
USACE / NAVFAC / AFCEA / NASA UFGS-31 63 16 (November 2008)

Preparing Activity: USACE Superseding
UFGS-31 63 16 (October 2007)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2009

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11/08

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SECTION 31 63 16

AUGER CAST GROUT PILES 11/08

NOTE: This guide specification covers the requirements for auger cast grout piles.

Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

PART 1 GENERAL

NOTE: Auger cast grout piles are not recommended in low strength soils such as peat or soils containing layers or fields of boulders or cobbles.

On the drawings, show:

1. Subsurface-soil-data logs
2. Locations and size (diameter) of piles.
3. Design tip elevation for each pile indicated.
4. Reinforcing steel details.
5. Locations of test piles if required.

6. Locations of soil probes if required.

1.1 MEASUREMENT AND PAYMENT PROCEDURES

NOTE: Where the basis for bidding is based on lump sum price, use the following paragraphs. If the bid is based on unit price, use paragraph UNIT PRICES.

1.1.1 Lump Sum

NOTE: The pile diameter specified should be the diameter of the auger (50 mm (2 inches)) larger in diameter than that used to calculate the structural capacity of the pile. The structural capacity of the pile should be based on an allowable design stress not greater than 20 percent of the 28-day grout strength.

The number of augering test piles would depend on degree of variations in subsoil conditions as revealed by test borings. In general, a minimum of three augering tests should be made and possibly more where subsurface conditions are questionable. One test pile should be load tested in each area of substantially different subsoil conditions, but not less than one pile load test should be made for the project.

The total test load would be twice the working load on the pile, which should not exceed 36 metric tons (40 tons) per pile. Withdrawal of auger and examination of the soil to verify the soil profile should be required for all test piles and for 10 percent of the remaining piles to supplement the soil boring information.

The contract price for piling will be a principal sum based on [_____] mm inch diameter piles, (including [_____] test piles), having a total aggregate length of [_____] linear m feet and will include [_____] pile load tests having a capacity of [_____] metric ton ton and [_____] auger withdrawals.

1.1.1.1 Variations in Pile Quantities

From the results of laboratory tests on soil samples and data obtained as a result of placing and loading the test piles specified herein, the Contracting Officer will determine and will list "calculated" pile tip elevations for all piles. The Contracting Officer reserves the right to increase or decrease the total length of piles to be furnished and installed by changing the pile locations or elevations, requiring the installation of additional piles, or directing the omission of piles from the requirements shown and specified. Should the total pile length installed vary from that specified as the basis for bidding because of

added or omitted piles or variations in the pile lengths, the principal sum will be adjusted by the amount bid per linear m foot for "Additional Pile Length" or "Omitted Pile Length".

1.1.1.2 Variations in Pile Load Test Quantities

The Contracting Officer reserves the right to increase or decrease the number of pile load tests from that specified for the basis of bidding. For changes in the number of load tests required, the contract principal sum price will be adjusted by the amount bid for "Each Additional Pile Load Test" or "Each Omitted Pile Load Test."

1.1.1.3 Variations in Auger Withdrawal Quantities

Should the number of auger withdrawals be increased above the specified contract number at the direction of the Contracting Officer, the contract principal sum will be adjusted by the amount bid for "Each Additional Auger Withdrawal."

1.1.1.4 Lump Sum Basis of Payment

The Contractor's furnished price shall include all necessary equipment, tools, material, labor, and supervision required for installing and cutting off the piles (including test piles), for conducting the load tests and for auger withdrawals in order to meet the applicable contract requirements. Payment for piles will be on the basis of the lengths of the piles measured from cut-off elevations to final tip elevations. No additional payment will be made for withdrawn, damaged, or rejected piles, for any portion of a pile remaining above the cut-off elevation, for cutting off piles, nor for any cut off lengths of piles. Payment for load tests will be made for each load test satisfactorily performed. Payment for auger withdrawal will be made for each auger withdrawal made at the direction of the Contracting Officer.

1.1.2 Unit Prices

1.1.2.1 Piles

The lump sum contract price does not include foundation piles, test piles, or the placement thereof; payment for which will be made in accordance with these paragraphs.

