TENSION PILE STUDY

VOLUME II

PLAN FOR PERFORMING OFFSHORE SMALL-DIAMETER PILE SEGMENT TESTS

Ertec

Ertec
The Earth Technology Corporation

3535 Briarpark Drive, Suite 100, Houston, Texas 77042
Telephone: (713) 974-1555

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Det Norske Veritas
Veritasveien 1
N-1322 Høvik
Oslo, Norway

Attention: Mr. Tore J. Kvalstad

TENSION PILE STUDY
CNRD 13-2

Volume II

Plan for Performing Offshore
Small Diameter Pile Segment Tests

Gentlemen:

In accordance with the contract between Ertec, Inc. and Det Norske Veritas, submitted herein is the second of a series of reports concerning the Tension Pile Study, CNRD 13-2, currently in progress. This report presents the test plan for performing small diameter pile segment tests offshore at West Delta Block 58 in the Gulf of Mexico. Also included are brief descriptions of the test instrument and the data acquisition system. Further documentation will be presented in a later report.

We look forward to working with you on the operational phase of this study soon to be performed. If there are any questions regarding the contents of this report, please contact us.

Very truly yours,

Jean M. E. Audibert, P.E.
Associate and Manager
Ertec, Inc., Gulf States Region

Thomas K. Hamilton, P.E.
Project Engineer

JMEA/TKH:sac
Enclosures
Distriubtion: (8) Det Norske Veritas
(2) Conoco, Inc. (PES)
Attention: Mr. J. H. C. Chan
(2) Conoco, Inc. (PRD)
Attention: Mr. J. L. Mueller

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PLATES AND TABLES

INTRODUCTION

This report presents information concerning the small-diameter pile segment test program to be performed at a decommissioned CAGC platform in Block 58 of the West Delta area, Gulf of Mexico. The small-diameter pile segment test discussed herein is part of a larger study with the overall objective of improving the understanding of pile-soil interaction during cyclic tensile loading, such as the loading expected to be produced by a deepwater Tension Leg Platform (TLP).

The information contained in this report is intended to provide a brief documentation of the test system, including the instrument design and the data acquisition system, and also to outline the operational plan for performing the small-diameter pile segment tests offshore. Furthermore detailed documentation of the instrument design and the data acquisition will be presented in a subsequent report.

This report is the second volume of a series of reports to be issued. Volume I, dated April, 1982, concerned the site investigation and soil characterization at the subject site. The small-diameter segment test planning, selection of test depths, and operational decisions presented in this report were based on the results presented in the Volume I report.

DESIGN OF PILE SEGMENT

General

Four small diameter pile segment instruments have been developed for use in this program. The tools will be deployed through standard drill pipe following the procedures outlined in the section of this report entitled "Operational Plan".

Each instrument is capable of measuring shear transfer, displacement of the instrument relative to the soil at test depth, total lateral pressure and pore water pressure. The instruments have 7.62 cm (3.00 in) outside diameters and are 407.24 cm (160.33 in) in length. The lower 213.4 cm (84.0 in) is a cutting shoe to simulate an open-ended pile. A diagram of the assembled pile segment instrument is shown on Plate 1. Also shown are enlargements of the load cells, pressure transducers, and displacement transducer. Further descriptions of these components are given in the following paragraphs.

Shear Transfer Measurements

Shear transfer will be measured by taking the difference in load on two cross sections of the model. The cross sections are separated by a length chosen to give an external surface area of approximately 2.0 sq ft (0.186 sq m) between the load measurement points.

The load cells shown in Plate 1 consist of an inner spool-shaped member with an external sleeve welded to the load cell at each end to provide mechanical protection and to seal the annulus. Each load cell has eight longitudinally-oriented strain gages bonded at equidistant locations around a circumference located at mid-height of the spool. Alternate strain gages on each load cell are connected in series, and the four series resistances thus created are connected to form a fully-active Wheatstone bridge. The strain gage bridge created will be sensitive only to axial loads applied to the model between the load cell locations, with strains arising from common axial loads and from transverse bending being self-cancelling.

The pile segment defined by the load cells and interconnecting sleeves will be calibrated in a specially-designed framework (see Plate 2). The pile segment will be prestressed, and calibration loadings applied to the segment between the load cells in such a manner so that the load cells will both experience the same changes in load. The load cells will also be calibrated independently, so that any differences in the strain gage output from each load cell may be accounted for in the computation of shear transfer.

The expected resolution in shear transfer is less than ± 1.0 psf (0.0479 kPa), resulting in an accuracy in determination of shear transfer considerably better than ± 1 percent.

Total Pressure Measurement

Measurement of total radial soil pressure will be made by weighing the force exerted on a small load cell with an active face which projects through the wall of the pile sement model. The active face of the transducer is shaped to conform to the outside surface of the tool, avoiding disruptions of radial pressure near the transducer. The active face of the transducer is circular and has a projected surface area of 1.00 sq in (6.45 sq cm).

The load transducer consists of a spool-shaped inner member, with a protective metal cover welded at the ends to seal and protect the annulus. Two 90° - rosette strain gages are bonded around a circumference at mid-height of the reduced cross-section. The four strain gage grids are connected in a four-arm fully active Wheatstone bridge configuration.

The load transducer will be calibrated by parallel measurements of water pressure with the precalibrated pore pressure transducers, with verification of the calibration made with a series of dead-weight loadings.

The expected resolution in radial stress measurement is approximately ± 15 psf (0.71 kPa) resulting in an accuracy in determination of total pressure of the order of 0.1%.

Pore Pressure Measurement

Pore water pressures will be measured by commercially-available diaphragm-type pressure transducers manufactured by Gould, Inc., Model Number PA856-500.

The pressure transducers will be mounted in a cylindrical housing for sealing and mechanical protection. The active face of the transducer will be separated from the soil by a porous carborendum filter, which will be shaped to conform to the exterior surface of the pile segment model.

The expected resolution in pore pressure data is better than $\pm$ 1 psf (0.0479 kPa).

Displacement Measurement

Displacement of the pile segment model will be measured by a DC-operated LVDT (linear variable differential transformer) manufactured by Schaevitz Engineering, Model Number GCD-121-SOO. The DC-LVDT will be encased in a sealed cylindrical housing which is mounted to the bottom load cell. The section of the tool surrounding the LVDT housing is built in three parts, so that the upper section of the tool (including the load cells) can move axially with respect to the lower section (including the cutting shoe) for a total distance of 1.0 in (2.54 cm). The core of the LVDT is fixed to the lower section, enabling down-hole measurements to be made of the relative movement between the sensitive section and the cutting shoe, which serves as an anchor.

The DC-LVDT has a nominal output rating by the manufacturer of approximately 20 volts/inch (7.87 v/cm). The resolution in the measurement of displacement will thus be better than $\pm$0.001 in (0.025 mm).

DATA ACQUISITION SYSTEM

The heart of the data acquisition system is a high-level language programmable laboratory computer system built by Digital Equipment Corporation. The MINC-23 computer is designed for data acquisition and control applications. The RT-11 operating system is written especially for real time data collection and dedicated acquisition and control applications. Acquisition programs are written in FORTRAN.

The incoming load and displacement signals are digitized by a HP-3497A scanner/digitzer. The HP-3497A built by Hewlett-Packard can scan up to 100 analog channels and provides high resolution A/D conversion of strain gage level signals without the need of any analog amplification. The ability to directly digitize the strain gage level signals eliminates noise and "zero" shifts often associated with analog amplification. The HP-3497A also has a digital output capability which will be used in conjunction with solenoid valves to control the loading sequence.

Data collected will be stored immediately as "raw" voltages on floppy disc, printed in engineering units on the printer and selected variables may, at the operators discretion, be plotted immediately on the digital plotter to aid in visualizing the test progress. Subsequently, the data stored on disc will be transferred to 9-track tape providing a permanent, transportable digital data record for future processing and analysis.

The status of each tool along with the last data collected and other key parameters will be displayed continuously on the control console. Each command entered into the system for purposes of controlling the experiment will be "echoed" on the printer along with the current time. The printer output will provide a chronological log of all data collected and all operator inputs. This will greatly aid the data analysis process. A complete documentation of the data acquisition system software will be included in a subsequent report.

The entire data acquisition system will be housed offshore in a waterproof, air-conditioned portable building. One generator will be dedicated solely to operation of the data acquisition system, thus preventing the possibility of power surges from air conditioner cycling, etc.

OPERATIONAL PLAN

Pre-test Planning

The planning phase for the offshore test program was a joint effort among personnel from Ertec, Conoco PES, Conoco, New Orleans Division, and McClelland Engineers, Inc. Several meetings were held to outline operational details. The following responsibilities were assigned at a meeting on May 26, 1982:

Conoco PES

- Contracting for major support equipment and services.
- Overall project supervision.

Conoco, New Orleans Division

- Preparation of the platform.
- Transportation to and from the platform.
- Subcontracting fabrication of lower load frame.
- Offshore safety.

Ertec, Inc.

- Instruments and all required cable, data acquisition equipment and personnel to perform the test.
- Test planning and management.
- Transportation of test equipment and personnel to and from mobilization dock.

McClelland Engineers, Inc.

- All drilling equipment including rig, pipe, drill rod, and mud system.
- Drilling personnel.
- Transportation of drilling equipment and personnel to and from mobilization dock.

Platform preparations will begin approximately three weeks prior to testing. These preparations will include clearing the deck to allow sufficient work space for performing the tests, and fabricating and installing required test fixtures. Ertec has supplied Conoco with plans for the lower load frames which will be fabricated and welded to the existing deck. Three are required.

Casing will be installed from the lower load frame to a sufficient depth below the mudline to protect the 4-1/2 in drill pipe from wave loading and possible communication with the test instrument. At the present time, 12-3/4 in O.D. casing is proposed. Guides will also be installed at EL + 10 on the platform to provide support and also to insure verticality of the casing.

Additional walkways will be constructed at the platform to insure safe working conditions.

Support Equipment

Transportation of equipment and personnel to and from the platform will be provided by a self-propelled, self-elevating barge. The barge will also provide living accommodations for the personnel offshore. The type barge to be used will have the following specifications:

- Three legs 125 to 130 ft (38 to 39.5 m) in length.
- Accommodations for approximately 20 persons excluding barge crew.
- Two 50 KW generators.
- Approximately 2,500 sq ft (233 sq m) of deck space.
- A 25-ton (223 KN) crane with a 70 ft (21 m) boom.

In addition, the platform is equipped with a fixed crane which, due to its location, will serve as the primary crane. The capacities at various reaches of the boom are listed below:

Boom Length, ft (m)		Capacity, kips (KN)	
16	(4.9)	26.10	(116)
20	(6.1)	20.80	(93)
30	(9.2)	13.65	(61)
40	(12.2)	9.90	(44)
50	(15.3)	7.70	(34)

Other support equipment to be provided by Conoco includes deck lights and a 150 CFM air compressor to pump seawater for drilling mud preparation.

Drilling Equipment and Personnel

The drilling equipment and personnel required to prepare the borehole for testing will be provided by McClelland Engineers, Inc. A single Failing 1500 drilling rig will be mounted on skid beams spanning the three boreholes. The rig will be winched from one borehole to another as required to accomplish the specified testing sequence. The drilling mud mixing and storage tanks will be placed on the platform deck; seawater will be pumped from below deck.

