

**START**



**MICROFILMED BY  
NATIONAL SPACE SCIENCE DATA CENTER  
GODDARD SPACE FLIGHT CENTER  
GREENBELT, MARYLAND 20771**

# SOIL MECHANICS EXPERIMENT (S-200)

## APOLLO 15 - LSRP DATA

AUGUST, 1971

<u>SECTION</u>	<u>ITEM</u>	<u>PAGES</u>
(A)	STRESS-PEN. CURVES	A-1 thru A-6
(B)	RAW & REDUCED DATA	B-1 thru B-6
(C)	NOTES - W.D. CARRIER	C-1 thru C-3
(D)	POST-FLIGHT CALIBRATION & NOTES ON CORRECTIONS	D-1 thru D-8
(E)	PRE-FLIGHT CALIBRATION	E-1 & E-2

A

APOLLO 15 ~ LSRP

STRESS - PENETRATION CURVES

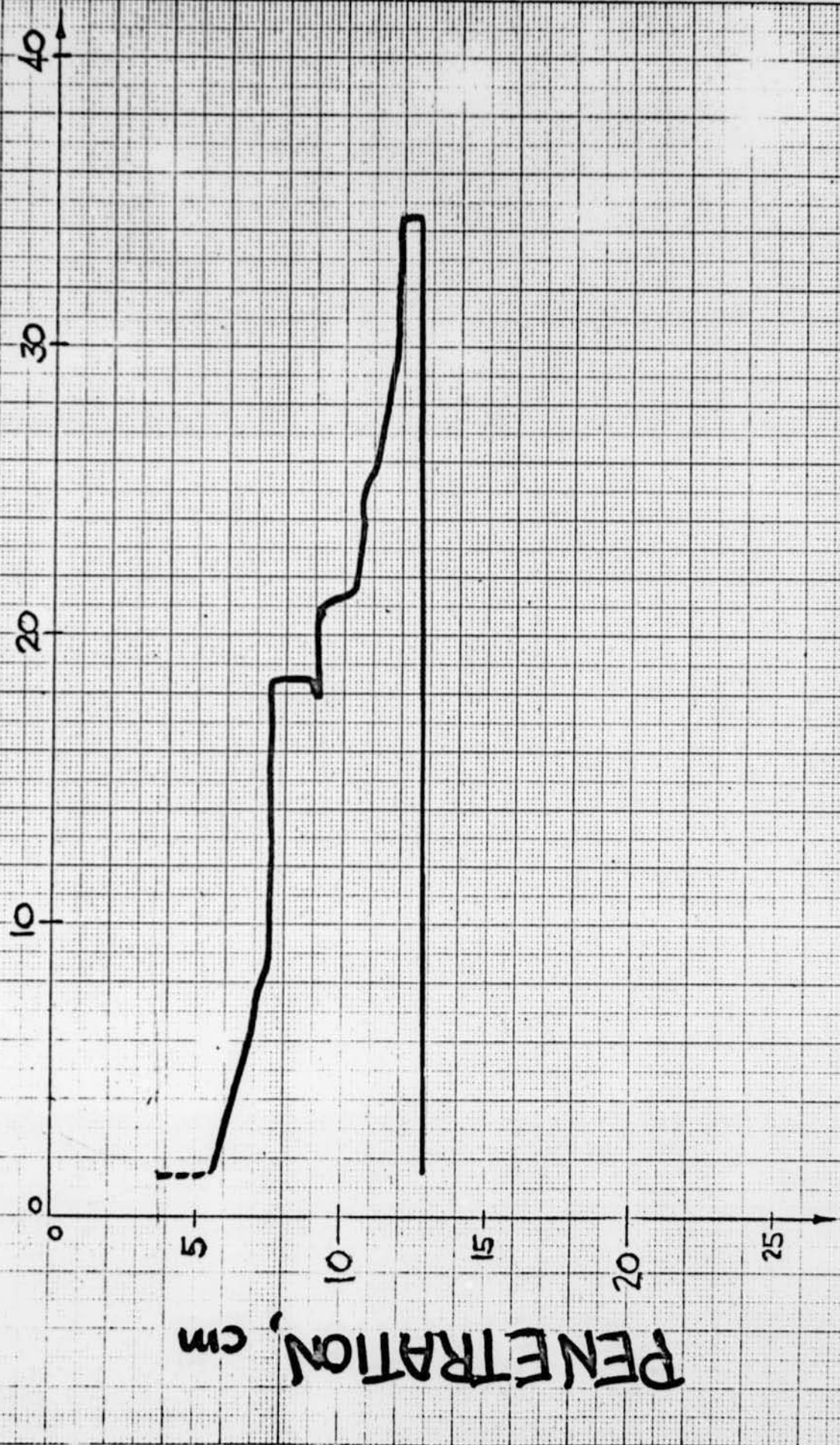
SQUARE 10 X 10 TO THE CENTIMETER AS 8014-G5

LSRP - APOLLO 15  
INDEX NO. 2

D.D.T.  
U.C.B. 8-14-71

STRESS, newtons/cm<sup>2</sup>

PENETRATION, cm



SQUARE 10 X 10 TO THE CENTIMETER AS 8014 CO

ES (ELECTRIC SYSTEMS) FOR SPACE CRAFT WITH LITHIUM BATTERIES B. J. P. NEW YORK

D.D.T.  
U.C.S. 8-14-71

LSRP - APOLLO 15  
INDEX No. 3

STRESS, newtons/cm<sup>2</sup>

40

30

20

10

0

PENETRATION, CM

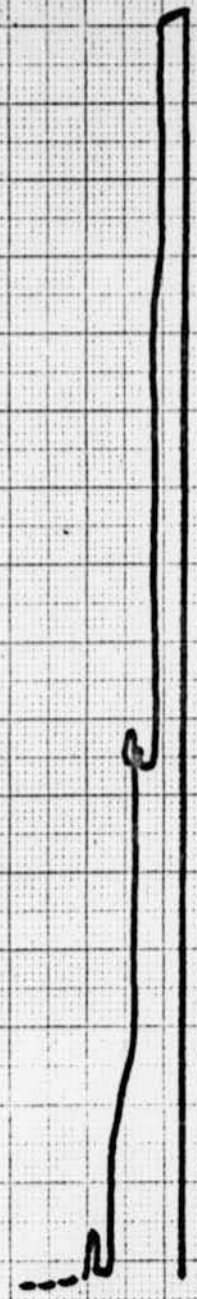
5

10

15

20

25



SQUARE 10 X 10 TO THE CENTIMETER AS 8514-G

GRAPHIC ENGINEERING CORPORATION, NEW YORK, N.Y.

U.S.A.

