
		60.0	106.5?			
		60.0	136.0?			Filling from #2
11:40	= 37.4	86.0	124.0			
		87.0	169.0?	0.178		Mixed - no chg in reading. Filling from #1
:52	= 42.3	105.0	163.5			
		107.5	129.5	0.144		
12:02	= 45.8	124.5	255.0?			
		126.0	251.0	0.123		

Conclusions:

① #2 counter erratic

② 10" Reactor Untamped H/X = 325 - not critical at maximum attainable height - H = 45.8 cm M = 8; as safety at ∞ length is doubtful -

Inventory

	H/X	Cm in 10" reactor (side)	
#1	325	~ 14.7 cm	18.3
2	325	~ 14.7 cm.	18.3
3	325	14.7 cm.	18.3
4	325	14.5 cm.	18.2
5	175	?	
6	226	(free)	
7	86	?	
8	175	?	
9		W +	

11/30/48 DC

H = 45.8 + 0.9 = 46.7 cm
H/X = 320 (see following page)
V = 23.66 ℓ.
M = 1.90 kg

Estimated:

Hc ≥ 75 cm
Vc > 38 ℓ
Mc > 3.0 kg.

EXPERIMENT 109

Fix — 10" REACTOR, TAMPED, H/X = 325 — 2/10/48

Cronin
Carrihan.

Trip. points, scales, source as in #108.
Counters: Top view N ← Counter — Bay — Reactor

		I	II	M^{-1} I	M^{-1} II	
1:35P	H = 0.7 cm	4.0	83.0			
		4.0	81.0			
		4.0	89.0			
		4.0	82.5			Filling from #4.
		4.0	85.1 ?			
:45	=5.2	4.5	74.0	0.889	-	
50	=9.7	5.5	6.5	0.728		
2:00	=15.5	12.5		0.320		#3 EMPTY, FILLING FROM #1.
:07	=18.1	20.5		0.195		
:12	=20.5	40.5		0.099		
:18	=21.8	64.0		0.063		
:25	=22.8,	120.0		0.033		
:30	=23.6	389.5		0.010		
39	=24.0	Slightly subcritical.				
44	=24.2	Critical with 20 cm Cd control rod below solution level.				

Conclusion - 10" Reactor, tamped, H/x = 325 - Critical at 24.1 cm.

Inventory: Same as pg. 94 & p 108.

NOTE: EACH CYLINDER IN PIT IS UNCOMFORTABLY FULL SO BE CAREFUL TO PREVENT OVERFILLING ON DRAIN BACK. DO

11/17/48DC 24.1 + 0.9 = 25.0 = He bottom corrected.
H/X = 319.9 W.% X 7.32
10" Stainless, tamped.
Sp Gr 1.10 gm X/cc sol. = 0.0805
V_c 12.67 l. M_c 1.02 Kg

Experiment 110 - 9" Stainless Reactor, Cadmium Tamped H/X - 325 - 2/11/48

Beck for Cronin

8:30 - Orvin, Olsen readjusting counter #2.
9:30 - Beginning check lists.
Trip points #3 tripped at 92, #4 at 83.
All instruments O.K. The two counters located 130 cm from assembly.

	Solution Level	Counting Rate C_1	Counting Rate C_2	C_0/C_1 #1	C_0/C_1 #2
	Background	2	2		
10:30	~~10:30~~	2	2		
10:35	0.2. Zero.	2	2		
10:50	30.0	6	6	.33	.33
10:56	35.1	7	7.5	.288	.269
11:00	39.3	8.5	8	.235	2.5

No more reactor height available.

Conclusion: does not go critical: - multiplication about 35 - and leveling off.

11/30/48
$H = 39.3 + 1.2 = 40.5$ cm
$H/X = 320$ (see following page)
$V = 16.62$ ℓ
$M = 1.34$ kg

Estimates:
$H_c = V_c = M_c = \infty$

9" reactor

Drawback
#1 - 18.3 cm
#2 - 16.
#3 - 16
#4 - 15.5

#9 7~~8~~ cm + dead volume.

Exp. III – 9" Reactor. Tamped. HX-325 2/11/48

Beck
~~Fox~~
Cronin

11:45 Instrument check – all OK.

Solution Level	Counting #1	Counting #2	C₀/C #1	C₀/C #2
0.2 zero	4	4		
"	4	4		
20.	15.5 ~~25.8~~	16.5	.258.	.242
23.9	28.5	30.	.135	.133
26.1	43.5	45	.092	.089
~~28~~ 27.9	69.5	71.	.575	.56
29.5	120.	121.5	.033	.033
30.4	180	191	.022	.021
31.6	not critical; but close.			
31.95	above critical.			
31.8.	Critical.			

Conclusion: Critical at 31.8.

Drainback	9" reactor	8" reactor
#1	18.3 +?	23
#2	16.	20.2 +?
#3	16.3	20.3
#4	16.	20.2
#9	7 + dead volume	8.8 + dead vol.

11/7/48 DC 31.8 + 1.2 = 33.0 cm = Hc bottom corrected.
HX – 319.9 WR% X = 7.32
9" Stainless tamped.
Sp Gr. 1.10 gm X/cc soln = 0.0805
Vc = 13.54 l. Mc = 1.09 Kg

Exp 112 8" Tamped H/4 = 325 2/11/48. Back for Cross

1:30 charged Reactor.

2:35 Instruments checked all OK.

	Solution Level	Rate #1	Rate #2	c/c #1	c/c #2
2:38	0.5 Zero	3.5	3.0		
3:00	30.3	15.5	15.5	.233	.1935
3:11	41.1	29.1	31.5	.120	.095
3:32	47.4	47.5	47.5	.079	.063
3:45	54.3	116	121	.03	.025
	56.6				
	57.2 not crit.				
	57.9 " "				
	58.6 Critical				

Conclusion: Critical at 58.6.

Drawbacks:

		Soln.
#1	23	10.2
#2	22	9.8
#3	22	9.8
#4	22	9.8

#9 Dead vol + 4 cm.

11/17/48 JE 58.6 + 1.5 = 60.1 cm = Hc bottom corrected.
H/V = 319.9 Sp Gr. 1.10
8" Stainless tamped.
W% of X = 7.32 gm X/cc = 0.0805
Vc = 19.48 l. Mc = 1.57 Kg

Experiment 113 - 12" untamped, $N_H/N_X \simeq 325$ 2/12/48

Cronin
Fox
Murray

9: changed reactor

Time	Solution level - Cylinder		Counts #1	Counts #2	(Multiplication)$^{-1}$ #1	(Multiplication)$^{-1}$ #2	Comments
10 30	0.0	#9	18.5	17.5	1.0	1.0	
10 40	1.5	#9 dry					
10 45	11.4	#1 dry					
10 50	15.0	#2	30.5	22	.60	.80	
			30.0	22	~~.58~~		
11 00	20.0	#2	61.	51	.30	34	
11 15	22.0	#2 dry	81	66	.23	.265	
11 20	27.1	#3 stopped fill.	271	241	.068	.073	
11 25	28.1	#4	409.5	378.5	.045	.046	
11 40	29.2	#4	1024	971	.018	.018	Rod out
			335		.055		Rod in
	30.0	#4 above critical					
	29.9	#4 below critical					

Conclusion: A height reading of 4mm corresponds to zero level in the reactor. Thus should subtract 0.4 cm from above. (PLEASE NOTE FOR OTHER 12" EXPERIMENTS)
H = 29.6 for 12" untamped $N_H/N_X \simeq 325$.

Drain back:

1	10.2
2	9.8
3	9.8
4	9.2

9 D.V. + 1.5cm.

11/17/48 ac 29.6 + 0.7 = 30.3 Cm = He bottom corrected
H_H = 319.9 Sp Gr = 1.10
12" Stainless untamped.
wt % X = 7.32 gm X/cc = 0.0805
V_c = 22.10 l. M_c = 1.78

Exp 114 12" tamped $N_H/N_x \simeq 325$ 2/12/47

Cronin
Fox
Murray

Source at 7 cm
Background $5\frac{1}{4}$, $5\frac{1}{2}$

Constructed broad flat Cd sheet for control rod → 6" X 32"
Zero position = 7 cm on control scale.

Time	Level	Cylinder		Counts #1	Counts #2	Recip. mult. #1	Recip. mult. #2	Comments
9 15	0	dead vol.		$5\frac{1}{4}$, $5\frac{1}{2}$		1.00	1.00	
2 25	8.1	4		$8\frac{1}{2}$, 10		.62	.55	
2 25	10.4	4	now M.T.	$11\frac{1}{2}$	$18\frac{1}{2}$	.46	.41	
2 45	12.6	3		18	$17\frac{1}{2}$	.29	.31	
2 50	14.9	3		31	32	.17	.17	
2 56	16.2	3	Stopped cooling	49.5	53	.11	10^+	
3 05	17.4	2		124	133	.042	.041	
3 10	18.0	2		216	1300	.0043	.0042	Multiplication of 230
3 20	18.2	supercrit. – Rod not out.						

error in level

Conclusion: Crit at 18.2 − 0.4 = 17.8 cm
$N_H/N_x \simeq 325$, 12" tamped

11/17 Vessel 17.8 + 0.7 = 18.5 cm He bottom corrected
H_H = 319.9 Sp Gr = 1.10
12" Stainless tamped.
Wt % X = 7.32 gm X/cc = 0.0805
V_c = 13.50 l. M_c = 1.09 Kg.

drain back

#	1. ~~10.2~~	≃	9.0
#	2. 9.8	≃	9.0
#	3. 9.8	≃	9.0
#	4. 9.8	≃	9.0
#			
#	9 d.v. + 1 cm		

2-16-48 Emptied sol. from #5 & #6 for evaporization
Put about 2 liters back into #6 at a sp. gr. of approx. 1.34

Preparation of Soln H/X^u 86 for experiment

Cyl No:	6	7	8	
Ht. =	48.2	90	61.0	in Storage cylinder (4")
Vol =	3.91 Liters	7.30	4.95	Sp. Gr. approx 1.310
Ht in 8" cyl	12.0 cm	25 cm	15.2 cm	

dead Vol. = 3.4 Liters = 42 cm in 4" cyl = 10.5 cm in 8" cyl.

102
2/23/48

Exp 115* To examine effect on critical conditions of increasing the thickness of stainless steel reactor wall.

Cronin
Fox
Visner
Callihan

a sheet of 302 stainless 1/16" thick was rolled to ca 7 3/4" radius with an overlap and fit snugly over the long (35") 8" reactor.

In order to measure this effect at two concentrations sufficient solution of H/X = 85 was prepared (see Exp 101). In addition we also have H/X = 320.

Further, in order to mix well the H/X = 85 an untamped experiment was done.

H/X = 85, 8" Reactor. Untamped.

Trip points # 3 - 87x100 #4 - 90x100

Scales # 3 - 100; #4 - 5, #5 = 2 P.E. = 25 mv.

Source (1x1) - [redacted] (on bottom at 4/39 cm on scale) placed at 10 cm from bottom (brass, paraffin ends, glass)

Top tamper in, but all way to top.

Control rod outside reactor

I	II
47.5	42.5
46.5	40.0
47.0	41.5

11:10 A — Filling from #6.

		I	II	M^{-1}	
:15	H = 0.5 cm	46.0	43.5		
		45.0	42.0		
		45.5	42.3		
11:30 A	=3.0			I	II
40	=16.2	50.0	44.0	0.910	0.97
		49.0	44.0		
57	=24.1	93.0	84.0	0.495	0.509
12:12 P	=34.6	133.0	118.0	0.342	0.363 ~~0.327~~
:18	=36.8	134.0	123.0	0.327	0.343

#6 Empty; Filling from #8

a) rod in space outside reactor (reactor tamped top position)

c) rod withdrawn - #8, empty, filling from #7

#7 Empty. #8 Empty. out of solution

Conclusion: Insufficient solution made it impossible to go beyond H = 36.8 cm. At this height the reactivity is somewhat greater (M = 3 vs. M = 2.3) than in Exp 67 - where conditions were about the same except for additional 1/16" wall thickness of reactor. This difference may be due to ① Somewhat different H/X; ② Tamping by additional 1/16" wall ③ change in source position giving differently shaped M^{-1} curves.

