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USACE / NAVFAC / AFCESA / NASA **UFGS-26 26 00.00 40 (January 2007)**

Preparing Activity: NASA **Superseding UFGS-26 26 00.00 40 (June 2006)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 19 March 2007

Latest change not indicated by CHG tags
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DIVISION 26 - ELECTRICAL

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POWER DISTRIBUTION UNITS

01/07

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USACE / NAVFAC / AFCESA / NASA	UFGS-26 26 00.00 40 (January 2007)
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SECTION 26 26 00.00 40

POWER DISTRIBUTION UNITS
01/07

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NOTE: This specification covers the requirements for poles, crossarms, hardware and pins, guying, racks, and insulators. Use Section 33 71 39.13 40 OVERHEAD HIGH-VOLTAGE WIRING for overhead primary conductors. If connections between overhead and underground primary are required, specify types of potheads or terminators.

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).
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PART 1 GENERAL

1.1 REFERENCES

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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.

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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.

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)

ATIS O5.1	(2002; 2004s; Supple A, 2003; Supple B, 2003; Supple C, 2004) Specifications and Dimensions (for Wood Poles)

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA A3	(2005) Standard Method for Determining Penetration of Preservatives and Fire Retardants
AWPA T1	(2005) Processing and Treatment Standard

ASTM INTERNATIONAL (ASTM)

ASTM A 675/A 675M	(2003) Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM D 1625	(1971; R 2000) Standard Specifications for Chromated Copper Arsenate

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C135.1	(1999) Standard for Zinc-Coated Steel Bolts and Nuts for Overhead Line Construction
IEEE C135.6	(1988) Zinc-Coated Ferrous Crossarm Braces for Overhead Line Construction
IEEE C2	(2002) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA C29.2	(1992; R 1999) Standard for Insulators - Wet-Process Porcelain and Toughened Glass - Suspension Type
NEMA C29.3	(1986; R 2002) Standard for Wet Process Porcelain Insulators - Spool Type

NEMA C29.4	(1989; R 2002) Standard for Wet-Process Porcelain Insulators - Strain Type
NEMA C29.6	(1994 R 2002) Standard for Wet-Process Porcelain Insulators - High-Voltage Pin Type
NEMA C29.7	(1996; 2002) Standard for Wet Process Porcelain Insulators - High-Voltage Line Post Type

1.2 SUBMITTALS

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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.
****

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.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Material, Equipment and Fixture Schedule

SD-02 Shop Drawings

Fabrication Drawings
Installation Drawings

SD-03 Product Data

Manufacturer's product data shall be submitted for the following items:

Wood Poles
Crossarms and Timbers
Crossarm Braces
Hardware, Pins, and Racks
Insulators
Guys
Accessories

SD-07 Certificates

Certificates shall be submitted for the following items showing conformance with the referenced standards contained in this section.

Wood Poles
Crossarms and Timbers
Crossarm Braces
Hardware, Pins, and Racks
Insulators
Guys
Accessories

1.3 GENERAL REQUIREMENTS

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NOTE: If Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.
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Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

1.4 MATERIAL, EQUIPMENT AND FIXTURE SCHEDULE

Material, equipment and fixture schedule shall be submitted for overhead pole line assemblies including manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information.

PART 2 PRODUCTS

2.1 FABRICATION DRAWINGS

Fabrication Drawings shall be submitted for the following items consisting of fabrication and assembly details to be performed in the factory.

Wood Poles
Crossarms and Timbers
Crossarm Braces
Hardware, Pins, and Racks
Insulators
Guys
Accessories

2.2 WOOD POLES

Wood poles shall be treated Southern pine in accordance with ATIS O5.1.

Poles shall be carefully selected for straightness and shall have no sweeps or short crooks exceeding the maximum sweeps and short crooks permitted in ATIS O5.1.

2.2.1 Preservative

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NOTE: Choose one of the following three types of preservatives, according to the environment.
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Preservative used for humid, harsh environment shall be Chromated Copper Arsenate type (A)(B)(C) conforming to AWPA T1 and ASTM D 1625.

Wood poles shall be treated with waterborne preservatives conforming to AWPA T1.

2.2.2 Preservative Application

Preservative treatment shall be applied using a pressure process conforming to and AWPA T1 for Southern Pine. Penetration of preservatives shall be determined as specified in AWPA A3 and complete sapwood penetration shall be obtained.

