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USACE / NAVFAC / AFCEA UFGS-02461 (February 2003)  
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Preparing Activity: NAVFAC Superseding  
UFGS - 02461N (September 1999)  
UFGS - 02461A (October 2001)

## UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 25 June 2004

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### SECTION 02461

#### WOOD MARINE PILES 02/03

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NOTE: This guide specification covers the requirements for furnishing all plant, labor, materials, and equipment, except material and equipment specified to be furnished by the Government, and for performing all operations in connection with the installation of round (treated) (untreated) (treated and untreated) timber piles and the testing of such piles for waterfront and other marine type structures as directed in accordance with this section of the specifications and the applicable drawings.

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).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

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NOTE: Requirements for materials and procedures for special or unusual design should be added as necessary.

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## PART 1 GENERAL

### 1.1 REFERENCES

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NOTE: Issue (date) of references included in project specifications need not be more current than

provided by the latest guide specification. Use of  
SpecsIntact automated reference checking is  
recommended for projects based on older guide  
specifications.

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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.

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA A1	(1998) Standard Methods for Analysis of Creosote and Oil-Type Preservatives
AWPA A4	(1993) Standard Methods for Sampling Wood Preservatives
AWPA A5	(2000) Standard Methods for Analysis of Oil-Borne Preservatives
AWPA A6	(2001) Method for the Determination of Oil-Type Preservatives and Water in Wood
AWPA A8	(1990) Qualitative Recovery of Creosote or Creosote Solution from Freshly Treated Piles, Poles, or Timber (Squeeze Method)
AWPA A9	(2001) Standard Method for Analysis of Treated Wood and Treating Solutions by X-Ray Spectroscopy
AWPA C1	(2000) All Timber Products - Preservative Treatment by Pressure Processes
AWPA C3	(1999) Piles - Preservative Treatment by Pressure Processes
AWPA M2	(2001) Standard for Inspection of Treated Wood Products
AWPA M4	(2001) Standard for the Care of Preservative-Treated Wood Products
AWPA M6	(1996) Brands Used on Forest Products

ASTM INTERNATIONAL (ASTM)

ASTM A 569/A 569M	(1998) Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip, Commercial
ASTM B 209	(2002a) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(2002a) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM D 1143	(1981; R 1994e1) Piles Under Static Axial

## Compressive Load

ASTM D 25	(1999e1) Round Timber Piles
ASTM D 390	(1992; R 1999) Coal-Tar Creosote for the Preservative Treatment of Piles, Poles and Timbers for Marine, Land, and Fresh Water Use
ASTM D 450	(1996; R 2000e1) Coal-Tar Pitch Used in Roofing, Dampproofing, and Waterproofing
U.S. GENERAL SERVICES ADMINISTRATION (GSA)	
FS RR-W-410	(Rev E) Wire Rope and Strand
U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)	
40 CFR 171	Certification of Pesticide Applicators
WESTERN WOOD PRESERVERS INSTITUTE (WWPI)	
WWPI Mgt Practices	(1996) Best Management Practices for the Use of Treated Wood in Aquatic Environments

## 1.2 SUBMITTALS

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NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

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 projects.

Submittal items not designated with a "G" are considered as being for information only for Army

**projects and for Contractor Quality Control approval  
for Navy projects.**

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Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Piles; G, [\_\_\_\_\_]

Pile driving equipment; G, [\_\_\_\_\_]

Submit complete descriptions of pile driving equipment, including hammers, leads, driving helmets, cushion blocks, driving blocks, collars, extractors, and other appurtenances for approval prior to commencement of work.

[ Pile caps; G, [\_\_\_\_\_]]

[ Pile shoes; G, [\_\_\_\_\_]]

[ Jetting equipment; G, [\_\_\_\_\_]]

[ Spudding equipment; G, [\_\_\_\_\_]]

[ Predrilling equipment; G, [\_\_\_\_\_]]

[ Spliced piles; G, [\_\_\_\_\_]]

[ The splice design for piles shall be submitted for approval prior to use in the work.]

[ SD-04 Samples

Test piles; G, [\_\_\_\_\_]

If approved after test completion, include properly located test piles in finished work.]

SD-06 Test Reports

[ Load tests; G, [\_\_\_\_\_]

Test data and results as specified in paragraph entitled "Load Tests."]

Preservative treated piles; G, [\_\_\_\_\_]

A certified test assay analysis from an approved testing organization attesting that the piles to be used in the work have been given the preservative treatment required by these specifications shall be submitted prior to commencement of the work.

## SD-07 Certificates

MSDS and CIS; G, [\_\_\_\_\_]

[ Pesticide Applicator; G, [\_\_\_\_\_] ]

[ Best Management Practices (BMPs); G, [\_\_\_\_\_] ]

## SD-11 Closeout Submittals

[Test piles and] Job piles driving records; G, [\_\_\_\_\_]

Submit pile driving records within 15 calendar days after completion of driving.

### 1.3 QUALITY ASSURANCE

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NOTE: Do not use untreated piling except for fender piles where an analysis of pile maintenance and replacement records clearly justifies its use or where plastic covered piling is specified. Special care in handling and frequent inspections of installed plastic-covered piles are required to ensure that no exposure of the untreated wood occurs.  
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NOTE: References listed in paragraph 1.1, "References", are intended for general references only. Consult with your environmental office for possible local regulations or policies that restrict either the use of treated wood in aquatic environments or the eventual disposal of treated piles. If applicable, the designer should add those regulatory requirements.  
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#### 1.3.1 Preservative Treated Piles - Timber

The Contractor shall be responsible for the quality of treated wood products. The Contractor shall provide the Contracting Officer's Representative (COR) with the inspection report of an independent inspection agency, approved by the Contracting Officer, that offered products comply with applicable AWPA standards. Identify treatment on each piece by the quality mark of an agency accredited by the Board of Review of the American Lumber Standard Committee. Inspect all preservative-treated wood visually to ensure there are no excessive residual materials or preservative deposits. Materials shall be clean and dry or it will be rejected because of environmental concerns.

