REPORT ON SAG AND GROUND CLEARANCE

Glenn Davis*

This report discusses the effects of sag on the positioning of wires and cables on electric utility poles. Cables attached to utility poles cannot be strung line-of-sight due to the basic effects of gravity, line weight, ambient temperature and span distances. In addition, ice- and wind-loading functionally increase line weight and, along with thermal loading on the conductor, cause additional line sag or stretching. The amount of sag is a function of the conductor size, material and span distance. Sagging calculations have to be included to determine pole attachment heights as dictated by the National Electric Safety Code (IEEE 1997) ("NESC"). In order to satisfy the NESC minimum mid-span ground clearance, attachment on the pole is generally eighteen feet (18') or higher. In order to comply with the NESC's mid-span clearance requirements, then, one must account for the total loading of the lines under worst case conditions (that is, the upper wire/cable loaded under the worst case and the next lowest cable loaded under the best case condition).

In 1990, the NESC was changed, but the change was primarily one of philosophy rather than one affecting the

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*. Glenn Davis, P.E., is Project Engineer for Delmarva Power and Light Company (P.E. by National Examination, March 1981, Ref. No. 5872), and has been employed thereby for 25 years. In his capacity as Project Engineer for Delmarva, he has become familiar with the pole attachment contracts, policies, procedures and construction practices employed by utility companies such as Delmarva.

requirements for positioning telecommunications and cable attachments vis-a-vis electric wires on utility poles. The NESC changed the above-ground "clearance" required for cables attached to utility poles from 18 feet to 15.5 feet. The underlying assumption in the change was that in many circumstances, thermal and ice loading would create a sag effect of approximately 2 1/2 feet -- thereby creating the change from 18 feet to 15.5 feet.

Based upon these average span lengths, sample sag calculation charts may be prepared. Such charts show that under the worst case loading conditions experienced by a utility, clearances and pole attachment heights, for common cable types over an average span of 200 feet, must be set to account for a total sag of 3.3 to 6.75 feet. *See* Tables 477AAC; 1/0 ACSR/AW; 1/0 Triplex and 4/0 Triplex, attached. This requires a minimum pole placement for such attachments of 18.8 to 22.25 feet. Telephone cables need to be placed between 19 to 20 feet on the pole, with CATV requiring higher placement.

In addition to the sag required as described above, many of the attachments used by communications companies experience more than the average amount of sag. Fiber optic cable, for instance, contains no metallic elements. When strung without a messenger, this type of attachment has a tremendous ability to sag, requiring higher than normal pole attachment clearance and pole placement. Communications lines also tend to be comprised of at least two wires (a messenger cable and a communications cable),

and sometimes several cables, especially in instances of overlashing. This creates an even greater amount of sag.

As to transmission towers, the amount and effects of sag are greatly increased as compared to distribution poles, with, for example, a transmission span of 600 feet potentially having as much as twenty to thirty feet of sag.

GLENN A. DAVIS
REGISTERED
NO. 5872
DELAWARE
PROFESSIONAL ENGINEER

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CLEARANCE ADJUSTMENT FACTORS

J-250.2

4/0 AAC 7 STR PHASE		Diameter = .522 in.				Span Length (ft.)								Weight = .1987 lb./ft.
		100	125	150	175	200	225	250	275	300	325	350	375	400
A	Final Sag (ft.) of Conductor at Maximum Operating Temperature	2.85	3.59	4.33	5.08	5.91	6.94	8.05	9.26	10.55	11.93	13.42	15.00	16.68
B	Final Sag (ft.) at 32 Degrees F. with 1/2" of Ice, No Wind	1.19	1.64	2.14	2.67	3.31	4.20	5.19	6.29	7.49	8.80	10.22	11.74	13.37
C	Final Sag (ft.) at 60 Degrees F.	1.09	1.44	1.81	2.21	2.75	3.63	4.62	5.71	6.91	8.22	9.64	11.16	12.80
Q	Horizontal Displacement Due to a 6 Lb. Wind (ft.)	.87	1.14	1.44	1.75	2.18	2.88	3.67	4.54	5.49	6.54	7.66	8.87	10.18

477 AAC 19 STR PHASE		Diameter = .793 in.				Span Length (ft.)								Weight = .4475 lb./ft.
		100	125	150	175	200	225	250	275	300	325	350	375	400
A	Final Sag (ft.) of Conductor at Maximum Operating Temperature	2.85	3.58	4.33	5.08	5.85	6.63	7.42	8.23	9.06	9.91	10.78	11.76	12.88
B	Final Sag (ft.) at 32 Degrees F. with 1/2" of Ice, No Wind	1.00	1.40	1.84	2.31	2.81	3.35	3.91	4.51	5.13	5.80	6.50	7.32	8.31
C	Final Sag (ft.) at 60 Degrees F.	1.09	1.44	1.82	2.22	2.66	3.11	3.60	4.11	4.64	5.23	5.84	6.61	7.59
Q	Horizontal Displacement Due to a 6 lb. Wind (ft.)	.72	.95	1.20	1.47	1.76	2.06	2.38	2.72	3.07	3.46	3.87	4.38	5.03

