CECW-EG Engineer Regulation 1110-2-1925	Department of the Army U.S. Army Corps of Engineers Washington, DC 20314-1000	ER 1110-2-1925 3 July 1969
	Engineering and Design FIELD CONTROL DATA FOR EARTH AND ROCKFILL DAMS	
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Basic Reprint with change 1 & 2 Included.

THIS CONSTITUTES CHANGE 2 TO ER 1110-2-1925, 3 JULY 1969
This change entirely supersedes Change 1, 14 April 1970

DEPARTMENT OF THE ARMY
Office of the Chief of Engineers
Washington, D.C. 20314

ENGCW-ES

ER 1110-2-1925
Change 2
20 August 1971

Regulation
No. 1110-2-1925

3 July 1969

ENGINEERING AND DESIGN
Field Control Data for Earth and Rockfill Dams
(RCS ENGCW-E-11 (R1))

* 1. Purpose. This regulation prescribes responsibilities and procedures for reporting field control data for earth and rockfill dams. *

2. Applicability. The reporting procedure described herein applies to all divisions and districts engaged in the construction of earth and rockfill dams.

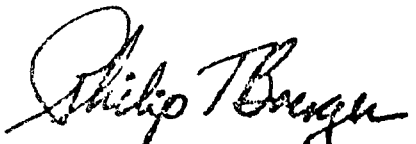
* 3. Policy. As required by EM 1110-2-2300, Earth and Rock-Fill Dams - General Design and Construction Considerations, a complete construction record of a dam will be kept for use in construction, operation, and maintenance of the project. These records provide useful data for designing alterations and additions to the structure or aiding in determining causes of operating difficulties. Included in these records are data on methods of compaction, in-place unit weight and moisture content, piezometers, surface monuments, and slope indicators. *

* 4. Procedure for Reporting. During construction of the dam, all control data will be summarized at the end of each month on the ENG Forms shown in Appendix I. Since these forms may be used to tabulate the daily field control data, it is necessary only to reproduce a copy to forward to the District. Data on ENG Forms 4287, 4287A, 4287B and on ENG Forms 4076, 4077, 4078, 4079, 4080, and 4081 will be forwarded by the District to Division offices. *

This regulation rescinds ER 1110-2-1925 dated 31 July 1967

5. Use of Forms. The ENG forms in Appendix I were developed after an analysis of the various field control data forms in use throughout the Corps. Instructions for completing the forms are outlined at the bottom of each form; supplementary instructions are given in Appendix II. While these forms are designed to permit recording of appropriate data for any type of dam, there may be situations where it is not necessary to use all columns. To prevent duplication, use of local forms in lieu of these standard ones should be discouraged, unless special circumstances indicate that local forms are more appropriate. However, the division or district may require additional presentations such as gradation curves or graphical summaries of the in-situ embankment water content as related to optimum water content. The information outlined in Appendix III should be submitted with the initial report or whenever changes are made.

FOR THE CHIEF OF ENGINEERS:



PHILIP T. BOERGER
Colonel, Corps of Engineers
Executive

3 Appendices
App I Reports Forms
App II Supp Instructions for Report Forms
App III Data to be Furnished with Initial Report

Appendix I

Report Forms for Field Control Data for Earth and Rockfill Dams

The following forms are to be used in reporting field control data to the U.S. Army Engineer Waterways Experiment Station:

