Figure 1

CALIBRATION OF INTEGRAL ORIFICE METER WITH HELIUM

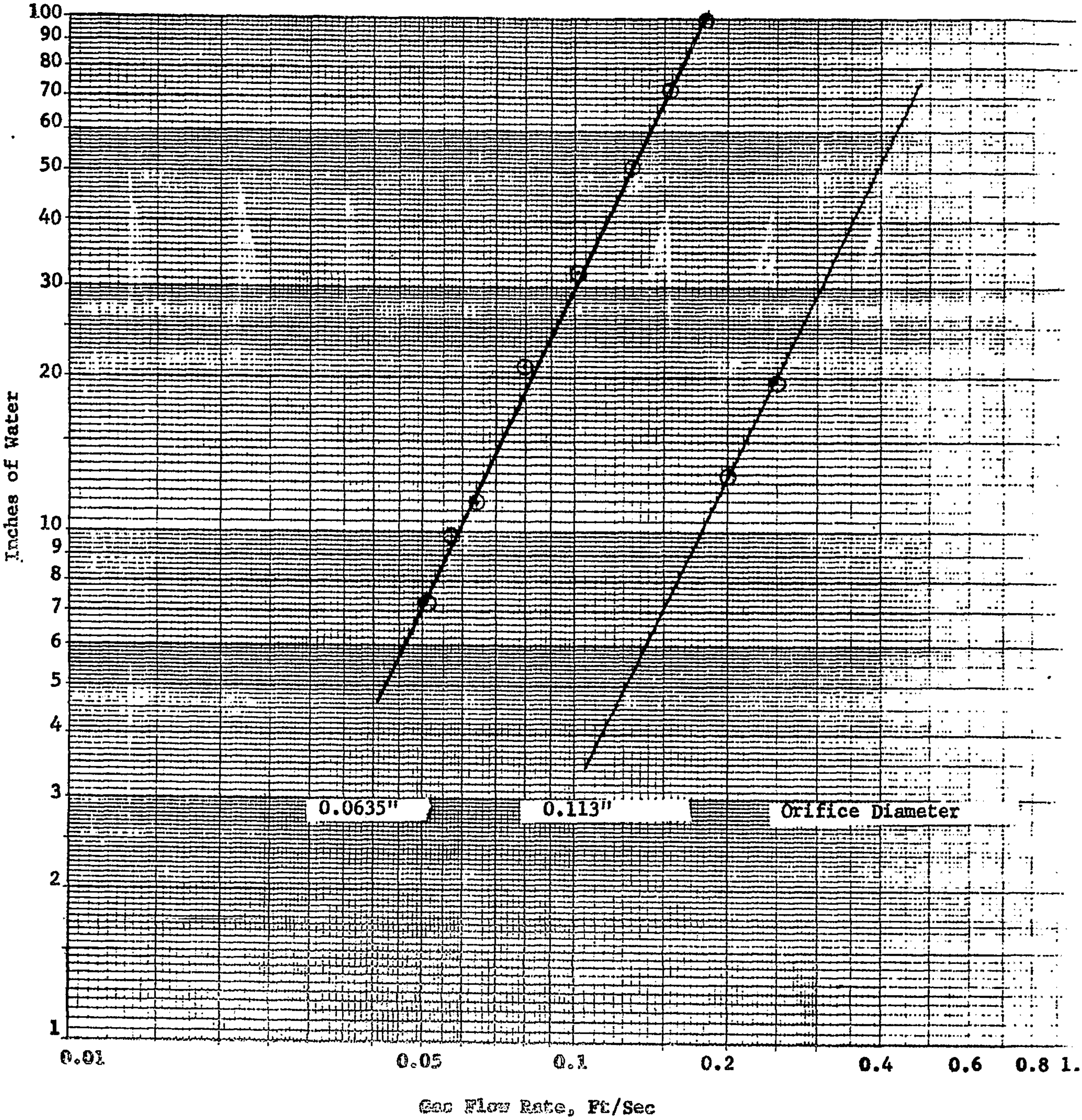


Figure 2
Catalyst Bed Settling Rate, Nitrogen, Run 212

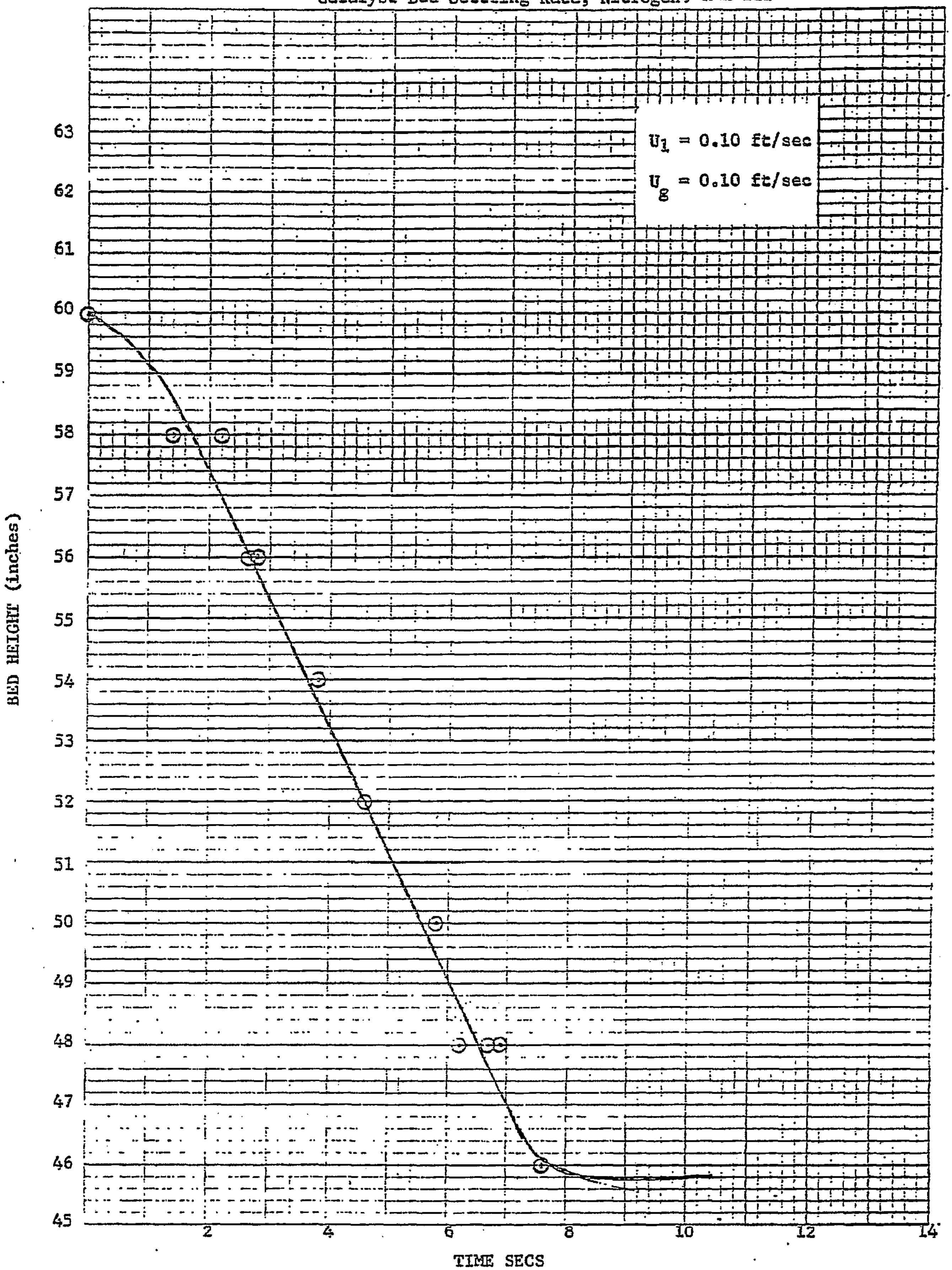


Figure 3

CATALYST BED SETTLING RATE, NITROGEN, RUN 212

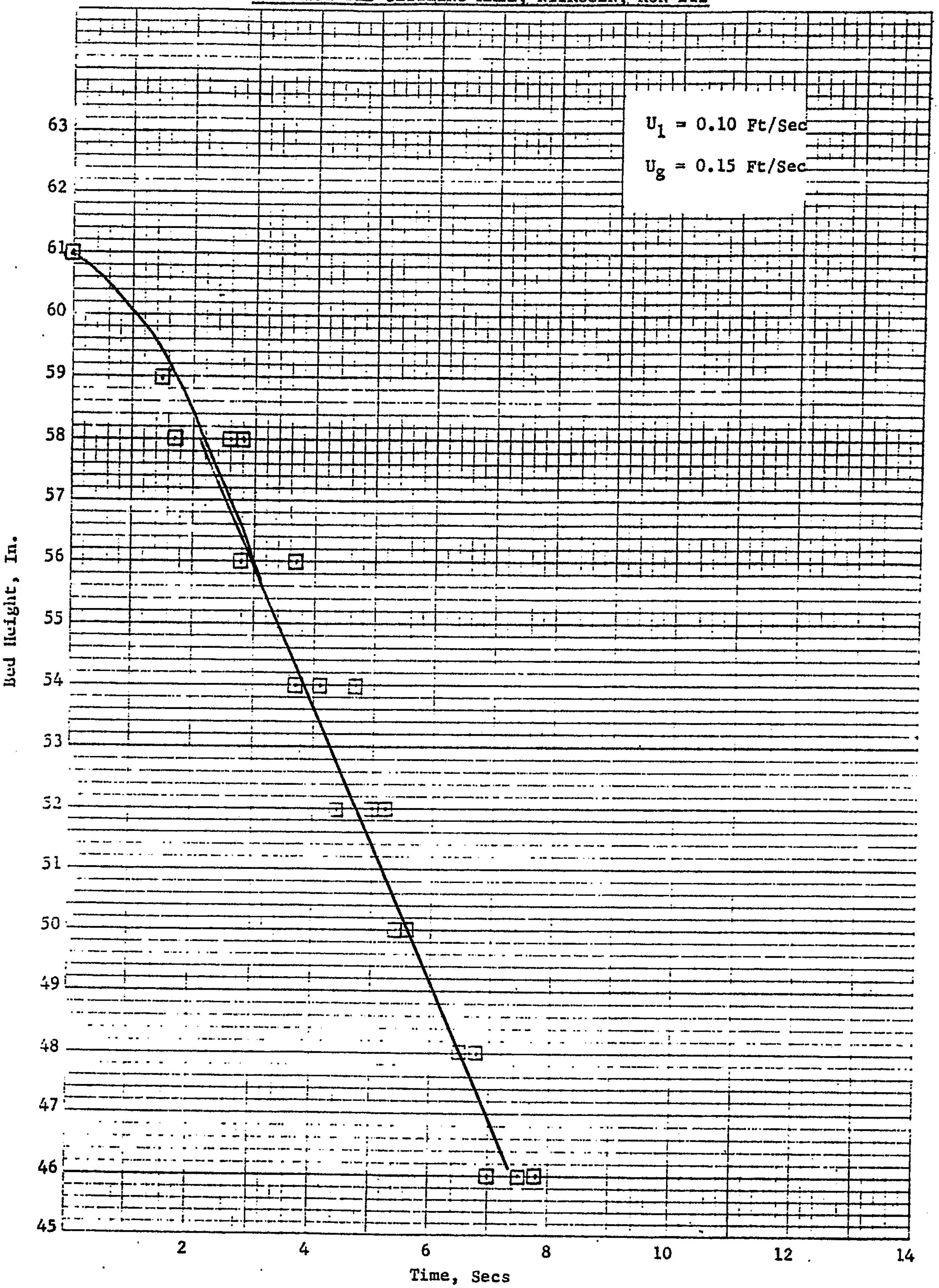


Figure 4

CATALYST BED SETTLING RATE, NITROGEN, RUN 212

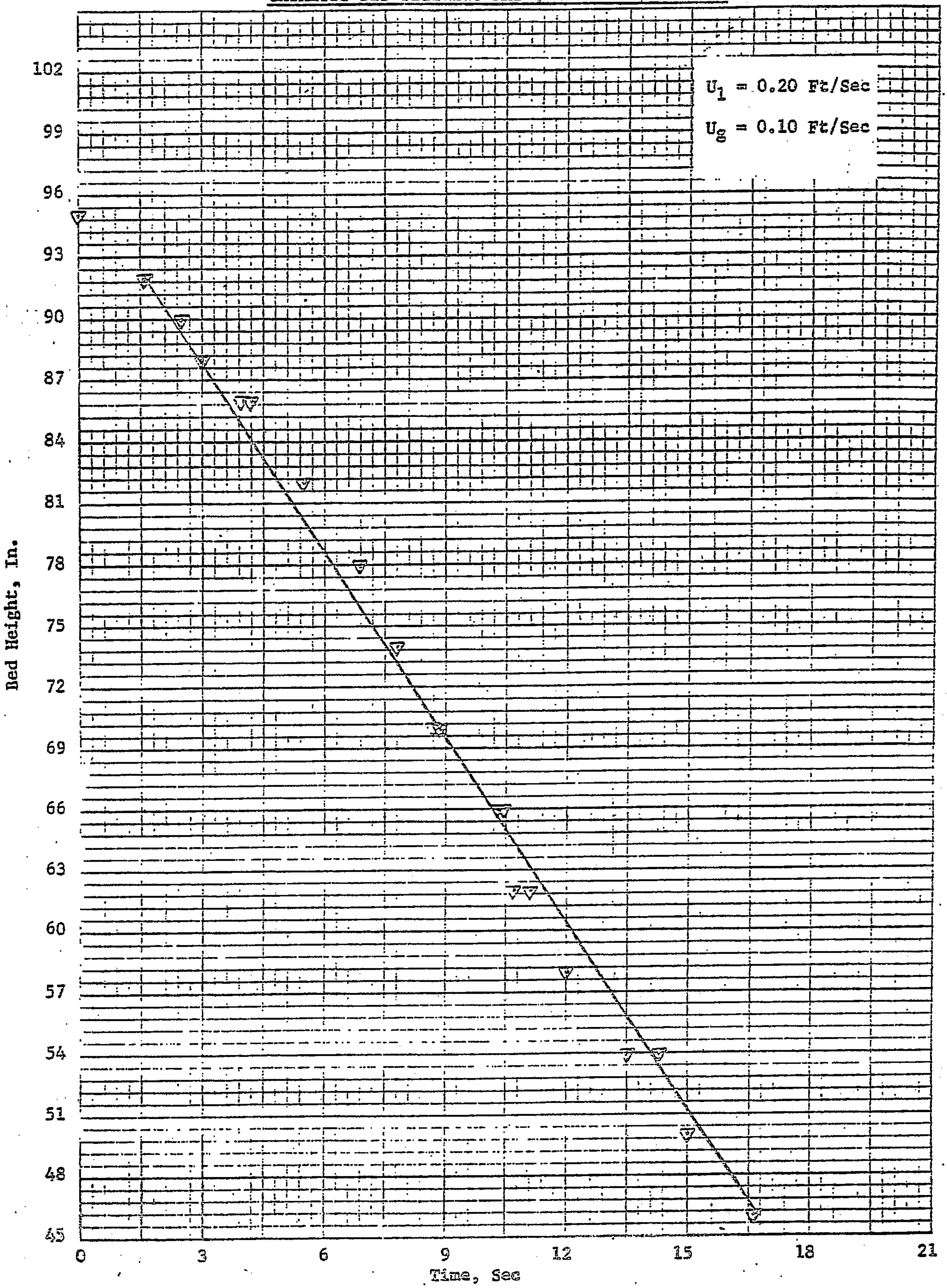


Figure 5
Catalyst Bed Settling Rate, Helium, Run 213

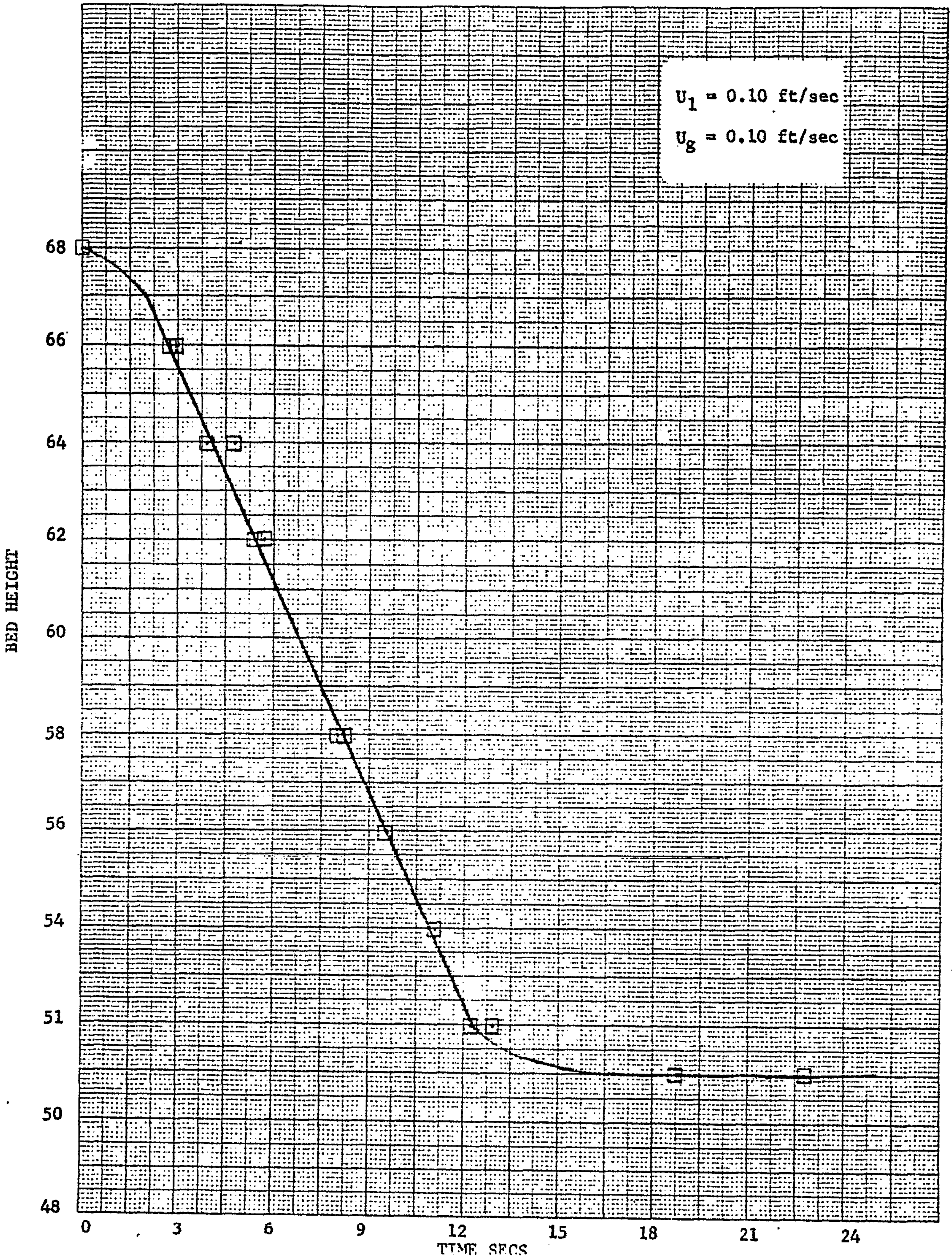


Figure 6

CATALYST BED SETTLING RATE, HELIUM, RUN 213

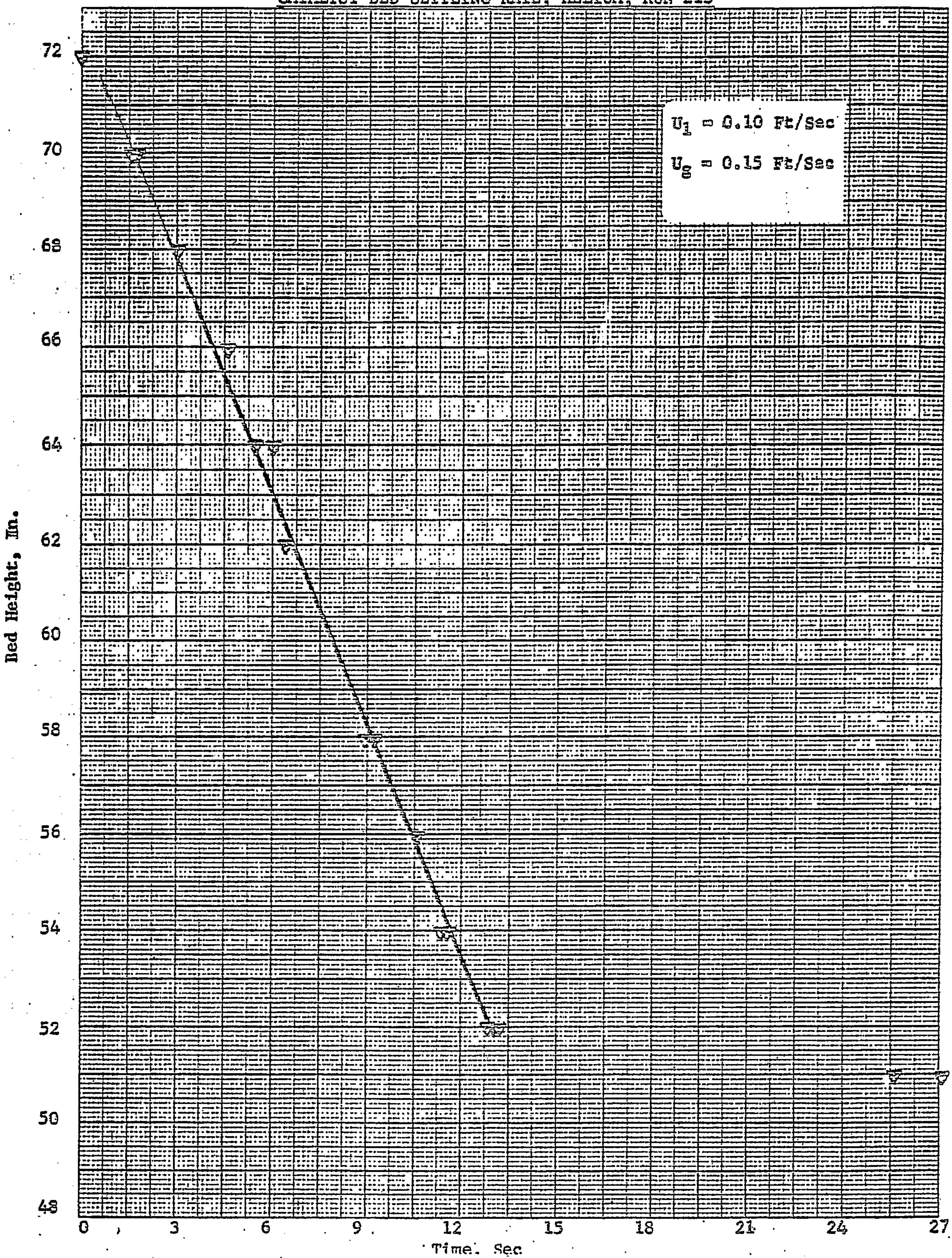