D.D.T.  
U.C.B. 8-14-71

LSRP - APOLLO 15  
INDEX NO. 4

STRESS, newtons/cm<sup>2</sup>

40

30

20

10

0

PENETRATION, cm

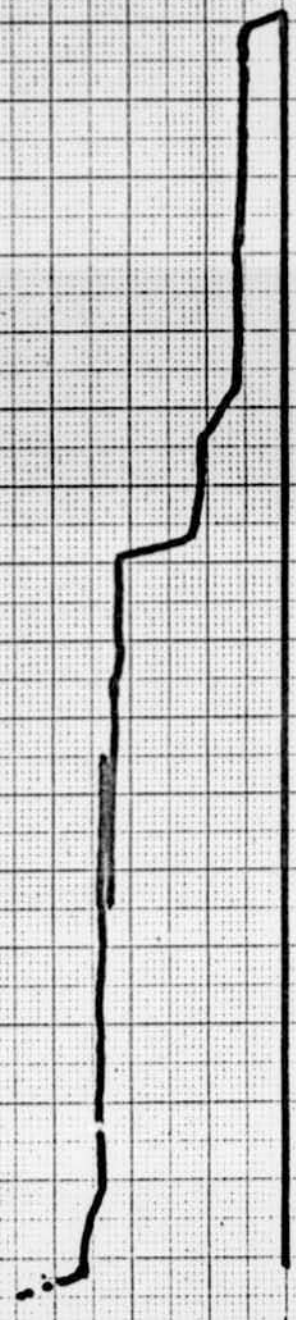
5

10

15

20

25



10  
25  
35

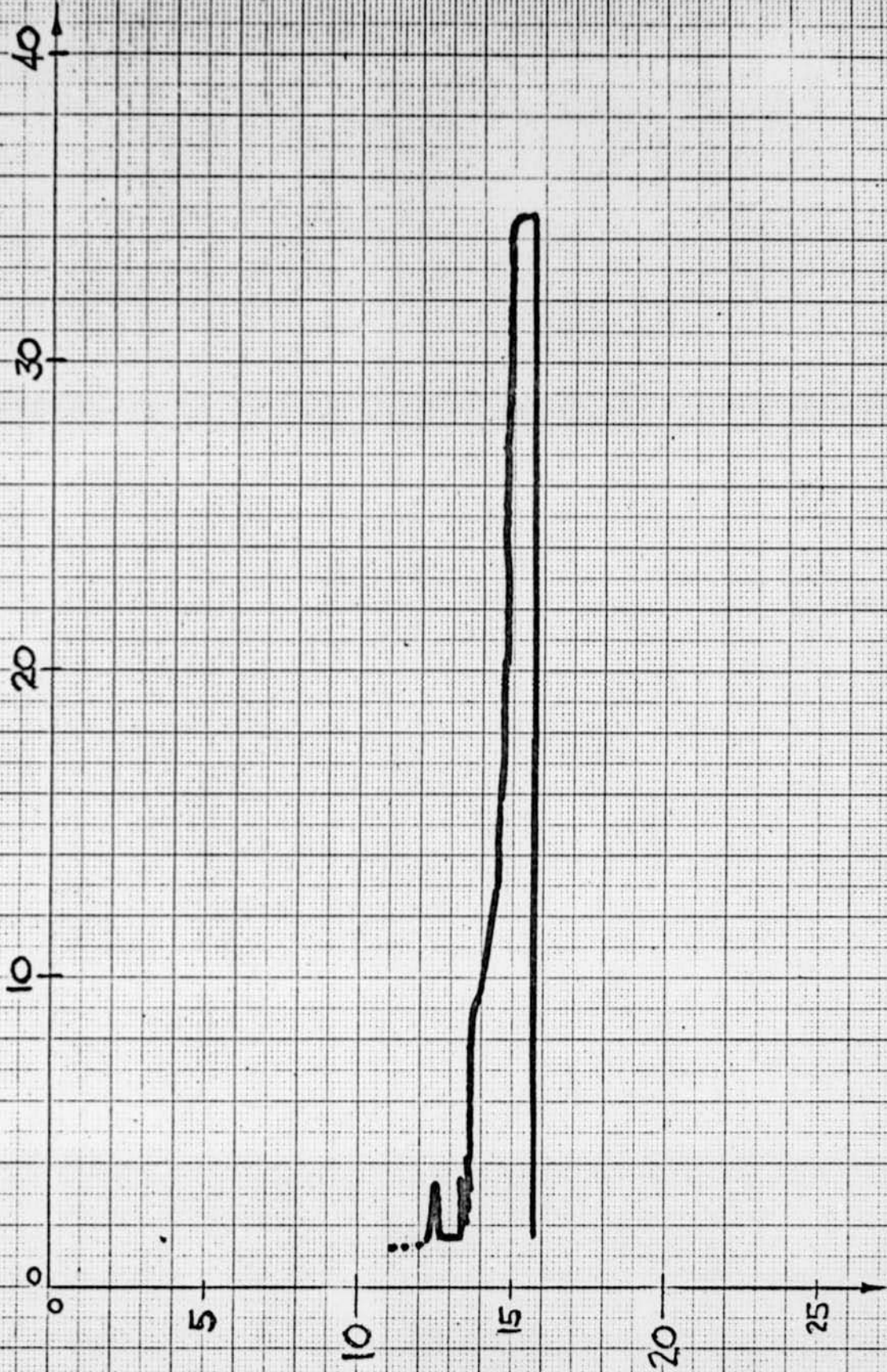
D.D.T.  
U.C.S. 8-14-71

LSRP - APOLLO 15

INDEX NO. 5

STRESS,  $\text{newtons/cm}^2$

PENETRATION, cm



LSRP - APOLLO 15

INDEX NO. 6 (plate)

STRESS, newtons/cm<sup>2</sup>

PENETRATION, cm

4.0

3.0

2.0

1.0

0

5

10

D.D.T  
U.C.B 8-14-71

(A-5)

30 JUNE 10 X 10 TO THE CENTIMETER AS 8014-60

GRAPHIC CONTROLS CORPORATION BUFFALO, NEW YORK  
Produced in U.S.A.



D.D.T.  
U.C.B. 8-14-71

LSRP - APOLLO 15

INDEX NO. 7 (plate)