Poles that are to be given a full-length preservative treatment shall be roofed, gained, and bored before treatment. Unused holes in poles shall be plugged with treated wood-dowel pins. Field-cut gains or field-bored holes in poles shall be treated with an approved preservative compound.

2.2.3 Storage

Poles stored for any reason more than 2 weeks shall be stacked on pressure treated or decay-resistant skids of such dimensions and so arranged as to support the poles without producing noticeable distortion. Poles shall be stacked in a manner that will permit free circulation of air; the bottom poles of the stacks shall be at least 300 millimeter 1-foot above ground level or any vegetation growing thereon. No decayed or decaying wood shall be permitted to remain underneath stored poles.

2.2.4 Handling

Treated poles shall not be dragged along the ground. Pole tongs, cant hooks, and other pointed tools capable of producing indentations more than 25 millimeter 1 inch in depth shall not be used in handling the poles. No tools shall be applied to the groundline section of any pole. Groundline section is that portion between 300 millimeter 1 foot above and 600 millimeter 2 feet below the ground line.

2.3 CROSSARMS AND TIMBERS

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NOTE: Crossarms shall be avoided wherever practicable due to failure rates and propensity for raptor nesting causing electrical outages.
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Before pressure treatment, crossarms shall be machined, chamfered, trimmed, and bored for pins and bolts required.

Crossarms and timbers shall be straight and close-grained pressure treated Southern pine, pressure-treated to 35 newton 8 pounds minimum retention with complete sapwood penetration. Treatment of crossarms and timbers shall meet the requirements of AWPA T1.

Crossarms shall be 110 by 135 millimeter by 2700 millimeter 4-1/4 by 5-1/4 inches by 9 feet, unless other dimensions are indicated, and straight and free of twists to within 2.5 millimeter per 1/3 meter 1/10 inch per foot of length. Bends or twists shall be in one direction only.

Vertical and longitudinal strength of crossarms shall conform to IEEE C2.

2.4 CROSSARM BRACES

Crossarm braces shall be zinc-coated structural steel conforming to ASTM A 675/A 675M.

Crossarm braces shall meet the requirements of IEEE C135.6.

Angle braces shall be 1500 millimeter 60-inches span by 460 millimeter 18 inches, drop-formed in one piece from a 45 by 45 millimeter 1-3/4 by 1-3/4-inch angle.

Flat braces shall be 6 millimeter by 32 millimeter 1/4 inch by 1-1/4 inches, not less than 500 millimeter 20-inches long for arms 1200 millimeter 4 feet or less in length, and not less than 710 millimeter 28-inches long for arms exceeding 1200 millimeter 4 feet in length.

2.5 HARDWARE, PINS, AND RACKS

2.5.1 Miscellaneous Hardware

Pole-line hardware shall be hot-dip galvanized after fabrication.

Suitable washers shall be installed under bolt heads and nuts on wood surfaces. Washers used on thru-bolts and double-arming bolts shall be approximately 60 millimeter 2-1/4-inches square and 5 millimeter 3/16-inch thick. Diameter of holes in washers shall be the correct standard size for the bolts with which the washers are used. Washers for use under the heads of carriage bolts shall be the proper size to fit over the square shank of the bolt.

Pole line hardware shall meet the requirements of IEEE C135.1 for steel bolts and nuts.

2.5.2 Pins

Pins shall be zinc-coated forged steel with lead-thread height to suit the insulator to be installed, but not less than 115 millimeter high by 16 millimeter diameter 4-1/2-inches high by 5/8-inch diameter. Shoulder shall be not less than 50 millimeter 2-inch diameter and shall be designed to distribute the load uniformly to the crossarm. Shank shall be not less than 16 millimeter diameter by 145 millimeter length 5/8-inch diameter by 5-3/4-inch length, equipped with a 50 millimeter 2-inch square washer, nut, and locknut, and shall project not less than 3 millimeter 1/8 inch nor more than 50 millimeter 2 inches beyond the locknut. Broad-base corner pins of drop-forged welded steel or malleable iron shall be used for turning small angles, as indicated.