#### 1.3.2 MSDS and CIS

Provide Materials and Safety Data Sheets (MSDS) and Consumer Information Sheets (CIS) associated with timber pile preservative treatment. Contractor shall comply with all safety precautions indicated on MSDS and CIS.

[1.3.3 Regulatory Requirements

[\_\_\_\_].

]1.3.4 Pesticide Applicators

Provide certifications for all individuals (applicators) who will be working with creosote products on site. All applicators shall be certified by the State or Environmental Protection Agency (EPA) (under the provisions of 40 CFR 171) to use wood preservatives, and have completed an approved EPA training program on the use of creosote products.

1.3.5 Best Management Practices (BMPs)

The producer of the treated wood products shall provide certification that Best Management Practices (BMPs) for the use of Treated Wood in Aquatic Environments were utilized including a written description and appropriate documentation of the BMPs utilized.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle and store piles in accordance with AWP4 M4. Comply with paragraph entitled "MSDS and CIS." Special care shall be taken in supporting piles to prevent the including of excessive bending stresses in the piles. Piles shall be carefully handled without dropping, breaking of outer fibers, and penetrating the surface with tools. Peaveys, cant hooks, pikes, and other pointed tools shall not be used in handling treated piles.

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NOTE: For NAVFAC (Navy) projects, use and edit the appropriate following paragraph(s) Do not use for Army projects.  
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[1.5 BASIS OF BIDS

]1.5.1 For Bearing Piles

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NOTE: Choose one of the following options.  
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NOTE: Choose this option for lump sum bidding of piles. This option should be used in all projects except those where exact quantities cannot be practically determined prior to the actual work. Numbers of piles, pile capacity, pile locations, and tip and cutoff elevations shall be clearly shown on the drawings.  
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NOTE: Use the second paragraph for unit price bidding of piles. Specify unit price bid items for piles only for projects where exact quantities cannot be practically determined prior to the actual work. Lengths of piles must be determined as accurately as possible prior to bidding, since the

unit price per meter foot of the pile varies as the  
length increases or decreases.

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[Base bids on the number, circumference, and length of piles from tip to cutoff as indicated. [Test piles shall be [1.5] [\_\_\_\_\_] meter [5] [\_\_\_\_\_] feet longer than bid length piles. [Base bids on the number of load tests indicated or specified.] From the data obtained as a result of driving the test piles [and load tests] specified herein, the Government will determine and list for the Contractor the calculated minimum pile tip elevations, the driving resistance for piles, or both. The information will be given to the Contractor no later than 10 days after receipt of complete test pile data. The list shall be used as the basis for ordering piles. The Contractor shall not order production piles prior to receipt of the above information from the Government.] Should the total number of piles or number of each length vary from that specified as the basis for bidding, the contract price will be adjusted in accordance with Contract Clause entitled "Changes." Adjustment in contract price will not be made for cutting off piles, for any portion of a pile remaining above the cutoff elevation, or for broken, damaged, or rejected piles.]

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NOTE: For PACNAVFACENGCOM projects: Edit  
applicable attachments from Document 00101 for  
inclusion in Standard Form 1442, "Solicitation,  
Offer and Award" and "Schedule of Bid Items." Select  
first bracketed text.

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[For unit price bid, see [SF 1442, "Solicitation, Offer and Award" and  
"Schedule of Bid Items." [Section 00101 BID SCHEDULES.]]

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NOTE: For LANTDIV projects, use the following basis  
of bid.

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#### [1.5.2 For Bearing Piles

Payment will be at the contract unit price for furnishing labor, materials, tools, equipment, and incidentals required for furnishing and driving piles. Work includes furnishing and driving piles including [test piles] [load test] [jetting] [spudding] [predrilling], pile cutoff, redriving, and removal and replacement of damaged, mislocated, or otherwise rejected piles. Base bids on the number of piles with pile length from tip to cutoff, as indicated, and on total length of piling from tip to cutoff, including test piles. Include in bid a unit price per [load test[s] and] unit length of piling based on the quantity stated. From data obtained as a result of driving the test piles [and load tests] specified herein, the Government will determine and list for the Contractor the calculated minimum pile tip elevations, the driving resistance for piles, or both. The information will be given to the Contractor no later than 10 calendar days after receipt of complete test pile data. The list shall be used as the basis for ordering piles. The Contractor shall not order production piles prior to receipt of the above information from the Government. If the Contracting Officer requires an increase or a decrease in the linear footage of piles furnished and installed, the contract price will be adjusted in accordance with "FAR 52.211-18, Variation in Estimated Quantity." [Adjustment in contract price will also be made for each

increase or decrease in number of pile load tests.]

] [1.5.3 For [Fender] [Cluster] [, and] [Dolphin] [\_\_\_\_\_] Piles

Base bids on the number, circumference, and length of piles from tip to cutoff as indicated.]