Drain back — 18.8 cm in 8" reactor into #8
18 " " 8" " " #7.

* Experiments 115–120 inclusive are considered as to give suspect results because, upon dumping from one concentration to the next, a build up of solution would change the H/X values.

Exp. 116 H/x = 85, 8" Reactor Tamped. 2/23/48

Double Reactor Wall Thickness

Visitors
Fox
Cronin
Callihan.

Trip points as before.
Source (1/c) 10 cm above reactor bottom.
Scale - #3-100, #4-5, #5-2. Read-out of order.

		I	II			
	H=-0.3 cm	5.0	5.0			
		4.5	5.5			
2:00 P	H= 4.9	6.0	6.0	0.800	0.883	Feeling for #7
:10	=10.0	9.5	9.0	0.505	0.589	
:16	=15.0	21.5	19.0	0.223	0.279	3cm left in #7 - Now beginning to fill for #8
:25	=17.9	38.5	36.0	0.125	0.147	
:31	=20.3	71.5	67.0	0.067	0.079	
:38	=21.5 =21.5	110.0	103.5	0.044	0.051	
:46	=22.5	209.0	189.0	0.023	0.028	
:55	=23.0		Not critical			
:59	=23.4		" "			
3:05	=23.5		" "			
07	=23.7	Critical with 6.7 cm Cd control rod below solution surface.				

Conclusion: ① 8" Reactor tamped, H/x = 85 with additional 1/16" stainless steel around reactor (i.e. reactor wall thickness doubled) critical at 23.6 ± 0.1 cm.

② If this H/x is the same as that used in Exp 66 (=86.3) the height now at criticality is 1.3 cm (23.6 - 22.3) greater than previously without the extra reactor wall.

Inventory:

	H/x	
1	320	- 9 cm in 12" Reactor = 20 cm in 8" Reactor.
2	320	9 " " " " "
3	320	9 " " " " "
4	320	9 " " " " "
5	Empty	
6	86	Dead volume
7	H/x = 86	- 18 cm in 8" Reactor.
8	86	18.8 cm in 8" Reactor
9	320	Dead volume

7/23/48

Exp 117 8" Reactor, H/X = 320 Tamped

Reactor wall thickness increased by 1/16" Stainless Steel.

JF
Cronin
Vitner
Callihan

Trip points as before.
Scales #3 - 100 #4 - 10 #5 - 2 R.E. out of order.
Source - 1/2 c - brass + paraffin - 12 cm from bottom of reactor.
Dead volume filled from #9.

		I	II			
3:40P	H = 0.2 cm	4.0	4.0			
		5.0	4.0	M^{-1}		
				I	II	Filling from #4.
4:10	= 21.8 cm	15.0	13.5	0.300	0.296	#4 Empty; Filling from #3
20	= 32.4	25.0	24.0	0.180	0.167	
26	= 41.4	37.0	36.5	0.122	0.110	#3 Empty; Filling from #2.
35	= 50.1	56.0	55.0	0.080	0.073	
43	= 57.0	99.0	96.0	0.045	0.042	#2 not empty; Filling from #1
50	= 62.6	392.0	402.0	0.011	0.010	
1:03	= 64.6	Critical with 12 cm of Cd control rod below solution level				
:08	= 64.3	" " 11 " " " " " "				
~~:11~~	~~= 63.8~~					
:11	= 63.7	Slightly subcritical				
:14	= 63.9	Very " "				
:16	= 64.1	" " "				
:19	= 64.3	Critical with 9 cm of Cd control rod below solution level.				

Conclusion: ① 8" Reactor, Tamped, H/X = 320, 1/16" additional to reactor wall thickness - Critical at 64.2 ± 0.1 cm.
② Compared with Exp. 112, the extra 1/16" of stainless steel wall increased the critical height by (64.2 − 58.6) = 5.6 cm or ca 9.5%

Inventory

	H/X	cm in 8" reactor
1	320	~ 20
2	320	~ 20
3	320	= 20.0
4	320	= 21.4
5	empty	
6	86	Dead volume
7	86	18.0
8	86	18.8
9	320	Dead vol +

Experiment 118 8" Reactor - Normal wall

H/x ≈ 85, Tamped

24 2/24/48 For Cronen Callihan

Purpose: to evaluate effect of increasing wall thickness of reactor by 1/16 stainless steel by comparing this experiment with #116. #116 has been compared with #66 but without analysis there is no assurance that the H/x values are the same

Continued on next Page

2/24/48 EXPT 118 8" Reactor H/X = 8ℓ Tamped

Reactor wall thickness = 1/16"

Callihan
Cronin
Fox

Trip points: #3 = 88 #4 = 85

scales; #3 - 100 #4 - 5 #5 - 2

source at 12 cm from bottom

2:30 PM started filling D.V. from #6

	HT.	I	II			
2:35	1.2cm.	5.0	5.0	M^{-1}		from #6
		4.5	6.0			
		5.0	5.0	I	II	
2:55	10.4cm	10.0	9.5	.500	.526	
3:01	15.0	20.5	20.0	.244	.250	
3:14	19.2	50.5	50.0	.099	.100	#7 empty
3:22	21.0	100.0	89.0	.056	.056	filling #8
3:42	22.1	188.0	171.5	.026	.029	
3:54	22.8	352.5	327.0	.014	.015	
3:58	23.2	not crit.				
4:05	23.4	"	"			
4:10	23.6	critical with 8cm control Rod in 2nd.				

Conclusion: ① Critical at 23.5 ± .1 cm.

② This agrees, within the experimental precision, with the value obtained with this solution when the reactor had a 1/16" sheet of stainless steel wrapped around it. The difference observed between Exp^ts 116 & 66 probably due to difference in H/x. This to be checked by sampling.

Drain back #8 18.8 cm in 8" Reactor
#7 18.0 " "
#6 D.V + 1 cm.

Others as on previous page (104)

3/25/48

Experiment 119 8" Reactor #/x = 320 Tamped. (Repeating 112).

Beck for Cronin Stanley McLendon

Repeating #112 because of diff in height between crit. in 8" reactor with and without extra steel around reactor, it was thought advisable to check the experiment performed earlier.

12:15 - Checking instruments. all OK except Reed, which is out for repairs.
Trip Points #4, 94 #3, 88.

	Solution Used	Counting Rate #1	Counting Rate #2	C/C #1	C/C #2	
12:40	Background	5	6			
		5	6			
12:45	Zero 0.0	4	4.5			lead val from #9.
12:50	31.0	31.0	29.0	.129	.155	from #4
1:30	44.9	114.	99.5	.035	.045	
1:40	50.0	above critical (crit with 6 cm rod left.).				
1:45	49.5	below critical.				
1:50	49.7	Barely below critical.				
2:00	49.8	Critical ———				

Conclusion: Critical at 49.8 ——— obviously the discrepancy between this and the previous value of 58.6 is due to inadvertent unmixing of #/8 = 86 stuff.

108

2/25/48

Experiment 120 8" reactor Tamped + 1/16" steel, H/x ≈ 320.

Repeating Exp 117 with stainless steel.

Effect of stainless steel on previous experiment.

Rock
Fox
Crowe
McLendon

all Instruments OK except recd out for repair and #5 drifts badly – needs new battery.

	Solution level	Counting Rate #1	Counting Rate #2	C/C #1	C/C #2	
2:13	Zero. 0.5,	5.5	7.0.			
2:30	35.4.	31.	26.0	.178	.25	
2:35		31.5	27.0	"	"	
2:45.	45.1	50.0	46.0	.11	.14	
2:55	54.2	122.0	109.0	0.045	0.064	Rock Out Counting Inc.
3:07	58.3	374.0	333	0.015	0.021	(filling for #2.)
3:12	59.9	Slightly Sub critical				
:15	60.0	" "				
30	60.2	With plunger down + Control rod all way out, removal of source to its maximum height causes n level to drop sharply and then become constant.				
35	60.3+	Critical with 15 cm control rod below solution level.				

Conclusions: 8" Reactor, with bottom 1/16" stainless steel were – H/x ≥ 320 –

Critical at 60.3 cm –

Inventory H/x

1 ~320 Critical 20 cm in 8" Reactor

2 ~320 ~20 " " " "

3 ~320 20.5 " " " "

4 ~320 - 20.5 " " " "

5 empty

6 ~86 Dead wt.

7 " 18.0 cm in 8" Reactor

8 " 18.8 " " " "

9 ~320 D.V.

2/26/48 Two samples of the solution used in the above Exp were taken during "drain back". These gave H/x = 293 = 300

Spl measurement at time of drain back H/x = 1.110

8" Reactor. $H/X = ?$ (~300)
Double wall reactor.
Experiment 121 Tamped.

3/27/48

Moffitt
Macklin
Cronin
Callihan

There is considerable doubt about the validity of the data of Exp 115–120 inc. because of uncertainty in the H/X ratio — both in its value & its constancy. It has been suggested that there is sufficient hold-up of say, $H/X = 85$, to significantly change the subsequent dilution, $H/X \simeq 320$, used.

To conform with earlier results the $H = 49.8^{cm}$ of Exp 119 corresponds to $H/X \simeq 280$. It would require 1.4 ℓ of $H/X = 85$ to be added to $H/X = 320$ to effect this dilution of the required total amount of solution.

It is attempted ~~here~~ to repeat explicitly here Exp 120 in order to check experimental precision. It is believed that solution was used in Exp. 120 from the following cylinders:

1. #9 — emptied to fill dead volume
2. #4 emptied
3. #3 emptied (when $H = \cancel{42}$ 45 cm).
4. #2 probably practically empty at $H = 60.3$ cm.

Drew back — 20.5 cm (8") into 3
" " " " 4
To H=0 " " 2
Dead volume " " 9.

Trip point	#3 - 86 × 100
	#4 - 81 × 100
Scales	#3 - 100
	4 - 20
	5 - 5
	RE - 25 mv

Source - 12 cm above bottom of reactor.

Time	H	I	II	M^{-1} I	M^{-1} II	Remarks
11:15 A	H = 0.4 cm.	4.0	5.5			#9 practically empty.
		4.0	5.0			
		4.0	5.0			Now filling from #4
45	= 20.5	14.0	15.0	0.286	0.353	#4, Empty, Filling from #3
50	= 30.0	23.5	22.0	0.170	0.241	
12:00	= 41.2	39.0	37.0	0.103	0.143	#3 Empty - filling from #2
:10P	= 49.9	68.0	63.5	0.059	0.083	
:15	= 54.9	115.0	105.5	0.035	0.050	
22	= 58.0	212.0	225.0	0.019	0.024	Not knowing how much is in #2 - we are draining 5 cm back into #3 - will then empty 9 + 2.
35	= 53.1					#9 Empty.
40	= 58.0					#2 not empty - filling from #3
43	= 60.0					Not critical -
:57	= 60.2 [(free surface 60.2") with tamper in contact - See H = 59.9 + tamper = 59.5 cm]					Not quite critical
1:09	= 60.3 " " " " " " - " = 60.0 " = 59.7					" " "
15	= 60.5 " " " " " " = 60.4 " 60.2					" " "
24	= 60.7 = 60.5 60.2					Slightly super critical with control rod all way out.

(Cont).

Drain back. 20.5 cm (8") were put into # 4 (60.7 - 40.2).

18.2 cm (8") " " " # 3 (40.2 - 18.2 = 22.0).

However # 3 contained 2.3 cm giving total of 20.5 cm

When H = 22.0 cm; free surface, the tamper, at contact reduced liquid level in pipet glass to 21.9 cm & tamper indicator was at 21.45 cm. Mixing by blowing back through pipet glass did not change these values.