Drilling will be performed using 4 1/2-in O.D. IF drill pipe and an open ended bit. Although casing will extend from the platform deck to below the mudline, open-hole (not recirculation) techniques will be used. This will be accomplished by placing a hole in the casing approximately 10 ft (3 m) above the water level. The drilling mud and cuttings will be expended through this hole. The advantage of this method is to reduce the mud pressure at the bottom of the borehole, thus reducing the possibility of fracturing the soft clay formation.

Drill rod (N-rod), which will be used to lower, raise, and load the test instrument, as well as associated hardware and tools to perform the drilling operations, will also be provided by McClelland.

The test plan was developed so that only one drilling crew will be required even though 24-hour operations and testing will be performed. This was accomplished by sequencing the drill crew work and rest periods with soil consolidation and test periods so that twelve hours or more of rest precedes drilling periods of twelve hours or less. The drilling crew will consist of one drilling supervisor, one driller (experienced in working with in situ equipment), and two helpers. An additional drilling crew, or portions of a drilling crew, may be required for mobilization and initial on-site set-up.

Testing Equipment and Personnel

Ertec will provide all test equipment and personnel associated with the operation of the pile segment tool. Four complete instruments, three primary and one spare, are planned for the program. Each instrument will be equipped with 500 ft (53 m) of cable. The cable will be pre-strung through 10 ft (3 m) sections of N-rod after arrival at the platform. The cable will then be attached to the data acquisition system inside the instrument control building.

The instrument control building is 20 ft x 8 ft (6.1 m x 2.5 m) and is fully air-conditioned. This building will house all data collection panels, a computer for data recording and test control, a data printer, a data plotter, and hydraulic controls for operating the loading system. An electrical generator will be dedicated to provide power only to the data recording system. Other instrument building power (air-conditioning, lights, etc.) will come from a separate source.

The hydraulic loading system will also be provided by Ertec. The system consists of a 150-ton (1,335 KN) hydraulic "through-hole" jack with a 12-in (25.4 mm) stroke, a hydraulic pump and reservoir, a control panel, an electrically actuated control valve, and all hoses and fittings. In addition, the upper load frame and loading fixtures will be supplied by Ertec. The sequence and method for installing and loading the small pile segment instrument has been planned so that data signals from the tool to the data acquisition system are never interrupted from the time the instrument is lowered down the casing until it is recovered.

The Ertec offshore test team will consist of at least four people for the duration of the program. These will include an onsite field manager, a test supervisor, a data system operator and an operations supervisor.

The field manager will be responsible for the offshore project supervision. The test supervisor will direct instrument installation, monitoring of consolidation, load testing and data collection. The test supervisor will be assisted by the data system operator. Additional assistance will be provided by Ertec personnel temporarily on the platform and by the Det Norske Veritas representative.

The operations supervisor will work with the drilling personnel to insure that the boreholes are properly placed and drilled according to specifications. The operations supervisor will generally work the shift opposite the testing personnel. An Organizational Chart for the Offshore Testing Program is given on Plate 3. A Deck Layout is given of Plate 4 showing the proposed location of all equipment.

Test Elevations

Three boreholes will be used for the testing program with each assigned particular test types or consolidation periods as shown below:

Test Boring No.1	-	Static and Two-Way Cyclic (Long-term consolidation).
Test Boring No. 2	-	Static and One-Way Cyclic (Short and Intermediate-term consolidation).
Test Boring No. 3	-	Progressive Two-Way Cyclic (Short and intermediate-term consolidation).

More details will be given in the section of this report entitled Load Test Program.

In each borehole, load tests will be performed at elevations which are multiples of 30 ft (9.15 m) from the first test in the borehole. This procedure allows installation of each instrument to be exactly the same, since the sections of 4-1/2 in (114.3 mm) drillpipe are 30 ft (9.15 m) in length. Therefore, a systematic and efficient procedure can be established. The initial test in each borehole will be accomplished at approximately 57 ft (16.8 m) below the seafloor.

A Schematic Diagram of Testing Depths (Test Depths 1 through 6) is shown on Plate 5. The relationship of these elevations with the soil types and properties determined from the site investigation is shown on Plate 6, Site Stratigraphy Showing Proposed Test Elevations.

The borehole number and elevations to be tested are shown on Table 1. For example, Test Number 2-3 indicates Boring No. 2, Test Depth (elevation) No. 3. A letter "R" after the Test Number indicates that subsequent testing will be performed at the same elevation at some additional consolidation time after the initial loading sequence at the same elevation.

One elevation will be examined from Stratum I. Since the support from this upper stratum will be minimal in the future large pile program, the testing of only one level is considered to be sufficient.

Stratum II displayed the widest variation in soil properties. Therefore, three elevations will be studied, one in each of the sub-strata noted on Plate 6. Two elevations in Stratum III will be tested. No tests below 220 ft (67.1 m) are planned since the tip elevation of the large-diameter test pile is planned to be at that level.

A schedule for testing is shown on Plate 7. This schedule shows the test plan for all three borings and, also, cumulative work periods for both the drilling and testing crews.

Installation Procedure

As previously discussed, the installation of the small pile segment instrument will be identical in each borehole and at each depth. Prior to installation, the borehole will be advanced to the desired test elevation (-1, -2, etc.) with mud pressure and mud weight carefully monitored. Charts showing the proposed drilling mud weight schedule and the resulting soil and mud pressure distributions are shown on Plates 8 and 9, respectively. Plate 8 also shows a comparison of the drilling mud schedule to be used and that typically used offshore in the Gulf of Mexico. The differences in the typical mud weight and that specified are to prevent the borings from "squeezing" closed while also preventing formation fracture. The allowable mud pressure to accomplish this purpose lies between the in situ pore pressure line and the total pressure line on Plate 9.

The required length of pre-strung (with cable) N-rod will be set out prior to beginning instrument installation. Also, the instrument will be prepared and checked for proper operation and the data acquisition system activated. After the proper borehole depth is reached, the pipe will be fixed using slips or clamps and the installation procedure will begin. This procedure is presented in pictorial form on Plate 10a through 10f. Steps 1 through 9 show the placement of the instrument and the first section of N-rod. Step 10 is to repeat Steps 6 through 9 until the desired elevation is reached. The instrument must not be rested on the soil at the bottom of the borehole at the completion of Step 10, but rather clamped at the top and supported on the top of the drillpipe. The Instrument Installation Schedule is shown on Plate 11 with a schematic shown on Plate 12. Steps 11 through 13 show the driving of the instrument to final test elevation. In the upper soft soils, the tool may settle to the desired depth under its own weight. The uppermost section of rod should therefore be clamped prior to driving (or lowering) to prevent excessive settlement.

Preparation of the loading assembly is shown in Steps 14 through 18. For the initial, "as driven", load test to be performed in each borehole and at each elevation, the loading rod need not be secured to the ram. Subsequent, "after consolidation", tests will be performed as shown in Steps 14 through 18. At the completion of testing at a particular elevation, Step 19 will be performed to dislodge the instrument. The recovery of the tool will be accomplished by reversing Steps 1 through 10. A diagram of the testing arrangement is shown on Plate 13.

Load Test Program

The program of load tests has been developed with the intent of investigating the behavior of a pile-soil system under the widest range of consolidation histories and loading patterns possible, within the constraints of the available time at the site. In order to plan and schedule the program of research, it was necessary to assume a pattern of consolidation behavior. It was therefore assumed that the time after insertion required for 90 percent of the soil reconsolidation to occur will be 72 hours. Assumptions regarding the time required for testing, removal and reinsertion of the model, and other physical activities were also necessary. The resulting schedule is shown on Plate 7.

The schedule was developed with the intent of devoting each borehole to one primary aspect of soil behavior. One borehole is devoted to investigating the long-term static capacity; the second is devoted to a shorter-term static capacity and an investigation of the effects of one-directional cyclic loading; the third is to be reserved for two-directional cycling with no static loading to failure prior to cycling. Based on our previous experience with axially loaded piles, both in the field and laboratory, the program is felt to be sufficiently diverse to fully investigate the unknown aspects of pile-soil behavior.

It should be noted that the schedule and sequence of load tests were based on a set of assumptions regarding the results of the tests themselves, and are thus likely to change during the course of the program. If the consolidation time is faster than those anticipated, it is likely that more reconsolidation tests will be performed. If the consolidation proceeds more slowly, some of the experiments may be dropped from the program. Full suites of tests will be performed at three primary levels; 57 ft, 147 ft, and 207 ft below the mudline.

The intermediate depths (87 ft, 117 ft, and 177 ft) will be tested, if possible, but would be the experiments eliminated from the program if necessity dictates.

The load test program has been developed with the intent to investigate the following aspects of pile-soil behavior:

1. The development of frictional resistance with time after insertion, as related to the parallel development of increases in radial effective stress;

2. The initiation and degree of cyclic losses in frictional resistance under one-way cyclic loading, with and without a static bias in the applied loads; Creep ??

3. An investigation of the initiation and degree of cyclic degradation under progressively increased symmetric reversed displacements; Displacement control

4. The maximum degree of cyclic degradation produced by fully reversed large displacements;

5. The capability of the soil to recover frictional resistance with time after cyclic loading; and

6. The development of correlations between frictional resistance and radial effective stresses observed during the research program.

Data Reduction

The data will be stored on flexible discs and on magnetic tape during the progress of the tests. The data will be stored as raw voltage readings rather than engineering units, in order to preserve the integrity of the data. In the field, printed copies of all the data will be generated in engineering units, but the reduced data values will not be stored.

Upon returning to the Houston office, data from each test at depth will be converted to engineering units and stored in separate files on magnetic tape in order to facilitate later analyses of the results of the tests.

The conversion of data from voltages to engineering units requires only a simple (mv + b) calculation, where m is the calibration factor for each transducer, e.g., psf per volt; v is the raw voltage reading, and b is the initial bridge imbalance, expressed in engineering units.

In addition to the tabulation of key values of the variables, the data will be cross-plotted for each experiment so that trend lines may be established. Included will be pressures against time and the logarithm of time during consolidation, frictional resistance and effective radial pressure with displacement during loading, and the ratio of friction to effective radial pressure with displacement during loading. Based on the trends developed by the relationships described above, additional tabulations and graphs will be prepared for use in developing reliable procedures for design of axial piles in soft clays.