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NOTE: For USACE (Army) projects, use and edit the  
appropriate following paragraph(s). Do not use for  
Navy projects.  
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#### [1.6 UNIT PRICES

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NOTE: If Section 01270, "Measurement and Payment",  
is included in the project specifications, this  
paragraph title (UNIT PRICES) should be deleted from  
this section and the remaining appropriately edited  
subparagraphs below should be inserted into Section  
01270.  
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] 1.6.1 Round Timber Piles, [Vertical] [Batter]

1.6.1.1 Payment

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NOTE: The tabulation shown below is for  
illustration only and should be revised if not  
applicable to the job for which the specifications  
are being prepared. The factors for unit price  
increase (for piles of increased length) should  
approximate the estimated increased cost to the  
Contractor for furnishing and driving the longer  
piles based on estimated cost of material and  
foundation conditions anticipated.  
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Payment for each acceptably driven pile will be made at the applicable contract price per linear meter foot as determined by the length and type of pile specified or directed to be driven; this price includes all items incidental to furnishing and driving the piles, redriving uplifted piles, any required notching, the cutting off of all piles at the cutoff elevation, [and the preservative treatment of the tops of treated piles which are headed] but exclusive of any capping of heads. Payment for piles driven in lengths as required up to and including [\_\_\_\_\_] meters feet in place below the cutoff elevation will be made at the applicable basic contract unit prices. Payment for piles driven in required lengths greater than [\_\_\_\_\_] meters feet will be made at an adjusted unit price. The adjusted unit price will be obtained by multiplying the applicable basic contract unit price by the applicable factor shown in the table below. The unit price so adjusted will be the applicable contract unit price for the length of pile driven below cutoff elevation.



INCREASE IN LENGTH (OVER [ ] METERS)	FACTOR (INCLUSIVE)
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0.1 to 1.5 meters .....	1.05
1.6 to 3.0 meters .....	1.10
3.1 to 4.5 meters .....	1.15
4.6 to 6.0 meters .....	1.30
6.1 to 7.5 meters .....	1.50

INCREASE IN LENGTH (OVER [ ] FEET)	FACTOR (INCLUSIVE)
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0.1 to 5.0 feet .....	1.05
5.5 to 10.0 feet .....	1.10
10.5 to 15.0 feet .....	1.15
15.5 to 20.0 feet .....	1.30
20.5 to 25.0 feet .....	1.50

#### 1.6.1.2 Measurement

Acceptably driven piles will be measured for payment based upon the lengths in place below the cutoff elevation. The cutoff portion of any pile, except the 300 millimeters 1 foot provided for heading, will be measured for payment as the length of such cutoff portion which does not exceed the difference between the length of pile specified to be driven below the cutoff elevation and the length actually driven below the grade. Pile and cutoff length will be measured to the nearest 100 millimeters 1/2 foot.

#### 1.6.1.3 Unit of Measure

Unit of measure: linear meter foot.

#### [1.6.2 Test Piles

##### ]1.6.2.1 Payment

Payment will be made for test piles, driven as directed and not incorporated in the permanent work. Payment will be made for test piles incorporated in the permanent work.

##### 1.6.2.2 Measurement

Test piles, driven as directed and not incorporated in the permanent work, will be measured for payment at twice the applicable contract unit price for a permanent pile of the same type and length, except that the specified length of test pile will be considered to have been driven below cutoff elevation whether or not so driven. Test piles, incorporated in the permanent work, will be measured for payment at the contract price per linear meter foot for permanent piles.

##### 1.6.2.3 Unit of Measure

Unit of measure: linear meter foot.

#### [1.6.3 Pile Load Tests

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**NOTE: The designer will specify the number of pile**

**loading tests to be performed and the loading data.**

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]1.6.3.1    Payment

Payment for each complete test load of a single pile will be made at the contract unit price for each pile load test. When a group of piles is required to be test loaded, payment for the load test will be made at the contract unit price for "Pile Load Test" for the first loaded pile of the group, plus 50 percent of this amount for each additional loaded pile in the group.

1.6.3.2    Measurement

Pile load test will be measured for payment based upon furnishing, placing, and removing testing equipment and test loads.

1.6.3.3    Unit of Measure

Unit of measure:    each.

[1.6.4    Pile Shoes

]1.6.4.1    Payment

Payment will be made for furnishing all plant, labor, and materials for pile shoes and will be paid for at the contract unit price for each pile shoe.

1.6.4.2    Measurement

Pile shoes will be measured for payment based upon each pile shoe furnished.

1.6.4.3    Unit of Measure

Unit of measure:    each.

[1.6.5    Round Timber Pile Splices

]1.6.5.1    Payment

Payment will be made for furnishing all plant, labor and material required to make each authorized pile splice.

1.6.5.2    Measurement

Round timber pile splices will be measured for payment based upon each pile splice made.

1.6.5.3    Unit of Measure

Unit of measure:    each.

1.6.6    Cutoffs

1.6.6.1    Payment

Payment will be made for the cutoff portion of any pile.

#### 1.6.6.2 Measurement

The cutoff portion of any pile will be measured for payment at the rate of 50 percent of the applicable contract unit price, and no other measurement or payment will be made for such cutoff.

#### 1.6.6.3 Unit of Measure

Unit of measure: each.

#### [1.6.7 Pulled Piles

#### ]1.6.7.1 Payment

Payment will be made for satisfactorily driven piles which are pulled at the direction of the Contracting Officer and found to be in good condition.

Payment will be made for pulled timber piles which are replaced with new piles. Where piles are pulled at the direction of the Contracting Officer and found to be damaged, no payment will be made for originally furnishing and driving such piles nor for the operation of pulling, and damaged piles shall be replaced by new piles for which payment will be made.

#### 1.6.7.2 Measurement

Satisfactorily driven piles which are pulled at the direction of the Contracting Officer and found to be in good condition will be measured for payment at the applicable contract unit price for furnishing and driving the pile at its original position plus 50 percent of this amount to cover the cost of pulling. Pulled timber piles shall not be redriven, but replaced by new piles which will be measured for payment at the applicable contract unit price for the lengths driven. Where piles are pulled at the direction of the Contracting Officer and found to be damaged, no measurement for payment will be made for originally furnishing and driving such piles nor for the operation of pulling, but the damaged piles shall be replaced by new piles which will be measured for payment at the applicable contract unit price for the lengths driven.

