

WE ENERGIES WORK PROCEDURE


 Work Procedure	MANUAL SECTION: 011 Customer Service – Technical – Part 2	
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SUBJECT: Overhead Service Conductors, General Information		

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SCOPE

This document provides final sags for conductors currently used in the “Electric Distribution, Design And Construction Manual, Overhead – Section 120 (Xpedio)” and the final sags for conductors that are used for maintenance in “Electric Distribution, Design And Construction Manual, Overhead – Section 106 (Xpedio).”

GENERAL

When a conductor is installed according to the initial sag tables, the final sags provided can be used to ensure that the construction meets the clearance requirements dictated by the National Electrical Safety Code (NESC).

PROCEDURE

1. CONDUCTOR APPLICATION

This document provides the sag for Duplex, Triplex, Quadruplex, and Lashed Secondary conductors. Lashed secondary cable (also known as PAP cable) is the conductors most commonly used as secondary main in pole-to-pole construction. This conductor is commonly known as Reverse Twist Secondary (RTS) conductor by the manufacturing sector and will hereafter be referred to as Secondary Cable (RTS). The Lashed Secondary mentioned below are 600 Volt underground conductors that are lashed to steel guy wire in the field. Applications for all secondary conductors can be found in the “Electric Distribution, Design And Construction Manual, Overhead – Section 120 (Xpedio).”

2. CONDUCTOR INFORMATION

The following illustrations provide the general information for the conductors in this document.

2.1. Table 1 – General Reference Information For Conductors

TABLE 1 GENERAL REFERENCE INFORMATION FOR CONDUCTORS				
Description	Construction Unit	Material Numbers*	Final Sag Table Location	Initial Sag Table Location
#6 Duplex	SDX6	101-9015	Table 3	120-02 p2
#2 Triplex	STX2	101-9350	Table 3	120-02 p2
1/0 Triplex	STX1/0	101-9813	Table 3	120-02 p2
1/0 Sec Cable (RTS)	SSC1/0	101-9872	Table 4	120-02 p3
4/0 Sec Cable (RTS)	SSC4/0	102-0978	Table 4	120-02 p3
336 Sec Cable (RTS)	SSC336	102-1737	Table 4	120-02 p3
1/0 Quadruplex	SQX1/0	101-9911	Table 5	120-02 p4
3/0 Quadruplex	SQX3/0	102-0552	Table 5	120-02 p4
3 - 1/0 AL Lashed	SAL31/0	102-0129 (103-0329)	Table 6	120-02 p5
3 - 3/0 AL Lashed	SAL33/0	102-0641 (103-0329)	Table 6	120-02 p5
3 - 350 AL Lashed	SAL3350	102-1940 (103-0329)	Table 6	120-02 p5
3 - 350, 1 - 3/0 AL Lashed	SAL3350N	102-1991 (103-0329)	Table 7	120-02 p6
2 - 750, 1 - 350 AL Lashed	SAL2750N	102-3756 (103-0329)	Table 7	120-02 p6
3 - 750 AL Lashed	SAL3750	102-3811 (103-0329)	Table 7	120-02 p6
3 - 750, 1 - 350 AL Lashed	SAL3750N	102-3870 (103-0329)	Table 8	120-02 p7

* $\frac{5}{16}$ inch messenger in parenthesis where applicable.

Illustration 1: Table 1 – General Reference Information For Conductors

3. CONDUCTOR SAG

The maximum allowable sag will be based on vertical clearances. The vertical clearance can be obtained from the NESC or the “Electric Distribution, Design And Construction Manual, Overhead– Section 119 (Xpedio).” The vertical clearance plus the greatest final sag will then be used to determine the minimum height of the attachment point. The conductor sags have been generated such that a consistent mechanical stress is applied on the conductors throughout the range of span lengths. As sag is reduced, the force at the attachment points will increase. In some cases, an alternate conductor can be chosen to provide less sag but generates a greater heavy loaded tension. Sag will also vary by conductor. For example, Lashed and Secondary Cable provide less sag versus Quadruplex and Triplex conductors.