795 AAC 37 STR PHASE		Diameter = 1.026 in.				Span Length (ft.)								Weight = .7464 lb./ft.
		100	125	150	175	200	225	250	275	300	325	350	375	400
A	Final Sag (ft.) of Conductor at Maximum Operating Temperature	2.83	3.56	4.30	5.05	5.82	6.59	7.38	8.19	9.01	9.85	10.71	11.58	12.47
B	Final Sag (ft.) at 32 Degrees F. with 1/2" of Ice, No Wind	.90	1.27	1.68	2.12	2.59	3.10	3.63	4.20	4.79	5.41	6.06	6.74	7.45
C	Final Sag (ft.) at 60 Degrees F.	1.05	1.40	1.78	2.18	2.61	3.07	3.55	4.06	4.60	5.16	5.75	6.37	7.02
Q	Horizontal Displacement Due to a 6 lb. Wind (ft.)	.59	.79	1.00	1.23	1.47	1.73	2.01	2.29	2.60	2.92	3.25	3.60	3.97

Q = C X SIN(ARCTAN(D/(2 X W)))

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DELMARVA POWER & LIGHT COMPANY
ELECTRIC DISTRIBUTION STANDARDS
ENGINEERING MANUAL

Clearance Adjustment Factors

#2 ACSR/AW 6/1 PHASE		Diameter = .316 in.				Span Length (ft.)								Weight = .0864 lb./ft.
		100	125	150	175	200	225	250	275	300	325	350	375	400
A	Final Sag (ft.) of Conductor at Maximum Operating Temperature	1.55	1.95	2.35	2.75	3.14	3.98	5.07	6.30	7.65	9.12	10.72	12.44	14.28
B	Final Sag (ft.) at 32 Degrees F. with 1/2" of Ice, No Wind	1.10	1.57	2.08	2.64	3.23	4.10	5.17	6.37	7.70	9.16	10.74	12.45	14.28
C	Final Sag (ft.) at 60 Degrees F.	.40	.60	.83	1.09	1.38	2.13	3.20	4.33	5.63	7.09	8.68	10.41	12.26
Q	Horizontal Displacement Due to a 6 lb. Wind (ft.)	.35	.52	.72	.95	1.21	1.86	2.80	3.79	4.93	6.22	7.61	9.13	11.10

#2 ACSR/AW 6/1 NEUTRAL		Diameter = .316 in.				Span Length (ft.)								Weight = .0864 lb./ft.
		100	125	150	175	200	225	250	275	300	325	350	375	400
A	Final Sag (ft.) of Conductor at Maximum Operating Temperature	.94	1.24	1.54	1.86	2.17	2.91	3.94	5.13	6.46	7.93	9.52	11.24	13.09
B	Final Sag (ft.) at 32 Degrees F. with 1/2" of Ice, No Wind	1.10	1.57	2.08	2.64	3.23	4.10	5.17	6.37	7.70	9.16	10.74	12.45	14.28
C	Final Sag (ft.) at 60 Degrees F.	.40	.60	.83	1.09	1.38	2.13	3.20	4.33	5.63	7.09	8.68	10.41	12.26
Q	Horizontal Displacement Due to a 6 Lb. Wind (ft.)	.35	.52	.72	.95	1.21	1.86	2.80	3.79	4.93	6.22	7.61	9.13	10.75

1/0 ACSR/AW 6/1 PHASE		Diameter = .398 in.				Span Length (ft.)								Weight = .1382 lb./ft.
		100	125	150	175	200	225	250	275	300	325	350	375	400
A	Final Sag (ft.) of Conductor at Maximum Operating Temperature	1.52	1.95	2.39	2.84	3.30	3.76	4.24	4.73	5.36	6.38	7.50	8.70	9.99
B	Final Sag (ft.) at 32 Degrees F. with 1/2" of Ice, No Wind	.93	1.34	1.79	2.29	2.81	3.37	3.96	4.57	5.30	6.30	7.40	8.58	9.86
C	Final Sag (ft.) at 60 Degrees F.	.42	.63	.87	1.13	1.42	1.74	2.07	2.43	2.95	3.93	5.04	6.25	7.46
Q	Horizontal Displacement Due to a 6 lb. Wind (ft.)	.34	.51	.71	.92	1.16	1.42	1.70	1.99	2.42	3.22	4.13	5.13	6.12

Q = C X SIN(ARCTAN(D/(2 X W)))

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ELECTRIC DISTRIBUTION STANDARDS
ENGINEERING MANUAL

Clearance Adjustment Factors

J-250.12

#4 TRIPLEX SERVICE		Diameter = .658 in.				Span Length (ft.)								Weight = .167 lb./ft.
		25	50	75	100	125	150	175	200					
A	Final Sag (ft.) of Conductor at Maximum Operating Temperature	.67	1.71	3.28	5.45	8.25	11.73	15.92	20.87					
B	Final Sag (ft.) at 32 Degrees F. with 1/2" of Ice, No Wind	.31	1.23	2.75	4.89	7.68	11.15	15.34	20.29					
C	Final Sag (ft.) at 60 Degrees F.	.26	1.16	2.68	4.82	7.61	11.08	15.27	20.22					
Q	Horizontal Displacement Due to a 6 lb. Wind (ft.)	.23	1.03	2.38	4.29	6.78	9.88	13.61	18.03					

1/0 TRIPLEX SECONDARY		Diameter = .976 in.				Span Length (ft.)								Weight = .360 lb./ft.
		100	125	150	175	200	225	250	275	300	325	350	375	400
A	Final Sag (ft.) of Conductor at Maximum Operating Temperature	2.50	3.24	4.03	5.27	6.75	8.43	10.31	12.39	14.68	17.17	19.87	22.79	25.92
B	Final Sag (ft.) at 32 Degrees F. with 1/2" of Ice, No Wind	1.80	2.54	3.35	4.56	6.01	7.66	9.52	11.59	13.86	16.34	19.04	21.94	25.07
C	Final Sag (ft.) at 60 Degrees F.	1.13	1.63	2.21	3.34	4.77	6.43	8.29	10.36	12.64	15.13	17.83	20.74	23.87
Q	Horizontal Displacement Due to a 6 Lb. Wind (ft.)	.90	1.31	1.77	2.68	3.83	5.17	6.67	8.33	10.17	12.17	14.34	16.68	19.20