It was decided to re-admit the solution from # 3 & 4 at this time & determine reproducibility. (However, tamper had been drained so it was refilled)

		I	II	M^{-1} I	M^{-1} II	
2:45P	H = 22.0 cm					Started filling from #3.
3:50	H = 43.2	44.0	42.5	0.091	0.125	#3 Empty. Filling from #4
3:07	H = 49.1	65.5	61.0	0.061	0.087	
3:15	= 56.0	140.0	129.0	0.029	0.041	
23	= 58.5	275.5	254.0	0.015	0.021	
32	= 60.1	Not Critical.				
37	= 60.3	" "				
45	= 60.6	Slightly below critical.				
58	= 60.8	Critical with 20cm Cd control rod below solution level.				

Drain back- 17.6 cm (8") into # 4 mixing its content 20.5 cm

into # 3 20.5 "

Conclusions:

① With H/X = 281.8 (to be determined), 8" Reactor, tamped double wall thickness - critical height = 60.7 cm.

② It was possible to check this value to ± 0.1 cm by draining about 2/3 of the solution and re-admitting it.

③ These values to be compared with 60.3 obtained under supposedly same conditions in Exp 120. Difference may be due to slight variations in H/X.

Sample taken on drain back for sp. gr = 1.108

& for H/X = 300 } obtained at F.05 by straight
288 } inspection

281.8 from Rm 8 DL-6 blood on one sample from wtr. burette and FD5's value of the sp. gr. (Sample electrolytical purified).

Tabulated Data on Wall Effects. 8" Reactors, Tamped

Exp #	Reactor Wall	H/x	Hc (corr.) (62.2)
121	1/8" SS	281.8	60.7
122	1/16" SS	302.5	52.3
123	1/16" SS	99.5	24.2
124	1/8" SS	91.2	25.5
125	1/16" Al	98.2	22.4
126	1/16" Al + 1/16" SS.	~98 (?)	23.8
127	1/16" Al + 1/16 SS	289.8	47.5
128	1/16" Al	289.8	40.1
129	1/16" Al	58.8	20.5
130	1/16" Al + 1/16" SS.	58.4	21.9
131	1/16" SS	58.4	20.8
134	1/16" Al + 1/16" SS.	192.	30.8
135	1/16" Al	192	28.1
136	1/16" SS.	192	29.4

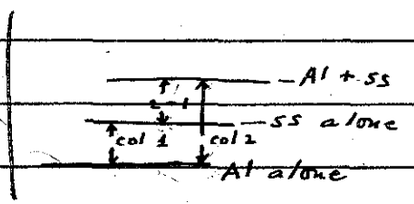
The above may be grouped as follows:

H/x Range	Al	SS	Al + SS.	SS + SS
58.6 ± 0.2	20.5	20.8	21.9	—
95.4. ± 4.2	22.4	24.2	23.8	25.5
192	28.1	29.4	30.8	—
292.1 ± 0.4	40.1	52.3	47.5	~~60.7~~ (62.2)

from which we see.

H/x - Range	Col. 1 ΔHc on substituting SS for Al	Col 2 ΔHc on adding SS to Al	Col 2 − Col. 1
58.6 ± 0.2	0.3	1.4	+ 1.1
95.4 ± 4.2	1.8	1.4	− 0.4
192.	1.3	2.7	+ 1.4
292 ± 10.4	11.8	7.4	− 4.4

The simplest way of showing the data to be inconsistent is to obtain the value: Col 2 − Col 1 & note what this value represent.



So Col 2 − Col 1 is a measure of effect of adding Al to stainless. Each value is expected to be positive & less than its corresponding value in column 1. This condition is not fulfilled anywhere. There are other inconsistencies the value C-1 (1.3) for instance should lie between 1.8 & 11.8.

For these reasons, the data were not reported in "Critical Mass Studies, Part III"

Experiment # 122. 9/27/48

8" Reactor H/X = 302.5 (~300) Cronin

Tamped - Normal reactor wall thickness, using same solution as used in #121. Moeller

Starting with H = 22. cm - as stated for #121 Magg-H.

Assume "Zero" count for I = 4.0 II = 5.3 - Cacchione

		I	II	$\frac{I}{M-1}$	$\frac{II}{M-1}$	
4:46P	H = 21.6 cm.	15.5	16.0	0.258	0.331	Filling from #4.
52	= 30.0 "	27.5	26.5	0.145	0.200	
49	= 37.5	46.5	43.0	0.086	0.123	
	= 41.[illegible]					#4 Empty, filling from #3.
5:09	= 45.2	101.5	97.0	0.039	0.055	
115	= 48.5	214.0	201.0	0.019	0.026	
22	= 50.1	NOT CRITICAL.				
25	= 50.5	"	"			
37	= 50.9	Critical with 12 cm Cd coated rod below surface of solution -				
35	= 50.75	NOT CRITICAL.				

During drain back - when H = 20 cm - sample taken for sp. gr. = 1.108

H/X = 241 } obtained at Rm 05 by direct ignition
= 246 }
= 280 obtained at Lab D as on pg 110.

Conclusion: 8" Reactor H/X 302.5 (~300) Tamped, Normal wall thickness - Critical at 50.8 cm.

Inventory		H/X	cm in 8" Reactor.
	1	? (~320.	~ 20 cm.
	2	~ 300	20.5 + cm
	3	~ 300	20.5
	4	~ 300	20.5 cm.
	5	empty	
	6	? ~ 86	Dead vol.
	7	"	18.0
	8	"	18.8
	9	~ 300	Dead volume +

% U = 9.136

11/17/48 DC 50.8 + 1.5 = 52.3 cm - Hc bottom corrected
H/X = 302.5
8" Stainless. Tamped.

H/X = 302.5

3/1/48 EXPERIMENT 123- 8" Reactor, Tamped, normal reactor wall thickness.

Macklin

$H/X^* = 98.2$ (~85).

Visner
Cronin
Callihan.

Purpose: To examine effect of increasing wall thickness of reactor by adding a 1/16 stainless steel sheet, with a higher concentration of active material than used in #121 & #122. This repeats #116 & #118 but with better care & sampling for H/X ratios.

Trip points #3 - 85×100 #4 - 84×100

Scales #3 - 100 #4 - 10 #5 - 2 R.E. - 50 ms.

Source 1/4 C, brass - paraffin enclosed - 12 cm from bottom.

1:50 Filling dead volume from #6

		#1	#2	c₀/c	
1:55.	H: 0.1 cm	4.5	6.0		
		4.5	5.5		
	→	4.5	5.7		

Filling from # 8. (Checked for cylinder valve leak; NG). First ht indication was ~10 cm; blew back manometer 4 times, each time the level appeared lowered, to a final value of 7.8 cm.

2:30	H = 7.8	7.5	8.0	0.60	0.71.

Filling from # 7.

2:45	H: 14.7	22.0	23.0	0.205	0.248
2:55	H = 17.5	43.0	40.5	0.105	0.141.
	H = 19.5	76.5	68.5	~~.083~~	
				.059	0.083
3:20	H = 21.0	144.0	128.0	.031	0.045
3:25	H = 22.2	456.0	405.0	.010	0.014

3:38 H: 22.6 Not Critical.

3:42 H = 22.8 Critical C.R. 8 cm below solution level.

Call 22.7 cm critical

Drawback

7 - 18 cm

Density measured: 1.311

H/X ~~= 92.4 from L&D analysis~~ of pipetted sample + F-05 sp. gr. - (Sample purified electrolytically).

* Ave of analyses Exp 123-126 inc. gives wt % X = 19.24
H/X = 99.5
Sp gr = 1.32 BK 22 pg 57

11/26/48 DC 22.7 + 1.5 = 24.2 cm. corrected for bottom.

"8" Stainless tamped
Sp gr = 1.32
H/X = 99.5
wt % X = 19.24 = 0.254 gm X/cc
Vc = 7.85 l
Mc = 1.99 Kg.

% U = 20.73

3/1/48. Experiment 124 8" st. st. reactor lumped $H/_4 \sim 85$ additional 1/16" stainless steel wall added.

Note: The 1/16" stainless cover does not fit as snugly on reactor as previously.

Scales #3 - 100 #4 - 10 #5 - 2 Rod - 25 mm.
Use background counts from Exp 123.
Source as in exp 123

4:20	H = 8.0	7.5	7.5	0.60	0.76
4:30	H = 15.9	25.5	24.0	0.18	0.24
4:35	H = ~~12.6~~ 18.5	45.0	39.5	0.10	0.14
4:40	H = 21.3	98.0	89.0	0.046	.064
4:50	H = 23.0	271.0	249.0	.017	.023
5:00	H = 23.9	Not Critical.		No 7 is dry.	
	Filling from #8				
5:08	H = 24.1	CRITICAL		C.R. 10 7/8 cm below sol. level	

Call 24.0 cm critical

Dranbach: # 7 - 16 cm in 8" reactor.
" 8 - 18 cm
" 6 - Dead volume.

Samples taken for $\rho_{eff} = 1.137$ (3/5 This value is obviously in error).
$H/_8 = 91.2$ Lab ① analysis with ρ_{eff} assumed 1.317.

Conclusion: Comparison of 123 & 124 & assumption that $H/_X$ same in both - the extra thickness of stainless increases critical height by 1.3 cm

$H/_X = 98.2$

$\%\ U = 20.78$

~~3/5/48~~

92
87

Experiment 125

~~Mar 4~~

8" Aluminium Reactor.

3/8/48

Tamped

~~Hx = 85~~

Marklin

Fox

Callihan

~~To determine the effect of removing the stainless steel~~

Cronin

Aluminium reactor (wall 40 mil al, base 1/2" 24ST al) substituted for stainless steel in order to evaluate poisoning effect of stainless — al reactor sprayed with tygon paint inside and out - due to poor alignment of top tamper + reactor some paint has been scraped off.

Trip points - 92×100 on 3.; 87×100 on 4.

Scales - #3 - 10; #4 - 10, #5 - 2; R.E. 25 m.s.

In order to examine bottoms of reactor, at wall to base plate weld, for leaks some solution will be put in before the tamper water.

Source (½c in brass sphere) 12 cm from reactor bottom = 45 on scale

→ Zero of sight glass - with this reactor - reads 2mm low.

→ Values of H listed below are those read, need to be corrected.

#6 empty. Filling from #7.

	H	I	II	n^{-1} I	n^{-1} II	
	H = 0.1 cm	5.5	5.5			
12:30 P	H = 1.6	4.5	6.0			
	=5.0	5.5	8.0	0.910	0.726	
	=10.0	11.5	11.0	0.435	0.528	
1:53	=14.0	22.5	23.5	0.222	0.247	Ca 2cm left in #7; now filling from #8
1:00	=16.0	36.0	38.0	0.139	0.153	
1:06	=18.0	76.5	75.5	0.065	0.077	
:12	=19.5	219.0	221.0	0.023	0.026	
:23	=19.8	248.0	247.5	0.020	0.023	
:31	=20.1	NOT CRITICAL.				
:36	=20.3	"	"			
39	=20.5	"	"			
42	=20.7	Critical with Cd control rod out.				

$\%U = 20.80$

Drain back to 14cm into 8; to 8.5 cm into #7.

Conclusion: critical with Height (Corrected) = 20.9 cm - al reactor Hx = 85, Tamped.

This value is 1.8 cm lower than the corresponding experiment with a stainless steel reactor of normal wall thickness.

Sample taken on drain-back gave:

(d = 1.319; Hx = 98.2)

11/17/48 DC 20.9 + 1.5 = 22.4 cm (as now corrected)

11/26/48 DC Hx = ~~98.2~~ 99.5

8" Aluminium, Tamped.

Dfgr = 1.32, with H_2O x = 19.24 = 0.2 ml gm x / cc.

~~Yc = 1.0~~ Yc = 1.264; Mc = 1.84 lbs

3/8/48

Experiment 126

Macklin
Fox
Cronin
Callihan.

8" Aluminium Reactor with 1/16" Stainless Steel Enclosing M.

Tamped.

H/x = 85. 98.2

Repetition of #125 with addition of 1/16" stainless sheet around Al. - Trip points as in #125

Scale #3 - 10, #4 - 10, #5 - 2, R. E. 50 mv.