2.5.3 Hot-Line Clamps

Connections to overhead primary conductors shall be made with hot-line clamps of the screw type with concealed threads. Thread chamber shall be filled with corrosion-resistant compound. Hot-line clamp tap conductor shall be bare soft-drawn seven-strand 5.2 millimeter diameter (No. 4) No. 4 copper, except that the hot-line clamp tap conductor for lateral lines 6.5 millimeter diameter (No. 2) No. 2 and larger shall be bare soft-drawn copper of the same size and stranding as the lateral line.

Stirrups shall be provided for hot-line clamp connections, shall be 100 by 100 millimeter 4 by 4 inches, and shall be constructed of bare hard-drawn copper the same size as the tap line but not less than No. 4.

2.5.4 Secondary Racks

Secondary racks shall be the 2-, 3-, or 4-wire type as required and shall be furnished complete with spool insulators.

Racks shall meet industry requirements for the strength and deflection of heavy-duty steel racks and shall be either galvanized steel or aluminum alloy.

Top of insulator points shall be rounded and smooth. Insulators shall be held in place with a 16 millimeter 5/8-inch buttonhead bolt equipped with a nonferrous cotter pin, or equivalent, at the bottom.

2.6 INSULATORS

Insulators for use on primary open-wire construction shall conform to NEMA C29.2, NEMA C29.3, NEMA C29.4, NEMA C29.6, and NEMA C29.7.

Insulators shall have a minimum wet flashover rating of 80 kV.

Suspension insulators shall be used on the primary system at corners, angles greater than 5 degrees, suspended buses, dead ends, and wherever pin insulators do not provide adequate strength.

Mechanical strength of suspension and strain insulators shall exceed the ultimate tensile strength of the conductor or guy attached thereto.

Pin insulators used on voltages in excess of 5,000 volts phase-to-phase shall be radio-noise free.

Insulators for various uses shall have ratings not lower than the classes

indicated as follows:

SERVICE	PIN	LINE POST	SUSPENSION
5,001- to 15,000-volt	56-3	27-21 or 2s	3 X 52-2*

*With a 300 millimeter 12-inch extension link in the center phase.

Spool insulators used on secondaries shall be not smaller than Class 52-2. For conductors No. 4/0 and larger, Class 52-4 spool insulators shall be used.

Insulator testing shall be in accordance with NEMA C29.2.

2.7 GUYS

Guys shall be the wrap type, except where storm guys are indicated.

2.7.1 Guy Hooks and Guy Strain Plates

Guy hooks and guy strain plates shall meet the requirements of IEEE C135.1. Steel and malleable-iron guy clamps shall meet industry requirements.

2.7.2 Guy Wires

Guy wires shall be [seven-strand copper-covered steel] [galvanized steel] with a breaking strength of not less than 45 kilonewtons 10,000 pounds.

2.7.3 Guy Protectors

Polyvinylchloride (PVC) guy protectors shall be 60 millimeter 2-1/4-inch outside width, with 2.5 millimeter 100-mil minimum thickness.

Guy protectors shall be used to visually mark the guy wire at all locations that are accessible.

2.7.4 Anchors

Anchors shall be screw type. A 380 millimeter 15-inch screw anchor with an 2-meter long by 40 millimeter 8-foot long by 1-1/2-inch diameter rod is acceptable as a 45 kiloNewtons 10,000-pound anchor.

2.8 FACTORY TESTING AND INSPECTION

Inspection of poles, crossarms, and timbers shall be accomplished by a recognized independent timber inspection company. Qualifications of the company shall be subject to approval. Poles, crossarms, and timbers shall be inspected prior and subsequent to treatment. For the material to be acceptable, the inspection company shall certify that the wood, treating material, and treatment are all in accordance with this specification.

PART 3 EXECUTION

3.1 INSTALLATION DRAWINGS

Installation Drawings shall be submitted for overhead pole line assemblies. Installation shall be in accordance with IEEE C2 for medium loading conditions, Grade B construction.

3.2 POLES

3.2.1 Gains

Gains shall be cut on the face concave side or side of greatest curvature in poles having reverse or double sweeps between the ground line and the top of the pole; the gained surfaces shall be in approximately parallel planes. Poles shall be framed as required for the application.

3.2.2 Setting Poles

Poles in straight runs shall be set in a straight line. Curved poles shall be placed with the curvature in line with the lead pole. Poles shall be set to maintain as even a grade as practical.

When the average ground run is level, consecutive poles shall not vary more than 1500 millimeter 5 feet in height. When the ground is uneven, poles differing in height shall be kept to a minimum by locating poles to avoid the highest and lowest points.

