

START



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

SOIL MECHANICS EXPERIMENT (S-200)

APOLLO 16 - LSRP DATA PACKAGE

MAY, 1972

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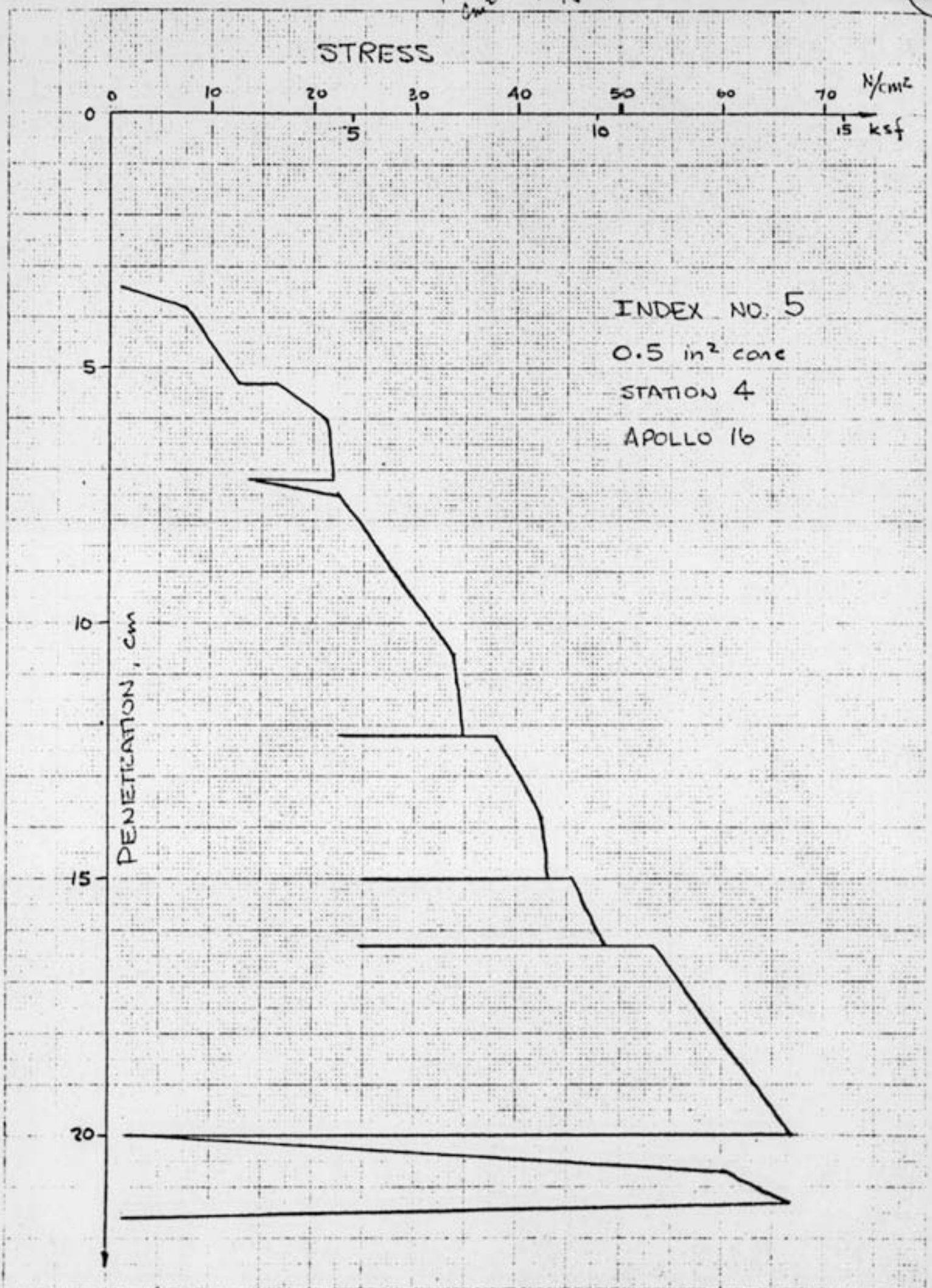
A