Below is quick reference table that shows the maximum sag for any aluminum conductor. For a more detailed breakdown by conductor, see the tables later in this document appearing in **“Section 5 – LARGEST FINAL SAGS TO BE USED FOR CLEARANCE REQUIREMENTS.”**

3.1. Table 2 – Final Sag Quick Reference Chart

TABLE 2 FINAL SAG QUICK REFERENCE CHART				
Span Length In Feet	Maximum Final Sag			
	Triplex	Secondary Cable (RTS)	Quadruplex	Lashed AL
10	4	4	3	2
20	7	7	6	4
30	11	11	9	7
40	16	15	13	10
50	20	19	17	15
60	26	24	22	20
70	31	29	28	25
80	38	34	34	32
90	45	39	41	39
100	52	45	48	47
110	61	52	57	55
120	70	58	66	65

Illustration 2: Table 2 – Final Sag Quick Reference Chart

For spans longer than 120’, contact the Application Support Group. The span length can be greater as long as the proper vertical clearance is maintained.

4. INITIAL SAG TABLE REFERENCE

The proper initial sag table can be found in “Electric Distribution, Design And Construction Manual, Overhead – Section 120 (Xpedio).” This initial sag table shall be referenced on the construction order.

5. LARGEST FINAL SAGS TO BE USED FOR CLEARANCE REQUIREMENTS

The following pages list the various conductor final sags at midspan in inches. These final sags are determined based on the temperature and loading conditions, given in NESC 232.A that produce the largest final sag. These points can be used to interpolate span lengths between the spans shown. The Alcoa SAG10 computer program was used to determine final sags.

The columns highlighted in the following tables (Illustrations 3-8) are the conditions that produce the greatest final sag. These final sags are used to determine clearance requirements only. The 167°F (75°C) temperature is the conductor temperature at the continuous rating. The 200°F (93°C) temperature is the conductor temperature at the emergency rating.

The 200°F temperature should be used for messengers that can carry current. The 167°F temperature should be used for lashed conductors. The span length is assumed to be the ruling span length. The maximum sag is highlighted below.

5.1. Table 3 – Duplex And Triplex Aluminum Conductors

TABLE 3 FINAL SAG FOR #6 DUPLEX AND #2, 1/0 TRIPLEX									
Span Length In Feet	#6 Duplex			#2 Triplex			1/0 Triplex		
	32°F ½" Of Ice	167°F	200°F	32°F ½" Of Ice	167°F	200°F	32°F ½" Of Ice	167°F	200°F
10	2	3	4	2	3	4	1	3	4
20	4	6	7	4	7	7	4	7	7
30	6	10	11	7	10	11	6	10	11
40	9	13	15	10	14	16	10	14	16
50	13	17	18	14	19	20	14	19	20
60	16	21	22	19	24	25	18	24	26
70	20	24	27	24	29	31	24	30	31
80	24	29	31	30	36	38	30	36	38
90	29	33	35	37	42	44	36	43	45
100	33	37	40	44	50	52	44	50	52
110	38	42	45	52	58	60	52	58	61
120	44	47	50	61	67	69	60	67	70

Illustration 3: Table 3 – Final Sag For #6 Duplex, And #2, 1/0 Triplex Conductors

5.2. Table 4 – Secondary (RTS) Cable Aluminum Conductors

TABLE 4									
FINAL SAG FOR 1/0, 4/0, AND 336 SECONDARY CABLE (RTS) CONDUCTORS									
Span Length In Feet	1/0 Sec Cable (RTS)			4/0 Sec Cable (RTS)			336 Sec Cable (RTS)		
	32°F ½" Of Ice	167°F	200°F	32°F ½" Of Ice	167°F	200°F	32°F ½" Of Ice	167°F	200°F
10	1	3	4	1	3	4	1	3	4
20	3	7	7	4	7	7	3	7	7
30	5	10	11	5	10	11	5	10	11
40	8	14	15	8	14	15	8	14	15
50	11	18	19	11	18	19	11	18	19
60	15	22	24	14	22	24	14	22	24
70	19	26	28	18	26	28	18	27	29
80	23	31	33	22	31	34	22	32	34
90	28	36	39	27	37	39	27	37	39
100	33	42	45	32	43	45	32	43	45
110	39	48	51	38	49	51	38	49	52
120	45	54	57	45	55	58	44	56	58

Illustration 4: Table 4 – Final Sag For 1/0, 4/0, And 336 RTS Cable Triplex Conductors