When it becomes necessary to shorten a pole, a piece shall be sawn off the top end. When poles are shortened after treatment, the shortened end of the pole shall be given an application of hot pressure treated.

Holes shall be large enough to permit the proper use of tampers to the full depth of the hole. Earth shall be thrown into the hole in 150 millimeter 6-inch maximum layers, then thoroughly tamped before the next layer is thrown in. Surplus earth shall be placed around the pole in a conical shape and packed tightly to drain water away from the pole.

Poles located at corners, angles, and dead ends shall be installed with a sufficient degree of rake to ensure sound pole-setting practices. When poles are set along the edge of cuts or embankments or where the soil may be washed out, special precautions shall be taken to ensure durable foundations. Setting depth shall be measured from the lower side of the pole. In normal firm ground, minimum pole-setting depths shall be as listed below.

MINIMUM SETTING-DEPTH OF WOOD POLES

OVERALL POLE LENGTH (MM)	POLES IN STRAIGHT LINES (MM)	POLES AT CURVES, CORNERS, AND POINTS OF EXTRA STRAIN (MM)
9000	1700	1700
11000	1800	1800
12000	2000	2100
14000	2100	2300
15000	2300	2400
17000	2400	2600
18000	2400	2600

MINIMUM SETTING-DEPTH OF WOOD POLES

OVERALL POLE LENGTH (MM)	POLES IN STRAIGHT LINES (MM)	POLES AT CURVES, CORNERS, AND POINTS OF EXTRA STRAIN (MM)
20000	2700	2900
21000	2980	3000
23000	3000	3200
24000	3200	3500
26000	3500	3800
27000	3800	4100
29000	4100	4400
30000	4400	4900

MINIMUM SETTING-DEPTH OF WOOD POLES

OVERALL POLE LENGTH (FEET)	POLES IN STRAIGHT LINES (FEET-INCHES)	POLES AT CURVES, CORNERS, AND POINTS OF EXTRA STRAIN (FEET-INCHES)
30	5-6	5-6
35	6-0	6-0
40	6-6	7-0
45	7-0	7-6
50	7-6	8-0
55	8-0	8-6
60	8-0	8-6
65	9-0	9-6
70	9-6	10-0
75	10-0	10-6
80	10-6	11-6
85	11-6	12-6
90	12-6	13-6
95	13-6	14-6

MINIMUM SETTING-DEPTH OF WOOD POLES

OVERALL POLE LENGTH (FEET)	POLES IN STRAIGHT LINES (FEET-INCHES)	POLES AT CURVES, CORNERS, AND POINTS OF EXTRA STRAIN (FEET-INCHES)
100	14-6	16-0

3.2.3 Marking

Each pole shall be marked in accordance with the requirements of ATIS O5.1. Marking on the face of the pole shall be located approximately 3 meter 10 feet from the butt on the pole. Where approved by the Contracting Officer, the marking on the face of the pole may be at other locations standard with the pole manufacturer.

Poles shall be numbered as indicated. Poles not having numbers indicated shall be numbered as directed by the Contracting Officer. Pole numbers shall consist of aluminum numerals and characters not less than 65 millimeter 2-1/2-inches high fastened to the pole with aluminum nails. Numerals shall be located to provide maximum visibility from the road or patrol route.

3.3 CROSSARMS AND TIMBERS

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NOTE: Vertical or triangular framing is preferred over crossarm framing. Use crossarm framing only where mandatory for ground clearances.

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Crossarms shall be set at right angles to line for straight runs and shall bisect the angle of turns.

Double crossarms shall be securely held in position by means of 16 millimeter 5/8 inch double-arming bolts. Each double-arming bolt shall be equipped with four nuts and four square washers.

Crossarms shall be bolted to poles with 16 millimeter 5/8 inch thru-bolts with square washers at each end. Bolts shall extend not less than 3 millimeter 1/8-inch nor more than 50 millimeter 2-inches beyond the nut.

3.4 CROSSARM BRACES

Crossarm braces shall be provided on crossarms.

Flat braces shall be bolted to arms with 10 millimeter 3/8 inch carriage bolts with a round washer between bolthead and crossarm and shall be secured to poles with 13 millimeter by 100 millimeter 1/2 inch by 4 inch lag screws after crossarms are leveled and aligned.