STRESS, newtons/cm<sup>2</sup>

4.0

3.0

2.0

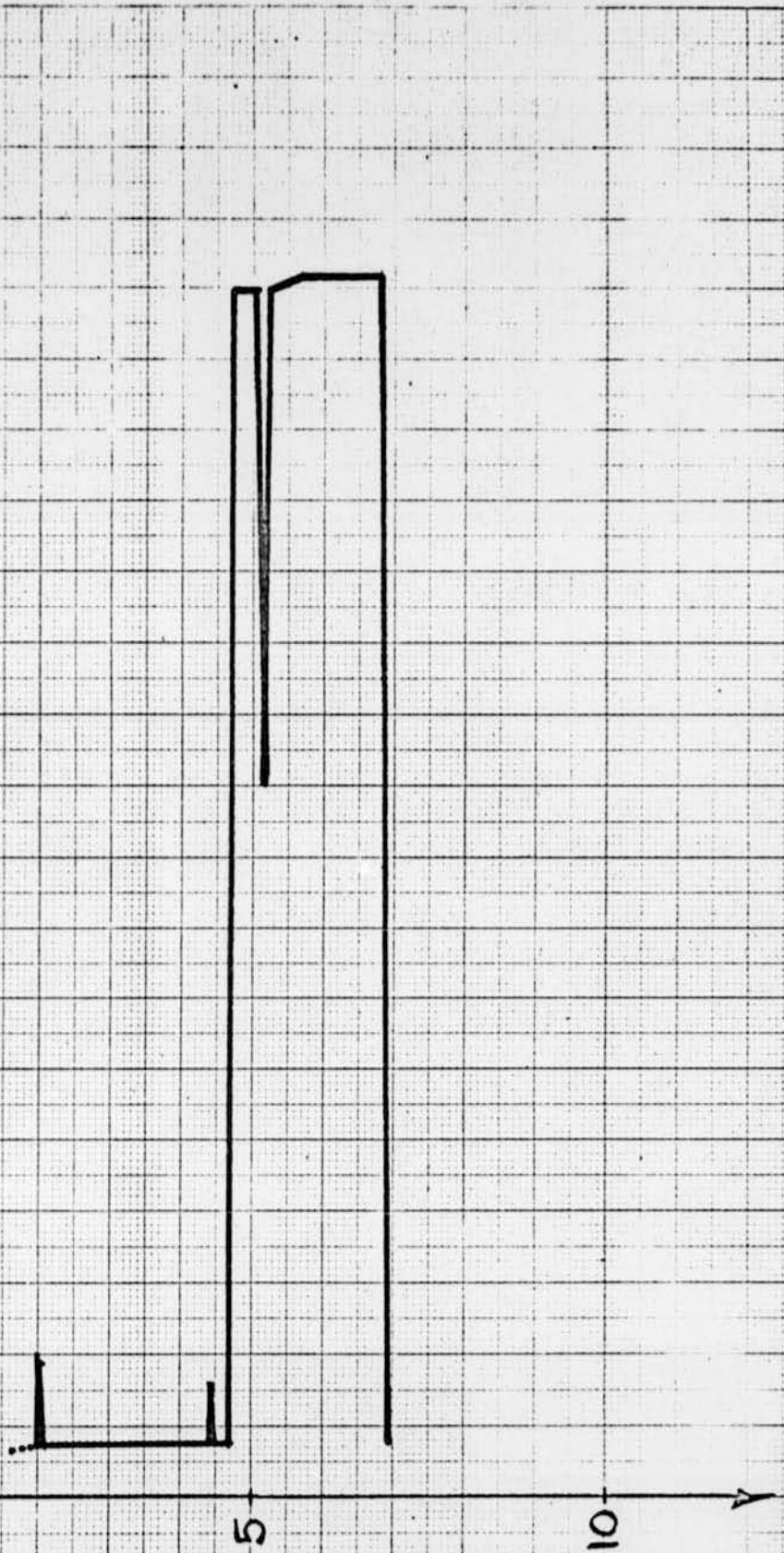
1.0

0

PENETRATION, cm

5

10



(B)

APOLLO 15 - LSRP

RAW & REDUCED LUNAR PENETRATION  
DATA FROM LUNAR DRUM (S/N 2002)

INDICES 2,3,4,5,6,7

UNIVERSITY OF CALIFORNIA  
Soil Mechanics Laboratory

APOLLO 15 - LSRP  
FLIGHT UNIT (S/N 2003)  
LUNAR DRUM (S/N 2002)

Date 12 & 13 AUGUST 1971  
LUNAR PENETRATION DATA REDUCTION  
INDEX No. 2 PAGE No. 1

0.5 in<sup>2</sup> = 3.226 cm<sup>2</sup>

(0.5 in<sup>2</sup> cone adjacent to trench)

INDEX No.	DRUM LOAD $\lambda$ deg-min.	x.5342		LOAD, newtons. (from calibration curve)	STRESS newt/cm <sup>2</sup>	INITIAL DRUM DEPTH FINAL cm	Δ DRUM DEPTH READING cm	PENETRATION DEPTH cm.	CORRECTION + CORRECTION (add 3.75)
		DRUM LOAD $\lambda$ deg.	DRUM CIRCUMF. DEFLECTION mm.						
2	0°00'	0.000	0.000	4.9 <sup>7</sup> 0.00		88.92	0.000	0.00	3.75 ✓
	0°00' *	0.000	0.000	4.9	1.52	89.01	0.090	2.84	6.59 ✓
	3°47'	3.783	2.097	18.4	5.71	89.015	0.095	2.99	6.74 ✓
	5°25 <sup>5</sup> '	5.425	3.007	24.3	7.53	89.025	0.105	3.31	7.06 ✓
	6°26'	6.433	3.565	28.1	8.71	89.040	0.120	3.78	7.53 ✓
	15°03 <sup>5</sup> '	15.058	8.345	59.4	18.4	89.040	0.120	3.78	7.53 ✓
	15°03 <sup>5</sup> '	15.058	8.345	59.4	18.4	89.085	0.165	5.20	8.95 ✓
	14°34'	14.567	8.073	57.6	17.9	89.09	0.170	5.36	9.11 ✓
	17°15 <sup>5</sup> '	17.258	9.564	67.4	20.9	89.09	0.170	5.36	9.11 ✓
	17°49 <sup>5</sup> '	17.825	9.879	69.4	21.5	89.13	0.210	6.62	10.37 ✓
	20°49'	20.817	11.537	80.4	24.9	89.14	0.220	6.93	10.68 ✓
	21°25'	21.417	11.869	82.5	25.6	89.15	0.230	7.25	11.00 ✓
	24°42 <sup>5</sup> '	24.708	13.693	94.6	29.3	89.175	0.255	8.03	11.78 ✓
	29°08'	29.133	16.146	110.6	34.3	89.18	0.260	8.19	11.94 ✓
	29°13.5'	29.225	16.196	110.9	34.4	89.20	0.280	8.82	12.57 ✓
	0°00' *	0.000	0.000	4.9	1.52	89.21	0.290	9.14	12.89 ✓

UNIVERSITY OF CALIFORNIA  
Soil Mechanics Laboratory

APOLLO 15 - LSRP  
FLIGHT UNIT (S/N 2003)  
LUNAR DRUM (S/N 2002)

Date 12<sup>th</sup> 13 AUGUST 1971  
LUNAR PENETRATION DATA REDUCTION  
INDEX No. 3 PAGE No. 1  
(0.5 in<sup>2</sup> cone in trench bottom)

INDEX No.	DRUM LOAD $\times$ deg.-min.	DRUM LOAD $\times$ deg.	DRUM CIRCUMF. DEFLECTION mm.	LOAD, newtons. (from calibration curve)	STRESS new/cm <sup>2</sup>	INITIAL DRUM DEPTH FINAL cm	$\times 31.50$ $\downarrow$ $\uparrow$ Δ DRUM DEPTH READING cm	PENETRA- TION DEPTH cm.	CORRECTION (add 3.75)
<b>3</b>									
	0°00'	0.000	0.000	4.9? 0.0		<del>88.920</del>	0.000	0.00	3.75
	0°00'*	0.000	0.000	4.9	1.52	<del>89.15</del>	0.260	8.19	11.94 ✓
	1°06.5'	1.108	0.614	8.6	2.67	<del>89.185</del>	0.265	8.35	12.10 ✓
	0°18.5'	0.308	0.171	5.6	1.74	<del>89.155</del>	0.265	8.35	12.10 ✓
	0°18.5'	0.308	0.171	5.6	1.74	<del>89.20</del>	0.280	8.82	12.57 ✓
	2°52.5'	2.875	1.593	15.0	4.65	<del>89.20</del>	0.280	8.82	12.57 ✓
	4°17'	4.283	2.374	20.1	6.23	<del>89.21</del>	0.290	9.14	12.89 ✓
	5°18'	5.300	2.937	23.9	7.41	<del>89.22</del>	0.300	9.45	13.20 ✓
	12°32'	12.533	6.946	50.2	15.6	<del>89.22</del>	0.300	9.45	13.20 ✓
	11°00.5'	11.008	6.101	44.9	13.9	<del>89.215</del>	0.295	9.29	13.04 ✓
	11°00.5'	11.008	6.101	44.9	13.9	<del>89.225</del>	0.305	9.61	13.36 ✓
	10°04.5'	10.075	5.584	41.2	12.8	<del>89.225</del>	0.305	9.61	13.36 ✓
	10°04.5'	10.075	5.584	41.2	12.8	<del>89.230</del>	0.315	9.92	13.67 ✓
	22°27'	22.450	12.442	86.3	26.8	<del>89.24</del>	0.320	10.08	13.83 ✓
	23°27'	23.450	12.996	90.0	27.9	<del>89.245</del>	0.325	10.24	13.99 ✓
	28°54.5'	28.908	16.021	109.8	34.0	<del>89.245</del>	0.325	10.24	13.99 ✓
	29°15'	29.250	16.210	111.0	34.4	<del>89.265</del>	0.345	10.87	14.62 ✓
	0°00'*	0.000	0.000	4.9	1.52	<del>89.26</del>	0.340	10.71	14.46 ✓

UNIVERSITY OF CALIFORNIA  
Soil Mechanics Laboratory

APOLLO 15 - LSRP  
FLIGHT UNIT (S/N 2003)  
LUNAR DRUM (S/N 2002)

Date 12<sup>th</sup> 13 AUGUST 1971  
LUNAR PENETRATION DATA REDUCTION  
INDEX No. 4 PAGE No. 1  
(0.5 in<sup>2</sup> cone in rover track)?