APOLLO 16 - LSRP

STRESS-PENETRATION CURVES

$\frac{1}{0.002} = 1.45 \text{ psi}$

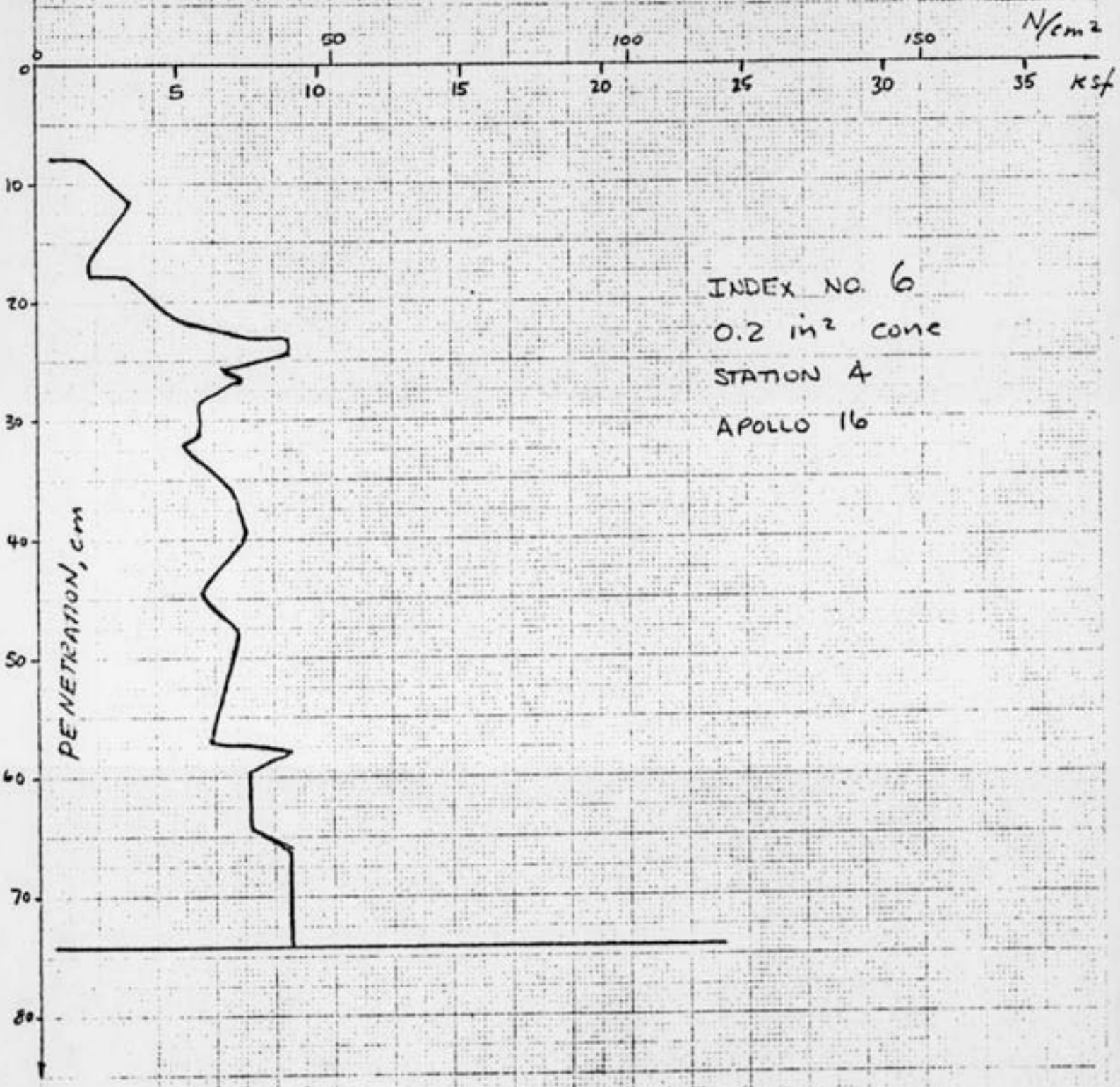
STRESS



INDEX NO. 5
 0.5 in² cone
 STATION 4
 APOLLO 16

REPRODUCED FROM THE ORIGINAL RECORDS OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
 REPORT NUMBER 78-1215

STRESS

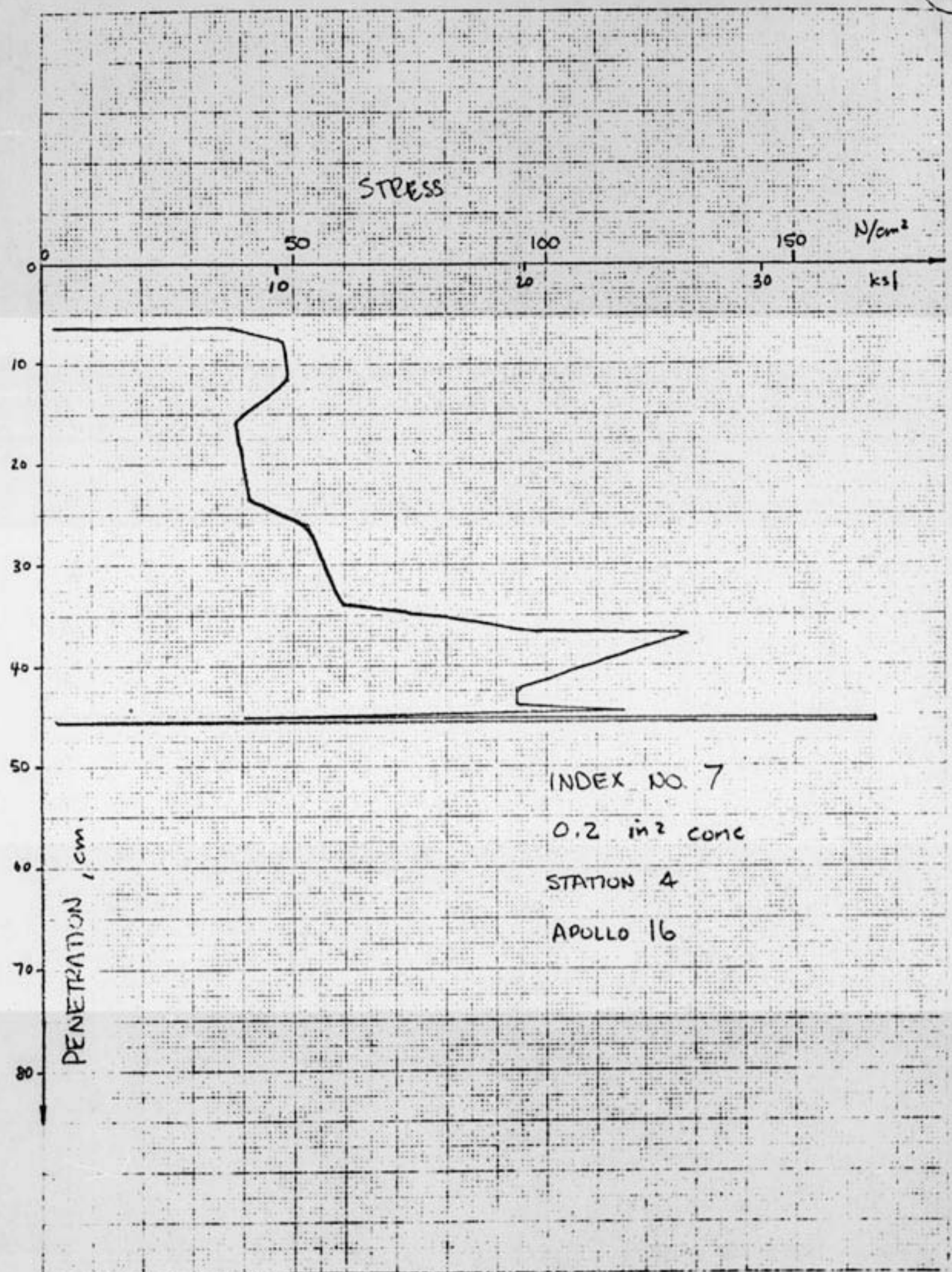


INDEX NO. 6
0.2 in² cone
STATION 4
APOLLO 16

PENETRATION, cm

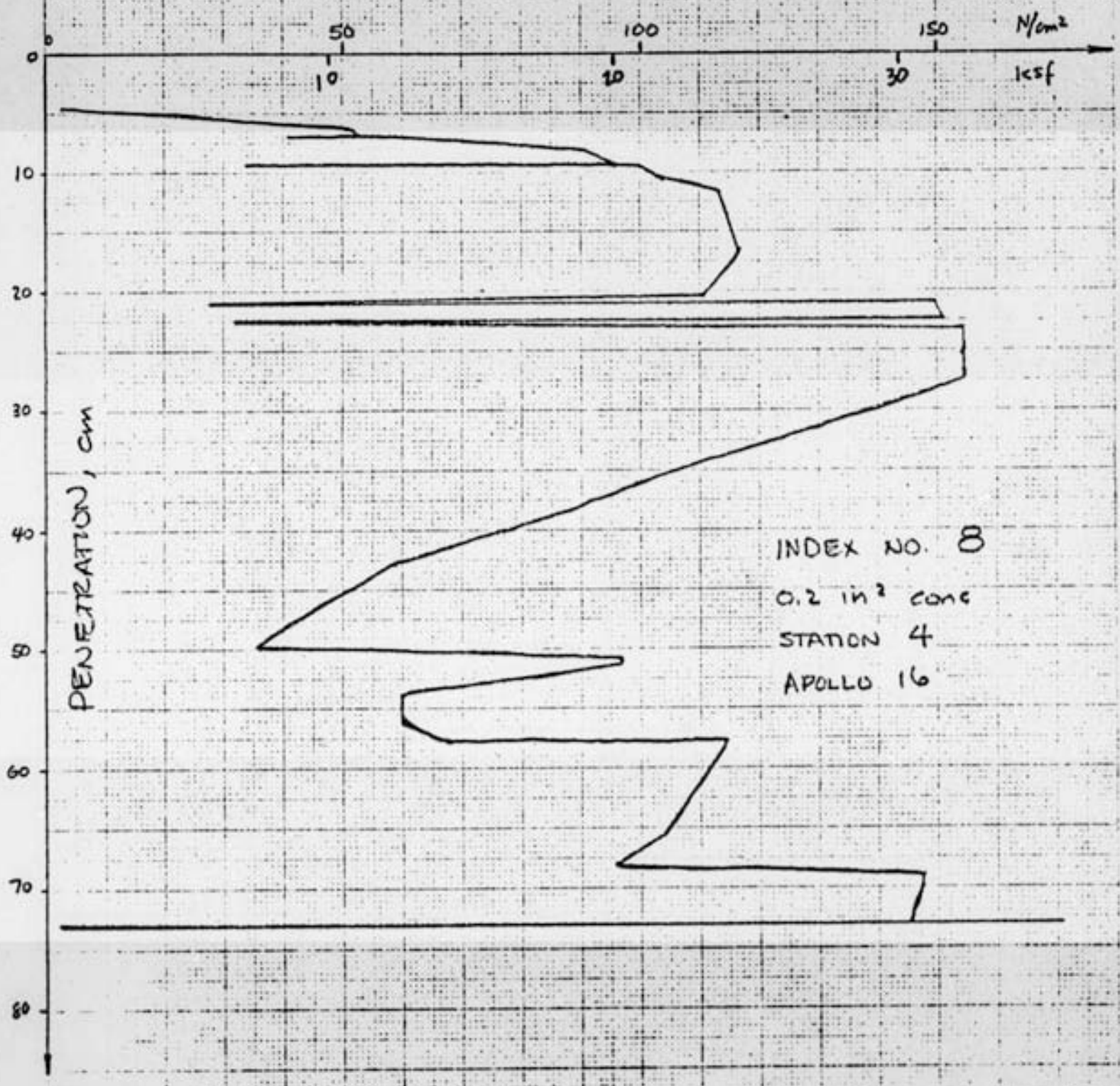
GENERAL PURPOSE CONE
TESTER
10 X 10 TO THE CENTERLINE
NO. 1215

PERMITS & EQUIP. CO.
10 X 10 TO THE CENTERLINE
NO. 1215

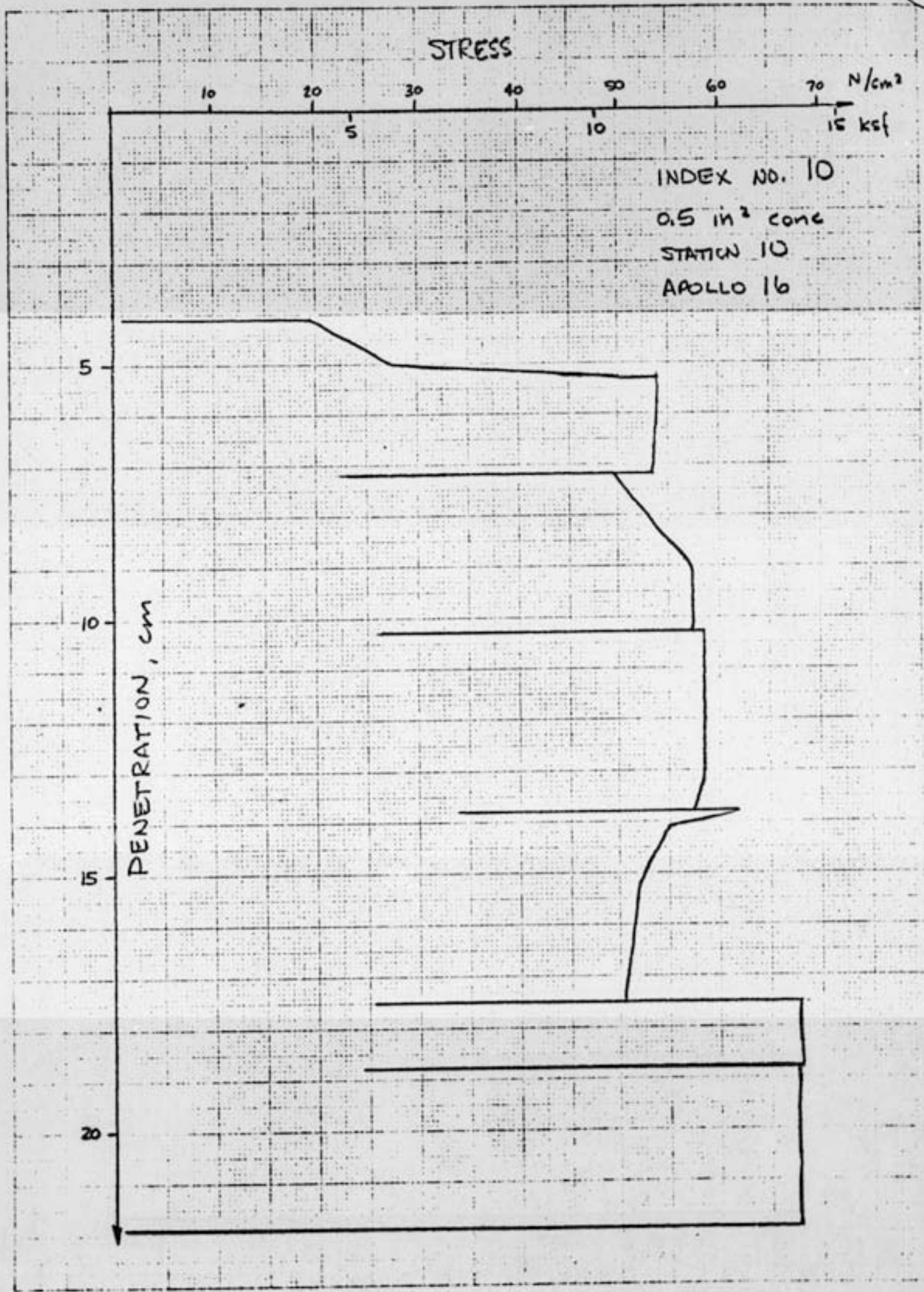


INDEX NO. 7