		I	II	I (m⁻¹)	II	
2:25P	H = 8.5 cm	~~8.0~~ 4.0	~~9.0~~ 5.0	0.625	0.644	Beginning to fill from #7
38	= 14.1 cm	20.0	21.0	0.250	0.275	#7 not empty - feeding from #8.
44	= 18.3	52.0	52.5	0.096	0.110	
50	= 20.3	109.5	112.0	0.046	0.052	
57	= 21.6	386.5	397.0	0.013	0.015	
3:05	= 21.9	NOT CRITICAL.				
:09	= 22.1	Critical with 5 cm Cd control rod below solution surface.				

DRAIN BACK: #8 - 18 cm in 8" Reactor
#7 - 16" " 8" "
#6 = Dead volume -

Conclusion - 8" Al reactor enclosed in 1/16" stainless sheet - critical at 22.3 cm (corrected for zero).

H/x ~ 100

Summary: #123 - Normal wall thickness stainless reactor H_c = 22.7 cm
#124 - Stainless reactor plus 1/16" stainless sheet. = 24.0 " } Δ = 1.3 } ~6.2% } Effect of 1/16" stainless shell.
#125 - Al reactor. = 20.9 "
#126 Al reactor plus 1/16" stainless sheet = 22.3 } Δ = 1.4

From #123 & 125 Al vs Stainless, bare Δ = 1.8 cm - however there is included effect of changes in H/x over period of a week. Final conclusions should be drawn after H/x determinations have been made.

% U = 20.88

116

8/9/48

Experiment 127

For

8" Aluminum Reactor encased in 1/16" Stainless Steel Shell.

Cronin
Callihan

Tamped. H/X = 300 (289.8)

to take with 128, the

Purpose: To examine effect of stainless steel on Critical conditions at this H/X = 300.

Solution lines redrained, with vacuum pumps to get our all H/X = 85 possible

Trip points: #3 86 x 100, #4 94 x 100

Scales #3 - 100, #4 - 5, #5 - 2, R.E - 25 ms.

Source - 1/2 c, brass sphere - 12 cm from bottom of reactor.

Zero on sight glass = 2 mm solution.

Filling dead volume from #9.

#9 empty; start filling from #4

		I	II	M→ I	II	
2:25P						
30	H = 1.0 cm	4.0	5.0			
		3.5	5.0			
36	= 8.4 cm	5.5	8.0	0.682	0.625	Sight glass = ~~8.4~~ 8.3, Tamper 9.0 indicating some inhomogeneity
	= 15.0					" = 14.9 " 15.8 " " "
	= 15.6	10.0	12.0	0.375	0.416	" = 15.75 " 15.75 after blow back.
3:15	= 23.0	18.0	20.0	0.208	0.250	#4 Empty; Now filling from #3
3:30	= 30.3	30.0	30.0	0.125	0.166	
36	= 40.0	74.5	75.0	0.050	0.067	#3 Not empty - but now filling from #2.
3:55	= 45.2	493.5	498.0	0.068	0.010 ~~0.001~~	
4:05	= 45.7	NOT CRITICAL				
:09	= 45.9	NOT QUITE CRITICAL				
:16	= 46.1	Critical with 12 cm CD control rod below solution level.				

Drain back into 2 to 40 cm

" " " 3 " 22 cm.

Removed stainless steel shell -

Took samples for Sp gr = 1.103; H/X = ___

Conclusions: Critical at 46.2 cm - Corrected for zero -

8.6% U 8.57

8.03% X

For H/X = 290 data

See Lab' data Report # A-1626

3/22/48

Experiment 128 — 3/9/48

8" Aluminum Reactor - Tamped, H/x ≈ 300. (289.8) — For Cronin Callihan -

Purpose - see #127. also see #125 for description of reactor.
Scales & trip points as before, also source.
"Background" count taken as in #127

		I	II	M^{-1} I	M^{-1} II	
5:18P	H = 21.9 cm	19.0	21.0	0.197	0.238	Beginning to fill from #3
27	= 32.5	58.0	59.5	0.065	0.084	
36	= 35.7	127.5	127.0	0.029	0.041	
43	= 37.5	379.5	382.5	0.010	0.013	
55	= 37.9 (corrected 39.9)	NOT CRITICAL				
6:02	= 38.2	"	"			
:06	= 38.5	CRITICAL with 3 cm Cd control rod below solution surface				

		H/x	8" centimeters
~~Drain~~ Inventory	1	? (~320)	~20 cm.
	2	~300	20.5+
	3	~300	20.5
	4	~300	21
	5	empty	
	6	~85	Dead volume
	7	~85	16 cm
	8	~85	18 cm
	9	~300	Dead volume + 1 cm.

Conclusions ① 8" al reactor - H/x ≈ 300 - Tamped Critical 38.6 cm (corrected for zero).

② H/x ≈ 300 -

al reactor	H_c = 38.6 cm	Exp 128	Δ = 7.6 cm = 18%	Effect of Stainless Steel sheet
" " + 1/16" Stainless sheet	= 46.2 "	127		
Stainless " , normal wall	= 50.8	122	Δ = 9.9 cm = 18%	
" " + 1/16" Stainless sheet	= 60.7	121		

③ Comparison of al & Stainless reactors:

Exp 128	H_c = 38.6	Δ = 12.2 cm ≡ 31.5% of al val -	
122	H_c = 50.8		
127	= 46.2	Δ = 14.5 ≡ 31.5%	
121	= 60.7		

④ Above assumes constancy of H/x values in two instances - respectively.

~~On dr~~ During drain back sample taken for ap. qr = 1.101
H/x = 289.8

11/17/47 DC 38.6 + 1.5 = 40.1 cm (bottom corrected)
H/x = 290. ; ρ/ρ₀ = 1.10 ; wt % X = 8.01 ≡ 0.088 gm X/cc.
8" al tamped.
V_c = 13.00 ℓ
M_c = 1.15 kg.

March 31, 1948 —

Beck
McFadden
Cronin.

8:30 AM. Removed cylinders #3, 4, and 7 — resoldered at leaking points.

3:07 PM. Purpose: Mixing solutions in cylinders 1, 2, 5, 9 — (nominally 25–100 $^{H}/_{X}$.)

3:15 PM — adding from #1. filling dead volume

	Counters #1	#2	
zero.	48(?)	56.	
2.7.	37	51	#1 empty.
	34	52.	

3:25 adding from #2.

7.9	47.	68.	#2 empty.
	46	67.	

adding from #5.

12.0	71	90	#5 empty.

adding from #9

16.0	73	95	#9 empty.

Mixed by bubbling air —
Net reading 21. cm –
73 - 95

Drainback — into #1 and #2 and 9
10cm drained back, then sample taken.
remainder drained back. Sp. H_1 = 1.6514 N_H/N_x = ~41

Drainback into 1, 2, 9.
#1 + 2 values very slow on drainback, even with Vacuum.

4/2/48

Solution Inventory:

	#1	#2	#3	#4	#5	#6	#7	#8	#9
$^{H}/_{X}$	~40	~40	300	100	~40	100	—	300	~40
h_1	66.5	~~34.0~~	68.6	59.3	72.7	62.4		69.0	MT
h_2	36.8	48.0	35.0	34.3	31.1	40.0		34.7	
Δh in manometer	29.7	6.0	33.6	25.0	41.6	22.4		34.3	
4cc cyl. lift	53.4	10.75	90.5	57.0	74.6	51		92.1	
8cc " "		2.7 ~~w~~		14.2	18.5	12.7			

During the period 3/9-31.

① The building wiring was renovated

② The laboratory rooms were decontaminated after it was found that there were accumulations of active dust on most all surfaces.

③ Preparations were made to improve recovery procedures by:

a) Construction of a new extraction column

b) Since burning of the waste paper, etc. containing active material in the open distributed activity in the atmosphere - a oven was designed and constructed.

④ a 6" al reactor was constructed.

⑤ It was proposed to investigate activity of 6" reactor in al at optimum H/X (for cylinder) for this purpose solution of H/X ≅ 24 (which had been in storage) was mixed with some H/X = 100 to give the solution described on page 118.

⑥ Replaced P-18 sight glasses.

4/7/48 Measurements of cylinder contents show ~11 ℓ of H/X = 40 which is insufficient to fill a 6" reactor plus dead volume, 17 ℓ being required. To increase the H/X and the volume additional H/X = 100 is to be added to the H/X = 41 —

120

4/7/48

Marsh
Macklin
Cronin
Callihan

To mix H/K = 40 with H/K = 100 - ~~#~~ solution

to be mixed in 8" reactor untamped.

Trip points # 3 = 88 ± 100
4 = 94 ± 100

Scales # 3 - 100
4 - 5
5 - 2
RE - 25 mv.

		I	II		M⁻¹
12:40 P		57.5	54.0		
		57.5	54.0	I	II
12:50 P	H=2.2 cm	33.5	30.0		
	H=3.0				
1:15	=19.8	97.5	84.0	0.59	0.64
25	=29.0	110.5	97.5	0.52	0.55
55	=40.8				

#1 Empty. Filling from #2

#2 Empty. Filling from #4.

#4 Empty* (Mixed pool). Filling from #5

#5 Empty - Well mixed.

Drain back: 1 Empty
2 Empty
3 H/K ≅ 300 90.5 cm in 4" cylinder
4 Empty
5 H/K ≅ 600 ? 70 cm. in 8" cylinder.
6 H/K ≅ 100 12.7 cm in 8" cylinder.
7 H/K ≅ 60 10 cm in 8" cylinder
8 H/K ≅ 300 92 cm in 4" cylinder
9 - H/K ≅ 60 11.4 cm in 8" Reactor

(Dead volume in pipettes).

Specific gravity of mixed solution = 1.51 ≅ H/K = 60

~~From the quantity~~

The quantity of solution mixed (40.8 cm in 8" reactor) corresponds to about 73 cm in a 6" reactor. It would be desirable to be able to put 80-85 cm in 6" reactor requiring about 2L additional solution.

* During the filling from #4:
a) a number of air bubbles were carried along by the stream -
b) long before #4 was empty, there was a persistent "feel" through the valve handle of a "bubbling" It was not possible to determine the source. Possibly due to constriction in line since flow was low. This prob. was not observed when filling from #5 -

Experiment 129. 8" al ~~H/X~~ Reactor. 4/2/48

H/X ≅ 60 Hanged.

Cronin
Morfitt
Macklin
Callihan

#5 chamber out of order.
Scales - #3 - 100 #4 - 10.5 RE 25 mv.
Source - (1c) on bottom of reactor.

	I	II			
H = cm.	-0.2 12.0	13.0			
	12.5	13.0			
	12.3	13.0			
			I M^{-1}	II	
3:02P	= 9.3	24.5	21.5	0.50	0.60
10 P	= 15.3	58.5	53.0	0.210 ~~0.245~~	0.245
17	= 17.2	117	110.5	0.101	0.117
25	= 17.9	212.5	186.0	0.058	0.071
33	= 18.3	484.0	418.0	0.0254	0.0304
48	= 18.7		Not Critical.		
55	= 18.9		Critical with 8 cm cd rod below solution level.		

Filling from #7.
#7 empty. Filling from #5.

Conclusion- 8" al Reactor. H/X ≅ 60, Critical at { 18.8 cm solution = 19.0 cm corrected for sight glass zero

Inventory: (see also pg 120).
#5 - H/X ≅ 60 20 cm in 8" reactor.
#7 H/X ≅ 60 9.3 cm in 8" reactor plus dead volume.

Specific gravity = 1.51
Sample taken for H/X determination-
H/X = 58.70 = 29.35% by wgt of U.

11/17/48 DC
19.0 + 1.5 = 20.5 cm - Hc bottom corrected
H/X = ~~58.7~~ ~~29.40~~ 58.8
8" al, Hanged.
ρ_{sp} = 1.51
wt% X = 27.45 ≅ 0.415 gm X/cc
V_c = 6.65 ℓ
M_c = 2.76 kg.

