

\*\*\*\*\*  
USACE / NAVFAC / AFCEA UFGS-02390 (August 2004)  
-----  
Preparing Activity: USACE Superseding  
UFGS-02390A (July 2004)

## UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 25 June 2004

Latest change indicated by CHG tags

\*\*\*\*\*

### SECTION 02390

#### MOORING AND GROUNDING POINTS FOR AIRCRAFT 08/04

\*\*\*\*\*

NOTE: This guide specification covers requirements for mooring and static grounding points for Army and Air Force aircraft.

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.

\*\*\*\*\*

## PART 1 GENERAL

\*\*\*\*\*

NOTE: The items specified will provide ground points with a resistance of no more than 10,000 ohms to ground if the resistance of the surrounding soil or rock is less than 2,000,000 ohm-centimeters. In high resistivity soils, over 2,000,000 ohm-centimeters, 3 meter (10 foot) or sectional rods may be used to obtain the required resistivity to ground; however, where rock is encountered, additional rods, a counterpoise, or ground grid may be necessary. Resistance to ground for static electricity dissipation may be as much as 1,000,000 ohms. Static grounds are not designed for aircraft lightning protection or for equipment grounding.

Grounding devices installed in hangar floors are intended to serve for airplane static and equipment

grounding. The resistance to ground for each device will be no more than 25 ohms. This requirement should not be a problem since the rods will be bonded to the facility ground. The resistance to ground of grounding rods installed in all other areas should be no more than 10,000 ohms.

Coordination with grounding requirements listed in other sections should be done to avoid duplication.

It is recommended that this specification, and other contract requirements for mooring and grounding points, be coordinated with ER 1110-3-430, Design of US Army Airfield Aircraft Mooring and Grounding Points for Rotary Wing Aircraft.

The mooring points in this specification are applicable to Army rotary wing aircraft only. The grounding points are applicable to both Army and Air Force aircraft.

\*\*\*\*\*

#### 1.1 REFERENCES

\*\*\*\*\*

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.

\*\*\*\*\*

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 WELDING SOCIETY (AWS)

AWS D1.4 (1998) Structural Welding Code - Reinforcing Steel

##### ASTM INTERNATIONAL (ASTM)

ASTM A 436 (1984; R 2001) Austenitic Gray Iron Castings

ASTM A 615/A 615M (2003a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM B 371/B 371M (2002) Copper-Zinc-Silicon Alloy Rod

ASTM B 8 (1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

ASTM C 94/C 94M (2003a) Ready-Mixed Concrete

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 407 (2001) Aircraft Fuel Servicing

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 300 (1990) Specifications for Membrane-Forming  
Compounds for Curing Concrete

UNDERWRITERS LABORATORIES (UL)

UL 467 (1993; Rev thru Feb 2001) Grounding and  
Bonding Equipment

1.2 SUBMITTALS

\*\*\*\*\*

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.

\*\*\*\*\*

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.] The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

As-Built Drawings[; G][; G, [\_\_\_\_]]

Drawings as specified.

#### SD-06 Test Reports

Concrete[; G][; G, [\_\_\_\_]]

Complete concrete mix design including all cement, aggregate, and concrete tests and compliance certificates.

##### Tests

An independent testing agency's certified reports of inspections and tests, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and test standards shall be described.

#### SD-07 Certificates

##### Mooring Devices

Certificate of compliance stating that the mooring devices meet the specified requirements.

##### Grounding Rods

Certificate of compliance stating that the grounding rods meet the specified requirements.

##### Grounding Connectors

Certificate of compliance stating that the grounding connectors meet the specified requirements.

##### Copper Conductors

Certificate of compliance stating that the copper conductors meet the specified requirements.

##### Reinforcing Steel

Certificate of compliance stating that the reinforcing steel meets the specified requirements.

### 1.3 AS-BUILT DRAWINGS

The Contractor shall submit AS-Built Drawings that provide current factual information, including deviations from and amendments to the drawings and changes in the work, concealed and visible.