Figure 7

CATALYST BED SETTLING RATE, HELIUM, RUN 213

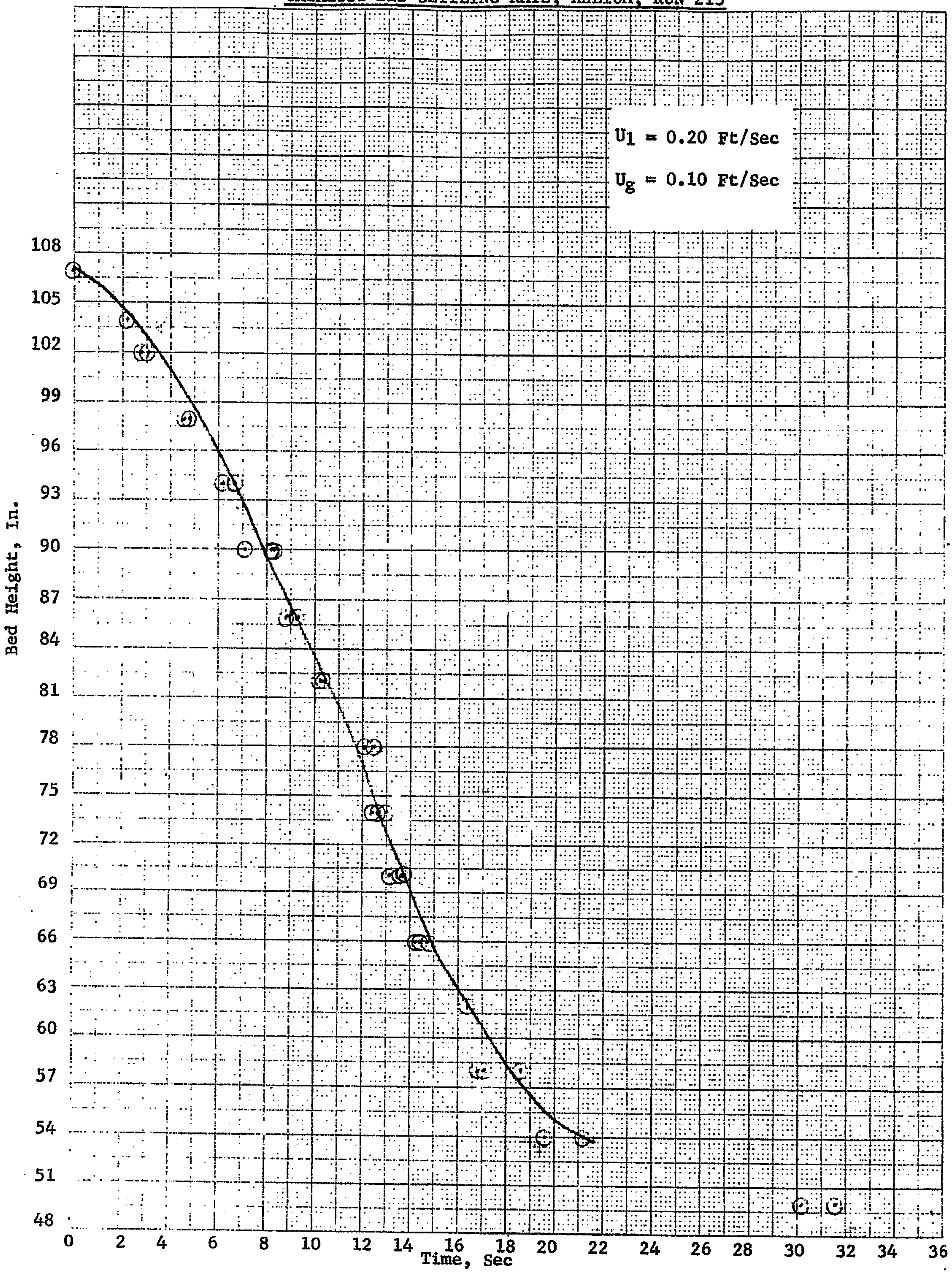


Figure 8

CATALYST BED SETTLING RATE, NITROGEN/15 VOL% COAL CHAR/KEROSENE

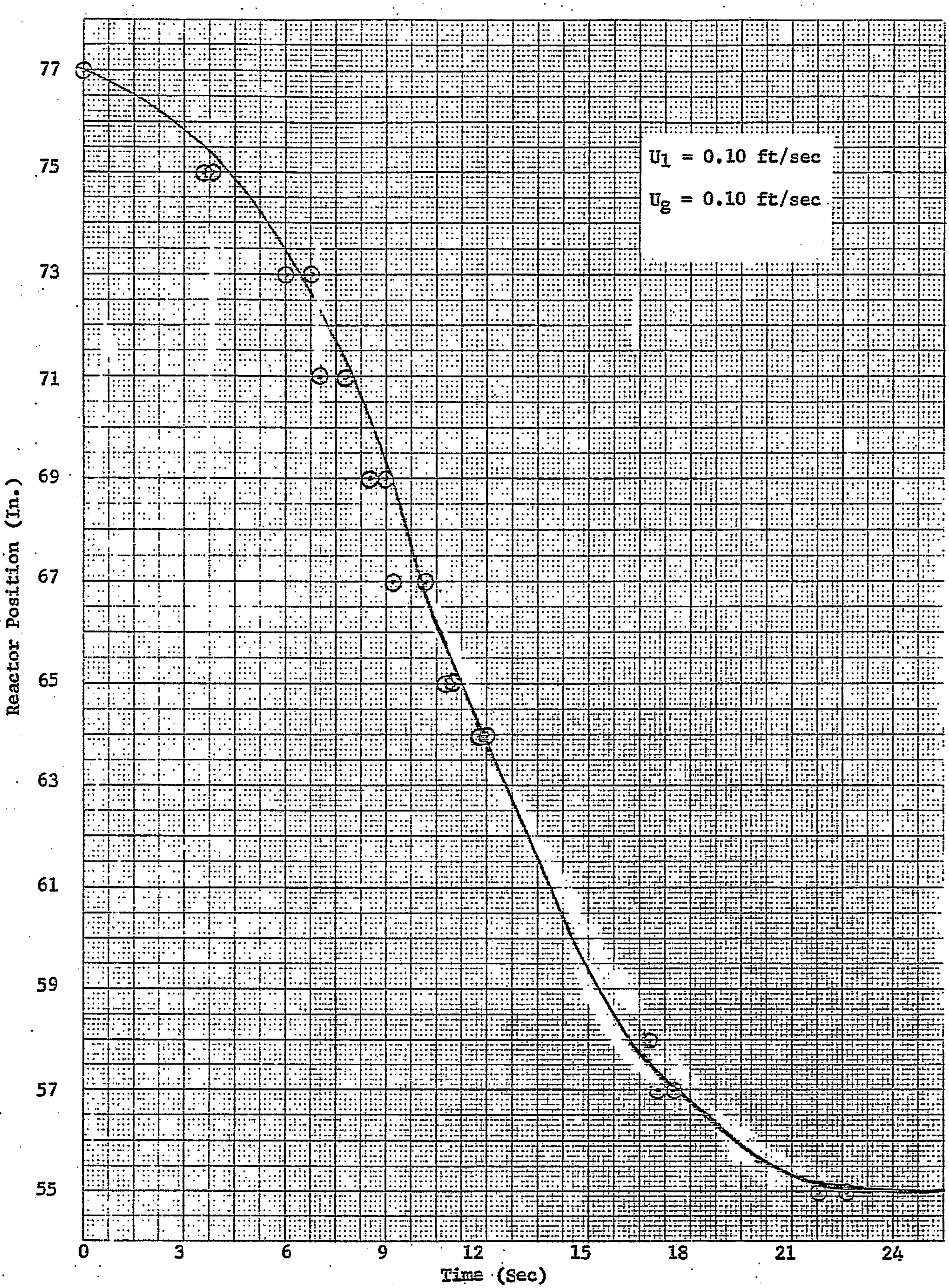


Figure 9

CATALYST BED SETTLING RATE, NITROGEN/15 VOL% COAL CHAR/KEROSENE

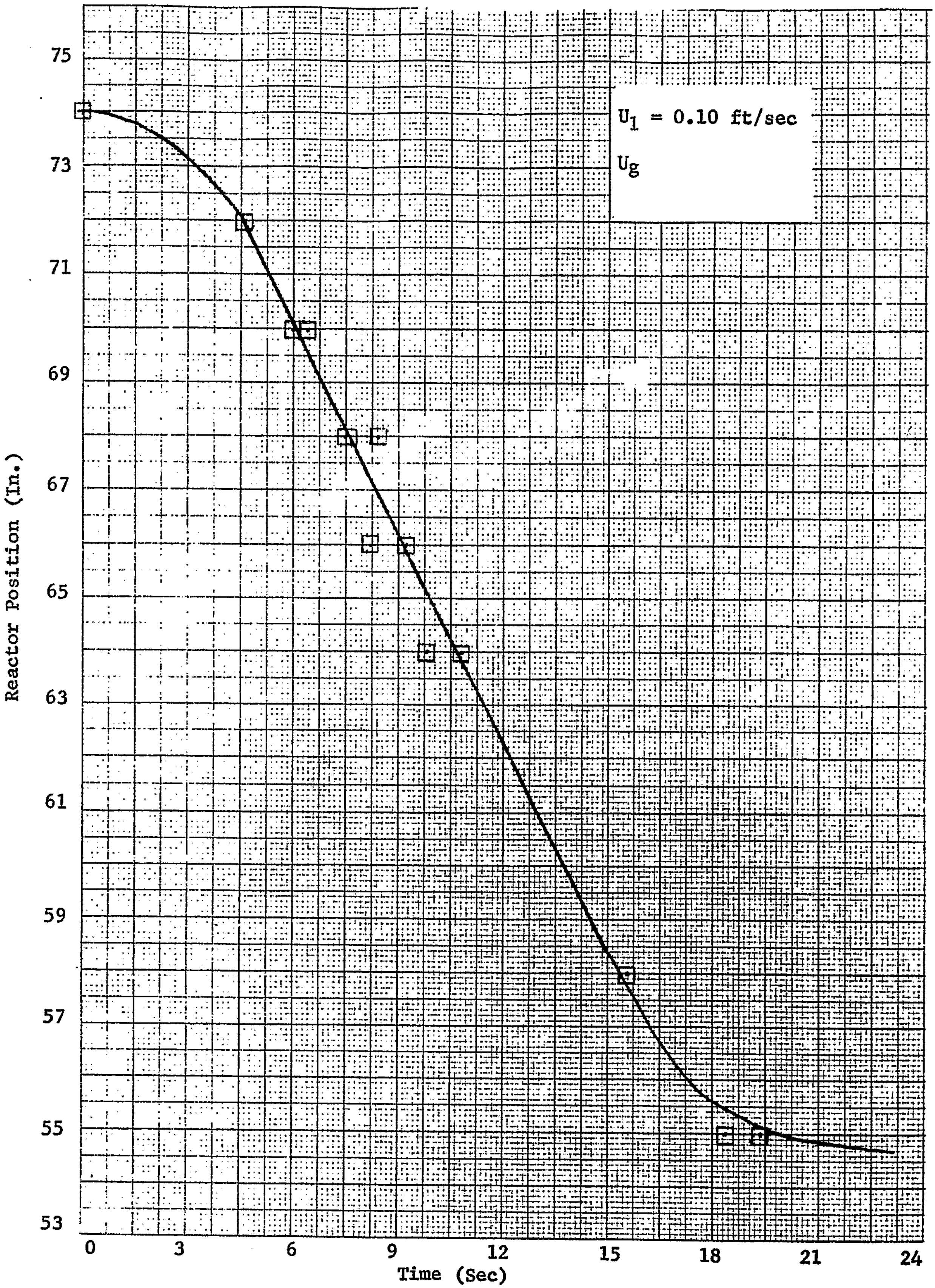


Figure 10

CATALYST BED SETTLING RATE, NITROGEN/15 VOL% COAL CHAR/KEROSENE

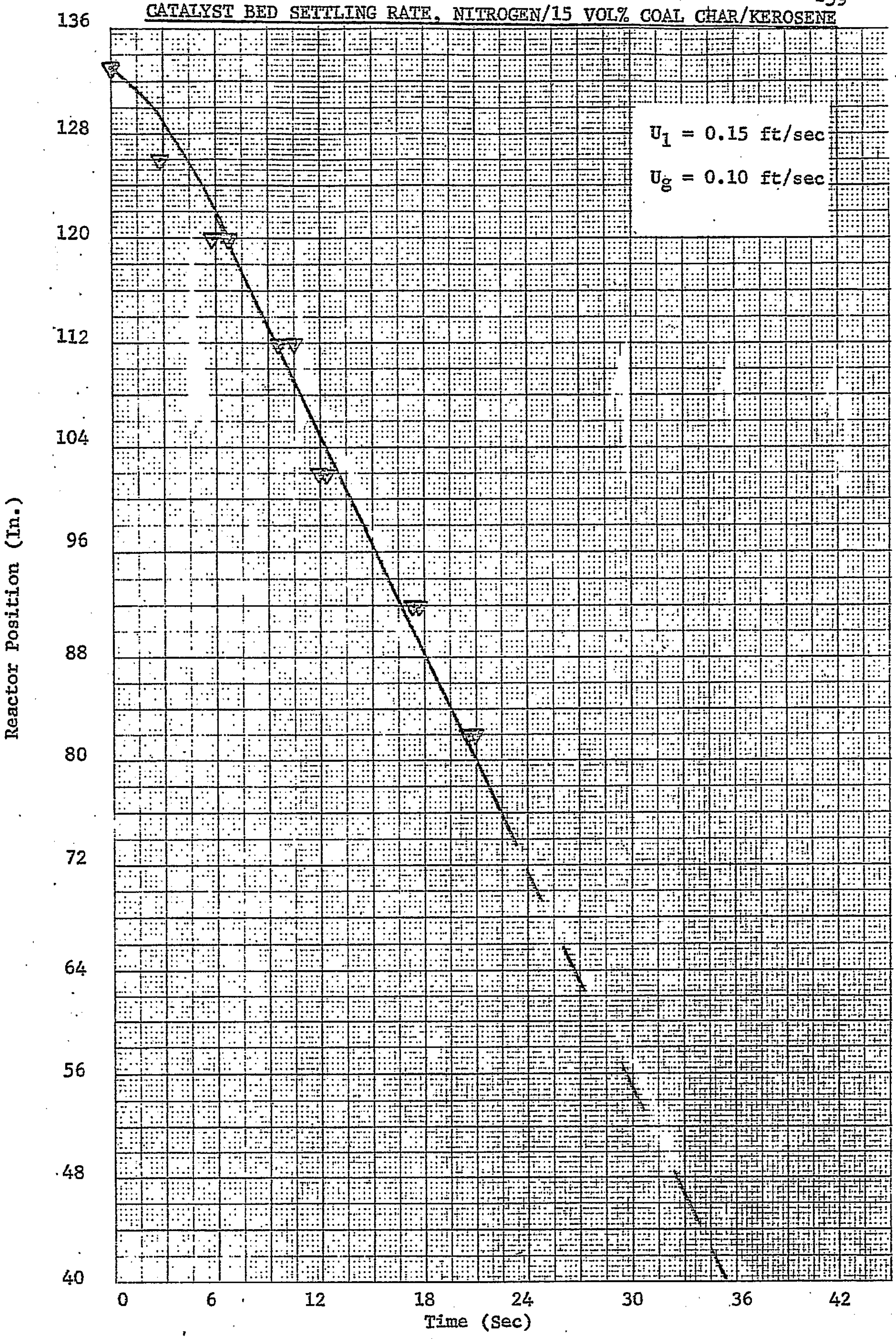


Figure 11

DRIFT FLUX VS. GAS HOLDUP--RUN 300: KEROSENE/NITROGEN

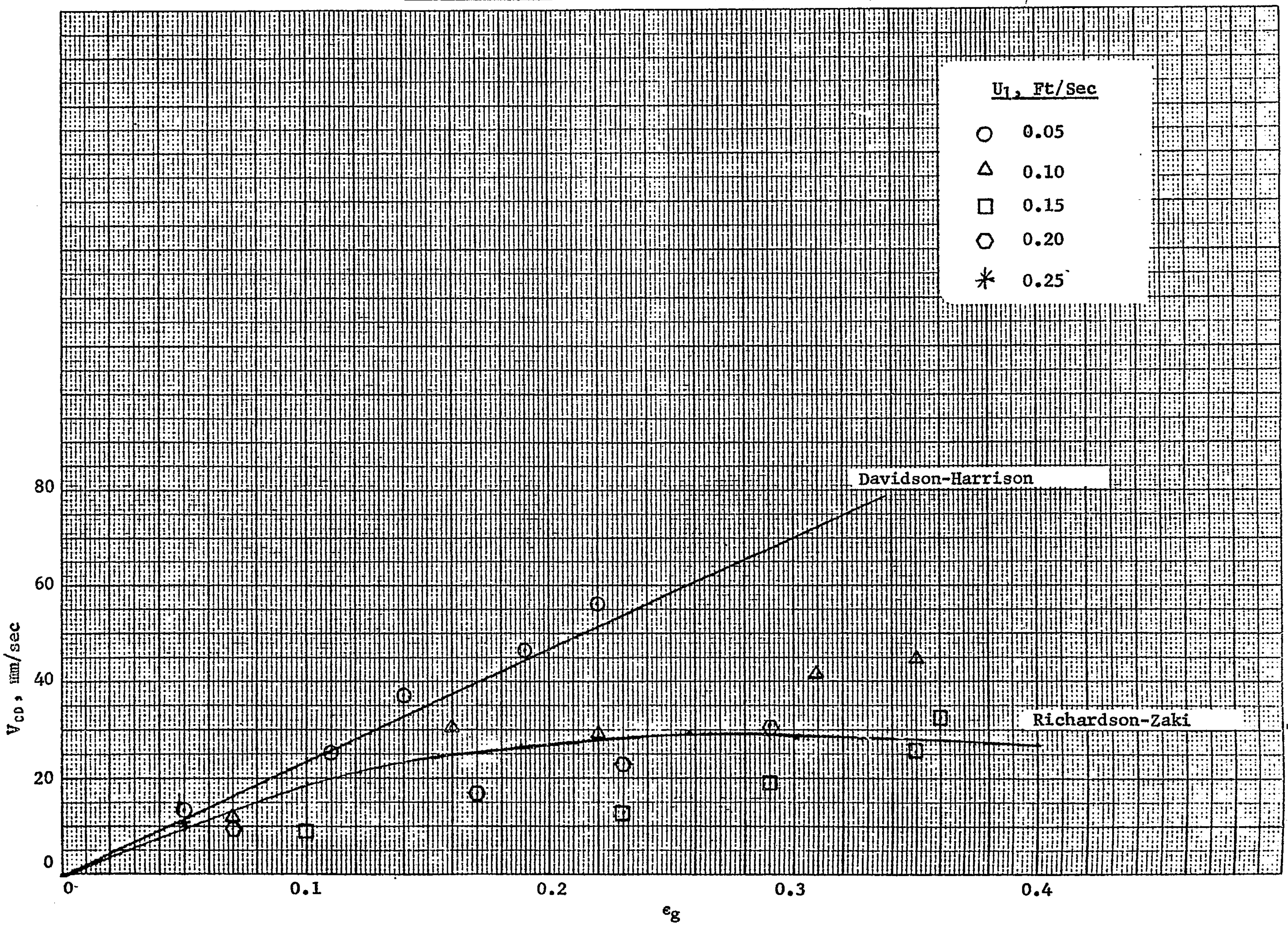


Figure 12

