

ORIGINAL

# BSU GEOPHYSICS VSP OBSERVER'S LOG

Coordinate System Origin at Borehole  
Casing Elevation: 0.64 m above G.L.

Reference Phone: Offset: 2.21 m

Azimuth x-axis: 90°

Azimuth 180

Azimuth y-axis: 90°

Elev. 0.10 m below G.L.

Well Coord: X= 9999.86(m)

datum

Y= 10002.81(m) Z= +850.29(m)

Channel

Borehole Phone

V=Channel 1

R=Channel 2

T=Channel 3

Reference Phone

V=Channel 4

R=Channel 5

T=Channel 6

Ref. Polarization:

V

R

T

Vert.

0

90

90

Date: 14 Oct 97

High-Cut 1000

Location: URISP B1

Low-Cut 4

Sample Int. 0.0002

Number Samples 2500

Shot		Borehole Phone			Source				Source Polarization		
Rec.	File	Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Azimuth	Vertical	
1	WLB10001	18.75		1.17(m)	180°		0(m)	-1.17(m)	270°	135°	
2		18.75							90°	135°	
3		18.50							270°	135°	
4		18.50							90°	135°	
5		18.25							270°	135°	
6		18.25							90°	135°	
7		18.0							270°	135°	
8		18.0							90°	135°	
9		17.75							270°	135°	
10	WLB10010	17.75							90°	135°	

Water table @ 9.804 m sub CE = 2.987 m sub CE [847.30 m elevation]  
T/D = (19.34 m)

# BSU GEOPHYSICS VSP OBSERVER'S LOG

Coordinate System Origin at Borehole

Casing Elevation: 0.64 m above G.L.

Azimuth x-axis: 90°

Azimuth y-axis: 0°

Well Coord: X= 9999.86(m) Y= 10002.81(m) Z= +850.29(m)

Channel Configuration: Borehole Phone V=Channel 1 Reference Phone V=Channel 4

R=Channel 2 R=Channel 5

T=Channel 3 T=Channel 6

Date: 14 Oct 97 Location: URISP B1

High-Cut 1000 Low-Cut 4 Sample Int. .0002

Number Samples 2500

Reference Phone: Offset: 2.21 m

Azimuth 180

Elev. 0.10 m below G.L.

X= 0 m

Y= -2.21 m

Ref. Polarization: Az 0

V 0

R 90

T 90

Vert. 0

90

90

Shot		Borehole Phone			Source			Source Polarization		
Rec.	File	Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Azimuth	Vertical
11	WLB1 0011	17.5					0 (m)	-1.17(m)	270°	135
12		17.5							90°	135
13		17.25							270°	135
14		17.25							90°	135
15		17.0							270°	135
16		17.0							90°	135
17		16.75							270°	135
18		16.75							90°	135
19		16.50							270°	135
20	WLB10020	16.50							90°	135

# BSU GEOPHYSICS VSP OBSERVER'S LOG

Coordinate System Origin at Borehole  
Casing Elevation: 0.64 m above G.L.

Reference Phone: 2.21 m

Azimuth x-axis: 90°

Azimuth 180

Azimuth y-axis: 0°

Elev. 0.10 m below G.L.

Well Coord: X= 9999.86(m)

Y= 10002.81(m)

Z= +850.29(m)

Channel

Borehole Phone

Reference Phone

Configuration:

V=Channel 1

V=Channel 4

R=Channel 2

R=Channel 5

T=Channel 3

T=Channel 6

Vert.

Az

0

0

90

0

90

270

Date: 14 Oct 97

Location: URISP B1

High-Cut 1000

Low-Cut 4

Sample Int. .0002

Number Samples 2500

Shot		Borehole Phone			Source			Source Polarization		
Rec.	File	Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Azimuth	Vertical
21	WLB0021	16.25					0(m)	-1.17(m)	270°	135
22		16.25							90°	135
23		16.0							270°	135
24		16.0							90°	135
25		15.75							270°	135
26		15.75							90°	135
27		15.50							270°	135
28		15.50							90°	135
29		15.25							270°	135
30	WLB10030	15.25							90°	135

11:17

# BSU GEOPHYSICS VSP OBSERVER'S LOG

Coordinate System Origin at Borehole

Casing Elevation: 0.64 m above G.L.

