

BOOK78R

Notes:

"INV 83" on front

"1509" on spine

Blank pages: 20, 68, 84, 88, 90, 96, 98

-the following pages have 1 large graph taped to the page at seam: 26, 28, 30, 32, 34, 36, 38, 40, 44, 46, 50, 52, 54, 56, 58, 60, 64, 66, 68, 70, 72, 74 (+ 1 small one), 76, 78, 84, 86, 88, 90, 92, 96

-page 37 has red post-it sticker at side

-pages 76/77 have 2 blank typing sheets between them

-page 81 has blue post-it sticker at top with "assay" written on it

-page 83 has red post-it sticker at top

Scanned by:

Sheila Finch

RSICC /Oak Ridge National Lab.

August 30, 1999

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3. This notebook must be returned to issuing office when completed or upon termination of assignee.
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6. Alteration or amplification of entries made on previous dates should be made as separate entries under their own dates and cross referenced to the previous entries.
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8. The notebook should be periodically reviewed by one or more independent persons in the department and should be signed and dated by them. (Likewise, they should make a statement that they have "read and understood the foregoing material." Witnessing stamps for this purpose are available in your department's office.
9. It is advisable to preface each new item, such as a heat treatment, process or reaction, etc., with a very brief description of the purpose, objective or approach.
10. Description of the invention or discovery should be complete enough to be understood by anyone skilled in the art.
11. Reference to name or catalogue number should be made when standard items are being discussed, i.e., Westinghouse pump.
12. In cases where work is conducted in cooperation with others, it is often necessary to meet with them from time to time and to discuss new developments. The occurrences of such conferences should always be entered in your notebook regardless of recording elsewhere, giving the date, who was present (if possible), and an outline of the subjects discussed. This often will establish error in occasional claims of other parties that you have appropriated information from them revealed during an interview, and thus provide you with patent protection.

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~~Attention Calvin Hopper~~

Assigned to: J. K. Foy
Department: 3405
Location: 9735
Date: September 25, 1957

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Classification changed to: Unclassified
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(classification guide)

ADC or ADD signature (first reviewer) Sethamnton 6/24/94

ADD signature (final reviewer) Ted Davis 6/24/94



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Program Outline

10-30-5

Min. mass
" Vol.

max. safe cyl. dia.

Nitrate

Bare

25 vs 20 N

VO₂F₂ conversion

Nuclear Properties of Fuel isotopes

Isotope	Thermal Neutron			1.6 MeV Neut.			
	σ_f	σ_c	η	σ_f	σ_c	η	ν
U ₂₃₃	505 Barns	5.0B	2.37(2.33±0.03)	1.95b	—	—	2.60
U ₂₃₅	550	98	2.16	1.33	.07	2.41	2.54
P ₂₃₉	715	330	2.02	1.94	.06	2.86	2.95
Th ₂₃₂	0	6.8	0	.08	2.14	—	—
U ₂₃₈	0	2.6	0	.35	.075	—	2.5

ORNL 51-5-98 Data on 23 Delays:

λ	Fraction	See CP 3147
80.2	1.83×10^{-4}	(sum 0.0027 compared to 0.0081 for 23)
31.76	5.82×10^{-4}	
6.51	8.57×10^{-4}	
2.19	6.22×10^{-4}	
0.61	1.82×10^{-4}	
0.24.26		

Production & Separation of U²³³
Mat. New Energy Ser. IV-17B

Specific Act. (varied enrichments)	M. Code	spec act.
	500	1.25 C/M/Sg.cm
	1000	3.83
	1800	34.4
	1900	143.4
	Pu	140,000
	Th	122,600
	233	20,950
	234	Signed

2

Date 4-14-52

Discussion of 33 procedure with J. W. M.

1. We need to know:

a) A lower limit of MCM & approx. conc. it occurs at.

b) Max. safe pipe dia.

2. Amt. of Material Available is ~ 1500 gm 33

3. Also Need chem. purity & isotopic assay.

4. Chem. form & conc. to be specified prefer VO_2F_2 ; suggested $H/33 < 50$ (a must) prefer max sol. conc.6. Est. MCM. 400-600 of 33 @ $H/K \sim 400$ For 400 gm = 6180 gm H_2O \therefore Calc. Cylinder sizes

a) Calc. vol of soln.

? b) from a) Calc. H & O of equivalent cyl

? c) Make extra cyl 1" bigger & 1" smaller

7. Pipe sizes 4, 5, & 6" dia. (Use all if possible).

8. Suggest 3" pipe for storage cyl. -
Newt. monitor while filling.9. Investigate possibility of using a "rope reactor"
to feed manifold of MCM expts.10. Determine no. of 3" cylinders - suggest 1'
edge to edge spacing. Accepted by ^{calculations} Morpitt11. Consider use of oil for top tamper.
Find out who at X-10 has used oil for
displacement pumping.

12. Consider floating paraffin top tamper

13. Consider switching completely reflected cycle with $H=D$ and using multiplication carrier. Will make $H=D$
14. Choose between liquid & solid fuel & bot. Tamps - using paraffin - chose paraffin
15. Height indicator - may use ht. of storage cyls with selen ϕ on rack left. Calibrating with water.
16. Safety devices - consider means of allowing storage cyls to drop - ruled out - ^{not} blade
17. Valving device - perhaps best is random ✓
18. Check the light cap. of racks. 250[#]
19. Source location - try locate in reflector
20. Provide plastic cover for inside of "Big Sid"
21. Check with Chemists on decontamination problem. (much same as for 233)
22. Provide unistrut vert. supports in "Big Sid" ✓ done

4

Date

$$\frac{V_{O_2} + V_{N_2}}{V_{H_2O}} = \frac{38 + 32}{483}$$

$$Fr \frac{H_1}{V_{H_2O}} = \frac{\frac{wt. H_2O}{9}}{\frac{wt O}{233}} = 400 \text{ (approx value at } m.c.m.)$$

$$wt H_2O = \frac{400 \times 9 \text{ } wt O}{233}$$

$$\text{For } 400 \text{ } gm^3 \quad wt H_2O = \frac{400 \times 9 \times 480}{233} = 6180 \text{ } gm$$

$$\text{For } 600 \text{ } gm^3 \quad wt H_2O = \frac{600 \times 9 \times 480}{233} = 9270 \text{ } gm.$$

Den. from part III at 400 H₁ ≈ 1.08 $\frac{gm}{cm^3}$
($\approx 0.06 \text{ } gm/cm^3$)

$$6180 + \frac{403}{233} \times 400 = 692 + 6180 = 6872$$

$$a) \quad \frac{6872}{1.08} \approx 6363 \text{ } cm^3$$

$$= 1038$$

$$b) \quad 9270 + \frac{403}{233} \times 600 = 10,308$$

$$\frac{10,308}{1.08} = 9544 \text{ } cm^3$$

For $H = 2r$

$$Vol = \pi r^2 \cdot 2r = 2\pi r^3$$

$$a) \quad 6363 = 2\pi r^3 \quad r^3 = 1013$$

$$r = 10.0 \text{ } cm$$

$$D_1 = 7.88 \text{ } in$$

$$b) \quad 9544 = 2\pi r^3 \quad r^3 = 1520$$

$$r = 11.5 \text{ } cm \quad D_2 = 9.06 \text{ } in$$

Signed

Date

$$1 \text{ in}^3 \approx 16.39 \text{ cm}^3$$

	4" dia x 36"	=	432	7,410 5
Volumes:	6" dia x 36" long	=	1020 in ³	16,708 16,708
	3" " x 36" "	=	255 "	4,180
	10" " x 10" "	=	786 "	
	11" " x 11" "	=	1045 "	17,400 17,100
	9 " x 9" "	=	571	
	8 " x 8" "	=	402	
	5 x 36	=	706	11,520

Make equalateral vessels 8", 8 1/2", 9" & 10 3/4"
in dia. & Ht.

Signed

6

Date

Part IV Fuel Data:

~ 1/2 molar

H/35-	N/35-	gm 35/gm ³	sp gr	Free HNO ₃
61.8	2,86	0.359	1.55	8.2, 8 gm/l.
88.0	7,48	.236	1.57	347. ≈ 5.5m.

Variation of fission cross-section for U²³³ as a function of μ Energy - see

CRGP-458 Fig 7

Follows $1/v$ law up to 0.1 ev. Has a resonance peak at ~ 1.8 ev. about as high as thermal

23-4

0.460 molar

1.6141 Density

400.82 wt U

896.81 ml

393.69 wt $\frac{233}{90}$ U 67.7

446.94 gm/l.

Total wt U = 1343.11 (1st 4 Batches)

Analytical data tabulated page 80

Extracted with NH_4NO_3 resin
~~152 gm/l~~ add acetic PH ~ 1.5 with
 addition of HNO_3

Will accept. in form of nitrate

1st lot ~ 500 - 600 gm
 Peroxide ppt. will only take 1-2 days
 Hexane has very low U solubility

Safety of batch of 300 gm in 4" pipe?

23-1A

H₂O 3.35 molar 1.6137

157.25 U 40.5% U

Vol. (4.38.09) ml
 358.95 gm/l U

1B

2.30 molar sp gr 1.6411

140.42 U

Vol. 385.78 ml

76.7% U

414.03 gm/l U

23-2

0.1 molar sp gr 1.5431

322.47 U

Vol 785.84 ml

71.5% U

410.35 gm/l U

23-3

0.50 molar sp gr 1.6845

302.15 U

Vol 361.34 ml

Concn 487.59 gm/l U

$\frac{H}{U} = 63.5$

Signed

8

Date 6-23-52

Finished passivating storage manifold over week-end - 25-30% nitric acid and rinsing.

Also re-checked for leaks at plant. Water pressure ~ 60 PSIG.

Vol. of manifold from valve to valve 23.8 liters - measured out into liter graduate from full system.

Vol. of 3" S.S. Pipe: $I.D. = 3.07"$, $r = 1.535$

$$3.14 \times (1.535)^2 \times 36" = 266"{}^3$$

$$\text{or Vol. of 36" of pipe} = 266 \times 16.39 = 4.365 \text{ liters}$$

For 5 cycles, Vol = 21.8 liters

$$\text{Area } \parallel \parallel \parallel = 0.0477 \times 5 = 2.385$$

leaving 1 liter for each of top & bottom manifolds.

Analyses:

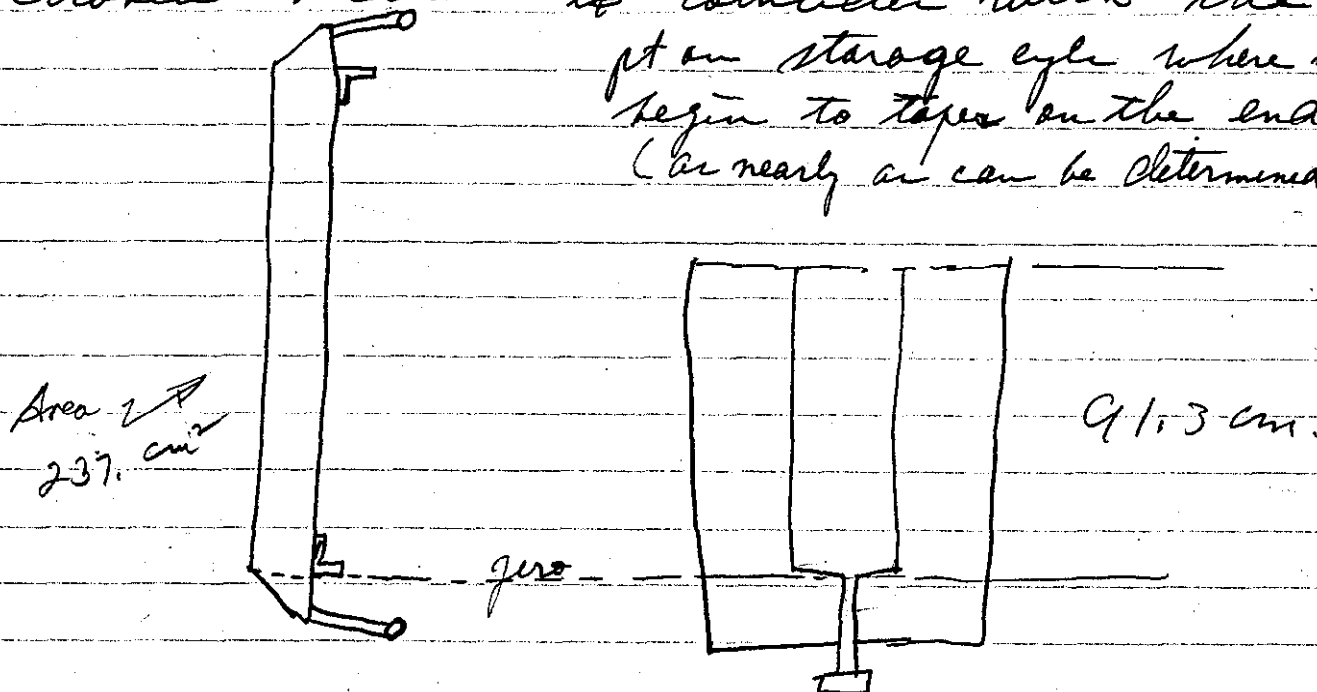
Signed

Date 7-17-52

9

Installed Manifold in Tank & 4" vessel ready for water test.

The arbitrary zero of the manifold will be when the bottom of the bottom angle iron cross is on the same level as the zero pt or bottom of the reactor. This was chosen because it coincides with the pt on storage eye where they begin to taper on the ends (as nearly as can be determined)



For levels of liquid in the storage system above the zero the relative ~~total~~ heights should be proportional to the

With Manifold at zero dead vol to zero of 4" reactor = 1220 ml.

Signed

10

Date

Area 9" cyl = 81.1 cm²

Dist. Level	Ht of manifold	Raised	meter reading		Ht of 9" cyl.	Vol
1 cm	2 in		90.6		0.4 cm	56.8 cm ³
.4 "	.4		90.4		0.90.6	73.0
.53	.6		90.0		1.3 1.0	105.5
.73	.8		89.7	Del. / in	1.6 1.3	129.7
.84	1.0		89.3	162.2 cm ²	2.0 1.7	162.2
1.05	1.2		89.0		2.3 2.0	186.5
1.24	1.4		88.7		2.6 2.3	210.8
1.44	1.6		88.4		2.9 2.6	235.2
1.57	1.8		88.0		3.3 3.0	267.6
1.88	2.0		87.8	81.6	3.5 3.2	284.0
1.32	3.0	(3.02)	87.7	251.6	6.6 6.3	535
3.25	4.0		84.1	49.0	7.2 6.9	584
4.50	5.0		82.8	105.	8.5 8.2	689
6.45	6.0		82.2	49	9.1 8.8	738
7.74	7.0		81.0	97	10.3 10.0	835
8.5	8.0		79.2	170	12.1 11.8	1005
9.85	9.0		78.0	73	13.3 13.0	1078
12.3	10.0		77.9	8	13.4 13.1	1086
17.2	12.0		77.7 77.7		13.6 13.3	1103
22.15	14.0		77.6		13.7 13.4	1111

[Better zero value = 91.0 cm]

Equiv. Ht. vs Vol in 9" cyl.

	Equiv. ht.	D.I.F.
1 liter	78.3 cm.	12.7 cm. 12.7 cm.
2	65.8	25.2 12.5
3	53.4	37.4 12.2 Av. 12.5
4	41.0	50.0 12.6
5	28.4	62.4 12.4
6	16.0	75.0 12.6
7	3.5	87.5 12.5

~ 130 cm³ Vol from zero of reactor to end of tubing

Signed

Date

7/23/52

Sent Mampold to Lambert - 9204-1
for X-ray study of welds.

325 cm²

48.6

81.1

105

138

162

186

211

243

259

510

559

665

713

811

957

1054

1062

1078

1087

Area 4" Dia Vessel = 81.1 cm² (calc.)

$\frac{1000}{81.1} = 12.35$ cm ht. equiv. to 1 liter ~ 4" dia. Vessel.

$\frac{1000}{12.5} = 80.0$ actual area.

$\frac{80}{\pi} = 25.13$

$r = 5.00$ cm

$\frac{5.00}{2.54} = 1.97$ "

$D = 3.94$ "

Signed

12

Date

Impurities: by phone from Don Overhalt

<u>Al</u>	<u>B</u>	<u>Ca</u>	<u>Cr</u>	<u>Cu</u>	<u>Fe</u>	<u>Mg</u>	<u>Mn</u>
20.9 ppm	17	270	15.07	4.19	31.0	15.33	16.2
12.43	—	610	8.05	14.8	14.89	17.53	—
12.55	16.5	—	6.28	16.72	10.9	—	1.04
11.2	13.45	33.7	4.92	2.68	6.73	5.37	4.93

<u>Ni</u>	<u>Pb</u>	<u>Ti</u>	<u>Be</u>	<u>Th₂₃₂</u>	Rad. Chem p-counts
29.8	97.7	9.77	>.03	34.8	
9.03	—	—	+	92.3	
—	—	4.18	ii	237.0	1.8. 2 $\mu\text{m}/\text{mg}^{23}$
13.46	40.4	3.34	ii	196.0	14.93

Rare earth - very low.

	1	2	3	4
<u>U₂₃₂</u>	$2.8 \times 10^{-4} \%$	3.7×10^{-4}	2.2×10^{-4}	2.8×10^{-4}
<u>U₂₃₄</u>	0.86%	0.52%	0.47%	0.54%
<u>U₂₃₅</u>	—	.04	.03	8.10
<u>U₂₃₈</u>	1.44	0.96	.92	1.06
		1.52	1.42	1.70
		98.48	98.58	98.30

.48

58

33

3 36
43

Signed

Date 7/28/52

Calibration of 8 1/2" Dia. Reactor Vessel.

Bottom cone very rough - required ~ 115 cm³ to fill cone. Overall Ht. inside 21 cm

Meter reading	Water Ht	Vol. added
21 cm	0	115 cm ³ (cone)
19.6	1.4 cm	500 " (above cone)
18.2	2.8	1000
15.5	5.5	2000
12.8	8.15	3000
10.0	11.0	4000
7.3	13.7	5000
—	14.6	6000
1.8	19.25	7000

Top cone
Equiv. to ~ 800 cm³

Area 8 1/2" Dia cir. = 56.7 cm²
 $\frac{1000}{56.7} = 3.07$ cm ht.

Actual corresponding ht. for 1000 cm³ = ~ 2.75 cm
 or $\frac{1000}{2.75} = 364$ cm² Area

$\frac{364}{\pi} = 1157 = r^2$, $r = 10.75$ cm = 4.23"
 $D = 8.46$ "

Measured Dia: Near Bottom:
 8.475" - 8.49"

Near Top
 8.39" - ~ 8.60"
 I.D. Gasket 7 1/4"

Signed

Calibration of 5" Dia Reactor

Zero = 90.9 with film of water

Vol. Water Added	Meter Reading	Equiv ht. d.f.
1 liter	83.0	8.0 cm
2	75.0	8.0
3	67.0	8.0
4	59.1	7.9
5	51.2	7.9 av
6	43.2	8.0 1.94
7	35.3	7.9
8	27.4	7.9
9	19.4	8.0
10	11.4	8.0
11	3.5	7.9

$$k = 6.32$$

$$\text{Area} = \frac{1000}{7.96} = 125.6 \text{ cm}^2$$

Calibration of 6" Dia Reactor

Vol. Water Added	Meter Reading	Equiv Ht.
0	91.0 (Film on Bottom)	0
1 liter	85.4	
2	79.7	
3	74.3	
4	68.7	
5	63.2	
6	57.7	
7	52.1	
8	46.6	
9	41.0	
10	35.5	
11	29.9	
12	24.3	

Signed 4.3

Date

13

18.8

14

13.2

15

7.6

14

2.1

Area 179.5 cm²

Re-calibration of Dead Vol.
(water Added with 2 liter Grad.)

1300 cm³ Equil. at 90.6 cm scale
reading in 6" Reactor. (91.0 = 0)

$$\begin{aligned} 4 \text{ cm in } 6" \text{ V.} &= \sim 73 \text{ cm}^3 \\ 8 \text{ } 14 \times 238.5 &= \sim \frac{95 \text{ cm}^3}{168} \end{aligned}$$

$$\frac{1300 - 168}{168} = 1132 \text{ (probably air bubbles)}$$

Recheck — Added 1130 cm³
+ 160
1290 cm³ to
bring level to zero in 6" Vesse)

Recheck after draining:

Vol. of Reactor End to End of
tube = 190 cm³
Added
+ 1000
+ 200
1200 = zero

Signed

16

Date

Dead Vol. cont!

4th Recheck1000.0 cm³

1 2 2 0

1 2 9 0

1 2 9 0

1 1 8 0

4 4 9 0

1 2 2 5

0 0

0 0

0 0

0 0

0 0

0 0

0 0

0 0

0 0

0 0

0 0

0 0

0 0

0 0

0 0

0 0

0 0

0 0

0 0

0 0

0 0

0 0

0 0

0 0

0 0

0 0

0 0

0 0

0 0

0 0

1 9 0

1 1 9 0 = 0-level

4] Check on Equivalent vol. in storage manifold - manifold at zero

Vol. added

Reading in 6" Reactor

Vol. added	Reading in 6" Reactor
0	DIF. 91.0 cm
1000 cm ³	2.5 88.5
2000	2.4 86.1
3000	(2.3) 83.8 (Manifold re-zeroed)
4000	2.4 81.3
4000	at 9:26
4000	at 9:33
4000	at 9:36
5000	2.4 81.4
5000	at 9:39
5000	at 9:49
6000	2.4 79.0
6000	at 9:51
6000	at 10:01
7000	2.4 76.6
7000	2.3 74.3
8000	2.4 71.9
9000	2.4 69.5

Continue Calibration by Raising Manifold

Manifold ht

Ht in 6" R.

Manifold ht	Ht in 6" R.
0	DIF. 69.5
2"	2.8 66.7
4"	2.9 63.8
6"	2.9 60.9
8"	2.9 58.0
10"	2.9 55.1
12"	2.9 52.2

Signed

Date

Calc. of equiv. area in manifold by adding 1 liter at a time to 6" Reactor:

Vol. added 1 liter

$$\text{Vol. remaining in 6" R} = \frac{2.4}{5.57} \times 1000 = 431 \text{ cm}^3$$

$$1000 - 431 = 569 \text{ cm}^3$$

level rise = 2.4 cm.

$$\therefore \frac{569}{2.4} = 237 \text{ cm}^2 \text{ per cm ht.}$$

Continued Previous Page:

Measured	14"	2.8	49.3	
ht. → 40.7 cm	16	2.9	46.4	
	18	2.8	43.6	
56.3	20.0	3.1	40.5	(Changed Reqs. re-zeroed.)
56.3	22.0 (55.9)	2.3	38.2	
	23.0	0.4	37.8	
	24.0	0.8	37.0	
	25.0	1.0	36.0	
	26.0	0.1	35.9	
	27.0	0	35.9	
	33.0	0.1	35.8	
	24.5		36.3	
	23.5		37.5	
	21.5		39.1	

Signed

18 Date

20.5
20.0

³
~~69.8~~
40.5

# 0	dif.	69.3 (69.4 repeat next day.)
- 2	2.9	72.2
- 4	2.9	75.1
- 6	2.9	78.0
- 8	2.9	80.9
- 10	2.8	83.7
- 12	3.03	86.7
- 15	4.3	91.0

9-29-52 Material returned to X-10 for evaporation.
Sample #U-15 composite of all five bottles

#1 #2 #3 #4 #5

4469.75	4466.82	4356.58	4447.52	4399.30
407.10	403.25	406.26	421.40	430.76
4062.65	4063.57	3950.32	4026.12	3968.54

03265 gm U/gm U-15

Sum $\sqrt{20071.20 \text{ gm}}$
 $\approx 19.2 \text{ liters}$
 $\approx 656 \text{ gm U}$
 $\approx 653.32 \text{ gm U}$
 ≈ 655.82

Signed

9-29-62 2nd Series lots-23 from X-10

Date	* 23-5+CP-1	23-6	23-7
Gross wt.	2250.82 259.48	1661.44 272.73	1760.76 273.90
net	1991.34	1388.71	1486.86

Samplers of above lots	U-14	U-17	U-18
	26.925	26.639	28.061
	22.625	22.697	22.650
net	4.300 gm.	3.942 gm ^U	5.411 gm ^U
89 gm ^U	2072 gm ^U /gm	2444 gm ^U /gm	2551 gm ^U /gm
	412.68 ✓	339.40 ✓	379.30 ✓
U* +U-10	6.38 gm		

Batch 23-8	# 2 Evap. Batch	3 rd Evap Batch
940.94	2040.43	2085.88
265.84	#/bottle → 407.10	Bottle #3 1404.24
674.10	1633.33	1679.62
	X-10 1629.34	1675.43

U-19	U-20	U-21
26.073	29.480	29.881
22.861	22.682	22.768
3.212	6.798	7.113
(.62 gm ^U) ✓	(1.43 gm ^U) ✓	(1.11 gm ^U) ✓
1911 gm ^U /gm ✓	2400. ✓	1553 ✓

128.82 gm ^U	392.0 ✓	261.18
	X10 387.73	257.76

* see page 82 for explanation of U-10.