INDEX	DRUM LOAD $\alpha$	DRUM LOAD $\alpha$	DRUM CIRCUMF. DEFLECTION mm.	LOAD, newtons. (from calibration curve)	STRESS newt/cm <sup>2</sup>	INITIAL DRUM DEPTH FINAL cm	4 DRUM DEPTH READING cm	PENETRATION DEPTH cm.	Correction + CORRECTION (add 3.75)
No.	deg.-min.	deg.							
<b>4</b>									
	0°00'	0.000	0.000	4.97 0.00		<del>88.930</del>	0.000	0.00	3.75 ✓
	0°00'*	0.000	0.000	4.9	1.52	<del>88.965</del>	0.035	1.10	4.85 ✓
	1°01.5'	1.025	0.568	8.3	2.57	<del>88.965</del>	0.035	1.10	4.85 ✓
	1°49.5'	1.825	1.011	11.2	3.47	<del>88.975</del>	0.045	1.42	5.17 ✓
	12°00'	12.000	6.650	48.3	15.0	<del>88.98</del>	0.050	1.58	5.33 ✓
	8°33.5'	8.558	4.743	35.7	11.1	<del>88.985</del>	0.055	1.73	5.48 ✓
	13°47'	13.783	7.639	54.7	17.0	<del>88.985</del>	0.055	1.73	5.48 ✓
	14°01.5'	14.025	7.773	55.6	17.2	<del>88.99</del>	0.060	1.89	5.64 ✓
	16°37'	16.617	9.209	65.1	20.2	<del>88.99</del>	0.060	1.89	5.64 ✓
	16°58'	16.967	9.403	66.4	20.6	<del>88.955</del>	0.125	3.94	7.69 ✓
	19°15.5'	19.258	10.673	74.6	23.1	<del>88.96</del>	0.130	4.10	7.85 ✓
	19°37.5'	19.625	10.876	76.0	23.6	<del>88.98</del>	0.150	4.73	8.48 ✓
	20°22'	20.367	11.287	78.6	24.4	<del>88.99</del>	0.160	5.04	8.79 ✓
	28°45.5'	28.758	15.938	109.2	33.8	<del>88.955</del>	0.165	5.20	8.95
	29°04'	29.067	16.109	110.3	34.2	<del>88.913</del>	0.200	6.30	10.05
	0°00'*	0.000	0.000	4.9	1.52	<del>88.913</del>	0.200	6.30	10.05

UNIVERSITY OF CALIFORNIA  
Soil Mechanics Laboratory

APOLLO 15 - LSRP  
FLIGHT UNIT (S/N 2003)  
LUNAR DRUM (S/N 2002)

Date 12 & 13 AUGUST 1971  
LUNAR PENETRATION DATA REDUCTION  
INDEX No. 5 PAGE No. 1

(0.5 in<sup>2</sup> conc adjacent to track)?

INDEX No.	DRUM LOAD $\lambda$ deg-min.	DRUM LOAD $\lambda$ deg.	DRUM CIRCUMF. DEFLECTION mm.	LOAD, newtons. (4 mm calibration curve)	STRESS newt/cm <sup>2</sup>	INITIAL DRUM DEPTH cm	$\Delta$ DRUM DEPTH READING cm	PENETRATION DEPTH cm.	CORRECTION (add 3.75)
5	0°00'	0.000	0.000	4.9? 0.0		89.93	0.000	0.00	3.75
	0°00'	0.000	0.000	4.9	1.52	89.20	0.270	8.51	12.26
	1°31.5'	1.525	0.845	10.2	3.16	89.21	0.280	8.82	12.57
	0°00'	0.000	0.000	4.9	1.52	89.21	0.280	8.92	12.57
	0°00'	0.000	0.000	4.9	1.52	89.235	0.305	9.61	13.36
	1°47'	1.783	0.988	10.9	3.38	89.235	0.305	9.61	13.36
	0°30'	0.500	0.277	6.3	1.95	89.235	0.305	9.61	13.36
	2°24'	2.400	1.330	13.4	4.15	89.24	0.310	9.77	13.52
	1°04.5'	1.075	0.596	8.5	2.63	89.24	0.310	9.77	13.52
	6°43.5'	6.725	3.727	29.2	9.05	89.25	0.320	10.08	13.83
	6°55.5'	6.925	3.839	29.9	9.27	89.255	0.325	10.24	13.99
	10°07.5'	10.125	5.611	41.5	12.9	89.27	0.340	10.71	14.46
	16°43.5'	16.725	9.269	65.5	20.3	89.28	0.350	11.03	14.78
	23°20.5'	23.342	12.936	89.7	27.8	89.28	0.350	11.03	14.78
	29°27'	29.450	16.321	111.6	34.6	89.29	0.360	11.34	15.09
	29°31'	29.517	16.358	111.8	34.7	89.305	0.375	11.81	15.56
	14°11'	14.183	7.860	56.3	17.5	89.31	0.380	11.97	15.72
	0°00'	0.000	0.000	4.9	1.52	89.31	0.380	11.97	15.72



UNIVERSITY OF CALIFORNIA  
Soil Mechanics Laboratory

APOLLO 15 - LSRP  
FLIGHT UNIT (S/N 2003)  
LUNAR DRUM (S/N 2002)

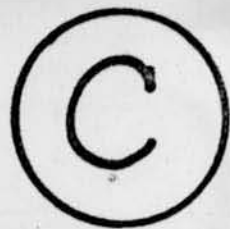
Date 12 & 13 AUGUST 1971  
LUNAR PENETRATION DATA REDUCTION

INDEX No. 7 PAGE No. 1

(1"x5" plate near top of trench wall)

INDEX No.	DRUM LOAD deg-min.	DRUM LOAD deg.	DRUM CIRCUMF. DEFLECTION mm.	LOAD, newtons.	STRESS new/cm <sup>2</sup>	INITIAL	Δ DRUM DEPTH READING cm.	PENETRA- TION DEPTH cm.
						DEPTH FINAL cm.		
<b>7</b>	0°00'	0.000	0.000	4.9 <sup>2</sup> 0.0		88.930	0.000	0.00
	0°00'	0.000	0.000	4.9	0.15	88.995	0.065	2.05
	2°00'	2.000	1.108	11.9	0.37	88.935	0.065	2.05
	0°00'	0.000	0.000	4.9	0.15	88.995	0.065	2.05
	0°00'	0.000	0.000	4.9	0.15	89.07	0.140	4.41
	1°36'	1.600	0.887	10.4	0.32	89.07	0.140	4.41
	0°00'	0.000	0.000	4.9	0.15	89.07	0.140	4.41
	0°00'	0.000	0.000	4.9	0.15	89.08	0.150	4.73
	28°51'	28.85	15.989	109.5	3.39	89.08	0.150	4.73
	28°51'	28.85	15.989	109.5	3.39	89.09	0.160	5.04
	16°38'	16.633	9.218	65.2	2.02	89.095	0.165	5.20
	28°56'	28.933	16.035	109.7	3.40	89.095	0.165	5.20
	29°11'	29.183	16.173	110.5	3.43	89.11	0.180	5.67
	29°11'	29.183	16.173	110.5	3.43	89.145	0.215	6.77
	0°00'	0.000	0.000	4.9	0.15	89.15	0.220	6.93

TREADWELL & MORIWAKI



NOTES by W. D. CARRIER

APOLLO 15 - LSRP

SRP - LEC GEMINI BISS.