#### 1.6.7.3 Unit of Measure

Unit of measure: linear meter foot.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

##### 2.1.1 Piles

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NOTE: Specify the minimum butt or tip circumference of the pile. For bearing piles, use the butt circumference for a friction pile and use tip circumference for an end-bearing pile. Clean-peeled piles should be specified where preservative treatment is required.  
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Provide Douglas fir or Southern pine [clean-peeled] [rough-peeled], [treated] [and] [untreated] piles conforming to ASTM D 25 and other requirements as specified. Piles shall be in one piece of the length[s]

[as shown] [as determined from pile load tests]. Splices will not be permitted. Each treated pile shall be branded by the producer, in accordance with AWPB M6. Pile circumferences shall be as follows:

- a. Bearing Piles: Minimum [butt circumference measured at 0.91 m 3 feet from the butt end] [tip circumference] shall be [[\_\_\_\_\_] mm inches] [as indicated].
- b. [Fender] [,] [and] [Cluster] [,] [and] [Dolphin] [\_\_\_\_\_] Piles: Minimum butt circumference measured at 0.91 m 3 feet from the butt end shall be [[\_\_\_\_\_] mm inches] [\_\_\_\_\_] .

#### [2.1.1.1 Spliced Piles

Spliced piles will not be accepted unless approved by the Contracting Officer. The Contractor shall submit the proposed splice design for piles for approval. Piles may be spliced with steel pipe sleeve or steel bar connections designed to resist bending, axial tension, and impact forces due to driving. Pipe sleeves shall have a wall thickness of not less than 6 millimeters 1/4-inch, be not less than 0.91 m 3 feet in length and fit tightly around the ends of the abutting pile segment after the ends have been trimmed sufficiently to preclude the cutting of objectionable shakes or splintering when the sleeves are driven on the ends. Abutting pile segments shall be in full contact without the use of fillers or cushions.

#### ]2.1.2 Preservative Treatment

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NOTE: Select preservative treatment of marine piles as follows (consult the nearest NAVFAC EFD/EFA Applied Biologist for specific requirements for specific locations):

1. In areas where teredo and pholad are present and limnoria tripunctata is unknown, absent, or not to be expected (primarily in northern latitudes but with exception in both northern and southern latitudes) creosote or creosote-coal tar solution will provide adequate protection.
2. In areas where teredo and limnoria tripunctata attack is expected and pholad attack is not, either dual treatment of arsenical salt (ACA, ACZA, CCA) and creosote or creosote-coal tar solution, or an arsenical salt (ACA, ACZA, CCA) with a minimum net retention of 40 kilograms per cubic meter (2.50 pcf) is recommended.
3. In areas where sphaeroma terebrans is present or where limnoria tripunctata and pholad attack is expected, dual treatment of arsenical salt (ACA, ACZA, CCA) and creosote or creosote-coal tar solution, is recommended.
4. In areas where limnoria, teredo or pholads are expected or known, pressure treated piles may be further protected by wrapping in plastic coatings. Load bearing piles not subject to excessive abrasion or severe impacts are particularly suited for this

process.

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NOTE: For fender piles, dolphin piles, and other piling requiring lateral load-carrying capacity, consideration should be given to increasing pile diameter because preservative pressure treatment tends to reduce lateral load-carrying capacity.

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Treat piles by the full-cell pressure process in accordance with AWPB C1 and AWPB C3 to the retention and penetration for marine piling and produce in accordance with WWPI Mgt Practices, as follows:

- a. Bearing Piles: [Creosote or creosote solution for marine piles] [Waterborne preservative for marine piles (ACA - Ammoniacal Copper Arsenate, ACZA - Ammoniacal Copper Zinc Arsenate, CCA - Chromated Copper Arsenate)] [Dual treatment of creosote or creosote solution plus waterborne preservative for marine piles].
- b. [Fender] [,] [and] [Cluster] [,] [and] [Dolphin] [\_\_\_\_\_] Piles: [Creosote or creosote solution for marine piles] [Waterborne preservative for marine piles (ACA - Ammoniacal Copper Arsenate, ACZA - Ammoniacal Copper Zinc Arsenate, CCA - Chromated Copper Arsenate)] [Dual treatment of creosote or creosote solution plus waterborne preservative for marine piles].

#### 2.1.3 Creosote

Creosote for brush treatment of piles shall conform to ASTM D 390.

#### 2.1.4 Coal-Tar Pitch

Coal-tar pitch for brush treatment of piles shall conform to ASTM D 450, Type A.

#### [2.1.5 Pile Shoes

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NOTE: Pile shoes should be required only when extremely hard driving is required in upper strata for the penetration of such strata to reach the bearing stratum.

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ASTM A 569/A 569M. Steel boot or welded-plate point shoe especially fabricated for pile driving. Shoes shall be the product of a manufacturer regularly engaged in the manufacture of pile fittings. Welding procedures shall be in accordance with a nationally recognized welding code. Provide size to fit pile tip. Fabricate boot type of 5 mm 3/16 inch carbon steel fully welded, with at least three straps, each with three 5 mm 3/16 inch nail holes. Fabricate welded-plate point type of four 5 mm 3/16 inch or 6 mm 1/4 inch steel plates, fully welded and sized to adequately cover full pointed area of pile; provide each plate with one 5 mm 3/16 inch or one 6 mm 1/4 inch nail hole. The length of the joints formed by the intersection of the sides shall not be less than one half of the height of the shoe. Shoes shall be cleaned and painted with at least one coat of paint. The color and paint shall be the manufacturer's standard. [Shoes may be

furnished without painted finish.] Provide on the point of [each pile]  
[each bearing pile] [each fender, cluster, and dolphin pile] [\_\_\_\_\_].