0.2 in² conc
STATION 4
APOLLO 16

STRESS

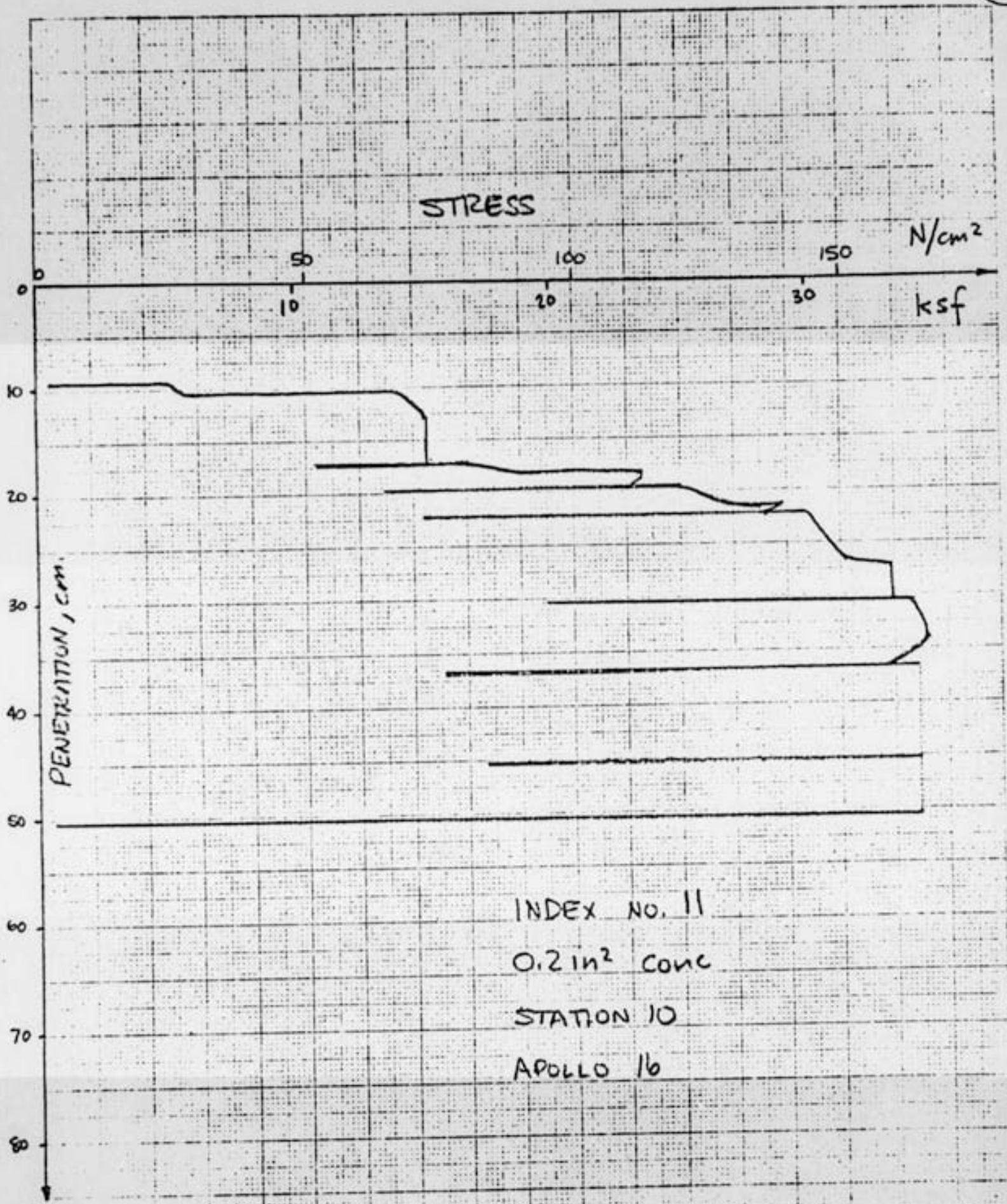


5121 DA. REVISIONS OF K OF THE CENTER FOR RESEARCH AND DEVELOPMENT



REPRODUCED FROM THE ORIGINAL REPORT
NO. 1215

STRESS

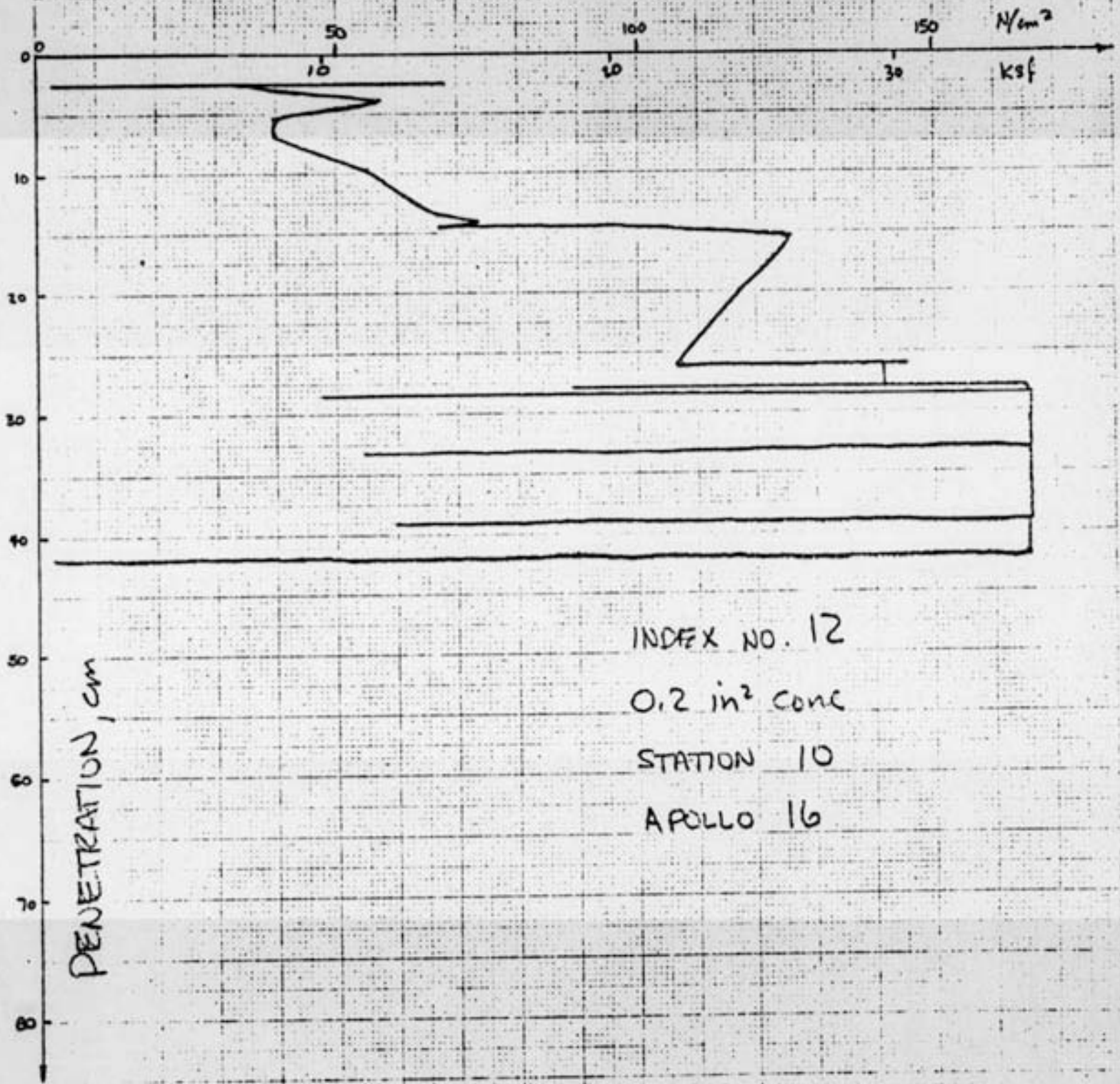


PENETRATION, cm.

INDEX NO. 11
 0.2 in² CONC
 STATION 10
 APOLLO 16

100% 16 x 50 cm
 100% 10 x 10 TO THE CENTIMETERS 40 1215

STRESS



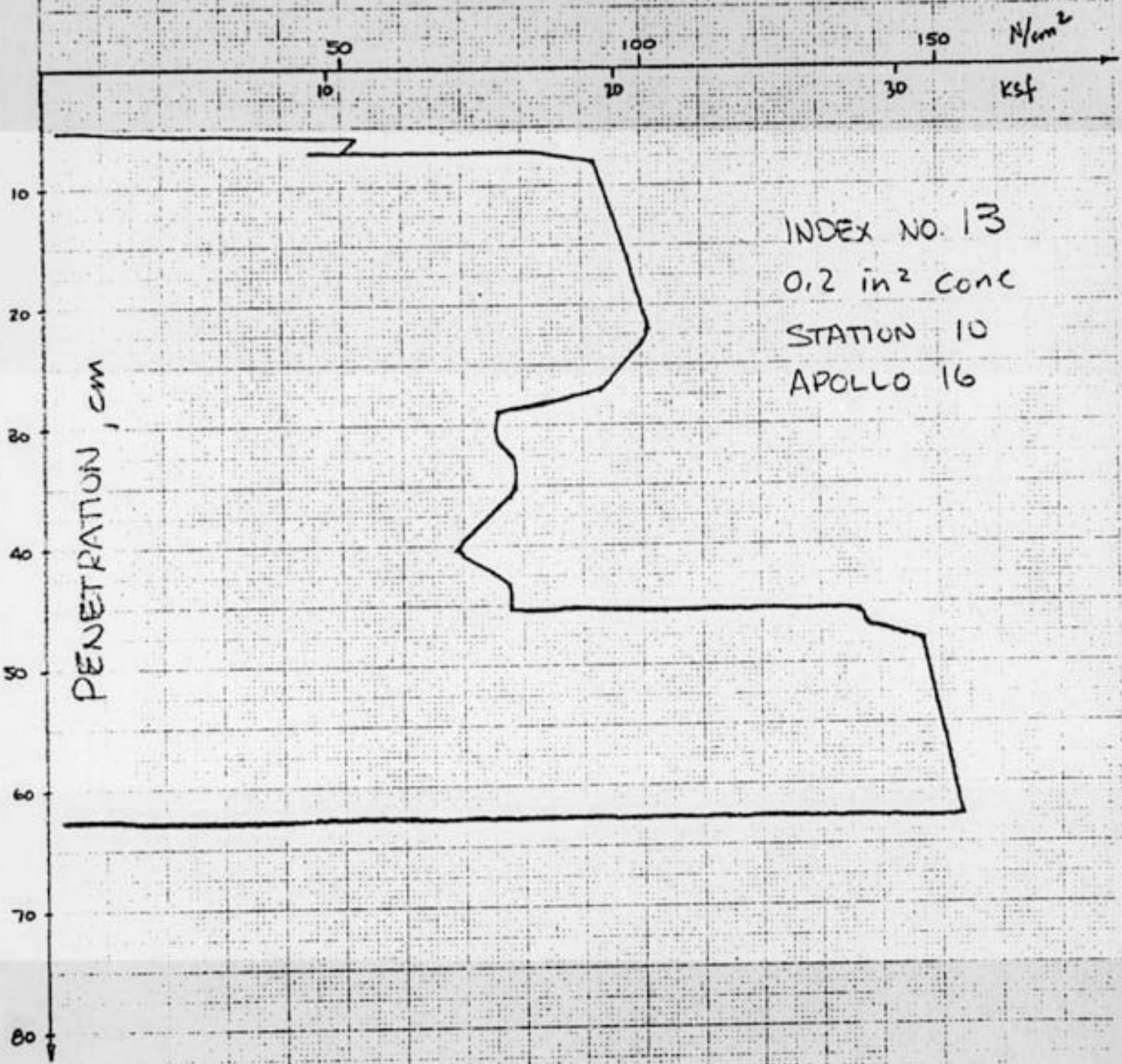
INDEX NO. 12
 0.2 in² CONC
 STATION 10
 APOLLO 16

PENETRATION, cm

APOLLO 16 STATION 10 TO THE CENTRE OF THE PENETRATION

SIZE ON REVISIONS SHEET OF X OF 2032
MILWAUKEE GRAPHIC CO.
100 WEST 25TH ST.