5.3. Table 5 – Quadruplex Cable Aluminum Conductors

TABLE 5 FINAL SAG FOR 1/0 AND 3/0 QUADRUPLIX CONDUCTORS						
Span Length In Feet	1/0 Quadruplex			3/0 Quadruplex		
	32°F ½" Of Ice	167°F	200°F	32°F ½" Of Ice	167°F	200°F
10	1	3	3	1	3	3
20	3	5	6	3	5	6
30	6	8	9	6	9	9
40	9	12	13	9	12	13
50	13	16	17	13	16	17
60	17	21	22	17	21	22
70	22	27	28	22	27	28
80	28	33	34	28	33	34
90	35	40	41	35	40	41
100	42	47	48	42	47	48
110	50	55	57	50	56	57
120	59	64	66	59	65	66

Illustration 5: Table 5 – Final Sag Table For Quadruplex Conductors (1/0 And 3/0)

5.4. Table 6 – 600 Volts AL Lashed Cable Aluminum Conductors – 350 kcmil And Smaller

TABLE 6 FINAL SAG FOR 1/0, 3/0, AND 350 600 VOLTS AL (LASHED SECONDARY CONDUCTORS)									
Span Length In Feet	3 - 1/0 600 Volts AL			3 - 3/0 600 Volts AL			3 - 350 600 Volts AL		
	32°F ½" of ice	167°F	200°F	32°F ½" of ice	167°F	200°F	32°F ½" of ice	167°F	200°F
10	1	2	2	1	2	2	1	2	2
20	2	4	5	2	4	5	2	4	5
30	4	7	8	5	7	8	4	7	7
40	7	10	11	7	10	11	7	10	10
50	10	13	14	10	13	14	10	13	14
60	13	17	18	14	17	18	14	17	18
70	17	21	22	18	21	22	18	21	22
80	21	25	27	22	26	27	23	26	27
90	26	30	32	27	31	32	28	31	33
100	32	36	37	33	36	38	34	37	38
110	38	42	43	39	42	44	40	43	45
120	44	48	50	45	49	51	47	50	52

Illustration 6: Table 6 – Final Sag For 1/0, 3/0, And 350 kcmil 600 Volts AL (Lashed Secondary Conductors)

- 5.5. Table 7 – 600 Volts AL Lashed Cable Aluminum Conductors – 350 kcmil With Neutral And Larger

TABLE 7 FINAL SAG FOR 3 - 350 W/ 1 - 3/0, 2 - 750 W/ 1 - 350, AND 3 - 750 600 VOLTS AL (LASHED SECONDARY CONDUCTORS)									
Span Length In Feet	3 - 350, 1 - 3/0 600 Volts AL			2 - 750, 1 - 350 600 Volts AL			3 - 750 600 Volts AL		
	32°F ½" Of Ice	167°F	200°F	32°F ½" Of Ice	167°F	200°F	32°F ½" Of Ice	167°F	200°F
10	1	2	2	1	2	2	1	2	2
20	2	4	5	2	4	4	2	4	4
30	5	7	7	4	6	7	5	7	7
40	8	10	11	7	9	10	8	10	11
50	11	14	15	10	13	13	12	14	15
60	15	18	19	14	16	17	16	18	19
70	20	23	24	19	21	22	21	23	24
80	25	28	29	23	26	27	27	29	30
90	31	34	35	29	31	33	33	35	36
100	38	41	42	35	37	39	40	42	43
110	45	48	49	41	44	45	47	50	51
120	53	56	57	48	51	52	56	58	60

Illustration 7: Table 7 – Final Sag For 3 - 350 kcmil W/ 1 - 3/0, 2 - 750 kcmil W/ 1 - 350 kcmil, And 3 - 750 kcmil 600 Volts AL (Lashed Secondary Conductors)

5.6. Table 8 – 600 Volts AL Lashed Cable Aluminum Conductors – 750 kcmil With Neutral

TABLE 8			
FINAL SAG FOR 3 - 750 W/ 1 - 350 600 VOLTS AL			
(LASHED SECONDARY CONDUCTORS)			
	3 - 750, 1 - 350 600 Volts AL		
Span Pan Length In Feet	32°F	167°F	200°F
	½" Of Ice		
10	1	2	2
20	3	4	4
30	5	7	7
40	9	10	11
50	13	15	15
60	17	20	20
70	23	25	26
80	29	32	33
90	36	39	40
100	44	47	48
110	53	55	57
120	62	65	66

Illustration 8: Table 8 – Final Sag For 3 - 750 kcmil 600 Volts AL With 1 – 350 kcmil (Lashed Secondary Conductors)

6. LARGEST FINAL SAGS TO BE USED FOR CLEARANCE REQUIREMENTS FOR SPANS GREATER THAN 120 FEET FOR STREET LIGHTING APPLICATIONS

The following pages list the various conductor final sags at midspan in inches. These final sags are determined based on the temperature and loading conditions, given in NESC 232.A that produce the largest final sag. The Alcoa SAG10 computer program was used to determine final sags.