Signed

392
261
653

U-1

Date

Calc. of H₂O at original conc. from analysis:

$$\begin{aligned}
 .2674 \text{ gm U/g} \times 1.67 &= .4465 \text{ gm salt/gm} \\
 .0548 \times 1.2 &= .0658 \text{ " HNO}_3\text{/gm} \\
 \hline
 &.5123
 \end{aligned}$$

1.0000

.5123

4877 gm H₂O/gm

.0094

.4971

$$.2674 \times 98.25 = 26.28 \text{ gm }^{23}\text{U/gm}$$

$$\begin{aligned}
 \text{H}_2\text{O Eq. of HNO}_3: \\
 \frac{9}{63} \times .0658 &=
 \end{aligned}$$

$$\begin{aligned}
 \text{H/23} &= \frac{\frac{.4971}{9}}{\frac{.2628}{233}} = 25.9 \times \frac{4971}{2628} = 49.0 \checkmark
 \end{aligned}$$

U-1 Composite assay:	98.49%	233
130350	.47	234
	1.04	235

22 Date 8/11/52

Weights of Material as received:

Containers	23-1-A	23-1-B	23-2
Sample	989.69 gm	921.80 gm.	1498.98
	20.52 gm - paper tare	20.52	20.52
From	969.17	901.28	1478.46
	972.95	905.03	1482.17
	3.84 - plastic	3.84	3.84
	969.13	901.19	1478.33
	972.95	905.03	1482.17
Tare	275.61*	273.13	275.17
Net	697.34	631.90	1207.00

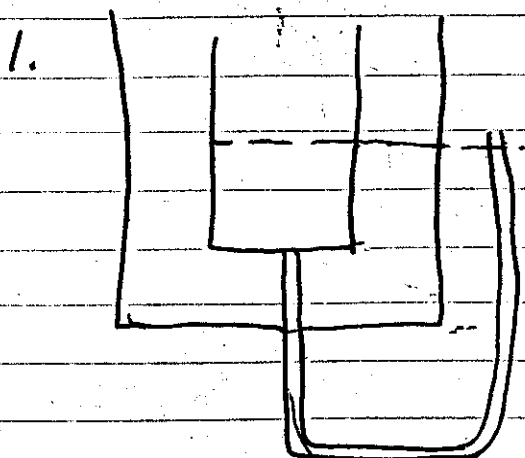
Cont.	23-3	23-4		Net wts
	1349.95	1726.65	1-A	697.34
	1349.90	1726.65	1-B	631.90
	20.52	20.52	2	1207.00
	1329.38	1706.13		1059.21
	1333.08	1709.78		1442.60
	3.84	3.84		
	1329.24	1705.94		
	1333.08	1709.78		
Tare	273.87	267.28		
net	1059.21	1442.50		

Total wt 5037.95 gm
 From U-1 (2674 gm/gm)
 $5038 \times 2674 = 134819m$
~~1348 x 98.25 = 13239m~~

see p. 18 for continuation

Date 8-12-52

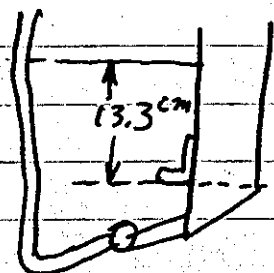
Estimate of total vol used in Expt # 1:



12.55
 $- 6.20 \text{ to zero}$

 6.35
 $6.35 \times 2.54 = 16.13 \text{ cm.}$
 $16.13 \times 179.5 = 2892.5 \text{ cm}^3$
 Dead vol $\frac{130}{3025}$

With soln drained back into manifold:



~~Ht. 13.3 cm above zero~~

~~$237 \times 13.3 = 3150 \text{ cm}^3$~~

~~(evidently some error in measurement)~~

U-2

$2226 \times \frac{389}{233} = 3715 \text{ gm. Salt/gm.}$

$(1.67) + .0548 \text{ " HNO}_3/\text{gm}$

~~.4298~~
.4263

H₂O Eq. of HNO₃

1.0006
 $.4263$

 $.5737 \text{ gm H}_2\text{O/gm}$
 $.0080 \text{ " " "}$

~~.5807~~
 $.5817$

Expt 2: $\frac{H}{23} = \frac{.5817}{9} = .0647$
 $\frac{.2185}{233} = .00938$
 $.0647 = 68.8 \checkmark$

Ched by Provia $\frac{N}{23} = \frac{.012}{14} = .00087$
 $\frac{.2176}{233} = .0093$
 $.00087 = .0934$

Signed

24 Date

8-13-52

Added 800 cm³ distilled water to system thru top of 6" Reactor. Rinsed out 5 polyethylene bottles into reactor (After Expt #1)

$$\text{@ 59 } H_{/23} = \sim 59 = \frac{\text{gms H}_2\text{O}}{9} ; \text{gms H}_2\text{O} = 2960$$

$$\frac{1300}{233}$$

$$H_{/23} = \frac{(H_2O)_1 + X}{9} = \frac{H_2O + X}{9}$$

$$\frac{1300}{233} = \frac{5.58}{1}$$

$$\text{@ 75 } 75 = \frac{(H_2O)_1 + X}{9} \quad 5.58 \times 75 \times 9 = H_2O + X$$

$$\frac{5.58}{1}$$

$$9 \times 75 \times 5.58 = 2960 + X \quad X = 800 \text{ cm}^3$$

add 800 cm³

6020
3760
2260

$$\text{@ 120 } 9 \times 120 \times 5.58 = 3760 + X$$

$$X = 6020 - 3760$$

$$\frac{.1748}{.0548} \times 1.468 = .0827 \text{ gm HNO}_3 \text{ Free}$$

$$\approx 1.31 \text{ molar}$$

$$\frac{.1748}{.0548} \text{ gm free HNO}_3 / \text{gm.}$$

see preceding page

U-2 sp gr. 1.4680 @ 29.4 °C

6.2226 gm/gm U ; .1748 gm/gm total
 2170 29/20 Signed (H. H. H.) HNO₃
 Combined 120

S. Wt. 70.429
22.549
net. 47.880

Date 8-11-52 Rohrer Morfitt Expt #1 6" Dia. Vessel
 Fox Cronin #1/23 ~ #9.0 25
 (See page 21)

Time	S.	Control rod	Safety R.	Manifold position	C ₁	C ₂	C ₃
3:25 PM	in	0	10.5	-45.24"	13.5	9.25	
3:35	"	0	"	-1.15	13.0	11.5	
3:43	"	11.2	"	0	12.5	12.25	
3:52	"	12.9	"	+ 6.32	12.75	16.25	
4:10	"	15.6	"	20.00	19.75	23.5	
4:20	"	15.6	0	20.00	14.75	18.00	.52

Total Vol ~ 31.00
 31.30 cm³
 Total 25 ~ 132.6 gm = 131.84
 8.6

20 cm³ Sample U-1 Taken 8-11-52 (0.2676 gm/gm = .26307 gm²³/gm
 sp. gr. @ 31.6°C = 1.6082 ~ 0.4304 gm/cc. = 4.225 gm²³/cc.

8-13-52 Expt. #2 (6" Vessel) #1/23 ~ 75
 Rohrer, Fox ~ 69

Time	Source	Control rod	Safety Rod	Manifold Position	C ₁	M-1	C ₂	C ₃
12:05 PM	in	7.11	10.4	-2.00	8.75	7.95	11.0	7.0
1:19 PM	"	7.11	"	6.00	11.0	7.95	15.75	7.0
1:34 PM	"	7.11	"	10.00	19.75	.44	26.25	.42
"	"	14.6	"	20.0	25.00	.35	31.25	.35
1:50 PM	"	"	0	"	15.5	.56	21.75	.51
"	"	12.05	10.4	20.0	26.50	.33	35.50	.31

9ms 7/3 = 3195 ✓
 cc

Total mass ~ 1305 gm

Total vol ~ 3980 cm³ - by adding 800 cm³ to 3180
 " " ~ 4160 " From Analysis

Measurement of Vol. 28.7 cm in reactor
 ~ 14.0 cm in storage manifold
 ~ 25 cm³ Sample U-2 Signed Taken 8-13-52

Dilution from ~ 75 to ~ 125 H₂O
 added 2500 gm H₂O

$$\frac{6600}{5400} \text{ cm}^3 \text{ above zero} = \frac{5400}{257} = 22.78 / 2.54 = \sim 9 \text{ in}$$

∴ add 9" to readings

Level reaches zero in manifold at $\frac{5400}{179.5 \times 2.54} = 11.8$ "
 " " " when manifold has been raised
 $11.8 + 9.0 = 20.8$ " from pt. salm inter reactor

$$.1558 \times \frac{167}{253} = .2600 \text{ gm salt/gm}$$

$$.1558 \times .0548 = .0384 \text{ gm free H/gm}$$

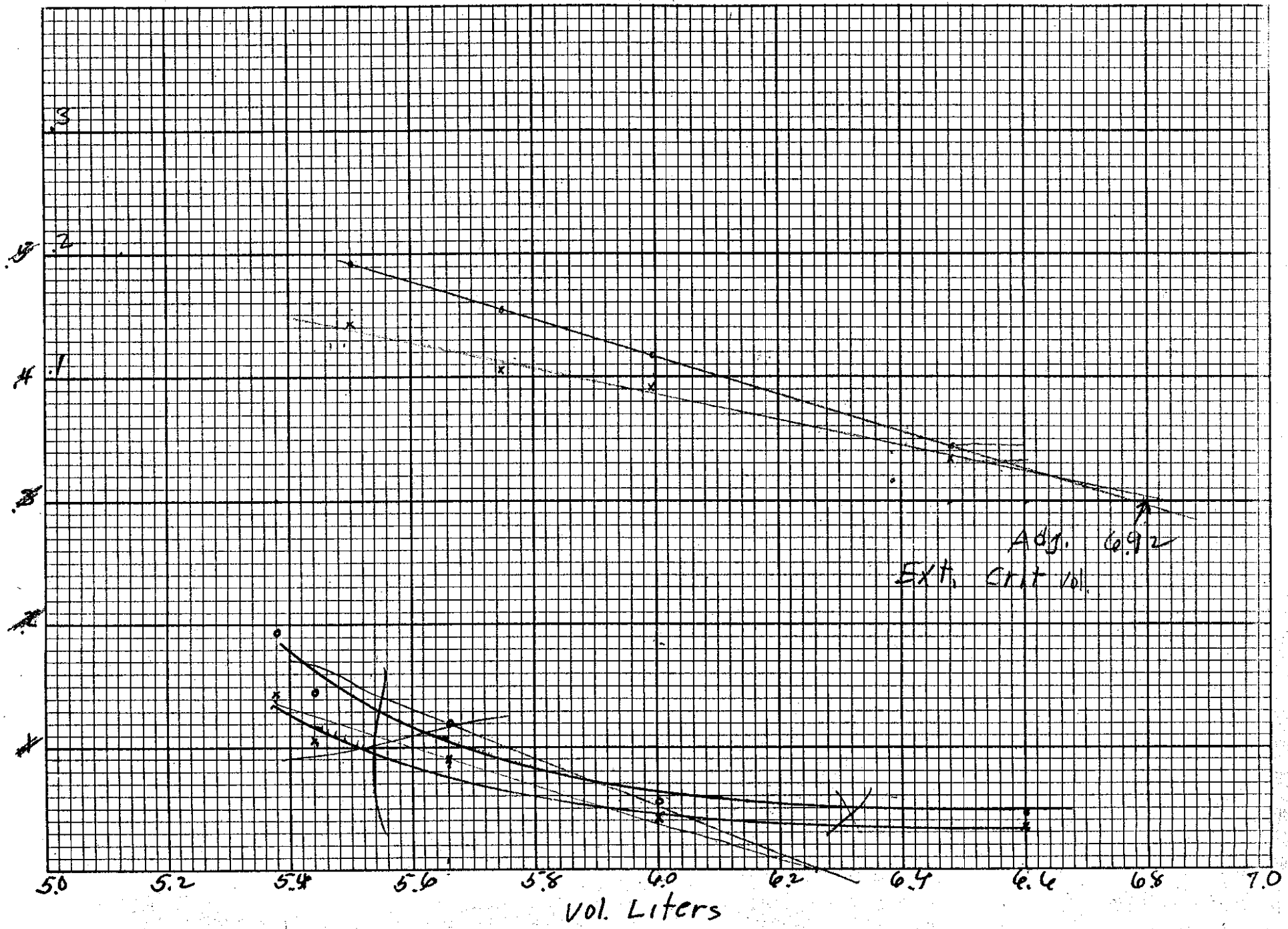
$$\text{H}_2\text{O eq. of HNO}_3 \cdot 0384 = .0655 \text{ gm H}_2\text{O}$$

$$\begin{array}{r} 2600 \\ 0384 \\ \hline 2984 \end{array}$$

$$\begin{array}{r} 1.0000 \\ 2984 \\ \hline 7016 \text{ gm H}_2\text{O/gm} \\ 0655 \\ \hline 7071 \end{array}$$

$$\frac{H}{23} = \frac{.7071}{9} = \frac{.0784}{.00657} = 119.6 \checkmark$$

gm H₂O = 911



Date 8-14-52 Fox
Rohrer

Exp # 3 (6" vessel)

27

4/23 ~ +85
119.4

Time	Source	Control	Safety	Manifold	C ₁	m ⁻¹	C ₂	m ⁻¹
10:06 A	in	in	11.6"	-8.00"	9.25		11.25	
10:15	in	9.32"	11.6"	3.04	8.00		13.00	~ + Vol
10:39	in	15.63"	17.1"	12.08 (21)	56.75	1.43	67.50	.193 5.51
—	in	17.78"	17.5	13.07 (22)	76.75	.104	89.50	.145 5.75
11:12	in	17.52"	17.5	14.07 (23)	89.5	.089	108.5	.120 5.98
11:21	in	17.15"	20.4	18.09 (21)	202.75	.039	231.5	.056 "
	in	18.02"	20.5	26.04 (35)	331.25	.034	275.25	.047 6.6

Manifold lowered - kink removed & Expt. repeated

10:4 PM	in	10.4 20.4	20.0	14.05	95.0	.095	120.0	
12:1 PM	in	17.4	20.0	18.10	192.0	.047	244.5	
	in	29.92	20.0	26.04	216.	.042	269.5	

↳ Empty

Measured total ht. from level in tube = 38.5
 " " " in manifold 23.5 (6688 cm⁵)
 Recheck " " 23.0 (6560)

Total vol. as 6600

Total vol by adding water vol 6400

Calc. from density and analysis = Total vol = 6.6 l.

Adj. Ext. Cont. Vol = ~ 6.9 l x .1972 = 1360 gm

U-3 Sample -
 71.6475
 21.6998
 49.9485 gm. net

✓
 .1558 gm/gm sp. gr. ✓
 .1530 gm/gm ✓
 1.2866 @ 30.8°C = .1472 gm²³/cc
 1300 / 1.97 = 6.60 l.

+ Data from manifold must be adjusted to correlate with total vol in manifold & D. Vol. of manifold.
 Signed

28

Date

EXPT 4

Calc. of zero shift:

$$\begin{array}{r} \text{Total vol } 6600 \text{ cm}^3 \\ \text{D. Vol. } 1200 \\ \hline 5400 = 8.99'' \\ \hline 237 \times 254 \end{array}$$

$$\begin{array}{r} \text{Manifold zero error } 9.25'' \\ 8.99'' \\ \hline .24'' \end{array}$$

$$\begin{array}{r} \text{Curt. ht} = 16.00 \text{ manifold reading} \\ - .26 \\ \hline 15.82 \text{ cm} \end{array}$$

$$15.8 \times 2.54 \times 237 = \frac{9580}{331 + 237} = 16.9 \text{ cm}$$

$$16.9 \times 331 = 5580 \text{ cm}^3 \quad \text{Curt. Vol.}$$

$$\begin{array}{r} 5580 \times 1.700 = 1100 \text{ gm}^2 \\ \hline 6600 \\ 5580 \times 1.972 = 1100 \text{ gm} \end{array} \quad \text{Curt. Man}$$

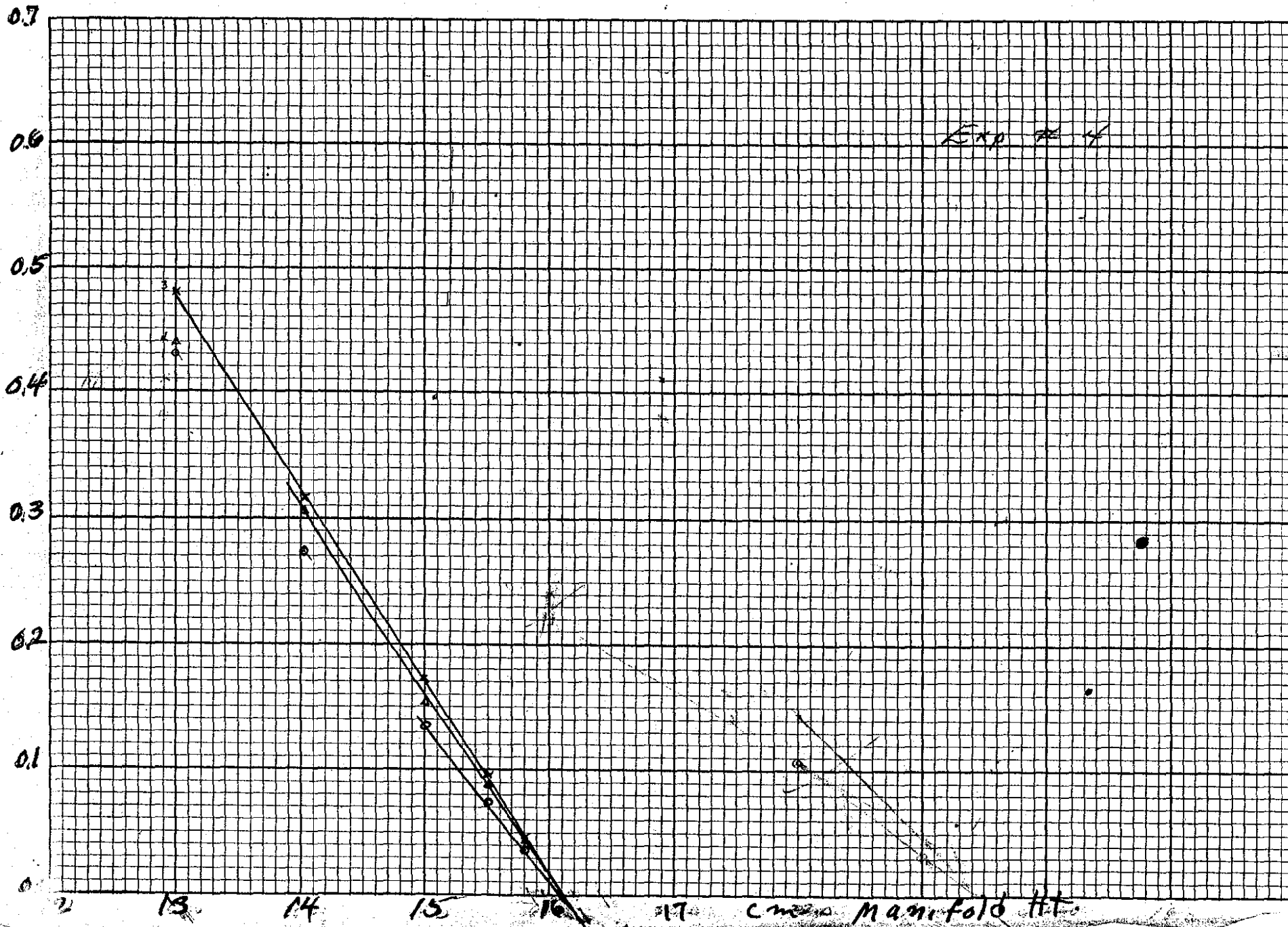
Total vol: see preceding page

Since the total Vol. is pretty well established at ~ 6600 & there is no curvature of M^{-1} curve, the Curt. vol. must be below $6600 - 1200 = 5400$

$$5400 \times .1972 = 1064 \text{ gm} \quad \begin{array}{l} 1060 \text{ rounded } 90 \\ \checkmark \end{array}$$

The value may be lower but not higher than the above.

Signed



Date 8-18-52 Roy Martin Crown

H/23 = 125 Exp " + 119.6 8" Vessel

29 8" Re Ht.

Time	Source	Control	Safety	Manifold	C ₁ /C ₄	M ₁	C ₃	M ₃	Ht.
10 ²² A	IN	IN .27	OUT 6.1	99075	11.25	1.0	17	1.0	0.0
—	—	—	—	Realt. To 000.07	11.50	1.0	19	1.0	—
10 ⁴⁶ A	IN	OUT 9.8	OUT 6.1	6.00	12.25	—	19.25	—	6.4
10 ⁵⁵ A	IN	OUT 10.88	OUT 6.1	13.3	15.	.77	24.0	.75	14.
11 ⁰⁹	IN	OUT 12.75	OUT 9.1	16.9	30.25	.38	43.5	.41	18.0
11 ²⁶	IN	OUT 13.27	OUT 13.1	20.01	51.5	.22	75.0	.24	—
11 ⁴¹	IN	OUT 13.16	OUT 13.1	22.04	108	.106	126	.143	—
11 ⁵¹	IN	OUT 13.3	OUT 13.1	23.00	359	.032	401	.045	—
12 ¹⁰	IN	OUT 13.35	OUT 13.1	24.00	1022	.011	1175	.0153	—
		New counter		M ⁻¹ = .0156	977		1200		
12 ³⁰	Partially out	3.31	OUT 13.1	24.25	Subcritical				
12 ³²	OUT	4.045	OUT 13.1	24.25	Supercritical				
12 ⁴²	OUT	4.01	OUT 13.1	24.01	Subcritical. Control full rod.				
12 ⁵⁷	IN	2.4	OUT 13.1	23.8	Subcritical but control scarce rods.				
2 ¹⁰	partially out	out	out	20.00	Supercritical				
	in	13.79	13.2	15.0	level dropping				
2 ¹⁸	"	"	"	15.4	158.25		170.0		
3 ¹⁴	out	13.79	13.5	16.16	Supercritical				
				16.10.	supercritical				
				16.00	subcritical				
<p>Out rod ~ 5350 in 3 M ~ 1100 in - 8-19-52 Rohrer FOX Repeat of above After lowering and shaking Manifold</p>									
9-13 AM	in	9.58	7.6	5.04"	15.9/3025	.43	19.0		
10 ³	"	13.8	13.9	12.98	34.75/68.0	.43/.44	39.5	.48	
10 ²²	"	13.8	13.9	14.04	54.75/98.5	.274/305	60.0	.317	
10 ⁴⁵	in	13.4	13.7	15.00	114.5/196.25	.135/153	110	.173	
11 ²²	in	13.77	13.9	15.50	202.75/338.5	.074/084	197.75	.095	
11 ³⁹	in	13.1	13.9	15.80	416/721	.036/042	407.	.047	
11 ⁵⁵	Out	13.62	13.9	16.06	Subcritical				
12 ⁰²	"	"	"	16.09	supercritical				
				16.06	subcritical				

Calc. P 28

Date
 Dilution $\approx 1/23 = \sim 160/151$

$$9 \times 338 \times 160 = 6260 + x$$

$$x = 8030 - 6260 = 1770 \text{ gm H}_2\text{O}$$

added 1700 gm

Previous vol $\sim 6560 \text{ cm}^3$

add

1700

8260

total vol of additi

dead vol

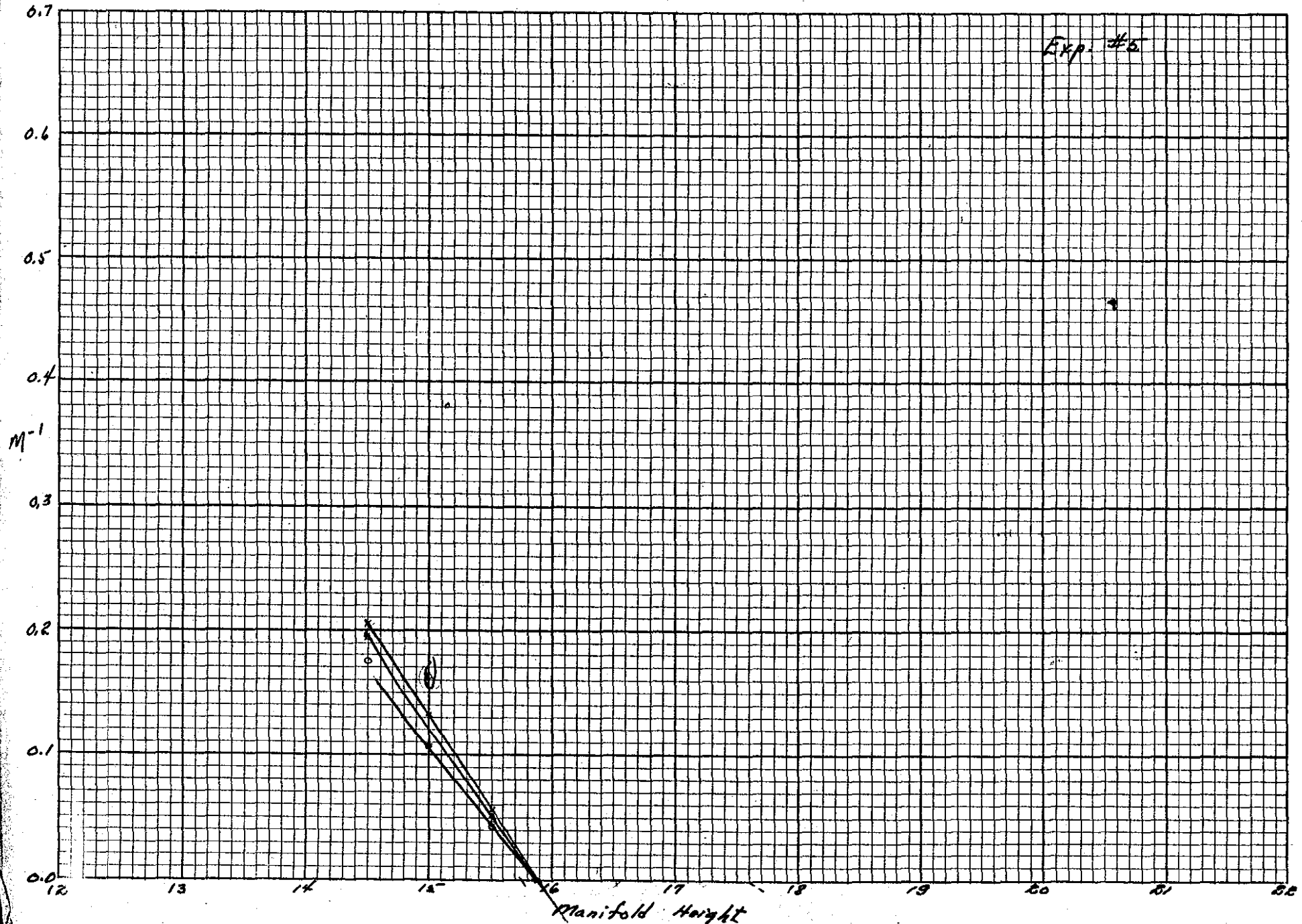
1220

7040

$$\Sigma g. ht. = \frac{7040}{237} = 29.7 \text{ cm} \approx 11$$

zero of manifold approx. correct.