PLATES
AND
TABLES

TABLE 1 - PROPOSED TESTS

Test No.	Boring No.	Elevation Below Seafloor, ft (Stratum)		Consolidation Time, Hours from Installation
1-1	1	57	(I)	74
2-1	2	57	(I)	12
3-1	3	57	(I)	16
2-2	2	87	(II)	8
2-2R	2	87	(II)	24(12)
3-2	3	87	(II)	12
3-2R	3	87	(II)	36(20)
2-3	2	117	(II)	12
2-3R	2	117	(II)	36(20)
3-3	3	117	(II)	28
1-4	1	147	(II)	72
2-4	2	147	(II)	12
2-4R	2	147	(II)	28(12)
3-4	3	147	(II)	16
3-4R	3	147	(II)	40(20)
2-5	2	177	(III)	8
2-5R	2	177	(III)	40(28)
3-5	3	177	(III)	16
1-6	1	207	(III)	70
2-6	2	207	(III)	16
2-7R	2	207	(III)	42(22)
3-6	3	207	(III)	18

Notes:

1. Numbers in parenthesis indicate time for reconsolidation after previous testing phase.

2. Essential tests are those to be performed at 57 ft, 147 ft, and 207 ft.

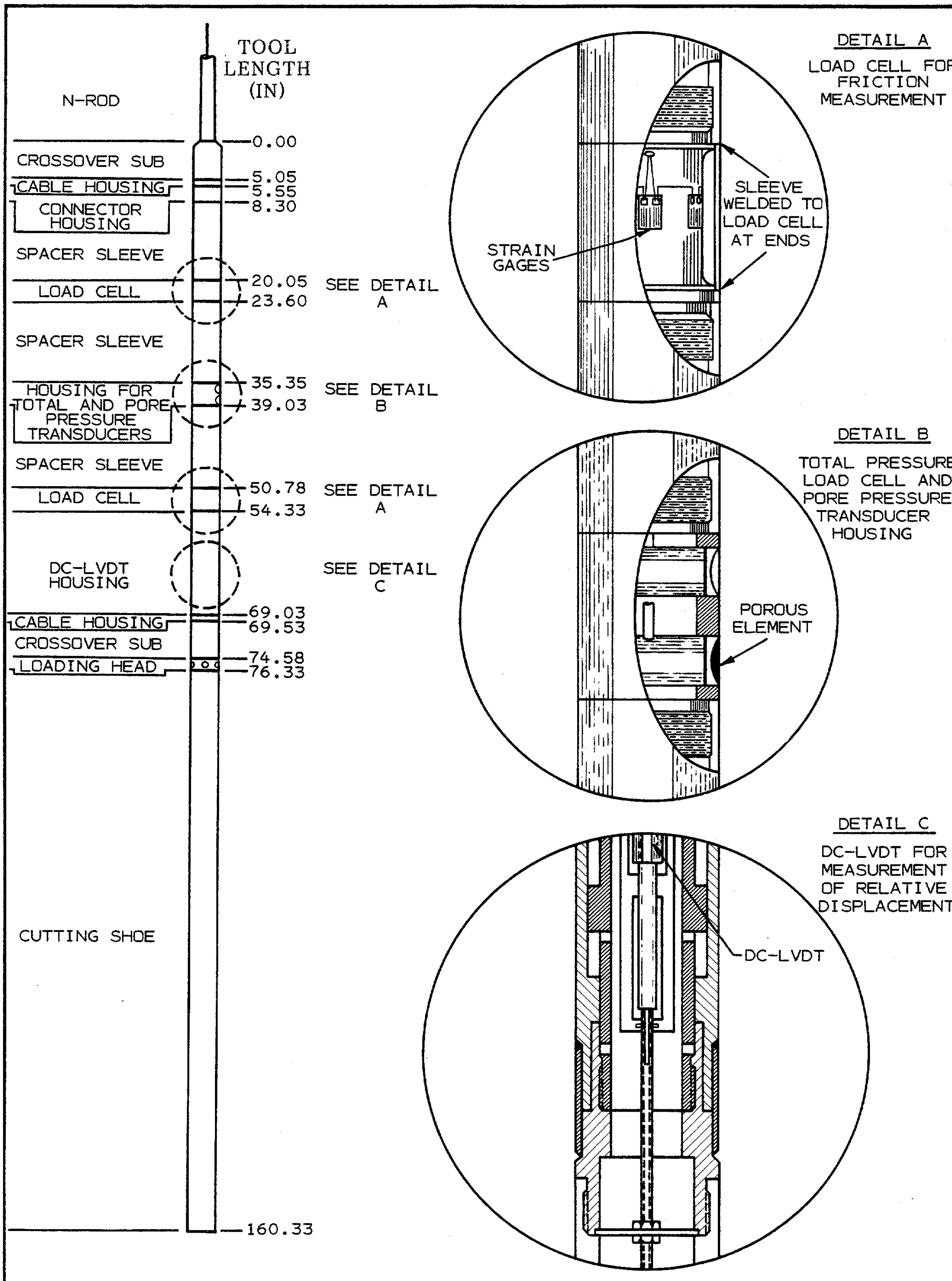

DIAGRAM OF SMALL DIAMETER PILE SEGMENT

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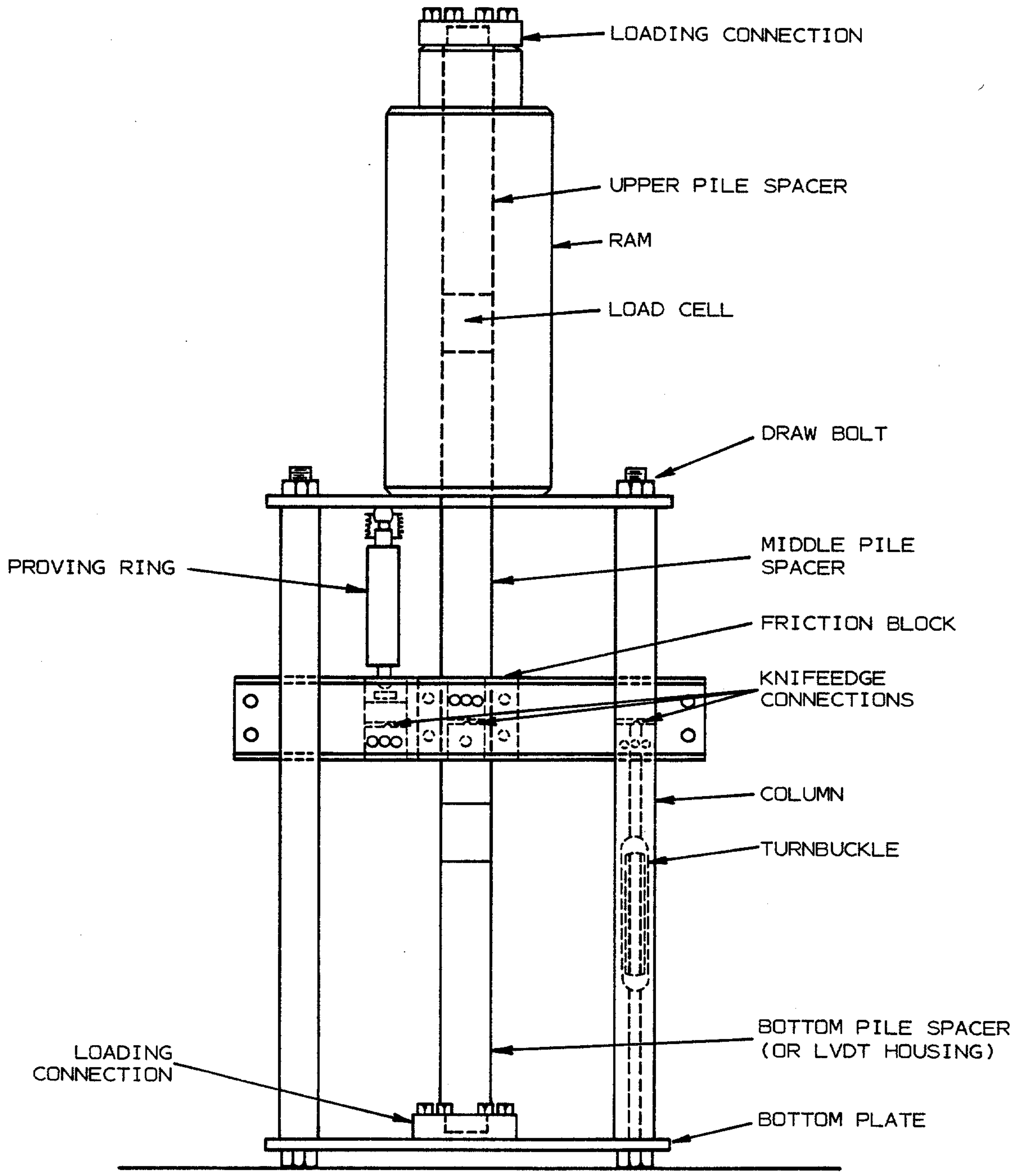
PLATE 1



CALIBRATION FRAME ASSEMBLED
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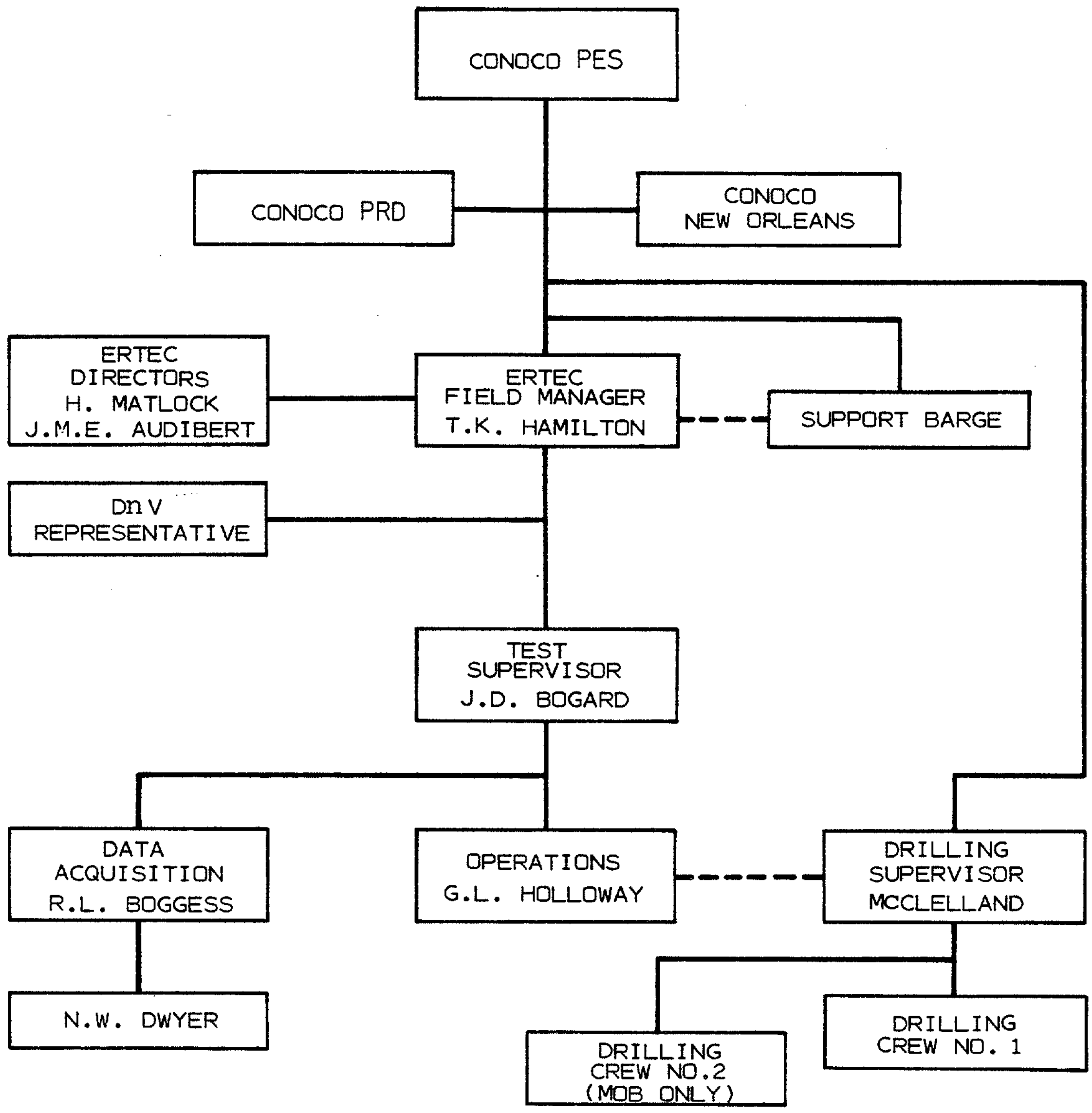