Azimuth x-axis: 90°

Azimuth y-axis: 0°

Well Coord: X = 9999.86(m) Y = 10002.81(m) Z = +850.29(m)

Channel

Configuration:

Borehole Phone

V=Channel 1

R=Channel 2

T=Channel 3

Reference Phone

V=Channel 4

R=Channel 5

T=Channel 6

Ref. Polarization:

V 0

R 0

T 270

Vert.

0

90

90

Reference Phone: Offset: 2.21 m

Azimuth 180

Elev. 0.10 m below G.L.

X = 0 m

Y = -2.21 m

Date: 14 Oct 97

High-Cut 1000

Location: URISP B1

Low-Cut 4

Sample Int. .0002

Number Samples 2500

Shot		Borehole Phone			Source			Source Polarization		
Rec.	File	Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Azimuth	Vertical
31	WLB10031	15.0					0(m)	-1.17(m)	270°	135
32		15.0							90°	135
33		14.75							270°	135
34		14.75							90°	135
35		14.50							270°	135
36		14.50							90°	135
37		14.25							270°	135
38		14.25							90°	135
39		14.0							270°	135
40	WLB10040	14.0					0	0	90°	135

11:23

# BSU GEOPHYSICS VSP OBSERVER'S LOG

Coordinate System Origin at Borehole

Casing Elevation: 0.64 m above G.L.

Azimuth x-axis: 90°

Azimuth y-axis: 0°

Well Coord: X = 9999.86(m) Y = 10002.81(m) Z = +850.29(m)

Channel

Configuration: Borehole Phone V=Channel 1

R=Channel 2

T=Channel 3

Reference Phone V=Channel 4

R=Channel 5

T=Channel 6

Date: 14 Oct 97 Location: URISP B1

High-Cut 1000 Low-Cut 4 Sample Int. .0002

Number Samples 2500

Reference Phone: Offset: 2.21 m

Azimuth 180

Elev. 0.10 m below G.L.

X = 0 m

Y = -2.21 m

Ref. Polarization: Az

V 0

R 0

T 270

Vert. 0

90

90

Shot		Borehole Phone			Source			Source Polarization		
Rec.	File	Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Azimuth	Vertical
41	WLB10041	13.75					0(m)	-1.17(m)	270°	135
42		13.75							90°	
43		13.50							270°	
44		13.50							90°	
45		13.25							270°	
46		13.25							90°	
47		13.0							270°	
48		13.0							90°	
49		12.75							270°	
50	WLB10050	12.75							90°	

11:30

# BSU GEOPHYSICS VSP OBSERVER'S LOG

Coordinate System Origin at Borehole

Casing Elevation: 0.64 m above G.L.

Azimuth x-axis: 90°

Azimuth y-axis: 0°

Well Coord: X= 9999.86(m) Y= 10002.81(m) Z= +850.29(m)

Channel

Configuration: Borehole Phone V=Channel 1

R=Channel 2

T=Channel 3

Reference Phone V=Channel 4

R=Channel 5

T=Channel 6

Date: 14 Oct 97 Location: URISP B1

High-Cut 1000 Low-Cut 4 Sample Int. .0002

Number Samples 2500

Shot		Borehole Phone			Source			Source Polarization		
Rec.	File	Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Azimuth	Vertical
51	WL810051	12.5					0(m)	-1.17(m)	270°	135
52		12.5					1		90°	
53		12.25							270°	
54		12.25							90°	
55		12.0							270°	
56		12.0							90°	
57		11.75							270°	
58		11.75							90°	
59		11.50							270°	
60	WL810060	11.50					N	N	90°	V

16:38

# BSU GEOPHYSICS VSP OBSERVER'S LOG

Coordinate System Origin at Borehole  
Casing Elevation: 0.64 m above G.L.