] 2.1.6 Wire Rope and Fitting

[FS RR-W-410, Type III, Class 2, zinc coated] [FS RR-W-410, Type I, Class 2]. [Provide 10 mm 0.38 inch diameter zinc-coated steel staples not less than 127 mm 5 inches in length.] [Provide clips or clamps of zinc-coated steel.]

] 2.1.7 Pile Caps

Provide [567 g20 ounce copper sheet] [1.0 mm0.040 inch aluminum alloy sheet, Alclad 3003, 3004, or 3005 in accordance with ASTM B 209M ASTM B 209].

] 2.2 TESTS, INSPECTIONS, AND VERIFICATIONS

2.2.1 Inspection of Piles

The Contractor shall provide the necessary facilities for the proper inspection of each pile. Piles to be preservative treated will be inspected prior to treatment. Piles will be inspected at the shipping point or at the work site if so decided. Pile inspection at the shipping point will not be performed for less than 100 piles in one locality. Piles with specified variations in characteristics shall be placed in separate lots for inspection. Piles shall be so marked or segregated into marked lots that there will be no possibility of error in assignment after they have been inspected. Piles damaged after inspection may be subsequently rejected if damage is deemed sufficient for rejection. All rejected piles shall be removed as directed.

2.2.2 Inspection of the Preservative Treatment Process

Inspection of the preservative treatment process will be in accordance with AWPA M2. The Contractor shall notify the Contracting Officer where preservative treatment will be done not less than 15 days prior to the start of the treatment and shall provide the necessary facilities for the proper inspection of the treatment process. Allow the Contracting Officer unlimited access to the plant and inspection privileges for each facet of the treating process.

2.2.3 Sampling and Testing

Sampling and testing shall be performed by an approved testing organization adequately equipped to perform such services.

2.2.3.1 Sampling

Representative samples of preservatives for testing shall be obtained from storage containers using the methods described in AWPA A4. The recovery of creosote and creosote solution and oil-borne preservatives from piles for testing shall be in accordance with the methods described in AWPA A8 and AWPA A6, respectively. The analysis of wood treated with waterborne preservatives shall be done in accordance with AWPA A9.

2.2.3.2 Testing

Creosote and creosote solutions, waterborne preservatives, and oil-borne

preservatives shall be tested for conformance to AWPA A1, AWPA A9, and AWPA A5, respectively. The net retention and the penetration of preservatives in piles shall be determined as specified in AWPA M2 and the additional requirements listed. The determination of the net retention of waterborne preservatives in piles which have received the dual treatment of waterborne preservatives and creosote or creosote solutions shall be made after the extraction of the creosote or creosote solutions.

## PART 3 EXECUTION

### 3.1 INSTALLATION

#### 3.1.1 Pile Driving Equipment

Pile driving equipment shall meet the following requirements.

##### 3.1.1.1 Pile Driving Hammers

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**NOTE: If vibratory hammers should not be used, the references to vibratory hammers should be deleted from the text.**  
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Pile driving hammers shall be steam, air or diesel drip, single-action, double-acting, differential-acting, [or] [vibratory] [\_\_\_\_\_] type. [The use of vibratory hammers is dependent upon satisfactory driving and load testing of piles.] The size or capacity of hammers shall be as recommended by the manufacturer for the pile weights and solid formation to be penetrated. The pile hammer shall be of sufficient weight and energy to install the specified pile without damage into the soils [as indicated] [expected to be encountered]. The maximum driving energy of hammers shall be [16,270] [20,330] joules [12,000] [15,000] foot-pounds for piles for any length. Test piles shall be driven with the same size and type hammer, operating with the same effective energy and efficiency as that to be used in driving job piles. Diesel powered hammers shall be operated at the rate recommended by the manufacturer throughout the entire driving period. Sufficient pressure shall be maintained at the hammer so that:

- a. For double-acting hammers, the number of blows per minute during and at the completion of driving of a pile is equal approximately to that at which the hammer is rated;
- b. For single-acting hammers, there is a full upward stroke of the ram; and,
- c. For differential-type hammers, there is a slight rise of the hammer base during each upward stroke.

##### 3.1.1.2 Leads

Leads are required and shall be fixed at the top and adjustable at the bottom. Swinging leads may be allowed if site conditions merit their use and are approved.

##### 3.1.1.3 Driving Cap or Helmet and Cushion Block

Driving cap or helmet shall be an approved design and shall be capable of protecting pile heads, minimizing energy absorption, and transmitting

hammer energy uniformly and consistently to piles. Place driving helmet or cap and cushion block combination between top of pile and the ram. Driving cap shall fit snugly on the top of piles and shall employ a cushion block to prevent impact damage to piles. The cushion block may be a solid or laminated softwood block with the grain parallel to the pile axis and enclosed in a close-fitting steel housing. The thickness of the block shall be suitable for the length of pile to be driven and the character of subsurface material to be encountered. [Generally, thicker blocks are required for longer piles and softer subsurface material.] If block is damaged, split, highly compressed, charred or burned, or has become spongy or deteriorated, replace with new block. Under no circumstances will the use of small wood blocks, wood chips, rope, or other material permitting excessive loss of hammer energy be permitted.

#### 3.1.1.4 Pile Collars

Collars or bands for protecting pile butts against splitting, brooming, and other damage while being driven shall be of an approved design.

#### 3.1.1.5 Jetting Equipment

Jetting equipment shall have not less than two removable or fixed, water or combination air-water type jets. Equipment shall be designed so that the discharge volume and pressure are sufficient to freely erode the material under and adjacent to the piles.

#### 3.1.2 Bearing Piles

Inspect piles when delivered and when in the leads immediately before driving. Cut piles at cutoff grade with pneumatic tools by sawing or other approved method. Where cutoff is below existing mudline elevation, complete excavation, sheeting and dewatering before pile is driven to cutoff elevation.