1/0 TRIPLEX SERVICE		Diameter = .976 in.				Span Length (ft.)								Weight = .360 lb./ft.
		25	50	75	100	125	150	175	200					
A	Final Sag (ft.) of Conductor at Maximum Operating Temperature	.78	2.07	4.08	6.91	10.60	15.25	20.95	27.84					
B	Final Sag (ft.) at 32 Degrees F. with 1/2" of Ice, No Wind	.44	1.63	3.60	6.41	10.10	14.75	20.44	27.33					
C	Final Sag (ft.) at 60 Degrees F.	.46	1.64	3.61	6.42	10.11	14.75	20.45	27.34					
Q	Horizontal Displacement Due to a 6 lb. Wind (ft.)	.37	1.31	2.90	5.16	8.13	11.86	16.45	22.00					

Q = C X SIN(ARCTAN(D/(2 X W)))

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DELMARVA POWER & LIGHT COMPANY
ELECTRIC DISTRIBUTION STANDARDS
ENGINEERING MANUAL

Clearance Adjustment Factors

2/0 TRIPLEX SECONDARY		Diameter = 1.268 in. Span Length (ft.) Weight = .498 lb./ft.												
		100	125	150	175	200	225	250	275	300	325	350	375	400
A	Final Sag (ft.) of Conductor at Maximum Operating Temperature	1.66	2.25	2.90	3.58	4.39	5.33	6.33	7.76	9.41	11.23	13.22	15.36	17.67
B	Final Sag (ft.) at 32 Degrees F. with 1/2" of Ice, No Wind	1.58	2.26	3.02	3.86	4.82	5.90	7.08	8.57	10.27	12.12	14.13	16.30	18.63
C	Final Sag (ft.) at 60 Degrees F.	.86	1.29	1.80	2.37	3.10	3.98	4.96	6.39	8.06	9.91	11.92	14.10	16.43
Q	Horizontal Displacement Due to a 6 lb. Wind (ft.)	.67	1.01	1.41	1.86	2.43	3.12	3.90	5.02	6.33	7.79	9.37	11.08	12.92

2/0 TRIPLEX SERVICE		Diameter = 1.268 in. Span Length (ft.) Weight = .498 lb./ft.												
		25	50	75	100	125	150	175	200					
A	Final Sag (ft.) of Conductor at Maximum Operating Temperature	.69	2.14	4.52	7.91	12.42	18.16	25.36	34.33					
B	Final Sag (ft.) at 32 Degrees F. with 1/2" of Ice, No Wind	.51	1.91	4.28	7.67	12.17	17.92	25.12	34.09					
C	Final Sag (ft.) at 60 Degrees F.	.52	1.92	4.29	7.68	12.18	17.93	25.13	34.10					
Q	Horizontal Displacement Due to a 6 Lb. Wind (ft.)	.40	1.50	3.37	6.03	9.57	14.10	19.76	26.81					

4/0 TRIPLEX SECONDARY		Diameter = 1.26 in. Span Length (ft.) Weight = .66 lb./ft.												
		100	125	150	175	200	225	250	275	300	325	350	375	400
A	Final Sag (ft.) of Conductor at Maximum Operating Temperature	2.51	3.24	4.02	4.86	5.74	6.68	7.68	8.97	10.49	12.13	13.91	15.81	17.85
B	Final Sag (ft.) at 32 Degrees F. with 1/2" of Ice, No Wind	1.51	2.15	2.87	3.65	4.51	5.43	6.41	7.68	9.16	10.77	12.52	14.40	16.42
C	Final Sag (ft.) at 60 Degrees F.	1.11	1.60	2.17	2.79	3.49	4.25	5.08	6.26	7.72	9.31	11.04	12.92	14.93
Q	Horizontal Displacement Due to a 6 lb. Wind (ft.)	0.77	1.10	1.50	1.93	2.41	2.93	3.51	4.32	5.33	6.43	7.62	8.92	10.31

$$Q = C \times SIN(ARCTAN(D/(2 \times W)))$$

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DELMARVA POWER & LIGHT COMPANY
ELECTRIC DISTRIBUTION STANDARDS
ENGINEERING MANUAL

Clearance Adjustment Factors

EXHIBIT 1

POLE ALLOCATION ON A THREE PARTY POLE

30 Foot Lift Pole

POLE SPACING ALLOCATION (measured in inches) POWER	TELE.	CATV	30 ft. POLE		POLE SPACING DESCRIPTION
2	2	2	6	in	UNUSABLE POLE
12	0	0	12	in	POWER SPACE
0	20	20	40	in	NESC CODE REQUIREMENT FOR POLE SEPARATION
0	0	12	12	in	CABLE TV SPACE
0	12	0	12	in	TELEPHONE SPACE
72.8	72.8	72.8	18.2	ft	NESC CODE REQUIREMENT FOR GROUND SEPARATION
20	20	20	5	ft	POLE SPACE BELOW GROUND FOR SUPPORT