ORGANIZATIONAL CHART FOR
OFFSHORE TESTING PROGRAM

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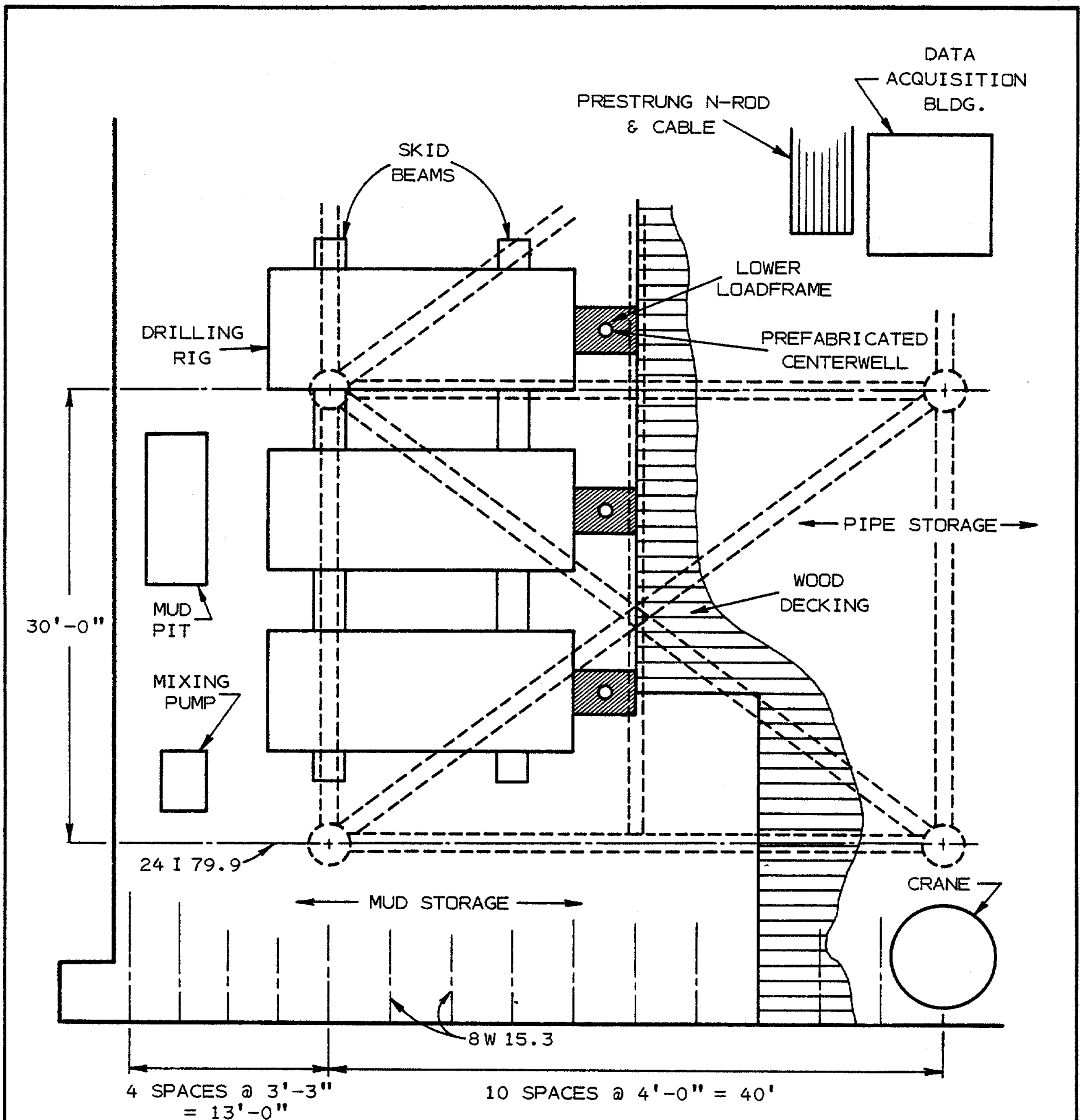

DECK LAYOUT

SCALE: 1" = 10'

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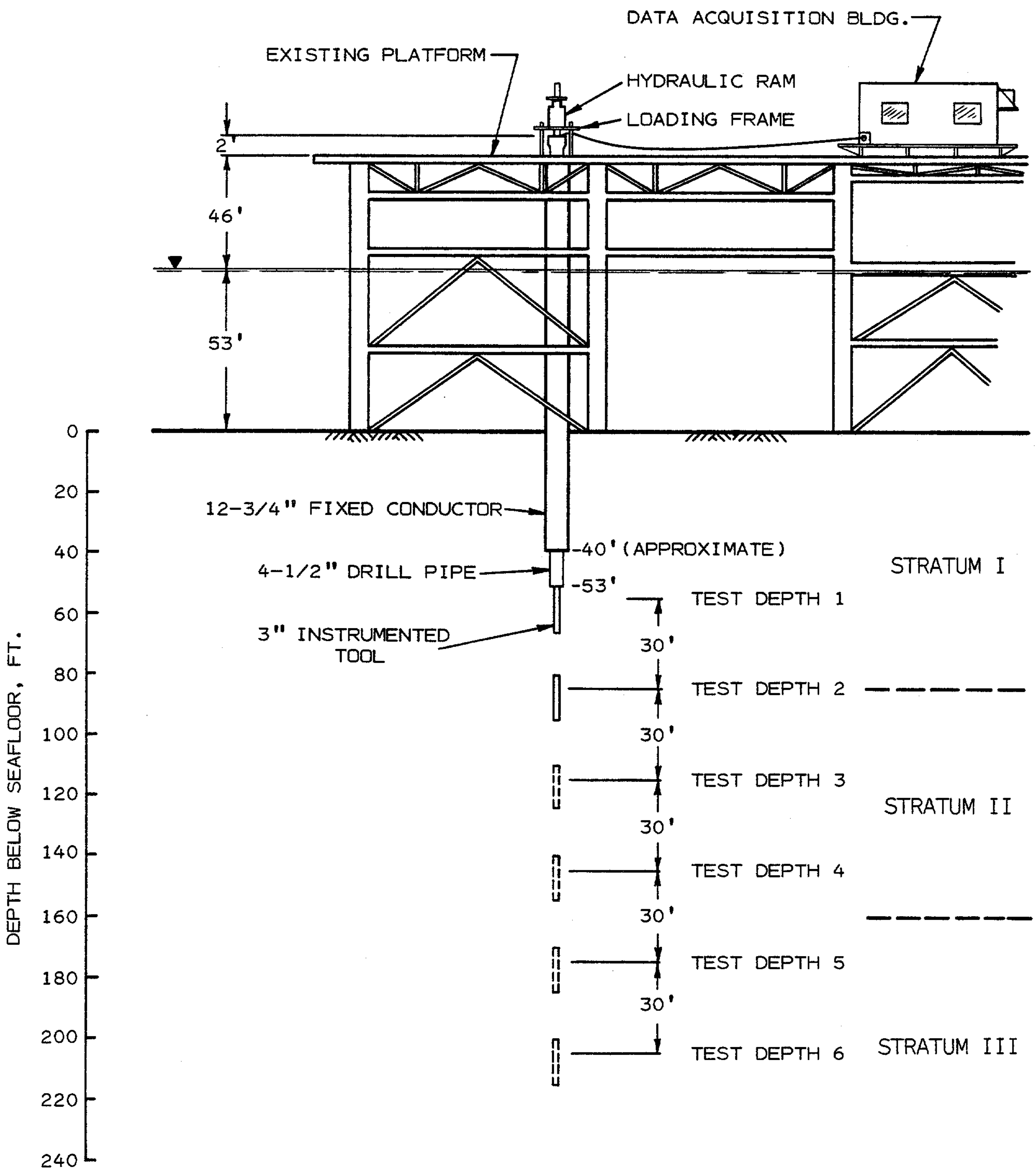

SCHEMATIC DIAGRAM OF TESTING DEPTHS

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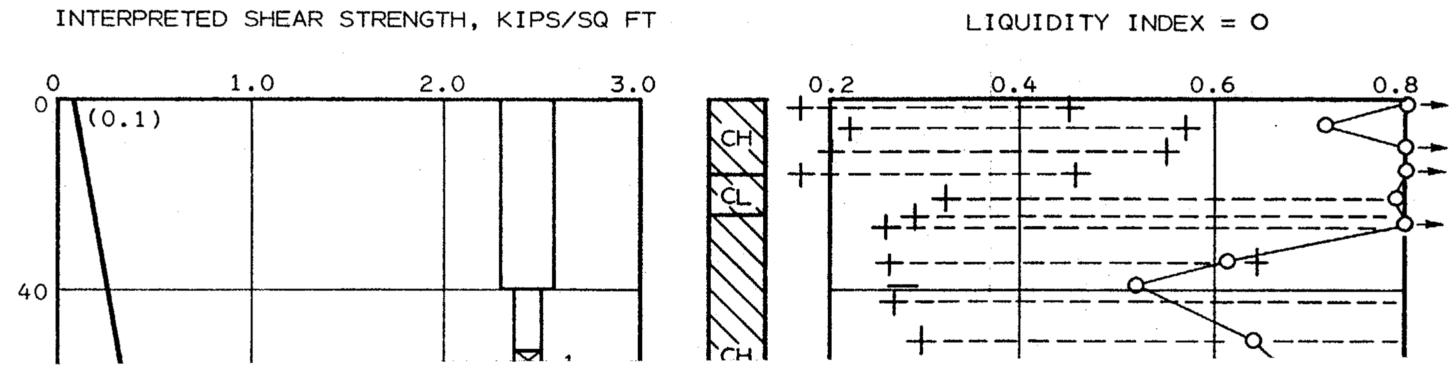