## PART 2 PRODUCTS

### 2.1 METALS

Combination of materials that forms an electrolytic couple, which accelerates corrosion in the presence of moisture, shall not be used, unless moisture is permanently excluded from the junction of such metals.

## 2.2 MOORING DEVICES

Mooring devices shall be cast in ductile iron 80-55-06 conforming to ASTM A 436. The device shall be as shown in the contract drawings. The Contractor shall submit certificates of compliance on the devices.

## 2.3 GROUNDING RODS

Grounding rods shall conform to UL 467 and shall be made of copper-clad steel. The rods shall be not less than 19 mm 3/4 inch in diameter and not less than 3 m 10 feet long. The copper cladding shall conform to the applicable requirements of ASTM B 371/B 371M, Copper Alloy UNS No's. c 69400, c 69430, c 69440 or c 69450. The copper cladding shall be not less than 0.25 mm 0.010 inches thick at any point and shall comply with adherence requirements and the banding requirements of UL 467. The Contractor shall submit certificates of compliance on the grounding rods. Rods shall be provided with a closed eye or shepherd's hook bend having an inside diameter of not less than 32 mm 1-1/4 inches. The rods shall be pointed unless used for flexible pavement. For flexible pavement, the rods shall have 19 mm 3/4 inch American standard rolled threads for attachment of a bottom anchor and shall be equipped with a screw-type bottom having a wing diameter of not less than 152 mm 6 inches.

## 2.4 COPPER CONDUCTORS

Copper conductors shall be bare number 4 AWG copper wire conforming to ASTM B 8. The Contractor shall submit certificates of compliance on the copper conductors.

## 2.5 GROUNDING CONNECTORS

Grounding connectors shall comply with UL 467 for the required application. The Contractor shall submit certificates of compliance on the grounding connectors.

## 2.6 CONCRETE

\*\*\*\*\*

NOTE: ASTM C 94 is set up to use Type I cement. If other types of cement are required due to site conditions, the designer should specify the proper cement type. A 28-day 40 MPa (6000 psi) compressive strength concrete is required for mooring point installation in drilled piers and in cored existing pavements. New rigid pavement 150 mm (6 inches) or greater in thickness with a minimum 90-day flexural strength of 3.5 MPa (500 psi) should be adequate for cast-in-place mooring point installation. Remove this paragraph if concrete is not required.

If concrete is specified in another section, a submittal for the mix design should not be required by this specification, and this section should be edited accordingly.

\*\*\*\*\*

Concrete shall be in accordance with [Section 02753 CONCRETE PAVEMENT FOR AIRFIELDS AND OTHER HEAVY-DUTY PAVEMENTS] [ASTM C 94/C 94M]. The concrete

shall be air entrained and have a minimum compressive strength of 40 MPa 6000 psi. The concrete shall have the following properties: Nominal maximum aggregate size of 25 mm 1 inch, air content of 6 percent, and a maximum slump of [100 mm 4 inches for drilled piers] [and] [ 50 mm 2 inches for all other applications]. The Contractor shall submit certificates of compliance of the concrete mix.

## 2.7 REINFORCING STEEL

Reinforcing steel shall conform to ASTM A 615/A 615M Grade 40 or 60 for #4 tie bars and Grade 60 for #6 vertical bars. Steel shall be welded into cages in accordance with AWS D1.4 and inserted securely in the piers, in position and alignment, as shown, prior to concrete placement. The Contractor shall submit certificates of compliance of the reinforcing steel.

## PART 3 EXECUTION

\*\*\*\*\*  
**Note: Types of mooring or grounding point  
installations not needed should be edited out.**  
\*\*\*\*\*

### 3.1 MOORING POINTS IN NEW RIGID PAVEMENTS OR CONCRETE PADS

The mooring device shall be installed within plus or minus 50 mm 2 inches of the location shown on the contract drawings. The top of the mooring device shall be set within 6 mm 1/4 inch of the plan pavement surface elevation, but not higher than the pavement surface. The mooring device shall be installed prior to placement of the concrete pavement. Concrete and reinforcement shall be placed in accordance with Section [\_\_\_\_]. Hand finishing of the concrete around the mooring devices shall be kept to a minimum.

