UNITED STATES DEPARTMENT OF AGRICULTURE
Rural Utilities Service

BULLETIN 1751F-635

SUBJECT: **Aerial Plant Construction**

TO: All Telecommunications Borrowers
RUS Telecommunications Staff

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OFFICE OF PRIMARY INTEREST: Outside Plant Branch, Telecommunications Standards Division

PREVIOUS INSTRUCTIONS: This bulletin replaces RUS Telecommunications Engineering & Construction Manual (TE&CM) Section 635, Construction of Aerial Cable Plant, Issue 3, dated February 1962; Addenda 2, 3, and 4, dated October 1966, March 1979, and August 1979; respectively.

FILING INSTRUCTIONS: Discard RUS TE&CM Section 635, Construction of Aerial Cable Plant, Issue 3, dated February 1962; Addenda 2, 3, and 4, dated October 1966, March 1979, and August 1979, respectively; and replace them with this bulletin. File with 7 CFR 1751 and is available to the RUS staff on RUSNET.

PURPOSE: This bulletin provides RUS borrowers, consulting engineers, contractors and other interested parties with information on the construction of aerial plant facilities.

Wally Beyer	6-12-96
Administrator	Date

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ABBREVIATIONS

°C	Degrees Celsius
CFO	Aerial Filled Self-Supporting Fiber Optic Cable Assembly Unit
CFR	Code of Federal Regulations
CO	Aerial Filled Fiber Optic Cable Assembly Unit
CW	Aerial Filled Cable Assembly Unit
EHS	Extra High Strength Galvanized Steel
°F	Degrees Fahrenheit
ft	Feet
in.	Inches
kg/m	Kilograms per meter
lbf	Pounds-force
lb/ft	Pounds per foot
m	Meter
mm	Millimeter
N	Newton
NESC	National Electrical Safety Code
R/W	Right-of-way
RUS	Rural Utilities Service
TE&CM	Telecommunications Engineering and Construction Manual

DEFINITIONS

Anchor: A device that serves as a reliable support to hold an object firmly in place. The term anchor is normally associated with cone, plate, screw, or concrete anchors, but the terms snub, deadman and anchor log are usually associated with pole stubs or logs set or buried in the ground to serve as temporary anchors. The latter are often used at pull and tension sites.

CFO: An aerial filled self-supporting fiber optic cable assembly unit which includes all the material and labor costs to install 1000 feet (304.8 meters) of self-supporting filled fiber optic cable. The units also includes the material and labor costs for installing all supporting hardware, cable guards, insulating tapes, and bonding of the shield and supporting member. This unit is presently a “nonstandard” assembly unit.

CO: An aerial filled fiber optic cable assembly unit which includes all the material and labor costs to install 1000 feet (304.8 meters) of filled aerial fiber optic cable. The unit also includes the material and labor costs for installing the suspension strand, lashing wire, attachments to strand, and bonding of the cable shield and suspension strand.

Construction Drawings: The drawings developed through the staking process and used to guide the construction of outside plant facilities.

Contractor: A provider of goods or services for the Project, other than the Engineer.

CW: An aerial filled cable assembly unit which includes all the material and labor costs to install 1000 feet (304.8 meters) of filled aerial copper cable. The unit also includes the material and labor costs for installing the suspension strand, lashing wire, attachments to strand, and bonding of the cable shield and suspension strand.

Figure Eighting: A method of removing cable or wire from a reel and forming the removed cable or wire in the shape of the numeral eight.

Guy: A tension member having one end secured to a fixed object and the other end attached to a pole or other structural part that it supports.

Guy Strand: A stranded group of wires used as a semiflexible tension support between a pole or structure and the anchor rod, or between structures.

Heavy Loading District: Horizontal wind pressure, at a right angle to the line, of 4 pounds per square foot (190 pascals) upon the projected area of the cylindrical surfaces of all supported wires (including suspension strand and cables) when coated with a radial thickness of 0.50 inch (12.5 millimeters) of ice at a temperature of 0°F (-20°C).

Inspect: To monitor and examine the work of the Contractor, compare the work to the contract, and note the details and quantities of construction on records and progress reports.

Inspector: A representative of the Engineer who Inspects construction and reports compliance or noncompliance to the Resident Engineer.

Lashed Aerial Cable: Cable that is attached to the separate suspension strand by lashing wire to support the cable.

Lashing Wire: A wire that is used to support the cable to the suspension strand by wrapping it around the cable and suspension strand.

Light Loading District: Horizontal wind pressure, at a right angle to the line, of 9 pounds per square foot (430 pascals) upon the projected area of the cylindrical surfaces of all supported wires (including suspension strand and cables) at a temperature of 30°F (-1°C).

Medium Loading District: Horizontal wind pressure, at a right angle to the line, of 4 pounds per square foot (190 pascals) upon the projected area of the cylindrical surfaces of all supported wires (including suspension strand and cables) when coated with a radial thickness of 0.25 inch (6.5 millimeters) of ice at a temperature of 15°F (-10°C).

Pole: A column of wood supporting overhead cables usually by means of brackets.

Pole Line: A series of poles arranged to support cables above the surface of the ground: and the structures and cables supported thereon.

Project: The telecommunications construction and procurements financed by a particular RUS loan.

Resident Engineer: The representative of the Engineer who is delegated full-time “on-site” engineering responsibilities for construction administration.

Right-of-Way: The strip of land over which facilities such as highways, railroads, power lines, other utilities, or telecommunication lines are constructed.

RUS Accepted (Material and Equipment): Material and equipment which RUS has reviewed and determined that:

a. Final assembly is conducted within the United States, Mexico, or Canada or any of their respective territories and the cost of United States, Mexican, or Canadian, manufactured components, in any combination, is more than 50 percent of the total cost of all components utilized in the material or equipment, and

b. The material or equipment complies with pertinent RUS or industry standards and field experience has demonstrated that the material or equipment is suitable for use on systems of RUS telecommunications borrowers.

RUS Technically Accepted (Material and Equipment): Material and equipment which RUS has reviewed and determined that:

a. Final assembly is not conducted within the United States, Mexico, or Canada, or any of their territories, or the cost of components within the material or equipment which are manufactured within the United States, Mexico, or Canada, or any of their territories, cost 50 percent or less than the total cost of all components utilized in the material or equipment, and

b. The material or equipment complies with pertinent RUS or industry standards and field experience has demonstrated that the material or equipment is suitable for use on systems of RUS telecommunications borrowers.

Sag: The distance measured vertically from a cable to the straight line joining its two points of support. Unless otherwise stated in the National Electrical Safety Code (NESC), the sag referred to is the sag at the midpoint of the span.

Self-Supporting Aerial Fiber Optic Cable: A cable consisting of one or more buffered optical fibers factory assembled with a messenger that supports the cable.

Span Length: The horizontal distance between two adjacent supporting points of a cable.

Suspension Strand: A stranded group of wires supported above the ground at intervals by poles or other structures and employed to furnish within these intervals frequent points of support for cables.

1. GENERAL

1.1 This bulletin discusses in particular the construction of aerial plant using filled copper cables and filled fiber optic cables. The information and recommendations in this bulletin are advisory.

1.2 Aerial plant for both filled copper cables and filled fiber optic cables should be constructed by attaching cables to utility poles at varying span lengths by lashing cables to separate suspension strands. Filled fiber optic cables may also be constructed using cables containing an integrated suspension strand. Filled fiber optic aerial cables containing integrated suspension strands are referred to as a self-supporting fiber optic cables.

1.3 Some of the work items associated with aerial plant construction are as follows:

a. Pre-installation inspection of copper cables and fiber optic cables;

b. Pre-installation inspection of self-supporting fiber optic cables;

c. Pre-installation inspection of suspension and guy strands and lashing wires;

d. Installation and tensioning of the suspension strand;

e. Installation of guy strands and pole anchors;

f. Installation of aerial splice and ready-access cases for copper cables;

g. Installation of aerial filled splice cases for fiber optic cables;

h. Installation of aerial filled splice cases for self-supporting fiber optic cables;

i. Installation of cable slack loops at utility poles for fiber optic cables;

j. Splicing of copper cables and connection of shield bonds and related grounding;

k. Splicing of fiber optic cables;

l. Connection of armor bonds and related grounding for aerial, armored fiber optic cables;

m. Terminating aerial service wire to filled terminal blocks in ready-access cases, fixed count and pole mount terminals;

n. Placement of load coils [When loaded lines are determined by RUS to be economically feasible and the overall system design complies with the Modernization Plan (7 CFR 1751, Subpart B)];

o. Placement of digital carrier repeater housings and lightwave repeater housings; and

p. Conducting acceptance tests.

1.4 Additional information for the use in the construction of aerial plant facilities can be found in the following Rural Utilities Service (RUS) documents:

a. RUS Form 515, RUS Telephone System Construction Contract (Labor and Materials);

b. RUS Bulletin 345-153, Specifications and Drawings for Construction of Pole Lines, Aerial Cables and Wires (RUS Form 515f);

c. RUS Bulletin 345-63, RUS Standard for Acceptance Tests and Measurements of Telephone Plant (PC-4);

d. RUS Bulletin 1728F-700, RUS Specification for Wood Poles, Stubs and Anchor Logs;

e. RUS Bulletin 1751F-626, Staking of Aerial Plant;

f. RUS Bulletin 1751F-630, Design of Aerial Plant;

g. RUS Bulletin 1753F-401(PC-2), REA Standard for Splicing Copper and Fiber Optic Cables (codified under 7 Code of Federal Regulations [CFR] 1755.200);

h. Telecommunication Engineering and Construction Manual (TE&CM) Section 650, Guy and Anchors on Wire and Cable Lines; and

i. Latest edition of the National Electrical Safety Code (NESC).

1.5 To convert the English Units to Metric Units for Tables 1 through 3 of Paragraph 5.2 and Tables 8 through 50 of Paragraph 8.2 use the following formulae:

a. Millimeters (mm) = Inches (in.) x 25.4;

b. Meters (m) = Feet (ft) x 0.3048;

c. Newtons (N) = Pound-force (lbf) x 4.448;

d. °C = 5/9 x (°F - 32); and

e. Kilograms per meter (kg/m) =
Pounds per foot (lb/ft) x 1.488.

2. INSPECTION OF CONSTRUCTION

2.1 The construction of aerial plant facilities should be inspected. This inspection should be accomplished after the construction operation has been completed by the resident engineer or resident engineer's assigned inspector. The resident engineer or resident engineer's assigned inspector also has the responsibility to verify that the correct class and length of pole; correct strand size; correct pair sizes, gauges, and type of copper cables; and the correct number of optical fibers, type of optical fibers, and types of fiber optic cables have been installed and free of damage after construction has been completed.

2.2 When more than one aerial plant construction operation is being performed at the same time, each construction operation after completion should be inspected. During construction of cables, construction may be stopped pending the resident engineer's decision concerning proposed changes in the construction route from that shown on the construction drawings. Undue delays in making such decisions are costly to the borrower and should be avoided.

2.3 All reels of filled copper and fiber optic cables; reels of filled, self-supporting fiber optic cables; reels of suspension strands; and spools of lashing wires should be inspected by the contractor before installation for visual signs of damage. In addition, filled copper, filled fiber optic, and filled, self-supporting fiber optic cable ends should be sealed to prevent moisture entry into the cores of copper and fiber optic cables during transportation, in storage, and during placement.

2.4 The aerial plant construction route should be inspected before beginning construction. When selecting the aerial plant construction route, the convenience and ease of installation should be considered providing the quality of construction, which would affect future operation and maintenance of the telecommunications system, is not decreased and construction costs to the borrower are not substantially increased.

2.5 Cables, suspension stands, lashing wires, etc. should be inspected after installation to ensure that cables, suspension strands, lashing wires, etc. have not be damaged and to verify that proper cable sags and tensions have been maintained

throughout the line. Cables should be checked for damage at severe changes in grade, corners, and corner angles after installation.

2.6 Installation of reel-end splices which may change proposed digital carrier or lightwave repeater locations should be considered for re-routing. Because of the limited deviations allowed in digital carrier or lightwave repeater spacings, all repeatered lines should be constructed first, starting at the central office and advancing in the direction of the repeatered line in a continuous operation to the last repeater point on each repeatered section unless otherwise specified in the contract. Deviations from this procedure should be approved in lieu of holding up the construction project in the event of late cable deliveries, or right-of-way (R/W) difficulties, etc.

2.7 Installation of reel-end splices on loaded lines [When loaded lines are determined by RUS to be economically feasible and the overall system design complies with the Modernization Plan (7 CFR 1751, Subpart B)] which may change proposed load coil locations should be considered for re-routing. Because of the limited deviations allowed in load coil spacings, all loaded lines should be constructed first, starting at the central office and advancing in the direction of the loaded line in a continuous operation to the last load point on each loaded section unless otherwise specified in the contract. Deviations from this procedure should be approved in lieu of holding up the construction project in the event of late cable deliveries, or R/W difficulties, etc.

2.8 Sequential markings on the outer jackets of cables are provided to facilitate proper spacing of digital carrier or lightwave repeater housings, load coils [When loaded lines are determined by RUS to be economically feasible and the overall system design complies with the Modernization Plan (7 CFR 1751, Subpart B)], but should not be used for the inventory of cable units. The inventory of aerial cable units should be based on span length measurements. The resident engineer and the contractor should agree on the inventory of aerial plant units as they are installed. Construction drawings should be appropriately marked so they can be used as permanent records of all plant items.

2.9 Aerial splices and cases for filled copper cables should be inspected to verify that:

a. Jackets have been properly prepared;

b. Conductors have been properly spliced;

c. Shields have been bonded and grounded; and

d. Aerial splice cases have been properly installed.

2.10 Aerial splices and filled aerial cases for filled fiber optic and filled, self-supporting fiber optic cables should be inspected to verify that:

a. Jackets have been properly prepared;

b. Optical fibers have been properly spliced;

c. Buffer tubes containing the optical fibers have a sufficient amount of slack;

d. Armors of armored, filled fiber optic cables have been bonded and grounded;

e. Encapsulating compounds have been properly mixed and applied; and

f. Aerial filled splice cases have been properly installed.

2.11 Ready-access cases and fixed count and pole mounted terminals for filled copper cables should be inspected to verify that:

a. Jackets have been properly prepared;

b. Cable conductors have been properly spliced;

c. Cable shields have been bonded and grounded;

d. Aerial service wires have been properly terminated; and

e. Ready-access cases and fixed count and pole mounted terminals have been properly installed.

2.12 Construction drawings should be accurately marked to indicate the following:

a. Routing of cables;

b. Class and length of each pole;

c. Location of each pole and anchor;

d. Pole numbers;

e. Span lengths;

f. Suspension strand size for each copper or fiber optic cable;

g. Lengths, pair sizes, gauges, and types of copper cables;

h. Lengths, number and types of optical fibers, and types of fiber optic cables;

i. Locations of aerial splice cases, fixed count or pole mounted terminals;

j. Locations of slack splicing loops and aerial filled splice cases for fiber optic cables;

k. Final sag and tension of copper or fiber optic cables;

l. Separation in feet or meters between telecommunications cables and foreign cables (such power, coax, etc.) on joint occupancy construction;

m. Locations of load coils [When loaded lines are determined by RUS to be economically feasible and the overall system design complies with the Modernization Plan (7 CFR 1751, Subpart B)];

n. Locations of digital carrier or lightwave repeater housings; and

o. Locations of other aerial utilities or obstacles.