STRESS



INDEX NO. 13
 0.2 in² CONC
 STATION 10
 APOLLO 16

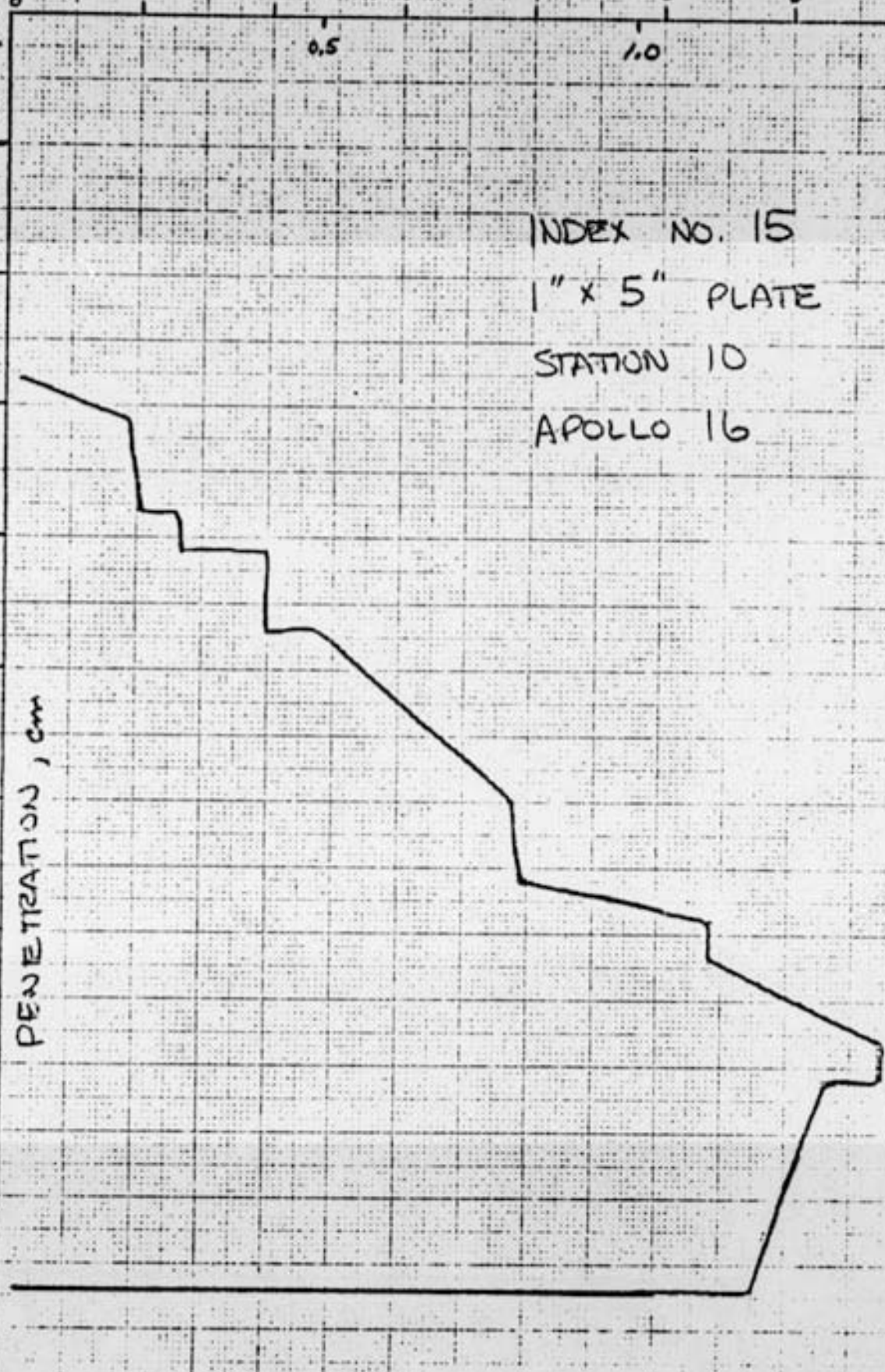
STRESS

0 1 2 3 4 5 6 7 N/cm²
 0.5 1.0 1.5 ksf

INDEX NO. 15
 1" x 5" PLATE
 STATION 10
 APOLLO 16

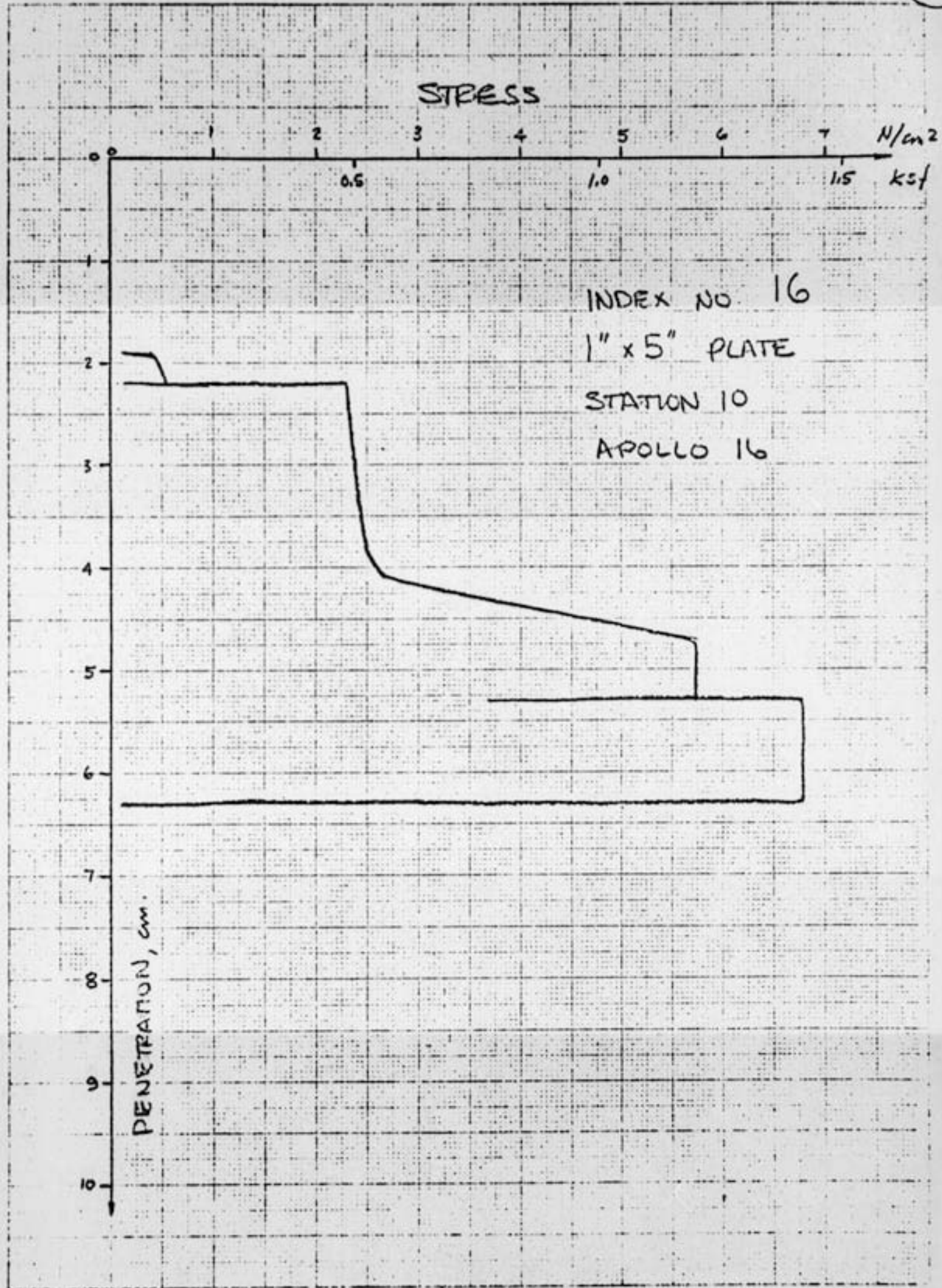
1
 2
 3
 4
 5
 6
 7
 8
 9
 10

PENETRATION, cm



RENTAL & FERRY CO.
 10 X 10 TO THE CENTERLINE 40 INIS

1.5 X 10 X 10 TO THE CENTIMETER 40 1215
GENERAL & SPECIAL



(B)

APOLLO 16 - LSRP

REDUCED DATA

CALIBRATIONS FOR APOLLO 16 DATA REDUCTION

PENETRATION

based on pre- and post-flight calibration
use ratio $\frac{\text{actual}}{\text{recorded}} = 31.3$

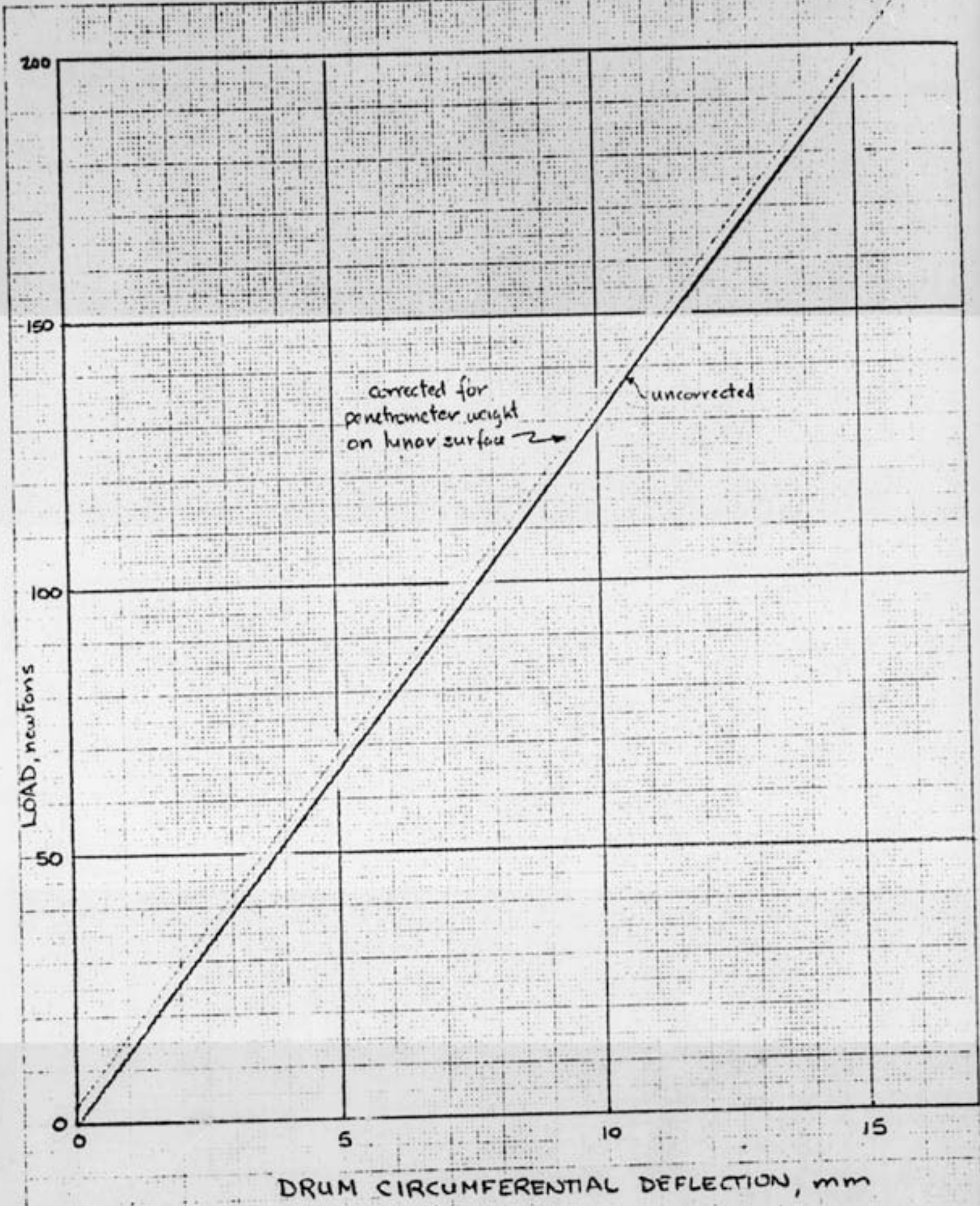
LOAD

penetrometer used w/o handle on moon

weight =	on earth	on moon
	4.70 lbs	⋮
	2.132 kg	⋮
	20.914 N	3.4857 N

∴ — use 3.49 N addition to calibration curve
on next page —

B-2



LOAD, newtons

DRUM CIRCUMFERENTIAL DEFLECTION, mm

APOLLO 16 LOAD CALIBRATION CURVE

REPRODUCED FROM THE ORIGINAL RECORDS OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

DOT

APOLLO 16

(B-3)

UNIVERSITY OF CALIFORNIA
Soil Mechanics Laboratory

APOLLO 16 - LSRP

Date 11/12

MAY 1972

FLIGHT UNIT (S/N 2004)

Lunar Penetration Data Reduction

LUNAR DRUM (S/N 2008)

Index No. 5 Page No. 1

0.5 in² conc. = 3.2758 cm²

DRUM LOAD ϕ	DRUM LOAD ϕ	DRUM CIRCUMF.	LOAD Newtons	STRESS		\rightarrow 31.3	\rightarrow
deg-min	degrees	DEFLECTION mm.	(from calib. curve)	newtons/ cm ²	MINOR DRUM DEPTH cm	Δ DRUM DEPTH READING cm.	ACTUAL DEPTH cm.
0°00'	0.00	0.00	0.0	0.0	89.77	0.00	0.00
0°00'	0.00	0.00 [*]	3.5	1.1	89.86	0.11	3.4
2°50'	2.83	1.57	23.8	7.4	89.89	0.12	3.8
5°14'	5.23	2.90	41.0	12.7	89.94	0.17	5.3
6°55'	6.92	3.84	53.0	16.4	89.94	0.17	5.3
9°05'	9.08	5.03	68.7	21.3	89.94	0.19	6.0
9°20'	9.33	5.17	70.3	21.8	90.00	0.23	7.2
5°40'	5.67	3.14	44.0	13.6	90.00	0.23	7.2
9°41'	9.68	5.36	72.8	22.6	90.01	0.24	7.5
14°38'	14.63	8.11	109.0	33.8	90.11	0.34	10.6
15°02'	15.03	8.33	111.7	34.6	90.16	0.39	12.2
9°38'	9.63	5.34	72.6	22.5	90.16	0.39	12.2
16°35'	16.52	9.19	122.7	38.0	90.16	0.39	12.2
18°33'	18.55	10.28	137.0	42.5	90.21	0.44	13.8
18°49'	18.72	10.43	137.8	43.0	90.25	0.48	15.0
8°49'	8.72	4.73	67.0	19.8	90.25	0.48	15.0
20°00'	20.00	10.8	147.3	45.7	90.25	0.48	15.0
21°19'	21.32	11.82	157.0	48.7	90.25	0.52	16.3
8°15'	8.25	4.57	62.5	19.4	90.25	0.52	16.3
23°24'	23.40	12.97	172.0	53.3	90.29	0.52	16.3

APOLLO 16

(B-5)

UNIVERSITY OF CALIFORNIA
Soil Mechanics Laboratory

APOLLO 16 - LSRP

Date 11/12 MAY 1972

FLIGHT UNIT (SN 2004)

Lunar Penetration Data Reduction

LUNAR DRUM (SN 2008)

Index No. 3 Page No. 1

0.2 in² conc = 1.2903 cm²

	$\times 5912$	\downarrow				$\rightarrow \times 31.3$	\downarrow	
DRUM LOAD λ	DRUM LOAD λ	DRUM CIRCUMF.	LOAD Newtons	STRESS		Δ DRUM DEPTH	ACTUAL DEPTH	
deg-min	degrees	DEFLECTION mm.	(from calib. curve)	newtons/ cm ²		READING cm.	DEPTH cm.	
0°00'	0.00	0.00	0.0	0.0	99.76	0.00	0.00	
0°00'	0.00	0.00*	3.5	2.7	99.03	0.25	7.8	
2°08'	2.13	1.18	17.3	14.2	99.03	0.25	7.8	
2°25'	2.42	1.34	20.6	16.0	99.15	0.37	11.6	
1°08'	1.13	0.63	11.5	8.9	99.31	0.53	16.6	
1°08'	1.13	0.63	11.5	8.9	99.35	0.57	17.8	
2°13'	2.22	1.23	19.5	15.1	99.35	0.57	17.8	
3°39'	3.65	2.02	29.5	22.9	99.46	0.68	21.3	
6°15'	6.25	3.46	48.3	37.4	99.53	0.74	23.2	
7°12'	7.20	3.99	55.1	42.7	99.53	0.74	23.2	
7°12'	7.20	3.99	55.1	42.7	99.57	0.79	24.7	
5°09'	5.15	2.85	40.4	31.3	99.60	0.82	25.6	
5°46'	5.77	3.20	45.0	34.9	99.63	0.85	26.6	
4°26'	4.43	2.46	35.5	27.5	99.63	0.91	28.5	
4°26'	4.43	2.46	35.5	27.5	99.75	1.00	31.3	
3°56'	3.93	2.18	31.8	24.6	99.80	1.02	32.0	
5°25'	5.42	3.00	42.5	32.9	99.92	1.14	35.7	
5°52'	5.87	3.25	45.8	35.5	99.94	1.26	39.4	
4°29'	4.48	2.48	35.8	27.7	99.20	1.42	44.5	
5°37'	5.62	3.11	43.9	34.0	99.30	1.52	47.6	