### 3.2 MOORING POINTS IN EXISTING RIGID PAVEMENTS

\*\*\*\*\*  
**Note: Existing rigid pavement must be equal to or  
greater than 150 mm (6 inches) thick and in good  
condition, with very few cracked slabs. This is  
required to provide adequate mass to resist the  
horizontal component of the mooring point load.**  
\*\*\*\*\*

The mooring points shall be installed in 305 plus or minus 13 mm 12 plus or minus 1/2 inch diameter holes cored through the pavement. The core holes shall be drilled within plus or minus 38 mm 1-1/2 inches of the location shown in the contract drawings. The mooring device and attached grounding rod shall be installed within plus or minus 13 mm 1/2 inch of the center of the core hole. The top of the mooring device shall be installed within 6 mm 1/4 inch of the surrounding pavement surfaces, but not higher.

#### 3.2.1 Coring Requirements

The holes shall be cored using rotary, non-percussion drilling techniques. The sides of the core hole shall be perpendicular to the pavement surface. Once the pavement is cored the base course shall be excavated as shown in the drawings. The sides of the core hole shall be cleaned of latence and roughened by sand blasting. The Contractor shall place the concrete around the mooring device in two or more lifts. The first lift shall be placed to

within 125 mm 5 inches of the pavement surface and thoroughly consolidated by spud vibrators. The second lift shall be placed and also consolidated by internal vibration. The surface of the concrete shall be finished and textured to match the adjacent pavement surface and elevation. White pigmented curing compound meeting the requirements of COE CRD-C 300 shall be uniformly applied at a coverage of not more than 4.5 square m/L 200 square feet per gallon.

### 3.2.2 Cleanup

The Contractor shall control all operations to minimize the amount of dust, dirt, debris and laitance in the work area. The Contractor shall clean all dirt, dust, debris, or laitance from coring or concreting operations, from the pavement surfaces prior to final acceptance.

### 3.3 MOORING POINTS INSTALLED IN DRILLED PIERS

Excavation of piers shall be coordinated so that reinforcing steel and concrete placement is a continuous operation performed the same day that the excavation is completed. Excavations shall not be left open overnight.

Concrete shall be placed within 3 hours after approval of the completed pier excavation. Pier drilling equipment shall have the minimum torque capacity and downward force capacity for the contract site conditions.

#### 3.3.1 Government Inspection

The Contracting Officer will inspect each drilled pier excavation. Concrete shall not be placed until the excavation has been approved. The Contractor shall furnish the Contracting Officer all necessary equipment required for proper inspection of drilled pier excavations.

#### 3.3.2 Installation Procedures

Piers shall be excavated to the depths and dimensions shown. Piers shall be core drilled through pavements. Bottoms of piers shall be cleaned of loose or soft material and leveled. Excavated material shall be disposed of in accordance with Section 02300 EARTHWORK. The following shall be performed:

a. The surrounding base courses, subgrade, and soil shall be adequately and securely protected against cave-ins, displacement of the surrounding earth, and retention of ground water by means of temporary steel casings. Casings shall have outside diameters not less than the indicated shaft sizes and shall be a minimum of 6 mm 1/4-inch thick. Steel casings shall be withdrawn, as the concrete is being placed, maintaining sufficient head of concrete within the casing to prevent extraneous material from falling in from the sides and mixing with the concrete. Casings may be jerked upward a maximum of 100 mm 4 inches to break the bottom seal; but, thereafter, shall be removed with a smooth, continuous motion.

b. The inside of steel casings shall be thoroughly cleaned and oiled before reuse.