This should facilitate future reinforcements which may be required on the project.

2.13 For copper cable aerial construction projects, aerial splice cases, labor, and other materials associated with the installation of reel-end splices are included in the CW assembly unit. Therefore, such splice cases are not covered in the final inventory for compensation purposes. Although the splice cases are not inventoried, all splice cases and cable lengths should be shown on the construction drawings for future reference. Construction drawings should also indicate the location of all aerial splice cases that were installed for the purpose of repairing cable damage that occurred during construction.

2.14 For fiber optic cable aerial construction projects, the CO and CFO assembly units do not include filled, aerial splice cases, labor, and other materials associated with the installation of reel-end splices. Therefore, such splice cases should be covered in the final inventory for compensation purposes. All aerial filled splice cases and cable lengths should be shown on the construction drawings for future reference. Construction drawings should also indicate the location of all filled, aerial splice cases that were installed for the purpose of repairing cable damage that occurred during construction.

2.15 The aerial construction route should be cleared to a width that will allow for passage of the cable and placing equipment. The responsibilities in regards to obtaining, operating on, clearing obstructions (trees, bush, etc.), disposal of debris and restoration of public and private R/W, including any compensations are defined in RUS Bulletin 345-153, Specifications and Drawings for Construction of Pole Lines, Aerial Cables and Wires (RUS Form 515f).

2.16 In addition to the recommendations given in this bulletin, installation of the aerial plant telecommunications cables should also be performed in accordance with the requirements of the latest edition of the NESC or Federal, State, or local codes. Where Federal, State, or local codes are more stringent than the NESC, the installation of the aerial telecommunications cables should be performed in accordance with the more stringent codes.

3. SUSPENSION STRAND STRINGING

3.1 The suspension strand usually will be supplied on a reel. To allow removal of the suspension strand from the reel, the reel should be supported using one of the following methods:

a. Pay-out frames;

b. Strand reel jacks;

c. Strand reel hangers; or

d. Cable reel jacks.

3.2 The suspension strand’s maximum practicable length should be payed-out in one pull. The length of the strand payed-out using the one pull method will depend on the following items:

a. Changes in grade;

b. Interference from trees, other cables, etc.; or

c. The number of corners and the corner angles.

3.3 When cutting of the suspension strand is required for placement of the strand, first wrap a double layer of friction tape around the strand for a length of 3.0 in. (76 mm) to prevent the spreading of individual strand wires and/or flying of metal particles. Then cut the stand at the mid-point along the tape. The strand should be cut using either a strand cutter or a hacksaw. Other methods and safety precautions for cutting the suspension strand may be used provided agreement is obtained between the contractor and resident engineer.

3.4 Factory splices in the strand from the manufacturer are be marked with a band of paint in accordance with 7 CFR 1755.370, RUS Specification for Seven Wire Galvanized Steel Strand. Such splices should not be bent around strand connectors, eye bolts, or at small radius bends.

3.5 Stringing of suspension strands for lashed filled copper or fiber optic cables should begin only after the guying of utility poles has been completed in a section of line.

3.6 The suspension strands should be placed on utility poles using one of the following methods:

a. Raising the strand from ground level up to the suspension clamps on the poles. This method should be used when no obstructions exist such as cables, guys, trees, etc.;

b. Placement of strand through the strand grooves of the suspension clamps. The clamp nuts should be tightened only enough to hold the strand in the clamp groove. This is to avoid binding of the strand during the pull-in or tensioning operation;

c. Placement of strand over the nut which is between the suspension clamp and the pole. The strand should be placed in the clamp groove at every fifth or sixth pole in straight sections of line and also where there is a high point or a dip. The clamps where the strand is placed in the grooves should have the clamp nuts tightened as stated in Item b of Paragraph 3.6; or

d. Placement of strand over drive hooks or nails driven into the poles at or below the expected height of the cable through bolts. If hooks are used, the hooks should be driven into the poles leaving only space enough between the hooks and the poles to permit slipping the strand in the hooks. As stated in Item c of Paragraph 3.6, the strand should be placed in the clamps at every fifth or sixth pole. The hooks should be removed after the through bolts have been placed and the strand has been placed in the clamps.

3.7 Where it is necessary to place the suspension strand above secondary power wires (not primaries), above guy wires to a power line on separate poles, or over highways, the strand should be installed between the poles using the rope method. This method consists of installing a rope containing rope loops or cable rings between the poles. The suspension strand is then placed in loops or rings to support the strand between the poles. The diameter of the rope should not be less than 0.5 in. (13.0 mm). The rope between the poles should remain in place until the strand has been tensioned and deadended.

3.8 Where there is a possibility of the strand coming in contact with the power wires during stringing or tensioning, the strand should be held in place with ropes having diameters equal to or greater than 0.37 in. (9.4 mm).

3.9 Where a cable diminishes in size and a smaller size of suspension strand could be used for the smaller cable it is more practical to continue to string the larger size strand rather than make a strand connection to the smaller size strand, if the extension beyond the diminishing point is equal to or less than 1,000 ft (305 m). A false deadend should be placed on the larger strand size and guyed as shown on Guide Drawing 211 of RUS Bulletin 345-153 (RUS Form 515f).

3.10 The stringing of the suspension strand on joint occupancy poles should be performed in accordance with the latest edition of the NESC.

4. SUSPENSION STRAND SPLICES

4.1 Two methods are available for splicing suspension strands. The first method uses guy clamps and strand connectors. The guy clamp method is shown on Guide Drawing 204 of RUS Bulletin 345-153 (RUS Form 515f).

4.2 The second method uses terminating devices that are rated to develop the strength of the appropriate suspension strand being used in the construction project. These devices are available in sizes for splicing two strands of the same size and for splicing 6M to 10M strands or 10M to 16M strands. These terminating devices should be used over the clamp method because the devices eliminate the cutting and clamping of lashing wires at strand splices. These devices are also more economical from the standpoint of material and labor costs.

4.3 Splicing of support strands of filled, self-supporting fiber optic cables should be made using insulated automatic type splicing sleeves. It is important that only enough insulation be removed from the support member to properly install the splicing sleeves.

5. SUSPENSION STRAND TENSIONING

5.1 The ambient air temperature at the time of strand tensioning should not be taken in direct sunlight because the hot sunlight will increase the strand temperature above that in an adjacent shaded area. The tension required for the shade temperature, if applied to the strand at the hotter temperature, will result in some tension increase when the strand cools. However, this has been taken into consideration in the sag and tension tables.

5.2 The initial strand tension required depends on the suspension strand size, the temperature at which the strand is tensioned, and on the average span length. There is a definite tension for each strand size for each average span length at each temperature. The initial tension and sag data for the installation of only the 6M, 10M, and 16M Extra High Strength Galvanized Steel (EHS) suspension strands at various temperatures and average span lengths are given in Tables 1, 2, and 3.

TABLE 1
6M EHS Suspension Strand
Initial Installation Tensions and Sags

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
Ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	1390	1	1290	1	1197	2	1100	2	999	2	898	2
150	1388	3	1292	3	1196	3	1100	4	1001	4	902	4
200	1385	5	1290	5	1195	6	1100	6	1002	7	905	8
250	1380	8	1288	9	1194	9	1100	10	1004	11	910	12
300	1375	11	1285	13	1192	14	1100	14	1006	16	915	18
350	1369	16	1281	17	1190	19	1100	20	1008	22	920	24
400	1364	21	1277	23	1188	24	1100	26	1012	21	925	32
450	1357	27	1271	29	1186	31	1100	33	1015	36	931	39
500	1349	34	1265	36	1182	39	1100	42	1018	45	936	48
550	1342	41	1260	43	1179	46	1100	50	1020	53	942	58
600	1334	49	1253	52	1175	55	1100	59	1024	63	947	67
650	1328	57	1248	61	1172	65	1100	69	1028	73	954	71
700	1322	67	1245	71	1171	76	1100	80	1031	86	961	92
750	1316	78	1242	83	1170	88	1100	93	1033	99	969	105

TABLE 2
10M EHS Suspension Strand
Initial Installation Tensions and Sags

Span Length Ft	Installation Temperature °F											
	0		20		40		60		80		100	
	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.
100	2476	1	2320	1	2163	1	2000	1	1833	2	1665	2
150	2471	3	2316	3	2161	3	2000	3	1836	4	1671	4
200	2466	5	2312	5	2159	6	2000	6	1839	7	1683	7
250	2461	8	2308	8	2156	9	2000	10	1842	10	1683	11
300	2456	11	2303	12	2153	13	2000	14	1845	15	1689	16
350	2450	15	2298	16	2149	17	2000	19	1848	20	1696	22
400	2442	20	2293	21	2145	23	2000	25	1851	27	1703	28
450	2432	26	2287	27	2142	29	2000	31	1854	34	1710	36
500	2422	32	2281	33	2139	36	2000	38	1858	41	1717	45
550	2412	38	2274	41	2136	43	2000	46	1862	50	1724	53
600	2402	46	2267	48	2133	51	2000	55	1866	59	1732	64
650	2392	54	2260	57	2130	62	2000	65	1870	69	1740	74
700	2382	63	2253	67	2127	71	2000	75	1874	80	1749	86
750	2372	72	2246	77	2123	81	2000	86	1879	92	1759	98
800	2362	83	2239	88	2119	93	2000	98	1884	105	1769	111
850	2351	94	2232	99	2115	105	2000	111	1889	117	1779	124
900	2340	107	2225	112	2111	110	2000	125	1894	131	1790	139

TABLE 3
16M EHS Suspension Strand
Initial Installation Tensions and Sags

Installation Temperature °F												
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	4666	1	4380	1	4093	1	3800	2	3494	2	3181	2
150	4661	3	4376	3	4091	3	3800	3	3497	4	3186	4
200	4655	5	4372	5	4089	6	3800	6	3500	7	3192	7
250	4648	8	4367	8	4087	9	3800	10	3504	11	3199	11
300	4639	12	4361	12	4084	13	3800	14	3508	15	3207	17
350	4629	16	4354	17	4080	18	3800	19	3513	21	3217	23
400	4617	21	4346	22	4076	23	3800	25	3518	27	3229	29
450	4603	26	4337	28	4071	30	3800	32	3524	34	3242	37
500	4588	33	4327	35	4066	37	3800	39	3530	42	3256	46
550	4572	39	4317	41	4060	44	3800	47	3536	51	3271	54
600	4555	47	4303	50	4054	53	3800	57	3544	60	3287	65
650	4537	56	4291	59	4047	63	3800	67	3552	71	3304	76
700	4518	65	4278	68	4040	72	3800	77	3560	82	3321	88
750	4498	74	4264	78	4032	82	3800	87	3569	93	3339	99
800	4477	85	4249	90	4024	95	3800	100	3578	106	3358	113
850	4455	97	4233	102	4015	108	3800	114	3588	120	3379	127
900	4432	109	4216	115	4006	121	3800	127	3598	134	3401	142
950	4408	122	4199	129	3996	135	3800	142	3609	149	3424	157
1000	4383	137	4181	143	3986	150	3800	158	3621	165	3448	173

5.3 Tables 4, 5, and 6 indicate the maximum span length for 6M, 10M, and 16M EHS suspension strands with aerial cable lashed to the suspension strands for each storm loading district as defined in the latest edition of the NESC.

TABLE 4
Maximum Span Lengths by Loading Districts
6M EHS Strand with Aerial Cable Lashed to Strand

Cable Weight	Maximum Span Lengths ft (m)		
Lb/ft (kg/m)	Heavy	Medium	Light
0.2 (0.3)	500 (152)	750 (229)	750 (229)
0.4 (0.6)	400 (122)	600 (183)	725 (221)
0.6 (0.9)	325 (99)	475 (145)	575 (175)
0.8 (1.2)	300 (91)	425 (129)	500 (152)
1.0 (1.5)	250 (76)	375 (114)	425 (129)
1.2 (1.8)	225 (68)	325 (99)	375 (114)
1.4 (2.1)	225 (68)	300 (91)	350 (107)
1.6 (2.4)	200 (61)	275 (84)	300 (91)
1.8 (2.7)	200 (61)	250 (76)	300 (91)
2.0 (3.0)	175 (53)	225 (68)	275 (84)

TABLE 5
Maximum Span Lengths by Loading Districts
10M EHS Strand with Aerial Cable Lashed to Strand

Cable Weight Lb/ft (kg/m)	Maximum Span Lengths ft (m) Heavy	Medium	Light
0.4 (0.6)	625 (190)	800 (244)	900 (274)
0.6 (0.9)	550 (168)	750 (229)	875 (267)
0.8 (1.2)	475 (145)	675 (206)	775 (236)
1.0 (1.5)	425 (129)	600 (183)	700 (213)
1.2 (1.8)	400 (122)	550 (168)	625 (190)
1.4 (2.1)	350 (107)	500 (152)	575 (175)
1.6 (2.4)	325 (99)	450 (137)	525 (160)
1.8 (2.7)	300 (91)	425 (129)	475 (145)
2.0 (3.0)	300 (91)	400 (122)	450 (137)
2.2 (3.3)	275 (84)	375 (114)	425 (129)
2.4 (3.6)	275 (84)	350 (107)	400 (122)
2.6 (3.9)	250 (76)	325 (99)	375 (114)
2.8 (4.2)	250 (76)	300 (91)	350 (107)
3.0 (4.5)	225 (68)	300 (91)	325 (99)
3.2 (4.8)	225 (68)	275 (84)	325 (99)
3.4 (5.0)	200 (61)	275 (84)	325 (99)
3.6 (5.3)	200 (61)	250 (76)	275 (84)
3.8 (5.6)	200 (61)	250 (76)	275 (84)
4.0 (5.9)	175 (53)	225 (68)	250 (76)
4.2 (6.2)	175 (53)	225 (68)	250 (76)
4.4 (6.5)	175 (53)	225 (68)	250 (76)
4.6 (6.8)	175 (53)	200 (61)	225 (68)
4.8 (7.1)	175 (53)	200 (61)	225 (68)
5.0 (7.4)	150 (46)	200 (61)	225 (68)

TABLE 6
Maximum Span Lengths by Loading Districts
16M EHS Strand with Aerial Cable Lashed to Strand

Cable Weight lb/ft (kg/m)	Maximum Span Lengths ft (m) Heavy	Medium	Light
1.0 (1.5)	750 (229)	1000 (305)	1000 (305)
1.5 (2.2)	625 (190)	825 (251)	925 (282)
2.0 (3.0)	575 (175)	700 (213)	775 (236)
2.5 (3.7)	475 (145)	600 (183)	675 (206)
3.0 (4.5)	425 (129)	525 (160)	575 (175)
3.5 (5.2)	375 (114)	450 (137)	525 (160)
4.0 (5.9)	350 (107)	425 (129)	475 (145)
4.5 (6.7)	325 (99)	375 (114)	425 (129)
5.0 (7.4)	300 (91)	350 (107)	375 (114)

5.4 A dynamometer should be used rather than sag measurements in suspension strand tensioning because strand sag is difficult to accurately measure. Shunt type dynamometers are more useful than tension type dynamometers because the shunt type dynamometers can also be used to test the tension of the strand after the strand as been installed. Dynamometer measurements should be made in

accordance with the manufacturer's instructions. Tension readings should made as indicated in Figure 1. The oscillation method for determining the strand tension should not be used.