APOLLO 16

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UNIVERSITY OF CALIFORNIA
Soil Mechanics Laboratory

APOLLO 16 - LSRP

Date 11/12 MAY 1972

FLIGHT UNIT (% 2004)

Lunar Penetration Data Reduction

LUNAR DRUM (% 2008)

Index No. 7 Page No. 1

0.2 in² cone

	↗ x.5542 ↘	↘ ↗					↗ x 31.3 ↘	↘ ↗	
DRUM LMD ↗	DRUM LOAD ↗	DRUM CIRCUMF.	LOAD Newtons	STRESS		MINOR DEPTH	Δ DRUM DEPTH	ACTUAL DEPTH.	
deg-min	degrees	DEFLECTIO mm.	(from calib. cone)	newton/cm ²		READING cm.	READING cm.	DEPTH cm.	
0°00'	0.00	0.00	0.0	0.0		89.78	0.00	0.0	
0°00'	0.00	0.00*	3.5	2.7		89.90	0.20	6.3	
6°14'	6.23	3.45	48.4	37.5		89.90	0.20	6.3	
8°05'	7.08	4.48	61.7	47.8		90.03	0.25	7.8	
8°17'	8.28	4.59	63.2	49.0		90.15	0.37	11.6	
6°28'	6.47	3.59	50.2	38.9		90.25	0.50	15.7	
6°52'	6.87	3.81	53.0	41.1		90.53	0.75	23.5	
8°57'	8.95	4.96	68.0	52.7		90.61	0.83	26.0	
9°15'	9.25	5.13	70.2	54.4		90.87	1.09	34.1	
13°26'	13.43	7.44	100.2	77.7		90.90	1.12	35.1	
16°59'	16.98	9.41	125.8	97.5		90.95	1.17	36.6	
22°32'	22.53	12.49	165.8	128.5		90.96	1.18	36.9	
16°21'	16.35	9.06	121.3	94.0		91.13	1.35	42.3	
16°21'	16.35	9.06	121.3	94.0		91.15	1.40	43.8	
20°07'	20.12	11.15	148.5	115.1		91.20	1.42	44.5	
6°45'	6.75	3.74	52.1	40.4		91.23	1.44	45.1	
29°25'	29.42	16.30	215.4	166.9		91.23	1.44	45.1	
29°25'	29.42	16.30	215.4	166.9		91.23	1.45	45.4	
0°00'	0.00	0.00*	3.5	2.7		91.25	1.45	45.4	

APOLLO 16

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UNIVERSITY OF CALIFORNIA
Soil Mechanics Laboratory

APOLLO 16 - LSRP

Date 11/12 MAY 1972

FLIGHT UNIT (SN 2004)

Lunar Penetration Data Reduction

LUNAR DRUM (SN 2008)

Index No. 3 Page No. 1

0.2 in² cone

	17 x .5542	↓				↑ x 31.3	↓	
DRUM LMD	DRUM LOAD	DRUM CIRCUMF.	LOAD Newtons	STRESS		Δ DRUM DEPTH	ACTUAL DEPTH	
deg-min	degrees	DEFLECTION mm.	(from calib. curve)	newtons/cm ²		READING cm.	DEPTH cm.	
0°00'	0.00	0.00	0.0	0.0		89.75	0.00	0.00
0°00'	0.00	0.00*	3.5	2.7		89.95	0.15	4.7
4°05'	4.08	2.21	32.2	25.0		89.95	0.17	5.3
8°50'	8.83	4.77	65.6	50.8		89.95	0.20	6.3
9°10'	9.17	4.97	68.1	52.8		90.01	0.22	6.9
6°57'	6.95	3.77	52.5	40.7		90.01	0.22	6.9
10°31'	10.52	5.71	77.7	60.2		90.01	0.22	6.9
16°03'	16.05	8.70	116.6	90.4		90.04	0.26	8.1
17°02'	17.03	9.24	123.6	95.8		90.05	0.30	9.4
5°39'	5.65	3.06	43.3	33.6		90.05	0.30	9.4
17°45'	17.75	9.63	128.7	99.7		90.05	0.30	9.4
18°33'	18.55	10.05	134.2	104.0		90.12	0.24	10.6
20°17'	20.28	10.99	146.4	113.5		90.15	0.37	11.6
20°50'	20.83	11.31	150.5	116.6		90.31	0.53	16.6
19°45'	19.75	10.70	142.6	110.5		90.45	0.65	20.4
4°34'	4.57	2.48	35.7	27.7		90.45	0.67	21.0
26°59'	26.98	14.61	193.4	149.9		90.45	0.67	21.0
27°12'	27.20	14.74	195.1	151.2		90.51	0.72	22.5
5°22'	5.37	2.91	41.3	32.0		90.51	0.72	22.5
27°52'	27.87	15.11	199.9	154.9		90.51	0.74	23.2

APOLLO 16

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UNIVERSITY OF CALIFORNIA
Soil Mechanics Laboratory

APOLLO 16 - LSRP

Date 11/12

MAY 1972

FLIGHT UNIT (5/12004)

Lunar Penetration Data Reduction

LUNAR DRUM (5/12008)

Index No. 8 Page No. 2

0.2 in² cone

	$\rho \times 5542$						$\rho \times 31.3$	
DRUM LOAD λ	DRUM LOAD λ	DRUM CIRCUMF.	LOAD Newtons	STRESS		INITIAL DEPTH	Δ DRUM DEPTH	ACTUAL DEPTH
deg-min	degrees	DEFLECTION mm.	(from calib. cone)	newton/cm ²		Final cm.	READING cm.	DEPTH cm.
27°52'	27.87	15.11	199.9	154.9		90.65	0.87	27.2
17°38'	17.63	9.57	127.9	99.1		90.95	1.15	36.0
16°13'	16.22	8.80	117.9	91.4		90.92	1.21	37.9
10°15'	10.25	5.56	75.8	58.7		91.15	1.37	42.9
5°49'	5.82	3.22	45.4	35.2		91.37	1.59	49.8
16°50'	16.83	9.32	124.7	96.6		91.40	1.62	50.7
16°50'	16.83	9.32	124.7	96.6		91.42	1.64	51.3
10°16'	10.27	5.68	77.3	59.9		91.50	1.72	53.8
10°16'	10.27	5.68	77.3	59.9		91.50	1.80	56.3
11°21'	11.35	6.29	75.3	66.1		91.62	1.84	57.6
20°04'	20.07	11.10	147.8	114.5		91.62	1.84	57.6
18°12'	18.20	10.07	134.4	104.2		91.87	2.09	65.4
16°40'	16.67	9.22	123.4	95.6		91.96	2.18	68.2
26°00'	26.00	14.40	190.7	147.8		91.90	2.20	68.9
25°36'	25.60	14.16	187.6	145.4		92.11	2.33	72.9
30°21'	30.35	16.72	221.6	171.7		92.11	2.33	72.9
0°00'	0.00	0.00*	3.5	2.7		92.11	2.33	72.9

APOLLO 16

B-10

UNIVERSITY OF CALIFORNIA
Soil Mechanics Laboratory

APOLLO 16 - LSRP

Date 11/12 MAY 1972

FLIGHT UNIT (5/11 2004)

Lunar Penetration Data Reduction

LUNAR DRUM (5/11 2008)

Index No. 10 Page No. 1

0.5 in² cone = 3.2258 cm²

	$\rightarrow \times 5542 \rightarrow$	\rightarrow					$\rightarrow \times 31.3 \rightarrow$	\rightarrow	
DRUM LOAD \times	DRUM LOAD \times	DRUM CIRCUMF.	LOAD Newtons	STRESS		INITIAL DEPTH	Δ DRUM DEPTH	ACTUAL DEPTH	
deg-min	degrees	DEFLECTION mm.	(from calib. curve)	newtons/cm ²		Final cm	READING cm.	DEPTH cm.	
0°00'	0.00	0.00	0.0	0.0		89.75	0.00	0.0	
0°00'	0.00	0.00*	3.5	1.1		89.81	0.13	4.1	
8°12'	8.20	4.54	62.5	19.4		89.81	0.13	4.1	
11°55'	11.92	6.60	89.3	27.7		89.84	0.16	5.0	
22°08'	22.13	12.23	162.5	50.4		89.85	0.17	5.3	
23°31'	23.52	13.01	172.6	53.5		90.01	0.23	7.2	
9°31'	9.52	5.27	72.0	22.3		90.01	0.23	7.2	
21°37'	21.62	11.97	159.1	49.3		90.01	0.23	7.2	
25°14'	25.23	13.98	185.2	57.4		90.07	0.29	9.1	
23°14'	25.23	13.98	185.2	57.4		90.11	0.33	10.3	
11°05'	11.08	6.12	83.1	25.8		90.11	0.33	10.3	
25°46'	25.77	14.25	188.8	58.5		90.11	0.33	10.3	
25°46'	25.77	14.25	188.8	58.5		90.20	0.42	13.2	
25°15'	25.25	14.00	185.5	57.5		90.22	0.44	13.8	
14°40'	14.67	8.11	109.8	33.7		90.23	0.44	13.8	
27°12'	27.20	15.05	199.2	61.8		90.23	0.44	13.8	
24°10'	24.17	13.38	177.4	55.0		90.23	0.45	14.1	
22°32'	22.63	12.53	167.4	51.9		90.27	0.49	15.3	
22°06'	22.10	12.26	162.9	50.5		90.34	0.56	17.5	
11°05'	11.08	6.14	83.3	25.8		90.34	0.56	17.5	

APOLLO 16

B-12

UNIVERSITY OF CALIFORNIA
Soil Mechanics Laboratory

APOLLO 16 - LSRP

Date 11/12 MAY 1972

FLIGHT UNIT (5/4 2004)

Lunar Penetration Data Reduction

LUNAR DRUM (5/4 2008)

Index No. 11 Page No. 1

0.2 in² conc. =

	$\pi \times 5542$						$\pi \times 31.3$	
DRUM LOAD λ	DRUM LOAD λ	DRUM CIRCUMF.	LOAD Newtons	STRESS		INCL. DRUM DEPTH Final cm	Δ DRUM DEPTH	ACTUAL DEPTH
deg-min	degrees	DEFLECTN. mm.	(from calib. curve)	newtons/ cm ²			RENDER cm.	DEPTH cm.
0°00'	0.00	0.00	0.0	0.0		89.77	0.00	0.0
0°00'	0.00	0.00*	3.5	2.7		90.07	0.30	9.4
3°52'	3.87	2.14	31.3	24.3		90.07	0.30	9.4
4°22'	4.37	2.42	35.0	27.1		90.10	0.33	10.3
11°31'	11.52	6.39	86.6	67.1		90.10	0.33	10.3
12°31'	12.52	6.93	93.6	72.5		90.21	0.44	13.8
12°31'	12.52	6.93	93.6	72.5		90.32	0.55	17.2
8°44'	8.73	4.23	66.3	51.4		90.32	0.55	17.2
13°51'	13.85	7.68	103.3	80.1		90.32	0.55	17.2
15°41'	15.68	8.69	112.5	90.3		90.35	0.58	18.2
19°43'	19.72	10.92	145.5	112.8		90.35	0.58	18.2
19°13'	19.22	10.65	142.0	110.1		90.40	0.63	19.7
11°01'	11.02	6.11	82.9	64.2		90.40	0.63	19.7
21°05'	21.08	11.68	155.3	120.4		90.40	0.63	19.7
22°55'	22.92	12.69	168.5	130.6		90.45	0.68	21.3
24°28'	24.47	13.55	179.7	139.3		90.45	0.68	21.3
23°53'	23.83	13.20	175.1	135.7		90.48	0.71	22.2
12°22'	12.37	6.84	92.4	71.6		90.48	0.71	22.2
25°21'	25.35	14.02	185.8	144.0		90.48	0.71	22.2
26°23'	26.55	14.69	194.5	150.7		90.62	0.85	26.6