The columns highlighted in “**Illustration 9: Table 9 – Final Sag Table For #6 Duplex Conductors**” are the conditions that produce the greatest final sag. These final sags are used to determine clearance requirements only. The 167°F (75°C) temperature is the conductor temperature at the continuous rating. The 200°F (93°C) temperature is the conductor temperature at the emergency rating.

6.1. Table 9 – #6 Duplex Aluminum Conductors

TABLE 9 FINAL SAG FOR #6 DUPLEX			
Span Length In Feet	#6 Duplex		
	32°F ½" Of Ice	167°F	200°F
130	49	52	56
140	55	58	62
150	63	66	70
160	73	75	79
170	83	85	89
180	93	96	100
190	105	108	111
200	117	120	123
210	129	132	136
220	142	145	149

Illustration 9: Table 9 – Final Sag Table For #6 Duplex Conductors

7. LARGEST FINAL SAGS TO BE USED FOR CLEARANCE REQUIREMENTS FOR MAINTENANCE CONDUCTORS

The following pages list the various maintenance conductor final sags at midspan in inches. These final sags are determined based on the temperature and loading conditions, given in NESC 232.A that produce the largest final sag. The Alcoa SAG10 computer program was used to determine final sags.

The columns highlighted in the following tables (Illustrations 10-14) are the conditions that produce the greatest final sag. These final sags are used to determine clearance requirements only. The 167°F (75°C) temperature is the conductor temperature at the continuous rating. The 200°F (93°C) temperature is the conductor temperature at the emergency rating.

7.1. Table 10 – General Reference Information For Maintenance Conductors

TABLE 10 GENERAL REFERENCE INFORMATION FOR MAINTENANCE CONDUCTORS				
Description	Construction Unit	Material Numbers*	Final Sag Table Location	Initial Sag Table Location
3 - 1/0 CU Lashed	SCL31/0	103-3964 (103-0264)	Table	120-02
4 - 1/0 CU Lashed	SCL41/0	103-3964 (103-0264)	Table	120-02
3 - 4/0 CU Lashed	SCL34/0	103-4171 (103-0329)	Table	120-02
3 - 4/0, 1 - 1/0 CU Lashed	SCL34/0N	103-4171 (103-0329)	Table	120-02
2 - 500, 1 - 4/0 CU Lashed	SCL2500N	103-5819 (103-0329)	Table	120-02
3 - 500 CU Lashed	SCL3500	103-5819 (103-0329)	Table	120-02
3 - 500, 1 - 4/0 CU Lashed	SCL3500N	103-5819 (103-0329)	Table	120-02
2 - 1000, 1 - 500 CU Lashed	SCL21000N	103-6335 (103-0329)	Table	120-02
3 - 1000 CU Lashed	SCL31000	103-6335 (103-0329)	Table	120-02
3 - 1000, 1 - 500 CU Lashed	SCL31000N	103-6335 (103-0329)	Table	120-02

* 1/4 inch or 5/16 inch messenger in parenthesis where applicable

Illustration 10: Table 10 – General Reference Information For Conductors

7.2. Table 11 – 600 Volts CU Lashed Cable Copper Conductors – 4/0 And Smaller

TABLE 11 FINAL SAG FOR 3 – 1/0, 4 – 1/0, AND 3 – 4/0 600 VOLTS (CU LASHED SECONDARY CONDUCTORS) – MAINTENANCE ONLY									
Span Length In Feet	3 - 1/0 600 Volts CU			4 - 1/0 600 Volts CU			3 - 4/0 600 Volts CU		
	32°F 1/2" Of Ice	167°F	200°F	32°F 1/2" Of Ice	167°F	200°F	32°F 1/2" Of Ice	167°F	200°F
10	1	2	2	1	2	2	1	2	2
20	3	4	5	3	4	5	3	4	5
30	5	7	8	6	8	8	5	7	8
40	9	11	12	10	12	12	9	11	12
50	13	15	16	14	16	17	13	15	16
60	18	20	21	20	22	23	17	20	21
70	23	26	27	27	29	30	23	26	27
80	30	32	33	34	36	37	29	32	34
90	37	40	41	43	45	46	37	40	41
100	45	48	49	52	54	55	45	48	49
110	54	57	58	62	65	66	54	57	58
120	64	66	68	74	76	77	64	67	68