5.5 The suspension strand should be tensioned using either a strand puller attached to a winch line or by a block and tackle. The tension should be slowly applied while the entire length of the strand being installed is observed for evidence of snagging or failure to slip through its temporary attachments at poles. The strand puller jaws should be kept free of oil, grease, etc. to prevent slippage.

5.6 The strand should be anchored at a deadend pole before the first section of strand is tensioned and terminated by the use of boltless guy clamps. Successive pulls should be made from the end of the first pull. If there is a possibility that the strand and cable may be extended beyond a deadend pole, a 3 ft (1 m) tail of suspension strand should be left beyond the deadend pole to allow for extension of the strand using a strand sleeve. A 6.0 in. (152 mm) suspension strand tail should be left at all other locations. The ends of the suspension strand tails should be secured using either stainless lashing wire wrapped around the strand or by guy wire clips. Guy wire clips are available in sizes to fit 6M, 10M, and 16M EHS suspension strands.

5.7 Dampers to protect the suspension strand from fatigue failure should be used when the cable is not immediately installed. For this purpose a piece of bridle wire may be installed along the top of the suspension clamp and wrapped around the strand extending 2 ft (607 mm) in both directions with the ends of the bridle wire sealed. Other methods of protecting the strand from fatigue failure may be used if allowed by the borrower.

6. CABLE INSTALLATION AND LASHING

6.1 Direct lashing of filled copper or fiber optic cables to suspension strands should be accomplished by either the moving reel or stationary reel method.

6.2 The moving reel method consists of a cable reel trailer and a towing vehicle. This method is preferred over the stationary reel method because of its faster installation time. This method should be used when the terrain along the side of the pole line on which the cable is to be installed is free of obstructions such as trees, guys, etc., which would prevent raising the cable to the strand. When using this method the pulling tension and bending radius of filled fiber optic cables should be in accordance with the manufacturer's recommendations. If not specified by the fiber optic cable manufacturer, the maximum pulling tension should not exceed 600 lbf (2,669 N) and minimum bending radius should not be less than 20 times the outside

diameter of the cable. Also when using this method, the bending radius of filled copper cables should be in accordance with the manufacturer's recommendations. If not specified by the copper cable manufacturer, the minimum bending radius should not be less than 10 times the outside cable diameter. Figure 2 depicts the moving reel method of installation.

6.3 The stationary reel method, which is depicted in Figure 3, consists of a cable reel, a suitable device for supporting the cable reel, and rollers attached to the strand to support the cable during the installation. When using the stationary reel method the pulling tension and bending radius of filled fiber optic cables and the bending radius of filled copper cables should be in accordance with Paragraph 6.2. Rollers used in the stationary reel method should be installed on the strand at various spacings depending on the weight of the cable. The roller spacing versus the cable weight that should be used with the stationary reel method is given in Table 7. Rollers should also be installed at all bends in excess of 45 degrees from normal.

TABLE 7
Roller Spacing Versus Cable Weight

Cable Weight lb/ft (kg/m)	Maximum Spacing ft (m)
1.0 (1.5) or less	35 (10.7)
1.5 (2.2)	33 (10.0)
2.0 (3.0)	25 (7.6)
2.5 (3.7)	20 (6.1)
3.0 (4.5)	16 (4.9)
3.5 (5.2)	14 (4.3)
4.0 (5.9)	12 (3.6)
4.5 (6.7)	10 (3.0)
5.0 (7.4) and greater	8 (2.5)

6.4 The cable should be pulled over the rollers in the stationary reel method using either a winch line, wire rope approximately 0.25 in. (6.4 mm) in diameter, or manila rope approximately 0.5 in. (12.7 mm) in diameter.

6.5 Because filled fiber optic cables are typically manufactured and installed in longer lengths than filled copper cables, special consideration should be given to reel placement to eliminate the need of figure-eighting the cable and a series of mid-assist pulls for both the moving and stationary reel installation methods.

6.6 Lashing machines are manufactured in several sizes. The size of the lashing machine used on the construction project should be based on the outside diameter of the cable to be installed on the project. The lashing machine should wrap the lashing wire around the cable and suspension strand in the

counterclockwise direction. Where grades in construction are encountered, the lashing of the cable to the strand should be performed in the downhill direction.

6.7 Stainless steel lashing wire should be used to lash cables to the suspension strand on aerial plant construction projects. The diameter of the lashing wire used on the construction project should be based on the outside diameter and weight of the cable to be installed and the size of the lashing machine.

6.8 Two types of lashing wire clamps are necessary in lashing cables to strands. The first type is a temporary clamp having a handle for opening and closing the clamp jaws. The second type is known as the permanent clamp. Temporary clamps are removed after the permanent clamps are installed. Guide drawings in RUS Bulletin 345-153 (RUS Form 515f) show how lashing wires are clamped in various situations. Lashing wire should be clamped at each side of each utility pole.

6.9 Lashing wires should be spliced using stainless steel compression sleeves for the appropriate sizes.

6.10 When filled copper or fiber optic cables are lashed at temperatures below 30°F (-1.1°C), the cables should be tensioned more than is usual at higher temperatures. This should prevent bowing in hot weather by causing cables to be lashed snugly against the strand.

6.11 When required because of construction constraints, etc., two filled copper or fiber optic cables may be lashed to the same suspension strand or a new filled copper or fiber optic cable may be lashed over an existing cable to the same strand. The combined diameters of the two cables can not exceed the diameter for which the lashing machine was designed.

6.12 In order to promote firm lashing when lashing two filled copper or fiber optic cables to the same strand, the diameter of first cable should not be more than twice the diameter of the second cable.

6.13 If the diameter of a filled copper cable or of two filled copper cables exceeds 2.0 in. (51 mm), two nuts should be placed between the suspension clamp and washer to provide clearance between the pole and cables.

6.14 Before lashing new filled copper or fiber optic cable to an existing cable on the same strand, the existing lashing wire should be examined for corrosion, pitting, breakage, sharp points or edges, etc. which could damage the new cable during installation. If the existing lashing wire is found to be severely corroded or pitted, broken, or containing sharp points

or edges, the existing lashing wire should be removed before installation of the new cable. However, it is generally not necessary to remove the existing lashing wire.

7. SELF-SUPPORTING, FILLED, FIBER OPTIC CABLE INSTALLATION

7.1 Installation of self-supporting, filled, fiber optic cables should begin only after the guying of utility poles has been completed in a section of line.

7.2 Self-supporting, filled, fiber optic cables should be installed using the moving reel method whenever possible. The cable should be placed in stringing rollers on the poles where it should remain during the remainder of the placing and tensioning operations. When using this installation method the maximum pulling tension and minimum bend radius of the self-supporting, filled, fiber optic cable should not exceed the manufacturer's recommendations.

7.3 Where it is necessary, because of physical obstructions, to install self-supporting, filled, fiber optic cables using the stationary reel method, cables should be strung through rollers under a sufficient amount of tension to avoid excessive bending and to prevent cables from contacting the ground or obstructions between poles. The rollers should be spaced as indicated in Table 7 of Paragraph 6.3. When using this installation method the maximum pulling tension and minimum bend radius of the self-supporting, filled fiber optic cable should not exceed the manufacturer's recommendations. Care should be exercised to prevent continuous spiraling occurring in self-supporting, filled fiber optic cables when installed using the stationary reel method. Since the cable is spiraled by hand from alternate poles after the cable has been tensioned, any existing spirals in the cable would be increased in one span and removed in the adjacent span. It would then be very difficult to obtain a uniform number of spirals in every span.

7.4 Self-supporting, filled, fiber optic cables should be tensioned with the aid of series dynamometers. The cable should be temporarily supported at each pole in rollers until after the cable has been tensioned and the tensioned equalized in all spans of the section being tensioned. Tension should be applied slowly while the entire length of cable being installed is observed for evidence of snagging or failure to move freely through its temporary supports at the poles.

7.5 The initial stringing tension for self-supporting, filled, fiber optic cables will depend on the size of its support strand, the size of cable core, the NESC storm loading district for the construction project, the maximum permissible span length, temperature at the time of tensioning, and the cable manufacturer's recommendations.

7.6 When tensioning self-supporting, filled, fiber optic cables, the insulation over the support strand should not be damaged. Tensioning by means of grips placed over the insulated support strand is the preferred method, provided that the tensioning can be accomplished without rupturing the insulation.

7.7 The initial sags and tensions for self-supporting, filled, fiber optic cables installed at various span lengths and temperatures in the three NESC storm loading districts should be obtained from the fiber optic cable manufacturer.

8. SAG AND TENSION OF INSTALLED FILLED CABLES

8.1 The sag and tension in a strand and a filled copper or fiber optic cable after their installation depends on the installation temperature, strand size, cable weight on a per foot basis, and the span length. The above information is known as the “initial” cable sag and tension.

8.2 The initial sags and tensions for filled copper cables installed on 6M, 10M, and 16M EHS suspension strands at various span lengths and temperatures are given in Tables 8 through 50.

TABLE 8
Initial Sag and Tension
6M EHS Suspension Strand Supporting
Cable Weighing 0.2 lb/ft for
Heavy, Medium, and Light Loading Districts

Span Length ft	Installation Temperature °F											
	0		20		40		60		80		100	
	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.
100	1409	3	1317	4	1222	4	1127	4	1032	5	936	5
125	1415	5	1326	6	1232	6	1138	7	1046	7	956	8
150	1423	8	1337	8	1246	9	1154	10	1064	10	980	11
175	1435	11	1352	12	1263	12	1175	13	1088	14	1005	15
200	1448	14	1366	15	1280	16	1196	17	1113	19	1030	20
225	1462	18	1382	18	1298	20	1217	21	1137	23	1056	24
250	1476	22	1382	22	1317	24	1239	26	1161	27	1082	30
275	1490	26	1414	27	1336	28	1261	30	1184	32	1107	34
300	1505	30	1431	31	1355	33	1282	35	1207	37	1132	39
325	1521	34	1447	36	1374	38	1303	40	1230	43	1157	45
350	1536	39	1466	41	1393	43	1325	46	1253	48	1184	51
375	1553	45	1484	47	1413	49	1347	51	1276	54	1209	57
400	1569	50	1503	52	1432	55	1467	58	1299	60	1235	63
425	1586	56	1522	58	1453	61	1388	64	1323	67	1261	70
450	1604	62	1541	65	1472	68	1410	71	1346	74	1286	77
475	1621	69	1559	71	1493	74	1431	78	1369	81	1311	85
500	1639	75	1578	78	1513	81	1453	85	1392	88	1336	92
525	1657	82	1597	85	1533	88	1474	92	1414	96	1360	100
550	1677	88	1615	92	1554	95	1495	99	1437	103	1384	107
575	1695	95	1634	99	1574	103	1515	107	1459	111	1407	115
600	1713	103	1653	107	1594	111	1536	115	1482	119	1430	124
625	1730	111	1671	115	1614	119	1556	123	1504	128	1453	132
650	1746	119	1689	123	1633	127	1576	132	1525	136	1475	141
675	1763	127	1707	131	1653	135	1596	140	1546	145	1497	150
700	1779	135	1725	140	1672	144	1616	149	1567	154	1518	159
725	1795	144	1743	148	1690	153	1636	158	1586	163	1539	168
750	1811	152	1759	157	1708	162	1656	167	1605	172	1559	178

TABLE 9
Initial Sag and Tension
6M EHS Suspension Strand Supporting
Cable Weighing 0.4 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	1430	5	1344	6	1258	6	1169	7	1080	7	994	8
125	1455	8	1372	9	1288	9	1203	10	1119	11	1037	12
150	1482	12	1402	12	1319	13	1239	14	1160	15	1082	16
175	1510	16	1432	17	1352	18	1275	19	1201	20	1127	21
200	1540	20	1464	21	1386	23	1313	24	1243	25	1172	27
225	1570	25	1497	26	1423	28	1353	29	1285	31	1218	32
250	1602	31	1531	32	1461	33	1393	35	1328	37	1264	38
275	1635	37	1566	38	1499	40	1434	41	1371	43	1309	45
300	1668	43	1602	44	1537	46	1474	48	1413	50	1353	52
325	1703	49	1638	51	1576	53	1515	55	1455	57	1397	60
350	1737	56	1675	58	1614	60	1555	62	1496	65	1441	67
375	1773	63	1712	65	1652	67	1594	70	1537	72	1483	75
400	1809	70	1751	72	1692	75	1635	77	1578	80	1525	83
425	1843	77	1786	80	1728	83	1672	85	1617	88	1565	91
450	1875	85	1821	88	1764	91	1709	94	1655	97	1604	100
475	1909	93	1855	96	1799	99	1745	102	1692	105	1643	109
500	1943	101	1889	104	1834	108	1782	111	1729	114	1680	118
525	1975	110	1922	113	1868	116	1817	120	1766	123	1717	127
550	2007	119	1955	122	1903	126	1852	129	1802	133	1754	137
575	2039	128	1988	132	1936	135	1886	139	1837	143	1790	146
600	2071	138	2020	141	1970	145	1921	149	1873	153	1825	156
625	2102	147	2053	151	2003	154	1955	159	1907	163	1860	168
650	2133	157	2084	161	2035	164	1988	169	1941	173	1895	177
675	2163	167	2116	171	2067	175	2021	179	1975	183	1929	188
700	2194	177	2147	181	2099	185	2053	189	2008	194	1963	198
725	2224	187	2177	191	2131	195	2086	200	2041	205	1997	209

TABLE 10
Initial Sag and Tension
6M EHS Suspension Strand Supporting
Cable Weighing 0.6 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	1473	7	1386	8	1306	8	1225	9	1142	10	1062	10
125	1520	12	1437	13	1359	13	1283	14	1205	15	1128	16
150	1567	17	1489	18	1414	19	1341	20	1267	21	1194	22
175	1615	23	1540	24	1467	25	1398	26	1327	27	1257	28
200	1663	28	1592	29	1521	30	1454	32	1387	33	1321	35
225	1711	34	1643	35	1574	36	1511	38	1447	40	1383	41
250	1758	40	1694	41	1629	43	1566	44	1504	46	1444	48
275	1806	46	1744	48	1681	49	1621	51	1563	53	1506	55
300	1853	53	1794	55	1676	59	1648	68	1619	61	1566	63
325	1901	61	1844	63	1728	67	1701	69	1674	71	1621	73
350	1948	69	1892	71	1782	75	1756	76	1729	77	1676	80
375	1996	77	1943	79	1833	83	1808	85	1782	86	1732	88
400	2044	85	1992	88	1939	90	1886	92	1835	95	1785	98
425	2091	94	2039	96	1986	99	1935	102	1886	104	1837	107
450	2138	103	2087	106	2035	108	1986	111	1938	114	1890	117
475	2186	112	2135	115	2084	118	2036	121	1988	124	1941	127
500	2233	122	2182	125	2132	128	2085	131	2039	134	1993	137
525	2278	132	2228	135	2179	138	2133	141	2087	144	2041	147
550	2323	142	2275	145	2227	149	2182	152	2136	155	2090	158
575	2367	153	2320	156	2273	159	2228	162	2184	166	2140	170