1.1.2.2 Unit Price Basis of Payment

The Contracting Officer reserves the right to increase or decrease the length of piles to be furnished and installed by changing the foundation pile locations or elevations, by requiring the installation of additional piles, or by requiring omission of piles from the requirements shown and specified. Whether or not such changes are made, the Contractor will be paid at the contract unit price per linear m foot (including control test piles), multiplied by the total linear m feet of acceptable piles actually installed; provided however, that in the event the Contracting Officer requires an increase or decrease in the total length of piles furnished and installed, the contract unit price will be adjusted in accordance with SPECIAL CONTRACT REQUIREMENTS.

1.1.2.3 Full Compensation

Payment in accordance with paragraph Unit Price Basis of Payment will

constitute full compensation for furnishing, delivering, handling, and/or installing (as applicable) all material, labor and equipment necessary to meet contract requirements applicable to the foundation piles. The Contractor will not be allowed payment for withdrawn, broken, or rejected piles nor (except for control test piles) for a portion of any pile remaining above the cut-off point.

1.1.2.4 Load Tests

The contract includes [_____] pile load tests. The Contracting Officer reserves the right to increase or decrease the number of pile tests. Adjustments in the contract price will be made for such increases or decreases in the amounts bid for "Each Additional Pile Load Test" or "Each Omitted Pile Load Test."

1.2 REFERENCES

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 109/C 109M	(2008) Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
ASTM C 150	(2007) Standard Specification for Portland Cement
ASTM C 31/C 31M	(2008b) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 33/C 33M	(2008) Standard Specification for Concrete Aggregates
ASTM C 39/C 39M	(2005e1e2) Standard Test Method for

Compressive Strength of Cylindrical
Concrete Specimens

ASTM C 618	(2008a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C 937	(2002) Grout Fluidifier for Preplaced-Aggregate Concrete
ASTM C 939	(2002) Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
ASTM C 942	(1999; R 2004) Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM D 1143/D 1143M	(2007e1) Piles Under Static Axial Compressive Load

1.3 SYSTEM DESCRIPTION

NOTE: Working load on the pile should be limited to 36 metric tons (40 tons) per pile. Assuming subsurface conditions are adequate, the working load on the pile should be limited to about 36 metric tons (40 tons) per pile for 300 mm (12 inch) piles up to about 73 metric tons (80 tons) per pile for 450 mm (18 inch) piles.

Auger cast grout piles are formed by the rotation of a continuous flight hollow-shaft auger into the ground to the tip elevation established by the requirements specified elsewhere in this section. Grout is then injected through the auger shaft as the auger is being withdrawn in such a way as to exert removing pressure on the withdrawing earth-filled auger as well as lateral pressure on the soil surrounding the grout-filled pile hole.

1.3.1 Equipment

The minimum inside diameter of the hollow shaft of the augerflight shall be 31.8 mm 1-1/4 inches. Provide grout injection equipment with a grout pressure gauge in clear view of the equipment operator. Rate of grout injection and rate of auger withdrawal from the soil shall be so coordinated as to maintain at all times a positive pressure on this gauge which will, in turn, indicate the existence of a "removing pressure" on the bottom of the augerflight. Magnitude of this pressure and performance of other augering and grouting procedures, such as rate of augering, rate of grout injection, and control of grout return around the augerflight, are dependent on soil conditions and equipment capability and shall be at the option of the Contractor, subject to review by the Contracting Officer. The auger hoisting equipment shall be capable of withdrawing the auger smoothly and at a constant rate.

1.3.2 Subsurface Data

NOTE: This paragraph is to be used by agencies that show the soil data log on the drawings and for agencies that retain subsurface samples of soil.

Subsurface soil data logs are shown on the drawings. The subsoil investigation report and samples of material taken from subsurface investigations may be examined in the [_____].

1.3.3 Grout Pump

Provide a positive displacement grout pump of an approved design. The pump discharge capacity shall be calibrated in strokes per cubic meter foot or revolutions per cubic meter foot by a method approved by the Contracting Officer. Remove oil or other rust inhibitors from mixing drums and pressure grout pumps prior to mixing and pumping.

1.4 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

Under SD-07, from 3 to 5 years experience in installation of auger cast grout piles should be required.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control

approval.][information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Auger cast Grout Piles[; G][; G, [_____]]

Detail drawings to demonstrate compliance of augering, mixing, and pumping equipment, installation, and installed piles with contract documents. Include with the drawings erection details and reinforcement as specified.

SD-03 Product Data

Test Piles[; G][; G, [_____]]

A complete and accurate record of all auger cast grout piles (both test piles and production piles), indicating the pile location, diameter, length, elevation of tip and top of pile, and the quantity and strength of grout material actually pumped in each pile hole.