Angle braces shall be bolted to crossarms with 13 millimeter 1/2 inch bolts with a round washer between bolthead and crossarm and shall be secured to poles with 16 millimeter 5/8 inch thru-bolts.

3.5 HARDWARE, PINS, AND RACKS

Eyebolts, bolt eyes, eyenuts, strain load plates, lag screws, guy clamps,

fasteners, hooks, shims, and clevises shall be used wherever required to adequately support and protect the poles, crossarms, guy wires, and insulators. Hardware shall be the correct size to fit the pole and crossarms on which they are being installed.

Racks for dead-ending four 11.7 millimeter diameter (No. 4/0) No. 4/0 or larger conductors shall be attached to poles with three 16 millimeter 5/8 inch thru-bolts. Other secondary racks shall be attached to poles with at least two 16 millimeter 5/8 inch thru-bolts.

Minimum vertical spacing between conductors shall be as follows:

SPAN LENGTH (METER)	VERTICAL SPACING BETWEEN CONDUCTORS (MILLIMETER)
Up to 60	150
61 to 76	200
77 to 91	300

SPAN LENGTH (FEET)	VERTICAL SPACING BETWEEN CONDUCTORS (INCHES)
Up to 200	6
201 to 250	8
251 to 300	12

3.6 GUYS

Guys shall be provided at the locations indicated, where conductor tensions are not balanced as at angles and deadends, and elsewhere as necessary or as required by IEEE C2. Where points of strain on a pole are separated by more than 900 millimeter 3 feet, separate down-guys shall be installed at each point of strain. Where a single guy cannot provide the required strength, two or more guys shall be provided.

A minimum of two guy hooks and two pole shims shall be provided for wrap guys. Three-bolt or offset guy clamps or approved guy grips shall be provided at each guy terminal.

Where the total unbalanced load on a pole exceeds 45 kilonewtons 10,000 pounds, multiple guys and anchors shall be installed. Guy strength shall be determined from the minimum holding power of any component.

Thimbles or thimble eyes shall be provided on anchor-rod and eye-bolt guy attachments to protect the guy strand. Care shall be taken to prevent damage to the copper coating. Nicks or similar damage will be cause for rejection.

Whenever possible, guys shall have a lead-to-height ratio of 1 to 1 and a minimum lead-to-height ratio of 1/2 to 1. When field conditions prevent the lead-to-height ratio of 1 to 1, anchors shall be placed in a location approved by the Contracting Officer. Guy strength shall be increased by the ratio of the sine of the lead angle indicated to the sine of the lead angle provided. Storm guys and other guys where road clearance is essential shall be installed with a minimum lead. Storm guys shall be

tensioned sufficiently to remove slack and present a neat appearance.

Ground end of each guy attached to a ground anchor shall be equipped with a half-round galvanized steel or gray PVC guy protector at least 2135 millimeter 7 feet long. Protector shall be securely clamped or bolted to the anchor rod or guy wire near the bottom and to the guy wire near the top.

Where shown on the drawings, guy wires shall be equipped with epoxy-bonded fiberglass strain insulators. Length of fiberglass shall be as indicated and shall be of sufficient additional length to provide a minimum 300 millimeter 12 inch clearance between the nearest energized surface and the strain insulator fitting farthest from the pole. When loaded to the tension indicated, fiberglass strain insulators shall be loaded to not more than two-thirds of the manufacturer's catalog rating.

Guys shall be solidly bonded to the system ground. Span guys shall be solidly grounded at each point of attachment to a pole. Guy wires shall be electrically bonded to the anchor rods by means of suitable guy-bond clamps.

Guy anchors and attachments shall provide a strength exceeding the required guy strength.

Anchors shall be installed so that the guy will be in a straight-line pull. Minimum strength of guy and anchor assembly shall be 22 kilonewtons 5,000 pounds.

3.7 FIELD TESTING

At least one anchor of each capacity installed shall be field-tested to ensure that the anchor develops rated holding power as indicated, without noticeable creepage. In the event of failure of a test anchor, all anchors of the size that failed shall be tested and those that fail shall be replaced; replacements shall be tested in the same manner as the original anchor. Materials, labor, and equipment required to perform the above test and for replacing anchors that fail shall be furnished at no additional cost to the Government. Anchors shall be tested prior to hanging guys. Anchors to be used as test anchors will be picked at random by the Government after all anchors have been installed.

-- End of Section --