% BED EXPANSION VS. U_g--RUN 301: KEROSENE/0% FINES
(PARTICLE LENGTH/DIAMETER = 6)

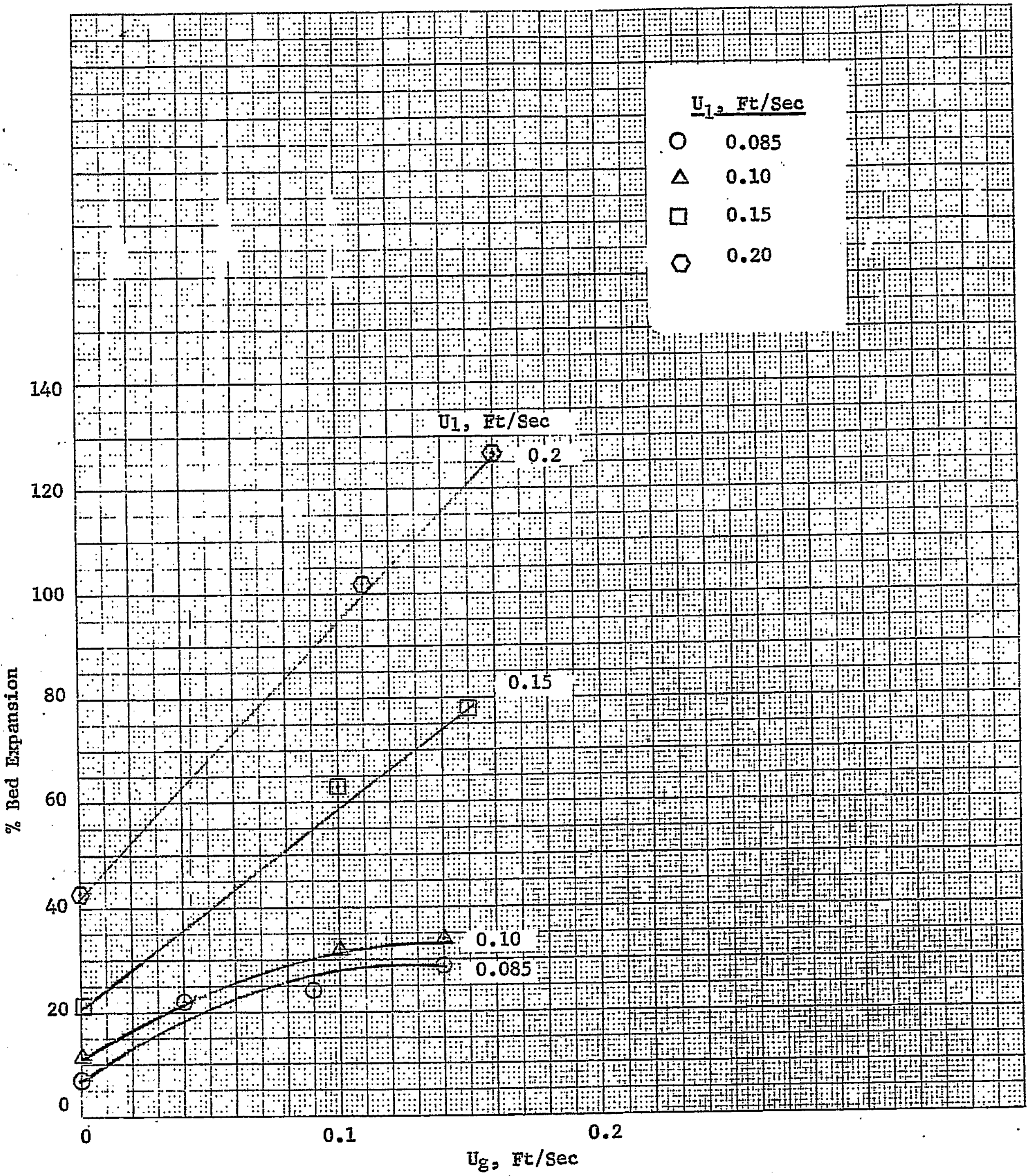


Figure 13

% BED EXPANSION VS. U_g--RUNS 212 AND 213: KEROSENE/0% FINES

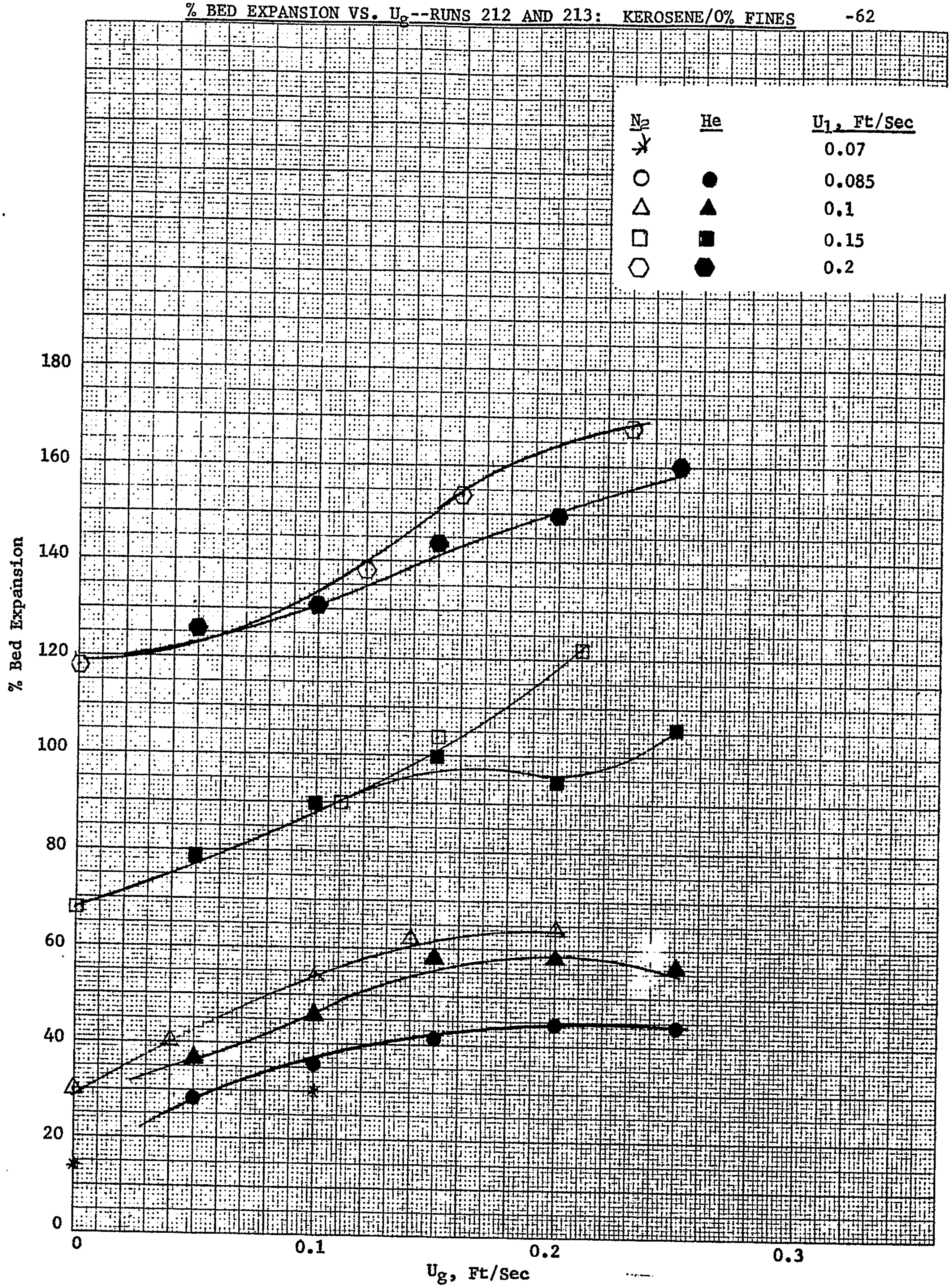


Figure 14
CATALYST HOLDUP VS. U_g--RUN 301: KEROSENE/0% FINES
(PARTICLE LENGTH/DIAMETER = 6)

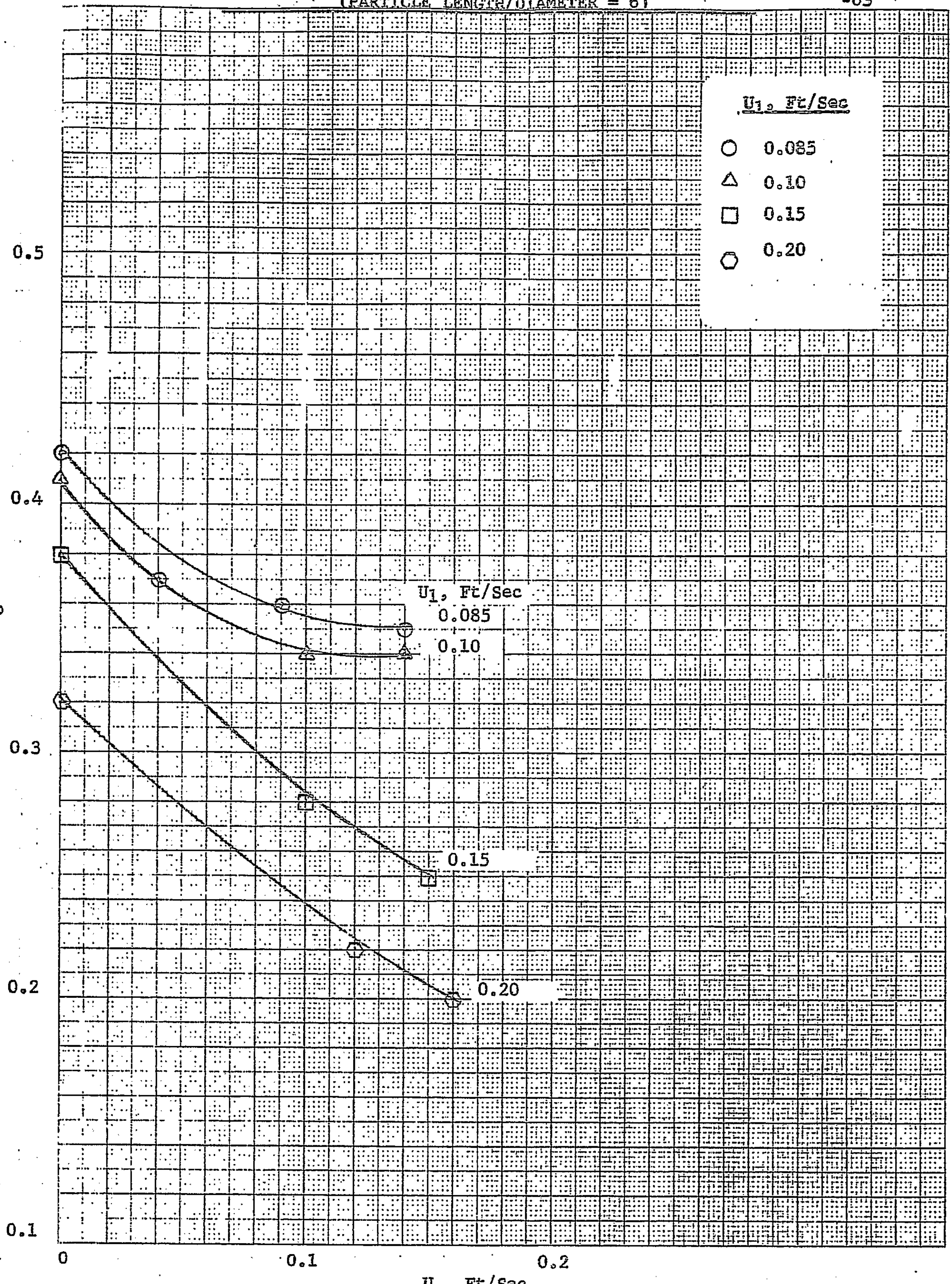


Figure 15

CATALYST HOLDUP VS. U_g--RUNS 212 AND 213: KEROSENE/0% FINES

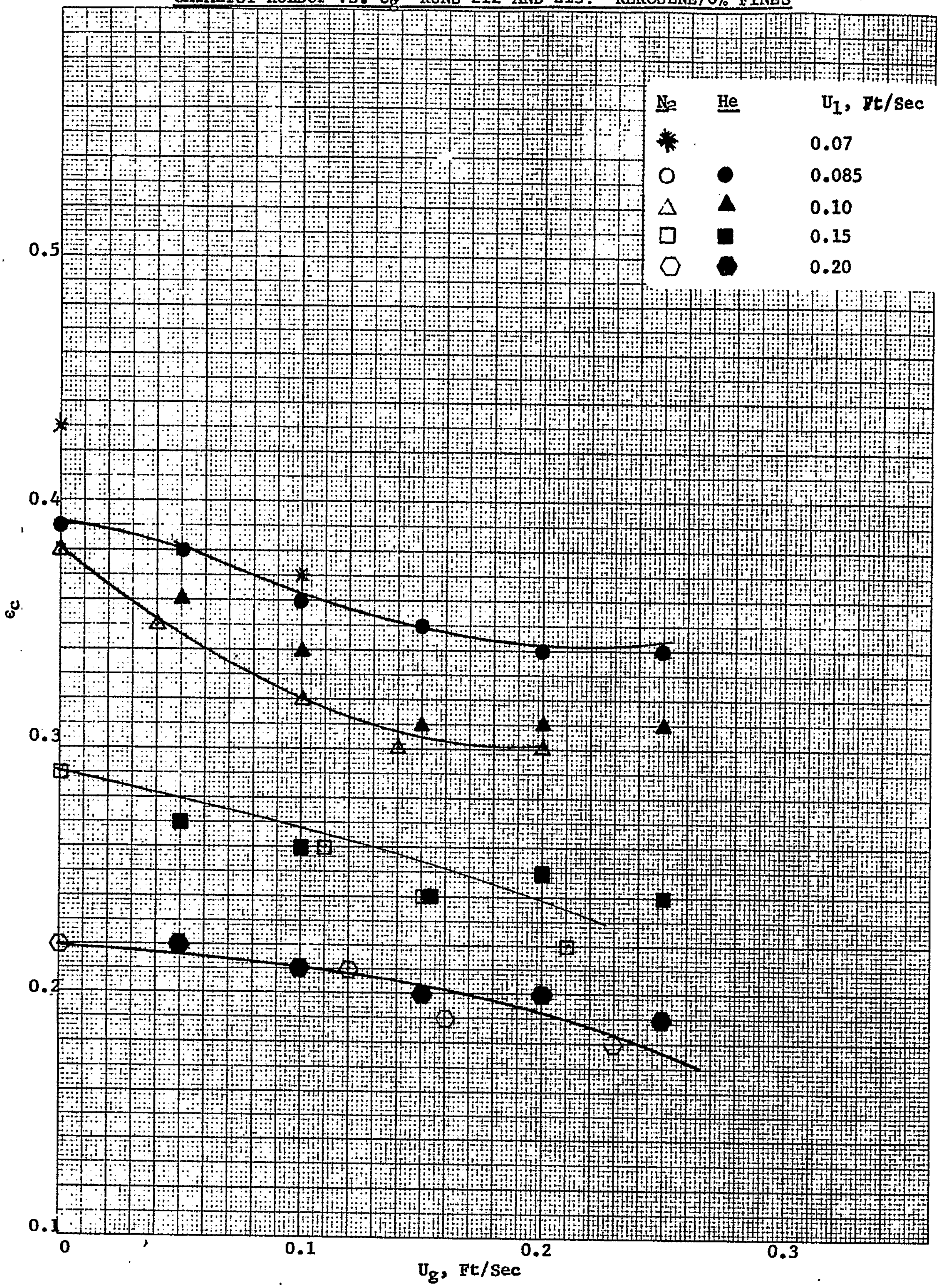


Figure 16

BED VOIDAGE VS. SUPERFICIAL LIQUID VELOCITY--RUN 301:
(PARTICLE LENGTH/DIAMETER = 6)