1. Summary of Field Compaction Control of Impervious or Semipervious Soils for Civil Works Projects (ENG FORM 4080)

2. Summary of Field Compaction Control of Pervious Soils and Rockfill for Civil Works Projects (ENG FORM 4081)

3. Closed-System Piezometer Data for Civil Works Projects (ENG FORM 4076)

4. Open-System Piezometer Data for Civil Works Projects (ENG FORM 4077)

5. Subsurface Settlement Plate Data for Civil Works Projects (ENG FORM 4078)

6. Surface Reference Point Data for Earth and Rockfill Dams (ENG FORM 4079)

7. Periodic Summary of Field Compaction Control Data (ENG FORMS 4287, 4287A, 4287B)

Appendix II

Supplementary Instructions for Report Forms

A. Summary of Field Compaction Control of Impervious or Semipervious Soils for Civil Works Projects

Column	Title	Instructions
-	Project	Name of dam, feature (e.g. main embankment, dike) and section (e.g. cutoff trench, cofferdam, closure, etc).
-	Report No.	Number the reports consecutively for a given project.
3	Type Test	Indicate by code (as shown at bottom of form) the method used to determine in-place density.
4	Station	Record to nearest foot.
5	Offset	Record to nearest foot
6	Elevation	Record (to nearest foot) the elevation of surface of fill where test is made.
10	Class. Word or Letter Symbol	Record color of soil. Letter symbol must be in accordance with Unified Soil Classification System.
14 & 15	Atterberg Limits	Record to nearest whole number (e.g. LL = 35, PI = 17).
16 & 18	Dry Density (pcf)	Record to nearest tenth.
17 & 19	Water Content (%)	Record to nearest tenth.
20	Test	Denote the correlative test or method used (e.g. enter (1-pt) for standard effort test, (RCM) for rapid control USBR method, (LL) for liquid limit correlation, (VS) for visual comparison).

B. Summary of Field Compaction Control of Pervious Soils and Rockfill for Civil Works Projects

Column	Title	†Instructions
-	Rock Description	Each general type or class of rock used as rockfill should be described. The relative hardness of rocks should be described as outlined in plate 2 of EM 1110-1-1806, Presenting Subsurface Information in Contract Plans and Specifications.
-	Gradation	Pertinent sieve sizes should be noted and units of percent passing in whole numbers.

C. Instructions for Preparing Periodic Summaries of Field Compaction Control Data on Earth and Rockfill Dams, ENG Forms 4287, 4287A and 4287B

1. Summaries of compaction control data are prepared at least monthly, using a tabular summary form (Incl 1) and two summary plots, one for soils requiring control of both water content and density (Incl 2) and one for soils requiring only density control (Incl 3).

2. The tabular summary form and an individual summary plot should be prepared for (a) significantly different materials (impervious, random, pervious, etc.) used in different zones of the embankment and (b) materials compacted by different equipment (e.g., impervious fill compacted by towed rollers and impervious backfill compacted by hand-operated power tampers).

3. Examples for preparing the summaries are shown in Incls 1, 2, 3, and 4. Additional examples of certain entries for the tabular summary are given in Incl 5.

4. Use of the summary plot for materials requiring water content and density control is illustrated in Incl 2. Two vertical lines are first drawn on the plot to show the limiting values of water content in percentage points from standard optimum. A horizontal line is drawn to show the desired or specified minimum percent of maximum standard dry density. The top margin and right side margin of the plot are marked to show the limiting values illustrated in Incl 2. The data are then plotted using symbols shown in the legend. Should an area be reworked more than once or reworked and retested more than

†Also refer to instructions in Part A of this Appendix.

once, only the last test result or last set of test results should be plotted. The test results are summarized in the tabulation form on the right side of the plot in Incl 2. Total number of tests is the total number of plotted data points. Check tests should not be included in the number retested.

5. Use of the summary plot for materials requiring only density control is illustrated in Incl 4. The inappropriate labels at the top and bottom of the plot are lined out. If the maximum density is determined using a vibratory procedure, "STD" should also be lined out. Suitable scales are added to the plot, and a vertical line is drawn to indicate the minimum value of relative density, minimum percent of maximum standard dry density, or minimum percent of maximum dry density by a vibratory procedure, whichever applies.

5 Incl

PERIODIC SUMMARY OF FIELD COMPACTION CONTROL DATA

Project Example Dam — Resident Engr S. J. Smith
District District — Insp. or Tech J. S. Jones
Location of Project Sunflower River, Webster, Miss.
Report No. 12 Period 5 Nov 68 to 5 Dec 68

TYPE OF FILL	IMPERVIOUS (CORE)
Soil Classification (USCS Symbols)	CH, CL
Stationing of Areas Tested	14+75 to 46+50
Elevation of Areas Tested	832 to 840
Compaction Equipment	Sheepsfoot roller, Ferguson self-propelled model SP-120B (315 psi)
Number of Passes	8
Uncomp. Lift Thick.	8 in.
Roller Speed, MPH	3 to 5
In-Place Density Method (Give % of tests made with each method)	Sand Volume (90%) Nuclear (10%)**
Method of Determining Field w	Oven Drying
Method of Relating Field w to Std Opt w, and Field Density to Max. Dry Density, or Relative Density	Field results compared to laboratory compaction curve for similar soil. Appropriate laboratory curve selected by 1 or 2-point Std compaction test at field w or drier, supplemented with liquid limit test correlation
Specified Range of w (Percentage Points Above & Below Std Opt w)	Opt -1 % to Opt +2 %
(Desired) (Specified) Min. (% Comp. ~~or Rel. Density~~)*	95%
No. Areas Tested	21
No. with w Outside Acceptable Limits	3
No. with Density Below Min.	2
No. with w and Density Outside Acceptable Limits	1
No. Areas Reworked	3
No. Areas Retested	4

Remarks **The two "initial" tests on impervious plot were by nuclear method; check test and remainder of tests were by sand volume method.