APOLLO 16

(B-14)

UNIVERSITY OF CALIFORNIA
Soil Mechanics Laboratory

APOLLO 16 - LSRP

Date 11/12 MAY 1972

FLIGHT UNIT (% 2004)

Lunar Penetration Data Reduction

LUNAR DRUM (% 2008)

Index No. 12 Page No. 1

0.2 in² cone =

	↗ x.5542 ↘					↗ x.313 ↘	
DRUM LMD λ	DRUM LOAD λ	DRUM CIRCUMF.	LOAD Newtons	STRESS		Δ DRUM DEPTH	ACTUAL PENETR.
deg-min	degrees	DEFLECTION mm.	(from calib.cure)	newton/cm ²	INITIAL DRUM DEPTH cm	READING cm.	DEPTH cm.
0°00'	0.00	0.00	0.0	0.0	87.72	0.00	0.0
0°00'	0.00	0.00*	3.5	2.7	87.82	0.08	2.5
11°36'	11.60	6.43	87.1	67.5	87.82	0.08	2.5
5°30'	5.50	3.04	43.0	33.3	87.87	0.08	2.5
9°45'	9.75	5.40	73.7	57.1	87.91	0.12	3.8
6°37'	6.62	3.66	51.1	39.6	87.96	0.17	5.3
6°37'	6.62	3.66	51.1	39.6	90.01	0.22	6.9
9°23'	9.38	5.20	71.1	55.1	90.10	0.31	9.7
11°26'	11.43	6.34	85.9	66.6	90.22	0.43	13.5
12°40'	12.67	7.01	94.6	73.3	90.23	0.44	13.8
12°40'	12.67	7.01	94.6	73.3	90.24	0.45	14.1
11°31'	11.52	6.39	86.6	67.1	90.25	0.46	14.4
11°47'	11.78	9.30	124.4	96.4	90.25	0.46	14.4
17°41'	17.68	9.78	130.6	125.9	90.26	0.49	15.3
18°39'	18.65	10.31	137.5	106.6	90.62	0.83	26.0
25°31'	25.52	14.18	187.8	145.5	90.62	0.83	26.0
24°52'	24.87	13.78	182.6	141.5	90.62	0.83	26.0
24°52'	24.87	13.78	182.6	141.5	90.68	0.79	27.9
15°26'	15.43	8.55	114.7	88.9	90.68	0.89	27.9
29°05'	29.00	16.05	212.1	164.4	90.68	0.89	27.9

UNIVERSITY OF CALIFORNIA
Soil Mechanics Laboratory

APOLLO 16 - LSRP

Date 11/12 MAY 1972

FLIGHT UNIT (SN 2004)

Lunar Penetration Data Reduction

LUNAR DRUM (SN 2008)

Index No. 13 Page No. 1

0.2 in² conc

	↗ x.5542	↓					↖ x.31.3	↓	
DRUM LMD &	DRUM LOAD &	DRUM CIRCUMF.	LOAD Newtons	STRESS		INITIAL SCALE DEPTH	Δ DRUM DEPTH	ACTUAL PENETR.	
deg-min	degrees	DEFLECTION mm.	(from calib. curve)	newton/ cm ²		Final cm	READING cm.	DEPTH cm.	
0°00'	0.00	0.00	0.0	0.0		89.77	0.00	0.0	
0°00'	0.00	0.00*	3.5	2.7		89.96	0.17	5.3	
8°52'	8.87	4.92	67.5	52.3		89.98	0.19	6.0	
8°28'	8.47	4.69	64.5	50.0		89.02	0.23	7.2	
9°30'	7.50	4.16	57.6	44.6		90.02	0.23	7.2	
14°22'	14.37	7.96	107.0	82.9		90.02	0.23	7.2	
16°00'	16.00	8.87	118.8	92.1		90.04	0.25	7.8	
17°40'	17.67	9.79	130.8	101.4		90.50	0.71	22.2	
11°10'	16.17	8.96	120.0	93.0		90.66	0.87	27.2	
13°05'	13.08	7.25	97.8	75.8		90.71	0.92	28.8	
13°05'	13.08	7.25	97.8	75.8		90.78	0.99	31.0	
13°35'	13.58	7.53	101.4	78.6		90.83	1.04	32.6	
13°35'	13.58	7.53	101.4	78.6		90.82	1.13	35.4	
11°45'	11.75	6.51	88.1	68.3		91.07	1.29	40.4	
13°24'	13.40	7.43	100.1	77.6		91.17	1.38	43.2	
13°24'	13.40	7.43	100.1	77.6		91.24	1.45	45.4	
23°57'	23.98	13.29	176.3	136.6		91.24	1.45	45.4	
24°15'	24.25	13.44	178.2	138.1		91.29	1.50	47.0	
25°52'	25.87	14.34	189.9	147.2		91.32	1.53	47.9	
27°30'	27.00	14.96	198.0	153.5		91.77	2.00	62.6	

0°00 0.00 0.00* 3.5 2.7

91.77 TREADWELL & MORIWAKI
2.00 62.6

UNIVERSITY OF CALIFORNIA
Soil Mechanics Laboratory

APOLLO 16 - LSRP

Date 11/12 MAY 1972

FLIGHT UNIT (SN 2004)

Lunar Penetration Data Reduction

LUNAR DRUM (SN 2008)

Index No. 15 Page No. 1

1" x 5" plate = 32.258 cm²

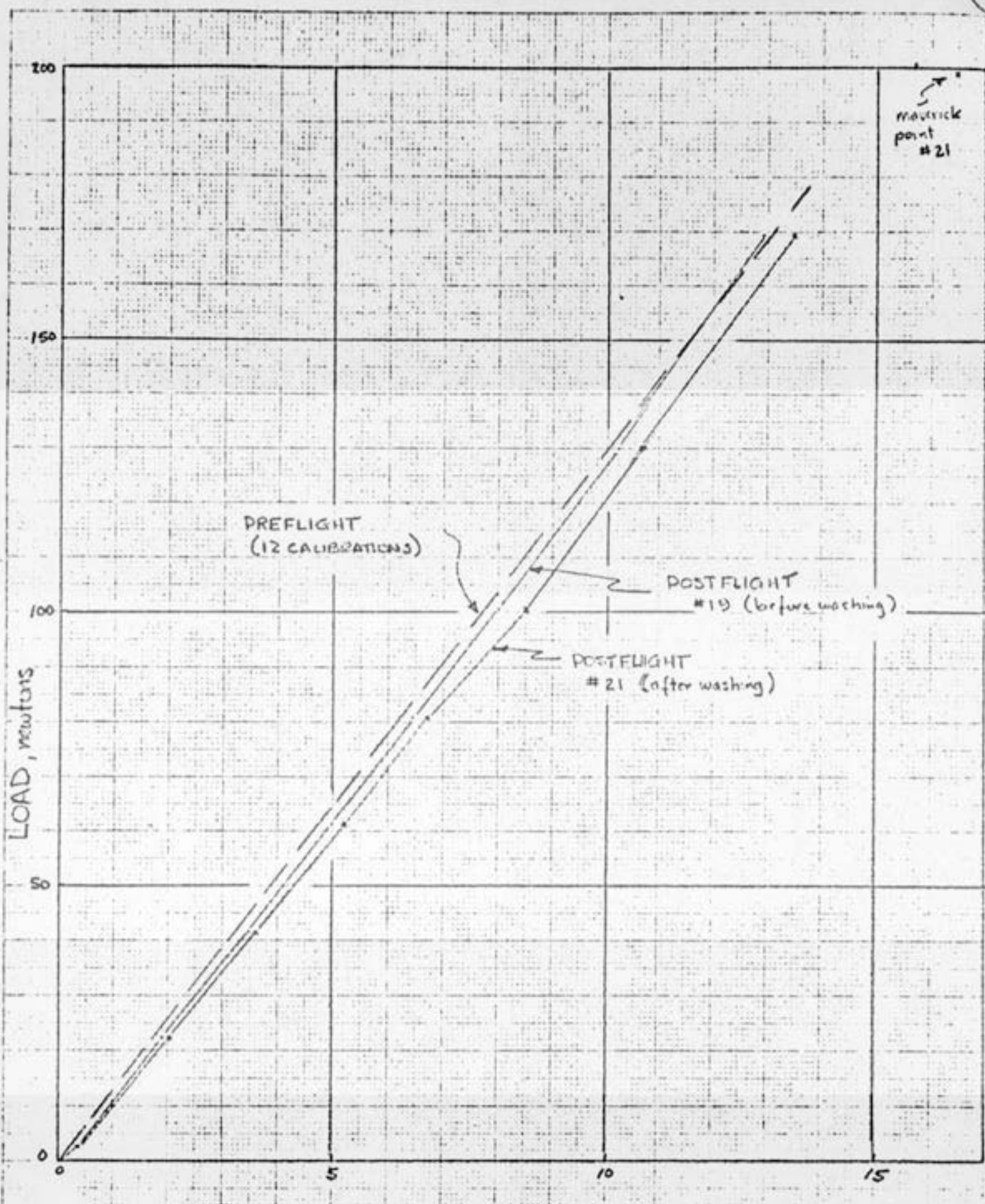
	→ X.5542	↘					→ X.31.3	↘	
DRUM LOAD λ	DRUM LOAD λ	DRUM CIRCUMF.	LOAD Newtons	STRESS		initial Dial Depth	Δ DRUM DEPTH	ACTUAL DEPTH.	
deg-min	degrees	DEFECTION mm.	(from calib. cone)	newtons/ cm ²		Final cm	READING cm.	DEPTH cm.	
0°00'	0.00	0.00	0.0	0.00		89.79	0.00	0.0	
0°00'	0.00	0.00*	3.5	0.11		89.82	0.09	2.8	
3°38'	3.63	2.01	29.6	0.92		89.81	0.10	3.1	
4°02'	4.03	2.23	32.5	1.01		89.71	0.12	3.8	
5°20'	5.33	2.95	41.9	1.30		89.71	0.12	3.8	
5°30'	5.50	3.05	43.2	1.34		89.92	0.13	4.1	
8°24'	8.40	4.66	64.1	1.99		89.92	0.13	4.1	
8°24'	8.40	4.66	64.1	1.99		89.94	0.15	4.7	
10°02'	10.03	5.56	75.8	2.35		89.94	0.15	4.7	
16°55'	16.92	9.38	125.4	3.89		89.98	0.19	6.0	
17°13'	17.22	9.54	127.5	3.95		90.00	0.21	6.6	
23°43'	23.72	13.15	174.5	5.41		90.01	0.22	6.9	
23°43'	23.72	13.15	174.5	5.41		90.02	0.23	7.2	
29°35'	29.58	16.39	216.6	6.71		90.04	0.25	7.8	
29°35'	29.58	16.39	216.6	6.71		90.06	0.26	8.1	
27°40'	27.67	15.33	202.8	6.29		90.06	0.26	8.1	
25°15'	25.25	13.99	185.4	5.75		90.10	0.31	9.7	
0°00'	0.00	0.00*	3.5	0.11		90.10	0.31	9.7	