11/10/48 H/X from Lab D - Report A1714 4/16/48
Exp 129 29.35% U
" 130 29.46
avg 29.40% U
H/X = 58.8

122 4/5/48

EXPERIMENT 130

Cronin, Fox, Visner, Callihan, Pressey

8" R Aluminum Reactor with 1/16" Stainless Steel Lined.
Extra Walladded -
H/X = 60.
Trip points - #3 85 x 110, #4 85 x 100.
Scale - #3 - 100; #4 - 10, #5 - 2, R.E. - 25 mv.
Source - 1Ci in brass sphere - 12 cm from bottom of reactor.

Filling dead volume from #7

1:25	H = -0.2 cm.	#1	#2	C/c	C/c	
1:40		5.5	4.5	Background.		
		6.0	4.5			
		5.7	4.5	← C_o		
1:50	H = 9.7 cm	12.0	11.0	0.48	0.41	cyl #7 dump.
2:05	14.1	27.0	25.0	0.21.	0.18	from #5
2:15	16.5	52.5	46.0	0.11	0.098.	
2:20	17.5	81.0	72.0	0.070	0.063	
2:25	18.4	126.0	114.0	0.045	0.390	
2:35	19.2	240.0	209.5	0.024	0.022	
2:45	19.6	400.0	350.0	0.014	0.013	
2:55	~~19.8~~ 19.9	Not Critical.				
3:00	20.1	Not Critical				
3:10	20.3	Critical with cd rod 10.3 cm below solution level				

Call 20.2 cm critical (uncorrected).

Drain back

#5 - 20 cm. (8")
#7 dead volume + 9.5 cm (8")

Conclusion. 8" al. reactor with 1/16" stainless steel extra wall is critical at { 20.2 cm with H/X ~ 60
{ = 20.4 corrected for sight glass 3cm

Specific gravity (measured) = 1.52
this corresponds to H/X ~ 57, 58

H/X = 58.38 = 29.46%

4/6/46
Cronin
Pressey
Fox
Callihan -

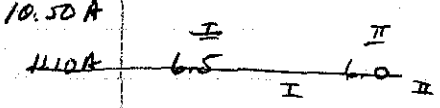
EXPERIMENT 131

8" Stainless Steel Reactor - Normal Wall

H/X ≅ 60, Tamped.
(58.38)

TRIP POINTS #3 86 x 100 #4 94 x 100.
Scales RE - 25mv. #3 - 100 #4 - 5 #5 - 2.
Source 12 cm from reacta bottom.

10.50 A
11.10 A



Filling dead volume from #7.

					M⁻¹	
11:10 A	H=0	6.5	6.0			
		6.0	5.0			
		(6.3)	(5.5)	I		II
20	H= 9.2cm	11.5	10.5	0.55		0.525
11:30	=14.6cm	31.5	29.0	0.20		0.19
45	=16.0	56.0	50.0	0.113		0.110
55	=17.3	100.5	87.0	0.063		0.063
12:00	=18.0	164.0	151.5	0.039		0.036
05P	=18.5	268	234.5	0.024		0.024 ~~0.019~~
15	=19.2	1007	982	0.006		0.006
35	=19.4	Critical with 6 cm of Cs control rod below solution level.				

#7 Empty - Fillings from #5

Conclusion: 8" Stainless Reacta, same ~~solution~~ as used in #129 & 130, H/X = 60
Critical at 19.3 cm - ~~(19.3 cm corrected for slight gloss).~~

Drain back: #5 - 20 cm in 8" reacta = 35.6 cm in 6" reacta
#7 - 9.5 cm " " - + dead volume = 16.9 " " + "
#9 11 " " = 19.6 " " - 05 →

11/17/46 DC 19.3 + 1.5 = 20.8 cm - Hc - bottom corrected.
11/~~14~~/46 ~~Hc = 18.4~~ 18.8
8" Stainless, flanged.
Wt 9% = 27.45 = 0.415 gm x /cc
ρ of 9% = 1.51
Vc = 6.74 ℓ
Mc = 2.80 kg.

Experiment 132

4/6/48

Cronin
Pressey
Jay
Callihan

6" Aluminum Reactor - Tamped

H/X ≃ 60 - (58.38)

Trip points same as before
Scales #3 - 100, #4 - 5, #5 - 2, RE - 25 mv.
Source - 12 cm from bottom of reactor.

3:20 Filling dead volume from #9.

		I	II		
3:27	H = 1 cm	6.5	5.0		
		6.0	4.5		
		6.3	4.8		
3:30	H = 1.8 cm				#9 Empty, filling from #7.
34	H = 5.1			M^{-1} I	II
45	= 15.1	15.5	11.5	0.41	0.42
55	= 20.0	19.5	15.5	0.32	0.31
4:05	= 25.0	27.0	21.0	0.233	0.23
20	= 35.0	37.0	30.0	0.17	0.16
25	= 36.5				#7 Empty, filling from #5
30	= 45.0	54.5	45.0	0.116	0.107
38	= 55.2	88.0	73.0	0.072	0.66
50	= 61.1	121.5	128.0	0.041	0.038
5:00	= 66.0	316.0	~~259.0~~ 258.0	0.020	0.019
10	= 68.0	768	624	0.008	0.008
30	= 68.5	NOT CRITICAL			
37	= 69.0	NOT CRITICAL			
45	= 69.9	Critical with 13 cm Cd control rod below sol. surface #5 empty.			
50	= 69.5	" " 8½ " " " " "			
55	= 69.2	" " Cd rod at surface of solution			

(Solution mixed - no change in sight glass value).

Conclusion 6" Aluminium Reactor - H/X ≃ 60, Tamped Critical at H = 69.2 cm.

Inventory

	H/X	
#1	-	Empty
2	-	Empty
3	≃300	90.5 cm in 4" cylinder
4	-	Empty
5	≃60	- 35 cm in 6" cylinder 25.7
6	≃100	12.7 cm in 8" cylinder
7	≃60	35 cm in 6" cylinder
8	~300	- 92 cm in 4" cylinder
9	≃60	Dead Volume

Sp gr taken on drain back = 1.51

11/17/48 DC 69.2 + 2.6 = 71.8 cm = Ht bottom corrected
H/X = ~~58.4~~ 58.8
6" al tamped
Wt H_2O = 27.45, = 0.415 gm/cc
Sp gr = 1.51
Vc = 13.10 ℓ
Mc = 5.44 kg.

Experiment #133. 7" stainless Steel. H/x = 60 (58.38) (Repitition of #6 & #7).

Back Pressy for Cross McLendon.

To measure effect of Top Tamping.

A - With Normal Tamping
Triga Points # 3,83 #4,95.
all Instruments OK.

Time	Solution Level	Counter Reading #1	Counter Reading #2	M⁻¹ #1	M⁻¹ #2	REMARKS
10:52.						Adding from #5
	Bckgnd.	4.5	5.5			
11:04	0.3	5.5	4.5			
		6.0	4.5			
11:13	20.0	30.0	25.5	.183	.177	#5 MT - (H=25.0)
11:24	25.0	66.0	53.0	.083	.085	
11:33	28.5	178.	147.5	.031	.031	Start adding from #7.
11:43	30.5	Not Critical - Close -. Rod out. -				
11:46	30.7	Critical; Rod out; Source removed. -				

Conclusion: 7" S.S. Reactor Tamped - H/x = 60 Critical at 30.7 cm.
This duplicates results of Exp. #6 within 1mm. -

Drain back part way; remove top tamper, and continue.
~~Drainback~~.

B. With No Top Tamper — otherwise Normal.
~~#5~~ - ~~30.7 cm.~~ -

		#1	#2	#1	#2	
12:06	27.5	67	54	.082	.083	#5 MT @ 31.0 cm
12:18	30.0	131	109	.042	.041	
12:23	32.1	447	373	.012	.012	
12:28	32.6	Not Critical - Rod Out -				
12:35	~~32.8~~	Critical ! - Rod Out, Source Removed. —				

Drainback

	#5	32.8	#7 9.7	#9 dead Vol.
		9.7	0.0	
7" cyl		23.1 cm	9.7	
4" cyl		~~47~~	~~5.46~~	
		70.1	29.7	

14
14

Dilution to W/N ~ 200

Solution Inventory:

	#1	#2	#3	#4	#5	#6	#7	#8	#9
H in 4" cyl.	—	—	90.5 cm	~~57.6~~	70.7	~~[illegible]~~	29.7	92.1	dead Vol
W/N			300	~~100~~ Empty	60	100	60	300	60
						~~5.5~~ 5.5 liter			

From calc. using all W/N 300 (ca 14 liters) and adding 6 liter W/N 100 should reach W/N ~ 200 or 18.5 additional in 8" reactor.
20 liter ≙ 49.5 cm in 8" reactor (~~to~~ dead Vol. subtracted)

Drawback of mixed W/N 200

#	
3	20 cm in 8" R
6	20 " " "
8	7½ + Dead Vol ≙ 17.3 cm Total

4/8/48

Crowne
Fox
[redacted]
Moffitt
Murray
Presley

Experiment #134 H/X ≥200 "8" Al - Reactor.

Tamped with 1/16" stainless

#3 - 100 scale 4 - 10 scale 5 - 25 scale Recd - 25 Scale.

Time	Soln Level	Counter Reading #1	#2	M^{-1} #1	#2	Remarks
9:20						Adding from 8
9:23	-0.1	4.0 ✓	7.0, 4.0, 8.0, 6.5 Use 7.0			
9:50	7.1	6.5	6.0	.63	—	8 empty adding from 6
10:00	15.1	14.8	14.5	.27	.48	
10:08	18.0	20.5	18.2	.195	.384	
10:13	22.0	39.0	32.0	.103	.22	
10:22	25.0	76.0	58.0	.053		Left 6 adding from 3
10:33	27.0	168.3	139.			
10:40	28.5	354.	287			
10:48	29.4	Critical with 7 cm of control still in				
11:05	29.2	Sub critical with Rod all out				

Critical at 29.3 cm ± 0.1 -

Drainbox as per ~~Exp #133~~ opp. Page

$H/X = 174.53$

11/17/48 ~~xc~~ 29.3 + 1.5 = 30.8 cm = Hc bottom corrected
H/X = ~~174.5~~

for H/X see pg 128 this book

128 4/6/48

Experiment #135 H/X ≈ 200 8" Al Reactor

Tanpad (#134 with Stainless Removed)

Cronin
Fox
Morrill
Murray
Pressey

#3 - 100X #4 - 20X 5 - 2X Reed 50X

	Liquid Level	COUNT #1	COUNT #2	RECP. #1	RECP. #2	Soln.
12:25 p	0	4.5 (4.5)	4.5 (EST.)			from #8
12:30 p.	7.1					8 empty 7cm +0X
15 12:35 p	15.0	15.3	14.5	.295	0.31	adding from #6
20 12:40 p	20.0	35.0	30	.13	.15	
23 12:47 p	23.1	78.0	66	.058	.068	
25 12:53 p	25.0	177.0	149.0	.025	.030	STOPPED #6
26 1:00 p	26.0	470	381	~~.030~~ .0096	.0305	from #3
26.5 1:10 p	26.5	NOT CRIT.				
26.8 1:17 p	26.8	super crit. at 17 cm rod in soln.			Dram back	same as
26.6		Est. Critical height 26.6 cm.				Exp. 134

Measured Sp G 1.167 approx H/X 182

This cannot be checked } { H/X = 174.53 ± 12.26% U by wt. } See Lab D report # A1714 4/16/48

11/17/48 DC 26.6 + 1.5 = 28.1 = Hc bo Hom corrected

Hc = ~~174.5~~ 192

8" al lamped.

ρ sp = 1.17

Vc = 9.11 ℓ

Mc = 1.22 kg.

H/X = 192

wt% x = 11.45

= 0.134 gm U/cc.