##### 3.1.2.1 Test Piles

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**NOTE: Insert the number of test piles required.**  
**Test pile locations should be shown on the drawings.**  
**The number of test piles is normally between 5 and 10 percent of the total number of piles required, dependent upon the magnitude of the project. Test piles are furnished longer than job piles to allow additional penetration if driving conditions dictate. Delete this paragraph if test piles are not required.**

\*\*\*\*\*

Provide [\_\_\_\_\_] test piles conforming to the same requirements as specified for job piles. Drive test piles in the same manner as specified for job piles. Furnish test piles [1.5] [\_\_\_\_\_] meters [5] [\_\_\_\_\_] feet longer than length specified for job piles and drive the additional depth, if directed. Drive test piles in locations indicated or as directed. Record driving data as specified in paragraph entitled "Records." Confirmation of the assumed allowable working loads of single piles shall be made by static loading and measuring [each] [\_\_\_\_\_] test pile[s] in the manner described below. Test piles indicated or directed to be driven in permanent locations may be incorporated into the work if, after satisfactory completion of the load test, they are approved for inclusion in the work by



the Contracting Officer. Every facility shall be provided by the Contractor for the Contracting Officer to inspect and measure the deflection or settlement of the pile under test. Furnishing of measuring equipment and making measurements of deflection or settlement will be the responsibility of the [Contracting Officer] [Contractor] [\_\_\_\_\_].

#### [3.1.2.2 Load Tests

\*\*\*\*\*

NOTE: Insert the number of test piles to be load tested. The safe design capacity of a test pile as determined from the results of load test shall be the lesser of the two values computed according to the following:

1. One-half the test load which causes a settlement of 0.25 mm per 907 kg 0.01 inch per ton of test load; and
2. One-half the test load that causes a gross settlement of 25 mm one inch provided the load-settlement curve shows no sign of failure.

\*\*\*\*\*

ARMY NOTE: The designer will specify the method of load testing and the specific pile driving formulas used for design.

\*\*\*\*\*

Perform load tests on [\_\_\_\_\_] test piles in accordance with ASTM D 1143, Standard Loading Procedure, as modified herein. Perform load tests at locations shown, or as directed. Provide testing and measuring equipment, perform loading, and provide observation facilities for a registered professional engineer employed by the Contractor to inspect and record settlement and deflection of piles under test loads. Do not mobilize load test equipment until directed. Loading frames and equipment shall be ready to place in operation as soon as a test pile has been driven. The loading equipment shall be of sufficient capacity to apply a maximum load of not less than [\_\_\_\_\_] kN. [\_\_\_\_\_] tons. The ultimate test load shall be maintained for not less than [24] [\_\_\_\_\_] hours and then unloaded in accordance with ASTM D 1143.

#### ]3.1.2.3 Driving Piles

Drive job piles with same hammer, cushion, or cap block, and using the same operating conditions as test piles. No piling shall be driven within 30 meters 100 feet of concrete which is less than 7 days old unless otherwise authorized. A complete and accurate record of the driving of piles shall be compiled by the Contractor for submission to the Contracting Officer. When driving long piles of high slenderness ratio, special precautions shall be taken to ensure against overstressing and leading away from a plumb or true position. During driving, pile driving hammers shall be operated at all times at the rate and conditions recommended by the hammer manufacturer. Each pile shall be driven continuously and without interruption [to the [calculated] [indicated] tip elevation] [until the required depth of penetration and penetration rate per blow have been attained in accordance with the schedule that the Contracting Officer will prepare from the test pile driving [and test] data]. Deviation from this procedure will be permitted only in case the driving is stopped by causes

which reasonably could not have been anticipated. The controlling penetration per blow will be determined by the Contracting Officer. Piles shall be driven to the full penetration required where practicable to do so without damage to the piles. If found impracticable to drive any pile to the depth required, such pile shall be cut off and abandoned or pulled as directed. Driven piles which have a penetration of less than [ ] meter [ ] feet [that specified for the following areas [ ]]] and have not been driven to the established maximum penetration per blow are not satisfactory. Driving of piles beyond the point of refusal, as indicated by excessive bonding of the hammer or kicking of the pile, or a blow count of greater than twice the blow count required to produce the safe bearing capacity shall not be attempted. Piles which have uplifted after driving shall be redriven to grade after conclusion of driving in that general area. The maximum permissible penetration per blow for the last 20 blows will be established by the Contracting Officer. When the penetration per blow of any pile during the final blows exceeds that permitted or it is found that a pile is not of sufficient length to give the capacity specified, and the pile has been driven to its full depth, the Contractor shall pull the pile and furnish and drive a longer pile or take other corrective measures as directed by the Contracting Officer. The use of followers or splices shall not be permitted except where specially authorized. After driving is completed, all piles shall be "headed" or cut off normal at the cutoff elevation. Headed treated piles, including those to be capped with concrete, shall be given two heavy coats of hot creosote, followed by the application of a heavy coat of coal-tar pitch. Piles driven in locations where they are constantly subject to water spray shall be given this treatment immediately after they are cut off and before the cutoff surface has been wetted. Cutoffs shall become the property of the Contractor and shall be removed at his expense.