Reference Phone: 2.21 m

Azimuth x-axis: 90°

Azimuth 180°

Elev. 0.10 m below G.L.

Azimuth y-axis: 0°

X = 0 m

Y = -2.21 m

Well Coord: X = 9999.86(m) Y = 10002.81(m) Z = +850.29(m)

Channel

Borehole Phone

V=Channel 1

R=Channel 2

T=Channel 3

Reference Phone

V=Channel 4

R=Channel 5

T=Channel 6

Ref. Polarization:

V 0

R 0

T 270

Vert.

0

90

90

Date: 14 Oct 97

Location: URISP B1

High-Cut 1000 Low-Cut 4 Sample Int. .0002

Number Samples 2500

Shot		Borehole Phone			Source			Source Polarization		
Rec.	File	Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Azimuth	Vertical
61	WLBS10061	11.25					0 (m)	-1.17 (m)	270°	135
62		11.25							90°	
63		11.00							270°	
64		11.00							90°	
65		10.75							270°	
66		10.75							90°	
67		10.50							270°	
68		10.50							90°	
69		10.25							270°	
70	WLBS10070	10.25							90°	V

11-43

# BSU GEOPHYSICS VSP OBSERVER'S LOG

Coordinate System Origin at Borehole  
Casing Elevation: 0.64 m above G.L.

Reference Phone: 2.21 m

Azimuth x-axis: 90°

Azimuth 180

Azimuth y-axis: 0°

Elev. 0.10 m below G.L.

Well Coord: X = 9999.86(m) Y = 10002.81(m) Z = +850.29(m)

§ datum

Channel

Reference Phone

Configuration: V=Channel 1

V=Channel 4

R=Channel 2

R=Channel 5

T=Channel 3

T=Channel 6

Ref. Polarization: Az

V

R

T

Vert.

0

90

90

Date: 14 Oct 97

Location: URISP B1

High-Cut 1000 Low-Cut 4 Sample Int. .0002

Number Samples 2500

Shot		Borehole Phone			Source			Source Polarization		
Rec.	File	Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Azimuth	Vertical
71	WLB10071	10.0					0(m)	-1.17(m)	270°	135°
72		10.0							90°	
73		9.75							270°	
74		9.75							90°	
75		9.50							270°	
76		9.50							90°	
77		9.25							270°	
78		9.25							90°	
79		9.00							270°	
80	WLB10080	9.00							90°	

11:50



# BSU GEOPHYSICS VSP OBSERVER'S LOG

Coordinate System Origin at Borehole

Casing Elevation: 0.64 m above G.L.

Reference Phone: Offset: 2.21 m

Azimuth x-axis: 70° Azimuth 180° m below G.L.

Azimuth y-axis: 70° Elev. 0.10 m

Well Coord: X= 9999.86(m) Y= 10002.81(m) Z= +850.29(m)

Channel Configuration: Borehole Phone Reference Phone

V=Channel 1 V=Channel 4

R=Channel 2 R=Channel 5

T=Channel 3 T=Channel 6

Ref. Polarization: Az Vert.

V 0 0

R 0 90

T 270 90

Date: 14 Oct 97

High-Cut 1000 Location: URISP B1

Number Samples 2500

Sample Int. .0002

Shot		Borehole Phone			Source			Source Polarization		
Rec.	File	Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Azimuth	Vertical
81	WLB10081	8.75					0(m)	-1.17(m)	270°	135
82		9.75							90°	
83		8.50							270°	
84		8.50							90°	
85		8.25							270°	
86		8.25							90°	
87		8.00							270°	
88		8.00							90°	
89		7.75							270°	
90	WLB10090	7.75							90°	

11:57

rec'd

# BSU GEOPHYSICS VSP OBSERVER'S LOG

Coordinate System Origin at Borehole

Casing Elevation: 0.64 m above G.L.