SITE STRATIGRAPHY SHOWING
PROPOSED TEST ELEVATIONS

Ertec PROJECT MASTER PLANNING AN

FORM PM 101

TKH

PAGE 1 OF 1

TITLE

OPERATIONAL TEST SCHEDULE

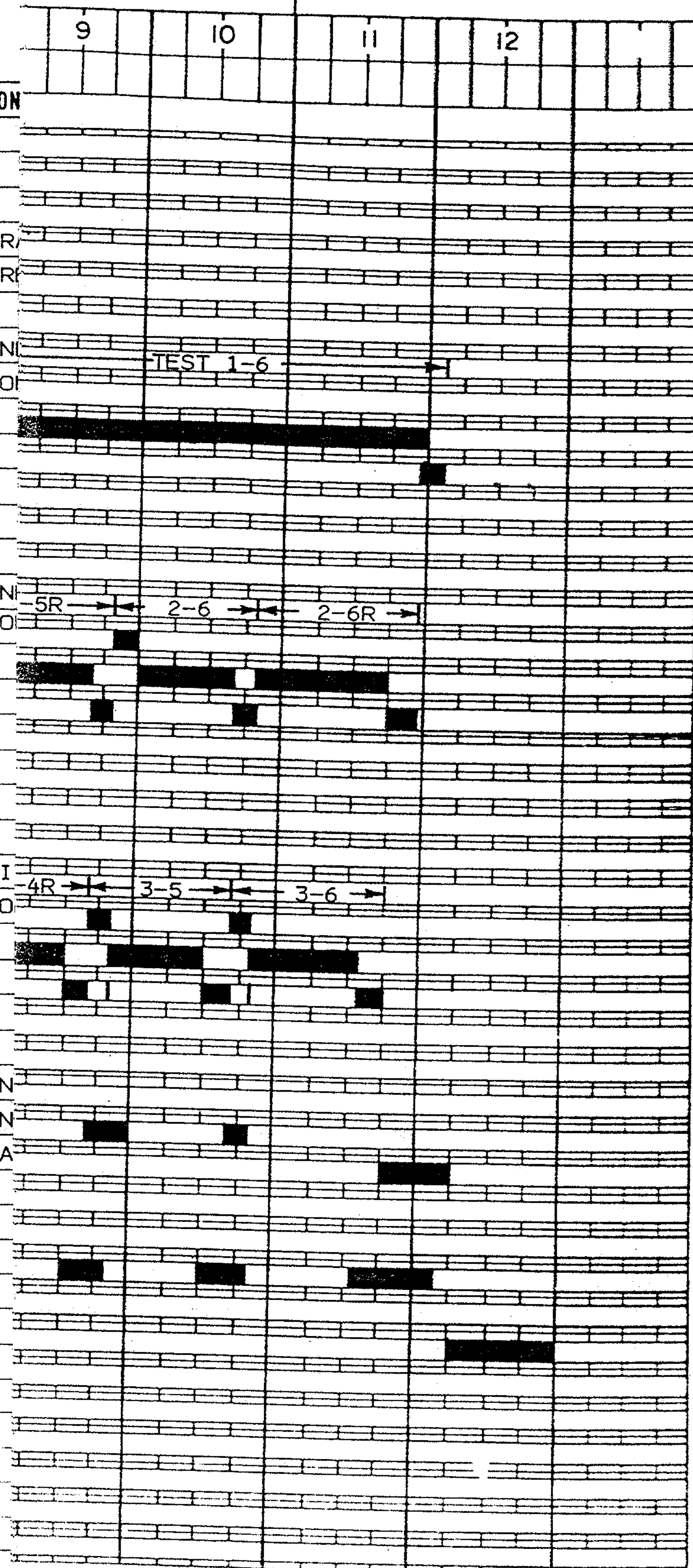
PROJECT NAME AND NUMBER

TENSION PILE TEST CNRD 13-2

roval

MILESTONES/FUNCTIONS

Phase	Task	Act	Item	TASK DESCRIPTION
				ARRIVE AT PLATFORM
				EQUIPMENT SET-UP AND PREPARA
				DRILLING CREW AND TEST CRE
				TEST BORING NO.1 (STATIC AND
				DRILLING AND INSTALLING OI
				CONSOLIDATION
				TESTING
				TEST BORING NO.2 (STATIC AN
				DRILLING AND INSTALLING OI
				CONSOLIDATION
				TESTING
				TEST BORING NO.3 (PROGRESSI
				DRILLING AND INSTALLING OI
				CONSOLIDATION
				TESTING
				DRILLING CREW - PREPARATION
				(CUMULATIVE) - DRILLING/IN
				- PIPE REMOVA
				TEST CREW - PREPARATION
				(CUMULATIVE) - TESTING
				DEMOB - BOTH CREWS



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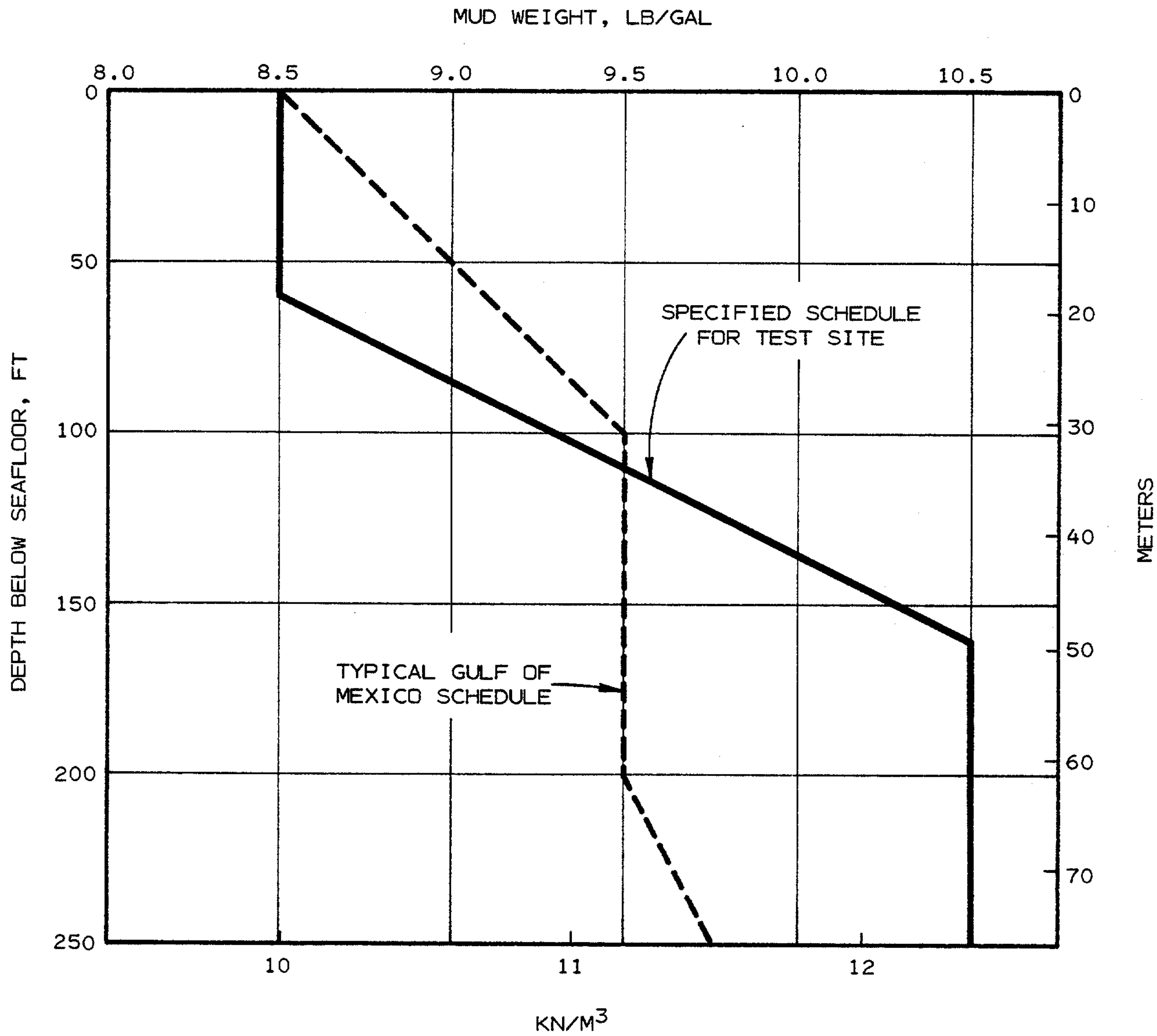
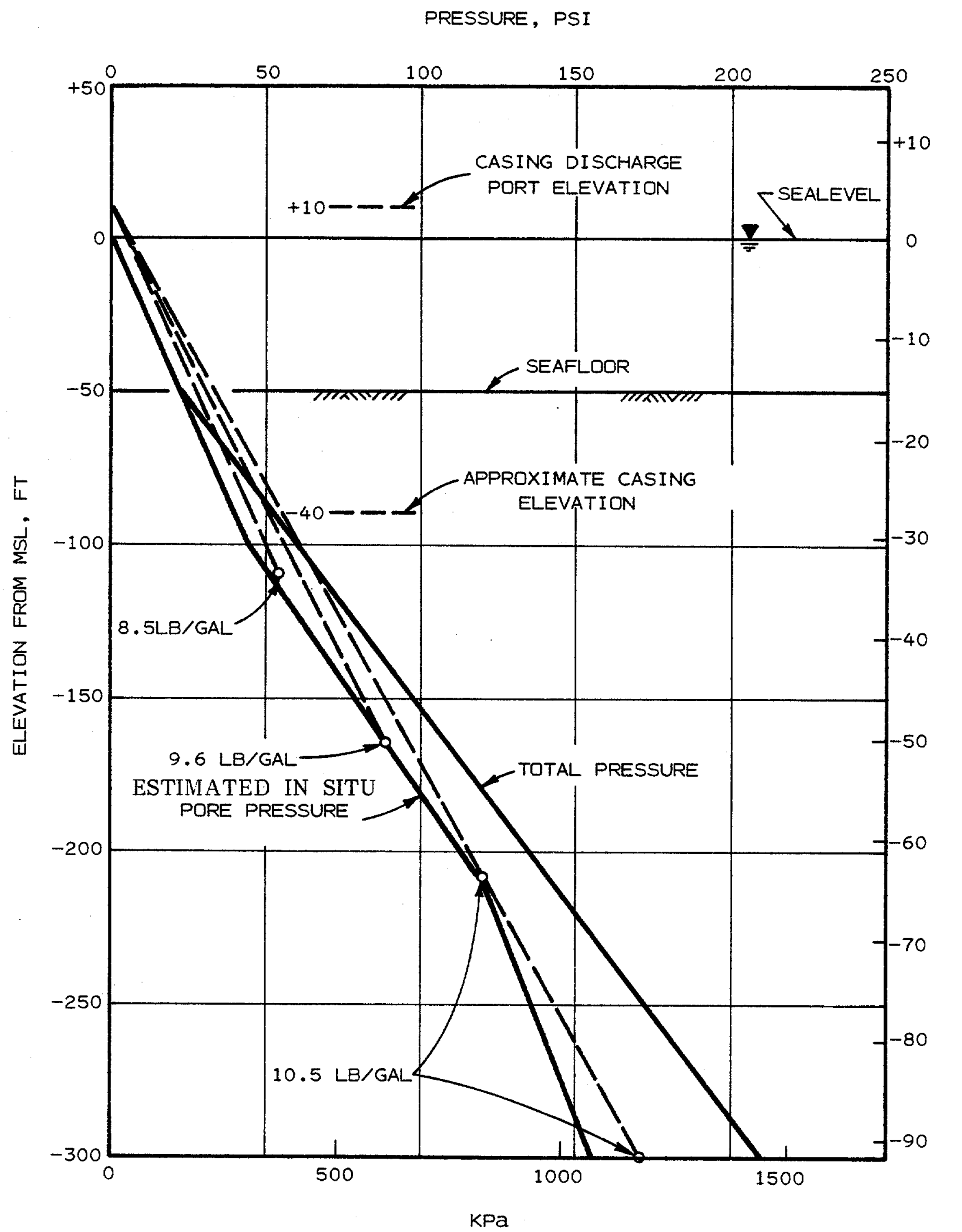
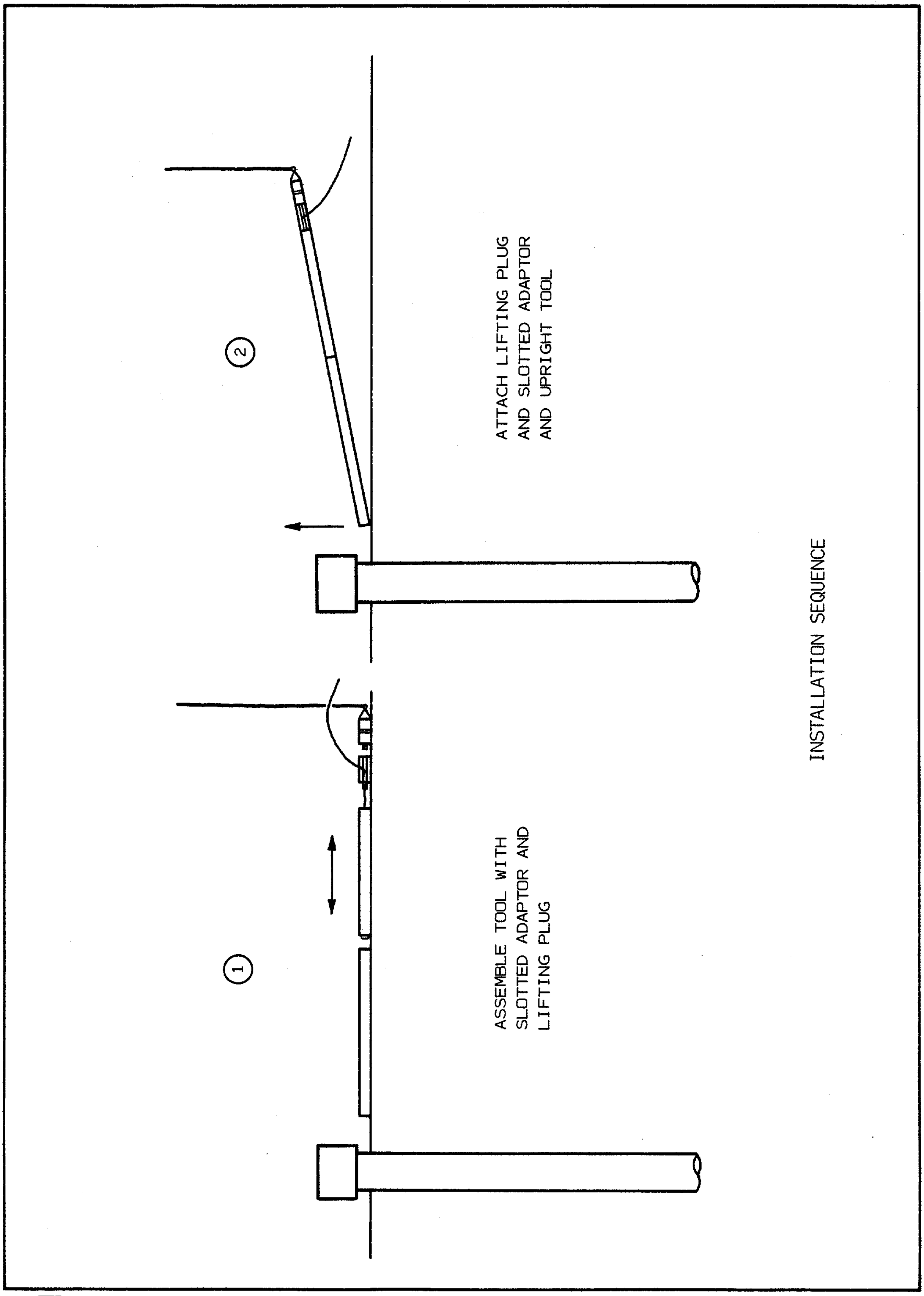