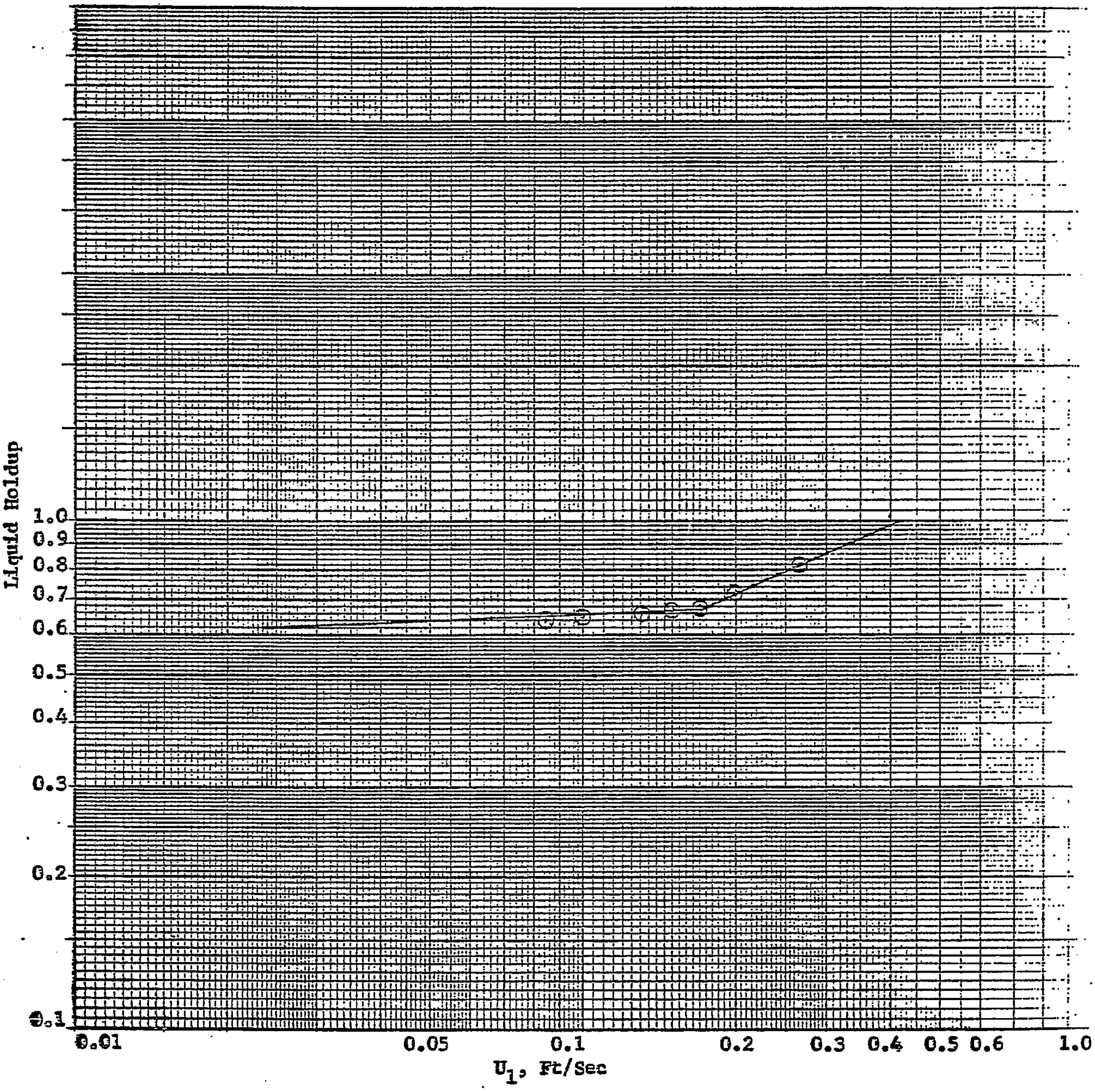


Figure 17

BED VOIDAGE VS. SUPERFICIAL LIQUID VELOCITY: KEROSENE/0% FINES

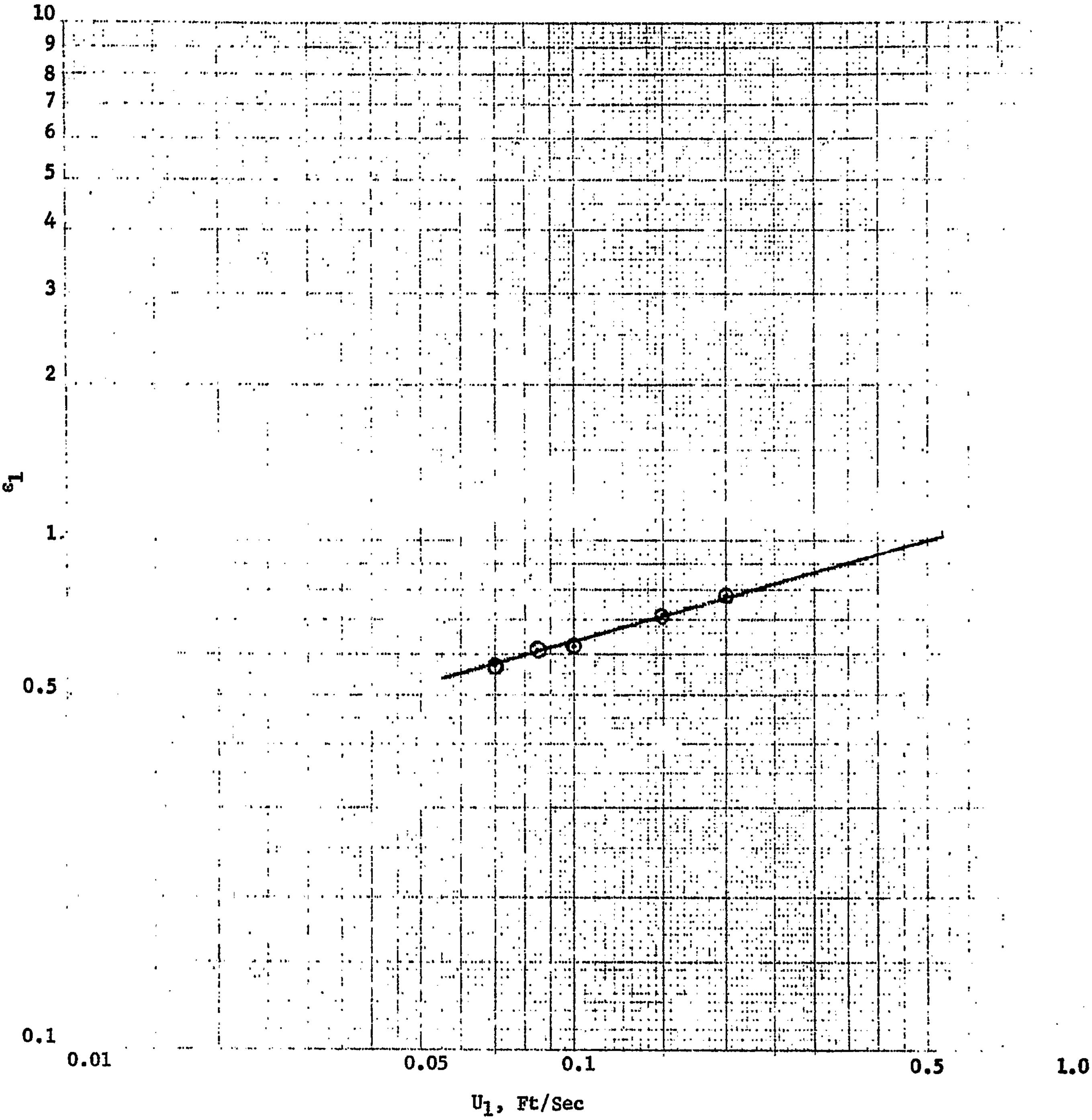


Figure 18

BED VOIDAGE VS. SUPERFICIAL LIQUID VELOCITY: RUN 214--
KEROSENE/15 VOL% FINES/150°F

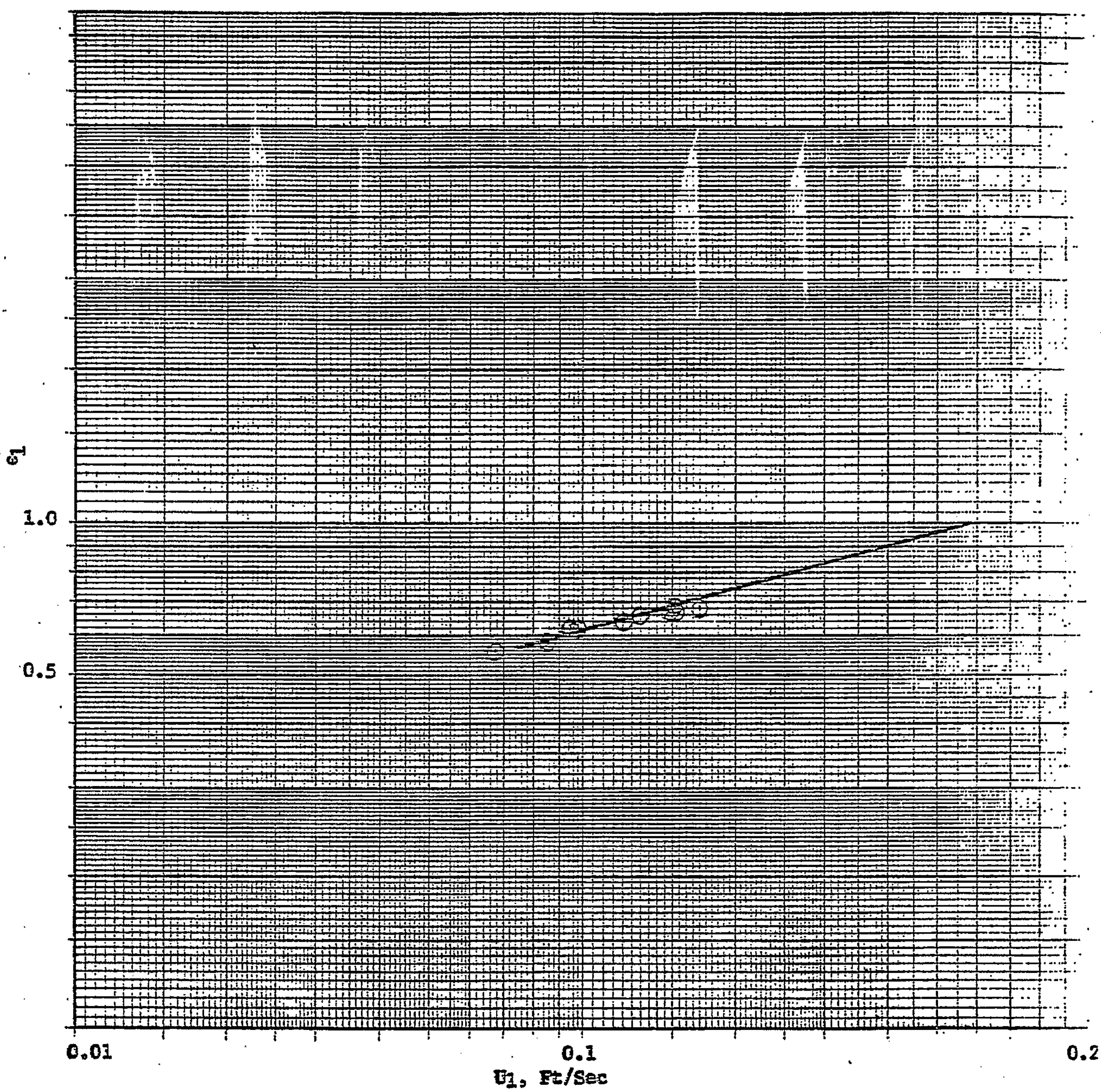


Figure 19

DRIFT FLUX VS. GAS HOLDUP, RUN 301: KEROSENE/0% FINES

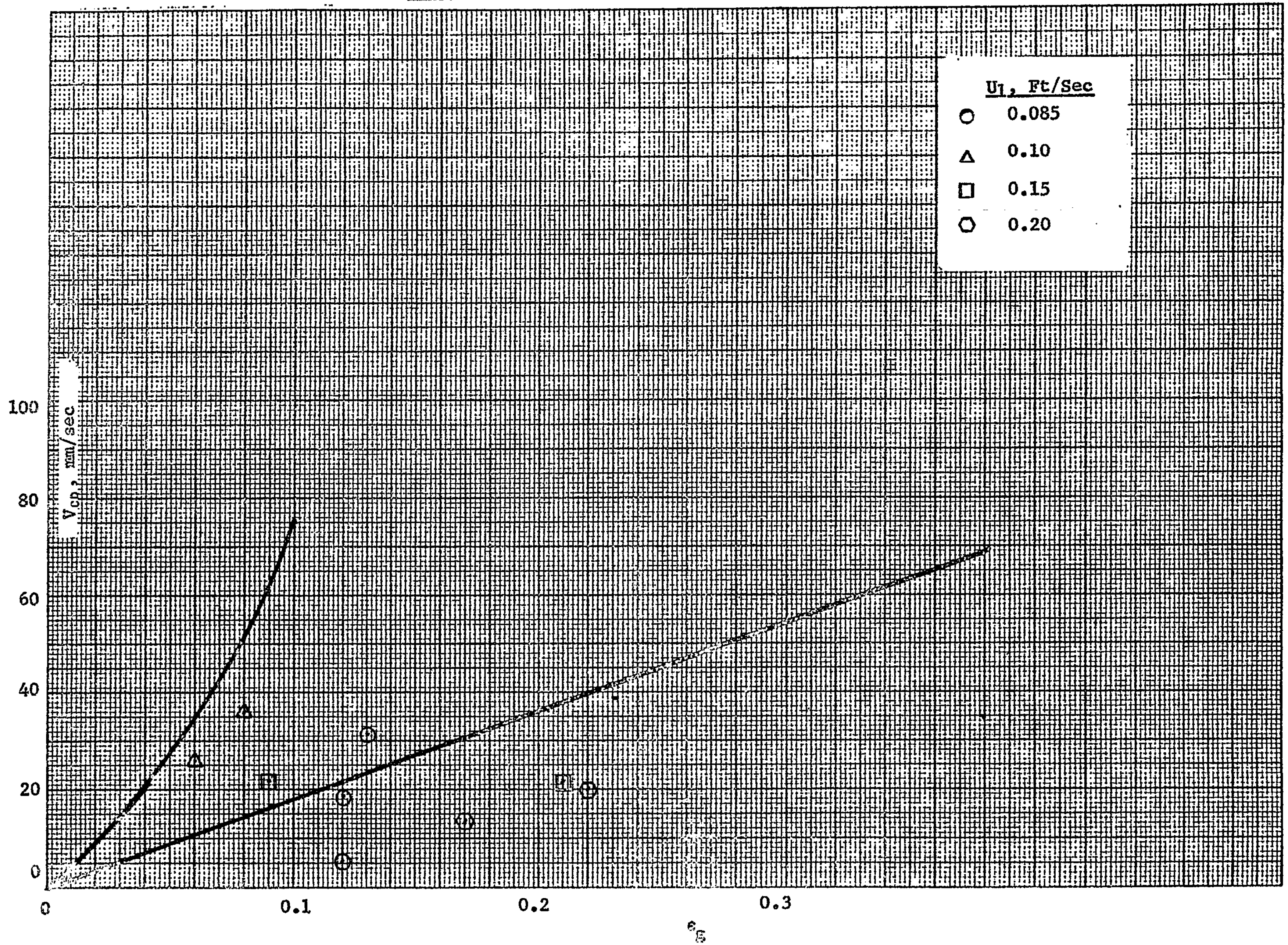


Figure 20

DRIFT FLUX VS. GAS HOLDUP, RUNS 212 AND 213: KEROSENE/0% FINES

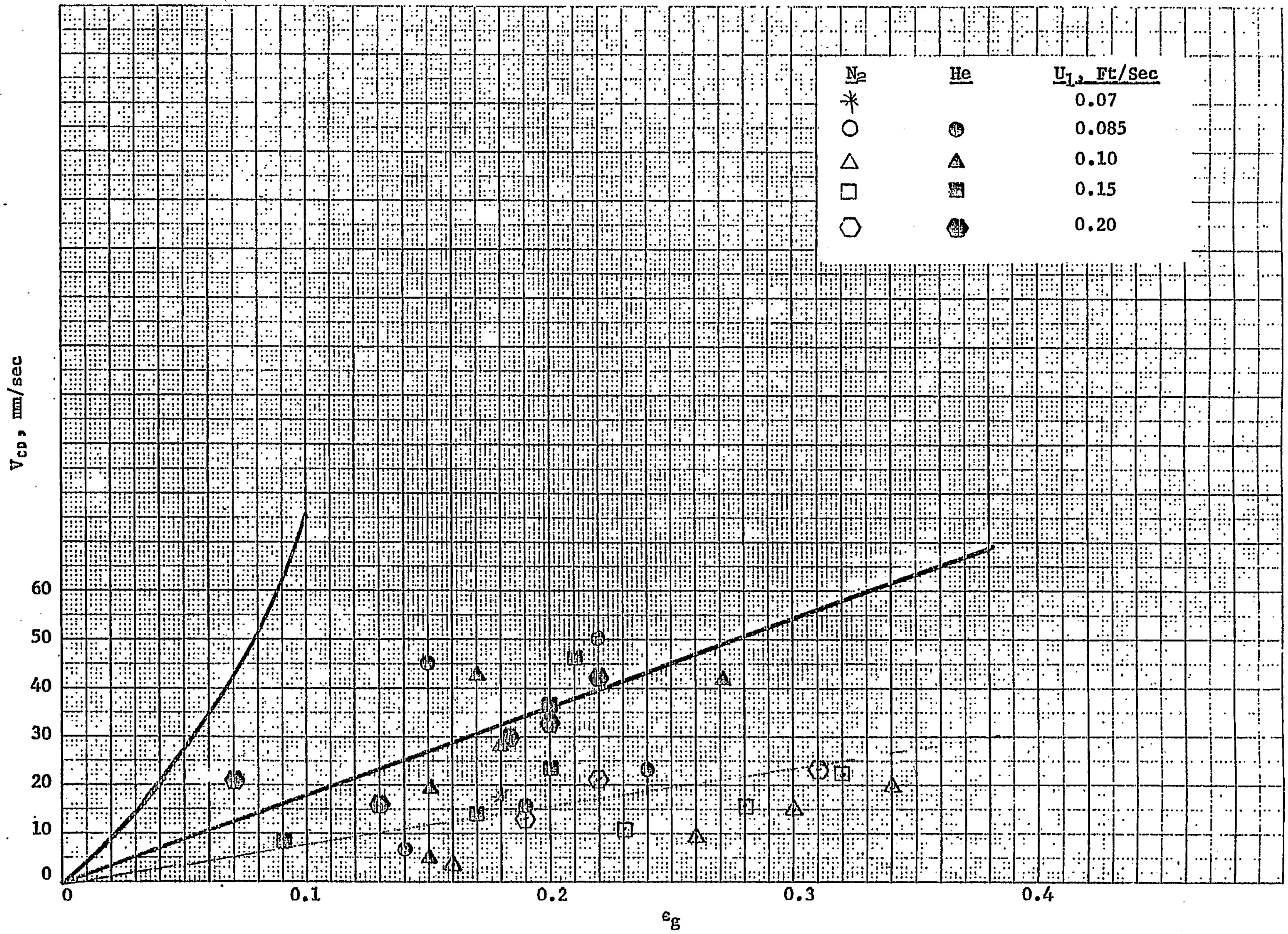


Figure 21

SOLUTION OF THE BHATIA-EPSTEIN MODEL

1) Select initial values of ϵ_c, ϵ_1, ϵ_g.

2) Compute: $V_{g_1}''' = U_{t_B} + 2\,U_g$.