Azimuth x-axis: 70°

Azimuth y-axis: 70°

Well Coord: X= 9999.86(m) Y= 10002.81(m) Z= +850.29(m)

Channel

Configuration:

Borehole Phone

V=Channel 1

R=Channel 2

T=Channel 3

Reference Phone

V=Channel 4

R=Channel 5

T=Channel 6

Ref. Polarization:

Az 0

V 0

R 90

T 90

Vert. 0

Date: 14 Oct 97

Location: URISP B1

High-Cut 1000

Low-Cut 4

Sample Int. .0002

Number Samples 2500

Shot		Borehole Phone		Source				Source Polarization			
Rec.	File	Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Azimuth	Vertical	
91	WLB10091	7.50					0(m)	-1.17(m)	270°	135°	
92		7.50							90°	135°	
93		7.25							270°		
94		7.25							90°		
95		7.00							270°		
96		7.00							90°		
97		6.75							270°		
98		6.75							90°		
99		6.50							270°		
100	WLB10100	6.50							90°		

# BSU GEOPHYSICS VSP OBSERVER'S LOG

Coordinate System Origin at Borehole

Casing Elevation: 0.64 m above G.L.

Azimuth x-axis: 90°

Azimuth y-axis: 90°

Well Coord: X= 9999.86(m) Y= 10002.81(m) Z= +850.29(m)

Channel Configuration: Borehole Phone V=Channel 1

R=Channel 2

T=Channel 3

Reference Phone V=Channel 4

R=Channel 5

T=Channel 6

Ref. Polarization: Az 0

V 0

R 90

T 90

Date: 14 Oct 97

Location: URISP B1

High-Cut 1000

Low-Cut 4

Sample Int. .0002

Number Samples 2500

Reference Phone: Offset: 2.21 m

Azimuth 180°

Elev. 0.10 m below G.L.

X= 0 m

Y= -2.21 m

Ref. Polarization: Az 0

V 0

R 90

T 90

Number Samples 2500

Shot		Borehole Phone			Source				Source Polarization		
Rec.	File	Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Azimuth	Vertical	
101	WLB10101	6.25					0 (m)	-1.17 (m)	270°	135°	
102		6.25							90°		
103		6.00							270°		
104		6.00							90°		
105		5.75							270°		
106		5.75							90°		
107		5.50							270°		
108		5.50							90°		
109		5.25							270°		
110	WLB10110	5.25							90°		

11 Oct 95

# BSU GEOPHYSICS VSP OBSERVER'S LOG

Coordinate System Origin at Borehole  
Casing Elevation: 0.64 m above G.L.

Reference Phone: 2.21 m

Azimuth x-axis: 90°

Azimuth 180°

Elev. 0.10 m below G.L.

Azimuth y-axis: 0°

X = 0 m

Y = -2.21 m

Well Coord: X = 9999.86(m) Y = 10002.81(m) Z = +850.29(m)

Channel

Borehole Phone

V=Channel 1

R=Channel 2

T=Channel 3

Reference Phone

V=Channel 4

R=Channel 5

T=Channel 6

Vert.

0

90

90

Ref. Polarization:

V

R

T

Az

0

0

270

Date: 14 Oct 97

Location: URISP B1

High-Cut 1000 Low-Cut 4 Sample Int. .0002

Number Samples 2500

Shot		Borehole Phone			Source			Source Polarization		
Rec.	File	Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Azimuth	Vertical
111	WL810111	5.0					0 (m)	-1.17(m)	270°	135°
112		5.0							90°	
113		4.75							270°	
114		4.75							90°	
115		4.50							270°	
116		4.50							90°	
117		4.25							270°	
118		4.25							90°	
119		4.00							270°	
120	WL810120	4.00					0	0	90°	0

(2:21)

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# BSU GEOPHYSICS VSP OBSERVER'S LOG

Coordinate System Origin at Borehole  
 Casing Elevation: 0.64 m above G.L.  
 Azimuth x-axis: 90°  
 Azimuth y-axis: 0°

Reference Phone: 2.21 m

Offset: 2.21 m  
 Azimuth 180°  
 Elev. 0.10 m below G.L.