Exp. #5



Date

Time	Source	Control Rod	Safety Rod	Manifold	C_1	M^{-1}	C_2	M^{-1}	C_4	M^{-1}
Zero on manifold lowered 2.45 inches from Exp.										
9:58	in	13.89	13.6	5.00	15.0		19.0		31.5	
10:20	in	13.89	13.6	14.50	90.75	.167	96.0	.198	163.5	.193
Manifold lowered to -15.2" for mixing										
10:53	in	13.89	13.6	14.50	85.75	.175	98.25	.205	163.5	.194
11:02	in	13.89	13.6	15.00	141.	.106	143.5	.132	252.5	.165
11:16	in	13.89	13.6	15.50	338.25	.044	338.25	.056	609.0	.052
11:29	out	13.89	13.6	15.82						
	out	13.89	13.6	15.87						
	out	13.89	13.6	15.88						
	out	13.89	13.6	15.86						
				15.82						
Repeat after Lowering Manifold to -20"										
12:44 PM	in	13.89	13.6	14.50	88.0		91.25		164.75	
12:56	in	13.89	13.4	15.50	328	.044	322.5	.058	584.25	.053
-	out	"	"	15.84						
1:16 PM	"	"	"	15.84						
1:18	"	"	"	15.82						
Crit. ht. ~ 15.84" 15.84" = 16.7 cm										
Out vol. = 5590 = 5590										
Air gap ~ 3cm. $\frac{5590}{820} = .683 \times 1300 = 887 \text{ gm} \approx 881$										
Original value more correct										
Out. Vol. = ~ 5590 5610 cm ³										
Out. Mass = ~ 884 881										
Total Vol. ↓ by adding water vol ~ 8300 cm ³										
2. " man. in manifold 8260										
3. Analyser 8100										
* Shift should be 2.85" Signed										

point to C4 is question

Date

~~October~~

Calc. of H_{23} at approx 160:

$$\begin{array}{r}
 .1321 \\
 \underline{.1297} \times 1.47 = .2205 \\
 .0548 \times \frac{1.47}{2176} = .0327 \text{ " HNO}_3/\text{gm} \\
 \text{(Correct)} \\
 \underline{.2493} \\
 .2532
 \end{array}$$

$$\begin{array}{r}
 1.0000 \\
 \underline{.2532} \\
 .7468 \\
 \underline{.0047} \\
 .7515
 \end{array}$$

H_2O Eq. of HNO_3 $\frac{9}{63} = .1428$

$$.1428 \times .0327 =$$

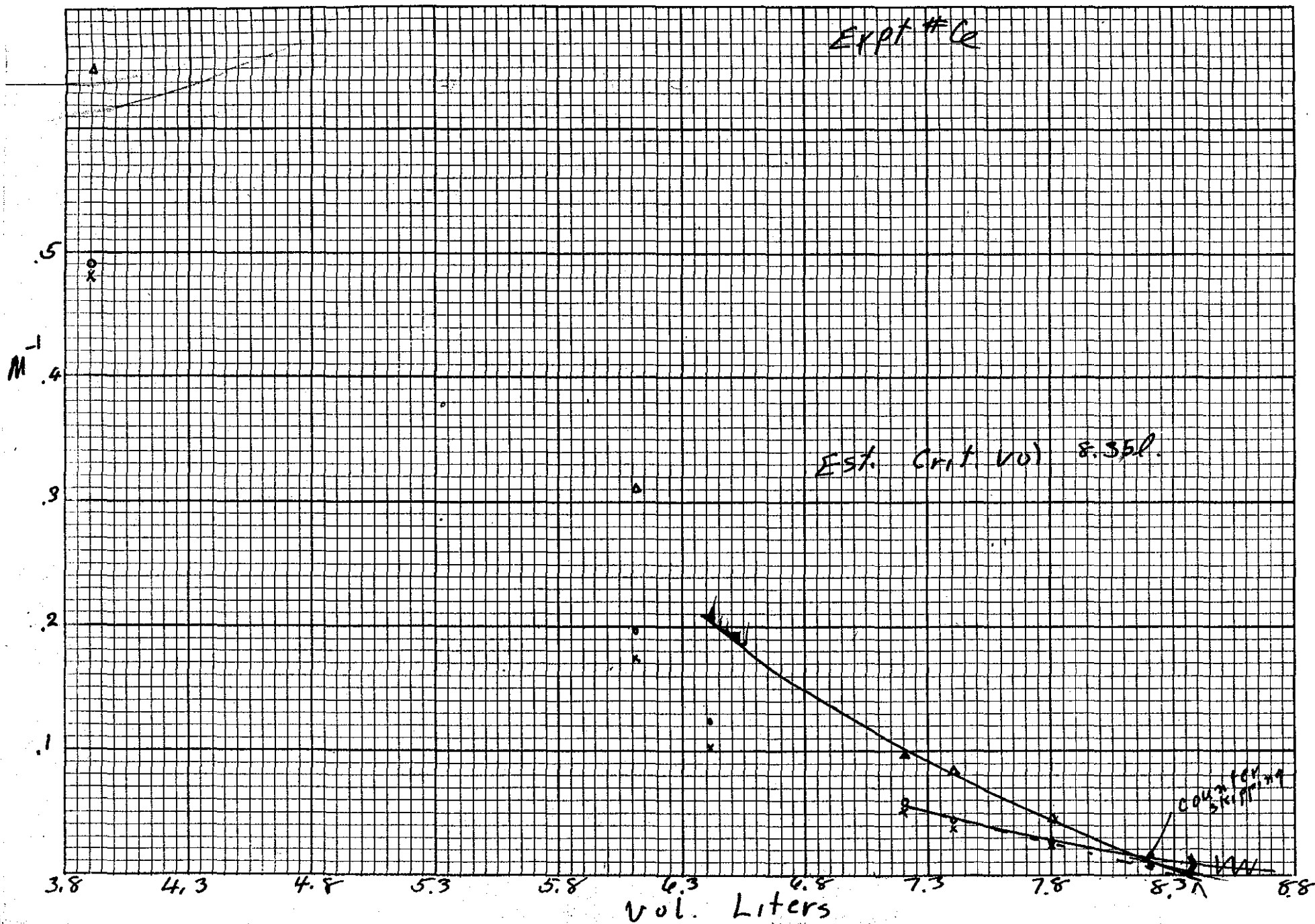
$$\begin{array}{r}
 1.0000 \\
 \underline{.2493} \\
 .7507 \text{ gm H}_2\text{O/g} \\
 \underline{.0047} \\
 .7554
 \end{array}$$

$$H_{23} = \frac{.7554}{.1297} \times 25.9 = 150.9 = \sim 151 \checkmark$$

Calc. of ht. soln level inter D. Vol.:

$$\text{act. Vol} = 8200 - 1200 = \sim 7000$$

$$\begin{array}{r}
 \frac{7000}{257} = 27.23 \\
 \frac{7000}{257} = \frac{39.00}{48.55 \text{ gm}} = 27.0 \\
 \underline{2.54}
 \end{array}$$



8-21-52

Morfitt

Expt #6
6" Dia. Vessel

H₂O ~ 140
151

33

Date

~~ROBERT~~
FOX

Time	Source	Control Rod	Safety Rod	Manifold Pos.	C ₁	M ₁ ⁻¹	C ₃	M ₃ ⁻¹	C ₄	M ₄ ⁻¹
12:40 PM	1M	29.55	37.5	5.00	11.5		12.5		358/70	
-	"	"	"	15.00	24.0	.48	25.5	.49	58/9.5	.60/.74
1:05 PM	"	"	"	23.50	47.0	.172	63.0	.198	113/84	.31/.50
1:22	"	"	"	26.00	112.0	.103	102.0	.122	167/38	.21/
1:32	"	"	"	28.50	231	.050	214	.058	354/75	.099/
1:51	"	"	"	30.0	302	.038	274	.044	423/97	.083/.072
	"	"	"	31.5	518	.022	474	.026	728/153	.048/.066
				32.5	Sub-crit.					
2:54	"	"	"	45.27	F	-	760	.0164	4900/800	.007/.008

Total vol by adding vol. H₂O = ~ 8100
 Measured total ht in reactor - manifold empty
 = 46.0 cm. ± 8.260 L
 Total vol from analysis = ~ 8100 cm³
 W. Total vol ~ ~~8.260~~ 8.150
 Extrapolated crit. vol. ~ 8.4 l
 Crit man = 1340 ✓

U-4 Sample

50.1228 - H₂O 137
 22.5798
 27.5430 g/m.

$$\rho_m U/m = 0.1321 \times 9820 = .1298 \text{ g}^2/\text{m} = \frac{\sqrt{1548} \text{ g}^2/\text{cc}}{.1599}$$

$$\rho_p \rho_n = 1.2322 @ 30.8^\circ\text{C} = \frac{\sim 1300}{.1598} = 8140 \text{ cm}^3$$

Signed

Date

Dilution to ~ 200 H/23 based on analytic results at ~ 120

at ~ 120 $\frac{\text{gm H}_2\text{O}}{\text{cc}} = .911$

∴ total vol. wa approx 6.60 liters ; Total water = $.911 \times 6.60 = 6010 \text{ gm}$

$$\frac{H}{23} = 200 = \frac{6010 + X}{9} = \frac{1300}{233}$$

$$200 \times \frac{50.2}{50.2} = 6010 + X$$

$$\frac{10,040}{6010} = 4030$$

$$\begin{array}{r} 6010 \\ 2130 \\ \hline 8140 \\ 1700 \\ \hline 9840 \end{array}$$

Previously added 1700 gm ∴ ~ 4000 - 1700 = 2300 gm

Added 2.130 liters

$$\frac{H}{23} = \frac{9840}{50.2} = \sim 196$$

$$\frac{.10675}{.2176} \times .0548 = .0269 \text{ gm free HNO}_3/\text{gm} \quad .02690$$

$$1.67 \times .1084 = .18125 \text{ gm salt/gm} \quad .18125$$

$$.1428 \times .0269 = .00384 \text{ H}_2\text{O equiv. of F. HNO}_3 \quad .00384$$

$$\frac{H}{23} = \frac{.79569}{.10675} \times 25.9 = 193 \checkmark$$

$$\begin{array}{r} \text{gm H}_2\text{O/gm} = .79185 \\ .00384 \\ \hline \text{Total H}_2\text{O} = .79569 \end{array}$$

Zero of manifold = error on basis of vol. added :

$$\frac{2130}{237 \times 254} = \frac{3.53}{2.20} \text{ "error"}$$

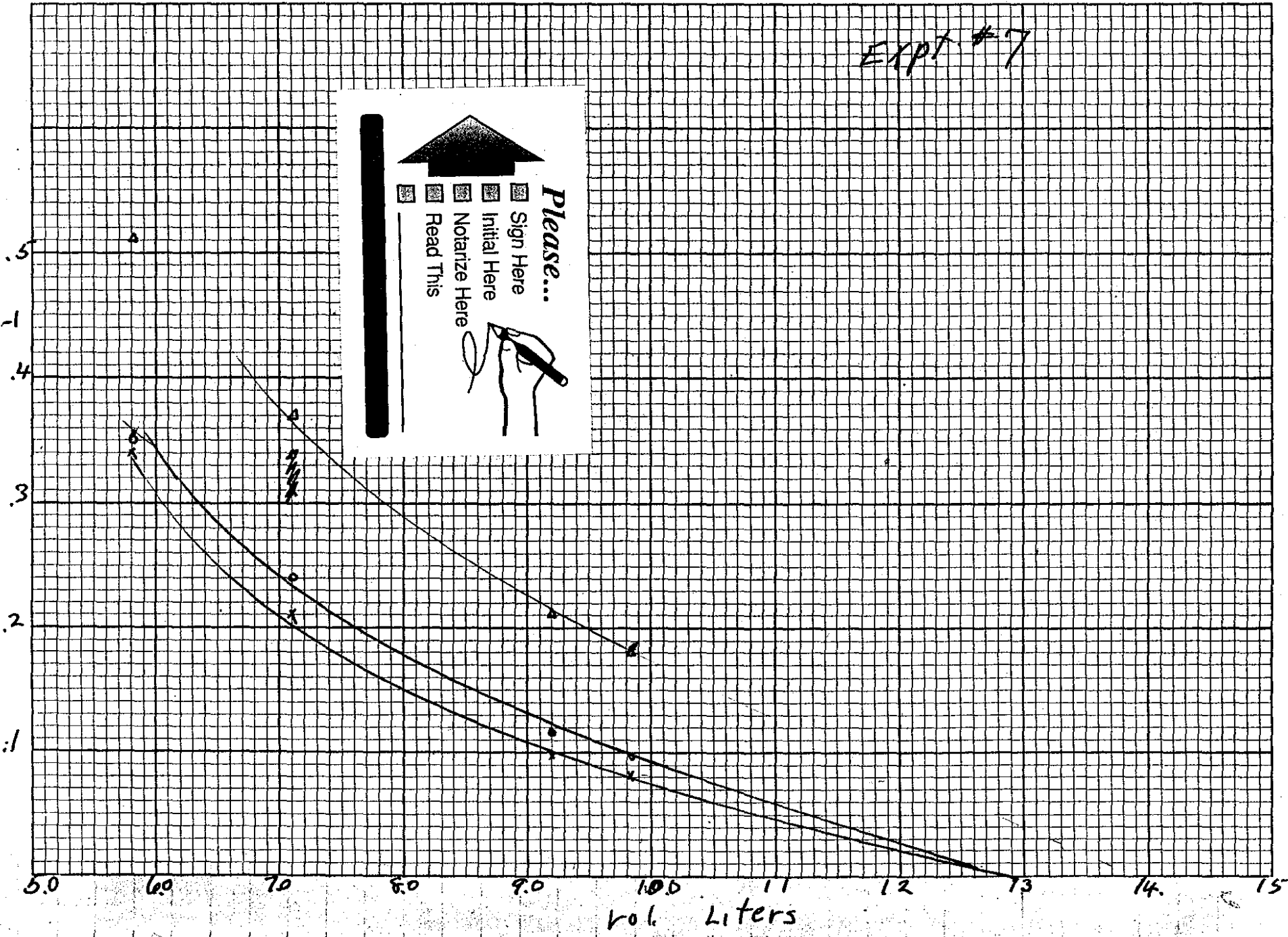
VOL. LITERS

EXPT #7

Please...

- Sign Here
- Initial Here
- Notarize Here
- Read This

M-1



analytic

6.60
10 gm

010
1.30
1.40
2.50
5.40

00 gm

690
125
815
100
150
85
84
569

d:

17
19
21
22

Why is this,
0.2176 not
0.2226?

1
4
3
M
1-M
2

21-52
Date Promin
Fox

Expt #7

6" Dia. Vessel

35

Time	Source	Manifold Control Rod	Lowered Safety Rod	Manifold ~ 2.2"	C ₁	M ₁ ⁻¹	C ₃	M ₃ ⁻¹		
12:30 PM	17	15.2	37.7	6.00	13.5		12			
1:35	"	15.2	37.7	21.00	39.5		34			*
Lowered Manifold for Mixing (2.2")										
2:09	"	15.2	37.7	6.00	12.5		13		37 / 225	
2:24	"	15.2	37.7	21.00	39.75	34	36.75	.35	73 / 40	.51 / .54
2:36	"	25.2	37.7	26.00	59.0	21	53.5	.24	100 / 57	.37 / .39
2:52	"	25.34	37.7	35.00	128.0	.098	110	.118	170 / 110	.21 / .21
3:20	"	25.3	37.7	52.51	156	.08	133	.098	204 / 136	.181 / .165

Soln level reaches 0 at $\frac{37.7}{33.3} \times 1.3 = \frac{37.7}{34.6}$ "

Extrap. cont vol. = ~ 13 l
est. cont mass = ~ 1640 gm

Total vol. in system:

1. Adaptor 10,230 cm³
2. Analytic 10,230

* measured total zero shift = 13.90" - previous shift
11.7" ∴ 2.2 Change Signed made Above.

Date $\frac{1}{33} \sim 120$

total vol = 660 liters

sp gr. 1.2854

\therefore total wt. = 8,510 gm

dil to ~140 added 1,700 "

" " ~196 2,130

12,340 gm total

shipped including sample ~ 4,800 "

7,540 gm left.

Before shipment total water was 9840 gm \approx 196 H₂O

present H₂O = $\frac{7540}{12340} \times 9840 = 6015$ gm

For dilution to $\frac{1}{23} \sim 250$

gm 23 = $\frac{7540}{12340} \times 1300$

= 611 x 1300

= 794 gm

250 = $\frac{6015 + x}{9}$

$\frac{794}{233} = 3.415$

250 x 9 x 3.415 = 6015 + x

7620
6015
1655

add 1650 gm H₂O

Measured vol. after removal of ~ 4800 gm but before whitening: 21.2 cm in manifold

237 x 21.2 = 5020 cm³

+ dead vol. 1000

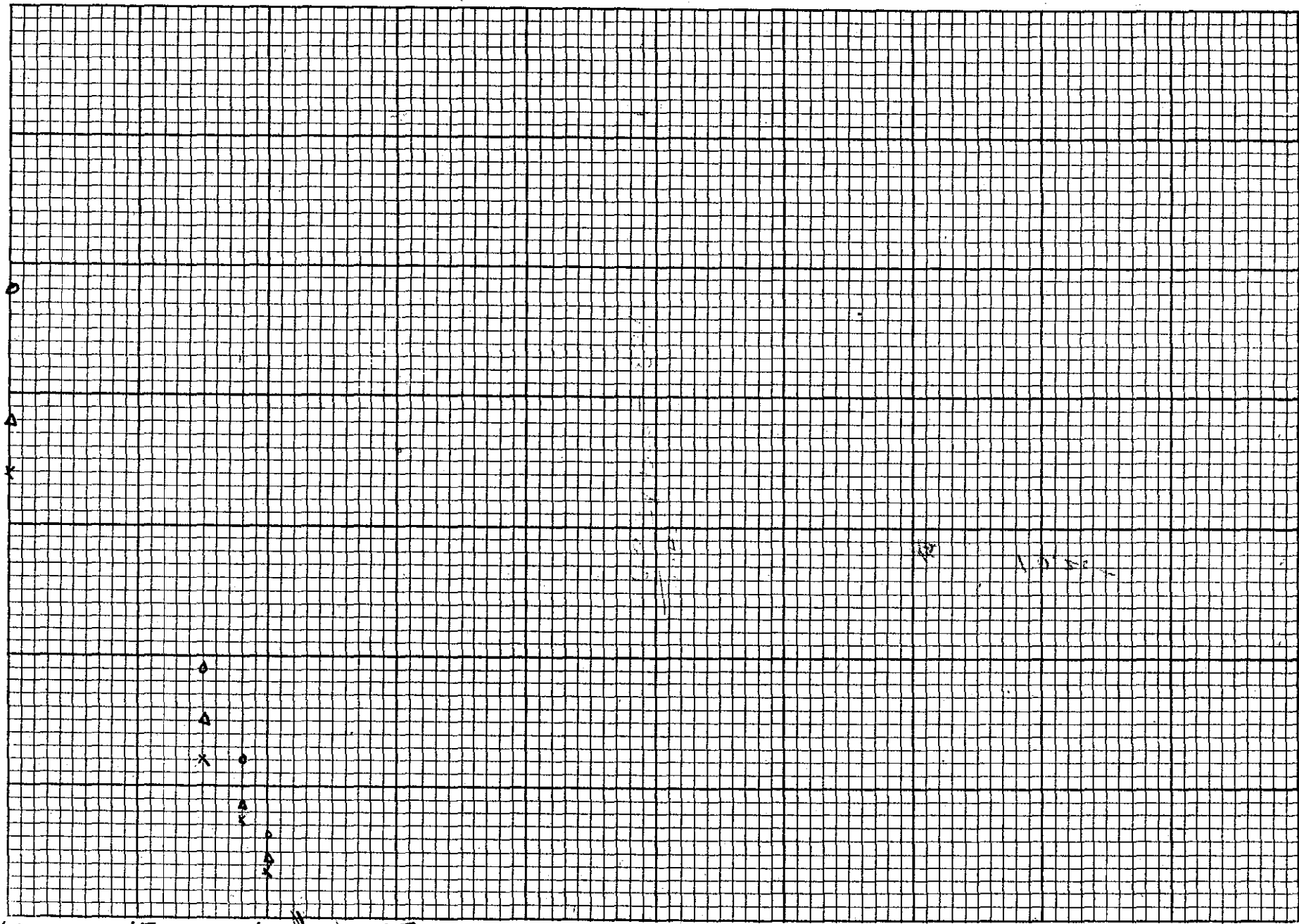
6120

1650

7770 cm³

Water added

M^{-1}



14 15 16 17 18

8-25-52

Robert Cronin
Tox

EXPT #8

#/23 - 200
193

37

Date	Source	Cont. Rod	Safety Rod	Manifold	8" Vessel	C ₁	C ₃	C ₄	C ₅			
2:27	12	10.5	12.7	7.02	22.5		38	1125	16			
2:41	"	"	"	14.02	66	.34	79.5	.48	29.25	.38	29.26	
2:53	"	"	"	15.49	176	.121	189	.19	76	.148	62	2.4
3:08	"	14.13	12.7	15.78	298	.075	317	.12	129	.087	100	.14
3:25	"	"	"	16.00	200	.037	599	.063	259	.043	184	
3:18	out	"	"	16.23	Slightly super - out.							
				16.22	" sub-crit (source not quite out)							

Source hung at ~ 12" from all-out position.
Repeat after lowering manifold and repair of source

3:22	"	11.23	12.5	14.00	41		755		290		270
	out			16.20							
				16.22							

Out. vol. = 188 x 331 = 622 l

Expt. run before removal of soln. for shipment

Crit. mass = ~ 787 gm. ✓

Air gap ~ 1 cm.

~ 790

Sample taken after removal of 4709 gm from system for concentrating:

U-5
 $\frac{110.124}{22.721} \times \frac{\#/23 = 193}{87.397 \text{ gm net.}} = 1.086 \text{ gm U/gm} = 1.0675 \frac{\text{gm}^{23}}{\text{gm}}$
 Spgr. 1.1854 @ 25.0°C
 (using assay 98.4%²³)
 $.1286 \text{ gm U/cc} = .1265 \frac{\text{gm}^{23}}{\text{cc}}$

Calc. #/23 P 34

Total vol: 1. additive ~~6190 cm³~~ 10,230 cm³
 2. Analysis 10,250

Signed

38

Date zero correction (estimated)

Total vol	10,430	before shipping
	7770	present vol
	<u>2660</u>	≈ 4.40 " shift. in metal

zero shifted up 4.40"

 \therefore present total shift = $13.90 - 4.40 = 9.5$ "Other value \rightarrow at $+2.625$ " selys reads 12.01 $12.01 - 2.625 = 9.385$ " shift.Assuming active vol = $6680 \text{ cm}^3 \div 2.54 = 11.1$ " not \therefore shift error = $11.1 - 9.38 = 1.72$ " trueDue to $8\frac{1}{2}$ " not having same zero ht. measured
value = 9.9 — $9.9 - 9.4 = .5$ "

Signed

EXPT #9

M⁻¹
M.4
.3
.2
.1

16 17 18 19
Manifold Reading (un corrected)

Best Extrapolation = ~ 18.3"

8-26-52
 Rohrer
 Date Fox

EXPT # 9

H/23 - 250 247

39

8" Dia. Vesse)

(see p 43)

Time	Source	Control	Safety	Mani-fold	C1	C2	C3	C4	C5	
3:45 PM	1m	8.39	12.7	*6.00	20		34	10	13	
3:40	"	"	"	16.00	90	.22	102.5	.34	36 .28	30 43
	"	"	"	17.00	177	.113	182	.187	65 .154	48.75 28.75 27
	1.1m	14.4	12.7	19.00	195		201	73.25	51.5	
				21.00	no change					
				17.87	begin to drop slightly					
				17.50	change in only slight					
				17.25	"	"	"	"	"	"
				17.00	"	"	"	"	"	"
				16.75	level drop more rapidly - D-2					
				16.50	"	"	"	"	"	"

Estimated Selys reading when reactor full = 17.0

Corrected reading = $17.0 + 1.72 = 18.72$

$$18.72 \times 2.54 = 47.5 \text{ cm} \times 237 = 11.25 \text{ l} = 19.8 \text{ cm}$$

Measured full ht = 19.9 cm

" vol when full 6.56 liters

~~Estimated critical vol = 6.72 liters~~

$$6.56 + 1.4 \times 331 = 7020 \text{ cm}^3 + 463.4 \text{ cm}^3 = 7483.4 \text{ cm}^3$$

Crit Man ~ 670 gm

700

Total vol. in system : 1. additive 7840

(total man in system ~ 7840) 2. analysis 7840

3. measurement 7770

* Manifold zero shifted 4.4"

Signed

measured height in manifold above zero - $\overset{28.4}{30 \text{ cm}}$
 " " " " " " $\overset{28.0}{\text{recheck}}$
 av $\overset{28.2}{28.2}$

$$28.2 \times 237 = 6680 \text{ cm}^3$$

Plus dead vol $\frac{1090}{7776}$ (1220-130) see p 34

Cont. ht = 20.2" Corrected value ≈ 21.9

$$21.9 \times 254 \times 237 = \frac{13180}{237+362} = 22 \text{ cm}$$

Previous measuring.

$$20.7 \times 254 \times 237 = \frac{12460}{511} = 20.8$$

cannot use because level was below manifold zero

From curvature of M^{-1} curve levels in manifold dropped below zero at $\overset{16.5}{17.5}$ which corrects to $\overset{17.5}{17.5}$

From D. Vol curve total vol change of manifold for $2 \frac{1}{2}$ " $\overset{680}{680 \text{ cm}^3}$
 av. area for $5 \frac{1}{2}$ " in manifold is $\sim 150 \text{ cm}^2$
 $\frac{680}{510} = 1.33 \text{ cm}$ & $\overset{680}{680 \text{ cm}^3}$
 $+ 2.08 \times 362 = 752$

Vol. del = total vol - vol in manifold at 1.33 cm = ~ 180
 $= 680 - 180 = \sim 500 \text{ cm}^3$
 & $500 \text{ cm}^3 \approx 1.38 \text{ cm} = 8 \frac{1}{2}$ " vessel.