Grout Pump

Materials

Grout Specimens for Laboratory Tests

Grout specimens for Contractor Tests

Casings

A description of the materials to be used and the proposed methods of operations.

SD-06 Test Reports

Test Piles

Loading Test

Flow Cone Test

..Test results.

SD-07 Certificates

Auger cast Grout Piles

Evidence to the Contracting Officer that the Contractor has been engaged in the successful installation of auger cast grout piles for at least [_____] years.

SD-11 Closeout Submittals

Records

..Specified records upon completion of work.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Grout

**NOTE: Insert the ultimate compressive strength
required by the design (20.7 MPa (3,000 psi)
minimum).**

Provide grout consisting of a mixture of portland cement, a pozzolanic material when approved, fluidifier, sand, and water proportioned and mixed to produce a grout capable of being pumped with an ultimate compressive strength of [_____] MPa psi at 28 days. Consistency shall not be less than 11 seconds when tested in accordance with paragraph FLOW CONE TEST. Other admixtures shall not be used.

2.1.1.1 Portland Cement

Portland cement shall conform to ASTM C 150.

2.1.1.2 Pozzolan

Pozzolan shall be a fly ash or other approved pozzolanic material conforming to ASTM C 618, Class F.

2.1.1.3 Grout Fluidifier

Grout fluidifier shall conform to ASTM C 937, except that expansion shall not exceed 4 percent. The fluidifier shall be a compound possessing characteristics which will increase the flowability of the mixture, assist in the dispersal of cement grains, and neutralize the setting shrinkage of the high-strength cement mortar.

2.1.1.4 Water

Water shall be fresh, clean, and free from sewage, oil, acid, alkali, salts, or organic matter.

2.1.1.5 Fine Aggregate

NOTE: To be used as alternate requirement.

Fine aggregate shall meet the requirements of ASTM C 33/C 33M. The sand shall consist of hard, dense, durable, uncoated rock particles and be free from injurious amounts of silt, loam, lumps, soft or flaky particles, shale, alkali, organic matter, mica, and other deleterious substances. If washed, a washing method shall be used that will not remove desirable fines, and the sand shall subsequently be permitted to drain until the residual-free moisture is reasonably uniform and stable. The sand shall be well-graded from fine to coarse, with fineness modulus between 1.30 and 3.40. The fineness modulus is defined as the total divided by 100 of the cumulative percentages retained on U.S. Standard Sieve 1.18, 0.600, 0.300 and 0.150 mm Numbers 16, 30, 50, and 100.

2.1.1.6 Aggregate

Aggregate shall meet the requirements of **ASTM C 33/C 33M**, for fine aggregate, except as to grading. The sand shall consist of hard, dense, durable, uncoated rock fragments and shall be free from injurious amounts of silt, lumps, loam, soft, or flaky particles, shale, alkali, organic matter, mica, and other deleterious substances. If washed, the method shall not remove other desirable fines, and the sand shall be permitted to drain until the residual free moisture is reasonably uniform and stable. Sand grading shall be reasonably consistent and shall conform to the following requirements as delivered to the grout mixer:

U.S. Standard Sieve Number	Cumulative Percent by Weight Passing	Cumulative Percent by Weight Retained
2.36 mm	100	0
1.18 mm	95-100	0-5
0.600 mm	55-80	20-45
0.300 mm	30-55	45-70
0.150 mm	10-30	70-90
0.075 mm	0-10	90-100

U.S. Standard Sieve Number	Cumulative Percent by Weight Passing	Cumulative Percent by Weight Retained
8	100	0
16	95-100	0-5
30	55-80	20-45
50	30-55	45-70
100	10-30	70-90
200	0-10	90-100

The sand shall have a fineness modulus of not less than 1.30 nor more than 2.10. Sand grading shown above may be modified with the approval of the Contracting Officer. Mortar test specimens made with the modified sand shall exhibit compressive strength equal to or greater than that exhibited by similar specimens made with sand meeting grading and other requirements shown above.

2.1.2 Reinforcement

Materials, assembly, and placement of reinforcement shall conform to the requirements of Section [03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE] [_____].

2.1.3 Casings

Casings shall be approved [steel] [_____] as soil warrants. Cylinder casings shall be of sufficient strength and rigidity to withstand all installation stresses, to prevent distortion caused by placing adjacent piles, and to prevent collapse due to soil or hydrostatic pressure.