TABLE 11
Initial Sag and Tension
6M EHS Suspension Strand Supporting
Cable Weighing 0.8 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	1520	9	1442	10	1362	10	1284	11	1207	11	1133	12
125	1585	13	1510	14	1434	15	1360	16	1287	16	1218	17
150	1648	19	1577	19	1505	20	1435	21	1365	22	1302	23
175	1712	24	1643	26	1575	27	1509	28	1443	29	1380	30
200	1775	31	1709	32	1644	33	1582	35	1518	36	1455	37
225	1837	38	1775	39	1713	41	1653	42	1594	44	1540	45
250	1899	46	1842	47	1782	49	1725	50	1668	52	1618	54
275	1963	54	1907	55	1849	57	1793	59	1741	60	1692	62
300	2026	62	1973	64	1917	66	1863	67	1811	69	1761	71
325	2089	71	2038	72	1983	74	1931	76	1882	78	1834	81
350	2151	79	2102	81	2049	83	1999	86	1950	88	1903	90
375	2213	88	2164	91	2113	93	2065	95	2017	97	1970	100
400	2275	98	2227	100	2178	103	2131	105	2083	107	2036	110
425	2334	107	2288	110	2241	112	2194	115	2147	117	2100	120
450	2394	117	2347	120	2300	123	2225	125	2210	128	2163	131
475	2453	128	2407	131	2360	133	2322	136	2271	139	2225	142
500	2512	139	2466	141	2419	144	2375	147	2331	150	2287	153

TABLE 12
Initial Sag and Tension
6M EHS Suspension Strand Supporting
Cable Weighing 1.0 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	1567	11	1492	11	1419	12	1351	12	1278	13	1211	14
125	1650	16	1579	16	1510	17	1443	18	1375	19	1310	20
150	1733	21	1664	22	1598	23	1534	24	1470	25	1408	26
175	1814	28	1747	29	1685	30	1623	31	1564	33	1504	34
200	1895	35	1831	36	1770	38	1712	39	1656	40	1599	42
225	1974	43	1912	44	1854	46	1800	47	1745	49	1691	50
250	2052	51	1992	53	1937	54	1889	56	1832	58	1781	59
275	2128	60	2070	62	2018	64	1967	65	1915	67	1867	69
300	2204	70	2148	71	2098	73	2048	75	1998	77	1951	79
325	2277	79	2225	81	2176	83	2132	85	2079	87	2033	89
350	2351	89	2301	91	2253	93	2205	95	2158	97	2113	99
375	2424	99	2375	101	2328	103	2281	105	2235	108	2191	110
400	2495	109	2449	112	2402	114	2356	116	2311	118	2267	121
425	2566	120	2521	122	2476	125	2431	127	2386	129	2343	132

TABLE 13
Initial Sag and Tension
6M EHS Suspension Strand Supporting
Cable Weighing 1.2 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	1625	12	1554	13	1492	13	1415	14	1348	15	1283	16
125	1722	18	1654	18	1588	19	1525	20	1461	21	1398	22
150	1818	24	1754	25	1692	26	1632	27	1570	28	1511	29
175	1912	32	1852	33	1793	34	1735	35	1678	36	1621	37
200	2005	40	1949	41	1892	42	1837	43	1782	44	1731	46
225	2097	48	2043	49	1988	51	1934	52	1882	53	1833	55
250	2189	57	2137	58	2085	60	2033	61	1982	63	1934	65
275	2279	66	2229	68	2179	69	2130	71	2080	73	2033	74
300	2369	76	2321	77	2273	79	2224	81	2175	83	2128	85
325	2457	86	2410	88	2363	89	2315	91	2268	93	2221	95
350	2545	96	2498	98	2452	100	2406	102	2359	104	2312	106
375	2629	107	2583	109	2536	111	2492	113	2446	115	2400	117

TABLE 14
Initial Sag and Tension
6M EHS Suspension Strand Supporting
Cable Weighing 1.4 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	1682	14	1613	14	1547	15	1483	15	1418	16	1353	17
125	1793	20	1727	20	1665	21	1605	22	1544	23	1483	24
150	1903	27	1841	28	1782	29	1725	30	1669	31	1611	32
175	2012	35	1953	36	1897	37	1844	38	1789	39	1735	40
200	2120	43	2064	44	2010	46	1960	47	1907	48	1854	49
225	2225	52	2171	53	2120	55	2071	56	2020	57	1970	59
250	2329	62	2277	63	2227	65	2180	66	2130	67	2082	69
275	2431	72	2381	73	2333	75	2286	76	2239	78	2192	79
300	2532	82	2483	84	2436	85	2390	87	2344	88	2299	90
325	2630	93	2583	94	2537	96	2494	98	2447	99	2402	101
350	2727	103	2681	105	2636	107	2592	109	2547	111	2502	113

TABLE 15
Initial Sag and Tension
6M EHS Suspension Strand Supporting
Cable Weighing 1.6 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	1742	15	1676	15	1610	16	1547	17	1484	17	1425	18
125	1867	21	1804	22	1742	23	1684	24	1628	25	1572	26
150	1992	29	1933	30	1874	31	1818	32	1766	33	1711	34
175	2114	37	2058	38	2002	39	1950	40	1900	42	1848	43
200	2235	46	2183	47	2130	49	2080	50	2030	51	1982	53
225	2353	56	2302	57	2252	58	2202	59	2153	61	2109	63
250	2470	66	2419	67	2371	68	2323	70	2275	71	2231	73
275	2582	76	2533	78	2487	79	2440	81	2394	82	2348	84
300	2692	87	2644	89	2600	90	2555	92	2510	94	2465	95

TABLE 16
Initial Sag and Tension
6M EHS Suspension Strand Supporting
Cable Weighing 1.8 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	1800	16	1737	17	1678	17	1616	18	1556	19	1497	19
125	1944	23	1884	24	1826	24	1768	25	1710	26	1654	27
150	2085	31	2027	32	1971	33	1914	34	1860	35	1808	36
175	2221	40	2166	41	2114	42	2060	43	2008	44	1857	45
200	2352	49	2302	50	2251	51	2199	52	2150	54	2101	55
225	2479	59	2433	60	2384	61	2334	63	2287	64	2241	66
250	2604	70	2559	71	2512	72	2464	74	2419	75	2375	77
275	2724	81	2680	82	2635	83	2590	85	2545	86	2501	88
300	2843	92	2800	94	2755	95	2711	96	2668	98	2626	100

TABLE 17
Initial Sag and Tension
6M EHS Suspension Strand Supporting
Cable Weighing 2.0 lb/ft for
Heavy, Medium, and Light Loading Districts

Installation Temperature °F												
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	1861	17	1799	18	1738	18	1680	19	1622	20	1566	20
125	2011	24	1954	25	1897	26	1843	27	1789	28	1736	29
150	2160	33	2108	34	2054	35	2002	36	1952	37	1902	38
175	2307	42	2257	43	2207	44	2158	45	2110	46	2062	47
200	2452	52	2406	53	2358	54	2311	55	2264	57	2218	58
225	2593	63	2549	64	2504	65	2457	66	2411	67	2365	69
250	2730	74	2686	75	2642	76	2596	77	2551	79	2506	80
275	2862	84	2820	86	2776	88	2732	89	2688	91	2645	92

TABLE 18
Initial Sag and Tension
10M EHS Suspension Strand Supporting
Cable Weighing 0.4 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	2503	4	2355	4	2200	4	2046	4	1891	5	1733	5
125	2524	6	2379	7	2229	7	2079	8	1929	8	1776	9
150	2547	9	2405	10	2260	10	2115	11	1968	12	1819	13
175	2571	12	2433	13	2293	14	2151	15	2088	16	1863	17
200	2596	16	2461	17	2323	18	2185	19	2047	20	1907	21
225	2622	19	2489	20	2355	21	2221	23	2087	24	1951	25
250	2648	23	2518	24	2386	26	2256	27	2125	29	1995	30
275	2674	27	2547	28	2419	30	2291	32	2163	33	2038	35
300	2700	31	2578	33	2453	35	2327	37	2203	38	2082	41
325	2727	36	2607	38	2486	39	2365	42	2244	44	2126	46
350	2758	40	2640	42	2520	44	2401	47	2283	49	2170	52
375	2787	45	2674	48	2558	50	2443	52	2329	55	2215	57
400	2820	51	2709	54	2596	56	2484	58	2372	61	2260	64
425	2853	57	2743	60	2633	62	2524	65	2414	68	2305	71
450	2885	64	2776	66	2664	69	2563	72	2455	74	2350	78
475	2918	70	2810	73	2705	75	2602	79	2493	82	2394	85
500	2951	77	2844	80	2740	83	2639	86	2537	89	2437	93
525	2983	84	2879	87	2778	90	2678	94	2578	97	2479	101
550	3016	92	2913	95	2814	98	2716	101	2618	105	2522	109
575	3049	99	2947	102	2849	106	2754	110	2659	113	2565	117
600	3082	107	2982	110	2886	114	2791	118	2697	122	2608	126
625	3115	114	3016	118	2918	122	2827	126	2736	130	2651	135
650	3149	122	3051	126	2955	130	2865	134	2776	139	2692	143
675	3179	130	3084	134	2988	139	2901	143	2815	147	2731	152
700	3210	139	3117	143	3023	147	2937	151	2853	156	2771	161
725	3241	147	3150	151	3058	156	2974	160	2891	165	2809	170
750	3272	156	3183	161	3093	165	3011	170	2929	175	2847	180
775	3303	165	3217	170	3128	175	3047	180	2966	184	2885	190
800	3335	175	3251	180	3167	185	3085	189	3004	195	2923	200
825	3366	185	3284	190	3201	195	3120	200	3040	205	2961	210
850	3397	195	3317	200	3235	205	3154	210	3076	215	2998	221
875	3429	205	3351	210	3265	215	3189	221	3115	226	3035	232
900	3461	215	3382	220	3302	226	3223	231	3147	237	3071	243

TABLE 19
Initial Sag and Tension
10M EHS Suspension Strand Supporting
Cable Weighing 0.6 lb/ft for
Heavy, Medium, and Light Loading Districts

Span Length ft	Installation Temperature °F											
	0		20		40		60		80		100	
	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.
100	2533	5	2390	5	2240	5	2089	6	1941	6	1790	7
125	2571	8	2432	8	2287	9	2142	9	1999	10	1853	11
150	2610	11	2475	12	2336	12	2197	13	2057	14	1916	15
175	2648	15	2520	15	2386	15	2250	16	2116	17	1980	17
200	2691	19	2565	20	2434	21	2303	22	2173	23	2042	25
225	2734	23	2609	24	2483	25	2356	27	2231	28	2105	30
250	2776	28	2655	29	2531	31	2409	32	2286	34	2166	35
275	2818	33	2700	34	2581	36	2461	38	2342	39	2226	41
300	2861	38	2747	40	2631	41	2514	43	2398	45	2287	47
325	2905	43	2793	45	2680	47	2567	49	2455	51	2347	54
350	2952	48	2842	51	2730	53	2619	55	2510	58	2406	60
375	2998	55	2891	57	2783	59	2676	62	2570	64	2466	67
400	3046	62	2941	64	2835	66	2731	69	2657	71	2524	74
425	3094	69	2990	71	2887	73	2785	76	2684	79	2583	82
450	3141	76	3038	78	2934	81	2839	84	2739	86	2641	90
475	3188	83	3087	86	2989	89	2892	92	2791	95	2698	98
500	3236	91	3136	94	3039	97	2944	100	2848	103	2755	106
525	3283	99	3186	102	3091	105	2997	108	2903	112	2811	115
550	3331	107	3234	110	3141	114	3049	117	2957	120	2867	124
575	3378	116	3282	119	3190	122	3101	126	3012	130	2923	133
600	3424	124	3331	128	3240	131	3151	135	3063	139	2979	143
625	3470	133	3378	137	3287	140	3201	144	3115	148	3034	152
650	3517	142	3425	146	3336	150	3251	154	3167	158	3087	162
675	3559	151	3470	155	3381	159	3299	163	3217	167	3137	172
700	3602	160	3515	164	3426	168	3346	173	3266	177	3188	181
725	3645	170	3560	174	3474	178	3394	182	3315	187	3237	192
750	3687	180	3604	184	3519	188	3441	192	3363	197	3286	202
775	3729	190	3648	194	3564	199	3487	203	3410	208	3333	213
800	3775	201	3692	205	3612	209	3534	214	3458	219	3381	224
825	3813	211	3735	216	3656	220	3580	225	3504	230	3429	235
850	3855	222	3779	227	3701	231	3624	236	3550	241	3475	247
875	3898	233	3824	238	3743	243	3670	248	3598	253	3522	258

TABLE 20
Initial Sag and Tension
10M EHS Suspension Strand Supporting
Cable Weighing 0.8 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	2563	6	2425	6	2280	6	2132	7	1991	8	1847	8
125	2618	9	2485	9	2345	10	2205	11	2069	12	1930	12
150	2673	13	2545	13	2412	14	2279	15	2146	16	2013	17
175	2727	17	2607	18	2479	20	2349	20	2224	21	2097	23
200	2786	21	2669	23	2545	24	2421	25	2299	27	2177	28
225	2846	27	2729	28	2611	29	2491	31	2375	33	2259	34
250	2904	32	2792	34	2676	35	2562	37	2447	39	2337	40
275	2962	38	2853	40	2743	41	2631	43	2521	45	2414	47
300	3022	44	2916	46	2809	48	2701	50	2593	52	2492	54
325	3083	51	2979	53	2874	55	2769	57	2666	59	2568	61
350	3136	58	3044	60	2940	62	2837	64	2737	66	2642	69
375	3209	65	3108	67	3008	69	2909	72	2811	74	2717	76
400	3272	72	3173	74	3074	77	2978	79	2912	82	2788	84
425	3335	80	3237	82	3141	85	3046	87	2954	90	2861	93
450	3397	88	3300	90	3204	93	3115	96	3023	98	2932	101
475	3458	96	3364	99	3273	102	3182	105	3089	107	3002	110
500	3521	105	3428	108	3338	111	3248	114	3159	117	3073	120
525	3583	114	3493	117	3404	120	3316	123	3228	126	3143	129
550	3646	123	3555	126	3468	129	3382	132	3296	136	3212	139
575	3707	133	3617	136	3531	139	3448	142	3365	146	3281	149
600	3766	142	3680	145	3594	149	3511	152	3429	156	3350	160
625	3825	152	3740	155	3656	159	3575	162	3494	166	3417	170
650	3885	162	3799	165	3717	169	3637	173	3558	177	3482	181
675	3939	172	3856	175	3774	179	3697	183	3619	187	3443	191
700	3994	182	3913	186	3829	190	3755	194	3679	198	3605	202
725	4049	192	3970	196	3890	200	3814	204	3739	209	3665	213
750	4102	203	4025	207	3945	211	3874	216	3797	220	3725	225
775	4155	214	4079	218	4000	223	3927	227	3854	231	3781	236

TABLE 21
Initial Sag and Tension
10M EHS Suspension Strand Supporting
Cable Weighing 1.0 lb/ft for
Heavy, Medium, and Light Loading Districts