#### 3.1.2.4 Tolerances in Driving Bearing Piles

Piles shall be accurately placed in the correct location and alignments both laterally and longitudinally and to the vertical or batter lines as shown. At cutoff elevation, butts shall be within [100] [ ] mm [4] [ ] inches laterally of the location indicated. [Manipulation of piles is prohibited.] [Manipulation to move piles into position will be permitted only within the aforementioned tolerance to return the pile to the design location. [However, piles shall not be manipulated more than 1.5 percent of the exposed length above the [ground] [mudline] surface.]] A variation of not more than 21 mm per m 0.25 inch per foot of pile length from the vertical for plumb piles or more than 42 mm per m 0.50 inch per foot of pile length from the required angle for batter piles will be permitted. The correct relative position of group piles shall be maintained by the use of templates or by other approved means. [In addition to complying with the tolerances stated herein or otherwise specified, clear distance between heads of piles and edges of caps shall be not less than 125 mm 5 inches. With prior approval of the Contracting Officer, the Contractor may provide additional concrete and reinforcement to maintain the required minimum clear distance. Redesign of pile caps or additional work required due to improper location of piles will be the responsibility of the Contractor.] Inspect piles for heave. Piles shall be driven to the depths [shown] [as directed]. Redrive heaved piles to the required tip elevation. Remove and replace with new piles those damaged, misplaced, driven below the design cutoff, or driven out of alignment, or provide additional piles, driven as directed at no additional cost to the Government.

### 3.1.2.5 Records

Keep a complete and accurate driving record of each pile driven. Indicate pile location, deviations from design location, diameter, original length, mudline elevation, tip elevation, cutoff elevation, penetration in blows per meter foot for entire length of penetration for test piles, penetration in blows per meter foot for the last 3 m 10 feet for job piles, hammer data including rate of operation, make, and size, and unusual pile behavior or circumstances experienced during driving such as redriving, heaving, weaving, obstructions, [jetting,] [spudding,] [predrilling,] and unanticipated interruptions. Preprinted forms for recording pile driving data are attached at the end of this section. Make pile driving records available to the Contracting Officer at the job site, a minimum of 24 hours after each day of pile driving. Include in the construction records the wood species, preservative type, retention, and producer of installed treated timber.

### 3.1.2.6 Survey Data

After the driving of each pile group is complete and before superimposed concrete is placed, provide the Contracting Officer with an as-driven survey showing actual location and top elevation of each pile. The Contractor shall not proceed with placing concrete until the Contracting Officer has reviewed the survey and verified the safe load for the pile group driven. A survey shall be presented in such form that it gives deviation from plan location in two perpendicular directions and elevations of each pile to nearest 13 mm half inch. Survey shall be prepared and certified by a [licensed land surveyor] [professional engineer].

### [3.1.2.7 Lengths of Job Piles

\*\*\*\*\*  
NOTE: For USACE (Army) projects, use and edit the following paragraph. When the actual required lengths of piles can be determined without test driving and loading of piles (such as when piles are to be driven to bedrock), the actual required lengths shall be indicated and listed in the unit price schedule.  
\*\*\*\*\*

[The estimated quantities of piles listed in the unit price schedule as to be furnished by the Contractor are given for bidding purposes only. The Contracting Officer will determine the actual lengths of piles required to be driven below cutoff elevation for the various locations in the work and will furnish the Contractor a quantities list which indicates lengths and locations of all piles to be placed. This determination will be made from the results of the test pile driving and test loading.] [The lengths of piles shall be as indicated.] The Contracting Officer will determine the number of overlength piles, if any, to be ordered to provide for variations in subsurface conditions. Where specified bearing capacities are attainable with piles of lesser length than those specified, shorter piles may be used subject to prior approval in writing. To provide for "heading" or cutting off normal after driving, piles shall be furnished in lengths at least 300 mm one foot greater than the lengths specified to be below the cutoff elevations.

#### ]3.1.2.8 Framing Treated Piles

Treated piles shall not be cut to permit fitting of timbers. Piles of uniform size shall be selected for each bent. If necessary, treated filler blocks shall be used to fill out between piles and bracing. Holes for drift bolts in the tops of piles shall be drilled to a depth of 75 mm 3 inches less than the penetration of drift bolts in the piles. Drill holes for drift bolts 3 mm 1/8 inch smaller than bolt diameter. Drill holes for through bolts 2 mm 1/16 inch larger than diameter of bolt shank. Counterbore holes for bolt heads and washers as indicated. Holes drilled into piles shall be filled with hot creosote or the same preservative used to treat the piles and when not used for bolts shall be tightly closed by a treated plug. Holes shall not be drilled or spikes shall not be driven into piles to support scaffolding.

#### 3.1.3 [Fender] [,] [and] [Cluster] [,] [and] [Dolphin] [\_\_\_\_\_] Piles

Inspect piles when delivered and when in the leads immediately before driving. Secure piles in their proper alignment and cut piles at cutoff grade with pneumatic tools by sawing or other approved method. Pile heads at cutoff shall be sound. Counterbore holes for bolts where indicated for countersinking bolt heads and washers. After installation of bolts, fill counterbored holes with an approved bituminous material. Drill holes for drift bolts 3 mm 1/8 inch smaller than bolt diameter. Drill holes for through bolts 2 mm 1/16 inch larger than diameter of bolt shank. Drill holes for lag bolts not larger than body of bolt at base of tread. Fender piles shall have tops bevelled outboard as indicated.

##### 3.1.3.1 Driving [Fender] [,] [and] [Cluster] [,] [and] [Dolphin] Piles

Pile hammers shall be air, steam, or diesel powered, and of an approved type with a capacity at least equal to the hammer manufacturer's recommendation for the total weight of pile and character of subsurface material to be encountered. Minimum driving energy shall be 10,840 joules 8,000 foot-pounds with maximum driving energy of 20,330 joules 15,000 foot-pounds. Weight of the hammer for drop hammers shall not be less than 907 kg 2,000 pounds.

##### 3.1.3.2 Fastening

Use washers of the size and type specified under bolt heads and nuts which would otherwise come in contact with wood.