PART 3 EXECUTION

3.1 GROUT VOLUME

The volume of grout per linear meter foot of pile shall be not less than

the volume of grout per meter foot of test piles. All volume measurements shall be made in the presence of the Contracting Officer's representative.

3.2 INSTALLATION

Install piles after rough grading at pile locations have been completed. The ground surface at each pile location at the time of augering and grouting shall be at least 305 mm 12 inches higher than the required pile cutoff elevation, unless a steel casing will be used, and the augered hole shall be completely filled with grout. All materials shall be fed to the mixer accurately measured by weight, except water that may be measured by volume. The order of placing the materials shall be as follows: (1) water, (2) fluidifier, and (3) other solids in order of increasing particle size. Time of mixing shall not be less than 1 minute. [Do not proceed with the installation of contract piles within any area of substantially different subsoil conditions until a satisfactory load test has been performed in that area.]

3.2.1 Casings Placement

Casings shall be approved by the Contracting Officer and shall be left in place and filled with grout. The casing shall be rotated by the auger drive unit or weighted or jetted to the required depth. After the casing is in place, the casing and hole shall be cleared of water, sediment, and debris prior to pouring the grout.

3.2.2 Drilling

**NOTE: Delete the sentence in brackets when test
piles, load tests, and soil probes are not used.**

Except where auger withdrawal is required or directed by the Contracting Officer, each pile hole shall be drilled and filled with grout in an uninterrupted operation. Drill each pile hole to the required tip elevation. [Should the required tip elevation shown on the drawings differ from the calculated tip elevation, an adjustment in the contract requirements will be made.] Advance the auger at a continuous rate which prevents removal of excess soil. Stop rotation of auger after reaching the required pile tip elevation.

3.2.3 Grouting and Auger Removal

At the start of pumping grout, raise the auger from 152 to 300 mm 6 to 12 inches and after grout pressure builds up, indicating discharge of grout, redrill auger to the required tip elevation, and fill pile hole with grout without interruption. When the auger is withdrawn to check the soil profile, it shall be reinserted in the pile hole to the required tip elevation and the pile hole then filled with grout without interruption. Coordinate rate of grout injection and rate of auger removal from the soil in such a manner as to maintain a positive pressure on the grout pressure gauge. The gauge indicates the existence of a removing pressure on the bottom of the augerflight. If the auger jumps upward during withdrawal, or if the grouting process is interrupted, or if there is decreased grouting pressure, reinsert it to the original tip elevation and decrease the rate of withdrawal to prevent further jumping. The auger may rotate very slowly during withdrawal. However, counterclockwise rotation is not permitted.

3.2.4 Pile Butts

Unless a permanent steel casing is provided as specified in paragraph entitled "Casings," place a steel sleeve at top of pile to form the pile butt. For pile cutoff above ground surface, the steel sleeve shall extend from the pile cutoff elevation to a point not less than 305 mm one foot below the ground surface. For pile cutoff at or below ground surface, the steel sleeve shall extend from the ground surface to a point not less than 300 mm one foot below the pile cutoff elevation. Pump excess grout to displace as much potential laitance as possible. Remove pile butt to required cutoff elevation or to sound grout, whichever is lower.

3.2.5 Placement Tolerances

Locate piles where indicated. The maximum permissible variation of the center of each pile from the required location is 50 mm 2 inches at the ground surface. No pile shall be out of required axial alignment by more than 2 percent. Periodically check the required axial alignment of each pile during the drilling operation and after reaching required tip elevation with not less than 1.5 m 5 feet of the augerflight extending above ground surface. Abandon piles which are damaged, mislocated, or out of alignment beyond the maximum tolerance and provide additional piles where directed.

3.2.6 Cutoff

Removal of pile butts above the indicated cutoff elevation may be accomplished by dipping the grout from the pile, while grout is fluid, but not less than one hour after installation. At the option of the Contractor, and as approved prior to pile installation, grout may be allowed to harden at its initial top elevation and then carefully trimmed off to the indicated cutoff elevation with hand operated chipping guns.

3.2.7 Disposal of Excavated Material

Do not leave any piles partially completed overnight. Completely grout and protect piles at the termination of each day's operation. Dispose of excavated material, resulting from augering, [within the area indicated] [off Government property] [_____].