3) Compute: $\epsilon_k''/\epsilon_g''$ - values given by Letan and Kehat.

4) Compute: $\epsilon_k = \epsilon_g \dfrac{\epsilon_k''}{\epsilon_g''}(1 - \epsilon_c)^3$

5) Compute: $V_g = U_g/\epsilon_g$

6) Compute: $\epsilon_1''_f$ from Richardson-Zaki relationship

7) Compute: $V_g = \dfrac{U_1 + U_g + \epsilon_1''_f\,(1 - \epsilon_g - \epsilon_k)V_{g_1}'''}{1 - \epsilon_c}$

8) Compute: $\epsilon_{1_2} = \epsilon_k(1 - X_k) + \epsilon_{1_f}''(1 - \epsilon_g - \epsilon_k + X_k\epsilon_k)$

9) Compute new ϵ_g: $\epsilon_{g_2} = U_g/V_g$

10) Average: $\epsilon_{g_1} + \epsilon_{g_2} = \epsilon_{g_{avg}}$

11) Compute new ϵ_c from $\epsilon_{g_{avg}}$ and ϵ_{1_2}

Iterate until $\Delta\epsilon_g$ $\Delta\epsilon_1$ are small.

Figure 22
EFFECT OF n ON THE BHATIA-EPSTEIN CORRELATION

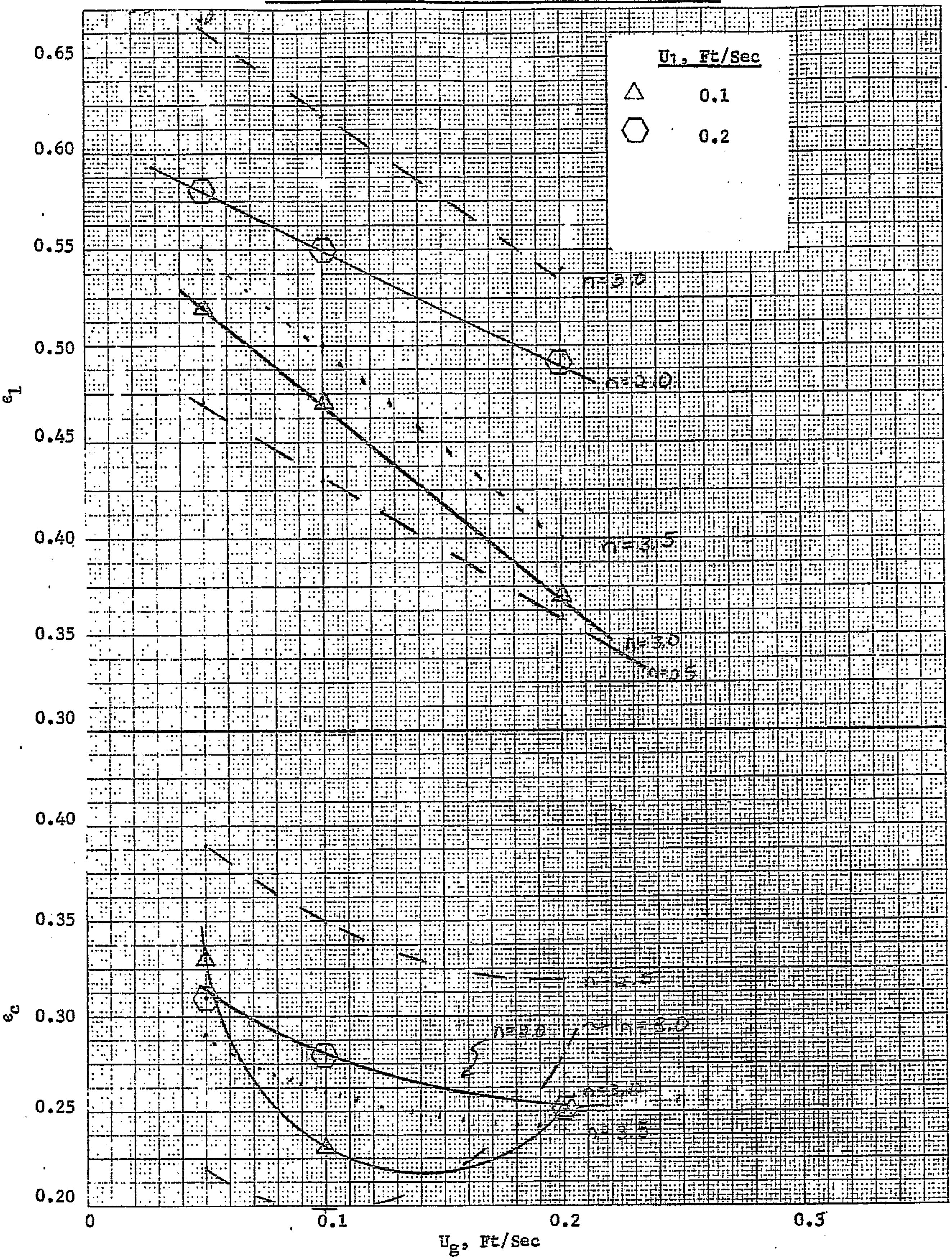


Figure 23

SENSITIVITY OF THE BHATIA-EPSTEIN MODEL TO X_k

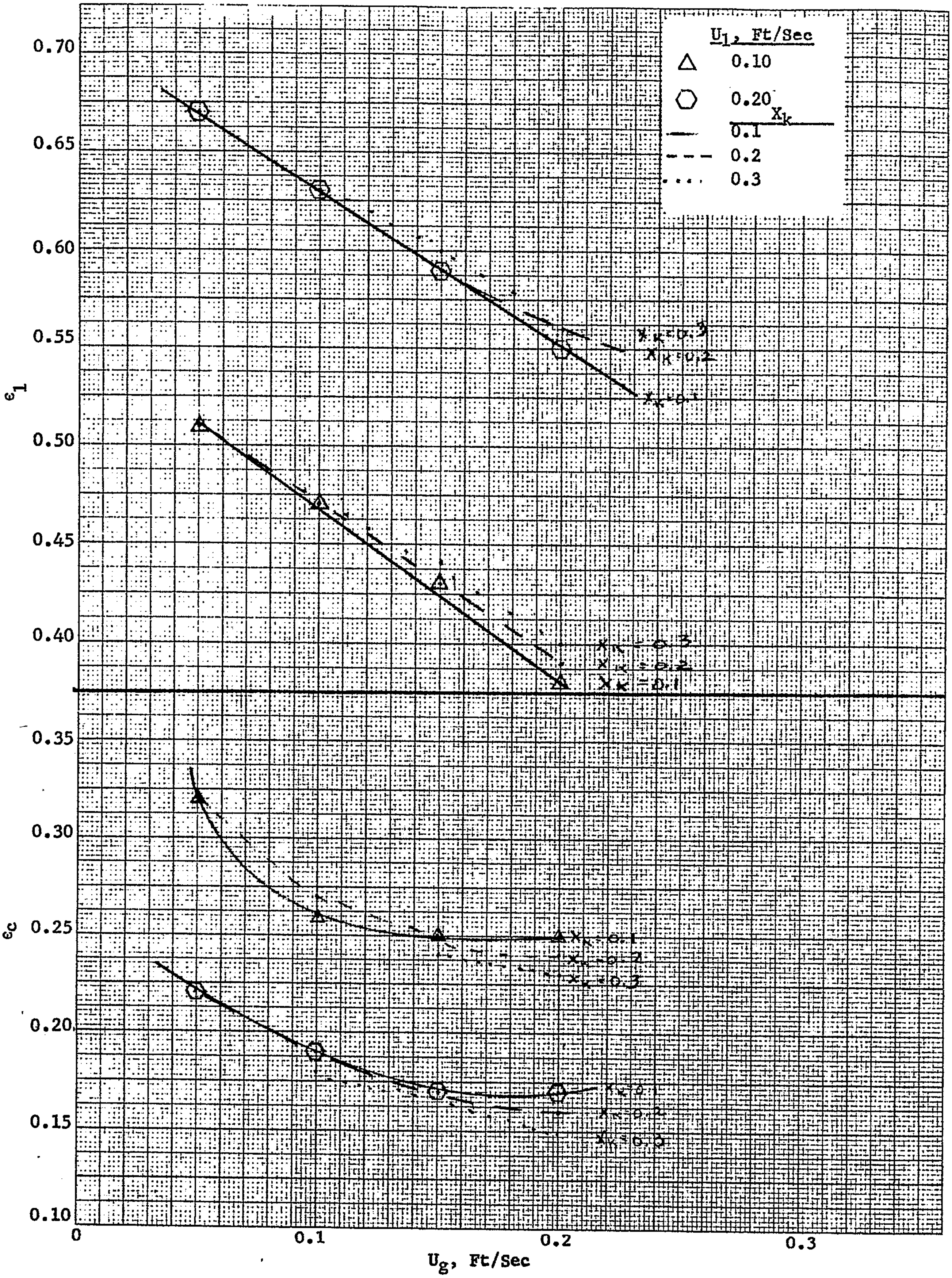


Figure 24

SENSITIVITY OF THE BHATIA-EPSTEIN MODEL TO U_{t_e}

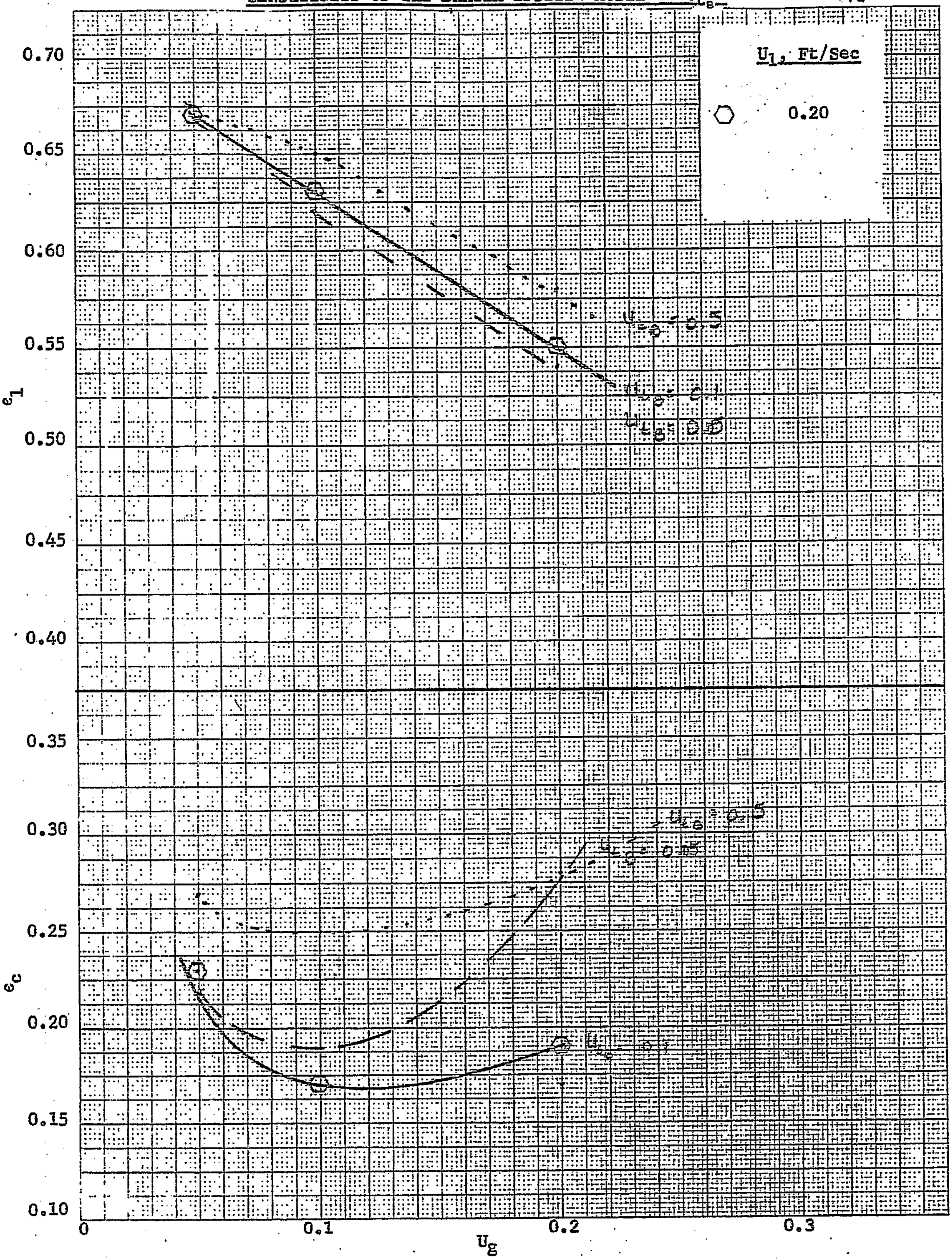


Figure 25
COMPARISON OF EXPERIMENTAL AND BHATIA-EPSTEIN MODEL CATALYST HOLDUPS:
RUN 212: KEROSENE/0% FINES

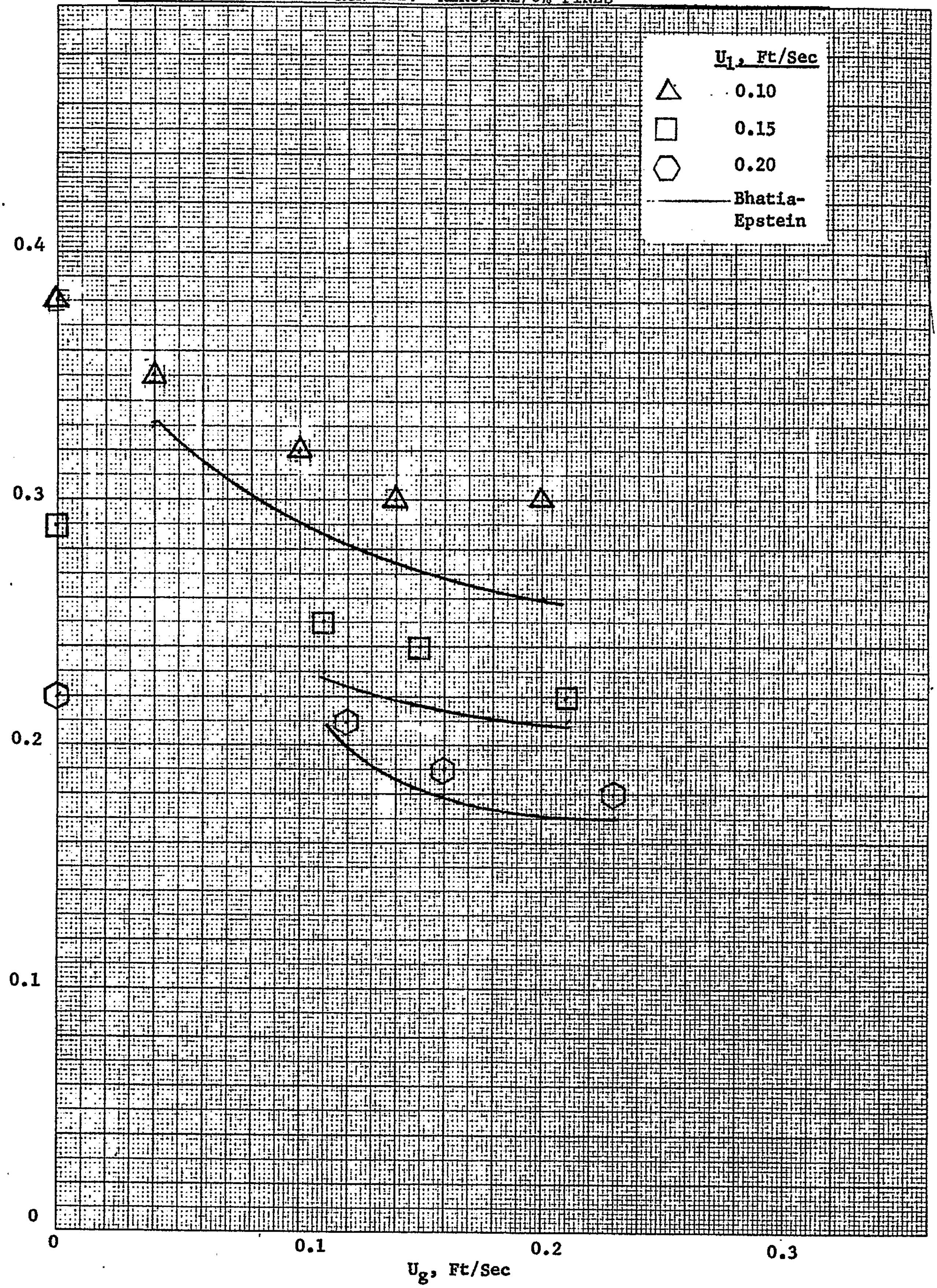


Figure 26
COMPARISON OF EXPERIMENTAL AND BHATIA-EPSTEIN MODEL GAS HOLDUPS, RUN 212: KEROSENE/0% FINES

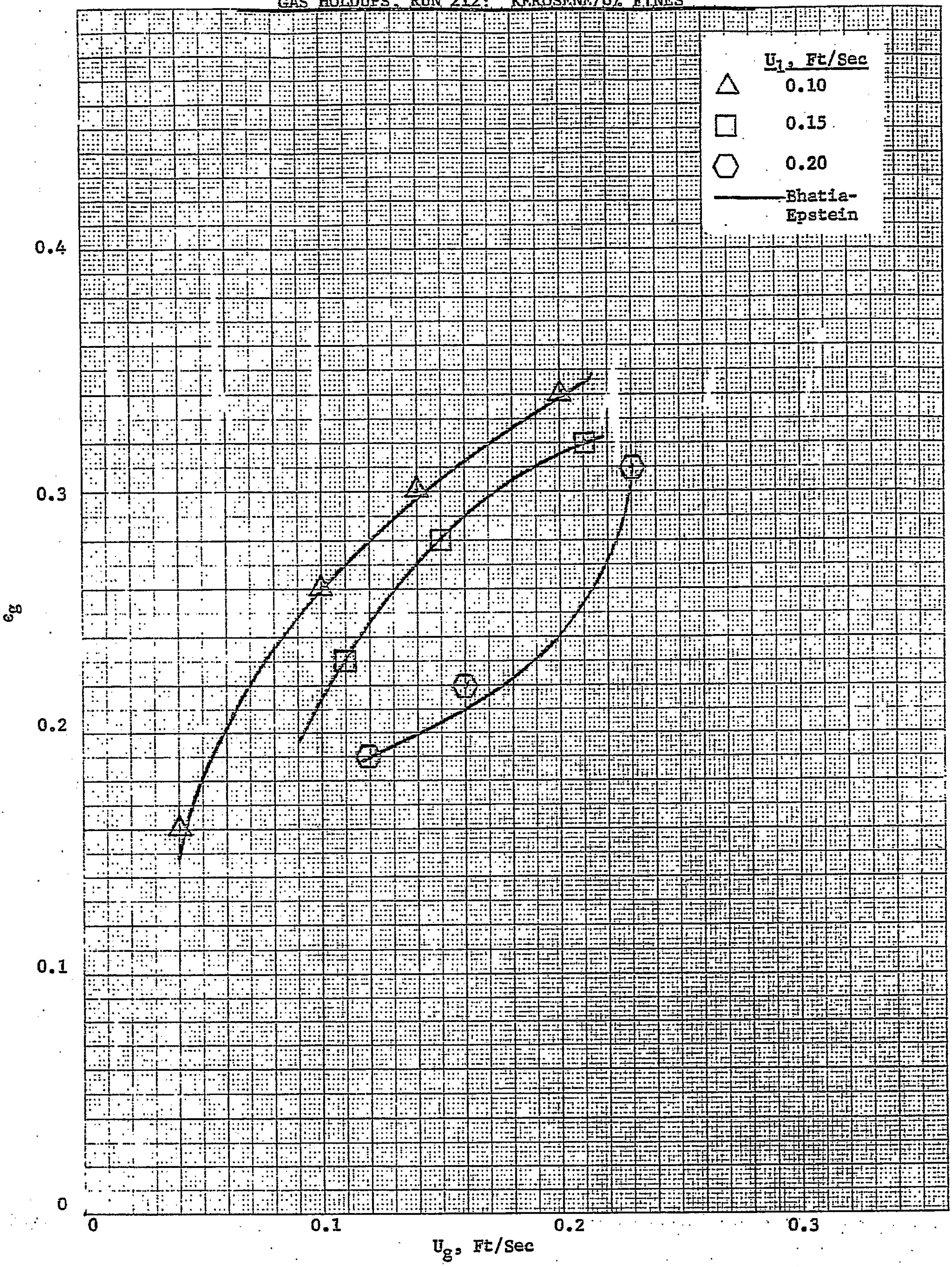


Figure 27
COMPARISON OF EXPERIMENTAL AND BHATIA-EPSTEIN MODEL HOLDUPS,
RUN 213: KEROSENE/0% FINES

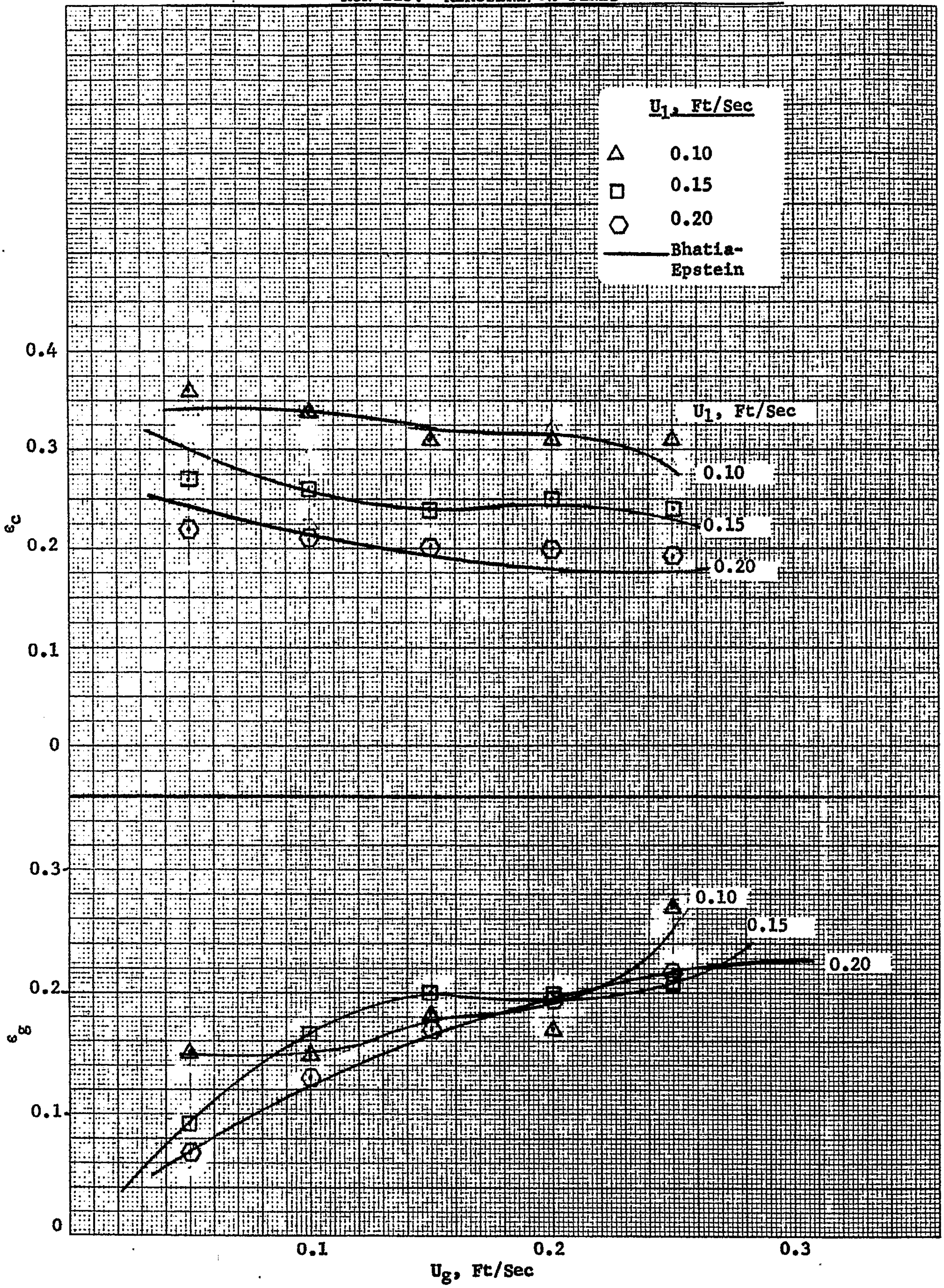
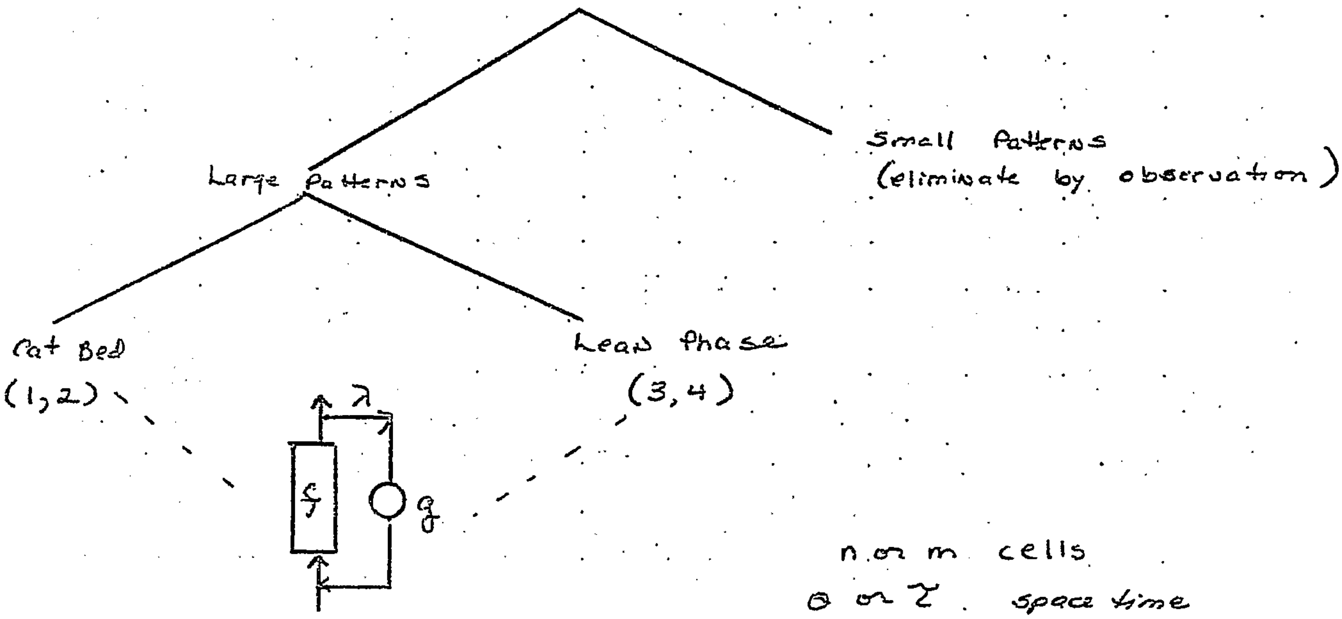


Figure 28

Methodology of Solution

Recirculation Model



$$\frac{f}{n,\ \theta} \qquad \lambda \qquad \frac{g}{m,\ \tau}$$

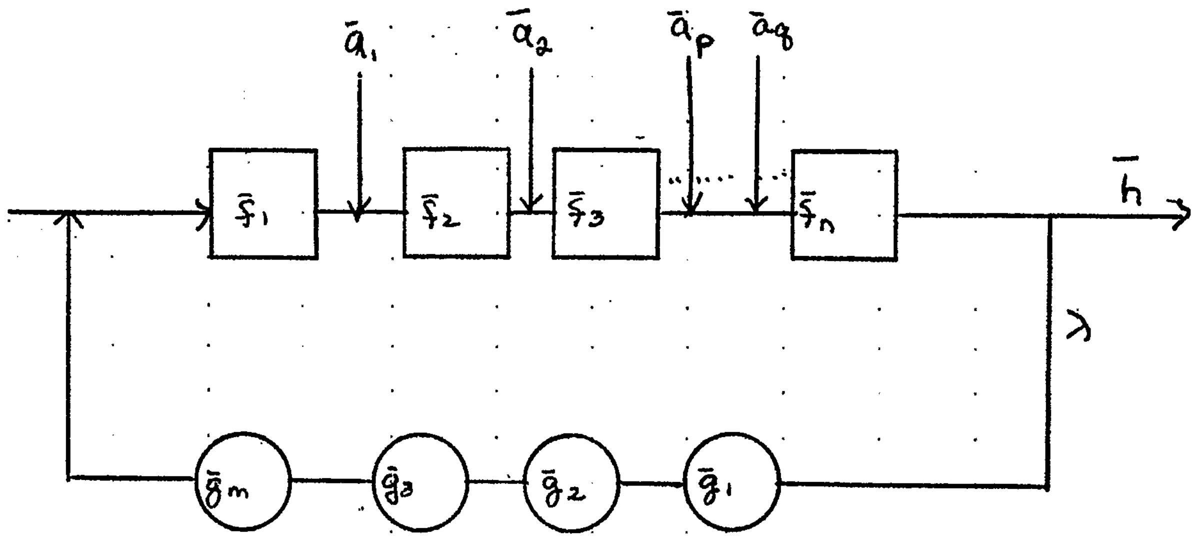
simplify

$\lambda\tau = \text{const.}$

$n \to \infty \therefore n\theta < \infty$

Figure 29

Schematic Diagram of Model System



$\bar{f}$ $\equiv$ upflow transfer function w/ θ space time

$\bar{g}$ $\equiv$ recirculation transfer function w/ τ space time

$\bar{h}_p = \frac{\bar{a}_p}{C_o}$ $\quad$ $\bar{h}_q = \frac{\bar{a}_q}{C_o}$

Figure 30 EXAMPLE OF CATALYST DISTRIBUTION AT THE TOP OF THE CATALYST BED

AU-77H GAMMA RAY PLOT FOR TEST #208-17 AND ZERO REFERENCE #1

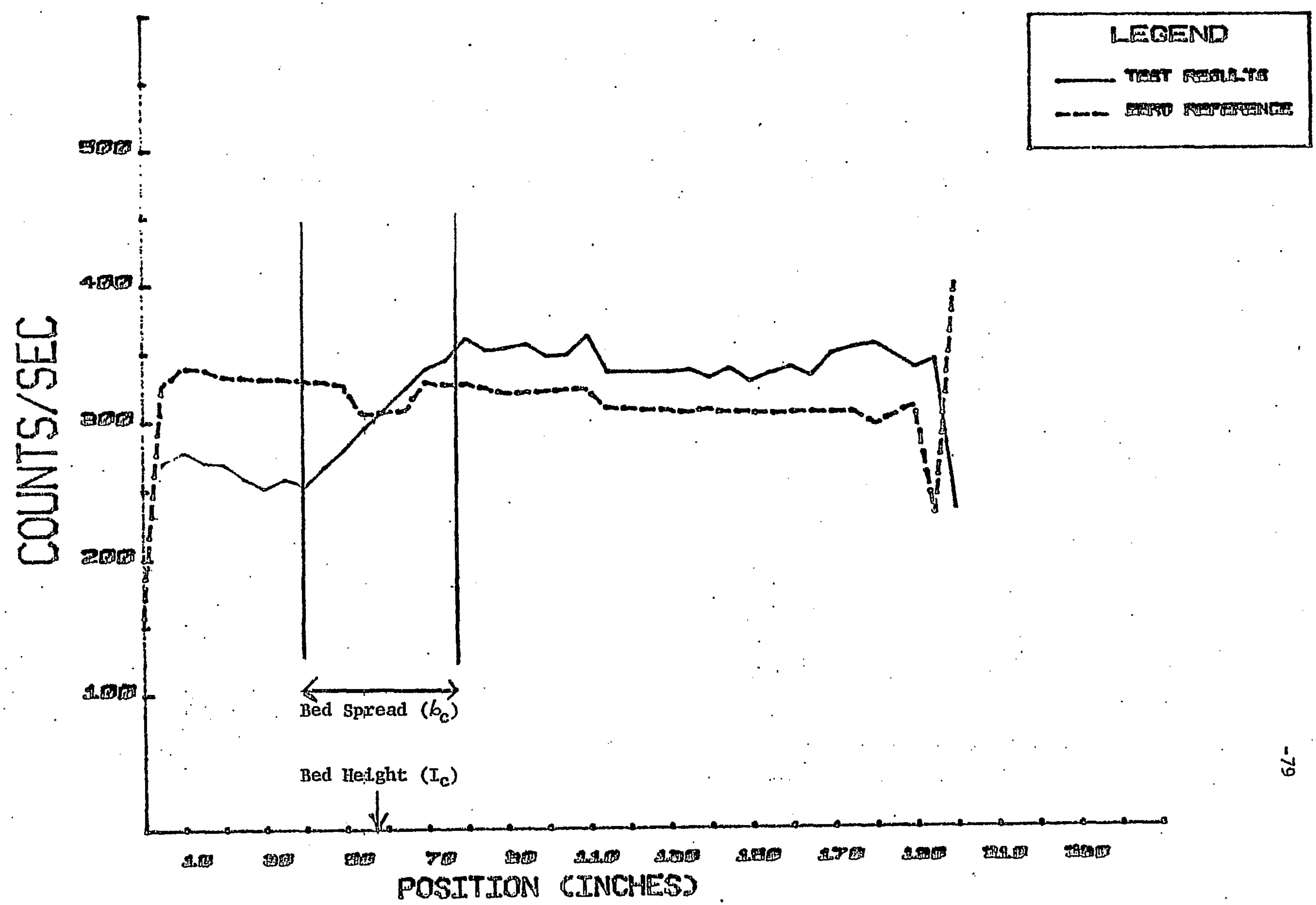
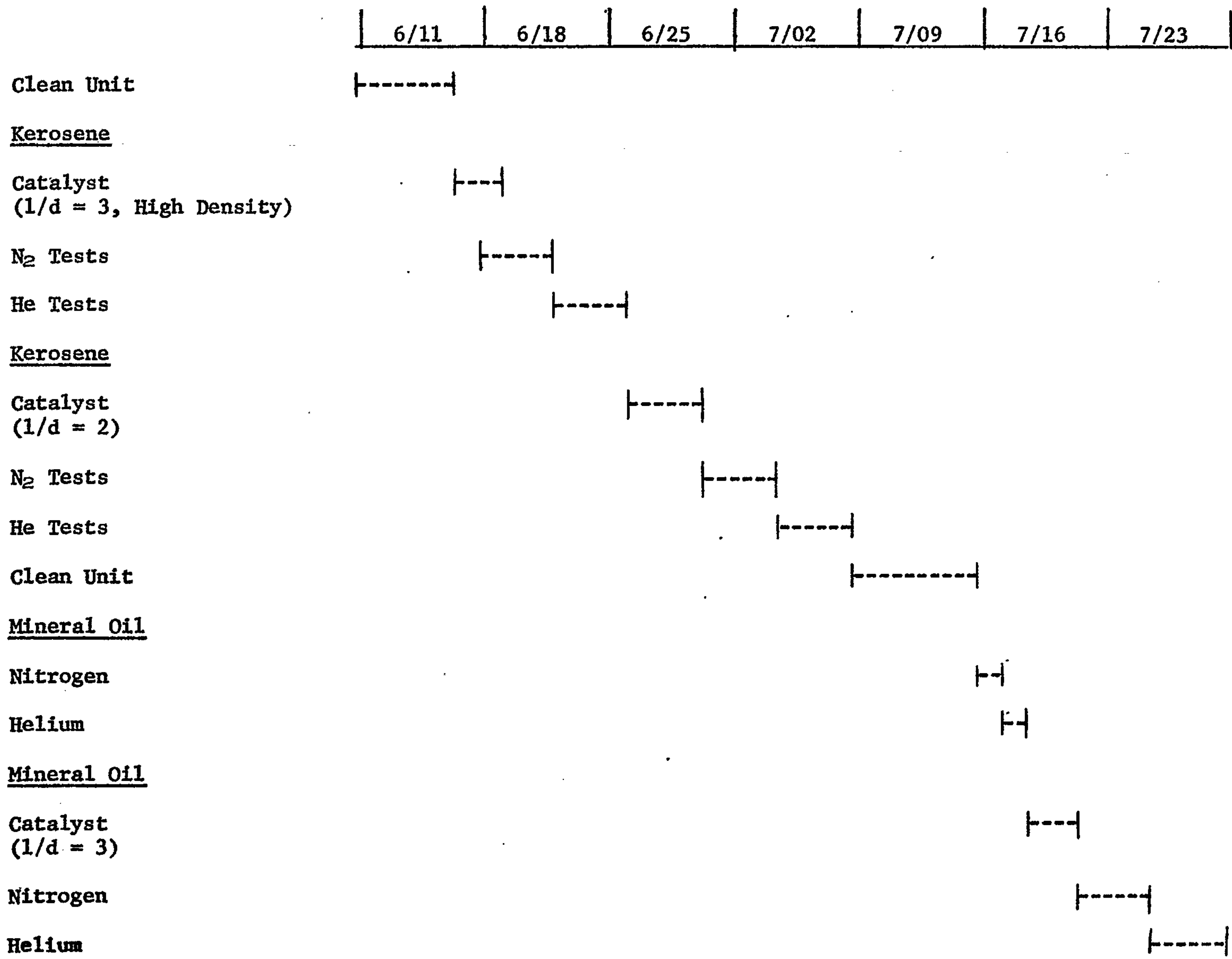