\$ datum

Well Coord: X = 9999.86(m) Y = 10002.81(m) Z = +850.29(m)

Channel Configuration: Borehole Phone  
 V=Channel 1  
 R=Channel 2  
 T=Channel 3

Reference Phone  
 V=Channel 4  
 R=Channel 5  
 T=Channel 6

Ref. Polarization: V 0 Az 0 Vert. 0  
 R 0 90  
 T 270 90

Date: 14 Oct 97

Location: URISP B1

High-Cut 1000 Low-Cut 4 Sample Int. .0002

Number Samples 2500

Shot		Borehole Phone				Source				Source Polarization		
Rec.	File	Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Azimuth	Vertical		
121	WL810121	3.75					0(m)	-1.17(m)	270°	135°		
122		3.75							90°			
123		3.50							270°			
124		3.50							90°			
125		3.25							270°			
126		3.25							90°			
127		3.00							270°			
128		3.00							90°			
129		2.75							270°			
130.	WL810130	2.75							90°			

12-28

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# BSU GEOPHYSICS VSP OBSERVER'S LOG

Coordinate System Origin at Borehole

Casing Elevation: 0.64 m above G.L.

Reference Phone: Offset: 2.21 m

Azimuth x-axis: 70°

Azimuth 180°

Azimuth y-axis: 70°

Elev. 0.10 m below G.L.

Well Coord: X = 9999.86(m)

\$ datum

X = 0 m

Channel

Y = -2.21 m

Configuration:

Ref. Polarization: Az

Borehole Phone

V 0

V=Channel 1

R 0

R=Channel 2

T 270

T=Channel 3

Vert. 0

Date: 14 Oct 97

Location: URISP B1

High-Cut 1000

Sample Int. .0002

Low-Cut 4

Number Samples 2500

Shot		Borehole Phone			Source			Source Polarization		
Rec.	File	Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Azimuth	Vertical
131	WUB10131	2.50					0 (m)	-1.17(m)	270°	135°
132		2.50							90°	
133		2.25							270°	
134		2.25							90°	
135		2.00							270°	
136		2.00							90°	
137		1.75							270°	
138		1.75							90°	
139		1.50							270°	
140	WUB10140	1.50							90°	V

12:36



# VSP Check List

12729.5 @ well  
13:35 leave well

Project: URISP

Van

Date: 14 October 97

Odometer Start: 12719.9 Finish: 12739.0  
Time Out: 9:14 Time In: 14:07

Item	Out	In	Comment
BHG-2 Borehole Geophone	✓	✓	
BHGC-1 Control Box (Blue)	✓	✓	
Cable: Spool to BHGC-1	✓	✓	
Cable: BHGC-1 to Bison	✓	✓	
Ban/Alligator Power Cables BHGC-1	✓	✓	
Break out box	✓	✓	
OYO 3-c Reference Phone (Blue)	✓	✓	
Dummy tool	✓	✓	
Snatch Block and Come-a-long	✓	✓	
Bison Seismograph	✓	✓	Replaced paper roll
<del>Vertical Hammer Source</del> 135° source	✓	✓	from yellow foot box
Black Tape			
WD-40	✓	✓	
Observer's Sheets/Note Book	✓	✓	
Rope	✓	✓	
Rock Hammer	✓	✓	
Tape measure (50m)	✓	✓	
Gloves	✓	✓	
Compass and Maps	✓	✓	
<del>Trigger Switch Toggle Box</del> 24 Volt BAT	✓	✓	
Gas Card & Keys	✓	✓	
Water Table Logging Probe	✓	✓	