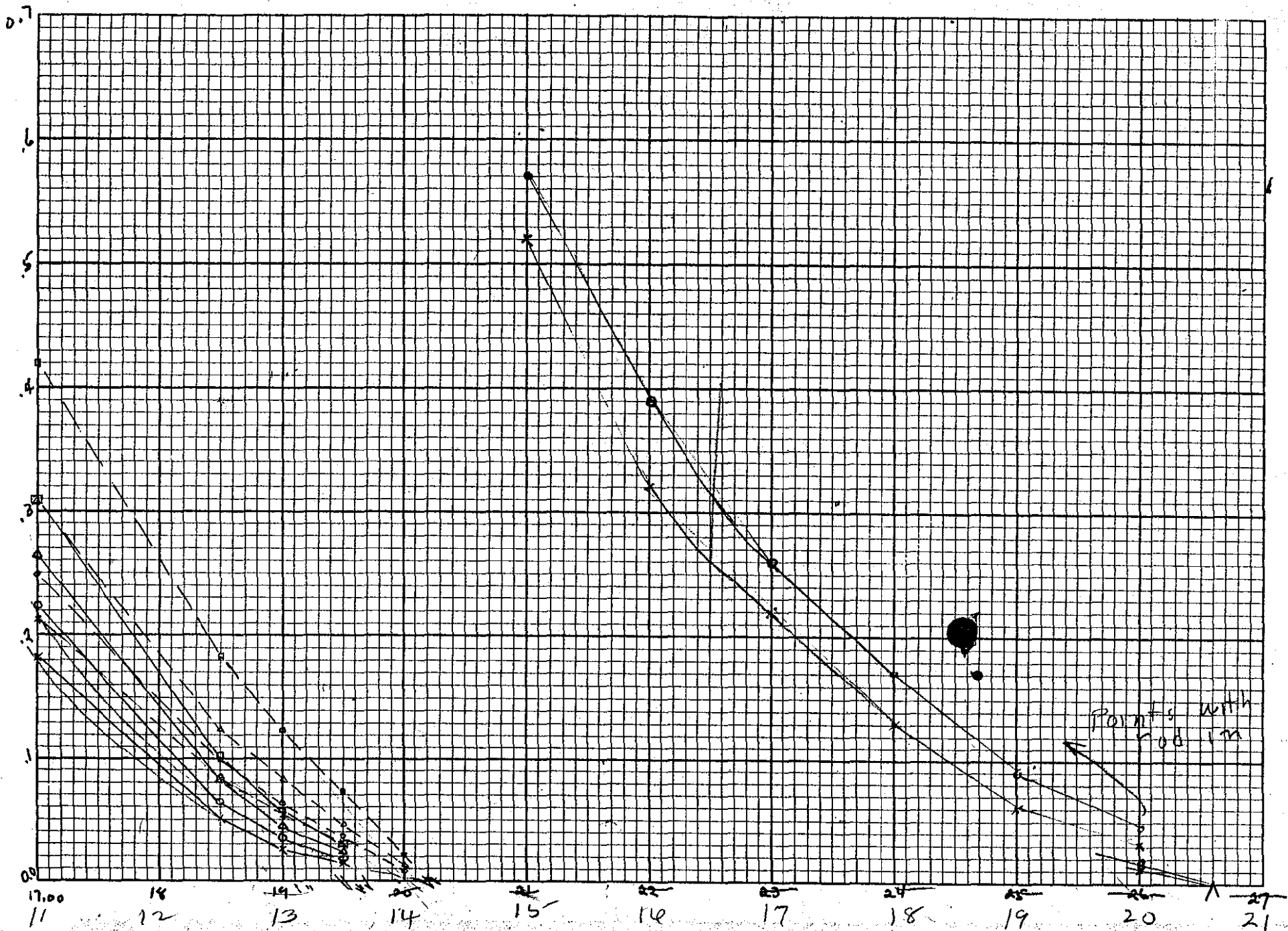
\therefore Estimated vol. del. is $\sim 500 \text{ cm}^3$
 Total vol. in Vessel is $6680 + 500 = 7180 \text{ cm}^3$

$\overset{17.5}{17.5}$ " $\approx \overset{17.5}{17.5}$ cm in $8 \frac{1}{2}$ " vessel
 $17.5 \times 362 = \frac{6340}{6340} \text{ cm}^3$

Adding amt del. from dead vol.:

Manifold raised ~ 4 " $\approx 10 \text{ cm}$
 $10 \text{ cm del.} \sim 1.95 \text{ cm into } 8 \frac{1}{2}$ " V.
 $1.95 \times 362 = \sim 700$
 Total vol = $\sim \frac{6340}{6340} + 700 = \sim \frac{6340}{7220} 7040$

MADE IN U.S.A. 10 X 10 PER INCH



MADE IN U.S.A.

10 X 10 PER INCH

(2)

5 ft below

5 ft

5 ft

8-27-24
Date Fox
Rohrer

Exp. 10
8 1/2" vessel. *

4/5250
123

Time	Source	Control	Safety In at 1.07	manifold	C ₁	M ¹	C ₃	m ⁻¹	C ₄	m ⁻¹	C ₅	m ⁻¹
12:4	in	9.09	14.4	11.01	17.25		19.0		8.5		11.0	
12:25	in	11.14	14.4	17.00	80.75	.214	76.5	.249	27.5	.309	24.25	.42
	in	"	"	18.50	209.25	.082	190.75	.0996	68.0	.125	60.0	.183
12:34	in	13.02	14.4	19.01	323.75	.053	300.5	.063	104.25	.081	88.25	.125
1:15	in	13.02	14.4	19.50	549.0	.031	511.25	.037	182.0	.046	148.50	.074
1:30	in	13.02	14.4	20.00	1038.25	(?)	1931.75	.0098	705.5	.012	530.25	.021
1:55	out			20.35	level rising seems to be supercritical.							
1:57					levels and starts drop.							
1:58				20.40	dropping							
1:59				20.47	level							
2:01				20.51	slight rise							
2:02				20.57	begins to drop							
Repeat after lowering manifold of mixing.												
2:50	in	13.02	14.5	17.01	12.50		15.25		6.75		6.25	
3:11	"	"	"	17.00	69.00	.181	68.75	.224	25.50	.265	20.25	.31
3:24	"	"	"	18.50	249.00	.0502	236.25	.065	81.25	.083	61.25	.102
3:35	"	"	"	19.00	461.0	.027	418.5	.0365	144.75	.0466	106.75	.0586
3:47	"	"	"	19.50	905.75	.0138	821.5	.0183	296.25	.0228	207.25	.030
	out			20.30	supercritical							
				20.27	supercritical							
				20.23	"							
				20.20	"							
				20.19	slightly-sub							
4:04				20.21	slightly-supercritical							

(Cont.) see page 42

Ulysses readings before shift to "Mell":

13.02 14.5 ~~9.9~~
96.37 - moved

45.8" to Limit switch
from zero

Zero of 8 1/2" R. measured = 9.9" below original manifold
" " " apparently 1" higher than 6" zero
* Bottom of vessel up 4.37" from Bottom of can.

Signed

42 Francis
Date 9-2-52 FOX

EXP-#10 (cont) $H_{23} = \sim 250$
247

TIME	Source	CONTM	SaAct	Manifd	Et	m ⁻¹	C3	m ⁻¹	C4	m ⁻¹	C5	m ⁻¹
10:12 A.M.	IN	.32	47.4 74.6	11.00	Manifold zero				12		11.5	
10:23 A.M.	"	"	"	15.00	(-10.0")				23.0	.52	20.0	.57
10:49 A.M.	"	"	"	16.00	Change zero				37.5	.32	29.15	.39
10:09 A.M.	"	"	"	17.00					55.5	.22	43.6	.26
11:15 A.M.	"	"	"	17.5					70.00	.17	51.5	.22
11:26 A.M.	"	"	"	18.00					90.75	.13	69.0	.17
11:36 A.M.	"	"	"	19.00					195	.06	130	.09
11:51	"	"	"	20.00					380	.032	246	.047
12:04	"	13.50	"	20.00					1164	.011	702	.016
	out	"	"	20.67	supercritical							
				20.65	supercritical							
				20.63	sub-critical							
12:20					Crit Vol				20.66 crit ht uncorrected			
	our gap ~ 20 am				Crit Man				7040			

Calc. P 40

Total vol. 28.0 cm in storage manifold (value rounded off to 200 gm)

" " see page 39
Dilution after sampling:

$$7660 + X = 300 \times 3.415 \times 9$$

add; $X = 1600 \text{ gm H}_2\text{O}$

U-4-py83

Sample U-7
(before dilution)

107,9748
22,7500

85,2248

$H_{23} \sim 250$

.08879 gm^U/gm

1.1451 @ 25.8°C

.08735 gm²³/gm

.1000 gm²³/cc

Date

Calc. $H/23 \sim 250$: $.08879 \times 1.67 = .14825$ gm salt/gm.

$$\frac{.08879}{.2226} \times .0548 = .0219 \text{ gm Free A/gm}$$

$$.0219 \times .1428 = .00312 \text{ gm H}_2\text{O (F.A. eq)}$$

$$\begin{array}{r} .14825 \\ .0219 \\ \hline .17015 \end{array}$$

$$\begin{array}{r} 1.00000 \\ .17015 \\ \hline .82985 \\ .00312 \\ \hline .83297 \end{array}$$

gm H₂O / gm

$$H/23 = \frac{.83297}{.08735} \times 25.9 = \underline{247} \text{ V}$$

R.O. on air gap $\approx 4.15\%$ change - man (K-25 Data)

$$702 \times .0415 = 29.2 \text{ gm}$$

$$702 - 29 = 673$$

Signed

44

Date

Manifold re-zeroed usually - zero used =
 Expt 11 $\sigma_z \approx +2.2$ zero shift = ≈ 13.0

Calc. $H_{23} \approx 300$!

$$.07604 \times 1.67 = .1269 \text{ gm salt/gm}$$

$$\frac{.07604}{.2226} \times .0548 = .00187 \text{ gm free A.} \quad \begin{array}{r} .1269 \\ .0187 \\ \hline .1456 \end{array}$$

$$.00187 \times 1.428 = .00267 \text{ [F.A. H}_2\text{O Eq.]} \quad \begin{array}{r} .1456 \\ .0027 \\ \hline .1483 \end{array}$$

1.0000

.1456

.8544

.0027

Total $H_2O \rightarrow .8571$

$$H_{23} = 25.9 \times \frac{.8571}{.0748} = 297 \quad \checkmark$$

Signed

106

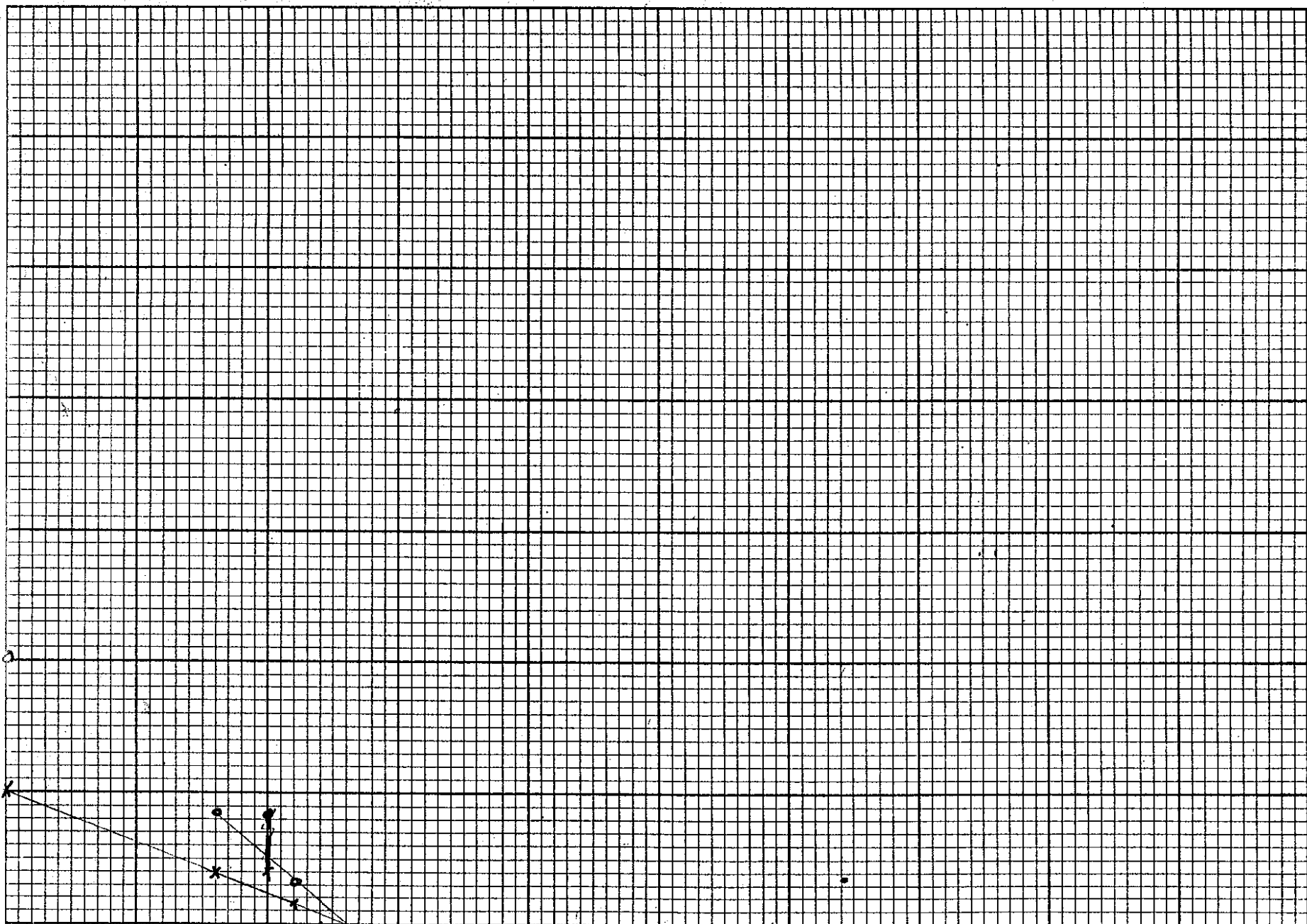
M^{-1}

.4

.3

.2

.1



18

19

20

21

22

Francis

Expt # 11

8 1/2 Reactor

45

Date
9-3-52

H/23 ~ 300
297

TIME	Source	Control	Safety	Manifold	G4	m ⁻¹	G-5	m ⁻¹	
1:00 PM	in	10.02	13.0	10.00	18.5		15.5		
1:24 PM	"	"	"	10.00	120		20.0	20	
1:36 PM	"	"	"	14.00	112.0	.1	100.0	.2	
1:50 PM	"	"	"	18.50 19.00	305.0	.0393	238.0	.084	
2:06 PM	"	"	"	19.10	940.0	.014	602.0	.032	
Source out				19.21	just crit.				
	"	"	"	19.23	super Crit.				
	"	"	"	19.19	sub. "				
Repeat after lowering for mixing									
	in	13.6	13.1	18.00	102.0	.118	89.0	.225	
	"	"	"	18.80	281.0	.0426	228.0	.088	
	"	"	"	19.10	940.0	.0143	617.0	.0325	
				19.27	super crit.				
				19.23	super crit.				
				19.21	super crit.				
				19.19	sub-crit.				
out ht = 21.4" ≈ 21.5 cm				7750		add ~ 2.2" to readings (see top page 44) gasket ~ .3" full ht ~ 21.5 cm			
Air gap = ~ 0		Crit. val. = ~ 7950							
		Crit. mass = 652		650 - rounded					
U-8 sample				130.6255	H/23 ~ 300		Calc. p 44		
				22.5022					
				108.9233 gm.					
				07604	gm²³/gm		1.1207 @ 28°C		
				0748	gm²³/gm		.0838 gm²³/cc		
Total vol: 1. additive 9440;									
soln ht = manifold 36.7" not correct									
Signed									

Dilution to ~350: $7460 + 1600 = 9260 \text{ gm H}_2\text{O at}$

$$9260 + x = 350 \times \frac{30.7}{34.15} x$$

$$= 10,750$$

$$x = \sim 1500 \text{ gms H}_2\text{O to add}$$

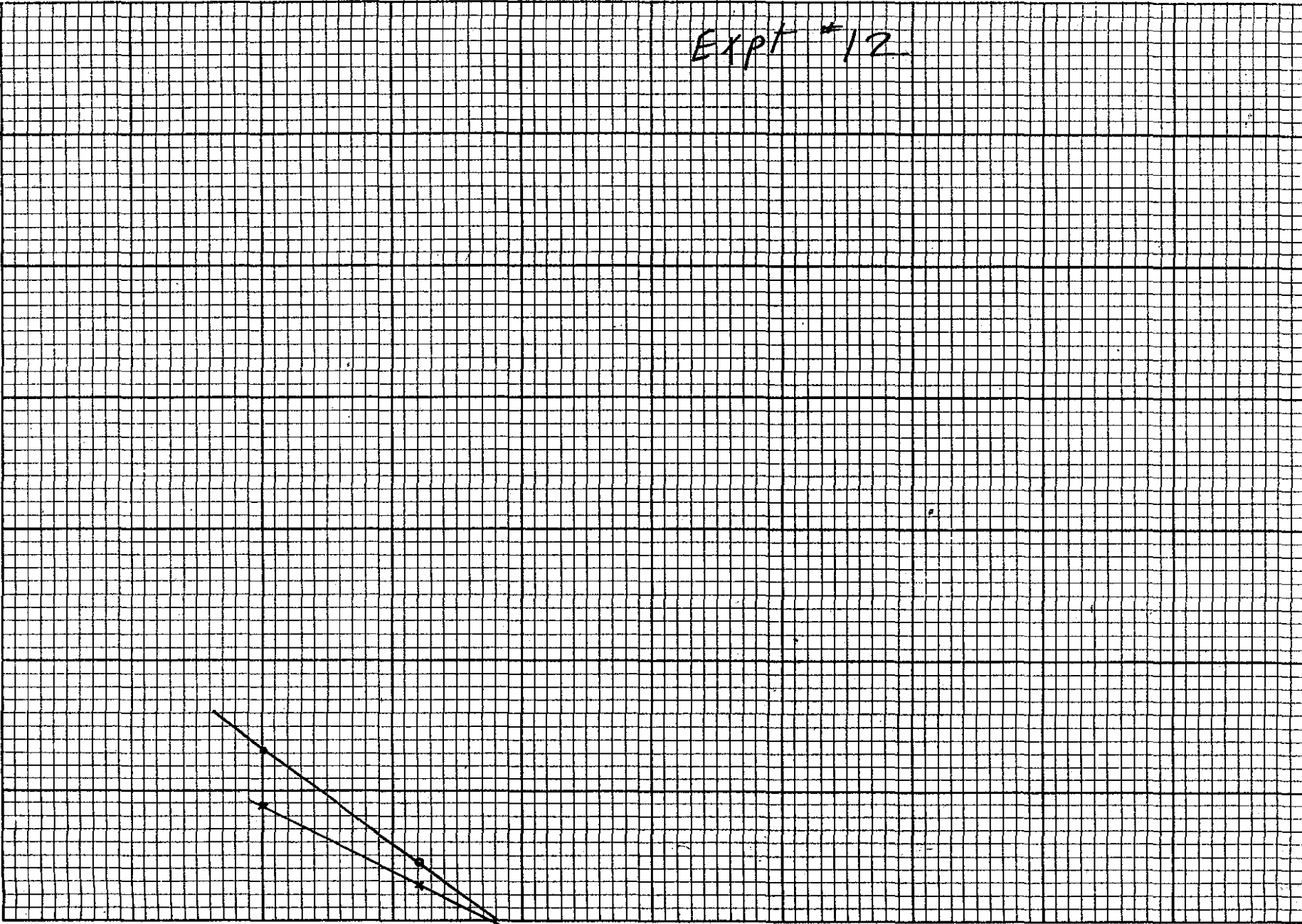
Manifold zero at $(-)14.25''$ "

Re-zeroed after expt #12: $-15.0''$ "

1500 cm^3 added to system is equiv. to $2.5''$
 $\& 13 + 2.5 = 15.5''$ or $1.25''$ below zero at
 start of Expt. 12

Avg. of these zero errors is: $\frac{15.25 + 14.25}{2} = 14.75''$
 $1.0''$

EXPT #12



Manifold ht in.

20 21 22

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

NO. 340 - 10 DIEZGEN GRAPH PAPER

10 X 10 PER INCH

Francis
FOX
Date
9-4-52

Expt #12

9" Reactor* 47

#/23 ~ 350
350e

Time	Source	Control	Safety	Manifold	C4		C5	
2:13 PM	in	13.5"	13.5"	*11.00"	130		19.0	
2:45	"	"	"	*21.0	145.0	.089	144.0	.132
2:55	"	"	"	21.60	452.0	.027	421.0	.0172
3:05	OUT	"	"	21.91	Sub critical			
	OUT	"	"	21.92	Supercritical			
				Repeat after lowering Manifold				
3:20	in	"	"	11.34	13		19	
	"	"	"	21.00	151		148	
	OUT	"	"	21.93	super crit.			
	"	"	"	21.90	super crit.			
	"	"	"	21.83	super crit.			
3:52	"	"	"	21.80	sub. crit.			
								add 17.0" spread- ing - 22.8" 2 21.3 cm"

air gap = ~ 2.0 cm
 Out vol = 8750
 Out Man = 615 cpm ✓
 .02025 gm³/cc

Total vol. 1. additive - 10,940 2. Meas. 10,820

** see page 46 for manifold zero
 9-5 soln. ht. 46.0 cm ≈ 16.15"

* measured zero 6.45" Started from bottom of can.

Date

Dilution to ~ 390:

$$10760 + x = 390 \times 30.74$$

$$x = \sim 1200 \text{ cm}^3 \text{ H}_2\text{O}$$

Approx. zero at -17.0"

Calc of H/23 at ~ 350:

U-9

$$.06491 \times 1.67 = .10835 \text{ gm salt}$$

$$\frac{.06491}{.2226} \times .0548 = .01597 \text{ gm F.A.}$$

$$.1428 \times .01597 = .00228 \text{ gm F.A. H}_2\text{O Eq.}$$

$$H/23 = \frac{.87796}{.06385} \times 25.9 = 356 \checkmark$$

$$\begin{array}{r} .10835 \\ .01597 \\ \hline .12432 \\ \\ 1.00000 \\ .12432 \\ \hline .87568 \\ .00228 \\ \hline .87796 \end{array}$$

Calc. of H/23 at ~ 390

U-11

$$.05921 \times 1.67 = .0989 \text{ gm salt}$$

$$\frac{.05921}{.2226} \times .0548 = .01456 \text{ Frec A.}$$

$$.1428 \times .01456 = .00208 \text{ gm F.A. H}_2\text{O Eq.}$$

$$H/23 = \frac{.88662}{.05825} \times 25.9 = \frac{395}{394} \checkmark$$

used 394

$$\begin{array}{r} .09890 \\ .01456 \\ \hline .11346 \\ \\ 1.00000 \\ .11346 \\ \hline .88654 \\ .00208 \\ \hline .88862 \end{array}$$

U-9 ~ 350:

$$106,7211$$

$$22,7135$$

$$\hline 84,0076 \checkmark$$

$$\checkmark .06491 \text{ gm/gm}$$

$$1.1009 @ 28^\circ\text{C}$$

$$.06385 \text{ gm}^2/\text{gm}$$

$$.07625 \checkmark \text{ gm}^2/\text{cc} \checkmark$$

Francis
Fox
Date 9-8-52

Expt. # 13
9" Vessel

H/23 ~ 390
394

49

Time	Source	Control	Safety	Manifold	C4 35		C5 8.5	
1:00	in	12.4	13.0	10.00				
	"	"	"	11.00	6.0		9.5	
	"	"	"	24.00	63.0	.095	61.0	.14
	"	"	"	25.00	66.0	.091	65.0	.13
		flashed		not crit.				

Out man > 600 gm

Total vol. addition 12,140 .2.

U-10 (~390)

124,2172
22,6974

101,5198 gm net.