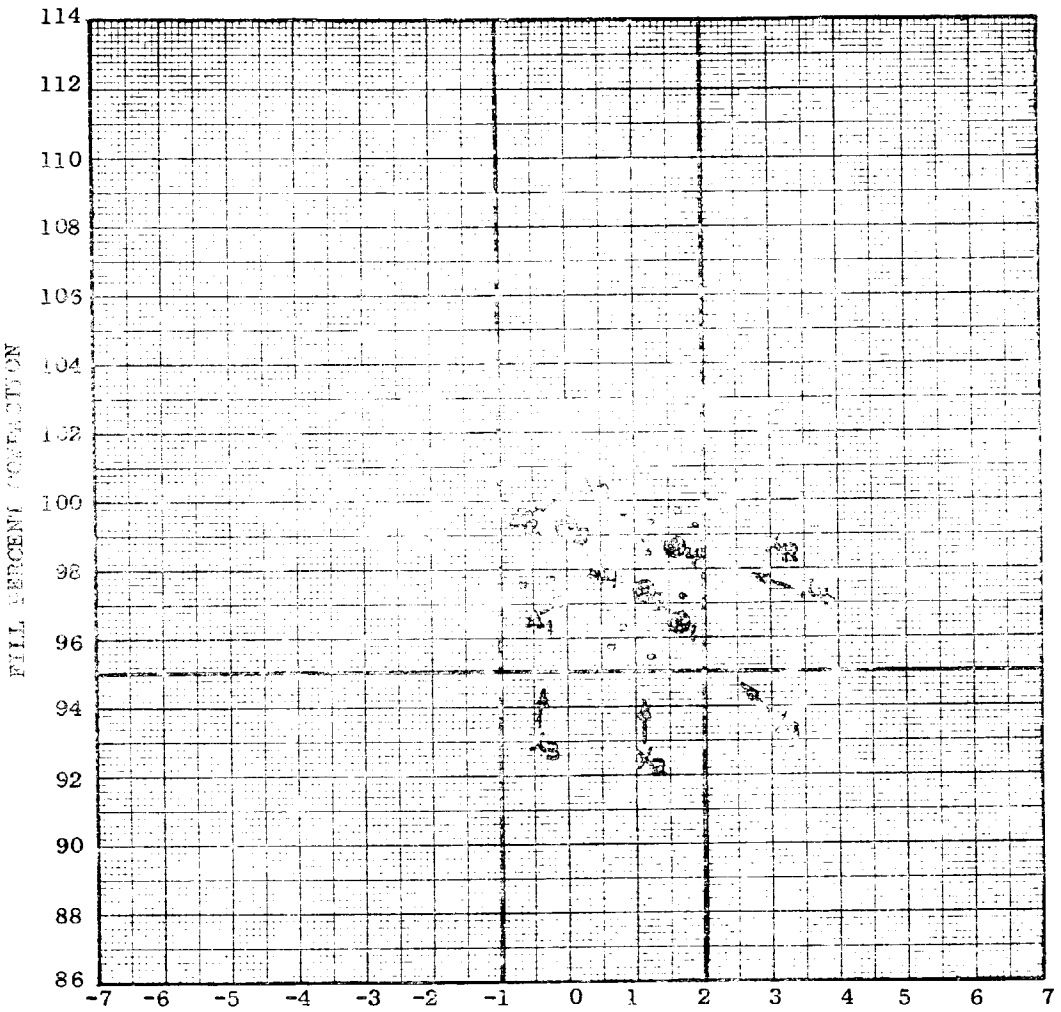
*Strike out inapplicable words.