Tripod

✓ ✓



# VSP Preliminary Data Sheet

Date: 14 Oct 97 Type of Phones OYO 1417

1. Well Name B1

2. Location of Well

X= 9999.86 Y= 10002.81 Z= +850.29 \$

Casing Elevation: 0.645m above G

3. Depth to top of water table (measured from CE) 9.80

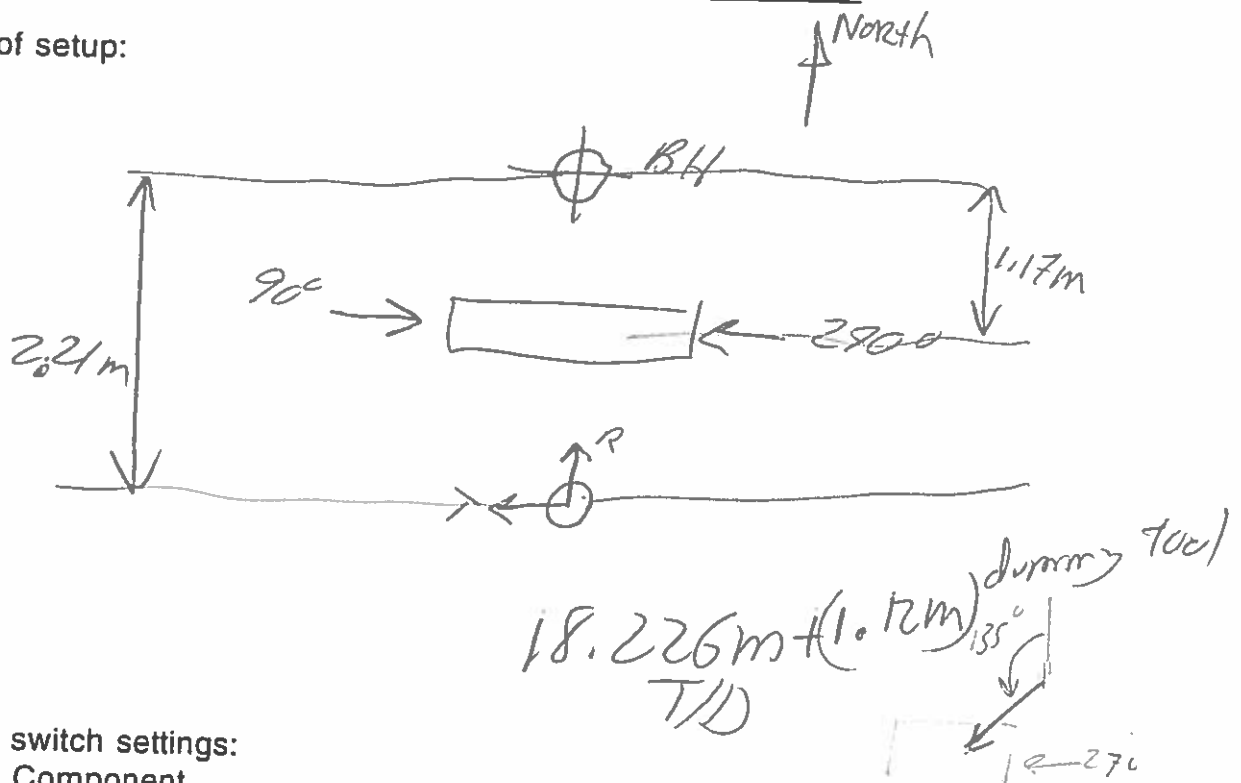
4. Casing Elevation, distance above ground level= 0.645m above G

5. Reference phone offset from borehole= 2.21m

6. Reference phone depth below ground level= 4"

7. Source Offset from borehole= 1.17m

8. Sketch of setup:



9. Blue Box switch settings:

Channel	Component
<u>1</u>	Vertical
<u>2</u>	Longitudinal (radial)
<u>3</u>	Transverse

ORIGINAL

4<sup>N</sup> BH  
SC 1.87ms

## Engineering Properties of Soils

13:18  
14 Oct 97

**Title:** Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

**Reference:** (ASTM D-1556-90)  
in American Society for Testing and Materials, 1996, "Annual Book of ASTM Standards", Section 4, Construction, Vol. 4.08 Soil and Rock (I): D420-D4914  
*Published by:* ASTM, 100 Barr Harbor Drive, West Conshohocken, Pa 19428, (610) 832-9500

### Requirements:

1. Calibration of sand cone apparatus, *if needed*.
2. Calibration of sand cone sand, *if needed*.
3. Conduct a field measurement of insitu unit weight using sand cone.
4. Write a brief report.