©

APOLLO 16 - LSRP

POST-FLIGHT CALIBRATION

PERMANENT RECORD COPY
FORM 10 X 10 THE CONTINENTAL
NO. 1215



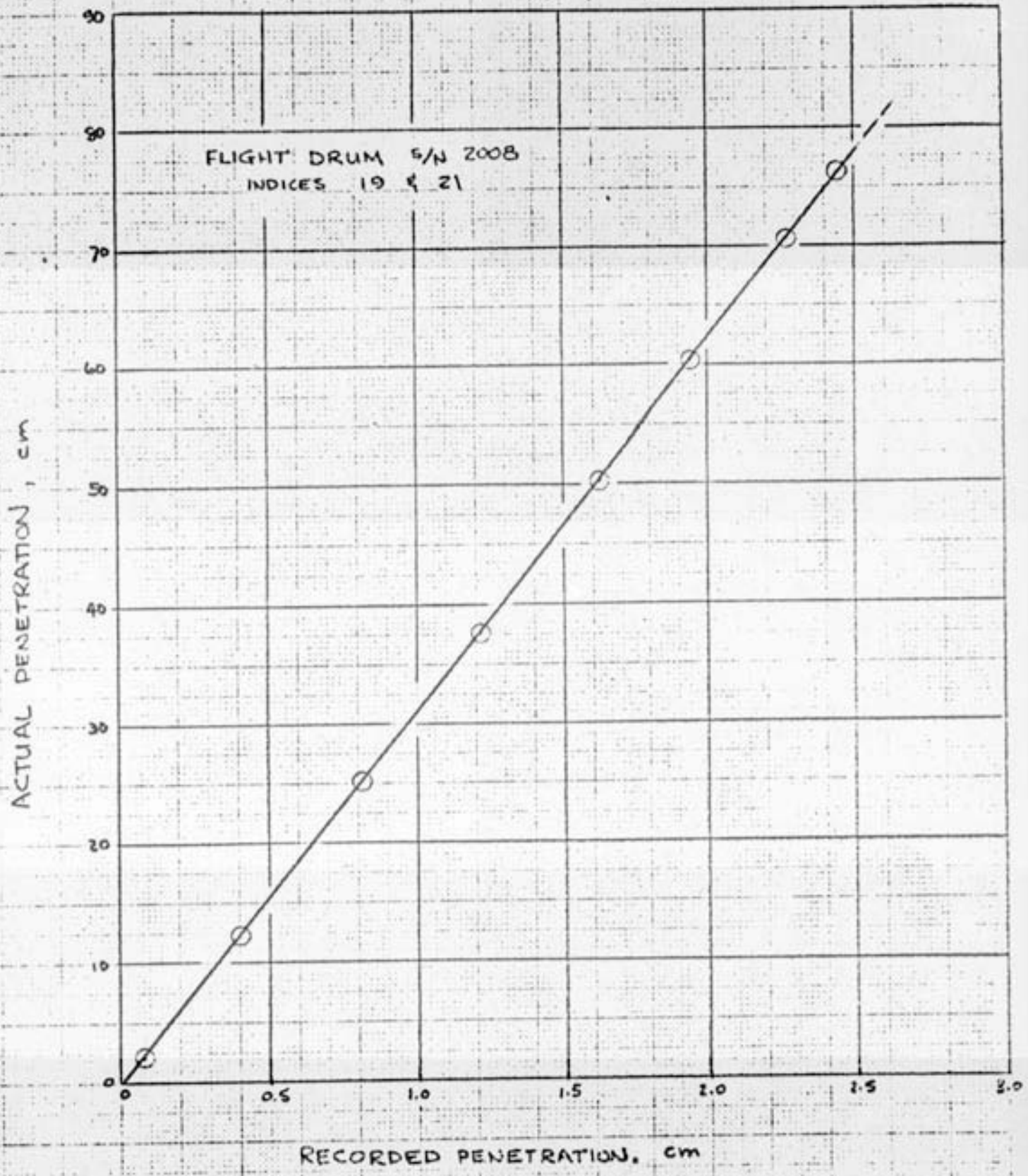
DRUM CIRCUMFERENTIAL DEFLECTION, mm

POSTFLIGHT LOAD CALIBRATION - APOLLO 16 LSRP.

+ COMPARISON WITH PREFLIGHT

DDT

RATIO $\frac{\text{ACTUAL}}{\text{RECORDED}} = 31.25$



REPRODUCED FROM THE ORIGINAL DRAWING BY THE ENGINEERING DEPARTMENT, NASA

POSTFLIGHT PENETRATION CALIBRATION - APOLLO 16 LSRP

DDT

UNIVERSITY OF CALIFORNIA
Soil Mechanics Laboratory

APOLLO 16 - LSRP

Date 11/12 MAY 1972

FLIGHT UNIT ()

Lunar Penetration Data Reduction

LUNAR DRUM (5/8 2008)

Page No. _____

Index #21

DRUM LOAD α	DRUM LOAD λ	DRUM CIRCUMF. DEFL. (mm)	LOAD RECTIONS (lb)	DRUM DEPTH PLAS cm	Δ DRUM DEPTH REORDER cm.	ACTUAL PENETR. DEPTH cm.
0°00'	0.00	0.0		89.80	0.08	0.0
0°41'	0.67	0.37	2.41	89.80		
0°41'				89.88	0.08	2.17
3°37'	3.62	2.04	22.05	89.88		
3°37'				90.20	0.40	12.23
6°30'	6.50	3.60	41.6	90.20		
6°50'				90.61	0.81	25.03
9°26'	9.43	5.22	61.2	90.61		
9°26'				91.02	1.22	37.60
12°06'	12.10	6.70	80.9	91.02		
12°06'				91.42	1.62	50.28
15°22'	15.37	8.51	100.6	91.42		
15°22'				91.75	1.95	60.43
19°15'	19.25	10.66	130.0	91.75		
19°15'				92.07	2.27	70.59
24°22'	24.37	13.48	169.3	92.07		
24°22'				92.24	2.44	76.2
0°00'	0.00			92.24		
SPECIAL PT = 29°45' = 29.75° = 44.71'						

57.5'

AFTER WASHING w/ALCOHOL

TRENDWELL & MORIWAKI

UNIVERSITY OF CALIFORNIA
Soil Mechanics Laboratory

APOLLO 16 - LSRP

Date 11/12

MAY 1972

FLIGHT UNIT ()

Lunar Penetration Data Reduction

LUNAR DRUM (SN 2008)

Page No. _____

(POST-IMPACT CORRECTIONS) Index #19

DRUM LOAD λ	DRUM LOAD λ	DRUM CIRCUF.	LOAD NEWTONS		MARK DEPTH	A DRUM DEPTH	ACTUAL DEPTH
deg-min	degrees	DEFLCEN mm.	(N.B.K.N.)		cm	READING cm.	DEPTH cm.
0°00'	0.00	0.00	0		89.80	0.00	0.0
0°35'	0.58	0.32	2.41		89.80		
0°35'					89.88	0.08	2.17
3°26'	3.43	1.90	22.05		89.88		
3°26'					90.20	0.40	12.23
6°18'	6.30	3.49	41.6		90.20		
6°18'					90.61	0.81	25.03
9°00'	9.00	4.98	61.2		90.61		
9°00'					91.01	1.21	37.60
11°37'	11.62	6.44	80.9		91.01		
11°37'					91.42	1.62	50.28
14°26'	14.43	8.00	100.6		91.42		
14°26'					91.74	1.94	60.43
18°26'	18.43	10.20	130.0		91.74		
18°26'					92.07	2.27	70.59
23°18'	23.30	12.90	169.3		92.07		
23°18'					92.24	2.44	76.2
0°00'					92.24		

BEFORE WASHING w/ ALCOHOL

TRENDEWELL & MORIWAKI

POST-FLIGHT CALIBRATION - APOLLO 16 LSRP performed at Lockheed Building, Houston 5-2-72

LOADING SEQUENCE

	TOTAL PEN.		TOTAL LOAD	
	in	cm	kg	N
no penetration	0	0	0.245	2.41
add cap (0.245 kg)				
1 st set of rods		2.17	2.245	22.05
add 2 kg				
2 nd set of rods		12.23	4.245	41.6
add 2 kg				
3 rd set of rods		25.03	6.245	61.2
add 2 kg				
4 th set of rods		37.60	8.245	80.9
add 2 kg				
5 th set of rods		50.28	10.245	100.6
add 2 kg				
6 th set of rods		60.43	13.245	130.0
add 3 kg				
7 th set of rods		70.59	17.245	169.3
add 4 kg				
go to latches		76.2		
remove all load (including cap)			0	0

special point on index #21 44.71 # \approx 199 N
@ 29.75° = 16.45 mm

Lockheed Bldg; Houston

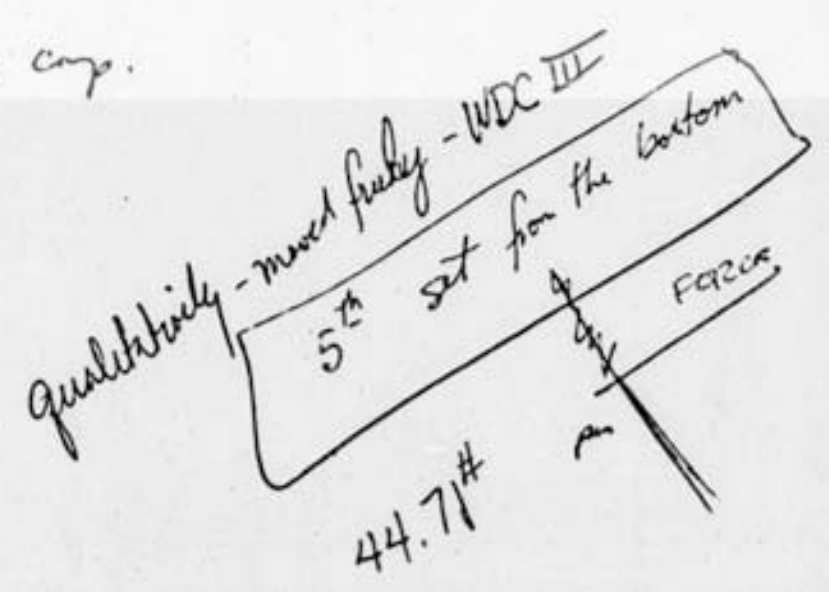
bottom out		
No penetration		Total load
	add cap (0.245 kg)	+ 0.245
1 st set rds		
	add 2kg ✓ ✓	2.245
2 nd set "		
	add 2kg ✓ ✓	4.245
3 rd set "		
	add 2kg ✓	6.245
4 th set "		
	add 2kg ✓	8.245
5 th set "		
	add 2 kg ✓	10.245
6 th set "		
	add 3	13.245
7 th set "		
	add 4 kg	17.245
	take off all load including cap	

go to latches

take off load including cap.