Summary Prepared by ARG Date 6 Dec 68
Summary Checked by JSJ Date 7 Dec 68

ENG Form 4287 JUN 69)
Incl 1

ENG Form 4287A (JUN 69)
Incl 2

SPECIFIED RANGE OF WATER CONTENT



(DESIRED) (SPECIFIED) MIN PERCENT OF MAX STD DRY DEN

PROJECT: EXAMPLE DAM
DISTRICT: DISTRICT
REPORT PERIOD: 5 NOV - 5 DEC 68
REPORT NO.: 12
TYPE OF MATERIAL: IMPERVIOUS (CORE)

	CUMULATIVE TO THIS REPORT	THIS REPORT
TOTAL NO. OF TESTS	270	21
NO. OUTSIDE LIMITS:		
TOTAL	57	6
w	42	3
DENSITY	12	2
w & DENSITY	3	1
NO. REWORKED	50	5
NO. RETESTED AFTER REWORKING	44	4

LEGEND:

- ● WITHIN ACCEPTABLE LIMITS
- X OUTSIDE ACCEPTABLE LIMITS
- X_R LATER REWORKED ONLY (NO RETEST)
- X_1, X_2 LATER REWORKED AND RETESTED
- $\oplus_1$, $\oplus_2$ RESULT OF RETEST AFTER REWORKING
- Δ_1, Δ_2 INITIAL TEST (USE ONLY w/CHECK TEST)
- $\blacktriangle_1$, $\blacktriangle_2$ CHECK TEST

NOTE: USE SAME NUMBER FOR LATER REWORKED AND RETESTED AND RESULT OF RETEST AND FOR INITIAL AND CHECK TEST. INDICATE PAIRS BY SHORT ARROWS, e.g., $X_1 \rightarrow \oplus_1$, $\Delta_1 \rightarrow \blacktriangle_1$

ER 1110-2-1925
3 July 1969
App II

PERIODIC SUMMARY OF FIELD COMPACTION CONTROL DATA

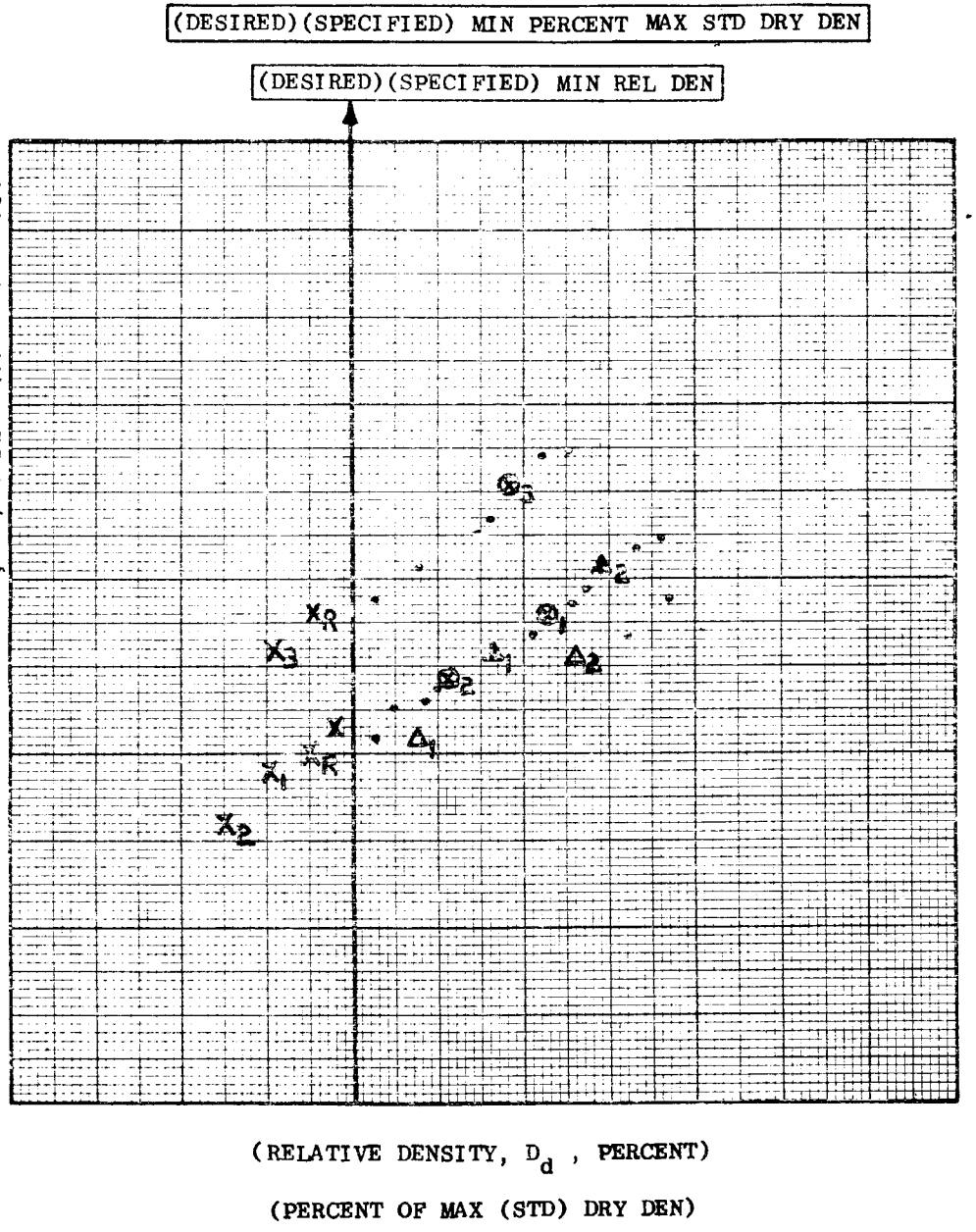
roject Example Dam — Resident Engr J. S. Smith
istrict District — Insp. or Tech S. J. Jones
ocation of Project Sunflower River, Webster, Miss.
eport No. 12 Period 5 Nov 68 to 5 Dec 68