8-11-71

TOTAL WT. OF PACKAGE AS RECEIVED FROM CURATOR (LRL) : 1334g

↙ upper portion (penetrometer (Geman rotor))  
 DRUM - BETA CLOTH BAG : 1107g

Stored on DUTCH #285

set on #7

NIT S/N 2003

DRUM S/N 2002

- Upper portion of penetrometer alone : 955 g.
- thin layer of dust on penetrometer : cleaned off by carrier
- index from #7 to #10  
(sound of dirt in mechanism)

top of 2003 joined with bottom of 2002 by W<sup>m</sup> Lyon

deadweight calibration " 10, 11, 12, 13, 14, 15

- spring sounds gritty -

12:50:15 next trench  
 just super  
 it really is hard  
 with taking photographs  
 color change near the bottom  
 walls are just about vertical

12:51:55 SAMPLING  
 14" or 16" deep

12:54:15 ~~sampling completed~~  
 still sampling  
 252: bottom of trench

12:56:30 ~~sampling completed~~ trench  
 253: top of trench

12:58:00  
 13:00:00 OPS done on CDR  
 13:00:35 putting cone on penetrometer

index to 2 13:01:15 adjacent to trench  
 13:02:12  
 3 13:03:30 trench bottom

index 4 (?) 13:04:25 on the tracks

index to 5 ✓ 13:05:15 next to track

13:05:45 going for plate

C-3

13:06:30

index to 6

plate: trench bottom

13:07:35

index to 7

about 4 inches out

13:08:50

slight amount of collapse

13:09:35

- but pushed it

finally after  
bottoming out

---

need photos of trench - diva remembered

13:12

finished

(D)

POST-FLIGHT CALIBRATION  
OF APOLLO 15 LSRP

+ NOTES ON CORRECTION FACTORS

APOLLO 15  
POST-FLIGHT CALIBRATION  
LUNAR DRUM (S/N 2002)

"LOAD CALIBRATION"

{ TOP OF FLIGHT UNIT (S/N 2003)  
+ BOTTOM OF QUAL UNIT (S/N 2002) }

LOAD, newtons

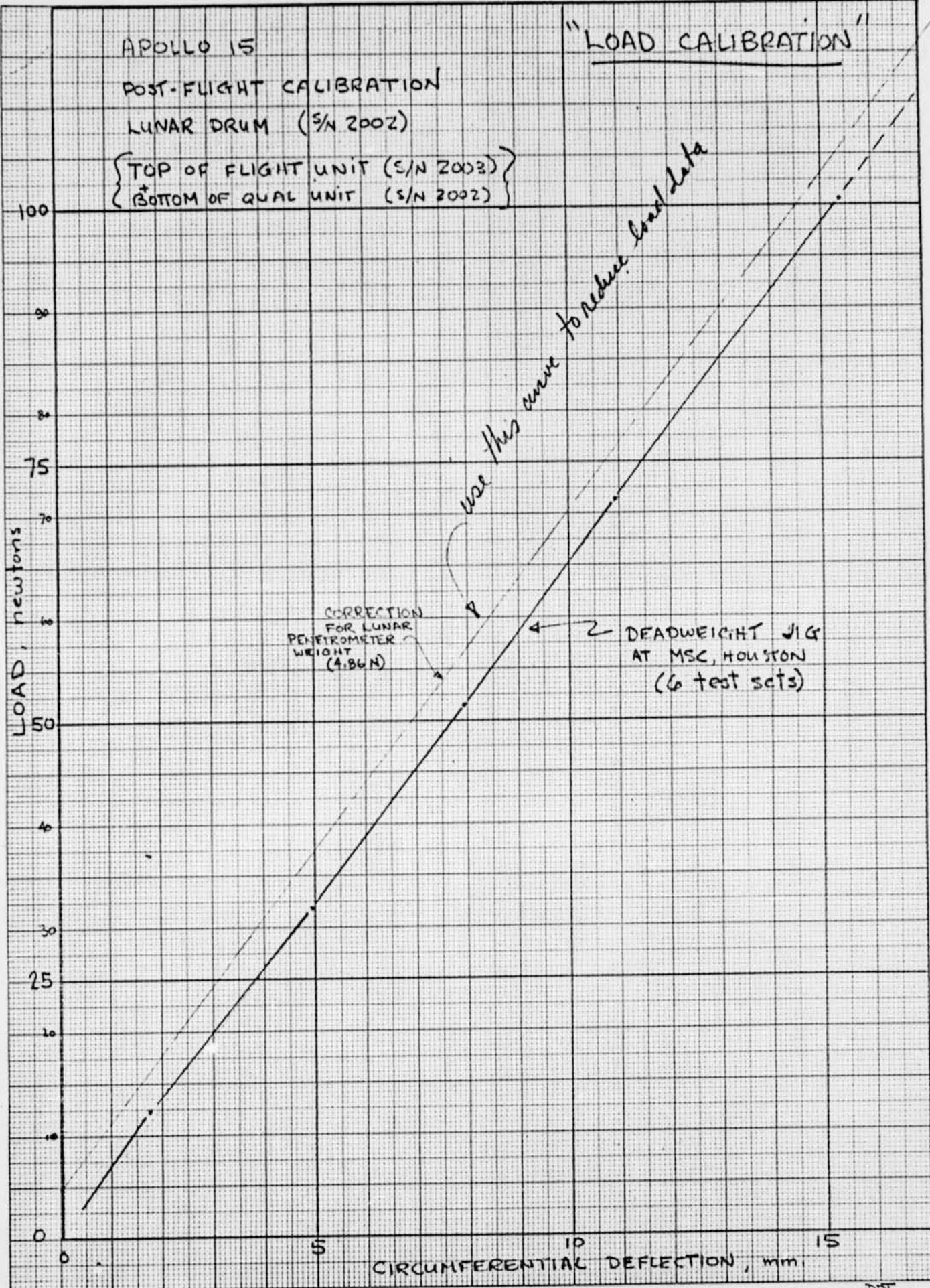
100  
75  
50  
25  
0

CIRCUMFERENTIAL DEFLECTION, mm

*use this curve to reduce load data*

CORRECTION  
FOR LUNAR  
PENETROMETER  
WEIGHT  
(4.86 N)

DEADWEIGHT JIG  
AT MSC, HOUSTON  
(6 test sets)



APOLLO 15  
POST-FLIGHT CALIBRATION  
LUNAR DRUM (S/N 2002)

"LOAD CALIBRATION"