Illustration 11: Table 11 – Final Sag For 3 - 1/0, 4 - 1/0, and 3 - 4/0 600 Volts CU (Lashed Secondary Conductors) – Maintenance Only

7.3. Table 12 – 600 Volts CU Lashed Cable Copper Conductors – 4/0 With Neutral And Larger

TABLE 12 FINAL SAG FOR 3 – 4/0 W/ 1 – 1/0, 2 – 500 W/ 1 – 4/0, AND 3 – 500 600 VOLTS (CU LASHED SECONDARY CONDUCTORS) – MAINTENANCE ONLY									
Span Length In Feet	3 - 4/0, 1 - 1/0 600 Volts CU			2 - 500, 1 - 4/0 600 Volts CU			3 - 500 600 Volts CU		
	32°F ½" Of Ice	167°F	200°F	32°F ½" Of Ice	167°F	200°F	32°F ½" Of Ice	167°F	200°F
10	1	2	2	1	2	2	1	2	2
20	3	4	5	3	4	5	3	4	4
30	6	8	8	5	7	8	6	7	8
40	9	12	12	9	11	12	9	11	12
50	14	16	17	14	16	17	14	16	17
60	19	22	23	19	22	23	20	22	23
70	26	29	30	26	28	29	26	29	30
80	33	36	37	33	36	37	34	37	38
90	42	45	46	41	44	45	43	45	46
100	51	54	55	51	54	55	52	55	56
110	61	64	65	61	64	65			
120	73	76	77						

Illustration 12: Table 12 – Final Sag For 3 - 4/0 W/ 1 - 1/0, 2 - 500 W/ 1 - 4/0, and 3 - 500 600 Volts CU (Lashed Secondary Conductors) – Maintenance Only

7.4. Table 13 – 600 Volts CU Lashed Cable Copper Conductors – 500 kcmil With Neutral And Larger

TABLE 13									
FINAL SAG FOR 3 – 500 W/ 1 – 4/0, 2 – 1000 W/ 1 – 500, AND 3 – 1000 600 VOLTS (CU LASHED SECONDARY CONDUCTORS) – MAINTENANCE ONLY									
Span Length In Feet	3 - 500, 1 - 4/0 600 Volts CU			2 - 1000, 1 - 500 600 Volts CU			3 - 1000 600 Volts CU		
	32°F ½" Of Ice	167°F	200°F	32°F ½" Of Ice	167°F	200°F	32°F ½" Of Ice	167°F	200°F
10	1	2	2	1	2	2	1	2	2
20	3	4	5	4	5	5	4	6	6
30	6	8	8	8	10	10	9	11	11
40	10	12	13	14	16	16	16	18	18
50	16	18	18	21	23	24	25	27	27
60	22	24	25	30	32	33	36	37	38
70	30	32	33	41	43	44			
80	38	41	42						
90	48	51	51						

Illustration 13: Table 13 – Final Sag For 3 - 500 W/ 1 - 4/0, 2 - 1000 W/ 1 - 500, and 3 - 1000 600 Volts CU (Lashed Secondary Conductors) – Maintenance Only

7.5. Table 14 – 600 Volts CU Lashed Cable Copper Conductors – 1000 kcmil With Neutral

TABLE 14			
FINAL SAG FOR 3 – 1000 W/ 1 – 500 600 VOLTS (CU LASHED SECONDARY CONDUCTORS) – MAINTENANCE ONLY			
Span Length In Feet	3 - 1000, 1 - 500 600 Volts CU		
	32°F ½" Of Ice	167°F	200°F
10	1	2	2
20	5	6	6
30	11	12	12
40	19	20	21
50	29	30	31
60	42	43	43

Illustration 14: Table 14 – Final Sag For 3 - 1000 600 Volts CU (Lashed Secondary Conductors) – Maintenance Only