TOTALS FOR THE ABOVE COLUMNS

106.80	126.80	126.80	INCHES	360
8.90	10.57	10.57	FEET	30
29.63%	35.18%	35.18%	PERCENT	100%

USABLE SPACE

12	32	32	INCHES	76
1.00	2.67	2.67	FEET	6.333
15.79%	42.11%	42.11%	PERCENT	100%

POLE ALLOCATION ON A THREE PARTY POLE
40 FOOT MAIN LINE POLE

POLE SPACING ALLOCATION (measured in inches) POWER	TELE.	CATV	40' POLE		POLE SPACING DESCRIPTION
90	0	0	7.5	ft	POWER SPACE
0	20	20	40	in	NESC CODE REQUIREMENT FOR POLE SEPARATION
0	0	12	12	in	CABLE TV SPACE
0	36	0	36	in	TELEPHONE SPACE
76.6	76.6	76.6	19.2	ft	NESC CODE REQUIREMENT FOR GROUND SEPARATION
24	24	24	6	ft	POLE SPACE BELOW GROUND FOR SUPPORT

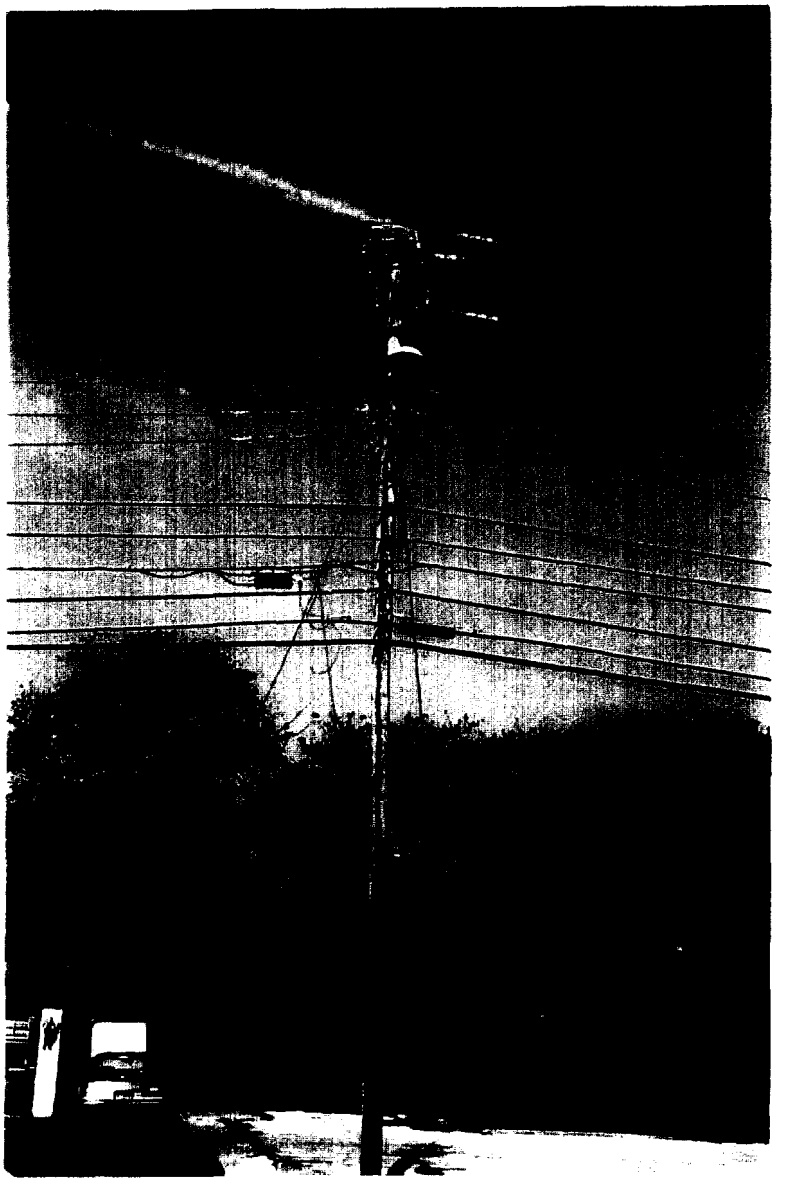
TOTALS FOR THE ABOVE COLUMNS

190.60	156.60	132.60	INCHES	480
15.88	13.05	11.05	FEET	40
39.72%	32.64%	27.64%	PERCENT	100%

USABLE SPACE

90	56	32	INCHES	178
7.5	4.67	2.67	FEET	14.8
50.56%	31.46%	17.98%	PERCENT	100%

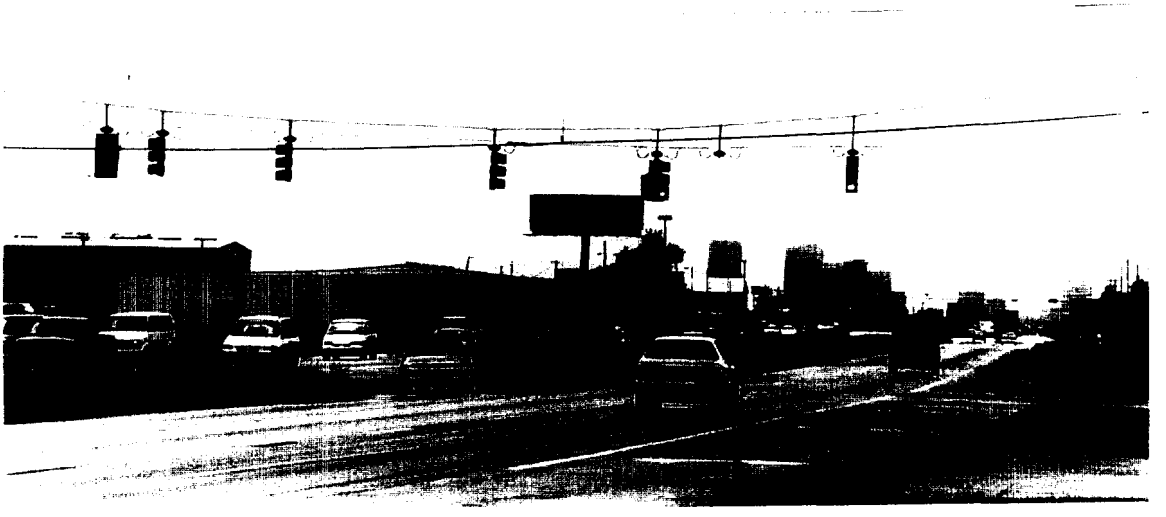
EXHIBIT 2



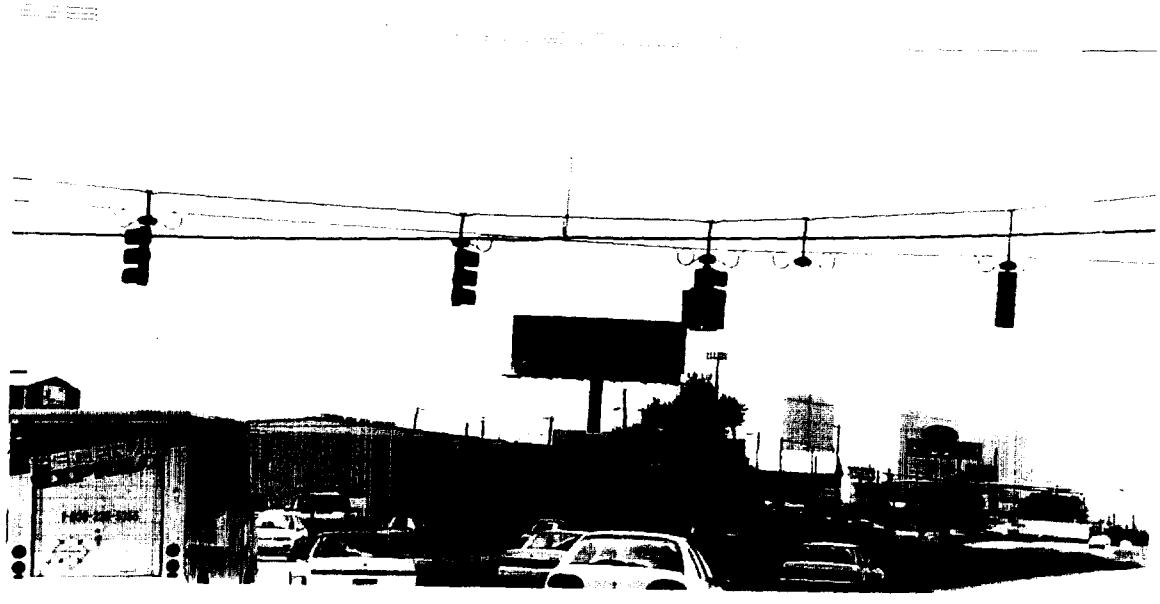
Loaded Pole: Top to Bottom

Energized conductors
Open wire secondary
Streetlight (in safety space)
Utility Telecommunications
City traffic cable
CATV
LEC

EXHIBIT 3



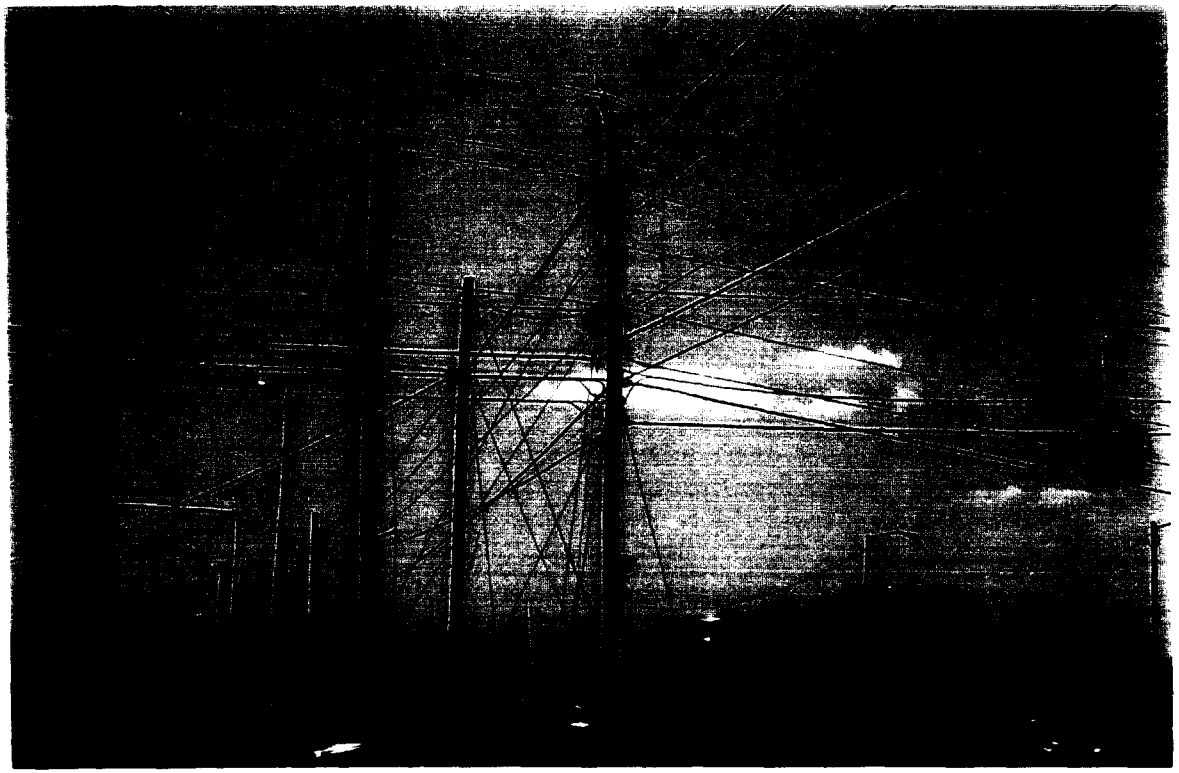
Cable Held Up By Rope (tied to two neutral places)