3.3 FLOW CONE TEST

The quantity of water used shall produce a grout having a consistency of not less than 21 seconds when tested with a flow cone in accordance with ASTM C 939. [The flow cone shall be modified by removal of the 13 mm 1/2 inch orifice allowing grout to pass through the 19 mm 3/4 inch hole in bottom of cone.] Conduct tests at the beginning of grout injection and at subsequent intervals to ensure specification requirements are met.

3.4 GROUT SPECIMENS FOR LABORATORY TESTS

NOTE: To be used as alternate requirement.

Conduct grout tests in accordance with [ASTM C 109/C 109M] [ASTM C 942] in a laboratory, approved by the Contracting Officer. Prepare test specimens by pouring grout into 50 by 50 by 50 mm 2 by 2 by 2 inch cube molds. Not less than 9 cubes shall be cast during each 8-hour shift. Three cubes

shall be tested at 7 days; 3 at 28 days; and 3 at 90 days.

3.5 GROUT SPECIMENS FOR CONTRACTOR TESTS

NOTE: The requirement of this paragraph may be waived by those agencies that so desire. Insert the total number of pile holes requiring withdrawal of auger before inserting the mortar. Withdrawal and examination of the auger to verify soil profile should be required at all test pile locations and at 10 percent of the remaining pile locations to supplement the soil boring information.

Conduct grout tests in accordance with ASTM C 31/C 31M and ASTM C 39/C 39M. Prepare test specimens of grout by pouring grout into 152 by 305 mm 6 by 12 inch cylinder molds. Provide molds with a top cover plate so designed as to restrain grout expansion and to permit escape of air and water. Not less than one set of cylinders shall be collected during the placing of each group of 15 piles or fraction thereof. One set shall consist of six cylinders of which three cylinders shall be tested in 7 days and three cylinders at 28 days. Any set of cylinders of which one or more cylinders test at 10 percent or more below the required strength shall be cause for rejection of the pile group.

3.6 TEST PILES

3.6.1 Placement

NOTE: Specify load tests when needed to confirm design capacities. The requirement for performing load tests would depend on the degree of variations in subsoil conditions. A minimum of one test pile should be load tested in each area of substantially different subsoil conditions. The requirement of performing the load tests under the direct supervision of a registered Professional Engineer may be waived at the discretion of the design agency.

Insert the grout strength required at the time the test load is applied which could be the specified 28-day strength if Type III (high-early strength) cement is used or 75 percent of the specified 28-day strength if regular cement is used.

Provide test piles of the required type placed in the manner specified elsewhere in this section for all piling. The Government will use test pile and load test data in addition to test reports on soil samples to determine "calculated" pile tip elevations. Piles immediately adjacent to the test pile shall be placed after placing test pile and prior to load testing. Test piles that are located within the tolerances indicated for all piles and provide a safe design capacity as determined by the results of a satisfactory load test may be used in the finished work. Test loads shall not be applied to the piles until the grout has obtained a minimum strength of [_____] MPa psi. Report immediately any unusual conditions encountered during pile installation to the Contracting Officer.

3.6.2 Depth

For all test piles, the auger shall be withdrawn after reaching the "calculated" tip elevation and before grout is pumped. The Contracting Officer will be present to check the soil conditions and will have the right to increase the test pile length if soil conditions warrant. In such cases, the Contracting Officer may require additional auger withdrawals after drilling to the lower tip elevation. Such additional auger withdrawals shall be included in the total number of auger withdrawals made. The pile hole shall not be filled with grout until the Contracting Officer has approved the final tip elevation.

3.6.3 Loading Test

NOTE: ASTM D 1143/D 1143M contains several requirements which would not be considered applicable to routine pile load testing. It may be advisable to qualify the requirement that load tests be performed in accordance with ASTM D 1143/D 1143M as follows: (1) delete the requirement for pretest information; (2) permit a recent calibration of the test jack, pressure gauge, etc., instead of requiring such calibration to be made immediately prior to the test; (3) permit the use of test jacks which are not equipped with spherical bearings; (4) permit the wedges and not the loads to be adjusted so they remain loose as settlement occurs; (5) permit the supports for beams to which dial gauges are attached to be a minimum distance of 1.5 m (5 feet) from the center of the test pile; (6) specifically delete the optional requirement for incremental strain measurement; (7) delete the requirement that the test load is to be removed upon reaching loads of 50 and 100 percent of the anticipated working load; (8) delete the requirement that the load is to be reapplied to 200 percent of the working load after removal of the test loads; (9) delete the requirement that the pile is to be tested to 300 percent of the anticipated working load.