1.09 ✓
1.0899 @ 27.0°C
0.0592 / gm U / gm
0.05878 gm 23 / gm
0.06347 gm 23 / U ✓

Signed

50

Date

John at #to.7 am in Mansfield
44 0

Signed

Expt. 14



Time	Source	Control	Safety	Manifold	C4	C5	
	IN	14.7	14.2	12.00 (H)	11.0 5.5	20.0 10.0	
	"	"	"	24.00	15.5	17.25	} Not equilibrated
11:15 AM	"	"	"	28.00	23.25	23.50	
11:25	Ran manifold to 32.00 & tried to equilibrate. Backed manifold down in steps as level continued rise. At 24.04 in manifold Pile power level.						
11:45	IN	14.7	14.2	24.21	283	159.5	
	Lowered manifold						
1:35	IN	14.7	14.2	12.00 (H)	13.0		
1:55	IN	14.7	14.2	24.00	171.5	.068	} av. ht. ~ 24.70" Zero correction -.54" = 24.16"
	"	"	"	24.50	624	.021	
2:25	"	"	"	24.60	1482	.0088	
2:37	Out	"	"	24.65	sup.		
	"	"	"	24.69	super crit.		
	Lowered manifold						
3:15	IN	14.7	14.2	24.21	263	.049	
3:30	in	14.7	14.2	24.66	sub crit.		
	"	"	"	24.72	super crit.		
				24.69	sub. crit.		
Air Gap: ~ 5.7 cm	Out Vol = ~ 9820		✓ (19.4 x 509) = 9820				
" " ~ 379 m	Out Mass 683		✓				

Total vol.: see p. 49

* John at zero when manifold reads +.54" - visually
* Reactor zero at 4.25" Signed

Date

Dilution to ~ 450 $H/23$:

$$10,760 + 1200 = 11,960$$

$$\sim 13,860$$

$$11,960 + X = 450 \times 30.74$$

$$11,960$$

$$\hline 1,900$$

$$X = \sim 1900 \text{ cm}^3$$

Calc. $H/23$ at ~ 450:

$$.0516 \times 1.67 = \overset{.08615}{\cancel{.0852}}$$

$$\begin{array}{r} .08615 \\ .01270 \\ \hline .09885 \end{array}$$

V-12

$$\frac{.0516}{.2226} \times .0548 = .0127$$

$$\begin{array}{r} .0852 \\ .0127 \\ \hline .0979 \end{array}$$

$$.0127 \times .1428 = .00181$$

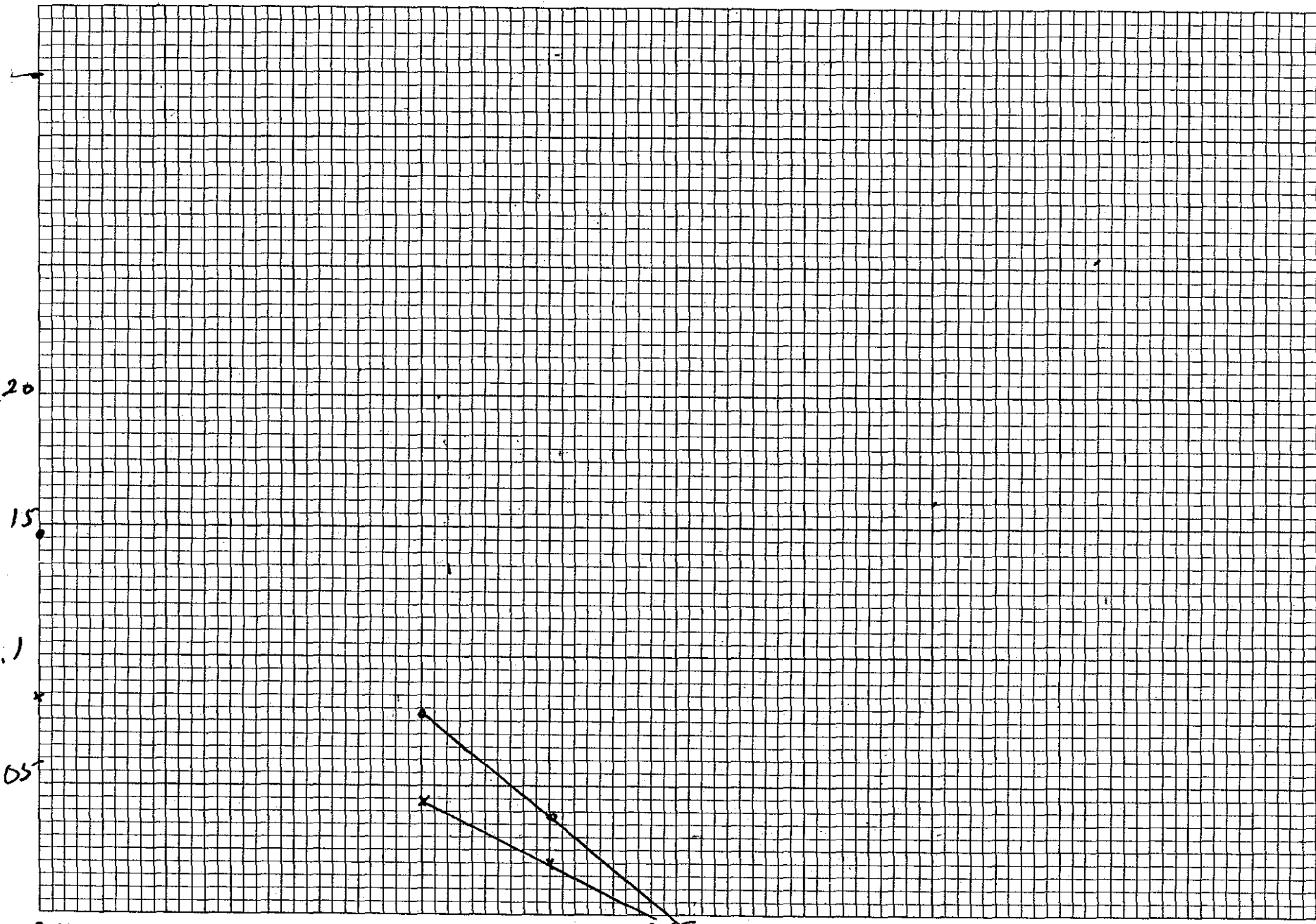
$$H/23 = \frac{.90296}{.9639} \times 25.9 = 461 \quad \checkmark$$

$$\begin{array}{r} 1.0000 \\ .0979 \\ \hline .9021 \\ .0018 \\ \hline .9039 \end{array}$$

$$\begin{array}{r} 1.0000 \\ .09885 \\ \hline .90115 \\ .00181 \\ \hline .90296 \end{array}$$

Soln. ht. in manifold 52.0 cm \approx 13,400

Signed



24

52

Carden, Francis, Fox
Date 9-10-52

Expt 15
10" Dia. Vessel

#/23 - 450
461 53

Time	S	Cont Pol.	Safety	Manifold	C4	C5
	in	14.2	14.7	10.00*	11.5	10.
	"	"	"	10.00	13.0	11.5
3:45	"	"	"	24.00	155.0 .064	78.0 .147
3:56	"	"	"	24.60	299 .0435	147 .078
	"	"	"	24.80	656 .020	312 .037
	out			25.00 sub crit.		
				25.03 sub crit.		
				25.09 sub crit.		

9-11-52

Repeat for checking

10:45 AM	in	14.2	14.7	10.00	12.5	12
	"	"	"	24.00	157.5	85.5
				24.71	535.0	291.0
11:40	out	"	"	24.99	Slightly sub.	
				25.01	" super crit.	

air gap: ~ 2.8 cm

" " ~ 2.8 gm

av. crit ht = 2.50 + 2.53 = 2.515

Cont vol. = 22.5 x 509 = 11,350 ✓

~~Cont Mass = 620~~ ✓

25.0 + 2.84" = 27.84" on manifold ~ 22.5

22.5 x 509 = 11,450 x 0.547 = 626 gm

Total vol.: 1. additional - 14,040 cm³ 2. Analytical - 13,950

U-12 (~450)

Calc. p. 52

143.4602 gm.
22.6608

120.7394 net

1.08 on written report.

1.0776 @ 27.02°C

0.5160 gm/gm ✓

0.5073 gm²³/gm

~~0.5160 gm²³/cc~~

0.547

Calc zero shift = 3.15" (use av. of 3.15 & 2.53 = 2.84")

* zero not shifted from previous dilution.

" at - 2.53" ~~[An assumed zero shift 19.3"]~~

54

Date

Dilution to $\sim 52\%$

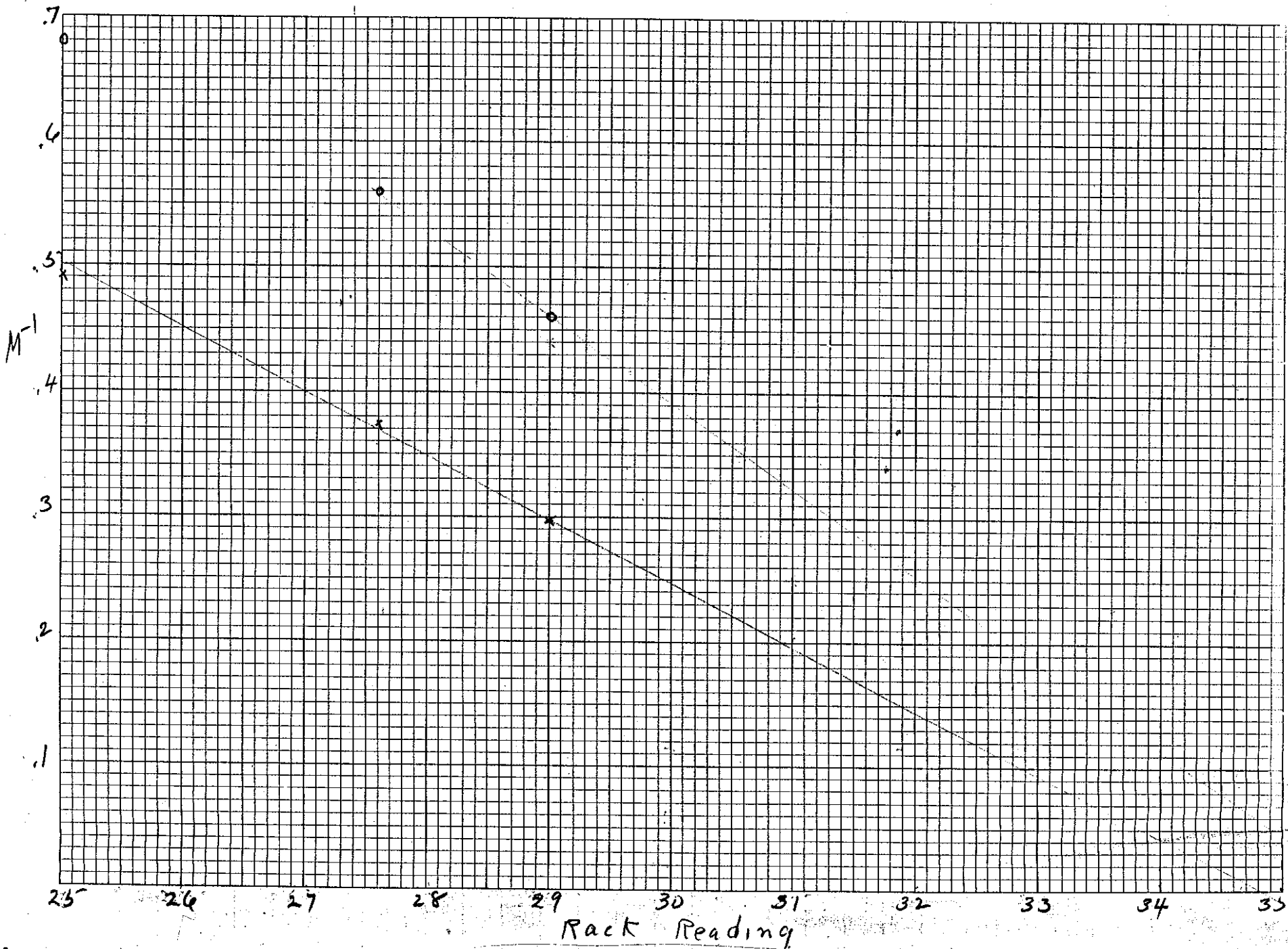
$$\text{Error} \rightarrow 13,860 + x = 525 \times 30.74$$

$$\begin{array}{r} 16,140 \\ 13,860 \\ \hline 2,280 \end{array}$$

$$x = \cancel{3300} \text{ ml.}$$

3300 cm³ was added! hence error in H/23
~~Dilution to $\sim 57\%$~~

~~$$17,100 + x = 575 \times 30.74$$~~



Crown
Fox

Expt. #16

H/23

582
~~582~~
55

Date

9-11-52 S

10" Dia. Vessel.

Control Safety Manifold.

C₄

C₅

Starting run

9:40 PM

1m

14.7

14.2

10.00

12.0

11.0

Manifold up to 40" & down

9/14/52 9:10

"

"

"

14.00

11.0

14.0

"

"

"

25.00

22.5

0.49

20.5

0.68

9:25 AM

"

"

"

"

22.5

20.5

"

"

"

27.63

29.5

.373

25.0

.54

"

"

"

29.00

37

.297

30.5

.46

1:00

"

"

"

31.00

43.75

.251

30.25

10:10

"

"

"

36.00

43.75

31.50

10:15

"

"

"

"

43.75

32.00

Not cut when flooded.

Ext. cut ht 29.0 cm = 14.750 cm³

~~crit man~~

(Long) Ext. cut man = 6460

Total vol. = 1 addition - 17,340 2.

Signed

56

Date

Dilution to ~ 600 : added 295 cm³ of re-
concentrated sol. & approx 4000 cm³ H₂O

↑ (equivalent to ~ 1115 gm) Expt. 17

(perhaps this should have been entered after ~~1245~~)

582

Calc. H/23 ~ ~~525~~

$$.04167 \times 1.67 = .0694$$

$$\frac{.04167}{.2226} \times .0548 = .01026 \text{ gm HNO}_3/\text{gm}$$

$$.01026 \times .1428 = .00146$$

$$\begin{array}{r} .06940 \\ .01026 \\ \hline .07966 \end{array}$$

$$H/23 = \frac{.9216}{.041} \times 25.9 = 582 \checkmark$$

$$\begin{array}{r} 1.00000 \\ .07966 \\ \hline 92014 \\ .00146 \\ \hline 92160 \end{array}$$

Signed

EXPT 17

M⁻¹

.4

.3

.2

.1

~~32~~ 30 ~~33~~ 31 ~~34~~ 32 ~~35~~ 33 ~~36~~ 34 ~~37~~ 35 36 37

CARDEN, FOX, FRANCIS

Date 9-18-52

Expt. 17

H/23 - 582 57

Time	Source	Control	2" Dia. Vessel	Safety manifold	C4	C5
2:00 PM	in	14.6	14.2	17.00	10.0	
2:35	"	14.6	14.2	32.07	670	1.15
2:46	"	"	"	33.20	156	.064
3:00	"	"	"	34.30	337	.0297
3:10	"	"	"	35.40	629	.0161
	out			36.09	super crit	
				36.03	slightly sub	
		Manifold lowered to 12"				
3:22	in	14.6	14.2	31.00	152	1.92
	"	"	"	33.20	159	1.83
4:25				36.15	super critical	
					indicated crit. pt. ~ 36.10 or less.	
					Av. crit. ht. ~ 36.05" - 1.15" = 34.90	
					M ⁻¹ curve begins to taper out at ~ 33.6 - 1.15"	
					32.45" ± 20.1 cm ≈ 14,700 cm ³ = 32.45"	
					34.90 - 32.45 = 2.45" used from D. Vol. ≈ 6.22 cm	
					6.2 cm ≈ D. Vol. ≈ 700 cm ³	
					Out Vol. ≈ 14,200 + 700 = 15,400 cm ³	
Air gap	~ 9.6 cm				Crit. Man. = ~ 670 g/m.	
H/23 = 582		U-13	135.1940	✓	.04167 gm U/gm	1.0608 @ 282
			22.5845		.0410 gm ²³ /gm	
			112.6095		.04347 gm ²³ /cc	✓

Manifold zeroed visually at 12" Reactor = 23.8" on rack. Rechecked & found off +1.15" add

Signed

58

Date

H, 23 at ~ ~~1.67~~: 600

$$.03872 \times 1.67 = .06467$$

.06467

.00958

.07425

$$\frac{.03872}{.2226} \times .0548 = .00958$$

$$.1428 \times .00958 = .00136$$

1.00000

.07420

.92580

.00136

.92716

16

$$\frac{H}{23} = \frac{.92716}{.03808} \times 25.9 = 630.16 \quad \checkmark$$

EXPT 18



3
2
1

from...
9-22-52

Expt. 18
12" Dia. Vessel

#/23 ~ ~~600~~
630 59

ts	Source	Control	Safety	Manifold	C4		C5	
12 PM	1m	14.6	14.2	24.00	7.0		9.0	
32	"	"	"	35.00	59.0	.1185	42.0	.214
47	"	"	"	36.00	110.0	.0633	70.0	.128
				36.87	352.0	.020	204.5	.094
59				37.25	subcritical			
				37.32	supercritical			
23-52	Frans Fox	Recheck after further mixing.						
9:12 AM	1m	14.4	14.8	24.00	8.0		8.0	
9:45	"	"	"	36.00	107.0	.075	69.0	.116
					109.0		68.0	
10:10	"	"	"	37.0	545.0	.0157	319.0	.025
	out	"	"	37.26	supercrit. (slightly)			
	"	"	"	37.23	supercrit.			
	"	"	"	37.20	subcrit.			
05=	u	Calibration of control Rod						
		0	18.8	3700	280	.028	171	.044
				37.51	supercrit.			
				37.44	subcrit.			
							av 37.4 + 1 = 38.4	
							38.4" ≈ 23.8cm	
		Critical vol = $\frac{23.8}{2.85} \times 73\% = 17, \frac{400}{2.85}$						
		Critical mass = $17,400 \times .0402 = 700 \checkmark$						
	Air gap 4.8 cm.							
				127.8843	✓			
U-14				22.6853	.03872 gm ⁴ /gm ¹	At 9.1.0556		✓
sum 58				105.1990	.03808 gm ²³ /gm			@28.2
				407 ✓	✓ .0402 gm ²³ /cc			✓
	Manifold shift near $\rightarrow 32$							
	Zero check 999.00 add 1" to readings							
	rechecked 998.90 Signed							

4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35

3 ch 4 198

60

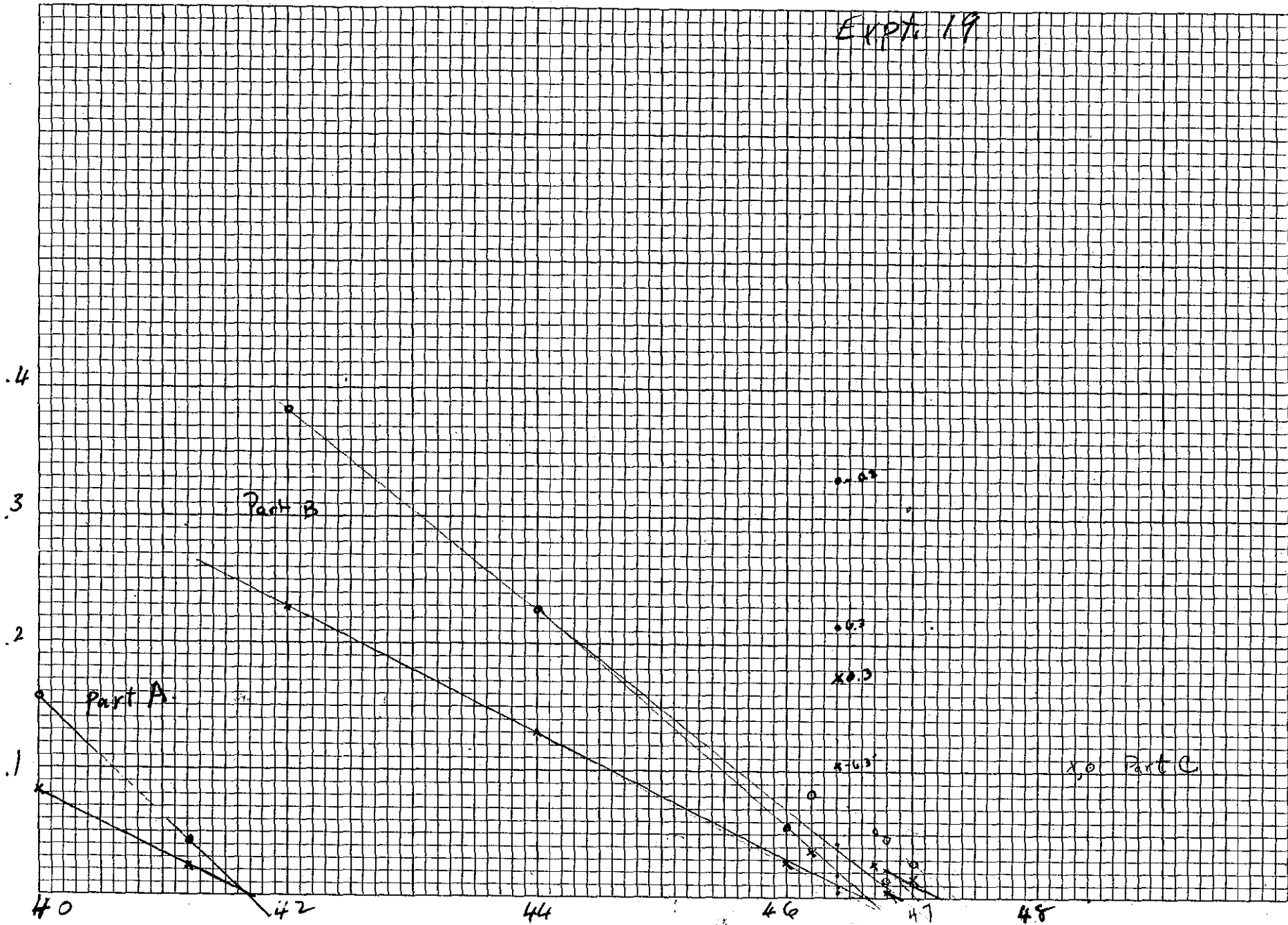
Date Before Expt #19: —

Removed approx 2 liter soln. & added
2 l. H₂O.

power

Signed

EXPT. 19



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

NO. 340-10 DIEZSEN GRAPH PAPER
10 X 10 PER INCH

10x
9-

4

9

Francis
Fox
Date 9-23-52

Expt #19 H/23 - 757 61
12" Dia. Reactor

Part A

Time	Source	Control	Safety	Manifold	04		05	
2:40 PM	in	14.4	18.8	24"	8		9	
3:19	"	"	"	40.0	95	.081	57.5	.1565
	"	"	"	41.2	368	.022	213	.042
Part B		Expt. stopped for further details - added 1 l. water - ran up Man. for mixing						
Fox, Rohrer 9-24-52	Reset	zero	(Manifold read 996.14 for zero ht. in vessel)					
9:35	in	14.22	18.8	37.00	8.5		7.75	
10:00	"	"	"	42.00	37.0	.229	20.25	.383
10:15	"	"	"	44.00	65.5	.130	34.0	.228
10:35	"	"	"	46.00	314	.027	143.25	.054
11:02	"	"	"	46.40	2024	.0042	835	.0093
	"	0	"	46.40	433	.0196	182	.0426
11:23	"	14.22	6.3	46.40	81	.105	36	.215
1:35	"	"	0	46.40	49.25	.173	23.25	.333
Part C		Cooled ~ 390 cm ³ H ₂ O						
1:48 PM	"	16.75	18.8	46.22	220	.0386	93	.083
2:06	"	"	"	46.80	1402	.0061	569	.0136
	"	in -0.09	16.8	46.8	388.5	.022	160	.0415
	out	in	"	47.29	super critical			
	"	"	"	47.00	sub-critical -			
		Added ~ 300 cm ³ H ₂ O						
3:23 PM	in	14.7	18.6	47.00	648	.013	289	.027
	in	0	10.0	only slight rise between 50" & 53"				
		Level begins to drop on instr. at 47.5 - sharp change in slope at ~ 47.0 on lowering manifold stepwise ~ 1/8" of .5"						
03 PM	out	16.38	17.9	47.37	super critical			
				47.30	"			
				47.45	sub-critical			
9-25-52	Repeat of above							
	"	16.4	15.8	250	8		8	

Signed

Time	Source Control	Safety	Manifold	C4	C5
9 ⁴⁵ AM	in	16.4	18.8	46.70	290 .027 153.5 ⁵ 052
	out	"	"	47.16	slightly sub crit
				47.20	" super "
10 ³⁵	"	5.44	11.0	47.74	just crit
	"	10.40	"	"	pos. prod ~ 50 -55

Calc. of crit vol must be based on reading when full, since zero was not checked after last small dilution
 Reactor full at manifold reading of ~ 47.5
 Hence crit with control & safety rods ^{as shown} out at
 ~ ~~3~~ 3" from full ≈ 2 cm

$$\therefore \text{Crit Vol} = \frac{21.85}{30.4} \times 731 = 22220$$

$$\text{Crit mass} = \frac{731}{30.4} \times 22220 = 747$$

U-15

$$\begin{array}{r} 130.0388 \\ 22.6361 \\ \hline 107.3827 \end{array}$$

- 351 gm U ✓ .03245 gm U/gm 24 gm. 1.0458 @ 28.2
- .03212 gm²³/gm
- .03072 gm²³/cc ✓
- .03358
- .03360

Checked zero shift = 34.7"

Signed

Date
10-2-52Calc. of $H/23$ at End of Expt #19:

$$.03245 \times 1.67 = .05453$$

$$\frac{.03245}{2224} \times .05453 = \frac{.00176}{2224} \text{ gm/gm } HNO_3 = \frac{.00804}{.06257}$$

$$H_2O \text{ eq of } HNO_3 = .008 \times \frac{1428}{63} = .00114$$

$$1.00000$$

$$.06257$$

$$\text{gm } H_2O / \text{gm} = .93743$$

$$H/23 = \frac{.93857}{.03212} \times 25.9 = 757 \quad \checkmark$$

$$.00114$$

$$.93857$$

After emptying system of dilute material,
Added the following:

1. Approx. 1 l. dilute soln.

2. Batches: 23-5, 23-6, 23-7 & 23-8 + CPI

($\frac{924}{1245}$ fraction) 3. Remainder of 1st Evap. batch see p. 83

4. 2nd & 3rd Evap. batch

$$\text{Total} = \sim 2275 \text{ gm } 23$$

Signed

64

Date 10-4-52

Total vol. in system prior to adding 3rd Evap
batch is 7,070 gal. - Manifold reads 24.8 cm.

$$7070 - 1200 = 5870 \text{ Above zero}$$

$$248 \times 237 = 5880 \quad \text{" "}$$

Added Evap. Batch #3 = 1300 cm³

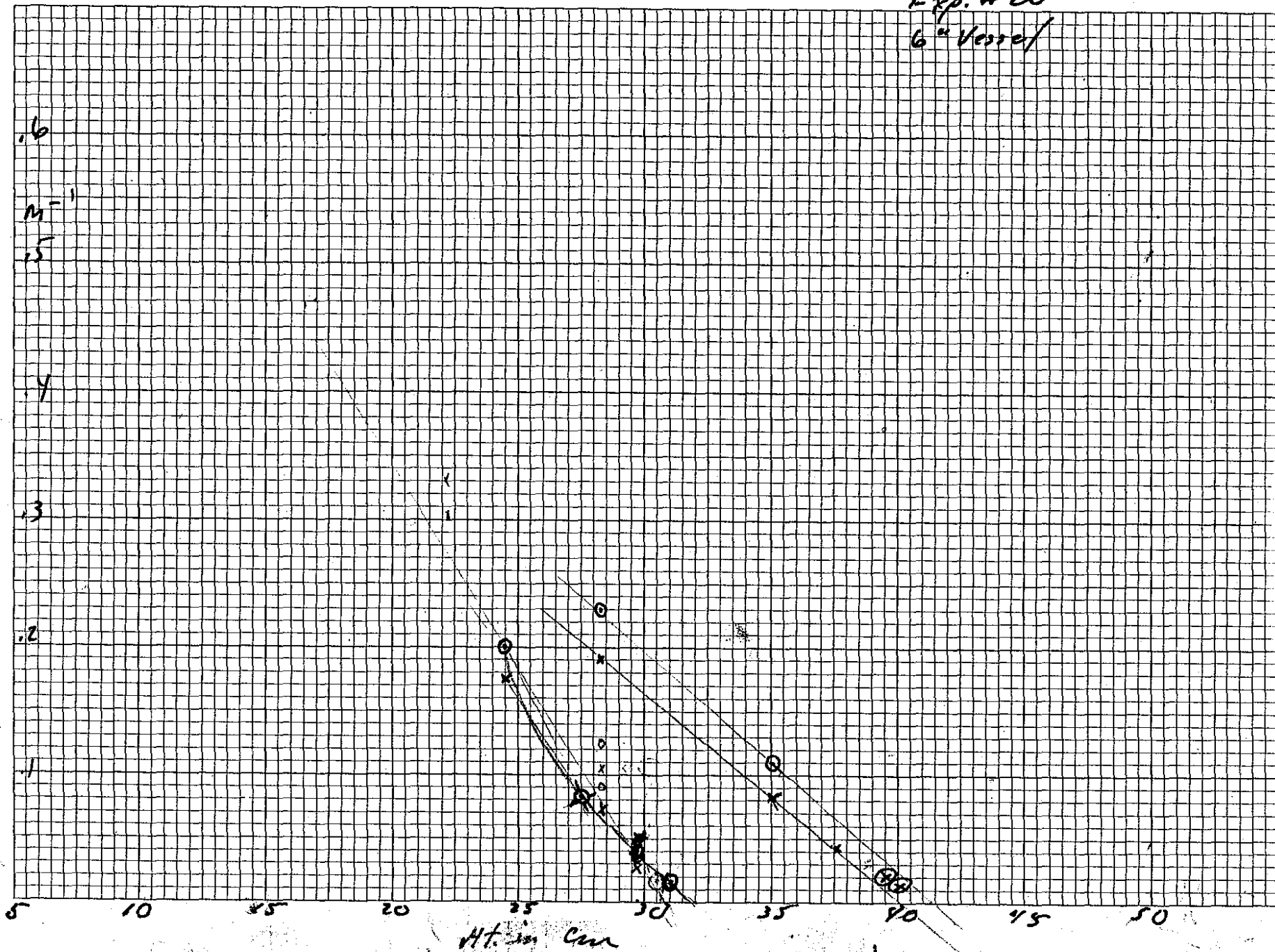
Total Vol. in manifold 8370 cm³

10-6-52 Total ht in manifold 30.8 cm.