{ TOP OF FLIGHT UNIT (S/N 2003)  
+ BOTTOM OF QUAL UNIT (S/N 2002) }

LOAD, newtons

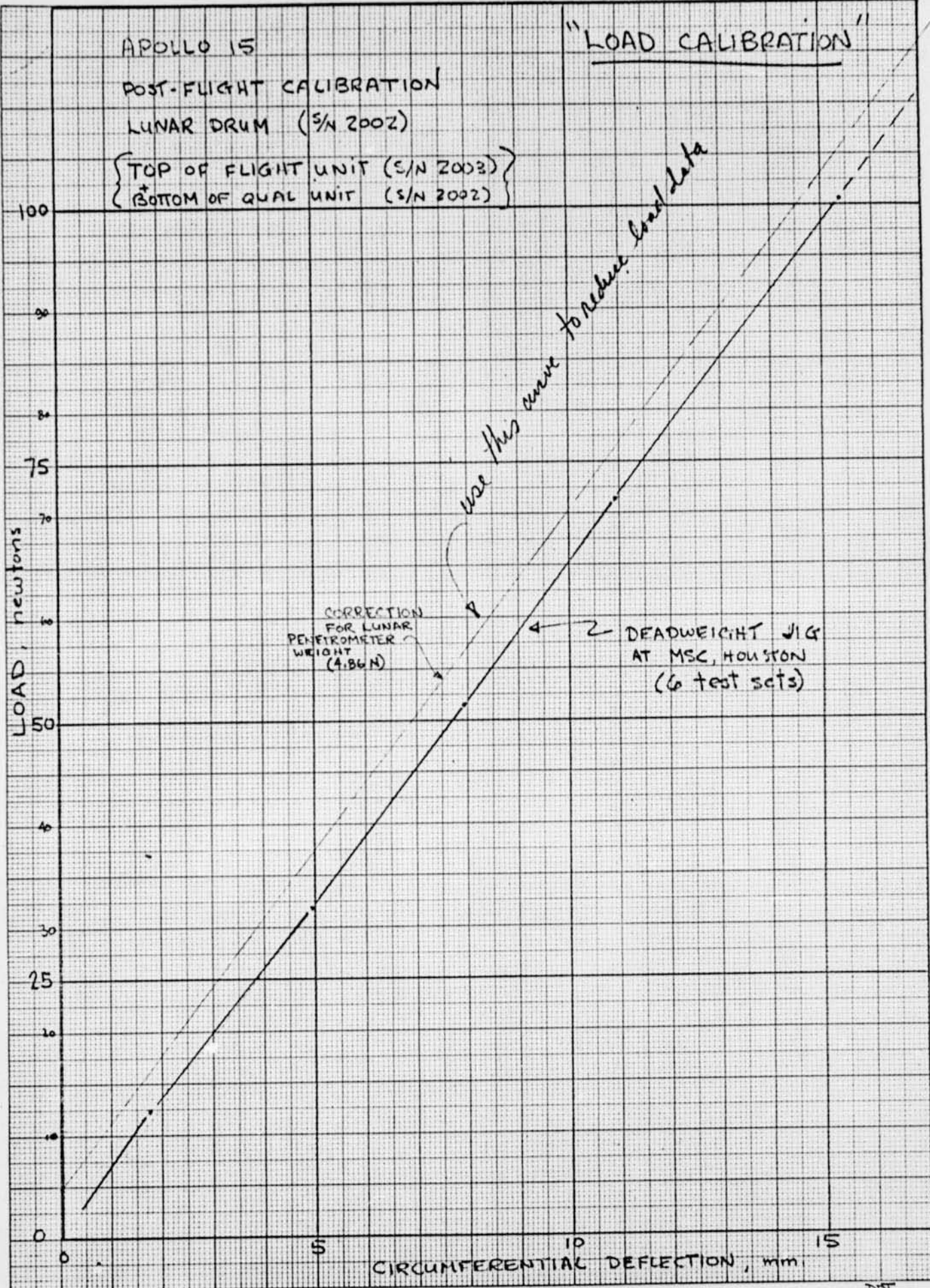
100  
75  
50  
25  
0

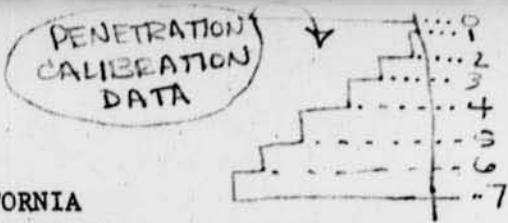
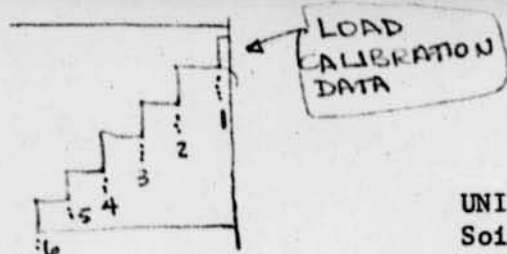
CIRCUMFERENTIAL DEFLECTION, mm

*use this curve to reduce load data*

CORRECTION  
FOR LUNAR  
PENETROMETER  
WEIGHT  
(4.86 N)

DEADWEIGHT JIG  
AT MSC, HOUSTON  
(6 test sets)





UNIVERSITY OF CALIFORNIA  
Soil Mechanics Laboratory

APOLLO 15 - LSRP

Date 12 August 1971

FLIGHT UNIT (S/N 2003)

{ CALIBRATION AT MSC HOUSTON  
ON 11 AUGUST 1971 USING BOTTOM  
HALF OF UNIT S/N 2002  
— DEADWEIGHT LOADING ON JIG —

LUNAR DRUM (S/N 2002)

"LOAD CALIBRATION"									
INDEX	VERT.	0.25 KG = 2.45 N	1.25 KG = 12.26 N	3.25 KG = 31.80 N	5.25 KG = 51.50 N	7.25 KG = 71.12 N	10.25 KG = 100.55 N		
NO	SCRIBE	1	2	3	4	5	6		
10	0°00'	8°10'30" 2°10.5'	3°10'50" 3°10.5'	8°43' 8°43'	14°23.5' 14°23.5'	19°48' 19°48'	27°51' 27°51'		
11	15°02'	5°15'30" 0°13.5'	18°13'30" 3°11.5'	23°55' 8°53'	29°17' 14°15'	34°47' 10°45'	42°34' 27°32'		
12	30°03'	30°12'30" 0°9.5'	33°17'30" 3°14.5'	38°50'30" 8°47.5'	44°07.5' 14°04.5'	49°45' 19°42'	57°46.5' 27°43.5'		
13	45°01.5'	45°16.5' 0°15'	48°15' 3°13.5'	54°01.5' 9°00'	59°26' 14°24.5'	64°45' 19°43.5'	72°54.5' 27°53'		
14	60°03.5'	60°17' 0°13.5'	63°12.5' 3°09'	69°02.5' 8°59'	74°19' 14°15.5'	79°34.5' 19°31'	87°24' 27°20.5'		
15	75°03.5'	75°18' 0°14.5'	78°08' 3°04.5'	84°17' 9°13.5'	89°40' 14°36.5'	94°51' 19°47.5'	102°56.5' 27°49'		
TS									
"PENETRATION CALIBRATION"									
INDEX		CENTIMETER READINGS, cm.							
NO.	Position	0	1	2	3	4	5	6	
10		88.905	88.970	89.290	89.690	90.085	90.495	90.815	91.140
11									
12									
13									
14									
15									
		88.905	88.970	89.290	89.690	90.085	90.495	90.815	91.140

# "PENETRATION CALIBRATION" - DATA AND ANALYSIS

 DDT  
 UCB  
 8-13-71

## BY INTERVALS

POSITION
~~READING~~  
 READING  
 cm

 INTERNAL  
 DRUM  
 cm.

 INTERVAL  
 ACTUAL  
 cm.