c. Water that flows into the excavations shall be continuously removed and all water shall be removed from the excavation bottom, to the extent possible, prior to concrete placement. The maximum permissible depth of water shall be 50 mm 2 inches. In the event of a severe water condition that makes it impossible or impractical to dewater the

excavation, concrete shall be placed using underwater tremie after water movement has stabilized.

d. Concrete shall be continuously placed ensuring against segregation and dislodging of excavation sidewalls; concrete shall completely fill the shaft. Concrete shall be placed by pumping or drop chutes in dry holes and by tremie or pumping in wet holes. The discharge shall be kept a minimum of 305 mm 1 foot below the fresh concrete surface during placement. Concrete placement shall not be interrupted in any pier for more than 30 minutes. The upper 1.5 m 5 feet of the concrete pier shall be vibrated.

e. Any pier out of center or plumb beyond the specified tolerance shall be corrected as necessary for compliance and the Contractor shall bear any cost of correction. Cross sections of shafts shall not be less than design dimensions. Piers shall be installed with top location deviating a maximum of 50 mm 2 inches from centerline locations.

f. The mooring device shall be installed within plus or minus 25 mm 1 inch of the center of the drilled pier. The top of the mooring device shall be within 6 mm 1/4 inch of the top of the pier, but not higher.

g. The Contractor shall replace, at no additional cost to the Government, piers found out of tolerance.

h. The Contractor shall provide protection around top of the excavation to prevent debris from being dislodged into the excavation and concrete.

### 3.4 GROUNDING POINTS

The grounding points shall be located as shown on the contract drawings to within plus or minus 50 mm 2 inches.

#### 3.4.1 Pavement Recess

The top of the grounding rod shall be set at or not more than 6 mm 1/4 inch below the pavement surface grade. A recess 70 mm 2-3/4 inches wide, and not more than 150 mm 6 inches long, with a smooth rounded edge shall be provided in the pavement around the grounding point anchor eye to permit the entrance of lines into the eye and to allow for attachment of the grounding cable. The depth of the recess shall be no deeper than the bottom of the opening of the grounding point eye.

#### 3.4.2 Installation

##### 3.4.2.1 Existing Rigid Pavement

Grounding rods shall be installed in holes cored through the rigid pavement using rotary, non-percussion drilling techniques. The core holes shall have a minimum diameter of 150 mm 6 inches. The grounding rod shall be installed by pushing or driving the rod through the pavement base courses and subgrade. The installation technique chosen by the Contractor shall not damage the grounding rod or the pavement. Installation shall be completed by placing concrete around the grounding rod in two lifts with each lift consolidated with spud vibrators.

#### 3.4.2.2 New Rigid Pavement

The grounding rod shall be installed by pushing or driving the rod through the pavement base courses and subgrade prior to concrete placement. The installation technique chosen by the Contractor shall not damage the grounding rod. Hand finishing around the rod shall be kept to a minimum.

#### 3.4.2.3 Flexible Pavement

Grounding rods shall be installed in portland cement concrete blockouts measuring 1.2 by 1.2 m 4 by 4 foot in plan dimensions. The thickness and reinforcing details are shown on the contract drawings. The grounding rod shall be installed by pushing or driving the rod through the pavement base courses and subgrade prior to concrete placement. The installation technique chosen by the Contractor shall not damage the grounding rod. Hand finishing around the rod shall be kept to a minimum.

#### 3.4.3 Interconnection

Grounding rods within aircraft hangars shall be electrically interconnected to the hangar electrical grounding system with not less than a number 4 AWG bare copper conductor. Grounding rods installed at fueling hydrant outlets shall be electrically interconnected with the fuel piping with not less than a number 4 AWG bare copper conductor.

### 3.5 TESTS

Resistance to ground tests shall be measured as specified in NFPA 407. Test results shall be submitted to the Contracting Officer. Any ground rods that have more than 10,000 ohms of resistance shall be reported to the contracting officer immediately.

-- End of Section --