Signed

Exp. #20

6" Vessel



Date 10-5-52
 For
 Cruise

Exp. # 20 (6" Vessel) $H_{23} = 84.4$
 $\approx 80-85$

Time	Source	Control	Safety	Mainfield	Ht ft	G ₁	M ₁ [']	G ₂	M ₂ [']
9 ⁵⁵ AM	IN	24.0	20.0	6.00	8.8	10.5		3.5	
	"	"	"	"		9.0		3.25	
10.40				17.00	24.6	26.5		11.0	
				"		35		15.0	
				"		42.5		16.5	
				"		46.0		18.5	
				"		49.0		20	0.175
				"		49.0	0.20	19	
				19.0	27.5	119.25	0.082	47.25	.082
11 ¹⁵				20.5	29.6	228	.04	66.5	.05
11 ³⁰				21.3	30.5	553	.017	153.5	.022
11 ⁴⁵	out	"	"	22.21					
				21.65					
				21.0					
<i>Solution not thoroughly mixed manifold run down & re-ran for mixture</i>									
				6.0	8.8	9.25		3.25	
2:55	IN	24.1	20.7	19.5	28.3	87.75	.1053	26.25	.124
<i>lower manifold for mixing</i>									
2 ²⁰ PM	IN	24.0	20.3	6.00	8.8	6.5/55		3.25	
2 ⁴⁵ PM	IN	24.0	20.0	19.50	28.3	26.5	.23	16.0	0.19
	"	"	"	24.0	35.0	57	0.11	36	.083
				26.0	37.5	1385	.043		
				27.0	39.5	248	.024		
				27.5	40.0	457	.013		
10-6-52	<i>Mainfield lowered and mixed by tilting</i>								
9:15	in	20.9	19.8	6.00		7.0-60		3.5-3.5	
9:45	"	"	"	19.5		82.5	.073	39.0	.090
10:00	"	"	"	20.50		233.0	.028	103.0	.034
				21.05					
<i>manifold zeroed in 6" vessel visually</i>									

66

Date

Cont. Exp # 20
6" vessel

H/23 ~ 85.844

TIME Source Control Safety Manifold

Ct

c5

TIME	Source	Control	Safety	Manifold	Ct	c5
11:00	in	20.2	20.3	20.6	230.0	99.2
			21.15	super crit		
			21.05	slightly super crit.		
			21.01	sub. crit.		21.05" ≈ 30.5 cm
				Crit. Vol = 5470 cm ³		
				Out Man = .2738 × 5470 = 1.498 gpm		

Calc. H/23 at ~ 80-85:

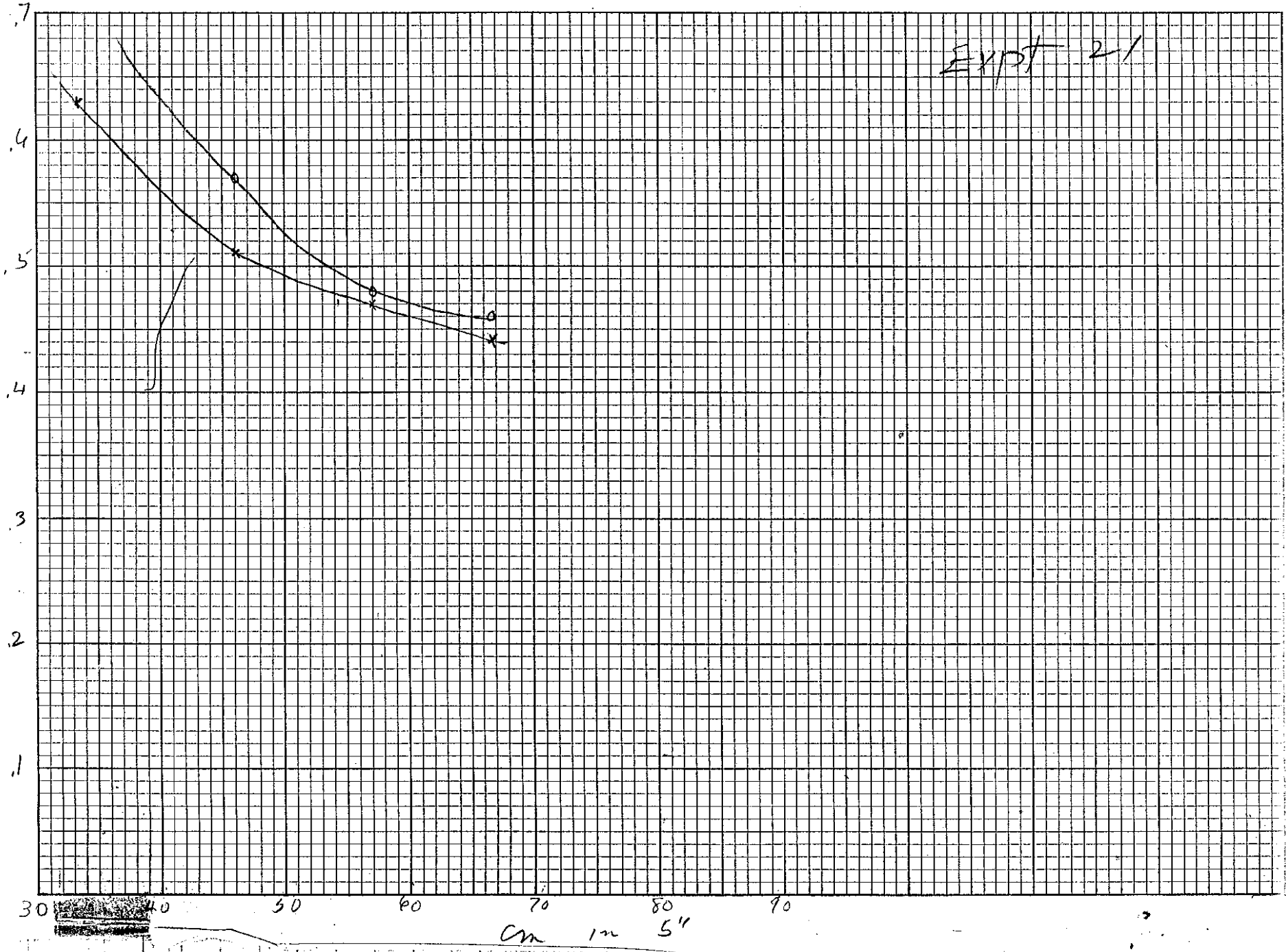
$$\begin{array}{r}
 V-22 \quad .1992 \times 1.67 = .3326 \\
 \text{gpm Free HNO}_3 = .0335 \checkmark \\
 \hline
 .3661 \\
 .1428 \times .0335 = .0048 \\
 \hline
 .3661 \\
 \hline
 1.0500 \\
 .3661 \\
 \hline
 .6839 \\
 .0048 \\
 \hline
 .6387
 \end{array}$$

$$\frac{H}{23} = \frac{25.9 \times .6387}{.1958} = 84.4 \checkmark$$

$$\text{Free } \frac{N}{23} = \frac{\frac{9m N}{14}}{\frac{9m 23}{233}} = \frac{.06744 \times \frac{14}{63}}{14} = \frac{.0335 \times \frac{14}{63}}{.1965} = .630$$

Total $\frac{N}{23} = 2 + .63 = 2.63$
 manifold 966.37 signed at bot. limit

EXPT 21



Date 10- Fox
Crown

Exp 21 5" diam H₂O = 84.4

67

Time	Source	Control	safety	Manifold	Pressure	C ₄	C ₅
3:25 PM	1N	24.4	20.4	12.0	20.0	12.5	6.0
4:05	"	"	"	29.0	24.6	24.5	10.0
				40.0		28.0	12.75
				50.0		28	14
8:50	1N	23.2	22.5	12.0	20	17.0	6.0
9:05	"	"	"	20.0	332	19.0	8.25
9:15	"	"	"	29.0	44	23.5	10.5
9:30	"	"	"	34.0	57	25.5	13.5
9:50	"	"	"	34.0	66.7	25.25	12.5
10:00	"	"	"	52.0	66.7	26.75	12.5
						27.25	13.0

$$\begin{aligned} & \checkmark \frac{2738}{2730} \text{ gm }^{23} / \text{cm}^3 \\ & \checkmark \frac{65}{1958} \text{ gm }^{23} / \text{gm} \\ & \checkmark .1992 \text{ gm } / \text{gm} \\ & \checkmark 1.3935 \text{ sp gr. at } 25.0^\circ \text{C} \end{aligned}$$

Sump 66 U-22
 130371
 ? assay value

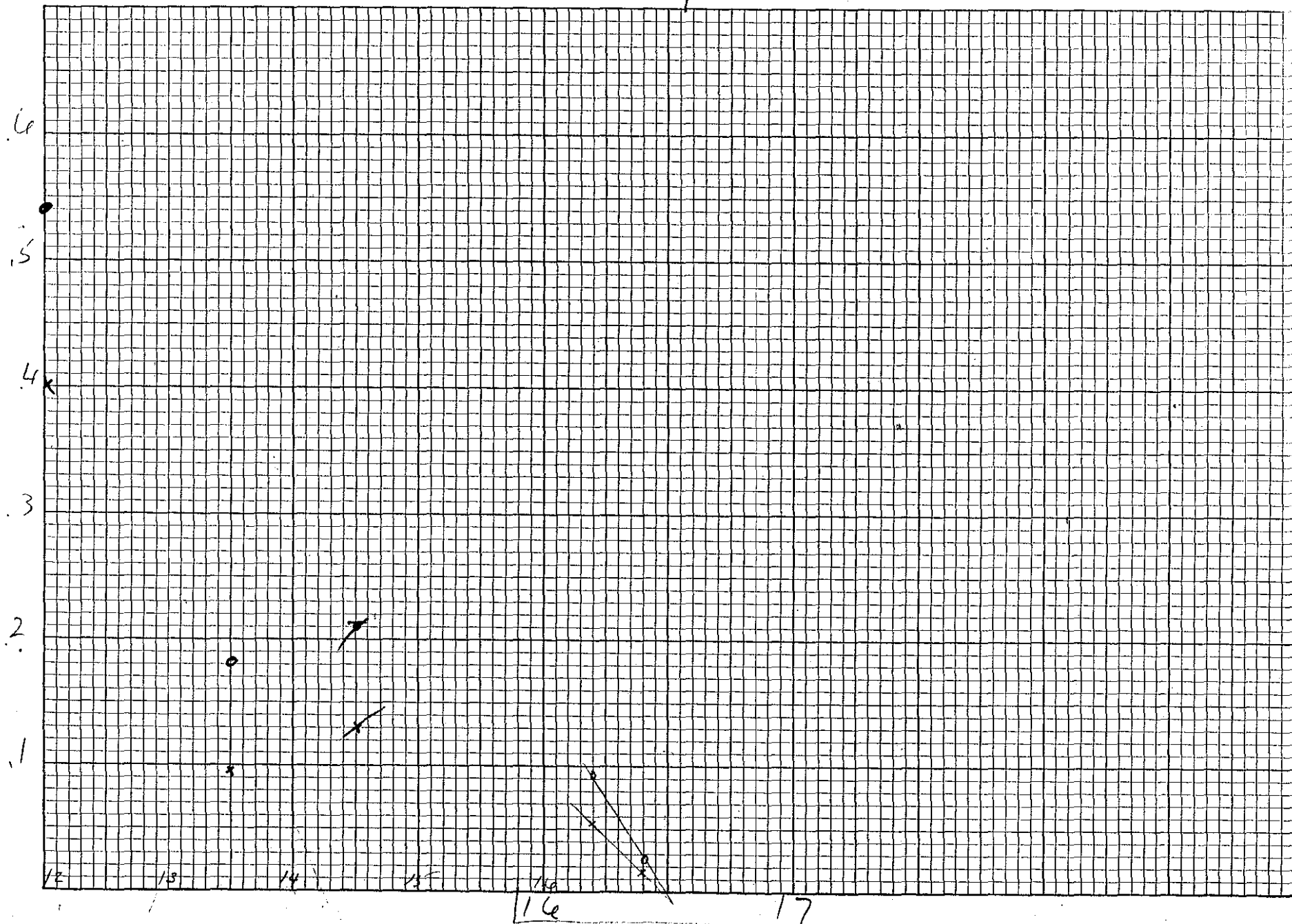
$$\begin{aligned} & 59,852 \\ & 22,720 \\ & \hline & 37,120 \end{aligned}$$

$$\begin{aligned} & \text{Total HNO}_3 = .1412 \text{ gm/gm} \\ & \text{Combined " } = .1077 \text{ " } \\ & \text{Free " } = .0335 \text{ "} \end{aligned}$$

$$\begin{aligned} & \text{Free N} = \frac{.00782}{.233} = .03358 \\ & \text{Total N} = .00782 \text{ gm/gm} \end{aligned}$$

Signed

Expt 22



Exp 22

8" DIA.

H/23

844 69

Date

Time	Source	Control	safety roughly	manifold	C9	C5
1:30	in	14.0	15.0	6.0	8.5	6.5
1:45	in	"	16.0	16.00	6.25	5.5
1:45	"	"	"	16.20	141.5	6575.091
2:00	"	"	"	16.40	510.5	2230.027
2:15	out	"	"	16.61 slightly		
	out	"	"	16.57 "		
2:20	out	"	"	16.49 "		
<p>soln level lagging 16.49 out.</p> <p>Manifold lowered zero checked found off 2 1/2</p>						
3:30	"	"	"	12.01	19.5	11.0
				*14.50	57.50	28.5
				13.50	76.0	32.25
<p>Line blocked</p>						
9:15	in	14.4	14.1	7.0	15.0	11.5
9:30	"	"	"	7.2	13.25	19.17
	"	"	"	14.00	76.50	
10:20	in	"	"	13.75	348.0	041
10:40	in	"	"	13.84	1632.	0096
<p>at ~ 13.90 photo-multiplier screamed</p> <p>est. crit ~ 13.90</p>						
					6.5	7.0
11:00	in	14.0	14.1	7.0	6.5	9.0
	"	"	"	"	6.5	9.0
11:29	out			13.92		
<p>System sluggish</p>						
<p>air gap = 4.5 cm</p> <p>out ht 13.8" ≈ 14.7 cm</p> <p>crit vol = 330 X 14.7 = 4850 cm³</p> <p>crit mass = 2738 X 4850 = 1328 gm</p>				13.87		
				13.89		
				13.86		
				13.83		
<p>Zero checked before and after expt</p>						
<p>* Excellent out - equilibrium</p>						

manifold
96620 down

70

Date

Calc. H₂O ~ 60: $\frac{.2927}{.2280} \times 1.67 = .4890$ gm salt

$$\frac{.2927}{.1992} \times .0335 = .0492 \text{ gm F. HNO}_3$$

$$\frac{.5382}{.5382} \text{ gm}$$

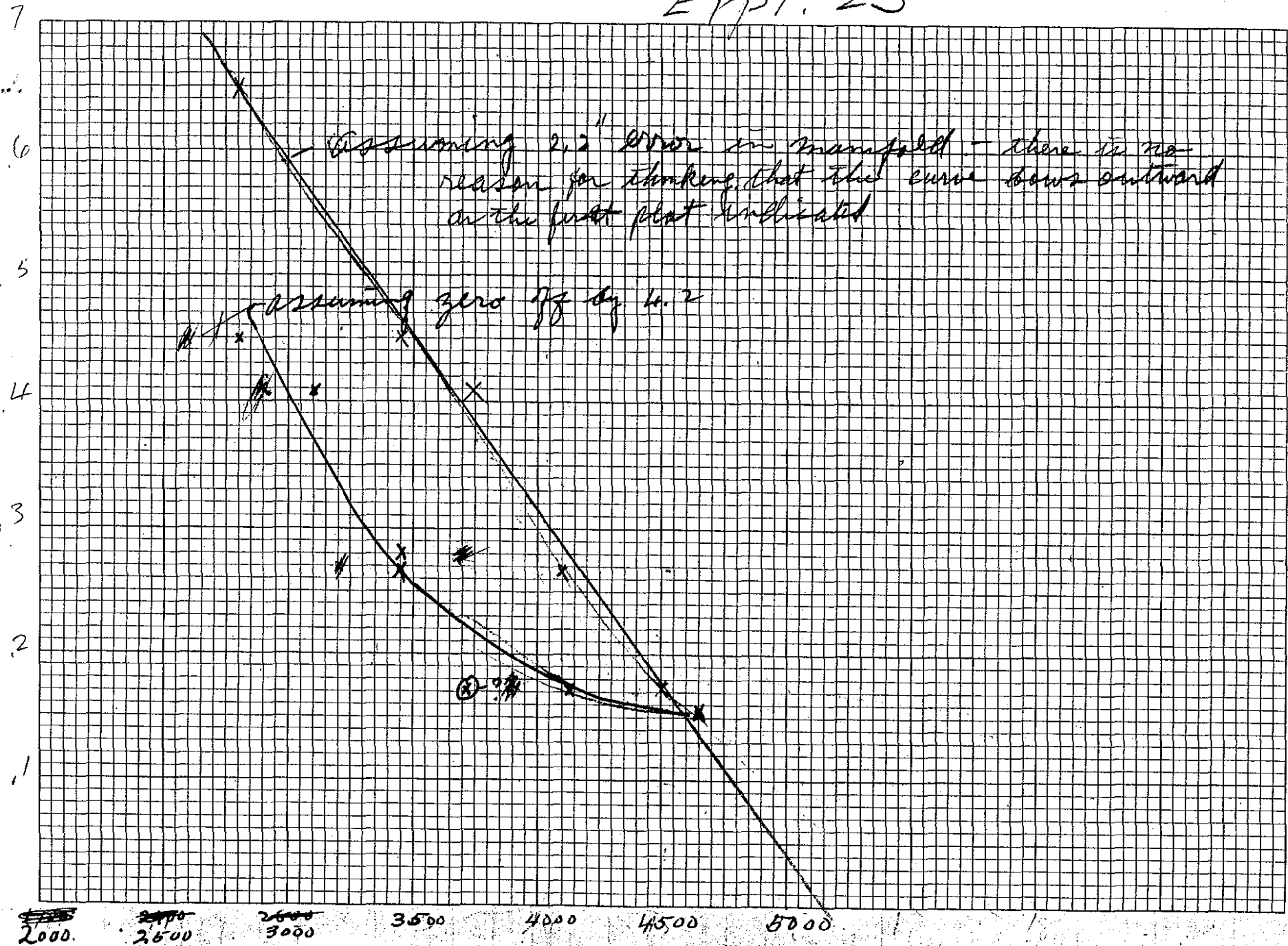
$$.428 \times .0492 = .0210 \text{ gm H}_2\text{O of 7 HNO}_3$$

$$\begin{array}{r} 1.0000 \\ 5382 \\ \hline \text{gm H}_2\text{O} \rightarrow .4618 \\ .0210 \\ \hline .4688 \checkmark \end{array}$$

$$\frac{.4688}{.2880} \times 25.9 = 42.2 \text{ H}_2\text{O} \checkmark$$

It was decided to evaporate soln. further, since we were not below the min. vol.

Eypt. 23



Date 10-1-52

Expt. # 23

after evaporating 8" Dia

H/23 ~ 71
600
422

Time	Source Control	Safety	Mannfold	C4	C5
12:45	10.2	10.8	8.00	16	6.5
1:00	13.00	40.5	.374
Vol. in Reactor 1:15	14.00	57.5	.28
3780 3750	..	corrected value 10.4	14.80	90.5	.168
4650	..	11.42	18.0	101.5	.1577
4650	25.0	102.	.156
3230 3460	..	41.00	14.0	60.0	.268
2550 2800	..	34.40	12.0 9.8	36.5	.445
2410 3130	..	37.50	13.0 10.8	39.0	.41
1910 2100	..	28.50	10.0 9.8	24.5	.65
3450 4120	..	45.00	16.0	90.5	.178

system empty at 18" entrance D. Vol. ~ 3" lower or at ~ 15"

11-12-52 Mannfold evidently not zeroed. From inventory below, soln. enters D. Vol at ~ 11.7 cm \approx 10.8" (15" - 10.8" = 4.2" zero in H/23)
Assuming zero of γ ~ 2.2

The M^{-1} curve is not definite enough for a prediction as to the amt. required for critical. M^{-1} curve should be fairly straight

Approx. Amt. in 8" vessel when all soln is in:
 $\approx 4.60 \text{ l} \times 490 = \approx 2250 \text{ gm U}_{235}$
 $C.V. = \approx 5.3 \text{ l}; C.M. = \approx 5.3 \times 490 = 2600 \text{ gm}$

U-23	58.744	22.892	35.852 gm net.	10.49	sp. gr. 1.6967 @ 24.5°C	v. 2927 gm D/gm	v. 2887 gm 23/gm	.4885 gm 23/cc	.4898
------	--------	--------	----------------	-------	-------------------------	-----------------	------------------	----------------	-------

Soln ht in storage manifold 15 cm = 3550 + 1100 = 4650 cm

Soln ht in reactor staged 40" ~ 6.25" = 5.15" \approx (13.1 cm)

72

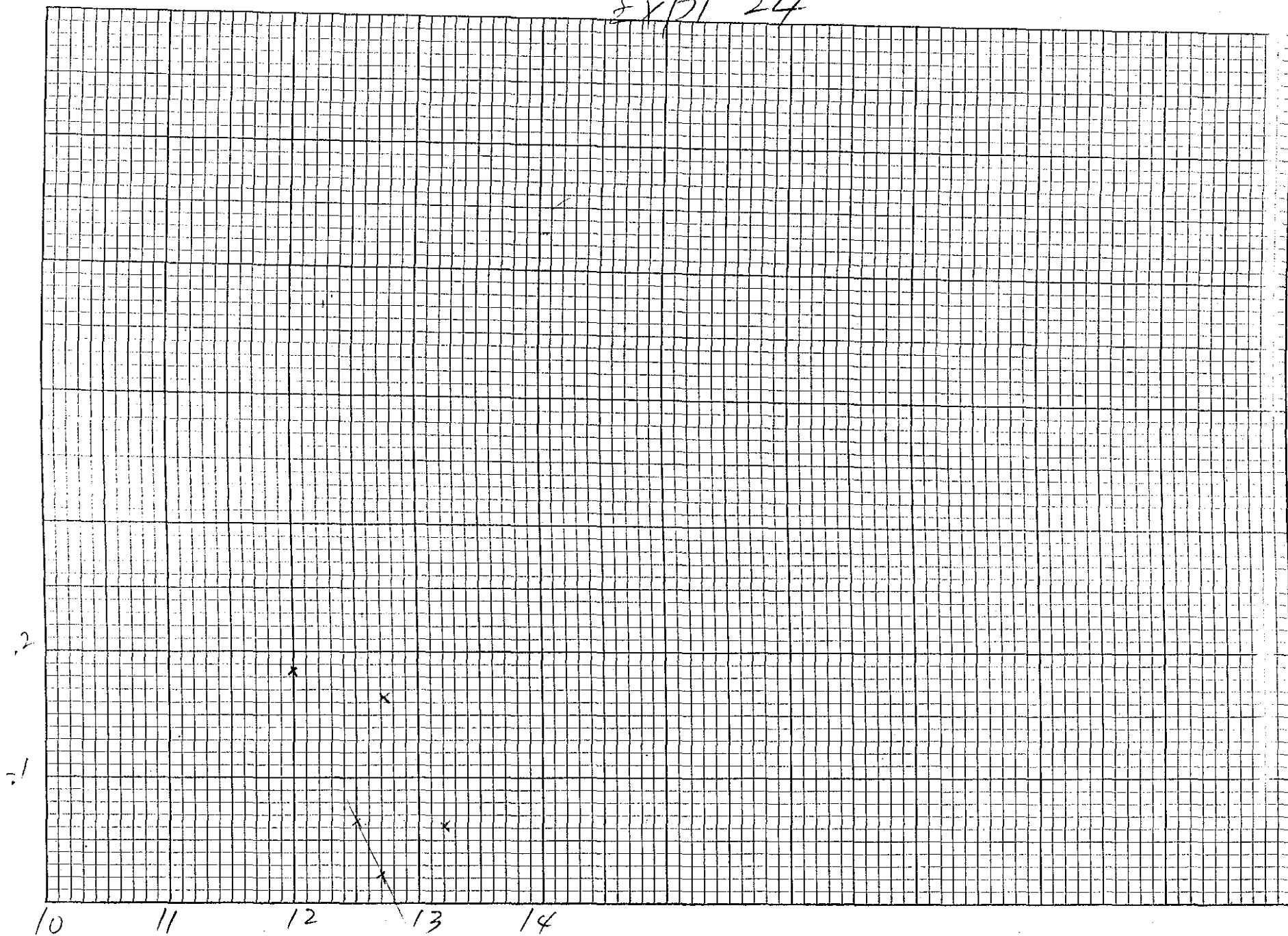
Date

Added approx 1700 cm^3 of dilute salt

Water ht. in manifold $22 \text{ cm} \approx 5220 + 1100$
 $\approx 6320 \text{ cm}^3$

Signed

EXPT 24



Date 10-18-52
Francis Ford

EXPT 24

8" Dia.
H/23

57.5-73
70

	Source	Control	Safety	Manifold	C4	C5
10:15	i	14.0	10.9	8.80	11.5	
10:45	i	"	"	12.00	61.5	.187
11:00	"	"	"	12.5	183.0	.063
11:10	"	"	"	12.70 12.70	538.0	.021
11:30				12.85	Sub. crit.	
				12.88 *	super crit.	
				12.85	best crit ht.	
1:00	i	13.9	10.2	8.00	12.5	
				12.70	76.5	.163
				13.20	200.0	.062
				13.52	Super Crit.	} = 14.4 cm
				13.50	Sub. Crit.	