Installation Temperature °F												
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	2593	7	2459	7	2319	8	2176	8	2040	9	1903	10
125	2664	10	2537	11	2404	11	2268	12	2138	13	2008	14
150	2736	14	2615	15	2488	16	2360	17	2236	19	2111	20
175	2809	19	2694	20	2572	21	2449	23	2331	24	2213	25
200	2882	24	2772	26	2655	27	2538	29	2425	30	2313	32
225	2957	30	2850	32	2739	33	2627	35	2518	37	2412	39
250	3031	37	2928	39	2822	40	2714	42	2609	44	2509	46
275	3107	44	3007	45	2904	47	2801	49	2699	51	2602	53
300	3183	51	3086	53	2987	55	2887	57	2789	59	2698	61
325	3261	58	3166	60	3069	62	2971	64	2877	67	2789	69
350	3340	66	3246	68	3151	70	3056	73	2965	75	2878	77
375	3419	74	3326	77	3232	79	3141	81	3052	83	2967	86
400	3497	83	3405	85	3313	87	3225	90	3138	92	3053	95
425	3575	91	3484	94	3394	96	3308	97	3223	101	3139	104
450	3652	100	3563	103	3475	105	3390	108	3307	111	3224	113
475	3729	109	3641	112	3556	115	3471	117	3388	120	3306	123
500	3807	119	3720	122	3636	124	3553	127	3471	130	3391	133
525	3883	129	3799	132	3716	135	3634	138	3554	141	3475	144
550	3960	139	3877	142	3795	145	3715	148	3636	151	3558	154
575	4035	149	3953	152	3873	156	3794	159	3717	162	3640	165
600	4108	160	4029	163	3949	166	3872	170	3795	173	3720	176
625	4180	170	4101	174	4024	177	3948	181	3873	184	3799	188
650	4252	181	4174	185	4099	188	4024	192	3950	196	3876	199
675	4319	192	4243	196	4168	199	4094	203	4021	207	3949	211
700	4387	203	4312	207	4237	211	4164	215	4093	218	4022	223

TABLE 22
Initial Sag and Tension
10M EHS Suspension Strand Supporting
Cable Weighing 1.2 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	2639	8	2508	8	2372	9	2234	9	2102	10	1970	11
125	2727	11	2603	12	2474	13	2343	14	2217	15	2093	16
150	2816	16	2698	17	2576	18	2452	19	2332	20	2212	21
175	2905	21	2793	22	2675	23	2555	25	2442	26	2328	27
200	2993	27	2886	28	2773	30	2661	31	2551	33	2443	34
225	3082	34	2978	35	2872	36	2764	38	2659	40	2556	41
250	3170	41	3070	42	2968	44	2865	46	2764	47	2667	49
275	3259	48	3163	50	3064	51	2965	53	2867	55	2773	57
300	3349	56	3255	57	3160	59	3064	61	2969	63	2880	65
325	3440	64	3348	65	3254	68	3160	69	3069	72	2983	73
350	3531	72	3440	74	3349	76	3257	78	3169	80	3084	82
375	3622	81	3532	83	3442	85	3354	87	3367	89	3184	92
400	3712	89	3623	92	3534	94	3449	96	3364	99	3282	101
425	3801	98	3714	101	3627	103	3542	106	3460	108	3379	111
450	3889	108	3803	110	3719	113	3636	115	3555	118	3475	121
475	3977	118	3892	120	3809	123	3727	125	3646	128	3567	131
500	4064	128	3980	130	3899	133	3818	136	3739	139	3661	142
525	4149	138	4069	141	3988	144	3908	147	3831	150	3753	153
550	4235	149	4155	152	4076	155	3998	158	3921	161	3845	164
575	4318	160	4239	163	4161	166	4085	169	4009	172	3934	176
600	4399	171	4322	174	4245	177	4170	181	4095	184	4022	187
625	4479	182	4403	186	4328	189	4255	192	4181	196	4109	199

TABLE 23
Initial Sag and Tension
10M EHS Suspension Strand Supporting
Cable Weighing 1.4 lb/ft for
Heavy, Medium, and Light Loading Districts

Installation Temperature °F												
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	2685	9	2557	9	2425	10	2292	10	2164	11	2038	12
125	2791	13	2670	13	2545	14	2418	15	2296	16	2178	17
150	2896	18	2782	19	2664	19	2544	21	2428	22	2313	23
175	3001	23	2892	24	2779	25	2661	27	2553	28	2444	29
200	3104	30	3000	31	2892	32	2784	34	2677	35	2573	37
225	3207	37	3107	38	3005	39	2901	41	2800	43	2700	44
250	3309	44	3213	46	3115	47	3016	49	2919	51	2825	52
275	3412	52	3319	54	3224	55	3129	57	3035	59	2944	61
300	3515	60	3424	62	3333	64	3241	66	3149	68	3062	69
325	3619	69	3530	71	3439	73	3349	75	3261	77	3178	78
350	3722	78	3634	80	3547	82	3458	84	3373	86	3290	88
375	3825	88	3739	89	3652	91	3567	93	3482	95	3401	97
400	3927	96	3841	98	3755	101	3673	103	3590	105	3511	107
425	4027	106	3944	108	3861	110	3777	113	3697	115	3619	118
450	4126	116	4043	118	3963	121	3882	123	3803	126	3725	128
475	4225	126	4143	129	4062	131	3983	134	3905	136	3828	139
500	4321	137	4211	139	4162	142	4084	144	4007	147	3931	150
525	4416	148	4339	150	4260	153	4183	156	4108	159	4032	161
550	4510	159	4433	162	4357	165	4281	167	4206	170	4132	173
575	4601	171	4525	174	4449	177	4376	180	4302	182	4229	186

TABLE 24
Initial Sag and Tension
10M EHS Suspension Strand Supporting
Cable Weighing 1.6 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	2731	9	2606	10	2479	11	2350	11	2227	12	2106	13
125	2855	14	2737	15	2616	15	2493	16	2375	17	2263	18
150	2976	19	2866	20	2752	21	2636	22	2524	23	2414	24
175	3097	25	2991	27	2883	27	2768	29	2664	30	2560	31
200	3215	32	3114	34	3011	35	2907	36	2803	38	2703	39
225	3332	40	3236	41	3138	42	3038	44	2941	46	2844	47
250	3448	48	3356	49	3262	51	3167	53	3074	54	2983	56
275	3565	56	3475	58	3384	60	3293	61	3203	63	3115	65
300	3681	65	3594	67	3506	68	3418	70	3330	72	3245	74
325	3798	74	3712	76	3625	78	3538	80	3454	82	3373	83
350	3914	83	3828	85	3745	87	3659	89	3577	91	3496	93
375	4028	93	3946	95	3862	97	3780	99	3697	101	3619	103
400	4142	103	4059	105	3976	107	3897	109	3817	112	3740	114
425	4253	113	4174	115	4095	118	4012	120	3935	122	3859	125
450	4364	124	4284	126	4207	128	4128	131	4051	133	3977	136
475	4473	135	4394	137	4315	139	4239	142	4164	144	4090	147
500	4579	146	4502	148	4425	150	4350	153	4275	156	4201	158
525	4683	157	4609	160	4533	162	4458	165	4385	168	4311	170

TABLE 25
Initial Sag and Tension
10M EHS Suspension Strand Supporting
Cable Weighing 1.8 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	2778	10	2656	11	2533	12	2409	12	2290	13	2174	14
125	2919	15	2804	16	2687	17	2569	18	2454	19	2349	19
150	3057	21	2950	22	2840	23	2729	24	2621	25	2515	26
175	3193	28	3090	29	2987	30	2875	31	2775	32	2676	33
200	3326	35	3228	36	3130	37	3030	39	2930	40	2833	41
225	3457	43	3365	44	3271	46	3176	47	3082	49	2989	50
250	3588	52	3499	53	3409	55	3319	56	3229	58	3141	59
275	3718	61	3631	62	3545	64	3458	65	3371	67	3286	69
300	3848	70	3764	71	3679	73	3595	75	3511	77	3428	78
325	3977	79	3894	81	3811	83	3728	85	3647	87	3568	88
350	4106	89	4023	91	3943	93	3861	95	3781	97	3703	99
375	4232	99	4153	101	4072	103	3993	105	3913	107	3837	109
400	4357	110	4278	112	4198	114	4121	116	4044	118	3969	120
425	4480	121	4404	123	4329	125	4247	127	4173	130	4099	132
450	4602	132	4525	134	4451	136	4374	139	4300	141	4229	143
475	4721	143	4645	145	4569	147	4495	150	4423	152	4351	155

TABLE 26
Initial Sag and Tension
10M EHS Suspension Strand Supporting
Cable Weighing 2.0 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	2825	11	2706	12	2587	13	2468	13	2353	14	2242	15
125	2983	17	2871	17	2758	18	2645	19	2534	20	2435	21
150	3138	23	3034	24	2928	24	2822	25	2718	26	2617	28
175	3289	30	3190	31	3091	32	2982	33	2887	34	2792	35
200	3437	38	3343	39	3249	40	3153	41	3057	43	2963	44
225	3583	46	3494	47	3404	49	3314	50	3224	52	3134	53
250	3728	55	3642	57	3556	58	3471	60	3385	61	3300	63
275	3871	65	3788	66	3706	68	3623	69	3540	71	3457	73
300	4015	75	3934	76	3853	78	3773	79	3692	81	3611	83
325	4157	85	4076	86	3997	88	3918	90	3840	92	3763	93
350	4298	95	4218	97	4141	98	4063	100	3986	102	3910	104
375	4436	106	4360	107	4283	109	4206	111	4129	113	4055	115
400	4573	117	4497	119	4420	121	4345	123	4271	125	4199	127
425	4707	128	4635	130	4563	132	4482	134	4411	137	4340	139
450	4840	140	4766	142	4695	144	4620	146	4549	149	4481	151

TABLE 27
Initial Sag and Tension
10M EHS Suspension Strand Supporting
Cable Weighing 2.2 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	2879	12	2763	13	2646	13	2530	14	2418	15	2309	15
125	3052	18	2942	18	2832	19	2721	20	2613	21	2514	22
150	3221	24	3119	25	3014	26	2910	27	2808	28	2709	29
175	3385	32	3288	33	3190	34	3085	35	2991	36	2897	37
200	3546	40	3454	41	3361	42	3267	43	3173	45	3082	46
225	3704	49	3617	50	3528	51	3440	52	3352	54	3264	55
250	3861	58	3776	59	3692	61	3608	62	3524	64	3441	65
275	4015	68	3934	69	3853	71	3772	72	3690	74	3608	75
300	4169	78	4090	79	4011	81	3933	83	3852	84	3773	86
325	4322	88	4243	90	4166	91	4088	93	4011	95	3935	97
350	4473	99	4395	101	4319	102	4242	104	4167	106	4092	108
375	4620	110	4546	112	4469	114	4394	116	4319	118	4246	120
400	4765	121	4692	123	4616	125	4543	127	4470	129	4399	131
425	4908	133	4837	135	4765	137	4687	139	4617	142	4547	144

TABLE 28
Initial Sag and Tension
10M EHS Suspension Strand Supporting
Cable Weighing 2.4 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	2933	13	2820	14	2705	14	2592	15	2483	15	2377	16
125	3121	19	3013	20	2906	20	2797	21	2692	22	2594	23
150	3304	26	3204	26	3101	27	2999	28	2899	29	2801	30
175	3482	33	3386	34	3290	35	3188	36	3095	38	3003	39
200	3655	42	3565	43	3473	44	3381	45	3289	47	3201	48
225	3826	51	3740	52	3652	53	3566	55	3480	56	3395	57
250	3994	61	3911	62	3828	63	3745	65	3663	66	3582	68
275	4159	71	4080	72	4000	73	3921	75	3840	77	3759	78
300	4324	81	4247	83	4169	84	4093	86	4012	87	3935	89
325	4487	92	4411	93	4335	95	4258	97	4182	98	4107	100
350	4648	103	4573	104	4498	106	4423	108	4348	110	4274	112
375	4804	114	4732	116	4655	118	4582	120	4509	122	4438	124
400	4958	126	4887	128	4812	130	4741	132	4669	134	4599	136

TABLE 29
Initial Sag and Tension
10M EHS Suspension Strand Supporting
Cable Weighing 2.6 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	2987	14	2877	14	2764	15	2654	16	2548	16	2445	17
125	3190	20	3085	21	2980	21	2873	22	2771	23	2674	24
150	3387	27	3289	28	3188	29	3088	30	2990	31	2894	32
175	3579	35	3484	36	3390	37	3291	38	3199	39	3109	40
200	3765	44	3676	45	3585	46	3495	47	3406	49	3320	50
225	3948	53	3863	55	3776	56	3693	57	3609	58	3526	60
250	4127	63	4046	65	3964	66	3883	67	3802	69	3723	70
275	4304	74	4226	75	4147	77	4070	78	3990	79	3911	82
300	4479	84	4404	86	4328	87	4253	89	4173	91	4097	92
325	4652	95	4579	97	4504	99	4428	100	4353	102	4279	104
350	4823	107	4751	108	4677	110	4603	112	4530	114	4456	116
375	4988	119	4918	120	4842	122	4770	124	4699	126	4630	128

TABLE 30
Initial Sag and Tension
10M EHS Suspension Strand Supporting
Cable Weighing 2.8 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	3042	15	2935	15	2824	16	2717	16	2613	17	2513	18
125	3259	21	3157	22	3054	23	2950	23	2850	24	2754	25
150	3471	29	3374	29	3275	30	3177	31	3081	32	2987	33
175	3676	37	3588	38	3490	39	3394	40	3303	41	3215	42
200	3875	46	3787	47	3697	48	3610	49	3523	51	3439	52
225	4070	56	3986	57	3901	58	3820	59	3738	61	3657	62
250	4260	66	4181	67	4100	69	4021	70	3942	71	3864	73
275	4449	77	4372	78	4295	79	4219	81	4140	82	4062	84
300	4634	88	4561	89	4487	91	4413	92	4334	94	4259	95
325	4817	99	4747	101	4673	102	4599	104	4524	105	4451	107
350	4999	111	4929	112	4856	114	4783	116	4712	118	4638	119

TABLE 31
Initial Sag and Tension
10M EHS Suspension Strand Supporting
Cable Weighing 3.0 lb/ft for
Heavy, Medium, and Light Loading Districts

Span Length ft	Installation Temperature °F											
	0		20		40		60		80		100	
	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.
100	3097	15	2993	16	2884	17	2780	17	2679	18	2581	19
125	3329	22	3229	23	3128	24	3027	24	2930	25	2834	26
150	3555	30	3459	31	3362	32	3266	33	3172	34	3080	35
175	3773	39	3682	40	3590	41	3497	42	3408	43	3321	44
200	3985	48	3898	49	3810	50	3725	51	3640	53	3558	54
225	4192	58	4109	59	4026	61	3947	62	3867	63	3788	64
250	4393	69	4316	70	4237	71	4159	73	4082	74	4005	75
275	4594	80	4519	81	4443	82	4368	84	4290	85	4215	87
300	4789	91	4718	92	4646	94	4573	95	4495	97	4421	98
325	4983	103	4915	104	4843	106	4770	107	4696	109	4623	110

TABLE 32
Initial Sag and Tension
10M EHS Suspension Strand Supporting
Cable Weighing 3.2 lb/ft for
Heavy, Medium, and Light Loading Districts