YPE OF FILL	PERVIOUS (SAND DRAIN)
oil Classification (USCS Symbols)	SW
tationing of Areas Tested	15+50 to 37+50
levation of Areas Tested	830 to 839
ompaction Equipment	Vibratory Roller, Tampo Model VC80 (static wt. = 3.5 tons, centrifugal force of 7.5 tons at 1600 rpm)
umber of Passes	4
ncomp. Lift Thick.	6 in.
oller Speed, MPH	2
n-Place Density Method Give % of tests made ith each method)	Sand Volume (90%) Nuclear (10%)
ethod of Determining ield w	Visual Observation
ethod of Relating ield w to Std Opt w, nd Field Density to ax. Dry Density, or elative Density	Field results compared to results of laboratory maximum (modified Providence vibrated) and minimum density tests on similar material. Appropriate laboratory results selected by gradation correlation.
pecified Range of w (Percentage oints Above & Below Std Opt w)	Saturated during compaction
(Desired) ~~(Specified)~~ Min. ~~(% Comp. or~~ Rel. Density)*	80%
o. Areas Tested	25
o. with w Outside Acceptable Limits	Not Applicable
o. with Density Below Min.	6
o. with w and Density Outside Acceptable Limits	Not Applicable
o. Areas Reworked	5
o. Areas Retested	3

emarks **The two "initial" tests on pervious plot were by nuclear method. Check tests and all other tests were by the sand volume method.

*Strike out inapplicable words.
ENG Form 4287 (JUN 69)
Incl 3

Summary Prepared by ARG Date 6 Dec 68
Summary Checked by JSJ Date 7 Dec 68



PROJECT: EXAMPLE DAM
DISTRICT: DISTRICT
REPORT PERIOD: 5 NOV - 5 DEC 68
REPORT NO. 12
TYPE OF MATERIAL: PERVIOUS (SAND DRAIN)

	CUMULATIVE TO THIS REPORT	THIS REPORT
TOTAL NO. OF TESTS	175	25
NO. BELOW MINIMUM	26	6
NO. REWORKED	23	5
NO. RETESTED AFTER REWORKING	18	3

LEGEND:

- ● ABOVE ACCEPTABLE MIN
- X BELOW ACCEPTABLE MIN
- X_R LATER REWORKED ONLY (NO RETEST)
- X_1, X_2 LATER REWORKED & RETESTED
- $\circledcirc_1$, $\circledcirc_2$ RESULT OF RETEST AFTER REWORKING
- Δ_1, Δ_2 INITIAL TEST (USE ONLY w/CHECK TEST)
- $\blacktriangle_1$, $\blacktriangle_2$ CHECK TEST