RATIO

0	88.905	0.000		
1	88.970	0.065	2.17	33.38
2	89.290	0.320	10.04	31.38
3	89.690	0.400	12.80	32.00
4	90.085	0.395	12.57	31.82
5	90.495	0.410	12.68	30.93
6	90.815	0.320	10.15	31.72
7	91.140	0.325	10.16	31.26

## BY TOTAL

RATIO

0	88.905	0.000	0	
1	88.970	0.065	2.17	33.38
2	89.290	0.385	12.23	31.77
3	89.690	0.785	25.03	31.89
4	90.085	1.180	37.60	31.86
5	90.495	1.590	50.28	31.62
6	90.815	1.910	60.43	31.64
7	91.140	2.235	70.59	31.58

## "LOAD CALIBRATION" - DATA &amp; ANALYSIS

13 AUG 1971  
D.O.T.  
@ U.C.B.

	<u>0.25 kg</u> <u>= 2.45 N</u>	<u>1.25 kg</u> <u>= 12.26 N</u>	<u>3.25 kg</u> <u>= 31.88 N</u>	<u>5.25 kg</u> <u>= 51.50 N</u>	<u>7.25 kg</u> <u>= 71.12 N</u>	<u>10.25 kg</u> <u>= 100.55 N</u>
INDEX 10	0° 10.5'	3° 10.5'	8° 43.0'	14° 23.5'	19° 48.0'	27° 51.0'
11	0° 13.5'	3° 11.5'	8° 53.0'	14° 15.0'	19° 45.0'	27° 32.0'
12	0° 09.5'	3° 14.5'	8° 47.5'	14° 04.5'	19° 42.0'	27° 43.5'
13	0° 15.0'	3° 13.5'	9° 00.0'	14° 24.5'	19° 43.5'	27° 53.0'
14	0° 13.5'	3° 09.0'	8° 59.0'	14° 15.5'	19° 31.0'	27° 20.5'
15	<u>0° 14.5'</u>	<u>3° 04.5'</u>	<u>9° 13.5'</u>	<u>14° 36.5'</u>	<u>19° 47.5'</u>	<u>27° 49.0'</u>
AVG (deg: min)	0° 12.75'	3° 10.58'	8° 56.0'	14° 19.92'	19° 42.83'	27° 41.5'
AVG (deg)	0.2125	3.1763	8.9333	14.3320	19.7138	27.6917
AVG (mm)	0.1178	1.7603	4.9508	7.9428	10.9254	15.3467

OBTAIN LOAD CALIBRATION FACTOR in  $\frac{\text{newtons}}{\text{millimeter}}$ 

(1) FROM ZERO

$$0 \text{ to } 2.45 \text{ N} \Rightarrow \frac{2.45}{0.1178} = 20.80$$

$$0 \text{ to } 12.26 \text{ N} \Rightarrow \frac{12.26}{1.7603} = 6.965$$

$$0 \text{ to } 31.88 \text{ N} \Rightarrow \frac{31.88}{4.9508} = 6.439$$

$$0 \text{ to } 51.50 \text{ N} \Rightarrow \frac{51.50}{7.9428} = 6.484$$

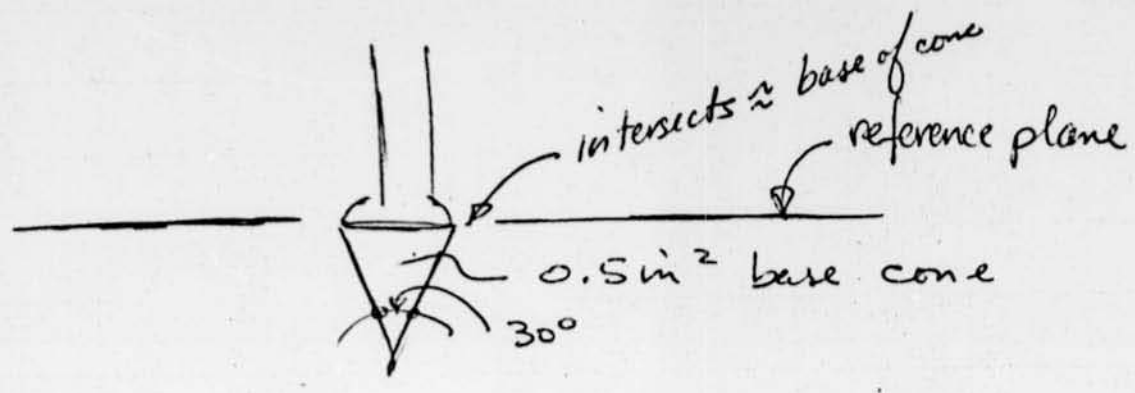
$$0 \text{ to } 71.12 \text{ N} \Rightarrow \frac{71.12}{10.9254} = 6.510$$

$$0 \text{ to } 100.55 \text{ N} \Rightarrow \frac{100.55}{15.3467} = 6.552$$

val 8  
981

MOON accel 162.11  
earth accel 981.0

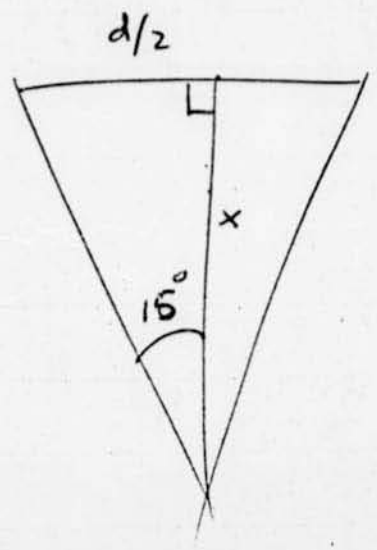
# "PENETRATION CORRECTION"



$$0.5 \sin^2 = \frac{\pi d^2}{4}$$

$$d^2 = \frac{2}{\pi} = 0.6366$$

$$d \approx 0.798''$$



$$\frac{d}{2} = \tan 15^\circ$$

$$x = \frac{.798}{2} \frac{1}{\tan 15}$$

$$x = \frac{.798}{2(.268)} = \frac{.798}{.536}$$

$$x = 1.48''$$

$$\approx 3.75 \text{ cm.}$$

# WEIGHTS - MOON VS. EARTH

(based on  $\frac{1}{6}$  ratio)

## WEIGHT OF PENETROMETER FLIGHT UNIT

$$\begin{aligned}
 &= 4.70 \text{ lbs} & \Rightarrow & \text{on moon } 0.7833 \text{ lbs} \\
 &= 2.132 \text{ kg.} & \Rightarrow & 0.3553 \text{ kg} \\
 &= 20.914 \text{ N} & \Rightarrow & 3.4857 \text{ N}
 \end{aligned}$$

## WEIGHT OF EXTENSION HANDLE

$$\begin{aligned}
 &= 0.8198 \text{ kg} & \Rightarrow & \text{on moon } 0.1366 \text{ kg} \\
 &= 1.8073 \text{ lb.} & \Rightarrow & 0.3012 \text{ lb} \\
 &= 8.0422 \text{ N} & \Rightarrow & 1.3404 \text{ N}
 \end{aligned}$$

## WEIGHT OF UNIT + HANDLE

<u>earth</u>		<u>moon</u>
6.5073 lbs.	$\Rightarrow$	1.0846 lbs
2.9518 kg	$\Rightarrow$	0.4920 kg
28.9562 N	$\Rightarrow$	4.8621 N

QUESTION? - WHAT ABOUT EFFECT OF LUNAR SURFACE REFERENCE PLANE SITTING ON LUNAR SURFACE?

ANSWER - IGNORE POSSIBLE REDUCTION - BECAUSE CABLE TENSION MAKES IMPOSSIBLE TO CALCULATE - WOULD BE SMALL ANYWAY -

o WEIGHT TO BE ACCOUNTED FOR IS 4.8621 N BECAUSE HANDLE IS ALREADY REGISTERED ON DRUM WHEN PENETRATION BEGINS.