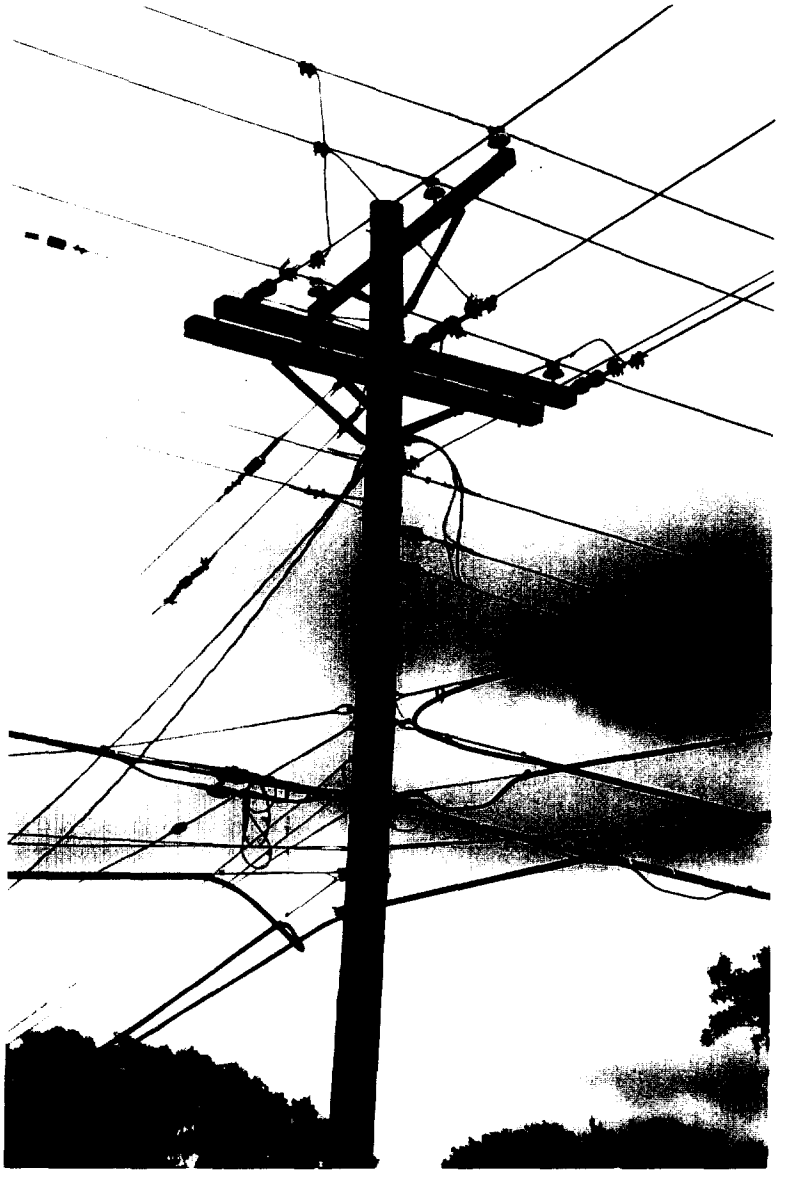
Cable Held Up By Rope (tied to two neutral places)

EXHIBIT 4

Multiple Overlashing With Drops Going to Power Supply Cabinet (shown)



Example of why communities ban additional wires in the air—this is a commercial/industrial area where cars are unloaded off trains.



Congested Pole - Note Cable Attachments at Different Levels
(LEC cable drops are two small cables together near bottom)

EXHIBIT 5

The Development and Application of the National Electrical Safety Code

Allen Clapp's

DANESC UPDATE™

Fall 1990 Special CLEARANCES SET, Part 1 Volume 2, Number 2

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From the Editor...

In our last issue, we concentrated on short descriptions of the major changes to the NESC in the 1990 Edition. This issue is the first volume in a reference set devoted to changes in the clearance requirements.

In this issue, we discuss the major changes in the requirements, how and why they were made, and special cautions about application of table values. We also answer a host of **Reader's Rack** questions received about clearance rules. For those of you that have submitted other types of questions to **Reader's Rack**, we will try to reply to many of those in the upcoming issue.

In the next issue, we present a set of charts which show the real impact of the changes in Tables 232-1 and 234-1, 2 & 3 and we give some useful tips for use in calculating conductor displacement under the required six-pounds-per-square-foot wind loading of Rule 234, as well as other goodies.

Several people have asked us to change the format to a shorter one published more often with fewer subjects in each issue so that it is quicker to read and doesn't get put to the bottom of the pile. We would like feedback. Would you rather have the normal twelve-page size or would you prefer most of the issues to be eight pages and arrive more often? Reply to **Reader's Rack**.

In the last issue, we asked for some feedback on whether you would like to see a **Code Quiz** problem added to each issue; we have received a few replies. What do you want to see?