Figure 31

DATA COLLECTION--FUTURE PLANS

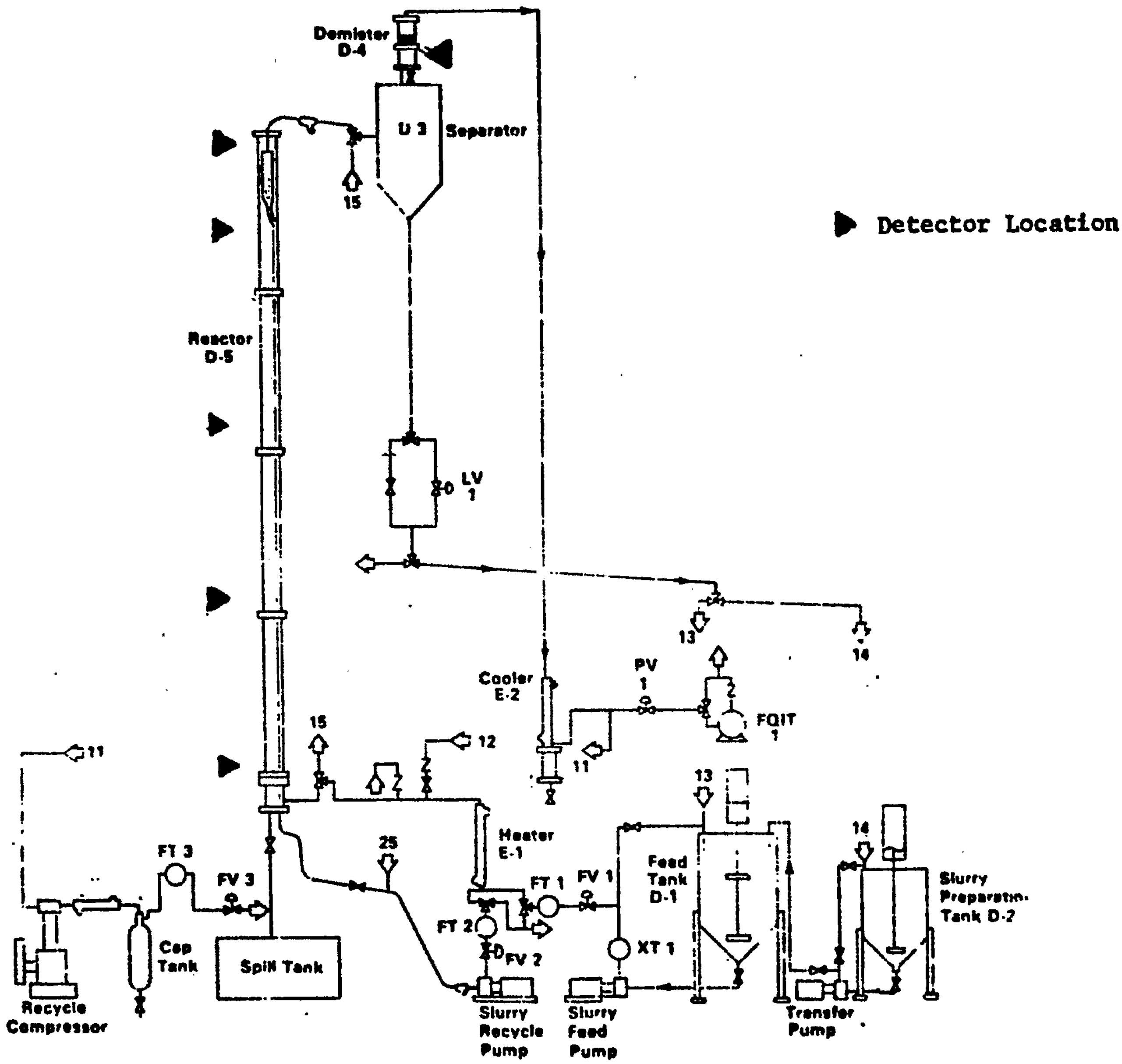


APPENDIX

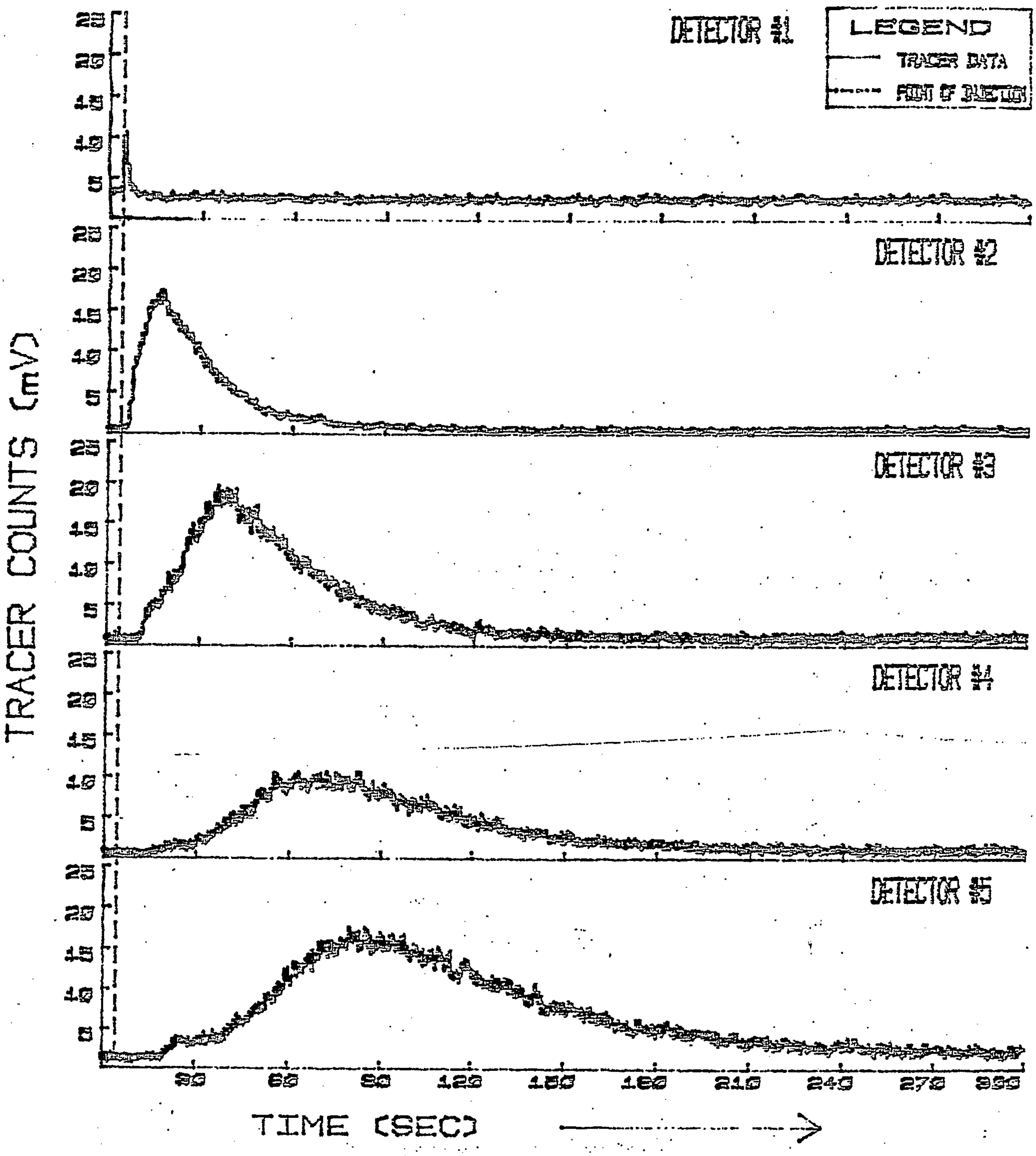
GAS RADIOACTIVE TRACER TESTS

RADIOTRACER DETECTOR LOCATION

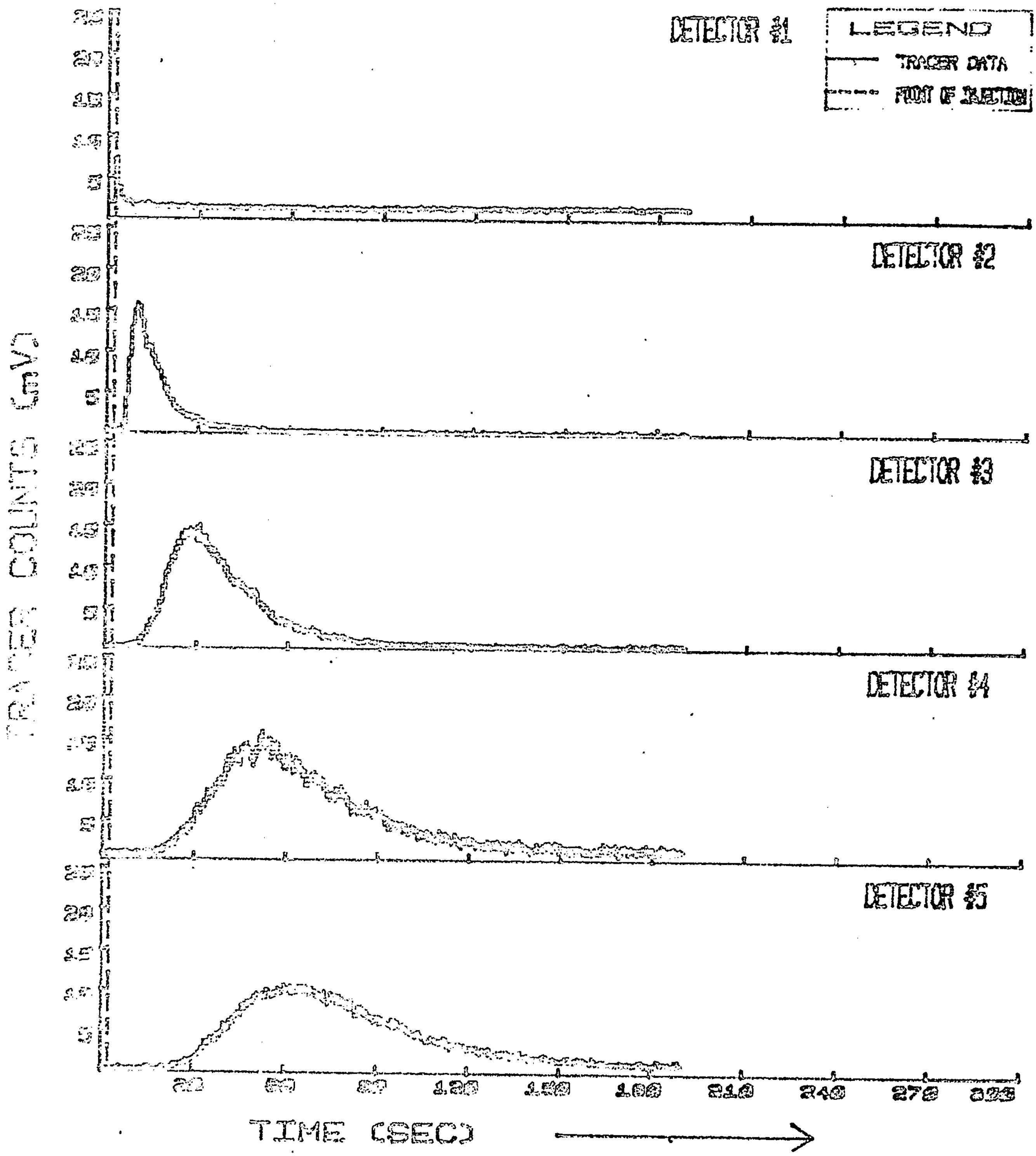
H-COAL FLUID DYNAMICS FLOWSHEET



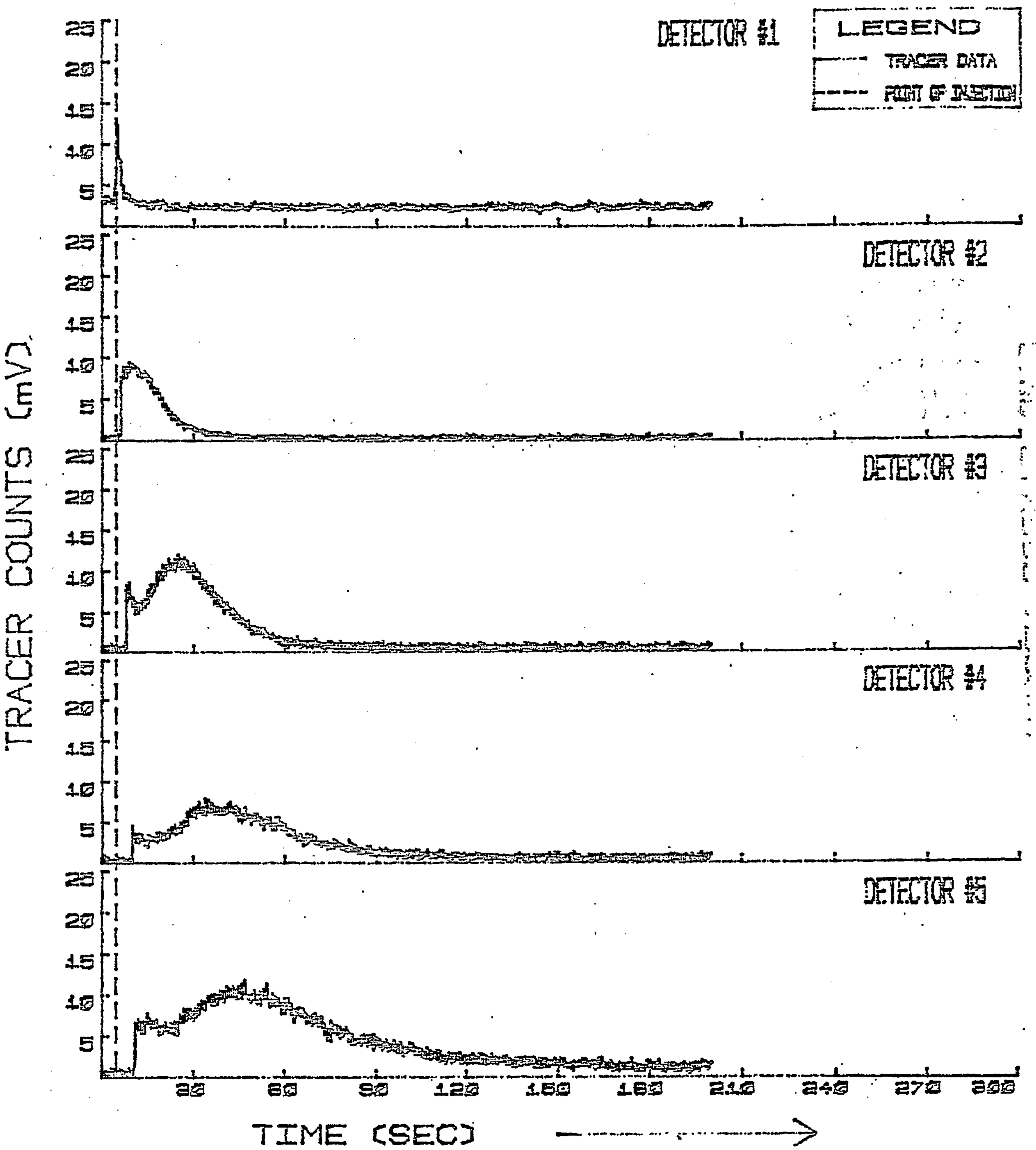
TRACER TEST #12 4/20/79 KERO N2 UL=0.10 UG=0.05 GAS
0% VOL. COAL CHAR; BED HT.= 67.0; INJECTION TIME= + 4.6



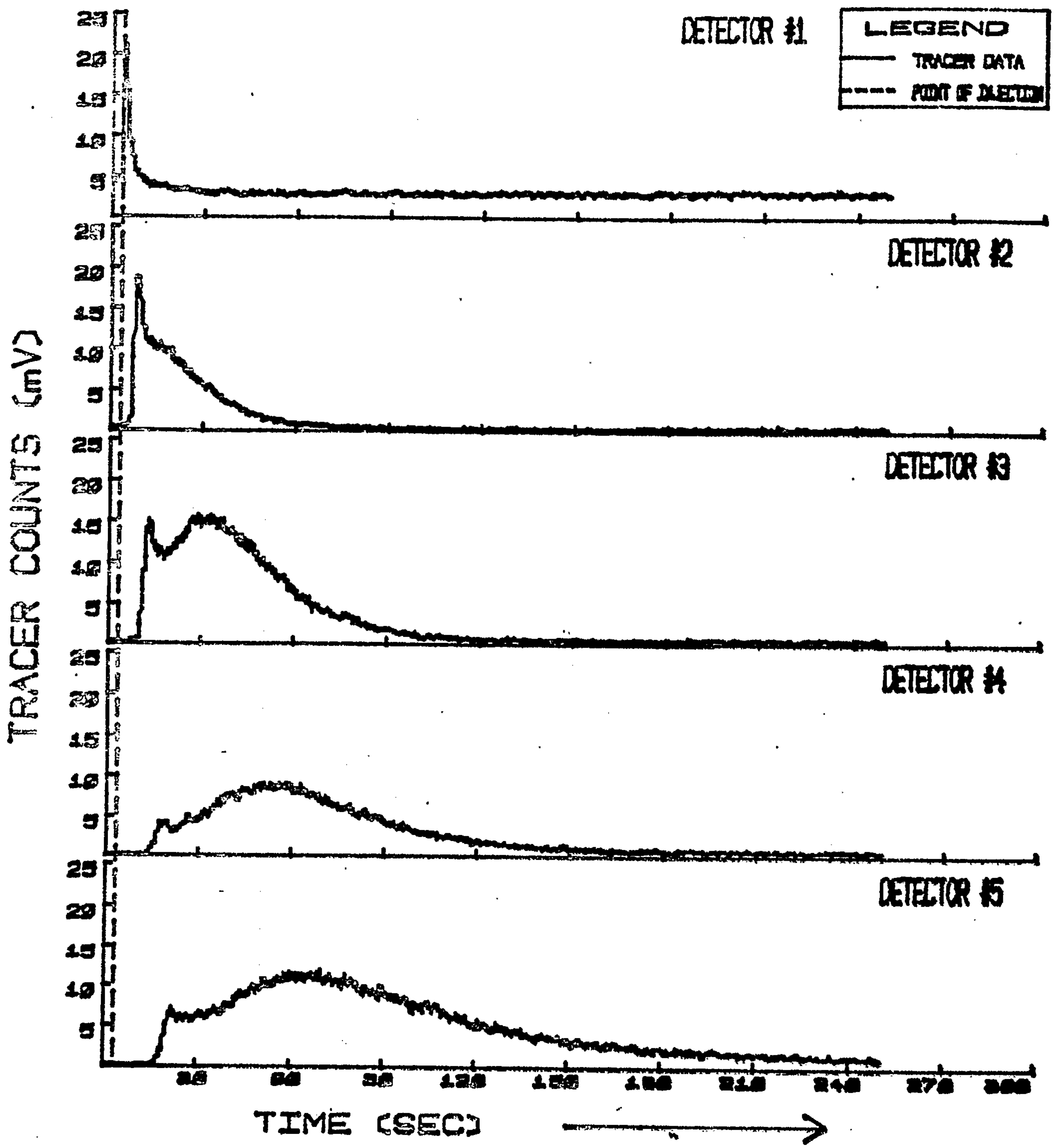
TRACER TEST # 8 4/20/79 KERO N2 UL=0.10 UG=0.10 GAS
3% VOL. COAL CHAR; BED HT.= 73.0; INJECTION TIME= + 2.5



TRACER TEST #13 4/20/79 KERO N2 UL=0.10 UG=0.20 GAS
0% VOL. COAL CHAR; BED HT.= 78.0; INJECTION TIME= + 4.8



TRACER TEST # 5 4/ 6/79 KERO N2 UL=0.10 UG=0.10 GAS
0% VOL. COAL CHAR; BED HT.= 0.0; INJECTION TIME= + 3.6



Tracer Test Results – 9/28/78 (1)

Conditions: Kerosene; Nitrogen; 0% Coal Char; HDS-2A Catalyst (L/D = 3)

Notes: Flow rates were changed with every injection; all injections were made through the first spoolpiece; the first detector was not in use.