DRILLING MUD SCHEDULE



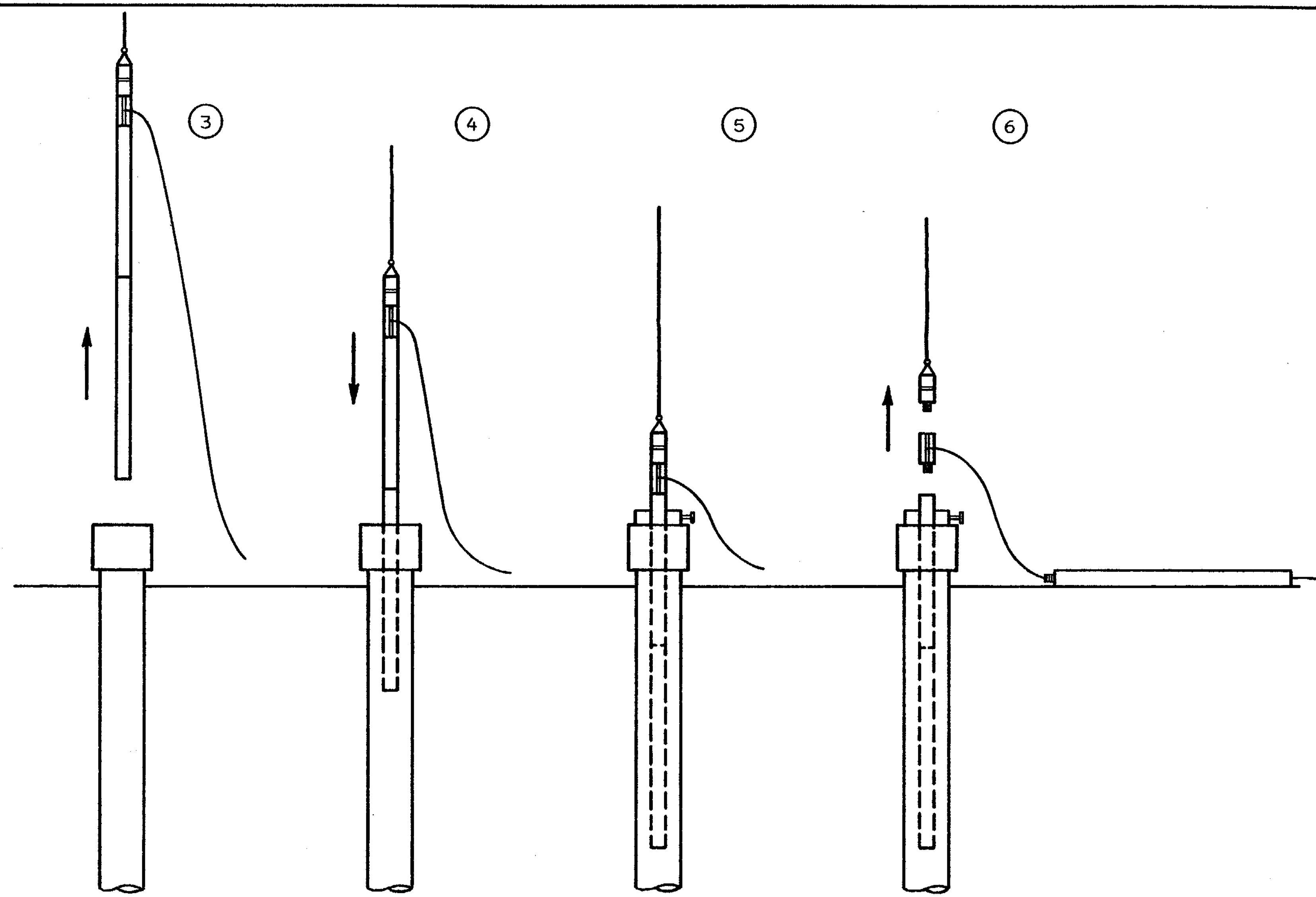
PRESSURE DISTRIBUTION USING SPECIFIED MUD SCHEDULE

JOB NO. ______



INSTALLATION SEQUENCE
1
ASSEMBLE TOOL WITH
SLOTTED ADAPTOR AND
LIFTING PLUG
2
ATTACH LIFTING PLUG
AND SLOTTED ADAPTOR
AND UPRIGHT TOOL