Span Length ft	Installation Temperature °F											
	0		20		40		60		80		100	
	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.
100	3154	16	3051	17	2944	17	2842	18	2743	18	2646	19
125	3398	23	3300	24	3202	25	3103	25	3008	26	2914	27
150	3636	31	3542	32	3448	33	3354	34	3262	35	3172	36
175	3864	40	3776	41	3687	42	3596	43	3509	44	3423	45
200	4088	50	4003	51	3918	52	3834	53	3751	54	3670	55
225	4304	60	4224	61	4143	62	4065	63	3986	65	3907	66
250	4516	71	4440	72	4363	73	4287	75	4210	76	4134	77
275	4727	82	4653	83	4578	85	4505	86	4428	87	4354	89
300	4932	94	4862	95	4791	96	4719	98	4642	99	4569	101
325	5133	105	5066	107	4995	109	4924	110	4851	112	4779	113

TABLE 33
Initial Sag and Tension
10M EHS Suspension Strand Supporting
Cable Weighing 3.4 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	3211	17	3109	17	3004	18	2905	18	2807	19	2711	20
125	3468	24	3372	25	3276	25	3179	26	3086	27	2994	28
150	3717	32	3626	33	3534	34	3442	35	3352	36	3264	37
175	3956	41	3870	42	3784	43	3695	44	3610	45	3526	46
200	4191	51	4109	52	4026	54	3943	55	3862	56	3782	57
225	4417	62	4339	63	4260	64	4183	65	4105	66	4027	68
250	4639	73	4565	74	4489	75	4415	77	4338	78	4263	79
275	4860	84	4787	86	4714	87	4642	88	4566	90	4493	91
300	5075	96	5006	98	4936	99	4865	100	4789	102	4718	103
325	5283	108	5217	110	5147	111	5078	113	5006	114	4935	116

TABLE 34
Initial Sag and Tension
10M EHS Suspension Strand Supporting
Cable Weighing 3.6 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	3269	17	3167	18	3065	18	2968	19	2871	20	2776	20
125	3538	25	3444	26	3350	26	3255	27	3164	28	3074	29
150	3798	33	3710	34	3620	35	3530	36	3442	37	3357	38
175	4048	43	3964	44	3881	45	3795	46	3711	47	3629	48
200	4294	53	4215	54	4134	55	4052	56	3973	57	3895	58
225	4530	64	4454	65	4377	66	4301	67	4224	68	4147	69
250	4762	75	4690	76	4615	77	4543	79	4467	80	4392	81
275	4993	87	4922	88	4850	89	4779	91	4704	92	4632	93

TABLE 35
Initial Sag and Tension
10M EHS Suspension Strand Supporting
Cable Weighing 3.8 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	3327	18	3226	18	3126	19	3031	20	2935	20	2842	21
125	3608	26	3516	27	3424	27	3332	28	3243	29	3155	29
150	3879	35	3794	35	3706	36	3618	37	3533	38	3450	39
175	4140	44	4059	45	3978	46	3895	47	3813	48	3732	49
200	4397	55	4321	56	4242	57	4162	58	4084	59	4008	60
225	4643	65	4569	67	4494	68	4420	69	4343	70	4267	71
250	4886	77	4815	78	4742	79	4671	81	4596	82	4521	83
275	5126	89	5057	90	4986	92	4916	93	4843	94	4771	95

TABLE 36
Initial Sag and Tension
10M EHS Suspension Strand Supporting
Cable Weighing 4.0 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	3385	19	3285	19	3187	20	3093	20	3000	21	2908	22
125	3678	27	3588	27	3498	28	3409	29	3322	30	3236	30
150	3960	36	3878	37	3793	37	3707	38	3624	39	3543	40
175	4232	46	4154	47	4075	47	3995	48	3915	49	3835	50
200	4500	56	4427	57	4350	58	4272	59	4195	61	4121	62
225	4756	67	4684	68	4612	70	4539	71	4463	72	4387	73
250	5010	79	4940	80	4869	81	4799	83	4725	84	4651	85

TABLE 37
Initial Sag and Tension
10M EHS Suspension Strand Supporting
Cable Weighing 4.2 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	3441	19	3342	20	3245	20	3153	21	3060	21	2969	22
125	3746	27	3656	28	3567	29	3479	30	3392	30	3306	31
150	4039	37	3958	38	3873	38	3789	39	3706	40	3624	41
175	4322	47	4245	48	4166	49	4087	49	4008	50	3928	51
200	4599	57	4526	59	4450	60	4373	61	4296	62	4222	63
225	4865	69	4793	70	4722	71	4649	72	4574	73	4499	74

250	5127	81	5058	82	4988	83	4919	84	4846	86	4773	87

TABLE 38
Initial Sag and Tension
10M EHS Suspension Strand Supporting
Cable Weighing 4.4 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	3497	20	3399	20	3303	21	3212	21	3120	22	3030	23
125	3814	28	3724	29	3636	30	3549	30	3462	31	3377	32
150	4118	38	4038	38	3954	39	3871	40	3788	41	3706	42
175	4412	48	4336	49	4257	50	4179	51	4101	51	4022	52
200	4698	59	4625	60	4550	61	4474	62	4397	63	4232	64
225	4974	70	4903	71	4832	72	4759	73	4685	75	4611	76
250	5245	82	5176	84	5107	85	5039	86	4967	87	4895	88

TABLE 39
Initial Sag and Tension
10M EHS Suspension Strand Supporting
Cable Weighing 4.6 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	3553	20	3456	21	3362	21	3271	22	3181	23	3091	23
125	3882	29	3792	30	3705	30	3619	31	3532	32	3448	32
150	4197	38	4118	39	4035	40	3953	41	3870	42	3788	43
175	4502	49	4427	50	4348	51	4271	52	4194	53	4116	54
200	4797	60	4725	61	4650	62	4575	63	4498	64	4424	65
225	5083	72	5013	73	4942	74	4870	75	4796	76	4723	77

TABLE 40
Initial Sag and Tension
10M EHS Suspension Strand Supporting
Cable Weighing 4.8 lb/ft for
Heavy, Medium, and Light Loading Districts

	Installation Temperature °F											
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	3609	21	3514	21	3421	22	3331	23	3242	23	3152	24
125	3950	30	3861	30	3775	31	3687	32	3603	32	3519	33
150	4281	39	4198	40	4116	41	4038	42	3952	43	3870	43
175	4592	50	4518	51	4439	52	4364	53	4287	54	4210	55
200	4897	61	4825	62	4750	63	4676	64	4600	65	4526	66
225	5193	73	5123	74	5052	75	4981	76	4908	78	4836	79

TABLE 41
Initial Sag and Tension
10M EHS Suspension Strand Supporting
Cable Weighing 5.0 lb/ft for
Heavy, Medium, and Light Loading Districts

Installation Temperature °F												
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	3665	21	3572	22	3480	23	3391	23	3303	24	3214	24
125	4019	30	3930	31	3845	32	3760	32	3674	33	3590	34
150	4357	40	4279	41	4197	42	4118	43	4034	43	3952	44
175	4683	51	4609	52	4531	53	4457	54	4380	55	4304	56
200	4997	63	4925	64	4850	65	4777	66	4702	67	4628	68
225	5303	75	5233	76	5163	77	5092	78	5020	79	4949	80

TABLE 42
Initial Sag and Tension
16M EHS Suspension Strand Supporting
Cable Weighing 1.0 lb/ft for
Heavy, Medium, and Light Loading Districts

Span Length	Installation Temperature °F											
	0		20		40		60		80		100	
	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
200	4973	17	4728	18	4479	19	4231	20	3985	21	3751	22
225	5051	20	4813	21	4570	22	4331	23	4093	25	3865	26
250	5129	24	4898	25	4660	26	4431	28	4200	29	3979	31
275	5207	28	4984	30	4750	31	4529	33	4305	35	4091	37
300	5286	33	5069	35	4840	37	4627	39	4410	41	4201	43
325	5365	39	5154	41	4930	43	4724	45	4513	47	4310	50
350	5443	45	5238	48	5019	50	4820	52	4614	54	4417	57
375	5521	52	5322	54	5108	57	4915	59	4714	62	4523	64
400	5600	59	5406	62	5196	64	5010	67	4813	69	4627	72
425	5679	67	5490	69	5284	72	5104	74	4910	77	4729	80
450	5757	74	5573	76	5372	79	5197	82	5007	85	4831	88
475	5836	81	5656	84	5460	87	5290	90	5104	93	4931	96
500	5915	89	5739	92	5548	95	5378	98	5199	101	5031	105
525	5993	97	5823	100	5635	103	5470	106	5295	110	5128	113
550	6072	105	5907	108	5723	111	5561	115	5388	119	5225	122
575	6151	113	5990	117	5810	120	5650	124	5481	128	5320	131
600	6229	122	6073	125	5897	129	5738	133	5574	137	5413	141
625	6307	131	6155	134	5983	138	5826	142	5665	146	5505	150
650	6385	140	6236	144	6068	147	5913	152	5755	156	5597	160
675	6463	149	6316	153	6153	157	5998	161	5843	165	5688	170
700	6541	158	6395	162	6235	167	6083	171	5931	175	5778	180
725	6618	168	6474	172	6317	176	6167	181	6018	185	5867	190
750	6695	178	6552	182	6399	186	6250	191	6105	195	5955	200
775	6772	187	6628	192	6480	196	6333	201	6190	206	6043	210
800	6849	197	6704	202	6560	206	6415	211	6274	216	6129	221
825	6923	208	6779	212	6638	217	6495	221	6355	226	6212	231
850	6997	218	6854	222	6715	227	6573	232	6435	237	6295	242
875	7069	228	6928	233	6790	238	6651	243	6514	248	6375	254
900	7141	239	7001	244	6864	249	6727	254	6591	260	6454	265
925	7211	250	7074	255	6937	261	6801	266	6667	272	6532	277
950	7281	262	7145	267	7009	272	6875	278	6742	283	6609	289
975	7349	273	7214	279	7079	284	6947	290	6816	295	6685	301
1000	7415	285	7282	290	7149	296	7019	302	6889	308	6762	314

TABLE 43
Initial Sag and Tension
16M EHS Suspension Strand Supporting
Cable Weighing 1.5 lb/ft for
Heavy, Medium, and Light Loading Districts

Installation Temperature °F												
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
200	5202	22	4973	23	4745	24	4525	25	4309	27	4104	28
225	5330	26	5101	28	4878	29	4662	31	4450	32	4246	34
250	5456	32	5230	33	5010	35	4799	37	4592	38	4392	40
275	5579	38	5357	40	5142	41	4936	43	4731	45	4537	47
300	5700	45	5482	46	5273	48	5072	50	4872	52	4682	54
325	5821	52	5607	54	5404	56	5206	58	5012	60	4828	62
350	5939	59	5733	61	5534	64	5342	66	5153	68	4972	70
375	6056	67	5856	69	5664	72	5477	74	5293	76	5115	79
400	6174	75	5979	77	5794	80	5612	82	5432	85	5258	87
425	6290	83	6101	85	5922	88	5746	90	5569	93	5403	96
450	6405	91	6224	94	6050	96	5879	99	5707	102	5543	105
475	6520	100	6347	102	6147	105	6012	108	5845	110	5683	114
500	6635	108	6470	111	6305	114	6144	116	5982	119	5826	123
525	6746	117	6584	120	6420	123	6262	126	6101	129	5946	132
550	6858	126	6697	129	6536	132	6381	135	6222	138	6069	142
575	6970	135	6812	138	6652	141	6498	145	6342	148	6193	151
600	7080	144	6925	148	6768	151	6615	154	6462	158	6313	162
625	7191	154	7038	158	6885	161	6732	165	6582	168	6435	172
650	7300	164	7151	168	7000	172	6848	175	6700	179	6556	183
675	7409	175	7262	179	7114	182	6964	186	6821	190	6677	194
700	7517	186	7374	190	7227	193	7079	197	6938	201	6797	206
725	7626	197	7485	201	7341	205	7194	209	7055	213	6916	217
750	7733	208	7595	212	7451	216	7308	220	7172	225	7033	229
775	7841	219	7704	224	7564	228	7422	232	7288	236	7152	241
800	7947	231	7814	235	7675	239	7536	244	7406	248	7271	253
825	8053	243	7922	247	7785	251	7645	256	7515	260	7383	265
850	8159	255	8029	259	7894	263	7753	268	7625	273	7493	278
875	8261	267	8132	271	8000	276	7860	280	7732	285	7600	290
900	8359	279	8232	284	8103	288	7964	293	7835	298	7706	303
925	8453	292	8330	296	8204	301	8062	306	7936	311	7807	316

TABLE 44
Initial Sag and Tension
16M EHS Suspension Strand Supporting
Cable Weighing 2.0 lb/ft for
Heavy, Medium, and Light Loading Districts

Installation Temperature °F												
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
200	5473	26	5259	27	5051	29	4846	30	4638	31	4433	33
225	5627	31	5422	33	5218	34	5026	36	4820	37	4623	39
250	5783	38	5584	39	5386	41	5202	42	5002	44	4812	46
275	5940	45	5745	46	5552	48	5378	50	5184	51	4998	53
300	6094	52	5906	54	5720	56	5550	57	5363	59	5182	61
325	6251	60	6066	62	5886	64	5722	66	5540	68	5365	70
350	6404	68	6227	70	6051	73	5892	75	5715	77	5545	79
375	6559	77	6386	79	6215	81	6060	84	5889	86	5725	88
400	6712	86	6544	88	6379	91	6225	93	6060	95	5900	98
425	6866	95	6702	97	6542	100	6390	102	6230	105	6075	108
450	7019	105	6860	107	6704	109	6552	112	6397	115	6245	118
475	7170	114	7016	116	6864	119	6712	122	6562	125	6413	128
500	7320	124	7172	126	7022	129	6872	132	6722	135	6577	138
525	7469	134	7324	136	7176	139	7027	142	6881	145	6737	148
550	7615	144	7473	147	7326	150	7179	153	7036	156	6894	159
575	7760	155	7620	158	7473	161	7329	164	7190	167	7047	171
600	7902	166	7762	169	7616	172	7474	175	7336	178	7197	182
625	8042	177	7903	180	7757	183	7617	186	7481	190	7344	193
650	8179	188	8040	191	7896	194	7757	197	7625	201	7488	205
675	8310	199	8172	203	8034	206	7896	209	7765	213	7629	217
700	8441	211	8302	214	8169	217	8034	221	7903	225	7768	229
725	8568	223	8432	226	8298	229	8166	233	8035	237	7901	241
750	8694	235	8561	238	8427	242	8296	246	8167	250	8033	254
775	8820	247	8687	251	8555	254	8426	258	8298	263	8165	267

TABLE 45
Initial Sag and Tension
16M EHS Suspension Strand Supporting
Cable Weighing 2.5 lb/ft for
Heavy, Medium, and Light Loading Districts