	Detector #	M(1)(sec)	M(2)(sec²)	u_g (ft/sec)	V_g (ft/sec)	ε_g	ε_g (γ-ray)
Injection #3 –	2	28.7	257	0.035	0.21	0.17	0.16
u_l = 0.10 ft/sec	3	64.1	1097	0.035	0.14	0.25	—
Bed ht = 87.0"	4	112.6	3218	0.035	0.11	0.32	0.14
recycle pump	5	—	—	0.035	—	—	—
Injection #4 –	2	16.3	127	0.20	0.37	0.54	0.34
u_l = 0.10 ft/sec	3	44.8	587	0.20	0.17	1.0	—
Bed height = 109.5"	4	86.7	2019	0.20	0.12	—	0.76
	5	119.7	6552	0.20	0.11	—	—
Injection #5 –	2	12.1	40	0.15	0.50	0.30	0.30
u_l = 0.10 ft/sec	3	27.3	83	0.15	0.33	0.45	—
Bed height = 98.0"	4	62.6	868	0.15	0.15	1.0	0.78
	5	84.1	1702	0.15	0.16	0.94	—
Injection #6 –	2	14.4	71	0.10	0.42	0.24	[illegible]
u_l = 0.10 ft/sec	3	32.6	205	0.10	0.27	0.37	—
Bed height = 95.5"	4	61.5	685	0.10	0.12	0.56	0.26
recycle pump	5	96.0	2132	0.10	0.10	1.0	—
Injection #9 –	2	16.0	84	0.05	0.38	0.13	0.12
u_l = 0.17	3	35.0	182	0.05	0.26	0.19	—
Bed ht = ~125"	4	60.7	412	0.05	0.20	0.25	—
recycle pump	5	88.0	1116	0.05	0.13	0.39	—

Tracer Test Results – 9/28/78 (2)

Conditions: Kerosene; Nitrogen; 0% coal Char; HDS-2A Catalyst (L/D = 3)

	Detector #	M(1)(sec)	M(2)(sec)	u_g (ft/sec)	V_g (ft/sec)	ε_g	ε_g (γ-ray)
Injection #8	2	13.2	25	0.10	0.46	0.22	0.17
u_l = 0.20 ft/sec	3	27.9	64	0.10	0.34	0.30	—
Bed ht = >125"	4	47.9	174	0.10	0.26	0.39	0.21
recycle pump	5	69.3	506	0.10	0.16	0.61	—
Injection #10 –	2	13.3	41	0.05	0.46	0.11	—
u_l = 0.20 ft/sec	3	30.1	100	0.05	0.29	0.17	—
Bed ht = >125"	4	50.4	230	0.05	0.25	0.19	—
recycle pump	5	73.8	649	0.05	0.15	0.33	—
Injection #11 –	2	10.6	14	0.10	0.57	0.17	0.17
u_l = 0.20 ft/sec	3	24.9	71	0.10	0.35	0.29	—
Bed ht = >125"	4	40.3	103	0.10	0.34	0.30	0.21
recycle pump	5	57.3	327	0.10	0.21	0.49	—
Injection #13	2	12.7	36	0.13	0.48	0.27	0.19
u_l = 0.20 ft/sec	3	27.9	144	0.13	0.33	0.40	—
Bed ht = >125"	4	40.3	120	0.13	0.42	0.31	0.23
recycle pump	5	55.5	267	0.13	0.23	0.56	—
Injection #15 –	2	16.5	97	0.25	0.37	0.68	—
u_l = 0.218 ft/sec	3	28.0	68	0.25	0.43	0.58	—
Bed ht = >125"	4	47.4	176	0.25	0.27	0.94	—
recycle pump	5	63.7	324	0.25	0.21	1.0	—

Tracer Test Results - 2/28/79

Conditions: Kerosene; Nitrogen; 10% Vol., 15% wt. Coal Char; HDS-2A Catalyst (L/D=3)

Notes: Injection made through first spoolpiece; IT = injection time.

	Detector #	M(1)(sec)	M(2)(sec)	u_g (ft/sec)	V_g (ft/sec)	ε_g	ε_g (γ-ray)
Injection #8	1	16.7	98	0.15	—	—	0.11
u_l = 0.10 ft/sec	2	27.2	319	0.15	0.32	0.47	0.11
Bed ht = 76.0"	3	45.1	602	0.15	0.28	0.54	0.11
IT = 8.0 sec	4	65.5	1144	0.15	0.25	0.59	0.11
	5	68.2	1486	0.15	1.20	0.12	—

Tracer Test Results - 4/6/79 (1)

-90

Conditions: Kerosene; Nitrogen; 0% Coal Char; No Catalyst

Notes: All injections were made through first spoolpiece; The injections with * were done with a lead insert in detector #3; IT = injection time

	Detector #	M(1)(sec)	M(2)(sec)	u_g (ft/sec)	V_g (ft/sec)	ε_g	ε_g (γ-ray)
Injection #3 -	1	10.9	18	0.10	—	—	0.16
u_g = 0.10 ft/sec	2	28.8	322	0.10	0.31	0.32	0.16
Bed ht = 0.0"	3	45.1	517	0.10	0.30	0.33	0.16
IT = 9.1 sec	4	73.8	1470	0.10	0.18	0.56	0.16
	5	86.7	1773	0.10	0.27	0.37	0.16
Injection #4 -	1	6.37	45	0.10	0.24	0.41	0.16
u_g = 0.10 ft/sec	2	23.0	266	0.10	0.32	0.32	0.16
Bed ht = 0.0"	3	37.5	468	0.10	0.34	0.29	0.16
IT = 2.9 sec	4	61.1	1011	0.10	0.22	0.46	0.16
	5	73.0	1546	0.10	0.29	0.34	0.16
Injection #5 -	1	6.5	132	0.10	0.28	0.35	0.16
u_g = 0.10 ft/sec	2	22.9	256.4	0.10	0.32	0.31	0.16
Bed ht = 0.0"	3	47.8	1349.4	0.10	0.20	0.50	0.16
IT = 3.6 sec	4	77.9	2242.1	0.10	0.17	0.58	0.16
	5	95.3	2707.2	0.10	0.20	0.50	0.16
Injection #6 -	1	7.9	236	0.10	—	—	0.16
u_g = 0.10 ft/sec	2	23.6	252	0.10	0.30	0.33	0.16
Bed ht = 0.0"	3	44.2	686	0.10	0.24	0.42	0.16
IT = 3.5 sec.	4	65.1	794.2	0.10	0.25	0.40	0.16
	5	80.1	1300	0.10	0.22	0.43	0.16

Tracer Test Results – 4/6/79 (2)

Conditions: Kerosene; Nitrogen; 0% Coal Char; No Catalyst

	Detector #	H(1) (sec)	H(2) (sec)	u_g (ft/sec)	V_g (ft/sec)	ϵ_g	ϵ_g (δ-[illegible])
Injection #7 –	1	5.7	24	0.10	0.22	0.45	0.16
u_g = 0.10 ft/sec	2	27.8	728	0.10	0.24	0.42	0.16
Bed ht = 0.0"	3	44.8	1605	0.10	0.29	0.34	0.16
IT = 1.9 sec	4	63.0	1521	0.10	0.28	0.35	0.16
	5	83.6	2648	0.10	0.17	0.59	0.16
* Injection #11 –	1	—	—	0.10	—	—	0.16
u_g = 0.10 ft/sec	2	23.6	469	0.10	0.31	0.32	0.16
Bed ht = 0.0"	3	39.5	616	0.10	0.31	0.32	0.16
IT = 3.9 sec	4	57.5	753	0.10	0.29	0.35	0.16
	5	64.4	949	0.10	0.50	0.20	0.16
* Injection #12 –	1	—	—	0.10	—	—	0.16
u_g = 0.10 ft/sec	2	20.1	203	0.10	0.38	0.26	0.16
Bed ht = 0.0"	3	45.7	1413	0.10	0.19	0.52	0.16
IT = 4.2 sec	4	68.1	1807	0.10	0.23	0.43	0.16
	5	83.5	2439	0.10	0.23	0.44	0.16
* Injection #13 –	1	—	—	0.10	—	—	0.16
u_g = 0.10 ft/sec	2	24.2	298	0.10	0.34	0.29	0.16
Bed ht = 0.0"	3	42.9	750	0.10	0.27	0.37	0.16
IT = 6.3 sec	4	64.2	1168	0.10	0.24	0.42	0.16
	5	70.5	1630	0.10	0.56	0.18	0.16

TRACER TEST RESULTS - 4/6/79 (3)

CONDITIONS: KEROSENE; NITROGEN; 0% COAL CHAR; NO CATALYST

	Detector#	H(1)(sec)	H(2)(sec)	u_g (ft/sec)	V_g (ft/sec)	ε_g	ε_g (γ-ray)
Injection #14	1	—	—	0.05	[redacted]	—	0.07
u_g = 0.10 ft/sec	2	43.0	3308	0.05	0.16	0.31	0.07
Bed ht = 0.0"	3	55.5	2068	0.05	0.40	0.13	0.07
IT = 5.1 sec	4	86.6	3051	0.05	0.17	0.29	0.07
	5	98.9	3799	0.05	0.28	0.19	0.07
Injection #15 -	1	—	—	0.05	—	—	0.07
u_g = 0.10 ft/sec	2	28.4	1171	0.05	0.25	0.20	0.07
Bed ht = 0.0"	3	—	—	0.05	—	—	0.07
IT = 4.2 sec	4	84.5	3084	0.05	0.18	0.28	0.07
	5	93.6	3631	0.05	0.38	0.13	0.07
Injection #16	1	7.4	24.5	0.20	0.23	0.87	0.31
u_g = 0.10 ft/sec	2	27.8	932	0.20	0.26	0.77	0.31
Bed ht = 0.0'	3	34.1	701	0.20	0.78	0.26	0.31
IT = 3.7 sec	4	46.3	751	0.20	0.42	0.48	0.31
	5	57.3	1027	0.20	0.32	0.62	0.31
Injection #17 -	1	12.0	133	0.20	—	—	0.31
u_g = 0.10 ft/sec	2	15.1	138	0.20	0.50	0.40	0.31
Bed ht = 0.0"	3	—	—	0.20	—	—	0.31
IT = 2.8 sec	4	53.8	1539	0.20	0.26	0.77	0.31
	5	66.3	1851	0.20	0.28	0.71	0.31

Tracer Test Results - 4/20/79 (1)

Conditions: Kerosene ; Nitrogen ; 0% Coal Char ; HDS-2A Catalyst (L/D = 3)

Notes: All injections were made through the first spoolpiece except injections indicated by ⊕; these were made before the bubble cap ;
IT = injection time.

	Detector #	H(1)(sec)	H(2)(sec)	u_g (ft/sec)	V_g (ft/sec)	ε_g	ε_g (γ-ray)
Injection #8-	1	7.2	43	0.10	0.18	0.37	—
u_g = 0.10 ft/sec	2	16.1	73	0.10	0.59	0.17	0.26
Bed ht. = 73.0"	3	41.4	560	0.10	0.19	0.53	0.26
IT = 2.5 sec	4	69.4	1018	0.10	0.18	0.56	0.26
	5	82.2	1186	0.10	0.27	0.37	—
Injection #9-	1	23.2	394	0.10	—	—	—
u_g = 0.10 ft/sec	2	22.9	117	0.10	—	—	0.26
Bed ht. = 73.0"	3	47.6	785	0.10	0.27	0.37	0.26
IT = 7.3 sec.	4	75.7	1170	0.10	0.18	0.56	0.26
	5	90.5	1502	0.10	0.24	0.42	—
Injection #15-⊕	1	26.6	308.2	0.10	0.04	—	—
u_g = 0.10 ft/sec	2	47.2	865	0.10	0.25	0.39	0.26
Bed ht. = 73.0"	3	66.8	914	0.10	0.25	0.40	0.26
IT = 4.3 sec.	4	94.3	1335	0.10	0.19	0.53	0.26
	5	105.0	1145	0.10	0.33	0.30	—

TRACER TEST RESULTS - 4/20/79 (2)

CONDITIONS: KEROSENE ; NITROGEN ; 0% COAL CHAR ; HDS-2A CATALYST (L/O=3)

	DETECTOR #	M(1)(sec)	M(2)(sec)	u_g(ft/sec)	V_g(ft/sec)	ε_g	ε_g(γ-ray)
Injection #11-	1	17.2	146	0.05	0.09	0.53	—
u_g=0.10 ft/sec	2	40.0	840	0.05	0.23	0.22	0.16
Bed ht = 67.0"	3	61.6	1049	0.05	0.23	0.22	0.14
IT = 8.4 sec	4	98.2	1823	0.05	0.14	0.35	0.14
	5	113.3	1893	0.05	0.23	0.22	—
Injection #12-	1	10.2	99	0.05	0.15	0.33	—
u_g=0.10 ft/sec	2	34.0	1618	0.05	0.22	0.23	0.16
Bed ht. = 67.0"	3	62.9	2505	0.05	0.17	0.29	0.14
IT = 4.6 sec.	4	85.4	2833	0.05	0.23	0.22	0.14
	5	92.2	2379	0.05	0.51	0.10	—
Injection #13-	1	7.9	26	0.20	0.27	0.74	—
u_g=0.10 ft/sec	2	19.9	482	0.20	0.44	0.45	0.34
Bed ht = 78.0"	3	35.8	782	0.20	0.31	0.64	—
IT = 4.8 sec.	4	54.3	1131	0.20	0.28	0.71	0.36
	5	67.0	1680	0.20	0.28	0.71	—

TRACER TEST RESULTS - 5/15/79 (1)

CONDITIONS: KEROSENE; NITROGEN; 15% VOL., 29% WT. COAL CHAR; HDS-2A CATALYST (L/D=3)

NOTES: All injections made through first spoolpiece except where indicated by ⊕, these were made before the bubble cap; IT = injection time.

	Detector #	M(1)(sec)	M(2)(sec)	u_l(ft/sec)	V_g(ft/sec)	ε_g	ε_g (γ-ray)
Injection #3 -	1	17.4	—	0.10	—	—	—
u_l = 0.10 ft/sec	2	20.4	432	0.10	0.46	0.22	0.11
Bed ht = 93.0"	3	42.6	1312	0.10	0.22	0.45	—
IT = 7.3 sec	4	68.2	1860	0.10	0.20	0.49	0.05
	5	78.4	7248	0.10	0.34	0.29	—
Injection #4	1	19.6	—	0.10	—	—	—
u_l = 0.10 ft/sec	2	25.2	1088	0.10	0.34	0.30	0.11
Bed ht = 93.0"	3	48.6	2184	0.10	0.21	0.47	—
IT = 7.2 sec	4	78.4	3040	0.10	0.17	0.58	0.05
	5	95.2	3860	0.10	0.27	0.37	—
Injection #5 -	1	9.0	77	0.10	—	—	—
u_l = 0.10 ft/sec	2	16.3	294	0.10	0.50	0.20	0.11
Bed ht = 93.0"	3	46.6	2184	0.10	0.16	0.61	—
IT = 4.0 sec	4	67.6	2072	0.10	0.17	0.60	0.05
	5	84.4	3204	0.10	0.21	0.48	—
Injection #6 -	1	20.0	44	0.10	—	—	—
u_l = 0.10 ft/sec	2	23.8	1260	0.10	0.33	0.31	0.11
Bed ht = 93.0"	3	40.6	1504	0.10	0.30	0.34	—
	4	69.4	2536	0.10	0.18	0.56	0.05
	5	82.4	3220	0.10	0.27	0.37	—

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Tracer Test Results – 5/15/79 (2)

Conditions: Kerosene; Nitrogen; 15% Vol., 22% wt. Coal Char; HDS-2A Catalyst (L/D = 3)

	Detector#	M(1)(sec)	M(2)(sec)	u_g(ft/sec)	V_g(ft/sec)	ε_g	ε_g(γ-ray)
Injection #10-	1	10.2	114	0.10	—	—	—
u_l=0.10 ft/sec	2	20.4	700	0.10	0.40	0.25	0.11
Bed ht = 93.0"	3	42.6	1704	0.10	0.22	0.45	—
IT = 5.2 sec	4	69.2	2336	0.10	0.19	0.51	0.05
	5	82.4	3052	0.10	0.27	0.38	—
Injection #11-	1	9.8	280	0.05	0.43	0.11	—
u_l = 0.10 ft/sec	2	41.0	4232	0.05	0.17	0.30	0.05
Bed ht = 86.0"	3	87.0	7824	0.05	0.11	0.46	—
IT = 7.9 sec	4	137.2	10,728.	0.05	0.10	0.49	0.01
	5	143.4	8000	0.05	0.56	0.09	—
Injection #12-	1	10.4	92	0.05	0.27	0.19	~~—~~
u_l = 0.10 ft/sec	2	23.8	1084	0.05	0.39	0.13	0.05
Bed ht = 86.0"	3	81.4	7640	0.05	0.09	0.58	—
IT = 7.3 sec.	4	104.0	6016	0.05	0.23	0.22	0.01
	5	124.8	7052	0.05	0.14	0.35	—
Injection #13-	1	8.0	264	0.05	0.35	0.14	—
u_l = 0.10 ft/sec	2	34.0	3612	0.05	0.20	0.25	0.05
Bed ht = 86.0"	3	69.8	6232	0.05	0.14	0.36	—
IT = 5.6 sec.	4	108.2	6652	0.05	0.13	0.37	0.01
	5	133.8	7792	0.05	0.14	0.37	—

Tracer Test Results - 5/15/79 (3)

Conditions: Kerosene; Nitrogen; 15% Vol., 22% wt. Coal Char; HDS-2A Catalyst (40-3)

	Detector #	H(1)(sec)	H(2)(sec)	u_g(ft/sec)	V_g(ft/sec)	ε_g	ε_g ([illegible])
Injection #14 -	1	14.8	94.8	0.15	0.28	0.54	—
u_l = 0.10 ft/sec	2	24.2	394	0.15	0.56	0.27	0.10
Bed ht = 87.0"	3	53.8	2560	0.15	0.17	0.89	—
IT = 11.8 sec	4	69.6	2604	0.15	0.33	0.45	0.69
	5	73.2	2632	0.15	0.98	0.15	—
Injection #15 -	1	14.2	96	0.15	0.22	0.68	—
u_l = 0.10 ft/sec	2	22.8	224	0.15	0.61	0.25	0.10
Bed ht. = 87.0"	3	42.0	932	0.15	0.26	0.58	—
IT = 10.4 sec.	4	58.6	1268	0.15	0.31	0.48	0.27
	5	64.0	1544	0.15	0.65	0.23	—
Injection #17 -	1	9.6	90	0.20	—	—	—
u_l = 0.085 ft/sec	2	16.7	220	0.20	0.52	0.39	0.08
Bed ht = 84.0"	3	28.0	436	0.20	0.44	0.45	—
IT = 4.9 sec	4	41.2	676	0.20	0.39	0.51	0.11
	5	43.2	732	0.20	0.29	0.69	—
Injection #18 -	1	14.8	126.4	0.20	—	—	—
u_l = 0.085 ft/sec	2	22.6	256	0.20	0.47	0.42	0.08
Bed ht = 84.0"	3	40.0	1084	0.20	0.28	0.70	—
IT = 9.7 sec.	4	58.4	1628	0.20	0.28	0.70	0.11
	5	57.8	1384	0.20	—	—	—

TRACER TEST RESULTS - 5/15/79 (4)

CONDITIONS: KEROSENE; NITROGEN; 15% VOL., 22% WT. COAL CHAR; HDS-2A CATALYST (L/D = 3)

	DETECTOR #	m(1)(sec)	m(2)(sec)	u_g(ft/sec)	V_g(ft/sec)	ϵ_g	ϵ_g (γ-ray)
Injection #16	1	38.4	148	0.10	0.06	—	—
u_g = 0.10 ft/sec	2	63.2	1224	0.10	0.21	0.47	0.11
Bed ht = 93.0"	3	75.8	716	0.10	0.39	0.26	—
IT = 23.7 sec	4	101.2	1100	0.10	0.20	0.50	0.05
	5	110.2	1900	0.10	0.39	0.26	—

m(1) 1st moment

m(2) 2nd moment

u_g Superficial Gas Velocity

V_g Linear Gas Velocity determined from tracer data

ϵ_g Gas Holdup determined from tracer data

ϵ_g(γ-ray) Gas Holdup determined using gamma-ray scans

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