Allen Clapp

NESC NEWS

Tentative Interim Amendment to the NESC

The first tentative interim amendment (TIA) to the NESC was issued on June 7, 1990. It concerns the method of adjusting required clearances above railroads which are limited to short or thin rolling stock, as are some narrow gauge railways and some mining railways.

Footnotes 2 and 16 of Table 232-1 and the definition of "V" in Rule 234I of the 1990 Edition refer to subtracting the restricted railroad height limit from 22 feet (6.7m) to obtain the allowed reduction in the clearances specified in the values of Table 232-1. The TIA changes these values back to 20 feet (6.1m) to match Figure 234-4 and keep the adjustment the same as it has always been. Prior to the TIA, there was a mismatch between the rule wording and Figure 234-4; the figure had not changed from previous editions.

Another TIA is in progress at this writing.

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1990 CLEARANCE CHANGES

Methodology Change

The 1990 Edition of the NESC changed the way we do business. Operating utilities and contractors can take maximum advantage of materials and construction types actually used for a given project; at the same time, those entities are required to take more responsibility to recognize the characteristics of such materials and construction.

There were two basic types of changes in the clearances area. First, **the NESC no longer includes any vertical movement of conductors and cables** due to sag changes under different loading conditions. Second, **the clearances were coordinated according to voltage level, grounded or ungrounded, insulated or noninsulated and fixed or nonrigid.**

A new Appendix A was added at the end of the 1990 Edition of the NESC to explain these differences. It is worth the time required to review that brief appendix and make sure that you understand both the old system and the new one.

The result of these changes is that you are no longer required to build excess clearances in places where the old clearance requirements were "lumpy" due to the simple system then used. However, you are now required to take into account the sag changes that will occur during the operation of your system in the manner in which you intend to operate it.

Sag Changes

Prior to the 1990 Edition, the NESC vertical clearances automatically included within the table values an assumed change in sag of 18" from the position required at 60°F.

The table values for vertical clearances were good for spans up to the Basic Span length for the loading area for conductors operating at 120°F or below at their maximum temperature.

Where conductors were expected to operate above 120°F at some time during their life (including emergency operation), the 1987 Edition required the substitution of the actual sag change from the 60°F position to the maximum sag position for the 18" of sag change assumed in the table value. In essence, the 1987 Edition required you to take the real clearance (the table value less 18") and to add your actual sag change to it to assure that, when you operated in your maximum sag mode, your line did not come below the desired level.

This is essentially what the 1990 Edition of the NESC has done for ALL clearances. Instead of having to be sure that your conductors were installed high enough to meet the table value requirement when they happened to be at 60°F, final sag, you now are given the "DO NOT EVER COME BELOW THIS LEVEL UNDER ANY CONDITIONS, EMERGENCY OR OTHERWISE" clearance value.

> As of 1990, you are no longer concerned with the sag change from your initial stringing sag down to final sag at 60°F. You are now concerned with the SAG CHANGE from your initial stringing level down to the "worst-case" sag: the greatest sag produced by either maximum ice at 32°F or high- temperature, emergency operating conditions.

Coordinated Clearances

Clearances of conductors, wires, cables, and rigid parts from structures and land areas were uniformly coordinated in the 1990 Edition. Regardless of the type of structure or land area being cleared, the Electrical and Mechanical Component of clearance that was included in the total clearance value of the tables is the same for a given system component.

Example: 4.5 feet always is included in the total clearance value where the clearance is from a supply distribution-voltage conductor to anything.

For each land area, there is a reference height included in the total clearance value shown in the tables.

Example: for truck areas, 14.0 feet is included.

For each type of structure, both horizontal and vertical reference dimensions are used to coordinate the clearances.

To obtain the required clearance, the Electrical and Mechanical Component and the Reference Component were added together. This process is explained in detail in Appendix A at the rear of the 1990 Edition of the NESC. Tables of the various components are shown there and will not be repeated in that fashion here. You may wish to refer to NESC Appendix A while reviewing the information that follows.

Although most of the time only one reference value is used for a given clearance type, there are a few places where one reference component is used for clearances to the grounded wires, cables meeting Rule 230C, etc., and another reference component is used for conductors meeting Rule 230D and bare, energized conductors and cables.

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xample: in yards where ticular activity is restricted. able 232-1 uses reference heights of 8 feet for triplex secondary cables meeting Rule 230C3 and 10 feet for open secondary conductors.

any of the clearance values did not change from what had been the intended result all along. However, others were found to be inconsistent with the basic coordinated system that had been ed for most of the early code evelopment. When that occurred, the old values were changed to achieve coordination unless a valid reason was found to do otherwise. As a result, two reference dimensions occasionally are used.

Where the coordination effort found a lack of coordination between the clearances for secondary voltages or for cables with respect to those required for distribution line phase voltages of 1V-22kV, the general action as to leave the high-voltage facilities where they had been, develop the Reference Dimension accordingly, and coordinate the communication facilities and the lower-voltage conductors and cables with the high-voltage values.

Thus, in the 1990 Edition, the closest-approach location of the 751V-22kV class of facilities essentially is unchanged from the previous edition, after taking into count the changes in the ethodology and removing any included sag change. However, the location of the lesser voltage facilities may have moved slightly to coordinate with the other clearances.

e careful also of the changes in footnotes to the tables. Several of the footnotes have changed wording and application.

major change in format was eliminate the columns of alues dealing with voltages of 22-50kV in most of the tables of Section 23. This allows the basic table values to apply to communication and supply distribution-voltage facilities up through 22kV. Voltage adders for subtransmission and transmission voltages are used to increase the basic table values appropriately for the circuits concerned.