11/20/48 DC

4/8/48 — Experiment #136, H/X ≥ 200 (174.53) 8" S.S. Reactor

~~Morfitt~~ Pressey, Murray, Fox

~~#3 - 1000 #4 - 5 #5 - 2~~

Reed 25

Background 4.5 on both #1 & #2

Time	Lq. Level	Counts #1	Counts #2	Recip. #1	Recip. #2	
2:25	6.5	—	—	—	—	~~#8 Empty~~ ?
2:35	15.3	15.5	13.5	.29	.33	start #3 at 11 cm.*
2:42	20.2	33.0	29.0	.136	.155	
2:50	25.0	92.0	80.6	.049	.056	
3:02	27.5	824	686	.0055	.0065	
3:10	27.9	[redacted] critical	with rod	out		

Drawback:

20 cm in #8
? #6
7 cm + d. Vol. #3

11/17/48 DC 27.9 + 1.5 = 29.4 cm Hc bottom (corrected)
11/20/48 H/X = ~~174.5~~ 192
8" Stainless tamped (?) probably
Sp. gr. 1.17
wt. % x 11.45 ≡ 0.134 gm X/cc
$V_c = 9.53$ l
$M_c = 1.28$ kg.

* Evidently some sol. was added from #6 by mistake

4/9/48 | Filtered H/X = 200 solution with glass wool - Flushed out sight glass & main liquid line with distilled water - Found Kleenex, proofcoat etc.

130 4/13/48

Ex. 137

CALLIHAN

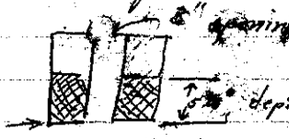
CRANIN

PRESSEY

FOX (P.M.)

7" Reactor H/X #60 with Modified Tamper

#3 - 100X
#4 - 5X
#5 - 2X
Electrometer 25



Source moves through 8" opening.
The 5¼" depth of water in tamper simulates the amount of 3" pipe at bottom of Reactor which is tamped.

	#5	#7	#9
cyl 7"	23 cm	29.7	dead Vol.

Control at zero (on scale) is actually 3 cm above bottom of Reactor.
Source 12 cm from bottom of reactor.

137a

10:00 AM. Back Ground Count. → #1. 7.0 #2. 6.0. (Soln level 0.2 cm).

Time.	Soln Level	TAMPER AT TOP OF SOLN LEVEL #1	#2	1/m.	1/m.	SOLN IN HOLE IN TOP TAMPER. #1	#2	1/m.	1/m.	
10:27A	3.6	7.0	5.5			4.5	4.0			
10:57A	6.5	7.0	6.0			7.0	5.5			
11:15A	12.6	10.0	8.0	0.7	0.75					
11:25A	~~16.7~~ 17.4	16.5	14.5	0.4¼	0.41	11.5	9.5	0.61	0.63	
1:07p	19.7	26.5	22.0	.26	.27	17.5	14.0	.40	.43	
1:27p	22.8	40.5	33.5	.173	.179	25	22	.28	.27	
1:43p	25.7	70.5	59	.10	.10	38.5	31	.18	.194	
2:01p	27.3	103	87	.068	.069	50	42	.14	.143	STOPPED USING #7
2:17p	28.9	180	151	.039	.040	65	56	.11	.11	Filling from #5
2:35p	29.9	350	293	.020	.020	80	67	.088	.089	
2:52p	30.65	* TAMPER POSITION INDICATOR SHOWED 1cm DISCREPANCY. INDICATOR RESET TO liquid level.				114	98	.061	.061	
	→	615	524	.011	.011	110	90			
3:10	31.3	Critical with only 27 cm of soln.				108(109)	89(88)	.065	.068	
						122	96.5	.057	.062	
3:18	31.0	Not quite critical.				177	143	.039	.042	
						256	212	.027	.028	
						681	556	.0103	.0108	

#9 MT @ 2.5cm Filling from #7

CRITICAL HEIGHT 31.1 cm

Not Critical
Super-Critical
CRITICAL Height. 28.8 cm in 7" dia
+ 30 cm in 3" dia

The soln. was Drained while critical from 57.7 cm to 42 cm before activity was noticably reduced.

NOTE: ① Voltage surges from TAMPER MOTOR made #4 inoperative on 5 SCALE. Put #4 on 100 SCALE & #3 on 10 scale.

② Approx 3:30 pm. It WAS NOTICED That water WAS ON floor UNDER REACTOR. TAMPER water INLET valve had leaked and overflow hose had fallen off. Mopping up operations followed.

Spec. Gravity = 1.498
($H/X = 60.85$)

Conclusions:

① 7" reactor, $H/X = 65$
Varied except for 3" dia. area at top –
Critical at 31.1 cm –

② 7" reactor as above but with 30 cm long 3" dia section at top critical at 28.8 cm –

③ Reducing this 30 cm to ca 75 cm did not noticeably reduce activity –

1376.

Soln 7" cyl.	soln. Ht. 3" ANN.	
~~0.8~~	~~30.8~~	
0.8	30.8	
6.8	36.7	
11.2	41.1	11:45A
14.3	44.1	1:15P
17.3	47.2	1:35P
20.4	50.3	1:52P
22.1	52.0	2:08P
23.7	53.5	2:25P
24.7	54.7	2:42P
25.2	55.2*	3:24P
25.2	57.2*	4:22P.
25.2	55.2	4:29P
25.7	55.8	4:42P
26.6	56.6	4:56P
27.3	57.2	5:07P.
28.3	58.3	5:20P
28.7	58.7	5:32P
28.9	57.7	5:35P

Inventory		H/X	
	1	Empty	(values need repair)
	2	Empty	
	3	200	Dead volume + 9/7 – 8" cm – = 23 –
	4	Empty	
	5	65	23 7" cm.
	6	200	?
	7	65	29 7" cm
	8	200	20 8" cm
	9	65	2 cm (7") + dead volume.

Lab Sample 28.47% U by Wt. 11/30/48 → H/X = 61.9.

4/14 – Values on 1 + 2 replaced

132-4

(3)-15-48

Experiment 138 (a)

MURRAY

7" Reactor H/x = 200 (180,04) with modified Top Tamper

Morfitt

Meter SCALE #3 100X ✓ #4 10X ✓ #5 2X ✓

FOX

Electrometer not WORKING.

CRONIN

Same Experiment as #137 except H/x ratio.

PRESSEY

Back ground counts #1 5.0 (6.0) #2 5.0 (5.0)

TAMPER AT top of soln level.

Time.	Soln. Level	#1	#2	1/m1	1/m2	
10:25 A.						TANKS DEAD VOL. from #8
10:45 A.	25 cm.					Filling from #6

The safety dump dumped while sight line was being blown out. #4 tripped. Activity level was 1½ on the 10X scale. Previously set to dump at 6 on the 100X scale. Draining back To #6. +8 ?

2:28 pm. Refilling from #8

Back ground counts #1 9.0 (9.0) #2 7.5 (7.0)

DEAD VOL. from #8

	Soln Level	1	2	1/m1	1/m2	
2:47p	25.1	16.5	145	.55	.48	7cm from #8 filling from #6.
2.55p	36.4					#6 MT. filling from #3.

At 2:59 pm The dump dumped again. This time we found the trouble. The frame of #4 meter is hot and was grounded by the chain touching the #9 valve rod.

4/20/48 Drain back on 4/15 into 6 & 8 from raw / DC

Experiment 138b.

4/20/48

7" Reactor. H/x ≃ 200 with modified top tamper. Standard stainless Reactor.

Fox
Pressey
Callihan

Soln. 15cm high in 3" hole in Top Tamper.

Scales: #3 100x #4 10x #5 2x R.E. out of order: Source on 12cm from bottom.

TRIP PTS - 9S Hi on #3 6.2x100 #4

~~Solns~~ TIME	SOLN Height in 7"cyl.	Soln Height in 3"cyl (cm)	#1	#2	$1/m_1$	$1/m_2$	
9:45A							Filling from #8
9:50A	-0.2cm		6.0	5.0			
			5.5	5.0			
9:58	10.7	0	7.5	6.0	0.477	0.83	#8 Empty, Filling from #6
10:07	20.1	0	14.0	10.5	0.415	0.476	
:15	~~17.2~~ ~~37.2~~	~~32.2~~ ~~19.2~~	12.0	10.0	0.483	0.500	
:21	27.1	0	21.0	17.0	0.276	0.294	
25	24.2	39.2	18.5	16.5	0.313	0.303	
32	34.7	0	29.0	25.0	0.200	0.200	#6 Empty
38	~~31.7~~ ~~46.7~~	~~44.7~~ ~~31.7~~	28.0	25.0	0.207	0.200	Filling from #3
47	43.0	0	44.0	39.0	0.132	0.128	
55	40.2	55.2	42.5	36.0	0.136	0.139	
11:05	50.1	0	72.0	~~61.5~~ 61.0	0.081	0.082	
11	47.4	62.4	63.0	56.0	0.092	0.089	Limit of motion of tamper.
25	49.8	64.7	77.0	70.0	0.075	0.071	#3 Empty.

DRAIN-

INVENTORY

				12"
1	Empty			
2	Empty			
3	22	7" cm	H/x ≃ 200	
4	Empty			
5	23	7" cm	H/x ≃ 65	7.8
6	22	7" cm	H/x ≃ 20	
7	29	7" cm	H/x ≃ 65	9.9
8	~~22~~ 8	7" cm	H/x = 20	
9	2	7" cm + Dead Volume	H/x ≃ 65	—

Conclusion: Because of insufficient solution and because reactor was too short it was not possible to reach criticality.

At multiplication of ~ 13 a Column of solution 3" dia x 15cm long reduced the 7" dia cylinder height ca 2 cm at this activity.

4/20/48

Pressey

Fox

Callihan

EXPERIMENT 139

7" REACTOR: Normal Stainless Steel -

Hx = 200 Tamped.

(180.04)

To compare ~~effect~~ normally tamped experiment with modified tamper -

Scales - #3 - 100x, #4: 10x #5 - 2x - Read else - out of order

Trip points - same as #138 b.

Source Ca 12 cm from bottom of reactor.

	H	I	II	I	II	
1:40 P	0.1 cm.	8.0	7.0			} These values high because top tamper was not all way down.
		8.0	7.0			}
		8.0	7.0			← Background Exp 138
:48	8.6 cm					Filling from #8
2:07	29.6 "	19.0	17.0	0.305 0.42	0.294 0.411	#8 Empty; filling from #6.
:10	37.7	28.5	23.0	0.203	0.217	#6 Emp ty; filling from #3
:25	44.9	41.0	36.0	0.141	0.139	Calculated from C
:31	50.0	63.0	41.0	0.092	0.093	= 5.8 / 5.0 =
:38	52.5	75.5	67.5	0.077	0.074	#3 Empty.

Conclusion: Insufficient data to reach criticality -
Extrapolation of above data to M = ∞ gives approximately Same Height (Hc) as modified tamper.

:55	-0.1 cm.	~~5.0~~ 4.0	3.5	} Background values taken during drain back - Effect of background is to change curve slope - probably not alter extrapolated values significantly -
		4.0		
		3.0	2.5	

Specific gravity 1.176

H/X = 183.

Analysis 12.78% U by wt. 11.94 % X by wt.

ρ_g = 1.18

0.141 gm U/cc.

Inventory: #8 - 8cm (7") + Dr. H/X = 200 - H = 52.5 + 1.9 = 54.4 cm

other - see pg 133 V = 13.50 ℓ

M = 1.90 kg

11/17/48 DC

Estimated Hc = 61 cm + 1.9 = 63 cm

Vc = 15.6 ℓ

Mc = 2.2 kg.

(4/21/48 JC) 103

Beck
for
Cronin
McLendon.

Experiment 120 –

12" Stainless Steel Cylinder – Tamped. H/X ≅ 60. (61.49)

Instruments – Trip on #3 = 90, #4 at 5½ (scale of 7).
#1, #2, #5 OK, Process monitor OK – Read out of order.

	Solution Level / Background	Counting Rate #1	Counting Rate #2	Co/C #1	Co/C #2	
10:15		6	5.5			
		6	5.5			
	zero –	6	6			
10:45	9.4	46	37	0.13	0.16	#5 MT
11:10	11.6" not critical					
11:10	11.7 super critical					

Conclusion: Critical at 11.65 ± .05 cm. Completely Tamped.