with dirt on Index 19

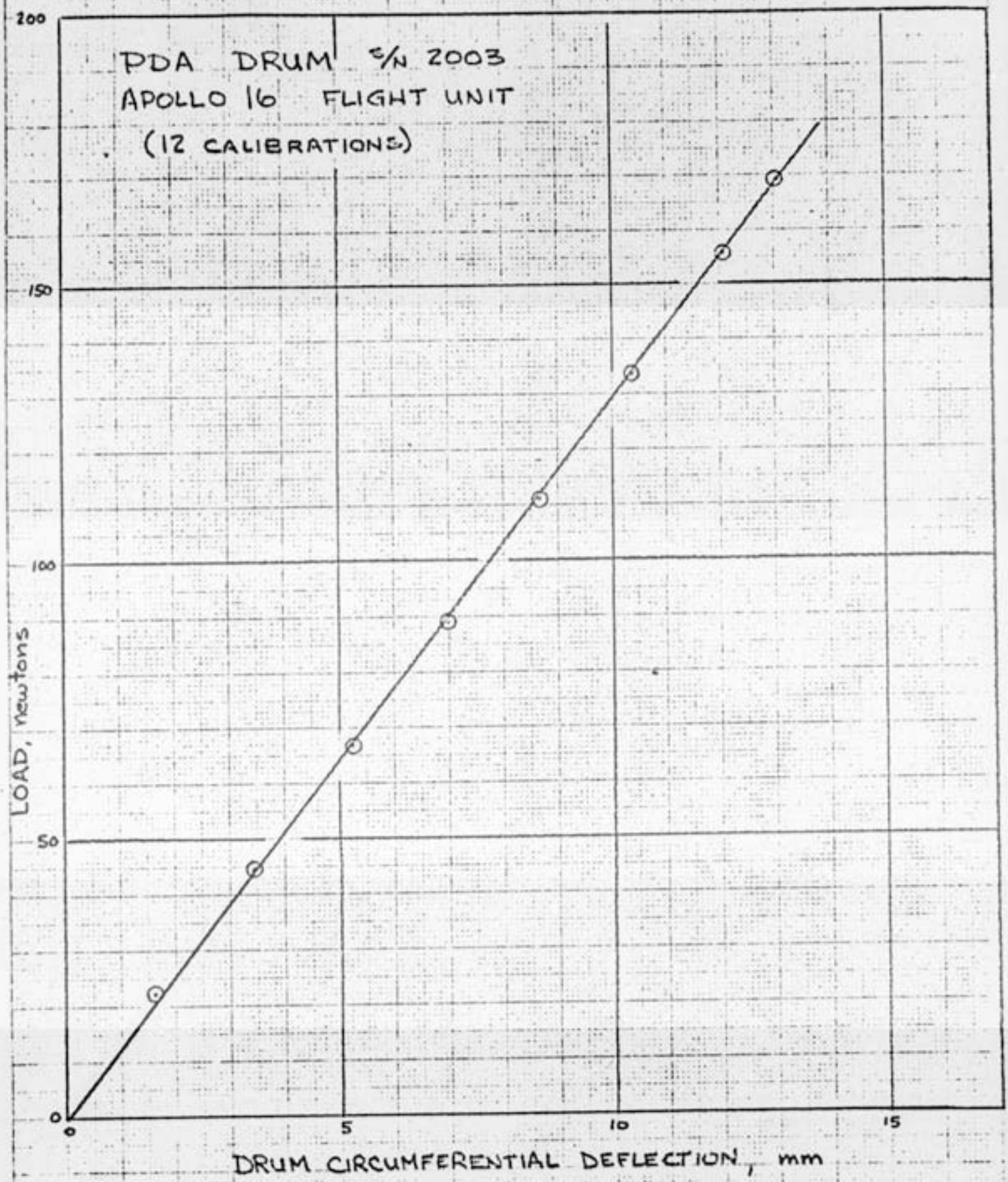
cleaned on Index 21 -



①

APOLLO 16 -LSRP

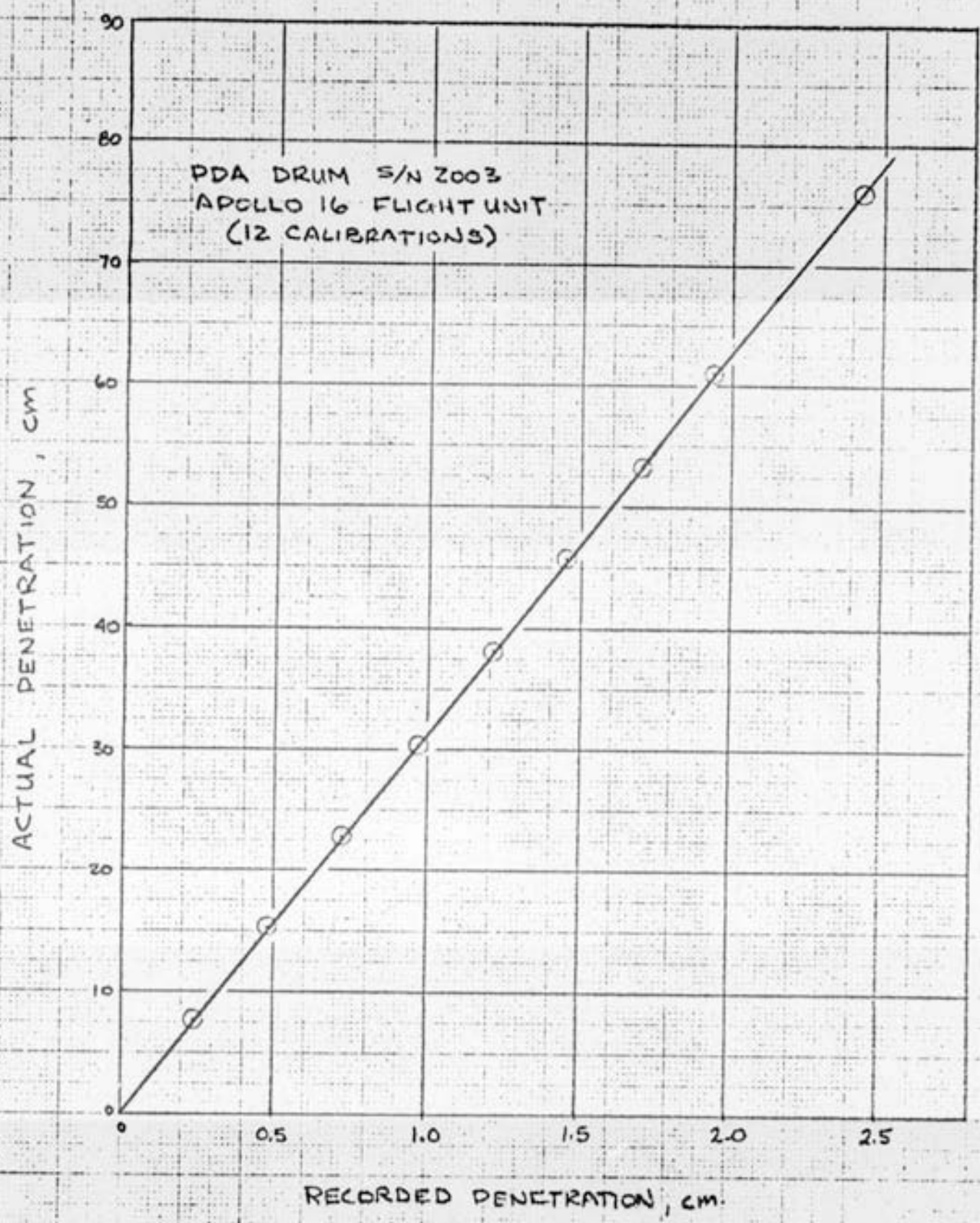
PRE-FLIGHT CALIBRATION



PREFLIGHT LOAD CALIBRATION - APOLLO 16 LSRP

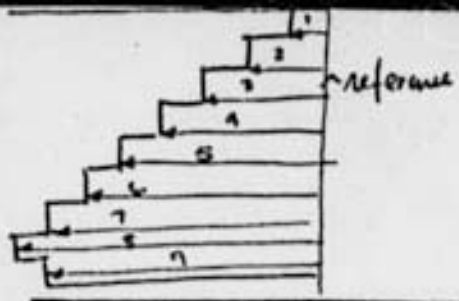
REPRODUCED FROM THE REPORT OF THE
COMMISSION ON THE SPACE SHUTTLE
PROGRAM

RATIO $\frac{\text{ACTUAL}}{\text{RECORDED}} = 31.3$



PREFLIGHT PENETRATION CALIBRATION - APOLLO 16 LSRP

10 X 10 TO THE CENTIMETER NO. 1215



UNIVERSITY OF CALIFORNIA
Soil Mechanics Laboratory

Date 19 April 1972

DEADWEIGHT LOADING

NASA Drum No. S/N 2003

"REPERMUTATION CALIBRATION"
"LOAD"

INDEX #	AZIMUTH									
	REF.	1	2	3	4	5	6	7	8	9
1	0°00'	2°53'	5°15'	10°02'	13°25'	17°06'	19°15'	21°46'	23°25'	21°46'
3	33°01'	32°57'	31°31'	29°33'	42°57'	45°25'	48°24'	51°51'	53°32'	52°51'
5	60°10'	63°03'	66°22'	69°39'	72°50'	75°25'	77°51'	79°50'	81°42'	82°50'
7	90°15'	92°52'	96°25'	99°43'	103°00'	106°01'	109°07'	112°12'	115°17'	112°12'
9	120°03'	123°05'	126°32'	129°52'	132°25'	135°00'	138°30'	142°00'	145°30'	142°00'
11	150°07'	152°01'	155°13'	159°33'	162°40'	165°25'	168°57'	172°30'	176°00'	172°30'
13	180°05'	183°01'	186°12'	189°34'	192°40'	195°45'	198°48'	201°50'	205°00'	201°50'
15	210°02'	213°02'	216°17'	219°31'	222°35'	225°26'	228°26'	231°24'	234°30'	231°24'
17	240°00'	242°57'	246°16'	249°31'	252°37'	255°42'	258°46'	261°51'	265°00'	261°51'
19	270°15'	272°52'	276°36'	279°15'	282°22'	285°26'	288°25'	291°24'	294°30'	291°24'
21	300°00'	302°58'	306°12'	309°31'	312°30'	315°31'	318°47'	321°36'	324°30'	321°36'
23	330°00'	332°05'	336°12'	339°24'	342°34'	345°31'	348°41'	351°42'	354°30'	351°42'
1	VV	VV	VV	VV	VV	VV	VV	VV	VV	VV
LOAD lbs	5	10	15	20	25	30	35	33	35	
LOAD, N	22.25	44.5	66.8	89.0	111.1	133.5	155.8	149.1	155.8	
AVG dy	2°54'	6°12'	9°27'	12°36'	15°38'	18°43'	21°48'	23°34'	21°48'	
AVG deg.	2.90°	6.20°	9.45°	12.60°	15.63°	18.72°	21.80°	23.57°	21.90°	
AVG ..	1.605	3.43	5.73	6.98	8.66	10.37	12.06	13.02	12.06	

REF.	1	2	3	4	5	6	7	8	9
1	0°00' / 2°50'	7°15' / 7°15'	10°02' / 10°02'	13°25' / 13°25'	17°46' / 17°46'	19°15' / 19°15'	21°46' / 21°46'	23°35' / 23°35'	21°46' / 21°46'
3	30°01' / 32°57'	37°07' / 7°06'	39°33' / 9°32'	42°38' / 12°37'	45°35' / 15°34'	48°34' / 18°33'	51°51' / 21°50'	53°33' / 23°32'	52°51' / 21°50'
5	60°10' / 63°03'	66°22' / 6°12'	69°39' / 9°29'	72°50' / 12°40'	75°53' / 15°43'	78°52' / 18°42'	82°00' / 21°50'	83°52' / 23°42'	82°00' / 21°50'
7	90°15' / 93°08'	96°26' / 6°11'	99°43' / 9°28'	103°00' / 12°45'	106°01' / 15°46'	109°07' / 18°52'	112°12' / 21°57'	113°52' / 23°37'	112°12' / 21°57'
9	120°08' / 123°05'	126°22' / 6°14'	129°32' / 9°24'	132°50' / 12°42'	135°58' / 15°50'	138°59' / 18°51'	142°00' / 21°52'	143°53' / 23°45'	142°00' / 21°52'
11	150°07' / 153°01'	156°13' / 6°06'	159°30' / 9°23'	162°47' / 12°40'	165°55' / 15°48'	168°57' / 18°50'	172°00' / 21°53'	173°51' / 23°44'	172°00' / 21°53'
13	180°05' / 183°01'	186°10' / 6°05'	189°34' / 9°29'	192°40' / 12°35'	195°45' / 15°40'	198°45' / 18°40'	201°56' / 21°51'	203°43' / 23°38'	201°56' / 21°51'
15	210°08' / 213°02'	216°25' / 6°17'	219°31' / 9°23'	222°35' / 12°27'	225°36' / 15°28'	228°36' / 18°28'	231°42' / 21°34'	233°15' / 23°07'	231°42' / 21°34'
17	240°00' / 242°52'	246°16' / 6°16'	249°31' / 9°31'	252°37' / 12°37'	255°40' / 15°40'	258°48' / 18°48'	261°51' / 21°51'	263°36' / 23°36'	261°51' / 21°51'
19	269°55' / 272°52'	276°06' / 6°11'	279°15' / 9°20'	282°30' / 12°35'	285°15' / 15°20'	288°35' / 18°40'	291°42' / 21°47'	293°28' / 23°33'	281°42' / 21°47'
21	300°00' / 302°58'	306°12' / 6°12'	309°31' / 9°31'	312°30' / 12°30'	315°31' / 15°31'	318°47' / 18°47'	321°39' / 21°39'	323°30' / 23°30'	321°39' / 21°39'
23	330°00' / 332°50'	336°12' / 6°12'	339°24' / 9°24'	342°34' / 12°34'	345°34' / 15°34'	348°41' / 18°41'	351°42' / 21°42'	353°29' / 23°29'	351°42' / 21°42'

D-4

UNIVERSITY OF CALIFORNIA
Soil Mechanics Laboratory

Date 19 April 1972

DEADWEIGHT LOADING

NASA Drum No. S/N 2003

"PENETRATION CALIBRATION"

INDEX											DELTA FROM REF. cm
NO. ↓	REF.	A	B	C	D	E	F	G	H	I	
1	89.87	90.11	90.35	90.53	90.74	91.02	91.32	91.57	91.81	92.30	
3											
5											
7											
9											
11											
13											
15											
17											
19											
21											
23											
AVERAGE Δ	0.00	0.24	0.48	0.72	0.97	1.21	1.45	1.70	1.94	2.43	
EQUIV inches	0	3	6	9	12	15	19	21	24	30	
EQUIV cm.	0	7.62	15.24	22.85	30.5	38.1	45.7	53.3	61.0	76.2	

cm. RDR, cm.
K