NOTE: USE SAME NUMBER FOR LATER REWORKED AND RETESTED AND RESULT OF RETEST AND FOR INITIAL AND CHECK TEST

Samples of Appropriate Entries on Tabular Summary

Compaction Equipment	Method of Relating Field w to Standard Optimum w ; and Field Density to Maximum Dry Density or Relative Density
Sheepsfoot roller, Bros, self-propelled, SP-255D (1030 psi)	Field results compared to results of complete standard compaction test on material from field test
Pneumatic roller, 50-ton Ferguson Model RT-100 S, 4-wheel (80 psi)	Field results compared to laboratory curves selected by (1 pt)(2 pt) standard compaction test on material from field test
Sheepsfoot roller, Bros Model G29, 1/2-ton (towed) (633 psi)	Field results compared to results of rapid compaction (USBR) tests on fill material
Sheepsfoot roller, Ferguson Model SP-120B, self-propelled (615 psi)	Field results compared to laboratory standard compaction results for minus 1 in. material, corrected for percent plus 1 in. material. Appropriate laboratory results selected by (gradation) (Atterberg limits) correlations.
Sheepsfoot roller (towed), American Steel Works, similar to Model ABD 120 (547 psi)	Compared visually to materials on which laboratory standard compaction tests were performed
D-8 crawler tractor (12.2 psi)	Maximum (vibratory table) and minimum density determined for each field density test
Pneumatic roller, 50-ton Bros Model 450, 4-wheel (80 psi)	Compared to results of laboratory maximum (modified Providence vibrated) and minimum density test on minus 2-1/2-in. fraction. Appropriate laboratory results selected by gradation correlation
Vibratory roller, Tampo Model VC 80 (static weight = 3.5 tons; centrifugal force = 7.5 tons at 1600 rpm)	Note: If more than one method used, show percentage use of each method.

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Appendix III

Data to be Furnished with Initial Report

I. The following information on the embankment, equipment and procedures will be submitted with the initial field control data report:

A. Embankment:

1. Typical plan and sections (if applicable, these may be copies extracted from plans and specifications).

2. Brief description of materials to be placed in the various zones.

B. Compaction Equipment:

1. For sheepsfoot rollers.

a. Make and model

b. Towed or self-propelled

c. Number, diameter, and length of drums

d. Base area, shape, and length of one tamping foot, number of feet per drum and per row, and number of rows

e. Roller weight empty and as used

f. Foot pressure

g. Type of cleaners and frame (rigid or oscillating frame)

h. Specified and actual maximum speed of travel during compaction

2. For pneumatic-tired rollers:

a. Make and model

b. Number, size, ply rating and spacing of tires

c. Roller width, weight (empty and as used) and tire pressure

d. Contact pressure (wheel load divided by contact area of tire)

e. Specified and actual maximum speed of travel during compaction.

3. For vibratory rollers:

a. Make and model

b. Towed or self-propelled

c. Number, diameter and length of drums

d. Static roller weight empty and with ballast

e. Dynamic pressure exerted

f. Vibrating frequency (report frequency of roller and rockfill within 2 feet of roller)

C. Summary of Test Procedures:

1. Method of correcting field and laboratory density and water content for material having plus 3/4" particle sizes.

2. Graphical presentation of compaction curves or other reference curves used for correlating field with laboratory density and water content.

3. Description of procedures for selecting appropriate laboratory maximum density and optimum water content for comparison with in-place data.

II. The following information on the instrumentation will be submitted with the initial field control data report:

A. Piezometers:

1. The type (e.g. USBR, Warlam, Hall, Casagrande, Wellpoint, etc.), tip dimensions and description of the component parts of the tip (e.g. size and type of porous stone, slot or screen size).

2. The type, wall thickness and inside diameter of pipe or tubing and method of joining sections.

3. The type, thickness, method of placement, gradation and top and bottom elevation of the filter surrounding the piezometer tip.

4. The type, thickness, method of placement and top and bottom elevations of the seal.

5. Type of gage and method of protection.

6. The type of surface protection, (e.g. shelter facilities, posts, etc.) date of installation, schedule of observations and problems encountered during installation and operation.

7. Plan and elevations showing location of piezometers.

B. Settlement Plates:

1. Description of settlement gage (e.g. dimensions, type, etc.) with a detailed drawing.

2. Type and size of riser pipe and method of joining sections.

3. Procedures for installation of instruments and obtaining measurements.

4. Plan and elevations showing locations of settlement plates.

C. Surface Reference Monuments:

1. Description of reference points (e.g. dimensions, type, depth of embedment, protection against damage, etc.) with a detailed drawing.

2. Description of bench marks.

3. Plan and elevations of reference points and bench marks.