28.28 % U by wt.

11/17/48 DC
11/26/48

11.65" + 0.65" = 12.3 cm = Hc bottom corrected
H/X = ~~61.5~~ 62.6
12" Stainless Tamped.
wht % X = 26.41 = 0.394 gm X/cc
ρ fr = 1.69
Vc = 8.978.
Mc = 3.53 kg.

H/X from Lab Analysis Report 1760A 4/29/48

~~12:~~
28.28 % U
26.41 % X } by wht.
H/X = 62.6
0.394 gm X/cc solution.

11/21/47 DC

Exp. 141. 12" Stainless Steel — Untamped H/X = 60 (61.49)

Beck Mednelson Fox Cronin.

Instruments same as for former experiment.

partial drainback — then removed Tamping and began this experiment there.

	Level	Rate		C/C		C/C adjusted to true zero - determined after Expt.	
	~~zero~~	#1	#2	#1	#2		
	~~zero (9.6)~~	~~[illegible]~~	~~[illegible]~~				
11:25	zero (9.6)	66	54.5				
	12.4	114.5	99.	.54	.55	.262	.252
	14.1	167.	142	.395	.385	.18	.187
	15.6	235.5	197	~~.280~~	~~.287~~	.13	.122
	17.1	322.	294	.204	.186	.093	.082
	18.5	575	481	.115	.113	.052	.05
		~~[illegible]~~	~~520~~	~~[illegible]~~			

True zero (30) (24)

Conclusion — (1) Did not become Critical at 18.5 cm solution level.
(2) Undoubtedly would have become critical at 21. ± 0.5 cm solution level.

Background counts at zero level

#1	#2
47	43
47	43.5

Sample taken for Lab Sp. Gr. - 1.486

11/17/47 DC
11/26/47 DC

$21 + \frac{0.7}{2.6} = \frac{21.7}{21.6}$ cm estimated Hc to Hom corrected

~~Hk = 61.5~~ 62.6

12" Stainless untamped.

$\nu b^2 \delta_0 X = 26.41 \equiv 0.394$ gm X/cc.

$\delta_{gr} = 1.49$

$V_c = 15.83$ ℓ

$M_c = 6.24$ kg.

Dilution to 4/4 500

3.40 Solution mm into 12" cyl to ht of 14.8 cm

drained ~~into~~ 11.95

into #1 2.85 cm = 2.06 liters

sol'n ht 9.05

into # 2 2.90 = 2.11 liters

3 2.90 = 2.11 liters

4 ?

5 3.00

6 2.30

7 1.70 =

8 ?

Calculated: for each liter of sol'n add 1.74 liter H_2O

1 liter in 4" cyl = 2.83 cm in 12" cyl.

at ht. 6.15 #8 was emptied to ht of 7.90

Total sol'n ht = 16.55 cm = 12.05 liters

3.5 dead Vol

15.55 liters sol'n

in # 4 + #8 dead Val added (must be measured)

before dilution

	1	2	3	4	5	6	7	8
h_1	57.6	57.2	57.7	57.31	57.2	55.6	55.9	57.7
h_2	45.2	45.5	45.1	45.4	45.5	46.9	46.9	45.0
Δh	12.4	11.7	12.6	12.2	11.7	8.7	9.0	12.7

296 / 117 = 2.52

ht in 4" cyl 31.2 29.5 31.8 30.8 29.5 21.9 22.7 32.0

area of 4" cyl 81.07

Vol 25.3 23.9 25.9 25.0 23.9 17.8 18.4 26.0 25.6

Vol 50 Lambda 4.40 4.15 4.50 4.35 4.15 3.10 3.20 4.50

6.96 6.54 7.09 6.85 6.54 4.88 5.04 7.10

12" cm = 9.55 9.0 9.7 9.4 9.0 6.7 6.9 9.75

Exp. 742 12" Stainless UNtamped #/x ≃ 500 (493.6)

Murray
Morfitt
Pressey
Fox

INSTRUMENTS #3 100X #4 10X #5 1X
Zero actually Zero on sight glass.

Time

2:05 pm Background. #1 30 (28) #2 20 (20)

	Soln Level	Count #1	Count #2	c/c #1	c/c #2	
						Cyl #8 MT @ 5.3 cm
						Cyl #7 MT @ 11.8 cm
2:27 pm	18.4 cm.	29.5	24	.98	.83	Cyl #6 MT @ 18.4 cm
2:42	21.9 cm	55	37.5	.53	.53	
2:45	24.4 cm	68	51	.43	.39	Cyl #5 MT @ 27 cm
2:52	27.1	91	68	.32	.295	
3:02	30.9	132	95	.22	.21	Cyl #4 MT @ 36.4
3:12	34.9	203	144	.143	.139	
3:22	39.0	322	240	.09	.083	
3:35	43.0	618	452	.047	.043	~~#1 MT~~
3:41						
3:45	45.6					#3 MT
3:47	85.6					Start #2
3:52	47.5	~~824~~ ~~778~~	778	.0325	.0257	20.5 cm of Rod in (Not Critical with Rod out but would not count)
~~4:07~~	~~49.9~~					
4:07	49.9	Super Critical	rod 17.9 cm in			
4:12	49.5	"	rod 16 cm "			
4:15	48.0	"	rod 10.3 cm "			
4:20	48.6	"	rod 8.2 "			
4:23	48.0	Sub Critical	rod out			
4:27	48.2	Critical	rod out			

Conclusion: Crit. Height ≃ 48.2 cm.

Sample taken for analysis Sp. 1.068 — 5.22% U by Wt.
See Lab D analysis Report 1760A 4/29/48

Drain back

	1	2	3	4	5	6	7	8	9
									N/Nc 60
Inches in 12" Reactor	9.55	9.5	9.7	9.4	9.0	6.7	6.9	9.75	

11/17/48 DC 48.2 + 0.65 = 48.9 = Hc bottom corrected

11/29/48 DC Hix = ~~494~~ 499 Vc = 35.67 L.

12" Stainless unstamped. Mc = ~~1.85 kg.~~ 1.86 kg.

ρ/ρ = 1.07

wU %x = 4.88 ≡ ~~0.0522~~ 0.0522 gm U/cc

Calliham
Cronin
Fox
Morfitt
Maccia

Exp 143 12" STAINLESS STEEL TAMPED $H/x = 500 - (493.6)$

Instruments - 3, - 100 X ; 4 - 10 X. 5 - 2x P.E - 25mm
Source - 1 Ve - 6 cm from bottom - #3 9/
Control Rod - Vane ∫ Co. #4 5.8

11:10 Filling dead vol. from number 8

Background - #1 5.0, 6.5, (5.5) used #2: 5.0, 4.5, (5.0) used

	Soln Level	Count		c/c.		
11:25						Filling from #5
11:40	5.3	4.5	4.5	—	—	
11:50	7.5	6.5	5.5	.847	.908	
11:55	9.2	—	—	—	—	#5 Empty
12:00	13.5	12.5	11.0	.440	.455	From 8 - 8 Empty.
12:15	20.2	35.5	31.5	.155	.158	#6 Empty
12:25	22.5	64.5	55.5	.082	.090	From #4
12:33	24.9	362.0	309.0	.015	.016	
12:43	25.2	765	670	.0072	.0074	
12:54	25.5	Not Critical with Vane out.				
1:11	25.7	Super Critical - Critical with rod 14 cm ~~out~~ from bottom				

Conclusion: Critical Height 25.6 ± 0.1 cm.

Drainbase: same as #142

11/17/48 DC 25.6 + ~~0.6~~ 0.7 = ~~26.2~~ 26.3 cm = He bottom corrected.
11/28/48 DC H/x = ~~497~~ 499
12" Stainless tamped.
Spgr = 1.07
wt % x = 4.88 ≡ 0.0522 gm x / cc sol.
V_c = 19.19 R
M_c = 1.00 kg

Corresponding to DC 11/28/48.
H/x = 499.4
wt % x = 4.88
sp gr = 1.07
0.0522 gm x / cc sol.

4/23/48 Experiment 144 12" STAINLESS STEEL REACTOR

H_2O TAMPED - Cd SHIELDED - H/X = 500

Fox
CRONIN
CALLIHAN.

Instruments - #3 - 100 - #4 - 10 #5 - 2 RE 25mv.
Source 6 cm from reactor bottom -
Trip points - Same as 143

		I	II	M^{-1} I	M^{-1} II	
3:03p						filling dead volume from #8.
07	H = 0.5cm	5.5	4.5			
		5.0	4.5			
		(5.3)	(4.5)			
:15	= 5.7					#8 EMPTY, filling from #6
21	= 12.2	8.5	7	0.624	0.643	#6 Empty filling from #5
:36	= ~~13~~ 17.5	~~13~~ 14.0	12.5	0.379	0.360	
:41	= 20.4	19.5	16.5	0.272	0.272	#5 Empty, filling from #4
55	= 24.9	32.5	28.0	0.163	0.161	
4:03	= 28.0	56.0	50.5	0.095	0.089	Ca 1.8cm left in #4; filling from #3
:12	= 31.1	243.0	212.5	0.022	0.021	
18	= 31.7	NOT CRITICAL.				
22	= 31.9	"	"			
33	= 32.1	CRITICAL WITH TOP TAMPER IN CONTACT -				

Conclusion - 12" Stainless Reactor - Tamped plus Cd shield - Critical with H = 32.1cm -

~~[illegible] when corrected~~
~~for [illegible]~~

INVENTORY		H/X				
	1	500	9.55	12" cm	= 13.7	10" cm
	2	"	9.0	"	= 13.0	"
	3	"	9.7	"	= 14.0	"
	4	"	~~9.1~~ 9.7	"	= 13.2	"
	5	"	~~9.0~~ 9.2	"	= 13.2	"
	6	"	9.6		= 13.8	"
	7	"	6.9	"	= 9.9	
	8	"	2.0 + Dead volume.		= 2.8 + DV.	
	9	60	?			

H/X = 493.6

11/17/48 DC 32.1 + 0.7 = 32.8 cm = Hc bottom corrected
11/28/48 DC H/X = ~~4.94~~ 499
12" Stainless, tamped, Cd shield
$\rho_{sp\,gr}$ = 1.07
with ρ_X = 4.88 = 0.0522 gm X/cc
Vc = 23.93 l
Mc = ~~1.24 kg.~~ 1.25 kg.

EXPERIMENT 145 10" STAINLESS REACTOR 4/26/48

H_2O tamped - $H/X = 501$

Pressey
Jnr
Cronin
Callihan

- Instruments: #3 - 100× #4 - 10× #5 - 2× RE - 25mv.
  Trip point #3 - 8.2 ×10 #4 - 5.1 ×100.
  Source - 15 cm from bottom of reactor.

Filling from #8

		I	II	M^{-1} I	M^{-1} II	
10:40A						
45	H= 0.0 cm	4.0	3.5			
		3.5	3.0			
		4.0	4.0			
		3.8	3.5			
	=2.4					#8 EMPTY - filling from #6 -
11:00	=7.2	~~5.0~~ 5.0	3.5			
09	=15.8	7.0	6.5	0.544	0.538	#6 EMPTY filling from #5
18	=27.5	16.0	14.5	0.238	0.241	
27	=28.1	21.5	18.5	0.177	0.189	
35	=~~28.~~ 28.8	31.0	26.0	0.123	0.135	#5 Empty filling from #4.
49	=35.1	76.0	68.5	0.050	0.051	Stop filling from #4 - Tank left.; filling from #3.
12: 10	=37.1	133.0	120.0	0.029	0.029	
19	=38.6	276.0	246.5	0.014	0.014	
29	=39.2	428.0	368.5	0.009	0.009	

Top tamper upper surface level with top of reactor.

At this point the top tamper, upper surface was ~ 2.5" above reactor top. There is a danger of losing solution through the annulus between the tamper & reactor, so no further solution was added - and present data were extrapolated.

Conclusion: Extrapolation of M^{-1} curve, from $M^{-1} = 100$ gives $H_c = 39.6$ cm -
10" stainless reactor, tamped, $H/X \cong 500$ -

= 39.8 cm when corrected for 3/8" glass shielding.