Installation Temperature °F												
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	5028	9	4785	9	4537	10	4291	10	4049	11	3814	11
125	5220	13	4989	13	4751	14	4513	14	4279	15	4058	16
150	5412	17	5190	18	4962	19	4734	20	4508	21	4298	22
175	5600	23	5390	24	5172	25	4952	26	4735	27	4536	28
200	5790	30	5587	31	5378	32	5168	33	4958	34	4772	35
225	5977	36	5784	38	5585	39	5383	40	5181	42	5001	43
250	6167	44	5979	45	5788	47	5595	48	5401	50	5230	51
275	6356	52	6172	54	5990	55	5805	57	5620	58	5453	60
300	6542	61	6363	62	6190	64	6014	66	5837	67	5673	69
325	6730	69	6553	71	6386	73	6213	74	6043	76	5886	78
350	6916	78	6743	80	6580	82	6412	84	6247	86	6095	88
375	7100	87	6932	89	6773	91	6610	93	6450	95	6300	97
400	7283	96	7120	98	6963	101	6805	103	6651	105	6505	107
425	7465	106	7305	108	7151	111	6997	113	6848	115	6704	118
450	7644	116	7487	118	7337	121	7188	123	7042	126	6900	128
475	7820	126	7668	129	7521	131	7376	134	7231	136	7092	139
500	7996	137	7849	139	7704	142	7560	145	7418	148	7282	150
525	8165	148	8024	150	7880	153	7736	156	7597	159	7462	162
550	8334	159	8193	162	8053	165	7912	168	7776	171	7640	174
575	8500	170	8364	173	8225	176	8085	179	7952	183	7816	186
600	8666	182	8534	185	8396	188	8256	191	8126	195	7991	198
625	8829	194	8699	197	8565	200	8427	204	8298	207	8165	210
650	8990	206	8862	209	8732	213	8594	216	8466	219	8336	223
675	9149	218	9024	221	8894	225	8760	228	8632	232	8503	235

TABLE 46
Initial Sag and Tension
16M EHS Suspension Strand Supporting
Cable Weighing 3.0 lb/ft for
Heavy, Medium, and Light Loading Districts

Installation Temperature °F												
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	5129	10	4904	10	4664	11	4433	11	4205	12	3976	13
125	5361	14	5145	15	4913	16	4691	17	4475	17	4258	18
150	5593	20	5383	21	5164	22	4984	22	4743	23	4541	24
175	5822	26	5620	27	5412	28	5204	29	5007	30	4817	32
200	6051	33	5856	34	5657	36	5459	37	5268	38	5090	39
225	6276	41	6090	42	5900	43	5711	45	5526	46	5358	48
250	6499	49	6322	50	6142	52	5959	53	5781	55	5624	56
275	6721	58	6550	59	6380	61	6206	62	6036	64	5885	66
300	6941	67	6776	68	6618	70	6450	71	6288	73	6141	75
325	7162	76	7003	77	6846	79	6684	81	6529	83	6386	85
350	7382	85	7228	87	7072	89	6915	91	6765	93	6625	95
375	7597	95	7447	97	7296	99	7142	101	6996	103	6855	105
400	7811	105	7665	107	7512	109	7365	111	7221	114	7082	116
425	8020	116	7877	118	7727	120	7585	122	7445	125	7301	127
450	8225	127	8086	129	7941	131	7802	134	7664	136	7519	138
475	8428	138	8292	140	8147	142	8015	145	7880	147	7738	150
500	8628	149	8494	151	8354	154	8225	157	8090	159	7946	162
525	8827	161	8695	163	8557	166	8431	169	8297	171	8154	174
550	9024	173	8896	175	8758	178	8632	181	8500	184	8362	187
575	9218	185	9091	188	8956	190	8831	193	8700	196	8565	199

TABLE 47
Initial Sag and Tension
16M EHS Suspension Strand Supporting
Cable Weighing 3.5 lb/ft for
Heavy, Medium, and Light Loading Districts

Installation Temperature °F												
	0		20		40		60		80		100	
Span Length	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag	Tension	Sag
ft	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.	lbf	in.
100	5265	11	5028	11	4806	12	4586	13	4366	13	4150	14
125	5525	16	5303	17	5098	17	4888	18	4685	19	4484	20
150	5787	22	5577	23	5387	24	5187	25	4996	26	4807	27
175	6049	28	5850	30	5669	31	5481	32	5298	33	5122	34
200	6310	36	6123	37	5947	38	5771	40	5595	41	5427	42
225	6572	44	6392	45	6222	47	6050	48	5876	50	5719	51
250	6832	53	6658	54	6494	56	6327	58	6155	59	6006	61
275	7089	62	6920	64	6762	65	6597	67	6433	69	6289	70
300	7343	72	7180	73	7025	75	6866	77	6706	79	6567	81
325	7595	82	7437	83	7284	85	7130	87	6975	89	6842	91
350	7843	92	7691	94	7540	95	7390	97	7242	99	7112	101
375	8087	102	7940	104	7791	106	7644	108	7494	110	7368	112
400	8328	113	8184	115	8037	117	7893	119	7745	121	7620	123
425	8565	124	8424	126	8279	128	8138	130	7992	133	7868	135
450	8797	135	8658	137	8517	139	8378	142	8236	144	8110	147
475	9026	147	8890	149	8751	151	8615	154	8475	157	8348	159
500	9250	159	9117	161	8980	164	8847	166	8709	169	8552	171
525	9470	171	9341	174	9207	176	9075	179	8940	182	8812	184

TABLE 48
Initial Sag and Tension
16M EHS Suspension Strand Supporting
Cable Weighing 4.0 lb/ft for
Heavy, Medium, and Light Loading Districts

Span Length ft	Installation Temperature °F											
	0		20		40		60		80		100	
	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.
100	5384	12	5161	13	4941	13	4733	14	4525	15	4320	15
125	5709	17	5492	18	5278	19	5076	20	4876	21	4680	21
150	6027	24	5820	25	5611	26	5414	27	5220	27	5033	28
175	6334	31	6138	32	5939	33	5746	34	5559	35	5380	36
200	6633	39	6449	40	6260	41	6072	43	5893	44	5721	45
225	6926	48	6749	49	6573	50	6392	52	6221	53	6054	54
250	7209	57	7043	59	6876	60	6704	61	6540	63	6385	64
275	7487	67	7325	68	7170	70	7006	72	6849	73	6699	75
300	7762	77	7606	79	7456	80	7300	82	7152	84	7011	85
325	8038	88	7885	89	7740	91	7585	93	7439	94	7301	96
350	8312	98	8162	100	8019	102	7867	104	7724	106	7586	108
375	8580	109	8435	111	8292	113	8144	115	8044	117	7868	119
400	8843	121	8702	122	8562	124	8417	127	8279	129	8144	131
425	9104	132	8966	134	8828	136	8685	139	8550	141	8417	143
450	9361	144	9224	146	9089	148	8950	151	8817	153	8684	155
475	9612	157	9479	159	9347	161	9211	163	9082	166	8948	168

TABLE 49
Initial Sag and Tension
16M EHS Suspension Strand Supporting
Cable Weighing 4.5 lb/ft for
Heavy, Medium, and Light Loading Districts

Span Length ft	Installation Temperature °F											
	0		20		40		60		80		100	
	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.
100	5511	13	5306	14	5098	14	4892	15	4687	16	4496	16
125	5869	19	5673	20	5472	21	5271	21	5072	22	4890	23
150	6214	26	6029	27	5839	28	5644	29	5451	30	5273	31
175	6554	34	6374	35	6197	36	6011	37	5825	38	5654	39
200	6880	42	6712	44	6545	45	6370	46	6192	47	6029	48
225	7201	52	7039	53	6882	54	6716	55	6551	57	6396	58
250	7516	61	7360	63	7210	64	7054	65	6901	67	6753	68
275	7825	71	7673	73	7530	75	7381	76	7231	77	7090	79
300	8133	82	7984	84	7845	85	7702	87	7557	88	7421	90
325	8438	93	8292	95	8155	96	8019	98	7878	100	7746	101
350	8738	104	8594	106	8461	108	8331	109	8192	111	8062	113
375	9034	115	8893	117	8761	119	8636	121	8498	123	8370	125
400	9322	127	9187	129	9057	131	8933	133	8797	135	8669	137
425	9612	139	9477	141	9347	144	9220	146	9085	148	8961	150

TABLE 50
Initial Sag and Tension
16M EHS Suspension Strand Supporting
Cable Weighing 5.0 lb/ft for
Heavy, Medium, and Light Loading Districts

Span Length ft	Installation Temperature °F											
	0		20		40		60		80		100	
	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.	Tension lbf	Sag in.
100	5664	14	5453	15	5248	15	5048	16	4855	17	4661	17
125	6049	20	5848	21	5648	22	5456	23	5283	23	5094	24
150	6427	28	6236	29	6044	29	5858	30	5699	31	5520	32
175	6793	36	6616	37	6434	38	6252	39	6100	40	5936	41
200	7149	45	6985	46	6815	47	6642	48	6490	49	6340	51
225	7498	54	7344	56	7187	57	7024	58	6876	59	6727	61
250	7843	65	7695	66	7548	67	7398	69	7250	70	7109	72
275	8184	75	8040	77	7895	78	7751	80	7612	81	7473	83
300	8524	86	8381	88	8237	89	8097	91	7965	93	7832	94
325	8858	98	8717	99	8576	101	8439	102	8305	104	8182	106
350	9184	109	9044	111	8907	112	8774	114	8636	116	8518	118
375	9503	121	9367	123	9233	125	9100	126	8960	128	8843	130

8.3 The initial sags and tensions for filled fiber optic cables installed on 6M EHS suspension strands at various span lengths and temperatures in the three NESC storm loading districts should be obtained from the fiber optic cable manufacturer.

9. RAILROAD CROSSING

9.1 Aerial construction involving the crossing of railroads should be performed in accordance with Section 24 of the latest edition of the NESC.

9.2 Aerial construction involving the crossing of railroads also should be performed in accordance with the latest edition of the “Specification For Communication Lines Crossing the Tracks of Railroads” issued by the Association of American Railroads.

10. POLE STEPPING

10.1 Poles should be stepped where indicated on the construction drawings.

10.2 The steps should be placed on poles as shown on Assembly Unit Drawing PM-5 in RUS Bulletin 345-153 (RUS Form 515f).

11. MECHANICAL PROTECTION OF CABLE AND PREVENTION OF CABLE DANCING

11.1 Aerial cables that could be damaged by chafing from trees or poles should be protected from damage by placing RUS accepted or technically accepted plastic split or spirally cut cable guards over the cable at those locations. Cable guards should also be placed on aerial cables at locations where the required clearance between the telecommunications cable and power cable can not maintained.

11.2 In areas where lashed aerial filled copper or fiber optic cables are subjected to high winds, cables should be spiraled around the suspension strand to minimize cable dancing. The spiraling of the cable around the suspension strand represents an irregular configuration of cable and strand to the wind pressure thereby tending to break up movement of cable and reduce dancing.

11.3 In areas where self-supporting, filled fiber optic cables are subjected to high winds, cables should be spiraled around the integrated suspension strand to minimize cable dancing. The spiraling of the cable around the integrated suspension strand represents an irregular configuration of cable and strand to the wind pressure thereby tending to break up movement of cable and reduce dancing.

11.4 The spiraling of the cable around the suspension strand to minimize cable dancing should be performed as indicated on Guide Drawing 250 for lashed filled copper and fiber optic cables and Guide Drawing 250-1 for self-supporting, filled fiber optic cable of RUS Bulletin 345-153 (RUS Form 515f).

11.5 The spiraling operation should be performed at alternate poles throughout the length of the affected section of the cable lead. Performing the spiraling operation at alternate pole locations results in the spiraling of two adjacent spans at the same time. The presence of a straight splice in the affected section of cable lead should not affect the spiraling operation.

11.6 Prior to spiraling of lashed cable, the lashing wire clamps should be temporarily loosened to eliminate tightening of the lashing wire during the spiraling operation. After spiraling, the lashing wire should be readjusted and reclamped.

11.7 The spiraling operation may be performed at poles where strand mounted terminals are installed provided that care is exercised to prevent damage to the terminal stub and splice.

11.8 In areas where high winds prevail and light weight cable is constructed on unusually long spans, addition spiraling of the cable may be required to obtain satisfactory results. The number

of additional twists at these locations should be indicated on the construction drawings.

12. HANDLING AND CARE OF MATERIALS DURING CONSTRUCTION

12.1 Extreme care should be exercised in handling materials during the construction process. The suspension strand should be handled and stored in such a manner as to prevent accelerated corrosion or physical damaged to the suspension strand.

12.2 Care should be exercised to prevent damage to exposed cables during the construction period. Construction work should be scheduled to keep such exposure to minimum.

12.3 Cables should be installed in aerial splice cases, ready-access cases, and pole mounted terminals as soon as practicable. The installation work should be completed as soon as practicable after the cables have been installed.

13. REPAIR OF CABLES DAMAGED DURING CONSTRUCTION

13.1 Minor damage to the outer jackets, where the shields or armors of the cables have not been bent, abraded, or penetrated should be repaired in accordance with Bulletin 1753F-401(PC-2), RUS Standard for Splicing Copper and Fiber Optic Cables.

13.2 Where shields or armors have penetrated the outer jackets of cables, the damaged sections should be enclosed in aerial splice cases. The outer jackets, shields, or armors of the damaged sections should be removed as though preparing for splicing. The shields or armors should then be bonded together. Damage to the copper conductors or their insulations or optical fibers or their buffer tubes should be repaired in accordance with Bulletin 1753F-401(PC-2), RUS Standard for Splicing Copper and Fiber Optic Cables.

13.3 Cables found to be damaged after installation should be repaired. If the damage is considered minor, the damage should be repaired in accordance with Bulletin 1753F-401(PC-2), RUS Standard for Splicing Copper and Fiber Optic Cables. If the damage is considered major, the damage should be repaired either by replacing the damaged sections with new cables spliced to the undamaged sections of the cable or repaired in accordance with the method specified in the contract.

13.4 All aerial splice cases added because of repairs should be shown on the construction drawings. However, they should not be included in the final inventory for compensation purposes as specified by the RUS 515 Contract and RUS Bulletin 345-153 (RUS Form 515f).

14. PREPARATION FOR SPLICING OR TERMINATION

14.1 Aerial filled copper cables should be spliced in accordance with Bulletin 1753F-401(PC-2), RUS Standard for Splicing Copper and Fiber Optic Cables and enclosed in RUS accepted or technically accepted aerial splice cases, ready-access cases, or pole mount terminals.

14.2 Aerial filled fiber optic or self-supporting fiber optic cables should be spliced in accordance with Bulletin 1753F-401(PC-2), RUS Standard for Splicing Copper and Fiber Optic Cables and enclosed in RUS accepted or technically accepted filled fiber optic splice cases.

14.3 RUS accepted or technically accepted filled terminal blocks should only be used in ready-access cases and pole mount terminals.

15. INSTALLATION PROCEDURES FOR FILLED CABLES IN COLD WEATHER

15.1 Flexibility of filled copper or fiber optic cables should not be a problem at normal operating temperatures. However, flexibility may be affected when cables are exposed to lower temperatures. The flexibility of filled copper or fiber optic cables could be sharply reduced at temperatures below 40°F (4.4°C). At temperatures below 40°F (4.4°C), almost twice the force may be needed to bend the filled copper or fiber optic cables. Filled copper or fiber optic cables should be inspected each morning to determine if the cables are flexible enough for aerial placement when night time temperatures drop below 30°F (-1.1°C). When filled copper or fiber optic cables have been stored outdoors and subjected to cold nights, considerable time may be lost each morning waiting for the cables to warm up even though the daytime temperature may be above 40°F (4.4°C). During the spring and fall of the year, the filled copper or fiber optic cables may be stored in heated warehouses prior to placement in the air. This storage in heated warehouses allows the filled copper or fiber optic cables to be transported to the project site as needed and installed while the cables are still flexible.