JOB NO. ________



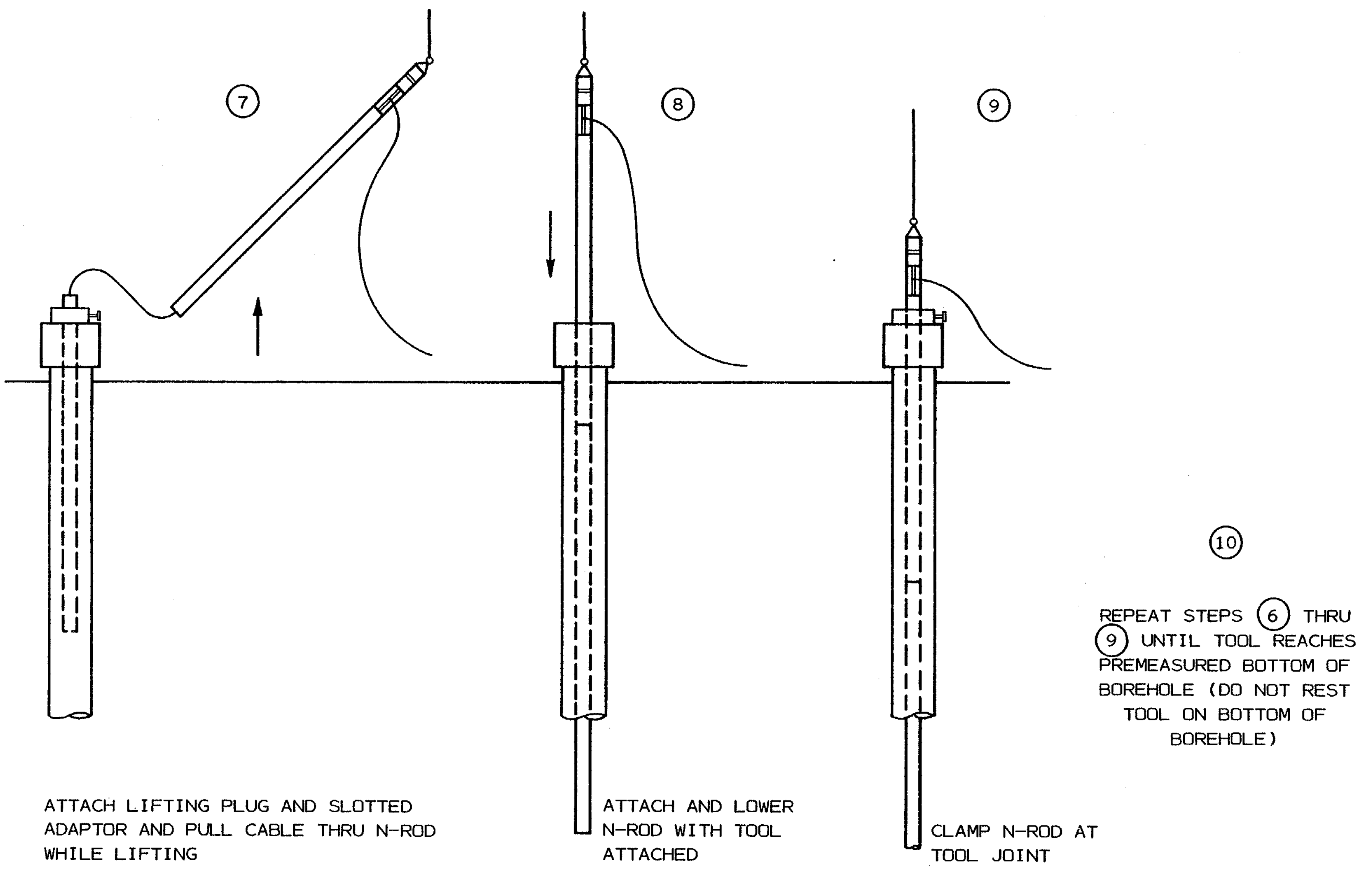
HANG TOOL OVER DRILL PIPE

LOWER TOOL INTO DRILL PIPE

CLAMP TOOL BELOW ADAPTOR AND REST CLAMP ON TOOL JOINT

REMOVE LIFTING PLUG AND SLOTTED ADAPTOR

INSTALLATION SEQUENCE (CONTINUED)



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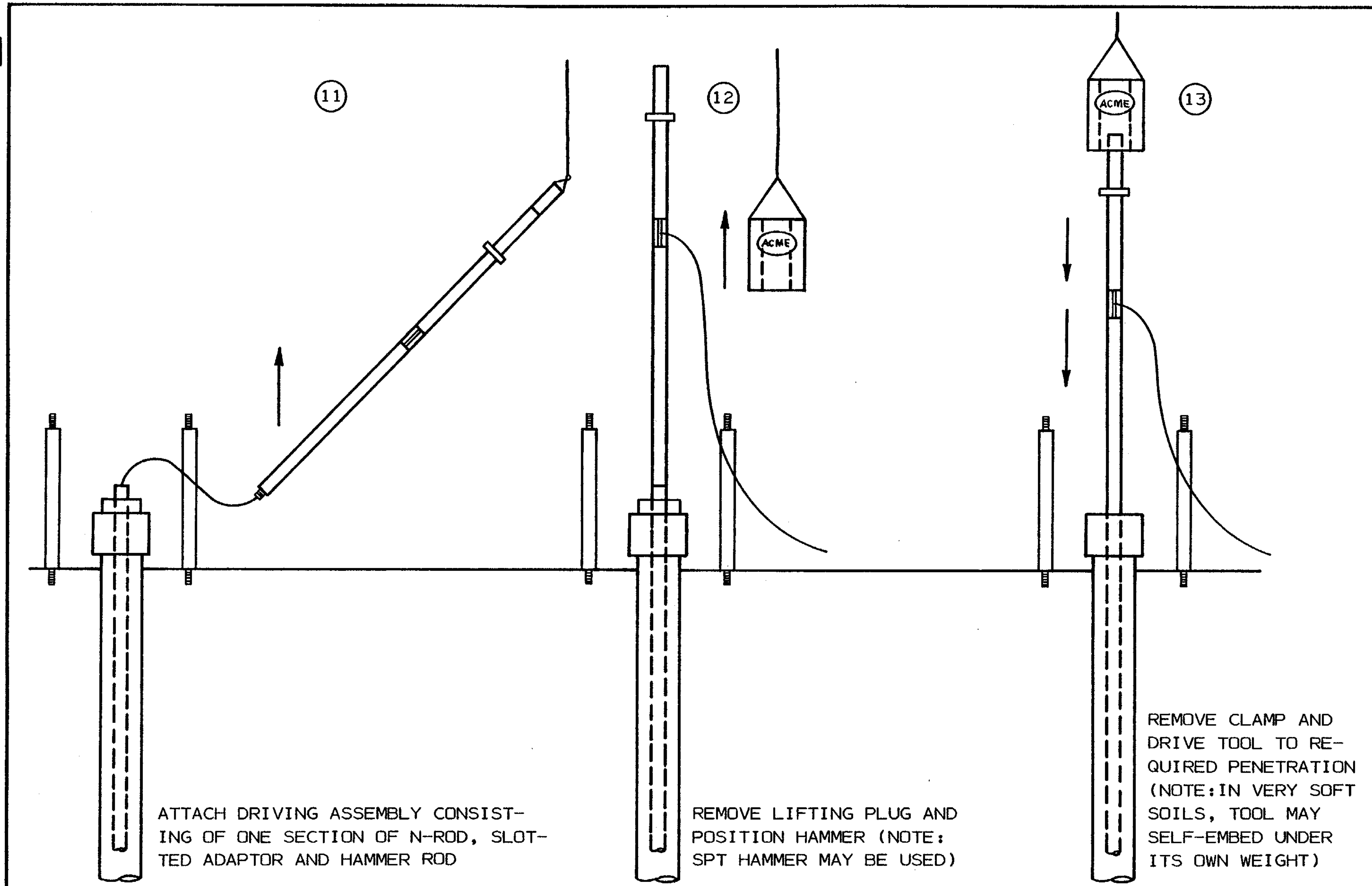

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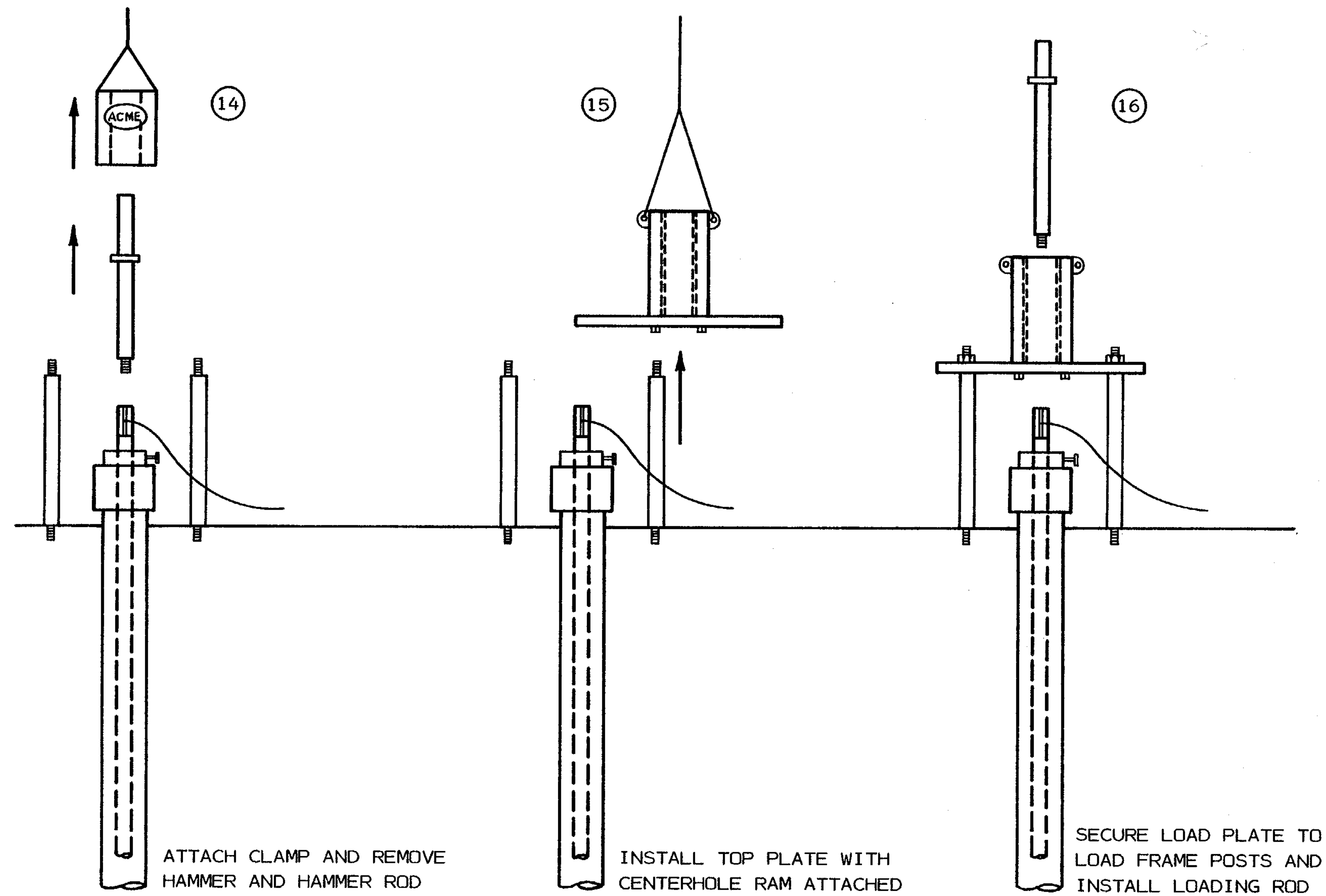

INSTALLATION SEQUENCE (CONTINUED)