Solution returned to cylinders from which it was removed.

$H/X = 493.6$

11/17/48 RE 39.8 ~~39.6~~ + 0.9 = ~~40.5~~ 40.7 cm estimated ~~Hc~~ H_c to Hom corrected

11/28/48 DC H/X = ~~494~~ 499

10" Stainless tamped.

$\rho_p q_p = 1.07$

wht % X = 4.88 = 0.0522 gm X/cc.

$V_c = 20.62$ ℓ

$M_c = 1.08$ kg.

142 4/26/48

EXPERIMENT 146

Pressey
Cronin
Fox
Callihan

10" Reactor (Stainless). Untamped; H/X = 500. (493.6)

Instruments: 3 - x100, 4 x10 5 x 1, RE - 25 mr

Trip points - see exp 145

Source - 15 cm from bottom of reactor.

1.45P

	I	II	I	II	
~~H=44cm~~					
H=24cm	26.0	26.0			
	27.0	25.0			
	26.5	25.5			
:59	=16.0	15.0	15.0		Filling from #6. #6 Empty; filling from #5
2:06	=25.3	38.5	37.0	0.689	0.689
16	=29.0	46.5	44.5	0.570	0.573 #5 EMPTY; filling from #4.
25	=35.0 (34.9)	57.0	56.0	0.465	0.455 ~~Stopped filling from #4~~
33	=39.0	62.5	60.5	0.424	0.427 Stopped filling from #4 (~3 cm left); filling from #3
40	=42.5	67.5	63.5	0.393	0.407
50	=45.0	70.0	66.5	0.378	0.387

Conclusion: 10" Stainless reactor, untamped, not critical at maximum height (45 cm). H probably would not be at ∞ length.

Check of zero of sight glass showed it to be reading 2mm too low.

11/30/48 DC
H = 45.0 + 0.9 = 45.9 cm
H/X = 499 Keff = 1.07
Wt% X = 4.88
0.0522 gm X/cc
V = 23.25 ℓ.
M = 1.21 kg.
Estimated
$H_c = V_c = M_c = \infty$

INVENTORY

		H/X						
1	~~58~~	13.7	10" cm	= 16.9	9" cm	= 21.4	8" cm
2	✓	13.0	"	= 16.0	"	= 20.2	"
3	✓	14.2	10" cm	= 17.5	"	= 22.1	"
4	✓	13.0	"	= 16.0	"	= 20.2	"
5	✓	13.0	"	= 16.0	"	= 20.2	"
6	✓	13.0	"	= 16.0	"	= 20.2	"
7	✓	9.9	"	= 11.1	"	= 14	"
8	✓	3.0	" + DV.	= 3.7	"	= 4.9	"
9	60	?					

EXPERIMENT 147 — 4/27/48 — Pressey, Frey, Cronin, Callihan

9" STAINLESS REACTOR - TAMPED, H/X = 500 (493.6)

Instruments #3 x100, #4 x10, #5 x1, RE - 25 mv.
Trip points #3 - 84 x100 #4 5.5 x100
Source 15 cm from reactor bottom -

		I	II			
8:48A						Filling from #8.
:55	H = -0.1 cm	3.5	3.5			
		3.5	3.0		M^{-1}	
9:05	= 4.2	3.5	3.3	I	II	#8 Empty; filling from #6 -
11	= 15.4	5.5	4.0	0.637	0.825	
20	= 20.0					#6 Empty; filling from #5
24	= 25.0	12.0	9.0	0.292	0.367	
32	= 30.1	15.0	11.5	0.233	0.287	
42	= 35.9	19.5	15.5	0.188	0.213	#5 Empty; filling from #3 - Upper surface of top layer at top of reactor.
52	= 39.3	21.0	18.0	0.167	0.183	

Conclusion: With available cylinder height System was not critical and probably would not be at ∞ extensions.

Solution returned to cylinders as indicated on preceding page.

11/30/48 JC

H = 39.3 + 1.2 = 40.5 cm
H/X = 499 (see preceding page)
V = 16.62 ℓ
M = 0.87 kg.

Estimated
Hc > 75 cm
Vc > 31 ℓ
Mc > 1.6 kg

144

4/27/48

Cronin

Fot

Pressey

Callihan

EXPERIMENT 148

8" Al Reactor, Tamped, H/X = 500 (493.6)

INSTRUMENTS 3×100 4×10 5×2 RE - 25 ms.

TRIP PTS same as 147 -

Source 15 cm from bottom of reactor -

		I	II		
10:50 A				Filling for #8.	
57	H = -0.5 cm	3.0	2.5	I	I
		3.0	3.0		
		3.0	2.8		
11:05	H = 5.6 cm.			#8 EMPTY.	#6 - Supply -
:16	= 15.1 "	5.5	4.5	0.546	0.622
25	= 25.1	8.5	7.0	0.353	0.400
:33	= 35.2	11.0	10.0	0.273	0.280
:41	= 45.4	14.0	13.0	0.214	0.215
:51	= 55.1	16.0	13.5	0.188	0.207
12:04 P	= 72.8	16.0	14.5	0.188	0.193

#6 Empty; filling from #5

#5 EMPTY; filling from #4

(10.5 in tube 4) filling from #3 -

Conclusion: 8" Al reactor - Tamped H/X = 500 NOT CRITICAL AT ∞ LENGTH -

With 8" Al reactor - sight glass reading are 2 cm low.

INVENTORY:		H/X				
	1	500	-	13.7 - 10" cm	= 6.1 - 15" cm	
	2	"	-	13.0 "	= 5.8 "	
	3	"	-	14.2 "	= 6.3 "	
	4	"	-	13.0 - "	= 5.8 "	
	5	"	-	13.0 - "	= 5.8 "	
	6	"	-	13.0 "	= 5.8 "	
	7	"	-	9.9 - "	= 4.4 "	
	8	"	-	3.0 " " + D.V.	= 1.3 "	
	9	60	?			

11/30/48 DC

Sight glass correction

H = 72.8 + 0.2 + 1.5 = 74.5 cm

H/X = 499 (see following page)

V = 24.15 ℓ.

M = 1.26 Kg.

Estimated. Hc = Mc = Vc = ∞

EXPERIMENT 149

5/10/48

15" STAINLESS REACTOR, TAMPED, H/X = 493.6 -

Visner
Pressley
Fox
Cronin
Callihan

Bottom of control sheet at level of reactor bottom
when scale = 5 cm.
Source - 5 cm from bottom of reactor -
Trip points #3 - 85 x100 ; #4 - 6.5 x100.
Instruments #3 x100, #4 x10, #5 x1, RE - 25 mc.

3:15 p. Filling from #8

		I	II			
3:20 p	H = 0.8 cm	5.5	3.5			#8 MT @ 1.8cm.
		5.0	3.0			
		5.25	3.25			

				I	II	
3:37	H = 4.0	6.0	3.0	0.88	1.10	Filling from #7
3:40	H = 6.4	NG	4.0	—	0.77	#7 empty.
		NG	4.5			

Filling from #6

4:02	H = 10.1 cm	11.0	7.0	0.50	0.46

#6 empty at 12.2.

filling from #5

4:13	H = 13.8 cm	21.5	13.5	0.24	0.24
:25	= 15.3	30.5	20.5	0.17	0.16
:35	= 16.9	54.5	33.5	0.096	0.093

stopped filling from #5 - Filling from #3

:45	= 18.3	116.0	71.5	0.045	0.045
:55	18.8	200.0	126.0	0.026	0.026
5:10	H = 19.25	444.0	278.0	0.012	0.012
5:13	= 19.40	Not critical.			
5:18	H = 19.7	Critical with Cd. sheet 18 cm from bottom of reactor.			

Consider 19.6 cm just critical
(=19.0 cm when corrected for slight glass zone).

Conclusion: 19.6 cm is critical in 15 in cylinder of stainless steel at H/X = 493.6. Tamped.

Drain back ! same as Exp 148

11/17/48 DC
12/28/48 DC

19.0 + 0.4 = 19.4 cm
~~19.6 + 0.4 = 20.0~~ = Hc bottom corrected.
H/X = ~~494~~ 499
15" Stainless, tamped.
$\rho_{app} = 1.07$
Wt% x = 4.88 ≡ 0.05229 m x/cc
Ve = ~~22,800~~ 22.12 R
Mc = ~~49 kg~~ 1.15 kg

146 5/11/48

EXPERIMENT 150.

15" STAINLESS REACTOR UNTAMPED H/X = 494.

For Pressey Mann Martin Cathen

Control rod in solution. Zero = Zero.
Source: 8cm from bottom of reactor.
Trip current - #3 - 85 x100, #4 6.3 x100.
Scales - #3 x100, #4 x10, #5 x 2 RE 25 mv.

11:25A Filling from #8.
Ck's Zero of sight glass - 0 = ~~red~~ rdg of 6mm
i.e. all sight glass readings are 6mm high

→

		I	II
H = 0.7cm		26.0	17.0
		29.5	16.5
		27.8	16.8

				M+		
11:35	=2.0					#8 Empty at 2.0. Filling #4
47	=7.5					#4 " " 7.5. Filling from #7
55	=12.2	22.5	15.0	I	II	#7 Empty - Filling from #6
12:038	=15.0	39.0	23.5	0.713	0.716	
:10	=17.7	60.5	38.0	0.459	0.442	#6 Empty Filling from #5
18	=20.0	95.5	57.0	0.291	0.295	
30	=22.4	161.0	96.0	0.173	0.175	Stopped filling (0.8cm left) from #5; Filling from #3
37	=~~24.9~~ 23.9	270.0	151.0	0.103	0.111	
40	=23.9	215.0	129.0	0.129	0.130	Control rod in - (=0.5cm Sol).
48	=24.9	372.5	228.0	0.075	0.074	
1:00	=~~26~~ 26.0	731	437	0.038	0.038	Stopped filling (2.4cm) from #3, filling from #2.
10	26.5	Not for critical.				
15	=26.8	"	"			
18	=27.0	"	"			
25	=27.2	"	"			
30	=27.3	Critical	8cm Cd rod below solution surface.			

Conclusion - 15" Reactor H/X = 494 - Untamped - Critical at ~~27.6~~ (27.2 - 0.6) = 26.6 cm (corrected for sight glass zero).

Drawback - Same as on page 144.

11/17/48 DC 26.6 + 0.4 = 27.0 cm = Hc (Bottom corrected).
11/28/48 DC H/X = ~~494~~ 499
15" Stainless, untamped. Vc = 30.78 ℓ
ρ_sol = 1.07 Mc = 661 Kg
Wt % X = 4.88 = 0.0522 gm X/cc

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Page 8 Current measurements on Safety Rod and Dump Valve Magnets

Check List

Date →

1. Storage Cylinders in Place and Properly Positioned
2. Solution levels Measured and Recorded
3. Calculation of Heights at which cylinders go empty.
4. Correct size Reactor in place and properly positioned
5. All Valves Positioned
6. Insert Hose + Stopper on Tamper Tank – Fill Tamper.
7. Smooth Action End Tamper Limit Switch – Safety Rod
8. Control rod guide – check for smooth action + zero
9. Engage Cd Safety Rod – Energize Solenoids, Set Dump Spring
10. Trip Safety devices with source, noting trip points, check all instruments
11. Re engage Safety devices. Move Safety rod to Top – Control Rod to bottom.
12. Check to locate ALL SOURCES check source pulleys
13. Final check of Safety devices including dump bar
14. Notify Guards, Close Closet door, ATTIC FAN Check Personnel, badges, dosimeters
15. Chain Up Red Light.

1/6/48	1/13/48	1/19/48	1/26/48	2/3/48	2/9/48	2/12/48	2/19/48	2/25/48	3/4/48	3/11/48	3/18/48	4/1/48	4/8/48	4/15/48	4/22/48
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Calc.

4/21/48 4/22/48 4/23/48 4/26/48 4/27/48 5/10/48 5/11/48 5/12/48