The requirement of performing the load tests under the direct supervision of a registered professional engineer may be waived by those agencies as desired.

Perform load tests in accordance with **ASTM D 1143/D 1143M**, cyclic loading method. The load tests at locations shown or directed shall be made on test piles placed to the tip elevation used for establishing lengths of piles for bidding, except as otherwise directed by the Contracting Officer. Perform loading, testing, and recording of data under the direct supervision of a registered professional engineer. The analysis of the load test data shall be done by the registered professional engineer. The registered professional engineer will be provided and paid by the Government. The installation of contract piles shall not proceed within each area of substantially different subsoil conditions until a satisfactory load test has been performed in that area.

3.6.4 Acceptance

NOTE: Insert twice the pile design working load.

Load test piles to twice the design working load of [_____] tons, unless failure occurs first. The safe design capacity of a test pile, as determined from the results of load tests, shall be the lesser of the two values computed according to the following:

- a. One-half the load that causes a net settlement after rebound of not more than **0.23 mm per metric ton** **0.01 inch per ton** of total test load.
- b. One-half the load that causes a gross settlement of not more than **25 mm** **1 inch** provided that the load settlement curve shows no sign of failure.

3.6.5 Tolerances

Locate test piles as shown on drawings or as otherwise directed by the Contracting Officer. Install piles from the ground surface existing after general excavation work has been completed. The maximum variation of the center of any pile from the required location shall be **50 mm** **2 inches** at the ground surface, and no pile shall be out of plumb more than 2 percent. Piles damaged, mislocated, or out of alignment beyond the maximum tolerance shall be abandoned and additional piles shall be placed as directed.

3.7 SOIL PROFILE

NOTE: The requirement of this paragraph may be waived by those agencies other than NAVFAC that wish to do so. Indicate on the drawings pile holes requiring soil probes. Soil probes should be required at all test pile locations, and at 10 percent of the remaining pile locations.

At [_____] pile holes, in addition to the test piles, the auger shall be withdrawn from the ground before the grout is pumped to check the soil profiles. Drill soil probes within a radius of **6 m** **20 feet** of their associated test pile. The Contracting Officer will be present to verify the soil condition at the "calculated" pile tip elevation and has the right to increase the soil probe length or require additional soil probes, if soil conditions warrant. After soil conditions have been inspected and approved by the Contracting Officer, install test pile[s]. Soil probes that are located within the tolerances indicated for piles shall be filled with grout and may be used in the finished work, if approved by the Contracting Officer and if satisfactorily load tested.

3.8 PROTECTION OF PILES

The sequence of pile installation shall be such that adjacent piles show no evidence of disturbance. This evidence would actually appear as a drop in the grout surface. The load applied to the soil by the drilling equipment shall be far enough away from the pile being drilled to avoid compressing or shearing of the soil which may in turn displace or squeeze-off the grout

column. No piles shall be placed within 1.5 m 5 feet of adjacent piles until the grout in the piles has set for 3 days, unless otherwise directed by the Contracting Officer.

3.9 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

NOTE: Include this paragraph only when special inspection and testing for seismic-resisting systems is required by Chapter 2 of FEMA 450, NEHRP RECOMMENDED PROVISIONS FOR SEISMIC REGULATIONS FOR NEW BUILDINGS AND OTHER STRUCTURES.

This paragraph will be applicable to both new buildings designed according to UFC 3-310-04 SEISMIC DESIGN FOR BUILDINGS, and to existing building seismic rehabilitation designs.

The designer must indicate on the drawings all locations and all features for which special inspection and testing is required in accordance with UFC 3-310-04 and Chapter 2 of FEMA 450. This includes indicating the locations of all structural components and connections requiring inspection.

Add any additional requirements as necessary.

Perform special inspections and testing for seismic-resisting systems and components in accordance with UFC 3-310-04 SEISMIC DESIGN FOR BUILDINGS and Section 01 45 35 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

3.10 RECORDS

Keep complete and accurate records of all auger cast grout piles. Indicate the pile location, diameter, length, elevation of tip and top of pile, quantity of grout material actually pumped in each pile hole, and the rated load capacity of the pile. Determine grout quantity by recording grout pump displacement or by other approved means. Record and report immediately any unusual conditions encountered during pile installation.

-- End of Section --