Rule 014: Emergency and Temporary Installations

Rule 014--Waiver has been completely rewritten to specify what, if any, changes in the normal requirements for permanent installations may be used during the term of an emergency or temporary installation, depending upon the expected seasonal loadings.

In the case of both emergency and temporary installations, the code recognizes that the installation may, or may not, be required to withstand the same loads expected of a permanent installation.

Example 1: temporary structures are to be installed to hold existing conductors and cables above an intersection during the six weeks required to remove the old utility structures, regrade the area and install permanent replacement utility structures.

In Example 1, the installation would not be in place long enough to expect significant rotting of the pole. Rule 014B requires the use of Grade N Construction. Grade N requires that the loads expected during the term of the temporary installation be withstood by the structure. The Overload Capacity Factors required for permanent Grade B, C and D installations are not required here. HOWEVER, THE NORMAL CLEARANCES APPLY!

Example 2: a multi-vehicle accident has wiped out the poles on both sides of an intersection: the facilities two spans away from the intersection in each direction are still intact.

In Example 2, we have an unplanned outage which affects safety features such as traffic signals, street lights, etc. The emergency provisions of Rule 014A apply. If you wish, you could run URD (underground residential distribution) cable meeting Rule 230C through a conduit laid directly on the roadway and connect it back into the line at two good poles on either side of the intersection until permanent repairs could be made.

Notice the requirement to guard and mark the cable to limit the opportunity for contact by pedestrians, damage of the conduit by vehicles (i.e., put enough dirt over it), or damage to vehicles (i.e., you'll need signs or flaggers to control traffic at the site during the emergency).

You also could suspend open supply conductors above the intersection from short-term emergency structures or existing structures at heights less than normally required, as long as they are appropriately above the height normally required for communication and guys above a roadway.

In Rule 014A, the NESC recognizes that there occasionally may be a large safety issue, such as traffic signals at major intersections on a high volume highway, that is directly affected by unplanned interruption of power service or communication service.

The code intentionally is not specific as to what additional clearance above the normal guy level is required to recognize the additional voltage involved with distribution lines; it is your responsibility to consider the given local conditions.

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Recommendation For Emergency Clearances For Open Conductors

During an emergency, DO NOT suspend energized open supply conductors at levels below that normally required by Rule 232 or Rule 234 unless there is some large measure of safety to be gained by re-energization of the line prior to the time when normal clearances could be met.

Rule 230 F and Definitions: Fiber Optic Cable Installations

The definition of fiber optic cable-communication and fiber optic cable-supply were changed and coordinated with new Rule 230F--Fiber Optic Cable.

The intention of these changes is to make two things clear: (a) you treat fiber optic cables just like what they are attached to, are located within, or surround; and (b) they must be physically located in either the supply space or the communication space. **Fiber Optic Cables cannot be located between the supply and the communication space**, even if they are completely dielectric and suspended from a completely dielectric messenger.

The code recognizes that the fiber optic strands themselves do not conduct electricity, but associated metallic messengers or internal metallic wires or shields may be capable of conducting electricity.

The code also recognizes that workers on overhead structures tend to locate themselves in places where it is most comfortable to work. Unfortunately, this can place personnel working on communication facilities in the wrong place unless the clearances of Rules 235 and 238 are maintained. This is why fiber optic cables are required to be in one space or the other, not between them even if the work is to be accomplished by a "supply worker."

If the fiber optic cable meets the requirements to be located in the communication space, it is treated as a communication messenger and must have the clearances required for a communication messenger to supply facilities.

If the fiber optic cable is located in the supply space and is carried on an effectively grounded messenger or a completely dielectric messenger, it is treated the same as a supply neutral. Otherwise, it is treated like the conductor to which it is attached.

Example: An open conductor 120/240V three-wire supply secondary is suspended above a CATV cable on a pole line. It is desired to add a fiber optic cable used in operation of the supply system to the pole line.

If the fiber optic supply cable (FOSC) in this example is to be located between the secondary and the CATV, and the FOSC is carried on an effectively grounded messenger, it can be treated the same as a supply neutral meeting Rule 230E1; and have a clearance above the CATV cable of 30" at the pole and 12" in the span (Rule 235C2b(1)(a) Exception and Table 238-1, Footnote 1). The FOSC also must maintain a clearance below the lowest secondary conductor (or triplex, if that is used) of 16" at the pole and 12" in the span (Rule 235C2b(1)(a) and Table 235-5).

Since clearances are clear distances between the nearest surfaces of the items in question, boring the holes 46" apart won't cut the mustard. In this case, the clearance between the supply cable and communication facilities is to be from the nearest surface of a cable or support bracket, but the clearance between the supply conductors and cables does not include the bracket; see Rules 235 and 238. The actual mounting holes would have to be far enough apart to allow for the size of the fiber optic cable, the bracket dimensions and any drip loops involved.

Rule 232: Clearances Above Ground, Roadway, Rail or Water Surfaces

Railroads:

The clearances of 751V-22kV conductors above railroads did not change, but coordination of the other items with that level resulted in decreases in clearances of from one to three feet, depending upon the item. The Reference Dimension remained at 22', the bridge height required over railroads.

CAUTION

The clearances above railroads are intended for main lines and normal sidings used for loading and unloading cars in a manner that does not require activity with conductive objects above the cars. On sidings where special activities are expected, such as where cranes are used to load cars or where hopper cars are manually cleaned from above with long-handled scrapers, Rule 012 requires the use of good practice for the given local conditions.

No specification was added in Table 232-2 for rigid parts above railroads. However, now that the coordinated system is being used, it is easy to determine what clearances are required if