### UNITS & CONVERSION

1 N	= 0.1019 kg.
1 N	= 0.2247 lb
1 lb.	= 4.45 N
1 lb.	= 0.4536 kg
1 kg	= 2.2046 lb
1 kg	= 9.81 N

<u>min</u>		<u>min</u>		<u>min</u>		<u>min</u>		<u>min</u>	
00.5	0.0083	12.5	0.2083	24.5	0.4083	36.5	0.6083	48.5	0.8083
01.0	0.0167	13.0	0.2167	25.0	0.4167	37.0	0.6167	49.0	0.8167
01.5	0.0250	13.5	0.2250	25.5	0.4250	37.5	0.6250	49.5	0.8250
02.0	0.0333	14.0	0.2333	26.0	0.4333	38.0	0.6333	50.0	0.8333
02.5	0.0417	14.5	0.2417	26.5	0.4417	38.5	0.6417	50.5	0.8417
03.0	0.0500	15.0	0.2500	27.0	0.4500	39.0	0.6500	51.0	0.8500
03.5	0.0583	15.5	0.2583	27.5	0.4583	39.5	0.6583	51.5	0.8583
04.0	0.0667	16.0	0.2667	28.0	0.4667	40.0	0.6667	52.0	0.8667
04.5	0.0750	16.5	0.2750	28.5	0.4750	40.5	0.6750	52.5	0.8750
05.0	0.0833	17.0	0.2833	29.0	0.4833	41.0	0.6833	53.0	0.8833
05.5	0.0917 <del>0.1000</del>	17.5	0.2917	29.5	0.4917	41.5	0.6917	53.5	0.8917
06.0	0.1000	18.0	0.3000	30.0	0.5000	42.0	0.7000	54.0	0.9000
06.5	0.1083	18.5	0.3083	30.5	0.5083	42.5	0.7083	54.5	0.9083
07.0	0.1167	19.0	0.3167	31.0	0.5167	43.0	0.7167	55.0	0.9167
07.5	0.1250	19.5	0.3250	31.5	0.5250	43.5	0.7250	55.5	0.9250
08.0	0.1333	20.0	0.3333	32.0	0.5333	44.0	0.7333	56.0	0.9333
08.5	0.1417	20.5	0.3417	32.5	0.5417	44.5	0.7417	56.5	0.9417
09.0	0.1500	21.0	0.3500	33.0	0.5500	45.0	0.7500	57.0	0.9500
09.5	0.1583	21.5	0.3583	33.5	0.5583	45.5	0.7583	57.5	0.9583
10.0	0.1667	22.0	0.3667	34.0	0.5667	46.0	0.7667	58.0	0.9667
10.5	0.1750	22.5	0.3750	34.5	0.5750	46.5	0.7750	58.5	0.9750
11.0	0.1833	23.0	0.3833	35.0	0.5833	47.0	0.7833	59.0	0.9833
11.5	0.1917	23.5	0.3917	35.5	0.5917	47.5	0.7917	59.5	0.9917
12.0	0.2000	24.0	0.4000	36.0	0.6000	48.0	0.8000	60.0	1.0000

E

PRE FLIGHT CALIBRATION (June 1971)  
U.C.B.)

APOLLO 15 LSRP



D.O.T. U.C. 6-24-70

RATIO

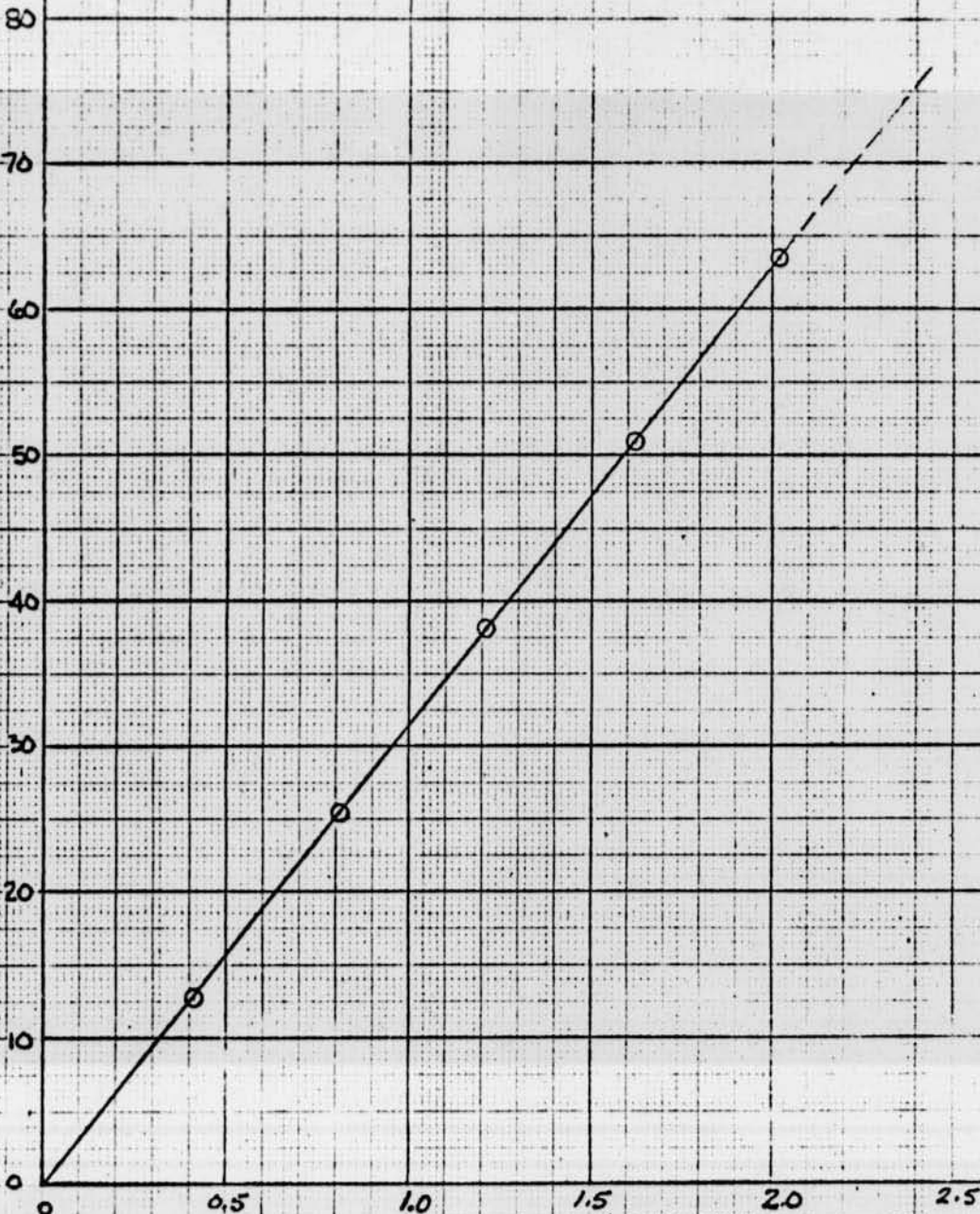
ACTUAL  
RECORDED

≈

≈ 31.40 to 31.50

~~31.52~~

ACTUAL PENETRATION, cm.



RECORDED PENETRATION  
SRP DRUM cm.  
S/N 2005

PENETRATION CALIBRATION - APOLLO 15 FLIGHT UNIT - 30A

GRAPHIC PAPER GRAPHIC CONTROLS CORPORATION BUFFALO, NEW YORK Product of U.S.A.