##### 3.1.3.3 Wrapping Piles

Draw piles tightly together with wire rope. Fasten each turn of the wire rope with a staple to each pile with which it is in contact. Fasten ends of wire rope with two clips or clamps. Number of turns shall be as indicated. Through bolts shall be in place and drawn up before wrapping is finally secured.

##### 3.1.3.4 Tolerances in Driving

Piles shall be driven in the locations indicated. Fender piles may be manipulated a maximum of 42 mm per m 0.50 inch per foot of pile length in a direction parallel to the pier face and 21 mm per m 0.25 inch per foot of pile length in a direction perpendicular to the pier face. Remove and replace with new piles those damaged, mislocated, driven below the design cutoff, or driven out of alignment.

#### 3.1.4 Jetting of Piles

\*\*\*\*\*

NOTE: Jetting should not generally be permitted when:

1. Piles are dependent on side friction in fine-grained, low-permeability soils (high clay or silt content) where considerable time is required for the soil to reconsolidate around the piles;
2. Piles are subject to significant uplift;
3. Piles are adjacent to existing structures; and
4. Piles are in closely spaced clusters, unless the load capacity is confirmed by test and unless jetting is completed before final driving of any pile in the cluster.

\*\*\*\*\*

Water jets [will be permitted to assist in driving] [may be used in driving only when specifically authorized by the Contracting Officer] [may be used to assist driving of the pile through strata which cannot be penetrated practicably by use of the hammer alone. After the penetration of the strata requiring jetting has been accomplished, the use of the jet shall be discontinued and direct hammer driving shall be resumed] [shall not be permitted to assist in driving]. [Discontinue jetting when the pile tip is approximately 1.5 m 5 feet above the [calculated] [indicated] pile tip elevation. Drive pile the final 1.5 m 5 feet of penetration [to the maximum penetration per blow established by the Contracting Officer]. Jetting method and equipment shall be approved by the Contracting Officer prior to commencing jetting operations.]

#### 3.1.5 Spudding of Piles

\*\*\*\*\*

NOTE: Spudding should not generally be permitted when:

1. Piles are dependent on side friction in fine-grained, low-permeability soils (high clay or silt content) where considerable time is required for the soil to reconsolidate around the piles;
2. Piles are subject to significant uplift;
3. Piles are adjacent to existing structures; and
4. Piles are in closely spaced clusters, unless the load capacity is confirmed by test and unless spudding is completed before final driving of any pile in the cluster.

\*\*\*\*\*

Spudding [will be permitted] [shall not be permitted]. [Discontinue driving and withdraw the spudding mandrel [approximately 1.5 m 5 feet above the [calculated] [indicated] pile tip elevation] [immediately after passing

through the resistant substrate layer].] [Drive pile the final 1.5 m 5 feet of penetration [to the maximum penetration per blow established by the Contracting Officer]. Obtain Contracting Officer's approval of spudding equipment, prior to commencing spudding operations.]

### 3.1.6 Predrilling of Piles

\*\*\*\*\*

NOTE: Predrilling should not generally be permitted when:

1. Piles are dependent on side friction in fine-grained, low-permeability soils (high clay or silt content) where considerable time is required for the soil to reconsolidate around the piles;
2. Piles are subject to significant uplift;
3. Piles are adjacent to existing structures; and
4. Piles are in closely spaced clusters, unless the load capacity is confirmed by test and unless predrilling is completed before final driving of any pile in the cluster.

\*\*\*\*\*

Predrilling [will be permitted] [shall not be permitted] [shall be provided]. [Discontinue predrilling when pile tip is approximately 1.5 m 5 feet above the [calculated] [indicated] pile tip elevation. Drive pile the final 1.5 m 5 feet of penetration [to the maximum penetration per blow established by the Contracting Officer]]. [Obtain Contracting Officer's approval of predrilling equipment prior to commencing predrilling operations.]

## 3.2 PROTECTION

### 3.2.1 Protection of Piles

Square the heads and tips of piles to the driving axis. Laterally support piles during driving, but do not unduly restrain piles from rotation in the leads. Swinging leads [will] [will not] be permitted. Where pile orientation is essential, take precautionary measures to maintain the orientation during driving. [Driven batter piles of sufficient unsupported lengths to cause a measurable deflection shall have free ends secured until piles are fixed in the structure to prevent excessive bending stresses.] Handle, protect, and field treat piles in accordance with AWP4 M4.

#### 3.2.1.1 Damaged Piles

Driving of piles shall not subject them to damage. Piles which are damaged, split, broomed, or broken by reason of internal defects or by improper driving below cutoff elevation so as to impair them for the purpose intended shall be removed and replaced; a second pile may be driven adjacent thereto at the Contractor's expense. Minor damaged areas of treated piles shall be brush-coated with creosote or the same preservative used to treat the piles. [The Contracting Officer may require the Contractor to pull certain selected piles after driving for test and inspection to determine the conditions of the piles. Any pile so pulled

and found to be damaged to such extent as to impair its usefulness in the completed structure shall be removed from the work and the Contractor shall furnish and drive a new pile to replace the damaged pile. Piles pulled and found to be sound and in a satisfactory condition shall be redriven.]

#### 3.2.1.2 On Site Application of Wood Preservatives

All on site application of wood preservatives must be performed by a person certified through an EPA approved training program for the application of wood treatment products in accordance with 40 CFR 171, regulated under 7 U.S.C.A. Sections 136 to 136y, Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). On site treatment shall also be in accordance with AWWA M4, Sections 1.5, 2.2, 2.3, and 3.1.

### 3.3 FIELD QUALITY CONTROL

#### 3.3.1 Inspections

When Government inspections result in product rejection, the Contractor shall promptly segregate and remove rejected material from the premises. The Government may also charge the Contractor an additional cost of inspection or test when prior rejection makes reinspection or retest necessary.

-- End of Section --