**Due Date:** 02 October 1997

### Introduction:

The sand cone test is used to calculate the field unit weight of soil (insitu). This is done by excavating a small hole, determining the weight and moisture content of the excavated soil, and measuring the volume of the hole by an indirect method of sand replacement and weighing. The method is appropriate for soils in which the majority of the soil grains is less than 1.5 inches (38mm) in diameter, in soils where the hole will not cave in (loose sandy soil can be a problem), or in soils in which the excavated volume will not distort (wet clays can be a problem if the material flows or weakens while you work around the hole).

The sand used in the test must be clean, dry, uniform in density and grading, uncemented, and free flowing. The maximum particle size should be 2mm or less (no. 10 sieve), and the uniformity coefficient  $C_u = D_{60}/D_{10}$  should be less than 2.0. Further, less than 3% of the sand by weight should pass the 250 $\mu$ m (no. 60 sieve).

### Soil Sample Size:

The volume of the test hole depends on the maximum size of grains present in the soil to be tested. Hole depths assume a 6.5 inch circular hole in base plate.

Max. Particle Size in (mm)		Min. Hole Volume cm <sup>3</sup> ft <sup>3</sup>		Min. Hole Depth cm in	
0.5	(12.5)	1420	.050	6.6	2.6
1.0	(25.0)	2120	.075	10	3.9
2.0	(50.0)	2830	.100	13.2	5.2

**Materials Needed:**

1. Sand Cone Apparatus; Bottle, Funnel, Sand, Cone, Baseplate
2. Balance capable of 5g precision, 20kg maximum capacity.
3. Oven for determination of water content.

**PROTOCOL:****CALIBRATION OF SAND CONE APPARATUS**

*Method A:* Determine the mass of each filled cone-baseplate set with a single sand.

*Method B:* Determine volume of each cone-baseplate set, and apply that volume to any sand unit weight that is used.

**Method A:**

1. Fill the sand cone apparatus with the sand to be used.
2. Determine the weight of the filled apparatus.  $M_1 = 13.90$  Lb.
3. Place baseplate on a clean, level plane surface.
4. Invert container/apparatus and set the funnel in the flanged center hole of the base plate. Mark the alignment of the parts with a pencil.
5. Open the valve fully until the sand flow stops. Don't jar or vibrate the setup.
6. Close the valve sharply, remove the apparatus.
7. Determine the mass of the apparatus, now less the sand in the cone.

$$M_2 = 10.60 \text{ Lb.}$$

8. Calculate the weight of the sand in the cone.

$$\text{Weight Cone Sand} = M_3 = (M_1 - M_2) = 3.30 \text{ Lb.}$$

The standard requires that the above procedure be done 3 times, and the difference between the average and any one determination shall not exceed 1% of the average. Use the average in the remaining calculations.

**CALIBRATION OF SAND DENSITY**

9. Calibrate a Proctor test mold (ASTM D-698). A 6 inch mold is preferred, but a 4 inch one will do. Calibrate the mold by measuring the amount of water required to fill the mold from a graduated cylinder. For a 4 inch mold, the volume should be about  $1/30 \text{ ft}^3$ .

10. Fill the sand cone apparatus with the sand to be used in the field.

11. Determine and record the weight of the calibration container (Proctor test mold and baseplate).

$$M_4 = 9.415 \text{ Lb.}$$

12. Invert the sand cone apparatus over the mold and fill the mold just as you would do in the field.

13. Close the valve on the apparatus once the sand flows over the top of the mold.

14. Use a straight edge to level the sand in the mold. Wipe off any excess sand from the mold and baseplate exterior.

15. Weigh the mold, baseplate, and sand.

$$M_5 = 12.27 \text{ Lb.}$$

16. Compute the weight of the sand in the mold.  
 $M_6 = (M_5 - M_4) = \underline{2.855} \text{ Lb.}$
17. Compute the unit weight of the sand.