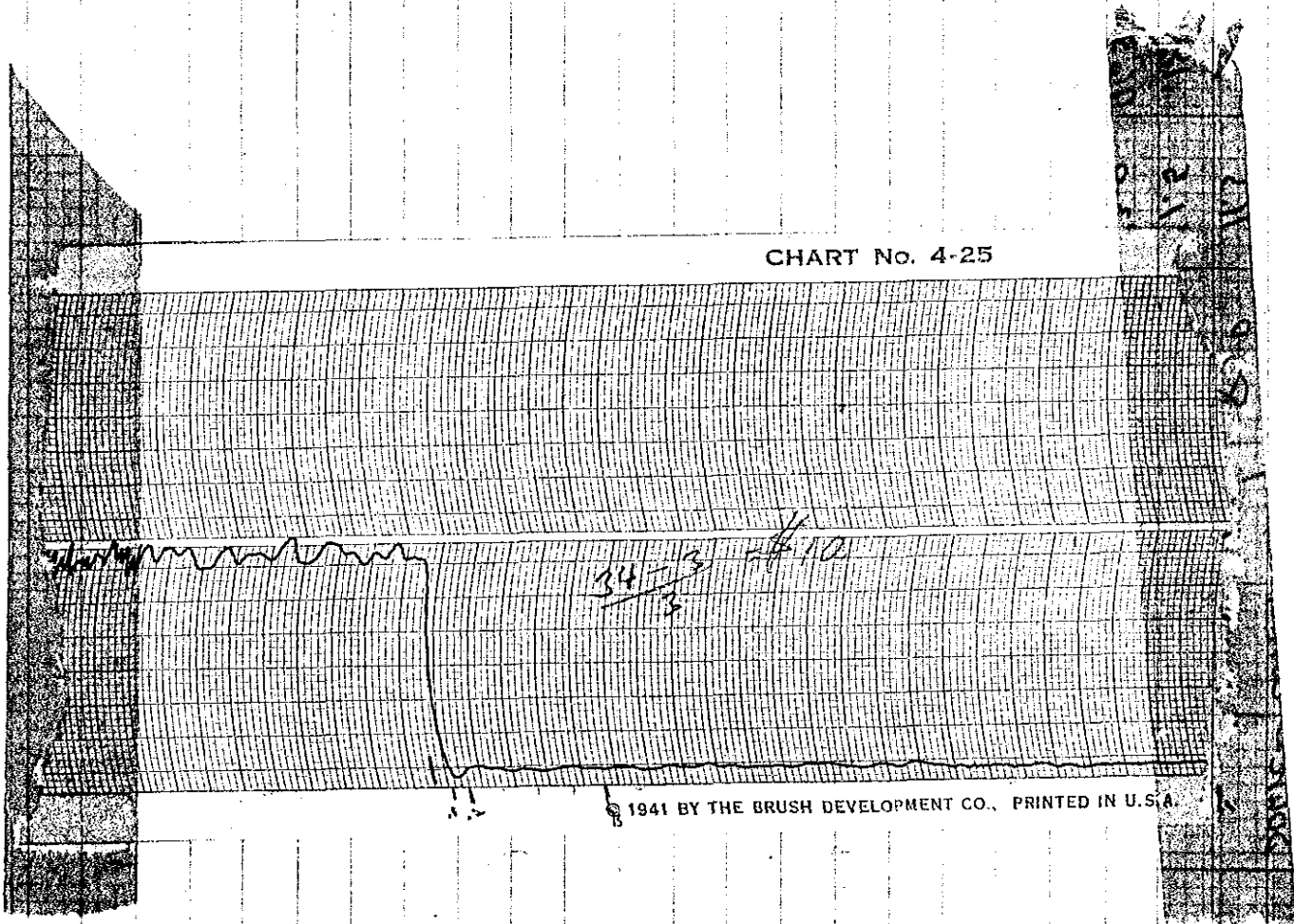
air gap ~ 5.0 cm

Crit. Vol. = 14.4 x 330 = 4750 cm³
 Crit. mass = 4750 x $\frac{3805}{3795}$ = 1807 gpm.

* Zero re-checked & shifted .70" down

Signed

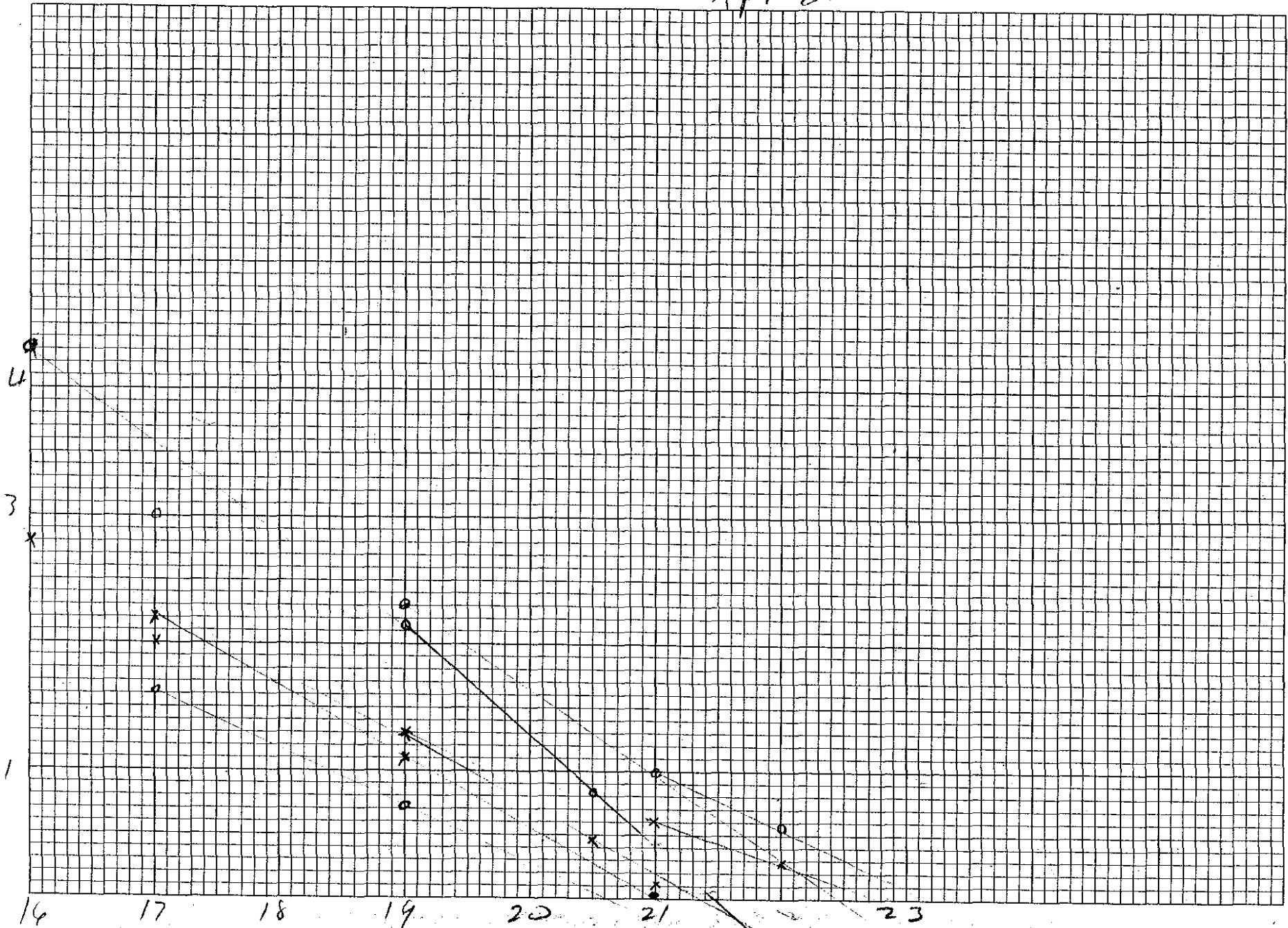
CHART No. 4-25



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Signed

EXPT 25



Date 10-20-52

Exp 25

H₂₂ ~ 57.5

6" Dia

Hot
Francis

75

Time	Source	Control	Safety	Manifold	04		01	
9:30	in	29.9	35.1	7.08	9.00		3.0	
9:35	in	"	"	7.08	9.00		3.25	
10:25	in	"	"	16.00	32.00	.281	7.0	.43
10:40	in	"	"	19.00	32.50	.128	14.0	.214
10:50	in	"	"	20.50	191.00	.047	37.25	.081
11:27	out	11.0		22.94	Super Crit.			
"		11.0		22.7	Sub. Crit.		Out at ~ 22.85	
Oct 26 1952	cont.	21.3			x		0	
2:00	in	18.2		8.00	7.0		3.0	
"	"	"	"	"	7.0		2.75	
2:45	"	"	"	14.00	14.0	.39	7.50	.40
3:00	"	"	"	17.00	35.0	.120	10.00	.30
"	"	"	"	19.00	53.0	.13	13.00	.23
"	"	"	"	21.00	118.50	.038 ^{0.54}	30.00	.10
"	"	"	"	22.00	235.00	.00298	56.50	.053
"	"	"	"	23.35	Super crit.			
"	"	"	"	23.25	Super crit.			
"	"	"	"	23.15	Super crit.			
Oct 27, 1952	cont	Run #3 on 6" dia Valve		Still rising at 22.5				
"	in	21.9	20.6	8.00	6.00		2.25	x
"	IN	21.9	20.6	16.99	37.00	.162	10.50	.22
"	"	"	"	19.00	84.5	.071	20.5	.11
"	"	"	"	21.00	3536	.0017	188	.012
"	out	"	"	21.3	Super			
"	"	"	"	20.0	Definitely sub			
"	"	"	"	20.6	Turned around now into super			
"	"	"	"	20.5	Definitely sub			
"	"	"	"	20.6	Just Critical			
"	"	"	"	20.7	No change in 3 min			
"	"	"	"	20.8	drift downward.			
"	"	"	"	21.0	Not critical going down			
"	"	"	"	21.16	Sub			
"	"	"	"	21.20	Sub			
"	"	"	"	21.5	Super			

Cont Page 77

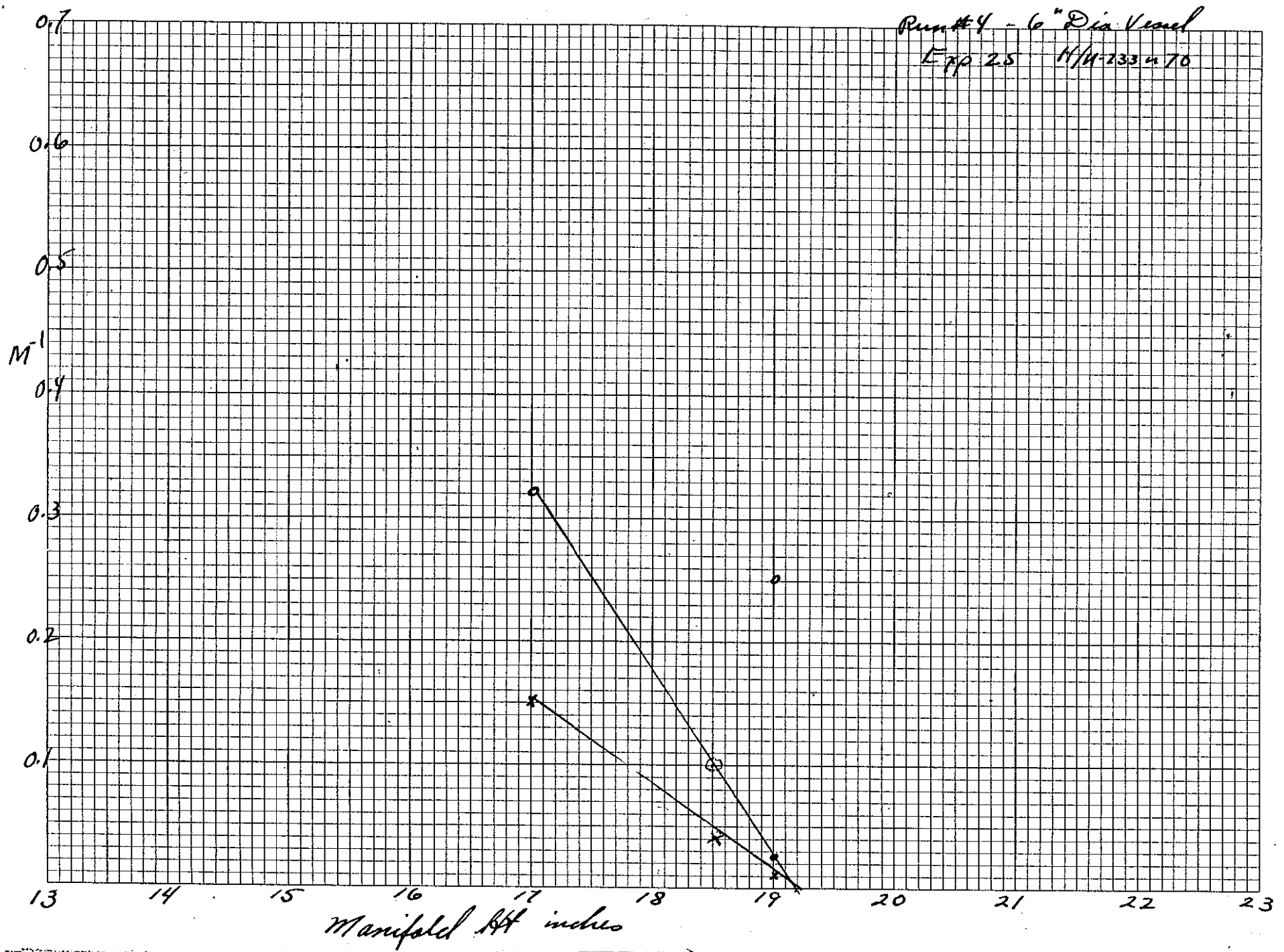
at ~ 20.0 after lowering to ~ 18.0" & raising the source was removed by system Signed was still on fact period

76

Date

~~the~~ such that it was thought well to use
the manual scram.

Run #4 - 6" Dia Vessel
Exp 25 H/M-733 in 70



Manifold Ht inches

For
Crown

Date 10-28-52

Expt 25 cont.

Run #4 on 6" Dia Vessel #14-233 = 170 57.6

Time	Source	Central	Safety	Manifold	C ₁	M ₁ ⁻¹	C ₄	M ₄ ⁻¹	x
1:20 PM	IN	21.9	20.3	10.00 <small>inches vessel diam</small>	4.0 3.50 2.50		6.50 7.50		
2:00 PM	"	"	"	17.00	11	0.32	47.50	0.15	
	"	"	"	19.0	142	0.025	2.50 0.71	0.001	
	out	"	"	19.30	Super critical				
2:05 PM	"	"	"	19.20*	still Super critical				
	"	"	"	19.10	definitely sub				
				19.15	Sub critical				
2:35	Note at 19:20 super going down -				Sub coming up.				
				19.20	still going down waiting				
2:47	manifold left at 19.20 - rate of decline has decreased - almost level but still slowly decreasing.								
Run #5									
3:20 PM	IN	21.9	20.3	18.50	35.0	0.10	173	.04	x
	out	"	"	19.30	Super critical				
3:35	"	"	"	19.20	still super				
3:36	"	"	"	19.0	Definitely Sub critical				
3:38	"	"	"	19.1	still sub				
3:40	"	"	"	19.20	appears to be still drifting downward				
3:48	"	"	"	19.26	System Super critical				
				19.21	still super after 2 min				
				19.18	Sub-crit.				

Crit ht. = 19.2" ≈ 27.7 cm.

Parts 1, 2 & 3 were probably not well mixed, or rather - line gave valve action

Crit. vol. = 27.7 x 179.5 = 4970 cm³ ✓

Crit Mass = 4970 x $\frac{3795}{3805}$ = 4885 gm ✓
1890

Signed

78

Date

Calc. H₂ @ ~ 70

U-24

$$.2500 \times 1.67 = .41740 \text{ gm salt / gm}$$

$$\frac{.2500}{1.1992} \times .0335 = \frac{.04205}{.45945} \text{ gm F. HNO}_3$$

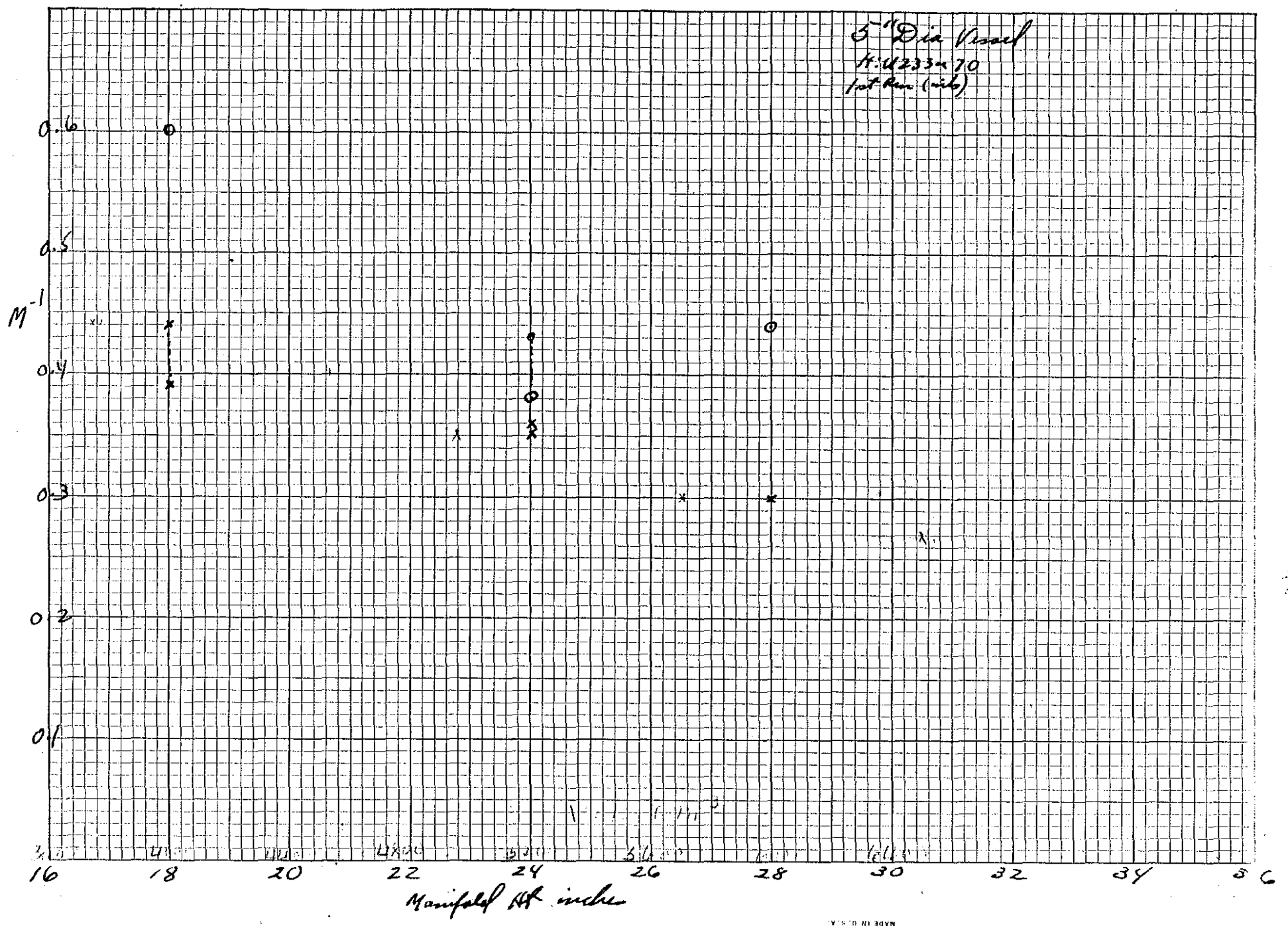
$$.1428 \times .04205 = .0060$$

$$\frac{H}{23} = \frac{.54655}{.246} \times 25.9 = 57.5 \checkmark$$

$$\begin{array}{r} 1.00000 \\ 45945 \\ \hline .54055 \\ .0060 \\ \hline .54655 \end{array}$$

Signed

5" Dia Vessel
 H: 4233 x 70
 1st Run (mils)



Expt 2c

Date 10-29-52

Fox-Cromin

1st Run 5" Dia Vessel H/4233 ~ 70 57.5"

Time	Source	Control	Stg	Manifold	Vessel	C ₁	M ⁻¹	C ₄	M ₄ ⁻¹
10 42 AM	IN	23.0	2.3	* 8.0	13.5	3.25 2.50	(3.0)	10.5 10.0	(10.75)
11 00 AM	"	"	"	18.0	29.8	6.0	0.6	24.5	.44
11 15 AM	"	"	"	24.0	37.5 39.5	7.0	0.43	24.75	.39
11 30 AM	"	"	"	28.0	47.5 46.0	8.0	0.38	30.0	0.36
11 38 AM	manifold set at 44.95 against upper limit.					6.75	0.44	30.5	0.35
11 39	"	"	"	44.95	65.0	7.0	0.4285	36.0	0.30
11 41	"	"	"					38.75	0.2774
11 44	"	"	"					40.00	0.269
11 47	Started lowered manifold down. Dropped blade -							39.25	0.274

Soln ht reaches D.V. at ~ 43cm ~ 5.40 l. ~ 24" Manifold.

Calc. H/23
p. 78

U-24

47.466
22.476

24.990

= 6.25 gm U ✓

✓
 25.00 gm U/gm
 2.466 gm 23/gm
~~2.466~~
 1.5432
 + 53.42 sp. gr. @ 24.6°C

 37.95 gm 23/cc ✓
 3805

Soln ht. in manifold ~ 23cm. - Total Vol ~ 6500

Signed

Gms

80 Date

Calculation of V-10 data on ~~first~~ batches

Batch NO	Free acid	sp. gr	gm/l U 23	Vol. ml	Assay%	
23-1 A	3.35 m.	1.6137	358.95	438.09	97.65	
23-1 B	2.3	1.6411	414.03	385.78	97.66	
				823.87		
23-2	0.1	1.5431	410.35	785.84	98.48	
23-3	0.5	1.6845	487.59	361.34 631.34	98.58%	
23-4	0.4	1.6141	446.94	896.81	98.22	
Weighted Ave.		1.6137(47)*		Total 3137.86*	Ave. 98.25	
			U ₂₃₄	U ₂₃₅	U ₂₃₆	U ₂₃₈
23 1 A			.84	-	-	1.69
" 1 B			.86	-	-	1.49
" 2			.52	.04	-	.96
" 3			.47	.03	-	.92
" 4			.54	.10	.08	1.06
23-5	.02	1.4524			1023.56	98.81
CP-1	2.12	1.4524			344.1	-
23-6	.55 basic	1.5108 (Th. 87%)	.374		919.69	99.4 85.9 83.5
23-7	.1M. basic	1.5299		390.81	972.33	98.94
23-8	.35 M	1.3687		264.33 130.42	493.41	98.80
						98.57

* On this basis the Total mass shipped was 5063.71 g

Total from per is 5037.95 g

Signed

Date
Received

Total gms. 12	Total gms 23	#/23	
157.25	153.55	95.7 (82.2)	69*
140.42	156.65		59.5
322.47	317.57	41.4	61.4
302.15	297.86	47.9	54.0
<u>40082</u>	<u>39369</u>	<u>57.</u>	<u>57.0</u>
1343.11	Total 1319.32	Weighted av.	58.8
984 X 5038 X .2674 = 1324			

* Evaluating F. Nitrate contribution to #/23

Samples

* U-10 50.9852 - 22.6874 = 28.2978 gm net.

- 336.47
- ~~87.17~~ 87.17
- 343.93
- 380.0

85.9

130.42

av = 8 batches

$\frac{5037.9}{1.6137} = 3122.8 \text{ cm}^3$

Signed * see next page:

Date

$$\frac{233}{9} \left(\frac{\text{mass sol.} - \text{mass } \text{CO}_2\text{NO}_3}{\text{mass 23}} \right) =$$

$$\frac{233}{9} \left(\frac{V \cdot e}{\text{mass 23}} - \frac{1.02 \left(\text{mass 23} \right) \frac{389}{233}}{\text{mass 23}} \right)$$

* varies with assay of soln.