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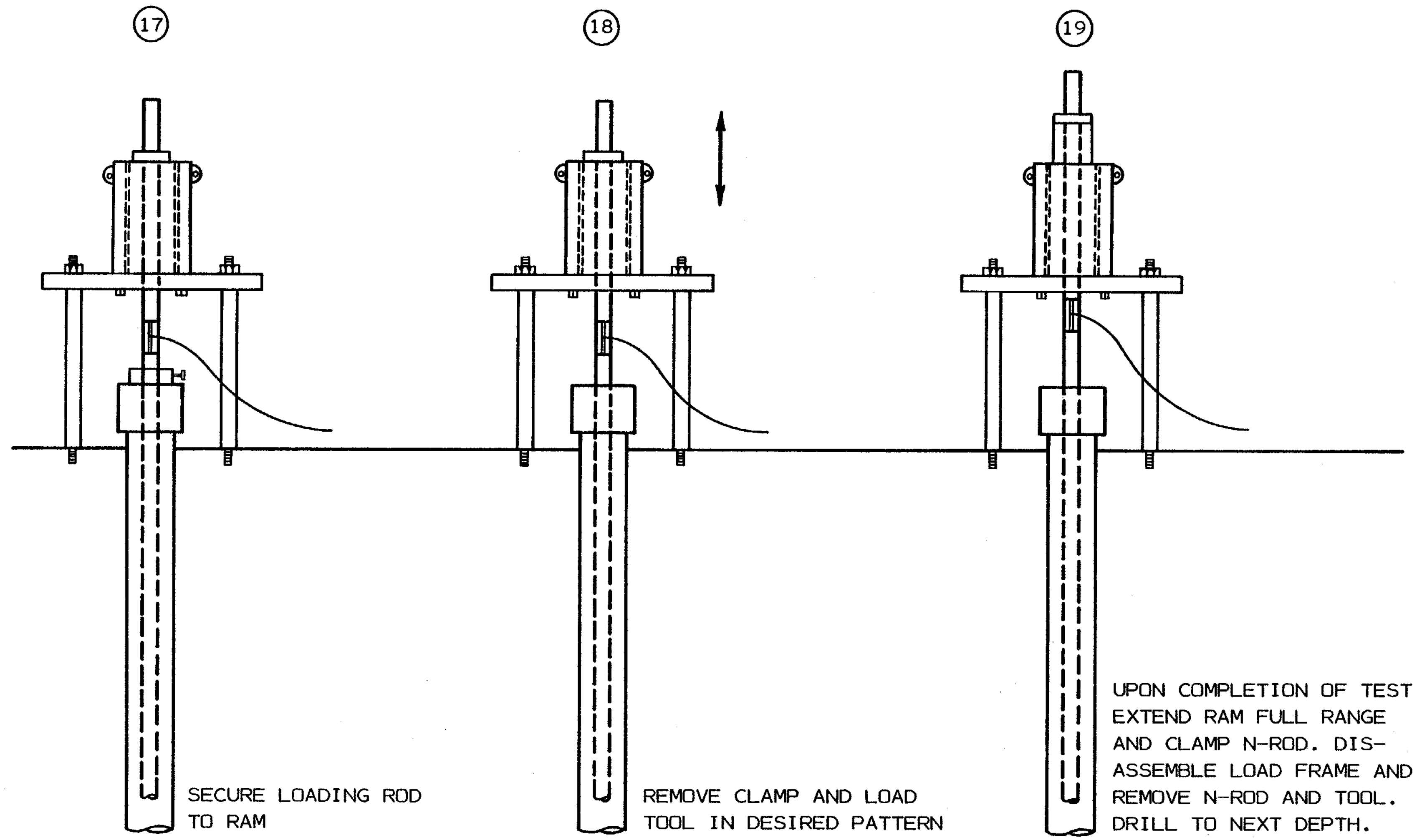
The Earth Technology Corporation

Ertec

JOB NO. ________



INSTALLATION SEQUENCE (CONTINUED)

Ertec
The Earth Technology Corporation

Ertec

PLATE 10f

	FIRST LOAD CELL (F+2.3)	4	5	6
S	NOMINAL TEST DEPTH (MIDPOINT OF FRICTION SLEEVE) (F+3.75)			

NOTES : 1. DRILLING DECK ELEVATION SHALL BE TAKEN AS ZERO DATUM.
2. TOTAL PIPE REQUIRED INCLUDES BIT LENGTH.
3. INITIAL MEASUREMENTS OF TOOL SHALL BE TAKEN (LVDT OPEN).
4. MEASUREMENTS OF SMALL TOOL SHALL BE TAKEN (LVDT CLOSED).
5. SMALL DIAMETER TOOL LENGTH SHALL TAKEN AS 14.0 FT.

INSTRUMENT INSTALLATION SCHEDULE

PLATE 11

	TEST D
A	PLA SU
B	
C	

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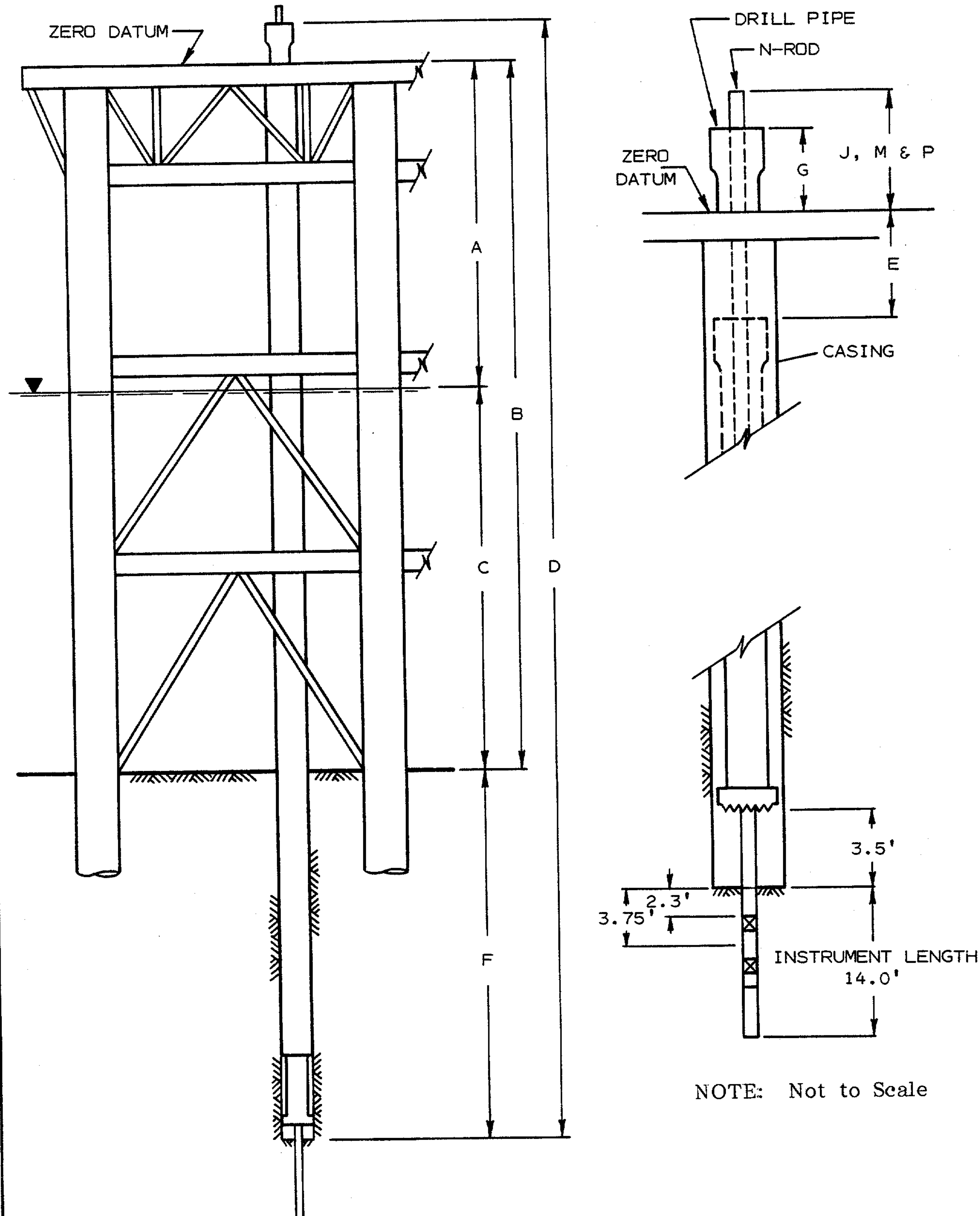
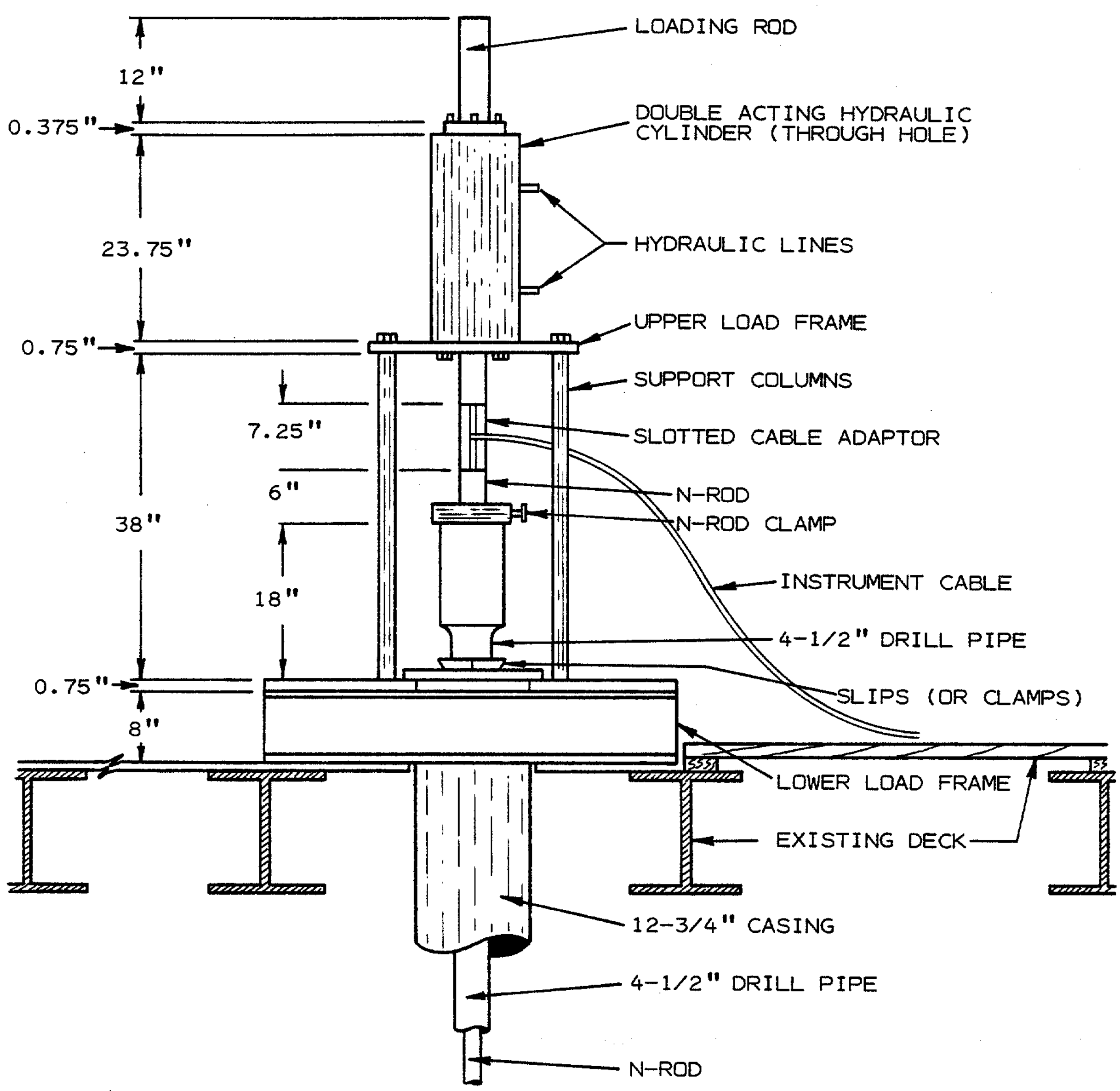


SCHEMATIC OF INSTALLATION SCHEDULE

Ertec



SCHEMATIC DIAGRAM OF TESTING ARRANGEMENT
FOR 3-INCH DIAMETER PILE SEGMENT TESTS