$$\gamma_{sd} = \frac{M_6}{V_{mold}}$$

$$\gamma_{sd} = \underline{85.65} \text{ Lb./ft}^3$$

### FIELD PROCEDURE

#### *In the lab*

18. Fill the sand-cone apparatus with calibrated sand.  
 19. Weigh the filled apparatus.

$$M_7 = \underline{13.81} \text{ Lb.}$$

#### *In the field*

20. Select a representative location to be tested.  
 21. Prepare the location by leveling the surface of the ground. The baseplate may be used as a tool for this purpose.  
 22. Seat the baseplate on the ground, taking care to make sure that the hole is in contact with the soil surface at every point. Mark the edges of the baseplate on the soil to keep track of any possible movement. Nails may be used around the perimeter to hold the plate in place.  
 23. OPTIONAL: If leveling is not possible, a test calibration to determine a cone+void volume may be done prior to digging the hole. This is analogous to the cone calibration above. Clean any sand away at completion if this is done.  
 24. Dig a small hole through the opening of the baseplate. The depth of the hole should be no less than that recommended on page 1. The sides of the hole should slope slightly inward and the bottom should be flat or concave. Avoid creating pockets or overhangs. Place all excavated soil in a container which can be sealed against moisture loss. Label the soil sample.  
 25. Clean any soil from the flange of the baseplate hole.  
 26. Invert the sand-cone apparatus and fit to the baseplate.  
 27. Open the valve fully and let sand flow into the hole until it stops flowing. Avoid jarring or vibrating the setup.  
 28. Close the valve once the sand has stopped flowing.

#### *Back in the Lab*

29. Weigh the sand-cone apparatus now less the sand in the hole and cone.

$$M_8 = \underline{7.975} \text{ Lb.}$$

30. Weigh the soil from the field hole.

$$M_x = \underline{3.830} \text{ Lb.}$$

$\frac{7.995 \text{ lb}}{M(s+c)} \mid \frac{0.165 \text{ lb}}{m_c}$

31. Determine the water content of the field soil according to ASTM 4643 (microwave oven method). Use the work sheet on the next page.

$$M_c = 12.09$$

$$M_c = \text{_____} \text{ g}$$

Net

275.78

271.35

Cumulative Drying Time (minutes)	Mass, $M_a$ (g)	Cumulative Drying Time (minutes)	Mass, $M_a$ (g)
0	287.87		
3	284.11		
6	283.26		
9	283.17		

$$M_c = 11.82 \text{ g}$$

$$\text{Water Content, } w = \frac{4.43}{271.35} = .016 = 1.633\%$$

#### CALCULATIONS

32. Compute the weight of the sand in the hole. ( $M_3$  is weight of sand in cone, step 8)  
 $(M_7 - M_8) = \text{weight sand in (hole + cone)}, M_7 - M_8 - M_3 = \text{weight sand in hole only}$

$$M_9 = M_7 - M_8 - M_3 = 2.535 \text{ Lb.}$$

33. Compute the volume of the hole in the field. (see step 17 for unit weight of sand)

$$V = M_9 / \gamma_{sd} = .030 \text{ f}^3 \quad 20.38 \text{ KN/m}^3$$

34. Compute the moist unit weight of the field soil.

$$\gamma_m = M_x / V = 3.83 / .030 = 127.404 \text{ Lb/f}^3$$

35. Compute the dry unit weight of the field soil.

$$\gamma_d = \frac{\gamma_m}{(1+w)}$$

$$w = \frac{w_w}{w_s}$$

$$\gamma_d = 127.325 \text{ Lb/f}^3 \quad 20.05 \text{ KN/m}^3$$

1	.1967
w	.0333
S	.7700

$$G_s = 2.65$$

$$V_v = .2300$$

$$V_s = .7700$$

$$e = .2987$$

$$n = 23\% \text{ porosity}$$

$$n = \frac{e}{1+e}$$

$$S = \frac{.0333}{.230} = 14.48\%$$

$$\frac{0.6}{\text{f}^3} \frac{\text{kg}}{2.206} \frac{\text{f}^3}{(.3048 \text{ m})^3} \frac{9.81 \text{ N}}{\text{kg}} \frac{157.4 \text{ N}}{\text{m}^2} = \frac{122}{\text{f}^3}$$