15.2 Some filling compounds used in the cores of filled copper cables may be stiff as the temperature decreases making it difficult to separate the cable pairs. In general, filled copper cables installations below 40°F (4.4°C) could be slow, difficult, and possibly even halted unless special precautions are taken to offset the effects of the lower temperatures.

15.3 Filling compounds used in loose tube buffers of filled fiber optic cables should not become stiff as the temperature

decreases. This should allow the optical fibers to be easily separated at low temperatures.

15.4 As mentioned in Paragraph 15.2, the copper pairs may be difficult to separate as the temperature decreases. At temperatures as low as 20°F (-6.7°C), the copper pairs may be separated by flexing the free ends of the cable cores and separating a few pairs at a time. It is also interesting to note that filling compounds at a temperature of 20°F (-6.7°C) are more user friendly to work with than at elevated temperatures. Consequently, the copper cable pairs may be spliced without wiping the pairs free of filling compound.

16. ASSEMBLY UNITS

16.1 Detailed descriptions of all standard aerial plant assembly units are given in RUS Bulletin 345-153, Specifications and Drawings for Construction of Pole Line, Aerial Cables and Wires (RUS Form 515f).

16.2 Where standard aerial plant assembly units are insufficient to provide for unique aerial plant construction requirements, detailed “nonstandard assembly units” should be created to meet those requirements. The aerial plant nonstandard assembly units should be approved by RUS prior to the bidding of the project. “Nonstandard assembly units” should be kept to the absolute minimum needed for the project.

17. NUMBERING AND ACCEPTANCE TESTING

17.1 The first, fifth, tap, breakdown, and end poles installed along the construction route should be marked with route letters, pole numbers, and, when required, the load point numbers (When loaded lines are determined by RUS to be economically feasible and the overall system design complies with the Modernization Plan [7 CFR 1751, Subpart B]).

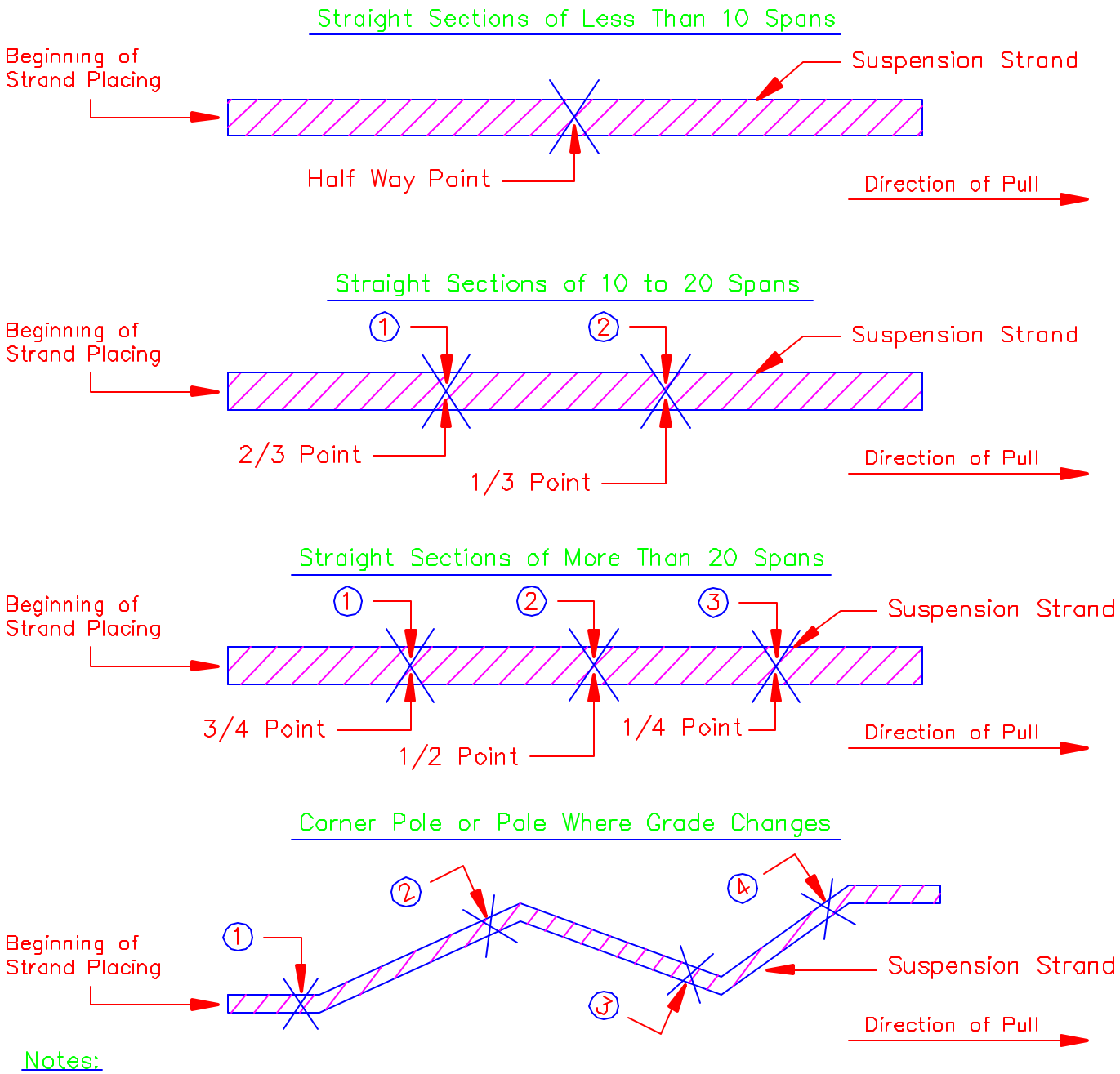
17.2 In lieu of Paragraph 17.1, every pole along the construction route may be marked with route letters, pole numbers, and, when required, load point numbers (When loaded lines are determined by RUS to be economically feasible and the overall system design complies with the Modernization Plan [7 CFR 1751, Subpart B]) when requested by the RUS borrower.

17.3 After installation, aerial copper cables should be tested in accordance with RUS Bulletin 345-63, RUS Standard for Acceptance Tests and Measurements of Telephone Plant (PC-4) and the RUS Form 515 Contract.

17.4 After installation, aerial fiber optic cables should be tested in accordance with the procedures listed in the contract.

FIGURE 1

SELECTION OF POINTS FOR READING AND EQUALIZING STRAND TENSIONS



Notes:

1. Sequence of procedure is indicated by the number inside the circle.
2. Points of tension equalization are indicated by the letter "X". The readings should be generally taken near poles.
3. In initial placing of strand the cable suspension clamps should be free enough to allow the strand to slide thru. The strand should first be pulled up until it is somewhat tighter than the required tension. The tension should then be eased off as the tension is equalized at the indicated points, after which the clamps should be permanently tightened.
4. When the above procedures listed in Notes 1. through 3. are followed, a reduction in cable dancing should occur.

FIGURE 2

MOVING REEL METHOD FOR LASHING
CABLE TO SUSPENSION STRAND

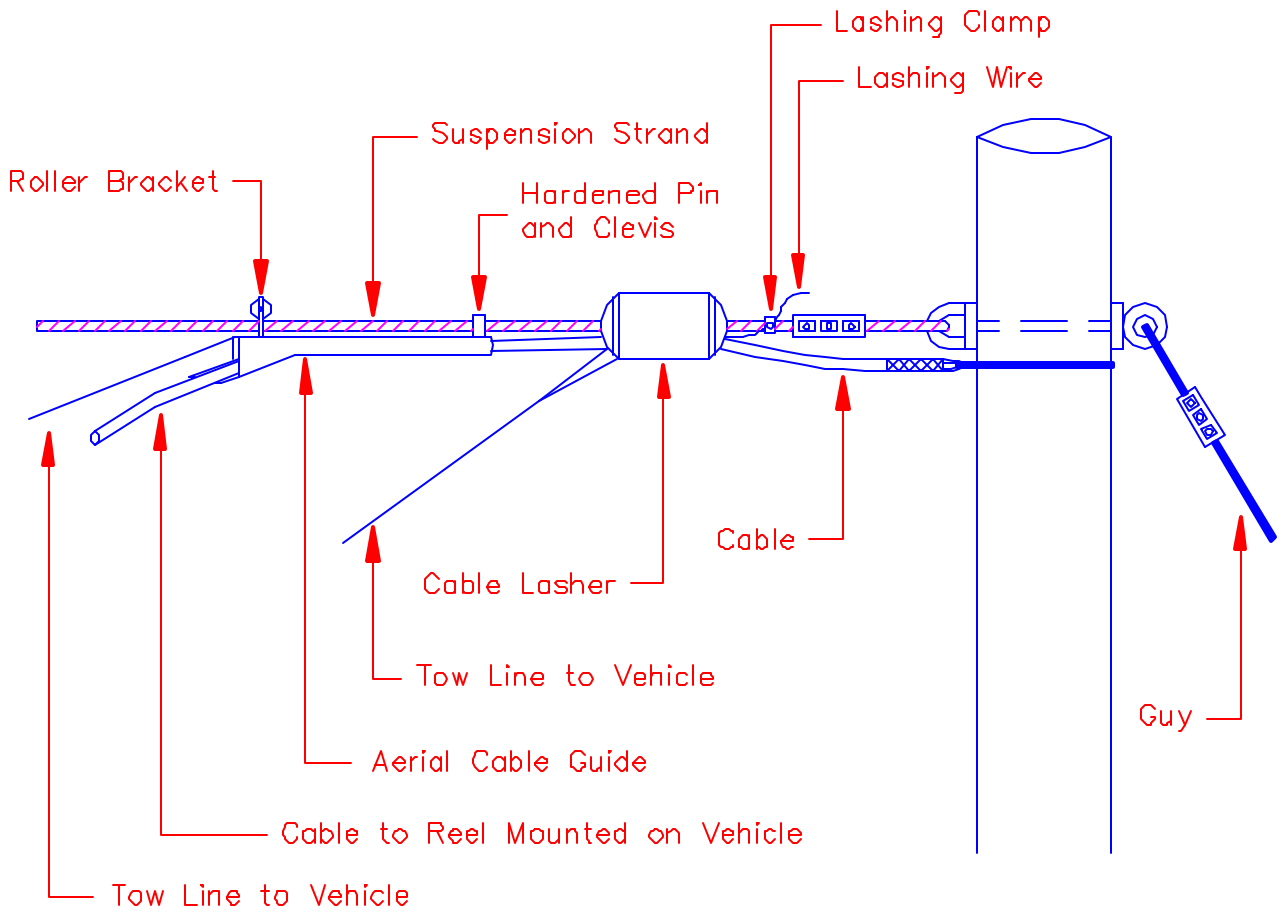
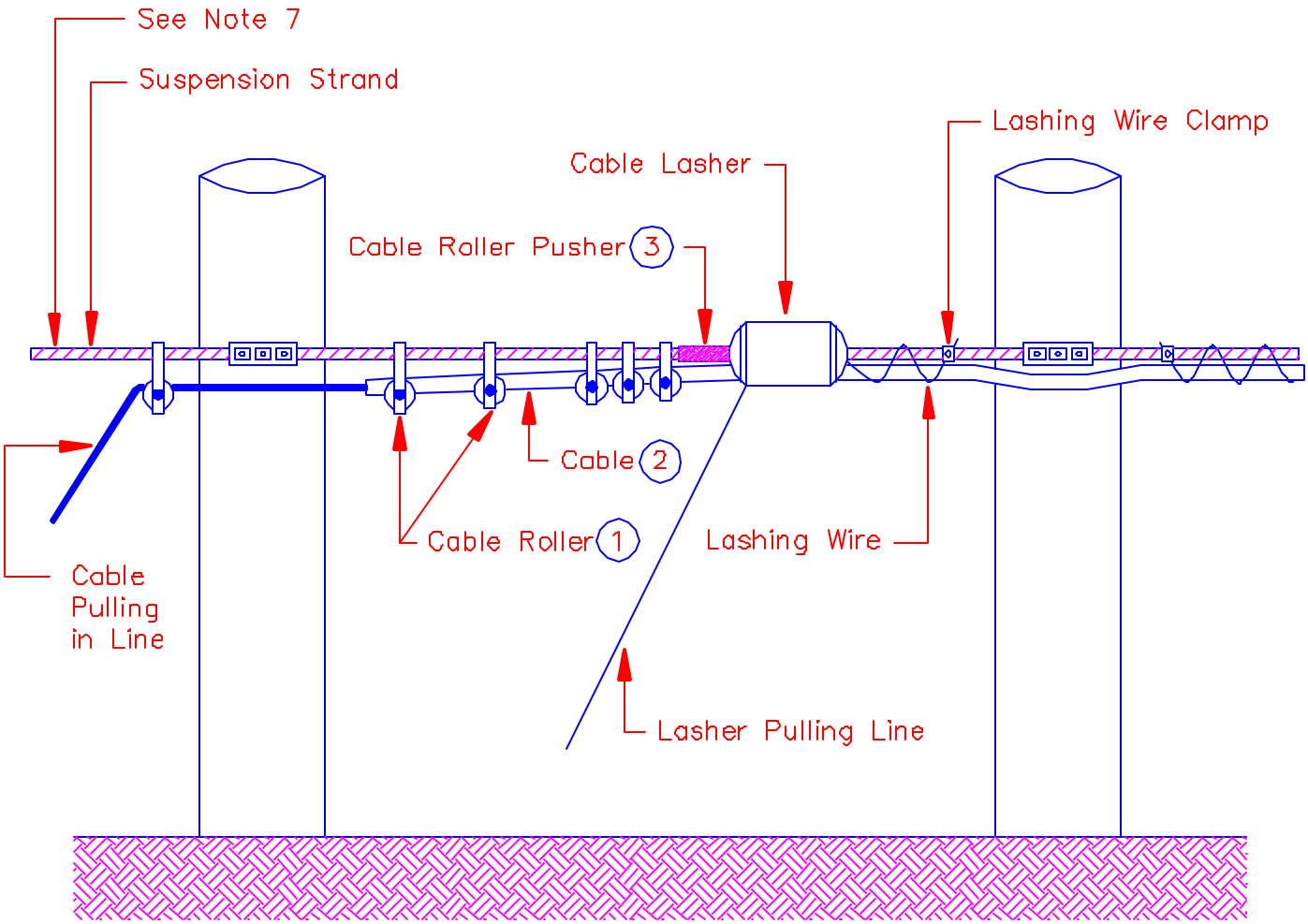


FIGURE 3

STATIONARY REEL METHOD FOR LASHING CABLE TO SUSPENSION STRAND



Notes:

1. Space rollers as indicated in Table 7 for proper support of cable.
2. Maintain necessary tension on cable to ensure an even and tight lashing job.
3. Cable roller pusher forces rollers along strand as lashing progresses.
4. Take necessary steps to prevent cable from riding out of rollers or upsetting other supports on changes in grade and on heavy corners.
5. Place rollers as needed to make a smooth and even bend of the cable on inside corners.
6. Place mats or folded cloth to protect the cable while being pulled around poles on outside corners.
7. Place rollers as needed for continuing the operation.