Accounting for effect of free HNO_3

$$\frac{\text{H}}{23} = \frac{233}{9} \left(\frac{\text{mass soln.} - \text{mass } \text{CO}_2\text{NO}_3 - \text{mass } \text{HNO}_3}{9} \right)$$

$$+ \frac{\text{mass } \text{HNO}_3}{63}$$

$$= \frac{233}{9 \times \text{mass 23}} \left(V \cdot e - 1.02 \text{ mass } \frac{389}{233} - \text{mass } \frac{1}{9} \cdot V \cdot 63 + 9 \text{ mass } \right)$$

$$= \frac{233}{9} \left[\frac{e \cdot V}{\text{mass 23}} - 1.02 \frac{\text{H} \cdot \text{st}}{233} - \frac{\text{mass } A \cdot V}{\text{mass 23}} \left(\frac{63}{9} \right) \right]$$

V-10 sp. 2.2. 1.4454 @ 27.2°C $2254 \text{ gm}^U/\text{gm}$
 $2218 \text{ gm}^{23}/\text{gm}$

Sample V-10 was taken from batch 23-5 before CP-1 was added to it

Date 8-29-52

Material returned to X-10 for concentrating:
#1 Bottle #2 Bottle

3.9495 gm plastic sheet

2705.620
438.274

2267.346

2843.5709
-401.8210

2441.749
2267.346

4709.095 gm total

1084 = 511.4120
110675 = 502.5 gm

8-29-52 Above material returned after concentrating
Bottle #2 X-10 wts. → our wts. → 2/354.91

2352.50
401.82

1950.68 gm

401.82

1953.08

net

494.52 gm

≈ 1245 cm³
Sample 26 left

Sample U-6: 631868
225947

405921 gm net

2532 gm/gm. 1.5685 @ 266
2490 gm 23/gm.
3905 gm 23/cc

See page 18 for other evap. batches

7 1/2" Reactor

○ = Run 1

○ = Run 2

○ = Run 3

0.6

0.5

0.4

0.3

0.2

0.1

10

11

12

13

14

15

16

17

18

19

20

Height cm

98

Date

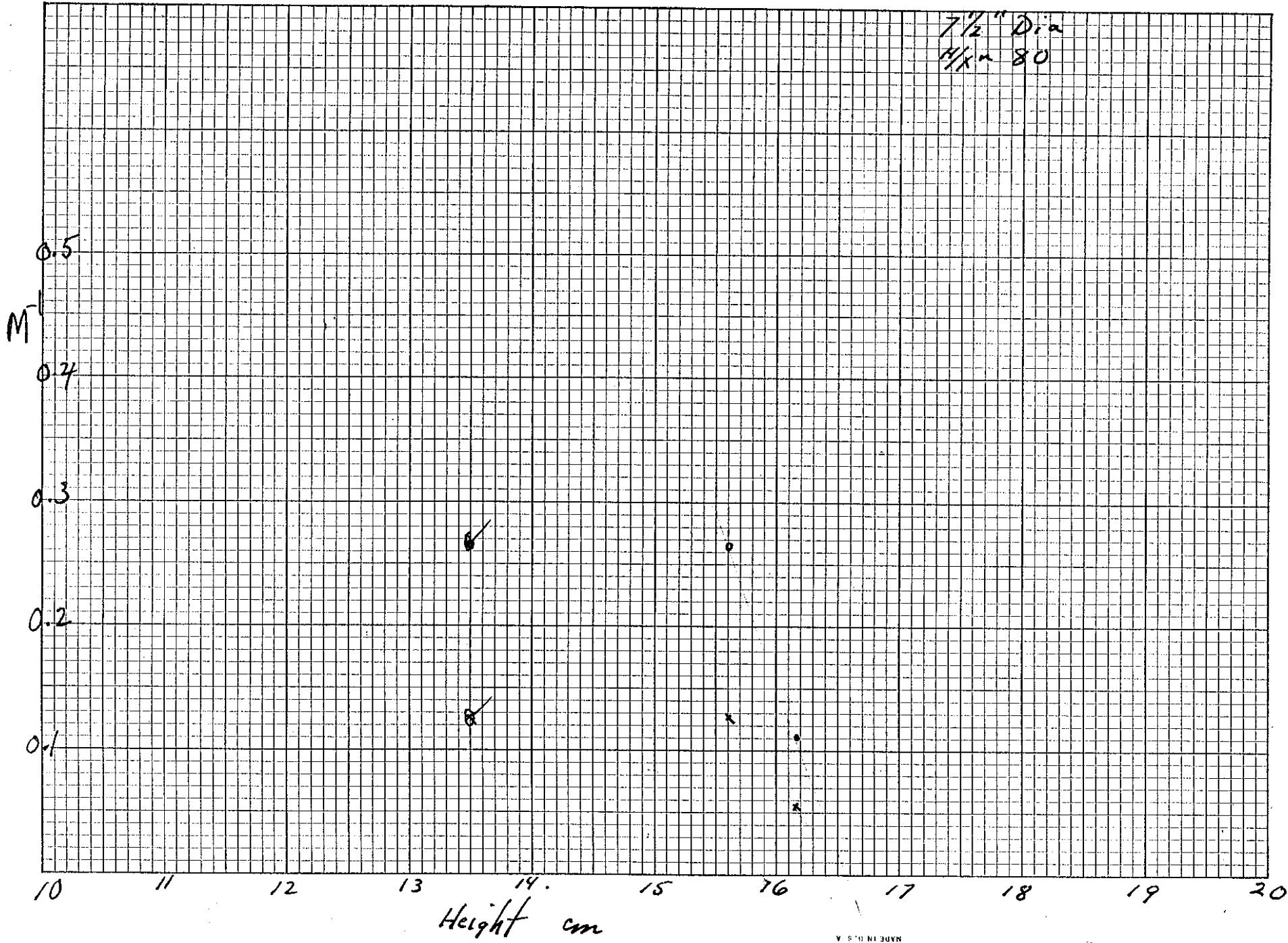
11-14-52

added ~ 1000 cm³ very dilute
washings to system

11-14-52

Signed

7 1/2" Dia
H/X ~ 80



Croni
Fax
Date 1-1-52

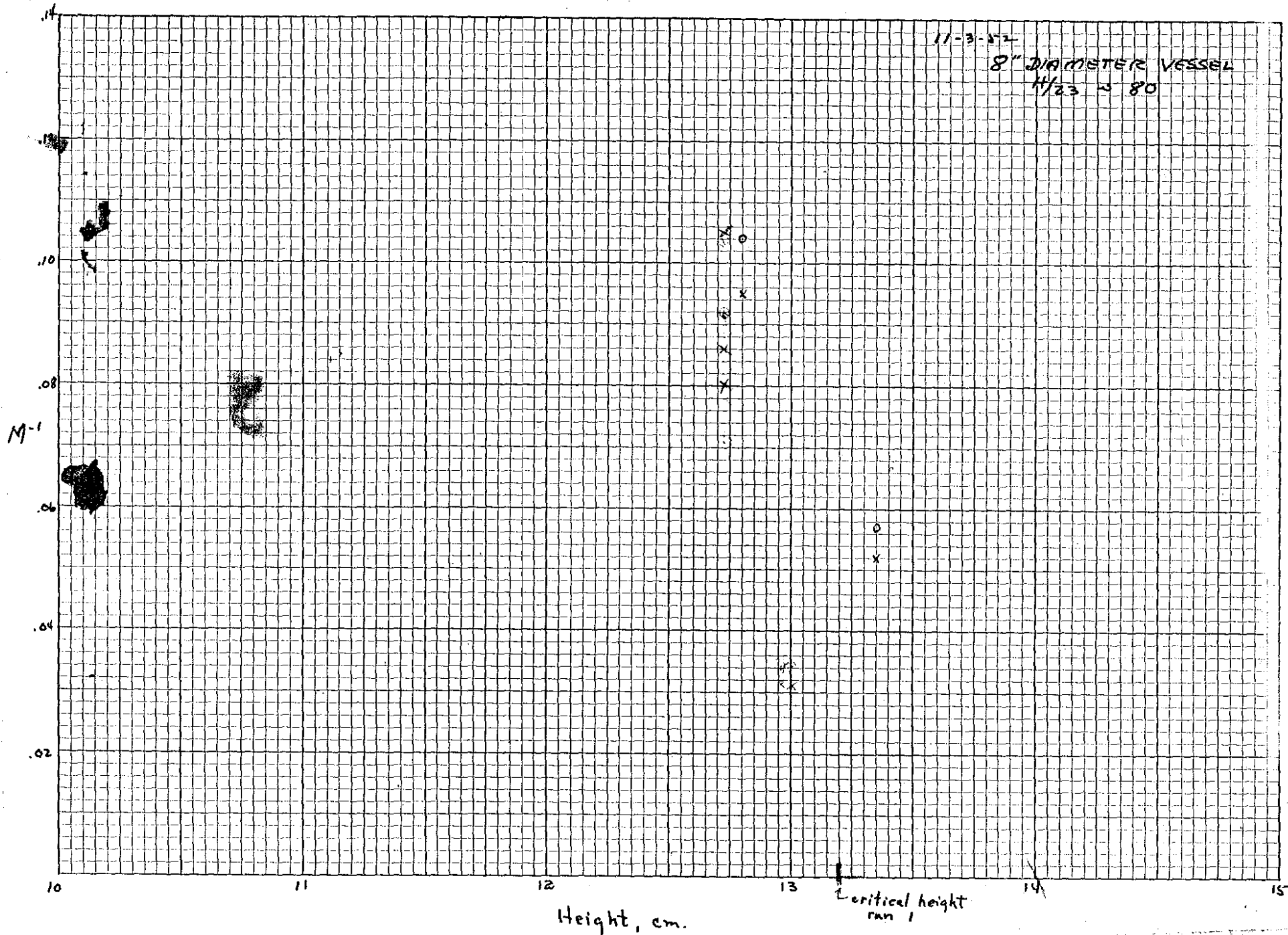
EYPT. # 28
7 1/2" Dia. Jessel

4/23 = ~~80~~
= 47 87

1240	Source 1N	Control 14.8	Safety 12.9	Manifold Inches	Ht. Cm Soln	C1		C4	
				6.00	6.93	4.50		10.0	
				13.50	15.4 15.4	16.50	.27	76.0	.131
				Lowered manifold for mix up					
135	"	"	"	13.50	15.4	17.0	.245	78.0	.128
				14.00	14.17	41.0	.11	186.0	.054
	Out	"	"	14.36	Super				
	"	"	"	14.30	Sub-cut				
				14.33	Super	crit			{ Lowered manifold.
			2nd	Run					
225	1N	14.8	12.9	13.50	15.6	17.5		74.5	
255	"	"	"	14.00	14.17	41.0	.11	186.5	.055
	Out	"	"	14.30	slightly Super				
315	aver gap ~ 2.3"	"	"	14.32	14.2 Super	crit			

$Crut Vol. = 162 \times 285 = 4620$
 $" Man = 4620 \times \frac{3355}{3354} = 4645 gm$

Signed



Fox
Shrer
Date
11-3-52

Expt 29
8" Dia. Reactor

H₂O = 80 wt 89

Time	Source	Cont.	Safety	N.H.T.	cm	C1	m ⁻¹	C4	m ⁻¹
10:10 A	in	14.3	14.8	6.00		3.00 3.25	3.125 = 1	13.0 12.5	12.75 = 1
10:35 A	"	"	"	11.99	12.8 cm	30.0	0.104	134.5 130.5	0.095
10:46 A	"	"	"	12.50	13.35	55.0	0.057	246.0	0.052
10:59 A	out	"	"	13.20					
				13.10					
				13.50					
11:07 A				12.40	13.2				
11:08 A				12.35					

Not well mixed or time plug difficulty

Run 2
11:17 in 14.3 14.8 manifold at 12.5 to get rise in power. to be reduced for multiplication determination. rise apparently very slow
11:23 very little indication of rise on instruments. manifold lowered.

2nd Run

Man. x 1.062 = cm

IN	14.3	14.1	12.00	12.74	27.0	0	113.5	
			"	"	30.0	.104	121.5	.105
					44	.071	158.5	.08
					37	.085	157.	.081
					34	.092	148	.086
			manifold marked level → 12.25	13.00	93	.034	398	
			12.23	12.98	97		409	.031
				13.11			402	

out " " 12:34 Sub-crit.

air gap = ~ 7.0 cm

12:40 13.17 Super

Crit. Vol. = 13.15 x 330 = 4340 cm³ ✓
 " " = 4340 x .3345 = 1452 cm³
 .3354 1456

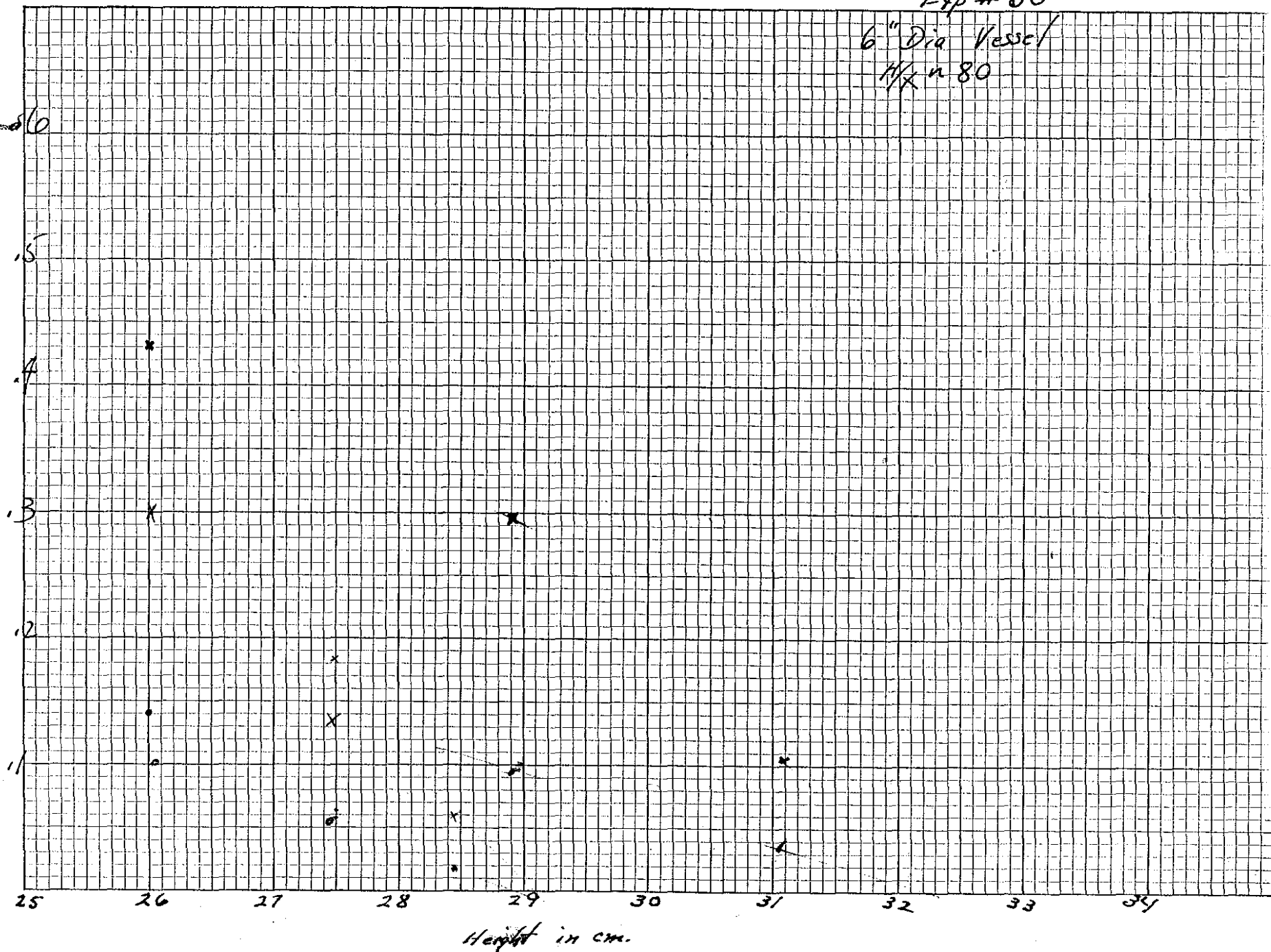
This value of CM seems to be inconsistent with several other values in this concentration range

Solu ht in manifold ~ 26.5 cm

Exp # 30

6" Dia Vessel

H₂ n 80



Height in cm.

Date 11-4-52

EXPT # 30

H/23 = 67

91

For Grain

6" Dia. Reactor
Manifold x 1.446 = cm in 6" vessel

Time	Source	Control	Safety	Manifold	Soln cm ht.	C ₁	x	C ₄	m!	
8:45	in	23.5	22.0	7.00	10.1	5.0	4.3	7.0	7.5	
						3.5		8.0		
9 ⁵²				18.0	26.03	10.0	0.43	53.0 52.5	0.14	
				20	28.9	14.5	0.295	78.0	0.096	
16 ⁰⁰	out			21.5	31.09	41	0.105	210	.035	
				23.5	33.98	Super Crit				
				23.0	33.26	still increasing but not at equilibrium				
				22.5	32.54	still drifting up.				
				22.0	31.8	still drifting up after 5 min.				
				21.0		Sub. Crit				
				21.5		Raising to this level made system go on to fast period.				
				Screened System to prevent manifold lowered further						
	IN	23.5	22.0	18.0		14.0	.30	72	.107	
						13.0		73.5		
				19.66	28.42	72.0	.059	106	.085	
				Cptors to 20.1 on manifold -						
				Manifold lowered to below zero.						
11 ^{AM}										
11 ³⁰	in	23.5	22.0	19.00	27.5	23.5	.183	117.0	.064	
11 ⁴⁴	out	"	"	19.82				128.5	.058	
11 ⁴⁶				20.00	20.0					
				19.95						
				Run # 4						
5 ³⁵				19.00	27.47	31.5	.137	141.5	.053	
				20.00	28.9	still Super.				
				19.92	28.80	Sub				
				19.96	28.86	still Sub				
				20.05	28.98	slightly Super				

Out val = 28.9 x 179.5 = 5190 cm³
 " Man = 3190 x .3346 = 1740 gm³
 54

Signed

92 Calc. ~ 80
Date

$$.2297 \times 1.67 = .3835 \text{ gm salt/gm}$$

$$\frac{.2297}{.1992} \times .0335 = .0386 \text{ gm free HNO}_3$$

$$.1428 \times .0386 = .0055 \text{ H}_2\text{O of gHNO}_3$$

$$\frac{H}{23} = \frac{.5834}{.2260} \times 25.9 = 66.8 \sim 67 \checkmark$$

$$\begin{array}{r} .3835 \\ .0386 \\ \hline .4221 \end{array}$$

$$\begin{array}{r} 1.0000 \\ .4221 \\ \hline .5779 \\ .0065 \\ \hline .5834 \end{array}$$

5" Dia Reactor
Exp 31 4/4/80
*



Date 11-5-52
 Top Pressure
 Time 10:30

Exp # 31
 5" Dia Reactor
 Same Central Safety Manifold
 H/23 = 66.8
 67.
 x 1.660
 C₁ M₁⁻¹ C₄ M₄⁻¹
 Reactor

11 31

Sample	Central	Safety	Manifold	Reactor	C ₁	M ₁ ⁻¹	C ₄	M ₄ ⁻¹
	24.80	21.1	8.00	13.28	5.50	4.9	10.5	10.5
			14.62	24.27	4.25		18.0	0.58
			23.49	38.99	8.0	0.61	27.0	0.39
					7.0		28.0	
			31.0	51.4	7.5	.650	32.0	.33
			42.87	59	10.0		39.0	
					9.5	.503	39.5	.268

11-7-52

U-25

47.031
 22.578

 24.453

.2297 gm U/gm
 .2266 gm 23/gm.
 1.480 mg/gm @ 26.0°C
 .3345 gm 23/cc
 .3354

See page 92
 = 5.62 gm U. ✓

Signed

34

Date 11-5-52

Withdrew $\sim 4000 \text{ cm}^3$ from system &
took sample U-25

To remaining $\sim 3500 \text{ cm}^3$ added $\sim 3500 \text{ cm}^3$
 H_2O . Water added by rinsing down thru
5" dia vessel.

$$\frac{3500}{7300} \times 2500 = \sim 1170 \text{ gm } 23$$

Fox
Eronin
Date 11-4-52

Expt. 32

#/23

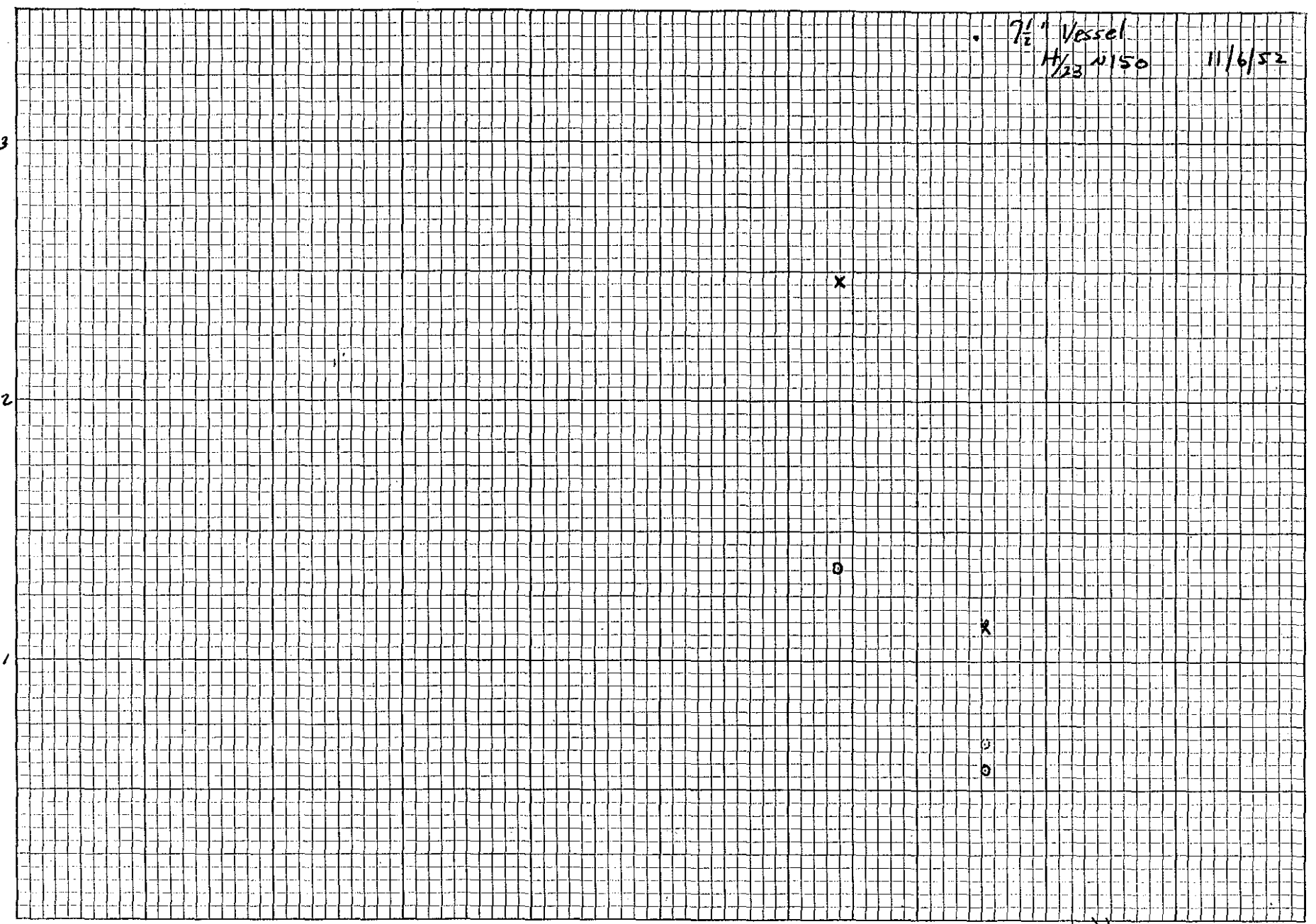
~~150~~
145 - 95

5.0" Dia Vessel

Time	Source	Control	Safety	Manifold	C1	C4
9:15	i	22.2	23.5	9.08	2.0	5.25
					2.0	6.00
				24.00	2.5	6.5
					2.5	6.5
				31.00	2.75	6.75
					3.0	8.0
					3.0	8.0
				45.0	3.5	10.75
					3.0	10.0

Signed

7 1/2" Vessel
H/23 N150 11/6/52



15 16 17 18 19 20

Height in cm.

OFFEL & ESSER CO.
MADE IN U.S.A.
1/2" to the inch, 1/32 in. lines included.

11/2
11/2
11/2
11/2

Rohrer
Fox
Date 11-4-52

EXPT #33

H₂ = ~~150~~ 145 97
23

Time	Source	Control	Safety	7 1/2" Vessel (INSF) Manifold Ht. Cur Soln		X C ₁	m ⁻¹	C ₂	m ⁻¹
20	in	17.4	13.6	6.00	6.33	3.5		8.25	
37	"	"	"	15.75	18.19	3.5	.246	60.5	.136
47	"	"	"	16.25	18.77	31.0	.113	143.25	.058
	out			17.4	20.097	super critical			
				17.29		needs to be level -			
		manifold lowered -							
	in	18.3	13.4	16.25	18.77	29.25	.120	122.0	.068
	out			18.37		super critical			
				19.9		and			
				18.2		about level.			
				18.3		super			
				crit at approx full					
Full vol ≈ 5280 cm ³				✓		1.66 ⁸⁷ / ₈₇		9m ² /ci	
				Crit. Mass =		878 g/m ³		✓	
						880			

Date

Lab. Date

Sample Summary:

Sample No.	Net. Wt.	Vol	Anal. - gm 23/gm	Total 23	Total U
U-1	32.65	20	.263	8.59	8.73
U-2	47.90 47.88		.2176	10.42	10.66
U-3	48.97 49.95		.1530	7.64	7.78
U-4	27.56 27.54		.1298	3.58	3.64
U-5	87.41 87.40		.10675	9.33	9.49
U-6	40.62 40.59 85.23		.2490 .08735	10.11	10.28
U-7	85.25 85.23		.08735	7.44	7.57
U-8	108.14 108.12		.0748	8.08	8.22
U-9	84.03 84.01		.06385	5.34	5.45
U-10	28.33 28.30		.2218	6.28	6.38
U-11	101.54 101.52		.05825	5.91	6.01
U-12	120.74 120.74		.05073	6.13	6.23
U-13	112.61				4.69
U-14	105.20				4.07
U-15	107.38				8.57
U-16	4.30				.89
U-17	3.94				.96
U-18	5.41			1.3594	1.38
U-19					.62
U-20					1.63
U-21					1.11
U-22					7.40
U-23					10.49
79 U-24					6.25
93 U-25	24.453				5.62
U-26					3.49
U-27					3.09
U-28					3.14
U-29					2.18
U-30					3.28
U-31					4.40
U-32					3.16

9 grams returned signed 159.88 (141.80) ✓

33

34

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